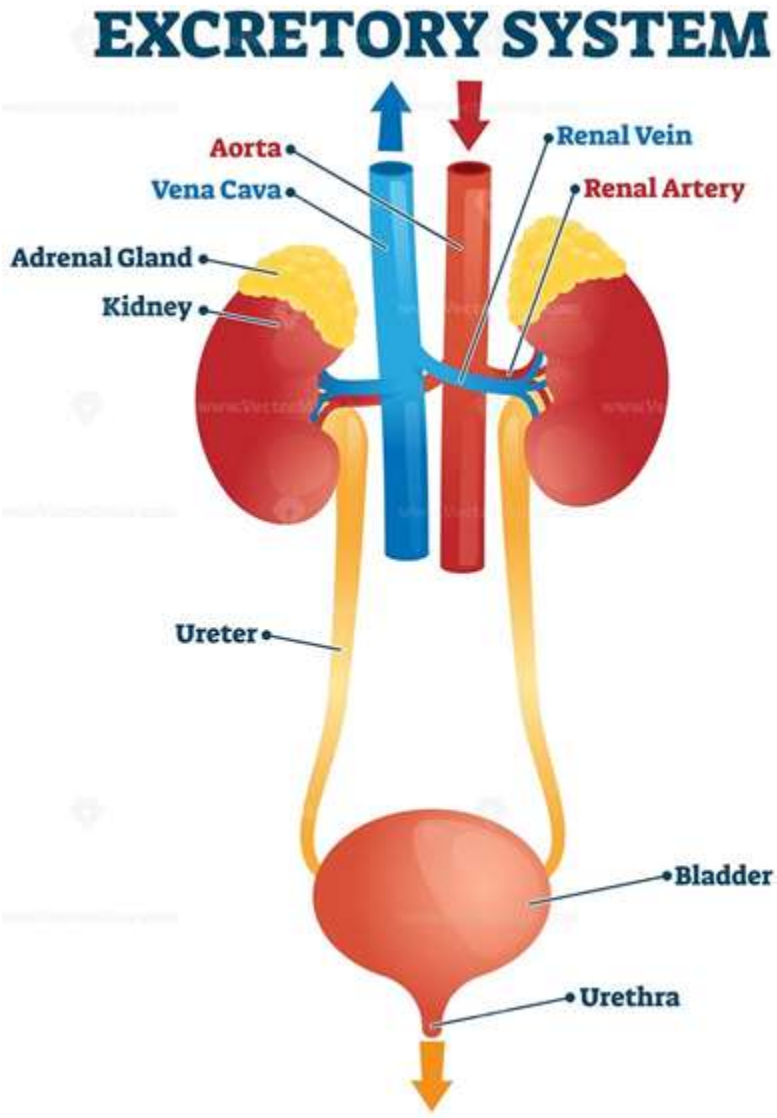
BIOLOGY

EXCRETORY PRODUCTS AND THEIR ELIMINATION

Human Excretory System

Anatomically, the human excretory system consists of a pair of kidneys, a pair of ureters, urinary bladder and the urethra. The kidneys contain tiny, numerous structures called nephrons. These are termed as the functional unit of the kidneys and are responsible for the separation of water, filter toxins and replenish necessary elements back into the bloodstream.



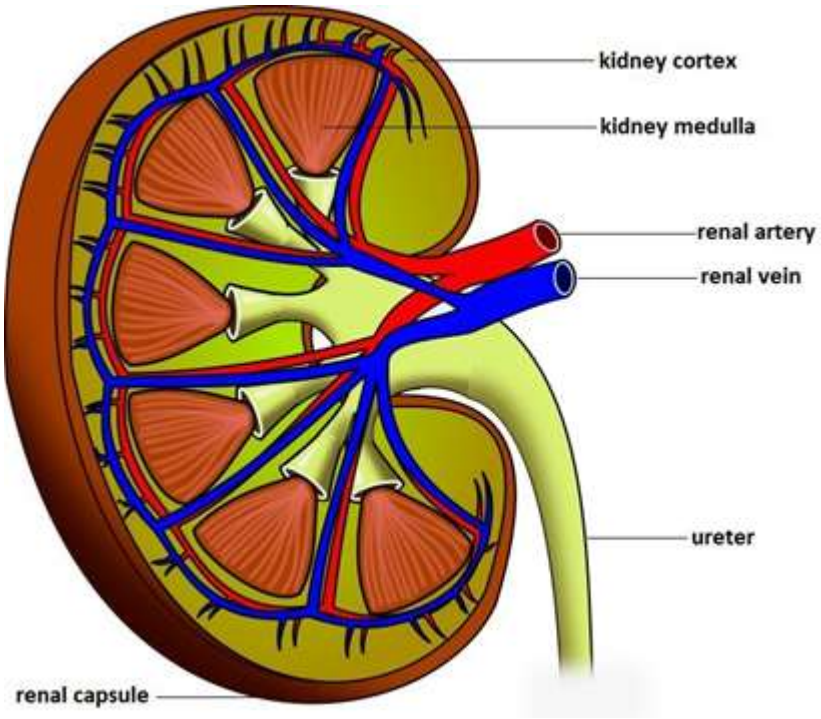
Ammonotelism: The animals which excrete ammonia are called ammonotelic and excretion of ammonia is known as ammonotelism eg. Amoeba, sycon, hydra, liver fluke, tapeworm, Leech, Prawn, bony fishes etc.

