Chapter - 19 Excretory Products and their Elimination

Question-1

What are nephrons?

Solution:

Renal tubules for excretion in man are called nephrons.

Question-2

The chances of kidney failure are more in those who have high pressure. Why?

Solution:

The chances of kidney failure are more in those who have high pressure because ultra filtration under abnormal high blood pressure may rupture the capillary walls of the glomeruli leading to kidney failure.

Question-3

What is sweat?

Solution:

sweat is the secretory product of sweat glands.

Question-4

What is ureotelism?

Solution:

The process of excretion of urea in the case of mammals, amphibians and cartilaginous fishes is called ureotelism.

Question-5

Why is reabsorption described as a selective process?

Solution:

The reabsorption process is said to be selective as certain essential substances are absorbed back into the blood while the wastes are retained in the filtrate. Distal and collecting tubules are parts of the nephron where reabsorption by active transport takes place.

Question-6

What is the basic nitrogenous catabolic product of metabolism?

Solution:

Ammonia is the basic nitrogenous catabolic product of metabolism.

Question-7

Describe the role of ADH and counter current system in the formation of hypertonic urine.

Solution:

Role of ADH

Antidiuretic hormone (ADH) is secreted by the posterior lobe of the pituitary gland. ADH promotes the reabsorption of water by distal convoluted tubules and controls the amount of water excreted in urine. It increases the permeability of the membrane of the collecting tubules. Absence of ADH makes the collecting tubules permeable to water. So less water is returned to the blood from urine by osmosis. Hence, ADH helps to conserve water. If the production of ADH is less, it could result in enormous loss of water from the kidneys.

Counter current system in the formation of hypertonic urine

When the amount of water is more than that needed by the organism, the walls of the distal convoluted tubules and collecting duct remain impermeable to water. The filtrate becomes more and more dilute and ultimately a large volume of hypertonic urine is excreted. When water is less, the walls of the distal convoluted tubules and collecting duct becomes permeable to water. The surrounding tissue is hypertonic due to active reabsorption of Na^+ and due to the retention of urea in the counter current system of the vasa recta. So water from walls of the duct get reabsorbed into the surrounding tissue and peritubular capillaries. The filtrate in the collecting duct becomes hyposmotic and strongly hypertonic urine flows out into the renal pelvis.

Question-8

What are the parts of renal corpuscle?

Solution:

The parts of renal corpuscle are

(i) Bowman's capsule and

Question-9

Mention the difference between uricotelism and ureotelism.

Solution:

The difference between uricotelism and ureotelism are as follows:

Uricotelism	Ureotelism
(i) The excretory product is uric acid.	(i) The excretory product is urea.
(ii) It is less toxic.	(ii) It is more toxic.
(iii) Less water is required for elimination.	(iii) More water is required for elimination.
(iv) It is insoluble in water.	(iv) It is soluble in water.
(v) More energy is required in water.	(v) Less energy is required.

Question-10

Define osmolarity.

Solution:

Osmolarity is the total solute concentration of two solutions.

Question-11

What are normal and abnormal constituents of urine?

Solution:

Normal urine contains as much as 95% water in which about 5% of other organic and inorganic substances are found in a dissolved state. The inorganic substances in urea are salts of sodium, potassium, etc. The organic substances are urea, uric acid creatinine, etc. If the percentage of any of the above increases their normal limits, the composition of urine becomes abnormal. Sometimes, the concentration of urine is disturbed by the secretion of substances like glucose, acetones, ketones, etc.

Question-12

How does the liver serve both as a digestive as well as excretory organ?

Solution:

The liver secretes bile containing bile pigments and bile salts. The bile salts help in digesting and absorbing fat. The liver is also considered as the principal organ for excretion as it is involved in the excretion of cholesterol. The inactivated products of steroid hormone, cholesterol and drugs are carried by bile to the intestine and ultimately eliminated with the fecas.

Question-13

In which animal malphighian tubules act as excretory organ?

Solution:

Cockroach and grasshopper

Question-14

What are chloride cells?

Solution:

Ionocytes are special cells in the gill membrane of fresh water fish. They are called chloride cells.

Question-15

Is the ultra filteration in the glomerulus a passive or active process?

