19. Excretory Products and Their Elimination

Question 1. Define Glomerular Filtration Rate (GFR)

Answer: The amount of the filtrate formed by the kidneys per minute is called glomerular filtration rate (GFR). The value of GFR in a healthy individual is approximately 125 ml/minute i.e., 180 litres per day

Question 2. Explain the autoregulatory mechanism of GFR.

Answer: 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 renin-angiotensin 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.

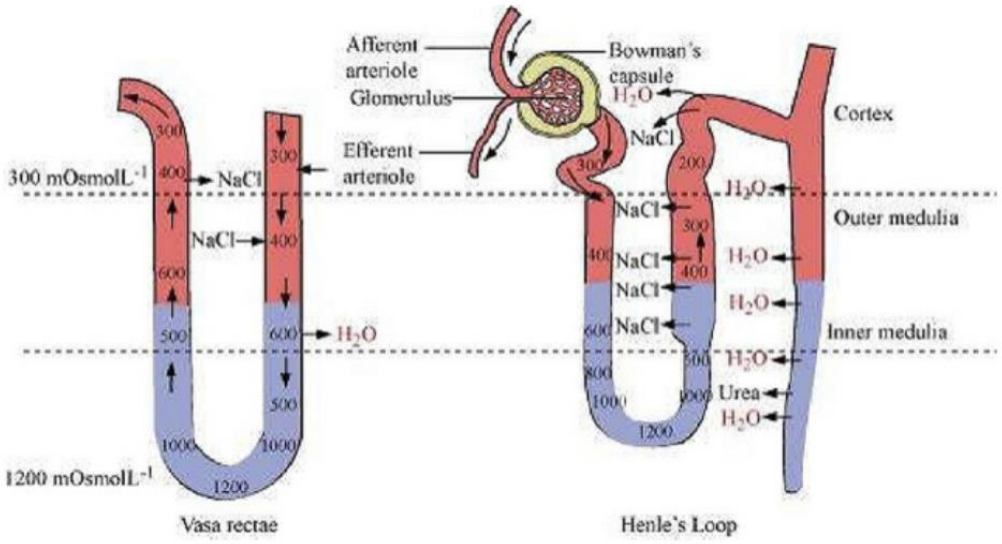
(e) Glucose is actively reabsorbed in the proximal convoluted tubule.

Answer:
(a) True
(b) False
(c)True
(d) True
(e) False

Question 4. Give a brief account of the counter current mechanism.

Answer: The function of the counter-current mechanism that operates inside the kidney is to conserve the water and make the urine concentrated. The counter-current mechanism depends upon the loops of Henle, vasa recta, collecting ducts and interstitial fluid. The blood flows in the two limbs of the tube in opposite directions giving rise to the counter-currents. The proximity between the loop of Henle and vasa recta, as well as the counter-current in them, help in maintaining an in increasing osmolarity towards the inner medullary interstitial fluid i.e. 300 mOsmol/L in the cortex to 1200 mOsmol/L in the inner medulla. This gradient is mainly caused by NaCl and urea. NaCl is transported by the ascending limb of the loop of Henle which is exchanged with the descending capillary of vasa recta. Similarly, small amounts of urea enter the thin segment of the ascending limb of the loop of Henle which is transported back to the medullary interstitial fluid by the collecting duct.

The counter-current mechanism helps to maintain a concentration gradient in the medullary interstitial fluid which helps in easy absorption of water from the filtrate present in the collecting duct so that the concentration of the filtrate is increased. The overall function of the counter current mechanism is to concentrate sodium chloride in the interstitial fluid and cause water to diffuse out of the collecting ducts and concentrate the urine. This leads to the production of hypertonic urine.



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

Answer:

Role of liver in excretion : Liver is the largest gland in vertebrates. Liver changes the decomposed haemoglobin of the worn out red blood corpuscles into bile pigments bilirubin and biliverdin. It helps

in detoxification of toxic chemicals and drugs. It excretes cholesterol, steroid hormones, drug metabolites and other waste materials produced in the body through bile. Urea produced in the liver (by urea cycle) is one of the major excretory product of humans.