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.

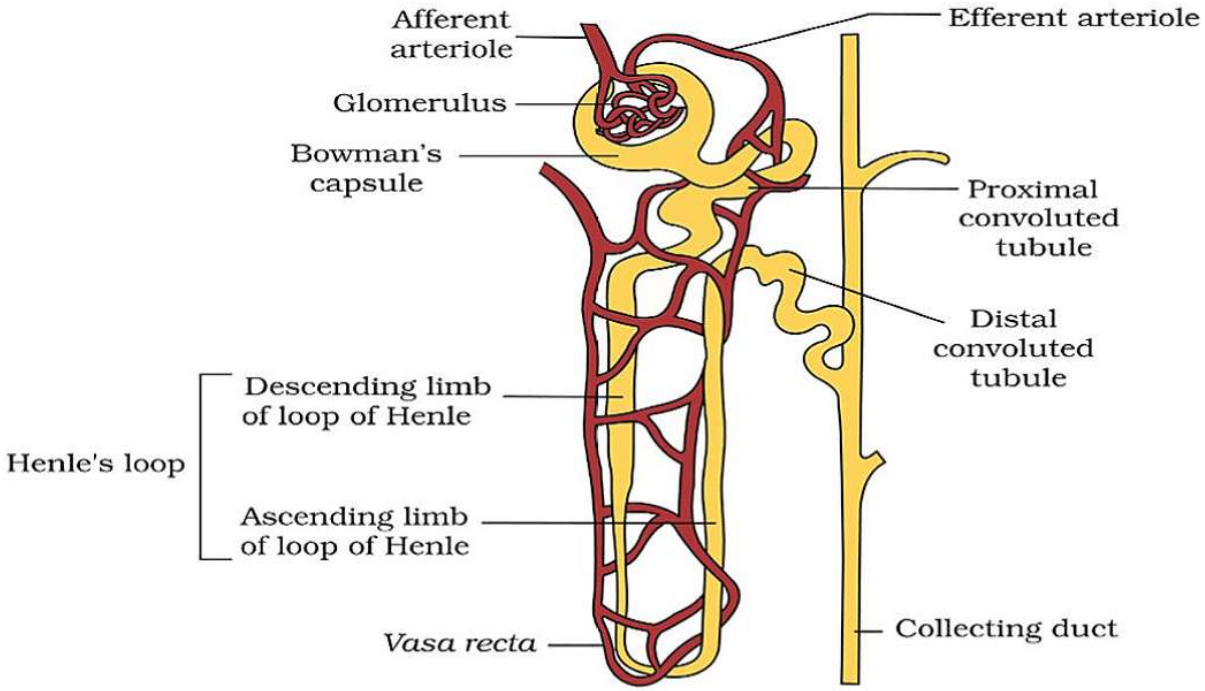
Kidneys

Kidneys are reddish brown bean shaped structure situated between last thoracic and lumber vertebra. Each kidney has a notch on its inner side called hilum through which ureter, blood vessels and nerves enter.