Solution:

The ultra filteration in the glomerulus is a passive process.

Question-16

Name two high threshold substances.

Solution:

Glucose and amino acid are the two high threshold substances.

Question-17

Expand RAAS.

Solution:

The expansion for RAAS is Renin Angiotension Aldosterone System.

Question-18

What happens to the walls of distal convoluted tubule (DCT) of a nephron when vasopressin is released by the pituitary into the blood stream?

Solution:

The walls of DCT of a nephron becomes permeable to water when vasopressin (ADH) is released into blood by pituitary

Question-19

What are the chief excretory products in human beings?

Solution:

The excretory products of human can be classified into the following categories,

(i) Carbonaceous – Carbon dioxide is produced as a result of respiration.

(ii) Nitrogenous – Containing urea.

(iii) Others – Such as bile pigments, water, excess of salts etc.

Question-20

What are the two modes of tubular reabsorption from the nephrons? Name the substances absorbed by each of these modes.

Solution:

The two modes of tubular reabsorption from the nephrons are

(i) Active

(ii) Passive

The active absorption of glucose and amino acids takes place in proximal convoluted tubules which open into Henle's loop.

The sodium and potassium are reabsorbed actively in distal convoluted tubules. It is a fast process. Finally the water is reabsorbed.

Question-21

Why is reabsorption described as a selective process?

Solution:

Ultra filtration takes place in glomerulus. The glomerulus filtrate contains essential or useful substances like water, glucose, amino acids, chlorides and sodium along with wastes like urea, creatinine and uric acid.

Question-22

Where does ultrafiltration, reabsorption and secretion of substances take place in nephron?

Solution:

Ultra filtration takes place in glomerulus and Bowman's capsule of the nephron.
Reabsorption takes place in the first coiled tube called the Loop of Henle and second coiled tube.

Secretion takes place in cells of proximal and distal tubules. The main substances secreted are potassium, ammonia, creatinine and very little uric acid.

Question-23

How does liver helps in the process of excretion?

Solution:

Liver plays a minor role in excreting waste products from the body. Urea, the chief nitrogenous waste material is formed in the liver. Ammonia is converted into urea in the liver. This urea is eventually thrown out by kidneys. Liver manufactures bile pigments from the haemoglobin of the red blood cells and through the bile duct it passes into the intestine.

Question-24

If one, drinks very little water, the volume of urine decreases. In what way does it affect his health?

Solution:

The ammonia formed due to the break down of proteins combines with carbon dioxide to form urea. Urea is toxic to the body if present in large quantity. It is soluble in water and excreted from the body in the form of urine. It has been estimated that about one litre of water is needed everyday in human beings to wash out urea from the body. If one drinks lesser amount of water, the concentration of urea will increase, thus urea deposited in the cells would disturb the chemical composition of protoplasm crippling the life activities.

Question-25

How does urine formation help in maintaining the correct composition of blood?

Solution:

As a result of metabolism various substances are continuously formed. These wastes are added in the blood. Due to the addition of lactic acid, carbonic acid the blood salts becoming acidic. Kidneys remove all these substances from the blood with the urine. Thus by urine formation the blood composition is kept normal and also blood remains alkaline.

Question-26

Suppose the kidneys of a person are damaged, can you predict what is going to happen to him?

Solution:

The kidneys are considered as master chemists of the body. If they are damaged, it would disturb the normal functioning of the life processes. Due to the effect of toxins produced by some bacteria the filters of tiny uriniferous tubules are damaged. They become perforated with larger holes and allow blood cells and proteins to pass through them along with the urea and water, during filtration of blood in formation of urine. Thus, urine contains blood proteins. It is a serious disease.

Question-27

A person suffering from very low blood pressure passes no urine. Why? What suggestion would you offer for the removal of waste products from the blood in such a situation?

Solution:

The reason for this is that the blood to pass through the glomerulus of the nephron must have the required amount of pressure in it. If the pressure is not sufficient it will not flow through the glomerulus and filteration would not take place. Hence no urine would be formed. This is quite harmful to the person as waste products go on accumulating in the body. To avoid this, a person should be advised to take sufficient amount of water and medicines to keep the blood pressure at an optimum level.

