Biology

(Chapter – 19)(Excretory Products and Their Elimination)

(Class – XI)

Question 1:

Define Glomerular Filtration Rate (GFR)

Answer 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.

Question 2:

Explain the autoregulatory mechanism of GFR.

Answer 2:

The mechanism by which the kidney regulates the glomerular filtration rate is autoregulative. It is carried out by the juxtaglomerular apparatus. Juxtaglomerular apparatus is a microscopic structure located between the vascular pole of the renal corpuscle and the returning distal convoluted tubule of the same nephron.

It plays a role in regulating the renal blood flow and glomerular filtration rate. When there is a fall in the glomerular filtration rate, it activates the juxtaglomerular cells to release renin. This stimulates the glomerular blood flow, thereby bringing the GFR back to normal. Renin brings the GFR back to normal by the activation of the reninangiotensin mechanism.

Question 3:

Indicate whether the following statements are true or false:

(a) Micturition is carried out by a reflex.

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

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

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

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

Answer 3:

(a) True

(b) False

(c) True

(d) True

(e) True

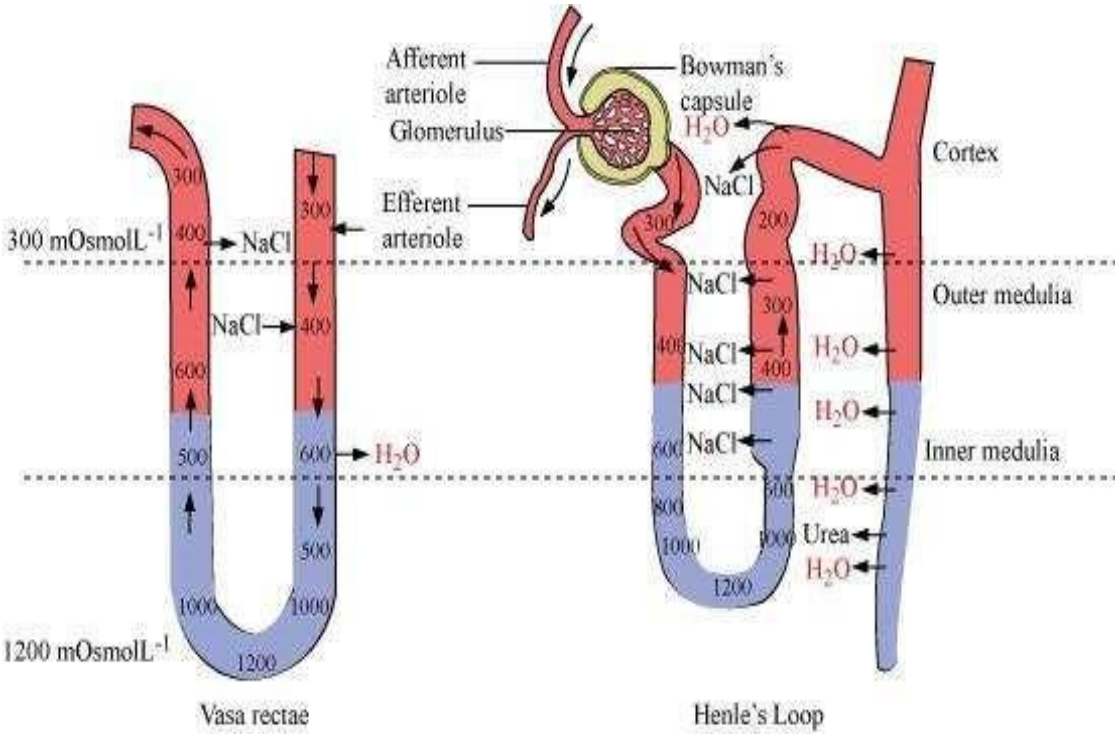
Question 4:

Give a brief account of the counter current mechanism.

Answer 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.

Question 5:

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

Answer 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.

Question 6:

Explain micturition.

Answer 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.

Question 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

Answer 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

Question 8:

What is meant by the term osmoregulation?

Answer 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.

Question 9:

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

Answer 9:

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

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

(b) 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.

Question 10:

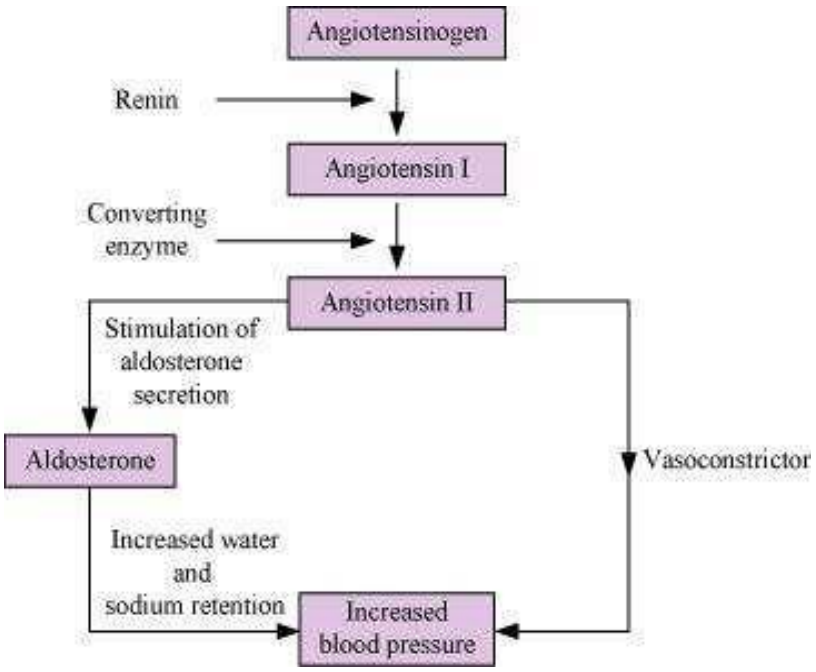
What is the significance of juxtaglomerular apparatus (JGA) in kidney function?

Answer 10:

Juxtaglomerular apparatus (JGA) is a complex structure made up of a few cells of glomerulus, distal tubule, and afferent and efferent arterioles. It is located in a specialised region of a nephron, wherein the afferent arteriole and the distal convoluted tubule (DLT) come in direct contact with each other.

The juxtaglomerular apparatus contains specialised cells of the afferent arteriole known as juxtaglomerular cells. These cells contain the enzyme renin that can sense blood pressure. When glomerular blood flow (or glomerular blood pressure or glomerular filtration rate) decreases, it activates juxtaglomerular cells to release renin.

Renin converts the angiotensinogen in blood into angiotensin I and further into angiotensin II. Angiotensin II is a powerful vasoconstrictor that increases the glomerular blood pressure and filtration rate. Angiotensin II also stimulates the adrenal cortex of the adrenal gland to produce aldosterone. Aldosterone increases the rate of absorption of sodium ions and water from the distal convoluted tubule and the collecting duct. This also leads to an increase in blood pressure and glomerular filtration rate. This mechanism, known as renin-angiotensin mechanism, ultimately leads to an increased blood pressure.



Question 11:

Name the following:

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

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

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

Answer 11:

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

(b) 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.

(c) 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.

Question 12:

Fill in the gaps:

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

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

(c) Dialysis fluid contains all the constituents as in plasma except _____.

(d) A healthy adult human excretes (on an average) _____ gm of urea/day.

Answer 12:

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

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

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

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