- Inside the hilum has broad funnel shaped space called renal pelvis with projection called calyces.
- Inside the kidney are two zone- outer cortex and inner medulla. Medulla is divided into medullary pyramids projecting into calyx.
- Cortex extends between medullary pyramids as renal column called Columns of Bertini.
- The functional unit of kidney is nephron. Each kidney contains about one million nephrons.
- Each nephron has two parts- the glomerulus and renal tubules. Glomerulus is the tuft of capillaries formed by afferent arteriole. Blood from glomerulus is carried away by efferent arteriole.
- Renal tubules starts with Bowman's capsule continue with tubular parts divided into Proximal Convoluted tubules, Henle's loop and Distal Convoluted tubule.
- The malpighian tubules, PCT and DCT of nephron are situated in cortical region where as loops of Henle's into medulla.

Types of Nephrons



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.

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 or vasa recta is highly reduced.

Urine formation

- Glomerular Filtration (Filtration of blood by glomerulus).
- Reabsorption (Reabsorption by renal tubules).
- Secretion (Tubular cells secretes H+, K+ ammonia into filtrate).

Glomerular capillaries: Glomerular capillaries blood pressure cause filtration of blood through 3 layers (endothelium of glomerular blood vessels, epithelium of Bowman's capsule and basement layer between two membranes as ultra-filtration.

glomerular filtration rate (GFR): The amount of filtrate formed by kidneys per minute is called glomerular filtration rate (GFR) which is 125 ml/minute.

Glomerular Filtration rate: Glomerular Filtration rate is controlled by Juxta glomerular apparatus (JGA).

Reabsorption: 99% of filtrate has to be reabsorbed by renal tubules called reabsorption.

Function of Tubules

- **Proximal Convoluted Tubules (PCT):** All the important nutrients, 70-80% electrolytes and water are reabsorbed.
- **Henle's Loop:** Maintains high osmolarity of medullary interstitial fluid.
- **Distal Convoluted Tubules (DCT):** Conditional reabsorption of Na+ and water. Maintains pH and sodium- potassium balance.
- **Collecting Duct:** Large amount of water is reabsorbed to produce concentrated urine.

Mechanism of concentration of urine: The flow of filtrate in two limbs of Henle's loop is in opposite direction to form counter current. The flow of blood in two limbs of vasa recta increase the osmolarity towards the inner medullary interstitium in the inner medulla.

The transport of substance facilitated by special arrangement of Henle's loop and vasa recta is called counter current mechanism.

Regulation of kidney function

- Functioning of kidney is monitored by hormonal feedback mechanism of hypothalamus and JGA. Change in blood volume, body fluid and ion concentration activates the osmoreceptors in the body that stimulate the hypothalamus to release ADH or vasopressin hormones. The ADH facilitates water absorption in tubules.

- Decrease in glomerular blood pressure activate JG cells to release renin which converts angiotensinogen to angiotensin I and II that increase the glomerular blood pressure and release of aldosterone that increase absorption of Na+ ions and water.

Micturition

- The process of expulsion of urine from the urinary bladder is called micturition. The neural mechanism that causes it is called micturition reflex. Urine formed in nephron is stored in urinary bladder till a voluntary signal is given by CNS. This initiates the contraction of smooth muscles of the bladder and simultaneous relaxation of the urethral sphincter causing the release of urine.

- Lungs, liver and skin also play important role in process of excretion. Lungs remove CO_2 and water, liver eliminates bile containing substances like bilirubin, biliverdin. Sweat glands remove NaCl, small amount of urea and lactic acid. Sebaceous glands excrete sterol, hydrocarbons and waxes.

Disorders of Excretory System

Uremia: There is high concentration of non-protein nitrogen (urea, uric acid, creatinine). Urea

can be removed by hemodialysis.

Renal failure: Also known as kidney failure where glomerular filtration is ceased and both kidney stops working. Kidney transplant is the ultimate method in correction of acute kidney failure.

Renal Calculi: Formation of stone or insoluble mass of crystallized salts formed within the kidney.

Glomerulonephritis (Bright's Disease): Inflammation of glomeruli of kidney due to entry of protein or red blood corpuscles in to filtrate due to injury.