Role of lungs in excretion : Lungs are the respiratory organs situated in the thorax. They help in filtration of air and excretion of carbon dioxide. It also helps in excretion of volatile drugs and alcohol metabolites during expiration.

Role of skin in excretion : Skin is the largest organ in the body that also helps in excretion through sweat glands and sebaceous glands. Sweat glands help in excretion of excess water, salts, uric acid and drug metabolites. Sebaceous glands secrete an oily secretion called sebum.

Question 6. Explain micturition.

Answer: 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**
(e) ADH	**(v) Renal tubule**

Answer:

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

(e) ADH	(ii) Water reabsorption

Question 8. What is meant by the term osmoregulation?

Answer: Osmoregulation is a process that regulates the body's salt and water concentration. Osmoregulators face some problems :

(a)In hypotonic medium, endosmosis occurs, therefore osmoregulators must eliminate excess water.

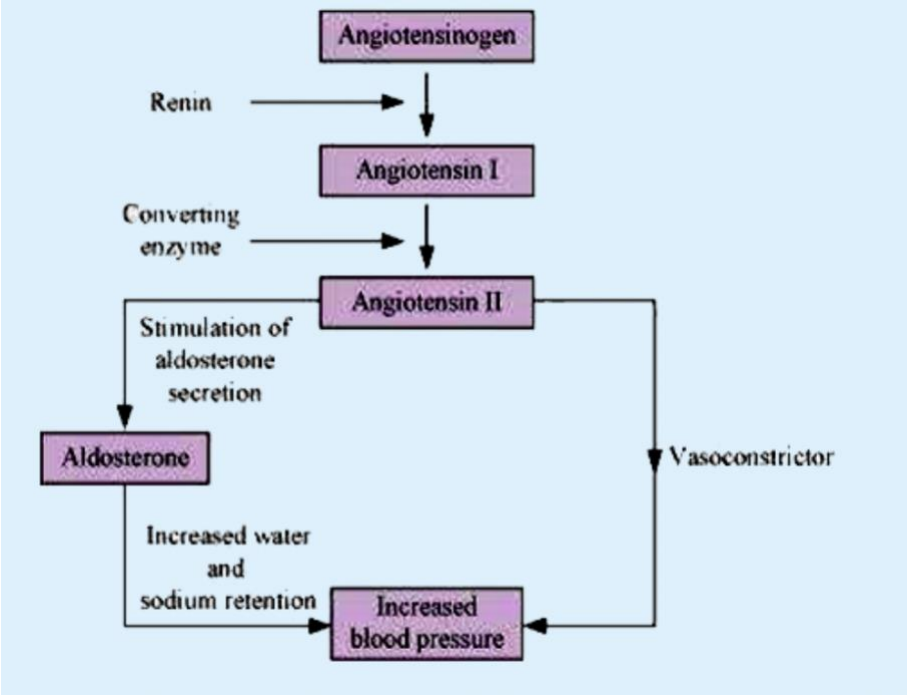
(b)In hypertonic medium, exosmosis takes place, hence they must continuously take water. These also have to spend energy to move water in or out.

Question 9. Terrestrial animals are generally either ureotelic or uricotelic, not ammonotelic, why?

Answer: Aquatic animals are ammonotelic as the ammonia is generally excreted by diffusion across the body surface. Whereas in terrestrial animals ammonia which is toxic cannot circulate in the blood till it reach the excretory system, it is converted into lesser toxic nitrogenous wastes like urea and uric acid by the liver and released into the blood from where it is filtered and excreted out by the kidneys. Hence terrestrial animals are either ureotelic or uricotelic.

Question 10. What is the significance of juxta glomerular apparatus (JGA) in kidney function?

Answer: 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:

(a) Amphioxus is a chordate animal having flame cells as excretory structures.

(b) Cortical portions projecting between the medullary pyramids in the human kidney are the columns of bertini.

(c) A loop of capillary running parallel to the Henle's loop is called as vasa recta. This together helps in control the ionic concentration in medullary interstitium.