Question-28

What is the role of aldosterone? How is kidney function regulated by JGA?

Solution:

The aldosterone is a hormone secreted by the adrenal gland. It controls the level of sodium in the blood. The reabsorption is controlled by a hormone renin produced in the kidneys. The function of the renin is the conversion of angiotensinogen into angiotensin, which is produced in the liver. This angiotensin stimulates the adrenal cortex to secrete aldosterone. Aldosterone induces the distal Nephron to reabsorb more water and Na^+.

Question-29

What is net filtration pressure? How it is obtained?

Solution:

Net filtration pressure is obtained because of the change in the diameter of afferent and efferent arterioles. The afferent arteriole has a larger diameter than the efferent arteriole. When the blood passes through the glomerulus, about one-fifth of it is forced out through the thin walls of the capillaries of glomerulus. The hydrostatic pressure of blood in the afferent arteriole is found to be 75 mm Hg. The osmotic pressure exerted by the plasma protein is about 30mm Hg. The interstitial pressure acting on the capillaries is only 10 mm Hg. Therefore, the final pressure or net filtration pressure comes to be 25-30 mm Hg.

Question-30

What would happen if the machinery for tubular reabsorption fails?

Solution:

During the ultra-filteration of blood in the initial stages in the glomerulus a large number of electrolytes, glucose, vitamins and other useful substances also pass out from the glomerulus. These are very useful for the body for this reason they are reabsorbed in the convoluted loop of the Nephron. If this process fails then these useful substances would go on harming the body of the person. This would cause serious disturbances.

Question-31

What would happen if you do not drink water for 24 hours in hot summer month?

Solution:

The kidneys play an important part in the osmoregulation of body fluids. If a person does not drink water for 24 hours in a hot summer month, the quantity of urine produced would be very much less. But it would be concentrated with waste excretory material. It is because of the fact that during active reabsorption the tubules, required quantity of water from the filtrate is again absorbed by the blood. Since there is already less quantity of water in the blood because the person has not consumed water the filtrate would become quite concentrated in excretory products and the volumes of urine excreted out would be very less.

Question-32

In what forms are nitrogenous wastes excreted in birds, humans and fishes?

Solution:

In birds nitrogen is excreted as uric acid. It is almost insoluble in water. Uric acid is less toxic and can be retained for long time in the body. It does not require much water for its removal.

In humans, ammonia, urea and uric acid are nitrogenous wastes. Ammonia is converted to urea in the liver of man. Urea is less toxic and requires very less amount of water for its removal.

The body of fishes are ammonotelic. They excrete ammonia. Ammonia is highly toxic and soluble in water.

Question-33

Fresh water animals pose two kinds of osmoregulatory problems. What are they?

Solution:

The fresh water animals pose two kinds of osmoregulatory problems, they are:-

(i) they gain water passively due to osmotic gradient.

(ii) They continuously lose body salts to the surrounding medium of much lower salt content.

Question-34

Discuss how the kidney helps in osmoregulation in mammals.

Solution:

Osmoregulation is a process which controls the osmotic pressure with in an organism. This is possible by maintaining a constant composition of urine by separating the excretory products from the blood and their elimination as urine from the body. The osmoregulation is done in body with the help of kidneys which take up the work of maintaining correct balance of urine by removing excess of water, from the body and also to maintain the correct acid base, balance in the body. The kidneys also regulate the concentration of salts in the body. If there is less water in the body, then less water is excreted through the urine. It is on this account the kidneys are considered as the master chemists of the body.

Question-35

How does osmoregulation takes place in mammals?

Solution:

When water intake by mammals is more; the kidneys excrete out dilute urine with excess of water. Contrary to this when the animal faces shortage of water, the urine excreted out is less in quantity and is hypertonic in nature. In this way the kidneys maintain osmotic concentration of the blood in a desired state. In fact, all the mammals and other vertebrates can produce hypotonic urine, diluter and lower in osmotic pressure than their blood. Mammals can excrete hypertonic urine, which is more concentrated than their blood. For this, the isotonic glomerular filterate is first filtered into their Bowman's capsules. Then they reabsorb from this filtrate a large amount of water, not accompanied by the reabsorption of proportionate amounts of solutes. This makes the urine more concentrated than their blood. This helps in the reduction of loss of water from the body. The mammalian kidney is the master chemist of the body. It can adapt itself to the changing conditions also according to the requirement of the body needs if the kidney excretes large, or small quantities of water and salts according to the situation. If these are in abundance, they are secreted in the large quantities and if they are in scarcity they are secreted in small quantities in order that the correct balance in the body is maintained. The volume of the fluid and osmolarity of the kidney gets regulated mainly by the movement of Na^+, Cl^- and water.