CHAPTER : 19 EXCRETORY PRODUCTS AND THEIR ELIMINATION

Excretory Products and Their Elimination

Modes of Excretion

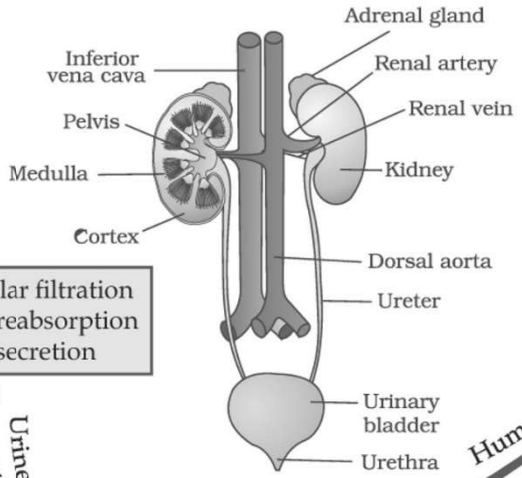
Ureotelism
- Excretory product is Urea
- Example–mammals, Terrestrial Amphibians

Ammonotelism
- Excretory product is ammonia
- Example– bony fishes, aquatic amphibians and insects

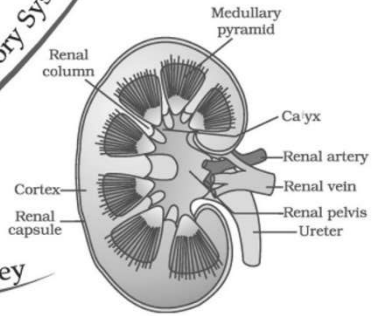
Uricotelism
- Excretory product is uric acid
- Example- Birds

Urine Formation
- Glomerular filtration
- Tubular reabsorption
- Tubular secretion

Human Excretory System
- A Pair of Kidneys
- Ureter
- Urinary Bladder
- Urethra

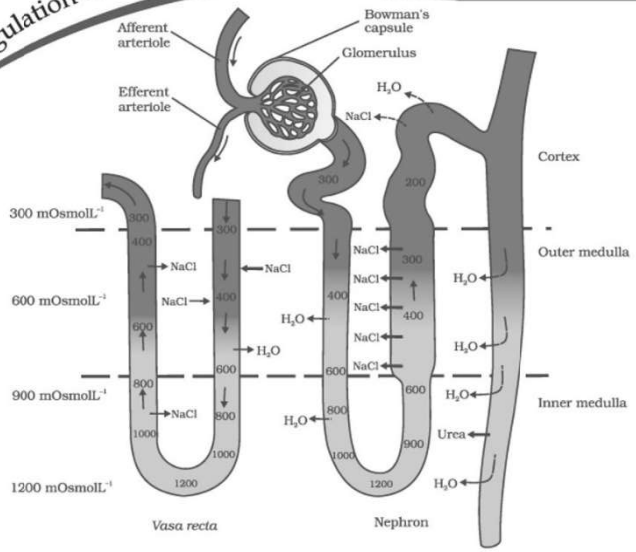


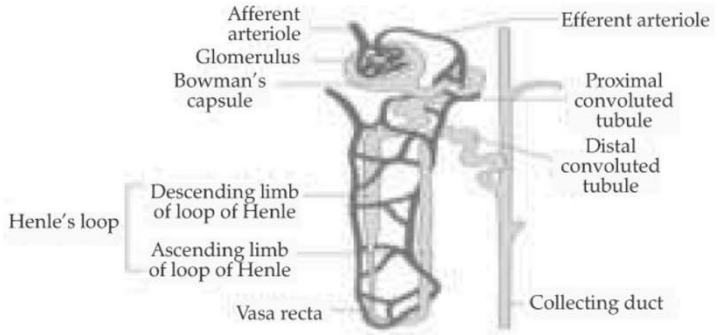
Structure of kidney



Function of the Tubules
- PCT
  70% of electrolytes are reabsorbed
- Henle's Loop
  Maintains high osmolarity of medullary fluid
- DCT
  Conditional reabsorption of Na^+ and water
- Collecting Duct
  Large amount of water is reabsorbed to produce concentrated urine

Counter-current mechanism
- Henle's loop
- Vasa rectae





Disorders of the excretory System
- Uremia
- Renal failure
- Renal Calculi
- Glomerulonephritis

Other organs in excretion
- Liver
- Lungs
- Skin

Micturition
The process of expulsion of urine from urinary bladder

Regulation of kidney
- By ADH (Vasopressin)
- By Juxtaglomerular Apparatus (Renin-Angiotensin mechanism)
- By ANF (in heart)

Important Questions

➢ Multiple Choice Questions:

Question 1. Blood coming out of liver has high concentration of

(a) Urea

(b) Protein

(c) Erythrocytes

(d) Oxygen.

Question 2. Urinary bladder opens into

(a) tlreter

(b) Urethra

(c) Uterus

(d) All of these.

Question 3. Reabsorption of water in the kidney is under control of

(a) ACTH

(b) LH

(c) PSH

(d) ADH.

Question 4. A normal adult excretes urine per day

(a) 3-4 litres

(b) 4-5 litres

(c) 12-i5 litres

(d) 2-3 litres.

Question 5. Excretory product of mammals in mainly

(a) Uric acid

(b) Ammonia

(c) Urea

(d) Creatinine.

Question 6. Loop of Henle lies in

(a) Medulla

(b) Ureter

(c) Cortex

(d) Pelvis.

Question 7. Removal of amino group from an amino acid is

(a) Amination

(b) Excretion

(c) Deamination

(d) Defecaetion.

Question 8. Glomerular filtrate differs from plasma

(a) Yellowish colour

(b) Presence of urea

(c) Absence of proteins

(d) Potassium concentration

Question 9. Glomerular present in glomerular filtrate is reabsorbed in

(a) Distal convoluted tubule

(b) Bowman's capsule

(c) Loop of Henle

(d) Proximal convoluted tubule.

Question 10. Nitrogenous wastes are excreted as uric acid in birds to help in

(a) Elimination of excess heat

(b) Conservation of body heat

(c) Reduce the change of kidney stone formation

(d) Conservation of water inside body.

Question 11. Structural and functional unit of kidney is

(a) Loop of Henle

(b) Malpighian body

(c) Glomerular

(d) Nephron.

Question 12. Glomerular capillaries receive blood having a hydrostatic pressure of

(a) 80mm Hg.

(b) 85mm Hg.

(c) 75mm Hg.

(d) 90mm Hg.

Question 13. Excretion of urea is called

(a) Ammonotelism

(b) Uricotelism

(c) Urination

(d) Ureotelism.

Question 14. In glycosuria, urine contains

(a) Glucose

(b) Inoraganic ions

(c) Amino acids

(d) Epithelial cells.

Question 15. The major excretory organs in mosquitoes are

(a) Flame cells

(b) Nephrons

(c) Nephridia

(d) Malpighian tubules.

➢ Fill In the Blanks:

1. ……., ……. and ……. are the major forms of nitrogenous wastes excreted by the animals.
2. The process of excreting ……. is Ammonotelism.
3. ……. are the tubular excretory structures of earthworms and other annelids.
4. …… tubules are the excretory structures of most of the insects including cockroaches.
5. ……. perform the excretory function in crustaceans like prawn.
6. In humans, the excretory system consists of ……., ……., ……. and …….

➢ True or False:

1. ADH facilitates water reabsorption from latter parts of the tubule, thereby preventing diuresis.
2. Angtiotensis II, being a powerful vasoconstrictor, increases the glomerular blood pressure and therby GFR.
3. The process of release of urine is called the micturition reflex and the neural mechanisms causing it is called the micturition.

4. The kidneys, lungs, liver and skin also help in the elimination of excretory wastes.
5. Our lungs remove large amounts of CO2 (18 litres/day) and also significant quantities of water every day.
6. Sweat produced by the sweat glands is a watery fluid containing NaCl. small amounts of urea, lactic acid, etc.

➢ Very Short Question:

1. What is a nephron?
2. What is a flame cell?
3. What is micturition?
4. What are ammonotelic animals?
5. What is a green gland and in which animal it is found?
6. What is an antidiuretic hormone?
7. Define excretion.
8. What is the color rendering substance found in urine?
9. What are diuretics?
10. What is osmoregulation?

➢ Short Questions:

1. What consequences will follow with the failure of tubular reab¬sorption in nephrons?
2. How the net filtration pressure is obtained?
3. List some important functions of kidneys?
4. How does the excretion of uric acid take place in birds and reptiles?
5. Name and state in brief the processes involved in the formation of urine.
6. What is Polynephritis? What is uremia?
7. How the net filtration pressure is obtained?
8. List some important functions of kidneys?

➢ Long Questions:

1. Briefly state the mechanism of urine formation in the human kidney.
2. Explain the following:

   (a) Skin functions as an accessory excretory organ.

   (b) Mammals can eliminate hypotonic and hypertonic urine according to body needs.

   (c) Micturition is a reflex process but is under some voluntary control.

(d) Mammals are ureotelic, but birds are uricotelic.

3. Describe the functional anatomy of a human nephron.
4. Describe the gross anatomical features of the human kidney with a suitable diagram.
5. Write a short account on hemodialysis.