When the protein free fluid is filtered into the Bowman's capsule from blood, it has the same osmo concentration as the blood plasma of the capillaries surrounding uriniferous tubules. In the proximal convoluted tubule Na^+ gets actively reabsorbed and Cl^- gets passively reasbsorbed, as it gets attracted to the positive changes of Na^+. This results in making the contents pf PCT diluter. Because of the abundance of water in surrounding capillaries about 75% of water flows out of the PCT. This results in reducing the volume of filtrate by 75% but it still remains isotonic to blood plasma. The concentration of urine is largely by the Henle's loop. The concentration of urine is also takes place because of blood vessels called vasa rectae in the kidneys. These vessels are in the form of loops. In these the blood flows in the opposite direction in the two limbs of each vasa rectae. This system makes the blood entering in the descending limbs come close to the out going blood in the ascending limb. This system is

called counter current system. Counter current system is also found in the two limbs of the Henle's loop. Here, the filtrate entering its descending limbs is close to that leaving its ascending limb. The ascending limb actively transports Na^+ and small amounts of urea into the surrounding medullary tissue of the kidney where it is retained by the vasa recti. This limb is impermeable to water, thus water cannot flow out of this. This makes the contents gradually diluter. On the other hand the walls of descending limbs are freely permeable to both salt and water. As result of this Na^+ from the surrounding fluid is reabsorbed and enters the descending limbs on one hand water diffused out of it and enters the surrounding tissue and then into the surrounding capillaries. In this way the contents of the descending limbs become hyperosmotic.

Question-36

Write the full form of ADH and describe how it affects the functioning of kidney tubules.

Solution:

ADH is abbreviation of Antidiuretic Hormone secreted by the posterior lobe of the pituitary gland. It is called vasopressin. The ADH promotes the reabsorption of water by distal convoluted tubules and controls the amount of water excreted in urine.

ADH increases the permeability of membrane of collecting tubules. Absence of ADH makes the collecting ducts impermeable to water. So less water passes back to the blood from urine by osmosis. Hence ADH help kidney to conserve water.

If ADH is produced in less proportion there is a enormous loss of water from the kidneys. This aliment is known as diabetes insipidus.

When the amount of water is more than what an organism needs, the walls of the DCT and collecting tubule and collecting duct remain impermeable to water. The filterate becomes more and more dilute and ultimately a large volume of hypotonic urine is eliminated.

When water is less, the walls of the DCT, collecting tubule and collecting duct become impermeable to water. The surrounding tissue is hypertonic due to the active reabsorption of Na^+ into it and due to the retention of urea in the counter current system of vasa rectae, so water from the walls of the duct gets reabsorbed into the surrounding tissue and particular capillaries. The filtrate in the collecting duct becomes hyposmotic and strongly hypertonic urine flows out into the renal pelvis.

Question-37

State the various parts of a Nephron. Give functions of each part of the Nephron.

Solution:

Parts of Nephron	Functions	Substance removed
Glomerulus	Glomerular ultra filtration – A passive process.	Water only creatinine, Hippuric acid etc.,
Proximal tubule	Selective reabsorption by active transport and reabsorption by diffusion.	
Henle's loop	Reabsorption by diffusion	NaCl
(a) Descending limb	Osmosis	H_2O
(b) Ascending limb	Diffusion	Urea
Distal tubule an collecting tubules	Reabsorption Secretion by DCT Active transport Tubular secretion by active transport	Sodium ions K^+ ions K^+, H^+, Uric acid, NH_3,etc. Pigments and drugs.

Question-38

Differentiate between ammonotelism, ureotelism and uricotelism.