Assertion Reason Question-

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   (c) If Assertion is true but Reason is false.

   (d) If both Assertion and Reason are false.

   Assertion: Sharks are said to be ammonotelic animals.

   Reason: Sharks have a ability to retain considerable amounts of ammonia in vertebrates.

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   (c) If Assertion is true but Reason is false.

   (d) If both Assertion and Reason are false.

   Assertion: Ammonia should be removed from the body as rapidly as it is formed.

   Reason: In water, ammonia is insoluble.

✓ Answer Key-

➢ Multiple Choice Answers:

1. (a) Urea.
2. (b) Urethra.
3. (d) ADH.
4. (c) 12-15 litres.
5. (c) Urea.
6. (a) Medulla.
7. (d) Defecaetion.
8. (c) Absence of proteins.

9. (d) Proximal convoluted tubule.
10. (d) Conservation of water inside body.
11. (d) Nephron.
12. (c) 75 mm. Hg.
13. (d) Ureotelism.
14. (a) Glucose.
15. (d) Malpighian tubules.

➢ Fill In the Blanks:

1. Ammonia, urea, uric acid
2. ammonia
3. Nephridia
4. Malpighian
5. Antennal glands or green glands
6. a pair of kidneys, one pair of ureters, a urinary bladder, a urethra

➢ True or False:

1. True
2. True
3. False
4. True
5. True
6. True

➢ Very Short Answers:

1. Answer: The functional unit of the kidney.
2. Answer: The excretory unit in planaria, tapeworm, and liver fluke.
3. Answer: It is the act of void of the urinary bladder, the activity under nervous and voluntary control.
4. Answer: The animals which excrete nitrogenous wastes as ammonia are ed ammonotelic animals, e.g., certain fishes.
5. Answer: It is an excretory structure found in prawns.
6. Answer: It is the hormone that helps in the reabsorption of water in the nephron, also called vasopressin (Secreted by post pituitary gland).

7. Answer: Excretion is the process of elimination of metabolic wastes from the body.
8. Answer: Urochrome.
9. Answer: The substances which increase the volume of water, to be excreted as urine, are called diuretics, e.g., tea, coffee, alcoholic beverages.
10. Answer: It is the maintenance of water and osmotic concentration of blood.

➢ Short Answer:

1. Answer: Nephrons are the structural and functional units of each kidney. With the failure of reabsorption in nephrons, much-needed substances like glucose, amino acids, water, salts, etc. will be excreted along with urine.

   The biological functioning of organs and body will be impaired, ultimately death will occur.
2. Answer: The pressure of blood in afferent arterioles is (+ mm Hg 75). This is opposed by the osmotic pressure of plasma proteins by (-) 30 mm Hg and intertubular pressure of (-) 20 mm Hg. The net filtration pressure is (+) 25 mm Hg that acts in glomerular filtration as a driving force. About 172 liters of glomerular filtrate are produced in 24 hrs. which is nearly 4-1/ 2 times the total fluid in the human body.
3. Answer: Kidneys play a vital role as follows:

   (a) It removes nitrogenous wastes from the blood.

   (b) It regulates fluid balance, between intake and fluid loss.

   (c) It removes drugs, penicillin, poisons, etc. from blood.

   (d) It maintains acid-base (pH) balance

   (e) It regulates electrolyte balance.
4. Answer: In birds and reptiles, uric acid is formed mostly in the liver, transported to the kidney through blood. It is separated by renal tubules and temporarily stored in cloacae. Water is absorbed by cloacal walls, needing only a minimum amount of water for excretion. In birds, urine is eliminated in a paste-like form along with feces.
5. Answer: The urine is formed by the combined processes as follows:

   (a) Glomerular filtration: Metabolism wastes and other substances are filtered out by glomerulus due to the generation of net filtration pressure.

   (b) Re-absorption: Water and other required substances are selectively reabsorbed from the filtrate, so that urine becomes concentrated.

   (c) Tubular secretion: Tubules secrete certain ions (like K+ in exchange for Na+), urea, creatinine, uric acid, ammonia, etc. This process is of more significance in marine fishes and desert amphibians than mammals.
6. Answer: It is a bacterial infection that causes inflammation of the renal pelvis, nephrons,

and medullary tissues of the kidney. It affects the counter-current mechanism. Its main symptoms are frequent and painful urination, fever, and pain in the lumbar region.

A high concentration of urea, uric acid, creatinine, etc. in the blood due to some bacteria infection or some obstruction in the passage of the urinary system is called uremia.

7. Answer: The pressure of blood in afferent arterioles is (+ mm Hg 75). This is opposed by the osmotic pressure of plasma proteins by (-) 30 mm Hg and intertubular pressure of (-) 20 mm Hg. The net filtration pressure is (+) 25 mm Hg that acts in glomerular filtration as a driving force. About 172 liters of glomerular filtrate are produced in 24 hrs. which is nearly 4-1/ 2 times the total fluid in the human body.
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(e) It regulates electrolyte balance.

➢ Long Answer:

1. Answer: Three main processes are involved in urine formation

1. Glomerular filtration: Kidneys filter the equivalent of blood volume every 4 – 5 minutes. Filtration slits are formed by the assemblages of fine cellular processes of podocytes (foot cells). The process of ultra-filtration depends upon two main factors, first the net hydrostatic pressure difference between the lumen of the capillary and the lumen of the Bowman's capsule favor filtration.

The glomerular ultrafiltrate contains essentially all the constituents of the blood except for blood corpuscles and plasma proteins. Nearly 15% – 25% of the water and salutes are removed from the plasma that flows through the glomerulus. The glomerular filtration rate is about 125 ml min1 or about 180 L day-1 in human kidneys.

2. Two important intrinsic mechanisms provide autoregulation of glomerular filtration rate.

(a) Myogenic mechanism: Increase in blood pressure will tend to stretch the efferent arteriole, which would increase the blood flow to the glomerulus. The diameter of the arteriole is reduced, increasing the resistance to flow. This myogenic mechanism thus reduced variations inflow to the glomerulus in case of fluctuations in blood pressure.

(b) Juxtaglomerular apparatus (JGA): This specialized cellular apparatus is located where the distal convoluted tubule passes close to the Bowman's capsule between the afferent and efferent arterioles. JGA cells secrete substances like renin that modulate blood pressure and renal blood flow and GFR are regulated.

Myogenic and juxtaglomerular mechanisms work together to autoregulate the GFR over a wide range of blood pressure. In addition to these extrinsic neural control also regulates the filtration rate.

3. Tubular re-absorption: The selective transport of substances across the epithelium of the excretory tubule from the ultrafiltrate to the interstitial fluid is called re-absorption. Nearly all the sugar, vitamins, organic substances (nutrients), and most of the water are reabsorbed.

4. Tubular secretion: It is a very selective process involving both passive and active transport. The filtrate travel through the nephron, substances that are transported across the epithelium from the surrounding interstitial fluid and join it. The net effect of renal secretion is the addition of plasma solutes to the filtrate within the tubule.

2. (a) Answer: The skin retains some excretory role in many animals. Human skin possesses two glands for secreting fluid on its surface. These are; sweat from sweat glands and sebum from sebaceous glands.

(b) Answer: When the animal takes a large quantity of water the kidneys excrete a very high amount of hypotonic urine. At the same time when the animal takes a small number of water kidneys to excrete a very high amount of hypertonic urine.

At the same time when the animal takes a small number of water kidneys to excrete a small amount of hypertonic urine, as kidneys need to conserve water. In this way, the osmotic concentration of blood is maintained by the kidneys. This flexibility of kidney nephrons is highly observed in mammals.

Hypotonic urine removes excess water from the body in order to raise the osmotic concentration of the blood to normal. Excess of water in body fluids generally lowers the osmotic pressure of blood and increases the volume of blood. This increase in the volume of blood raises the blood pressure and hydrostatic pressure which increases the rate of ultrafiltration. In this way, a large amount of hypotonic urine is produced in order to bring the volume of fluids to normal.

(c) Answer: It is the process of passing out urine. Nephrons produce urine and drain. When enough urine collects in the bladder the distension of its walls raises enough pressure which generates a spontaneous nervous activity under the stimulation of the sympathetic and parasympathetic nervous system. This nervous stimulation causes the smooth muscles on the urinary bladder to rise too high to control.

Similarly, micturition can voluntarily be initiated even before enough urine has accumulated in the bladder. Backflow of the urine into the ureters from the urinary bladder is prevented because the terminal part of each ureter passes through the bladder and gets closed as soon as the contraction of the bladder occurs.