Solution:

Ammonotelism	Ureotelism	Uricotelism
Excretory waste is ammonia.	Excretory waste is urea.	Excretory waste is uric acid.
It is characteristic of aquatic animals such as protozoans, sponges, coelenterates, crustaceans, bony fishes and echinoderms etc.	It is characteristic of mammals, cartilagous fishes and amphibians etc.	It is characteristic of terrestrial reptiles and insects. All the birds are uricotelic.
Excess of water is required to eliminate ammonia. It is highly toxic.	Less water is needed: urea is less toxic than ammonia. It can be retained for sometime in body without any harmful effect.	Less water is needed. Uric acid is least toxic.
Water loss is about 300-500 ml to remove one gram of ammonia.	Water loss is about 50ml to eliminate one gram of urea.	Water loss is about 10ml to excrete out one gram of uric acid.
Ammonia is formed in liver cells by the deamination of the aminoacids.	Urea is formed in liver by the detoxification of ammonia.	Uric acid is formed mainly from the purines in liver cells. In insects uric acid is formed in malphigian tubules.

Question-39

Explain the excretory system of cockroach.

Solution:

Excretion in cockroach takes place by malpighian tubules, fat body, cuticle of skin and mushroom gland of males.

Malpighian tubules – These are main excretory organs of cockroach. These are grouped in six bundles. The wall of each tubule is thick having inner epithelium of cubical cells and outer capsule of elastic connective tissue alongwith muscle fibres. Microvilli are located at the brush boarder of epithelial cells. Excretory substances are uric acid and urates. These tubules absorb these from the haemolymph. Solid waste is then pasees into hind gut. Here more water absorption takes place and solid crystals are discharged out with faeces. So cockroach is uricotelic.

Cuticle of skin – During moulting nitrogenous waste materials passes through the critical.

Mushroom gland – This is accessory reproductive gland found in male species of cockroach. Some cells of mushroom gland receive nitrogenous waste from haemolymph and change them into uric acid which is discharged during copulation over the spermatophore.

Question-40

What are renal calculi?

Solution:

Insoluble mass of crystallized salts are known as renal calculi.

Question-41

What are ducts of Bellini?

Solution:

These are the collecting ducts which unite together in the medulla region and form the duct of Bellini.

Question-42

If the urine of a person contains sugar,what does this indicate?

Solution:

The presence of sugar in the urine of a person indicates that he /she suffers from diabetes mellitus.

Question-43

The Urine of a person contains blood. What does this refer to?

Solution:

This condition indicates injury or damage to the filters of the kidney

Question-44

Define excretion? Where is urea synthesized in mammals?

Solution:

Excretion is the removal of metabolic wastes, water and salts from the body. Urea is synthesized in the liver of mammals. It is also synthesized in kidney in small quantities. Urea formation takes place by ornithine cycle.

Question-45

State the role of blood capillaries associated with the nephrons in the kidney?

Solution:

Formation of network of capillaries around nephrons. (b) selective reabsorption of water, glucose salts, vitamins and other necessary materials.

Question-46

What are podocytes?

Solution:

Epithelial cells of Bowman's capsule are named as podocytes. They are arranged in an intricate manner so as to leave some minute spaces known as filtration slits or slit pores.

Question-47

Name three process involved in the urine formation?

Solution:

The three main process included in the urine formation are (a) Urine formation. (ii) glomerular filtration (iii) selective reabsorption and excretion.

Question-48

Where do ultra filtration, reabsorption and secretion of substances take place in nephron?

Solution:

(a) Ultra Filtration: It takes place in the glomerulus and Bowman's capsule of the nephron.

(b) Reabsorption: It takes place in the first coiled tube called the loop of Henle and second coiled tube.

(c) Secretion: It takes place in the cells of proximal and distal tubules. The main substances secreted are potassium, hippuric acid ammonia, creatinine and little uric acid

Question-49

What is a dialysis machine? When is it needed?

Solution:

Dialysis machine is also known as artificial kidney. It filters the waste from the body when the kidneys fail. In dialysis, small solute molecules diffuse through a semi permeable membrane as a substitute for glomerulus. It has a cellophane membrane where the blood of the patient is made to flow on one side of the membrane and the surrounding fluid on the other side. The wastes from the blood move into the surrounding fluid through the cellophane membrane.