(d) Answer: Mammals are ureotelic animals as they eliminate nitrogen mainly urea. It is very soluble in water and needs a considerable amount of water for its elimination. Mammals can thus form hypertonic urine which they excrete. While the birds cannot excrete urine as hypertonic since nitrogen occurs mainly in the form of uric acid. The uric acid is insoluble in water and does

not require much water for its elimination.

3. Answer: Nephrons are structural and functional units of each kidney to form the urine. Each nephron is fine; microscopic highly coiled tubular structure differentiated into malpighian body and the renal tubule. The malpighian body comprises a large double-walled cup-shaped structure the Bowman's capsule present in the renal cortex. It is lined by thin, semipermeable epithelial cells, the podocytes. Bowman's capsule receives the blood supply through a branch of the renal artery.

   The afferent arteriole forms a fine capillary network in the form of glomerules with high hydrostatic pressure. The lumen between two layers of Bowman's capsule is continuous with the lumen of the tubule. The Bowman's capsule and the glomerulus together form a globular body, the Malpighian body or the renal capsules.

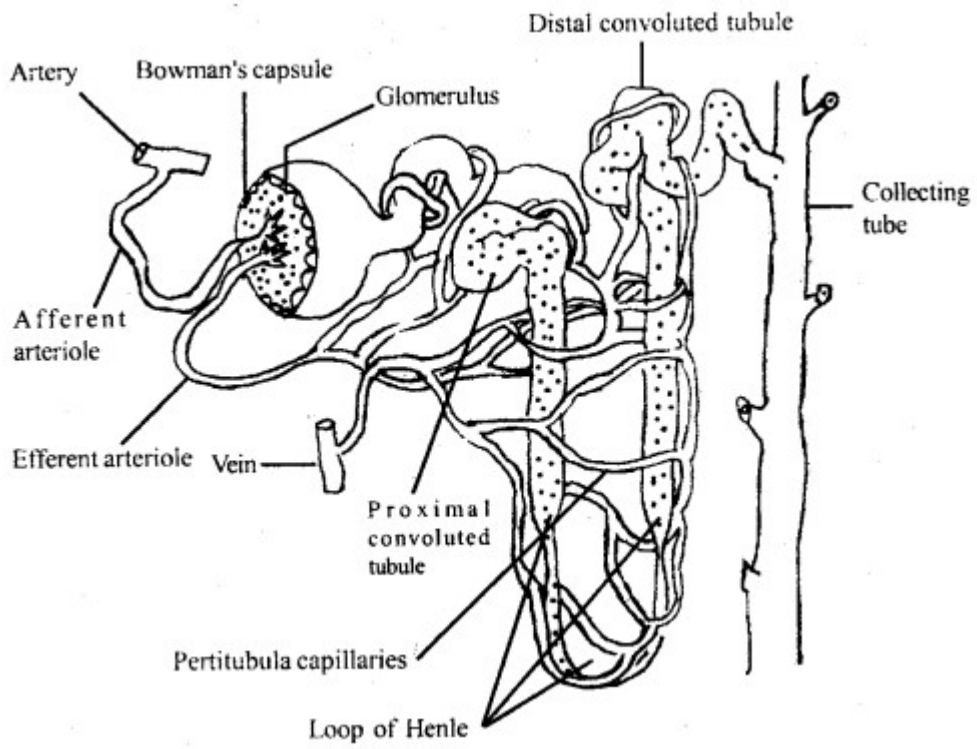
   The capillaries forming the glomerulus at the exit of Bowman's capsule unite to form a narrow efferent arteriole which breaks up into a peritubular network of capillaries with low hydrostatic pressure.

   The renal tubule is a long highly coiled tubular structure differentiated into proximal convoluted tubule (PCT) Henle's loop, distal convoluted tubule (DCT). The U-shaped loop-like structure, descending and ascending from the renal tubule is called Henle's loop.

   Collecting tubules of several nephrons open into a wider duct called the collecting duct. A number of collecting ducts unite with each other in the medulla to form the ducts of Bellini, which drains down the urine into the ureter from each kidney to be stored in the urinary bladder.

   The efferent arteriole emerges out from the glomerules breaks up into a peritubular capillary network around the renal tubule in the cortex. These capillaries also form a thin-walled, straight capillary the vasa recta. The vasa recta help in retaining the reabsorbed ions and urea in medullary interstitial fluid to maintain high osmotic pressure in kidneys.

   Glomerular filtrate undergoes tubular reabsorption and tubular secretion for the formation of urine. (See diagram opposite page)



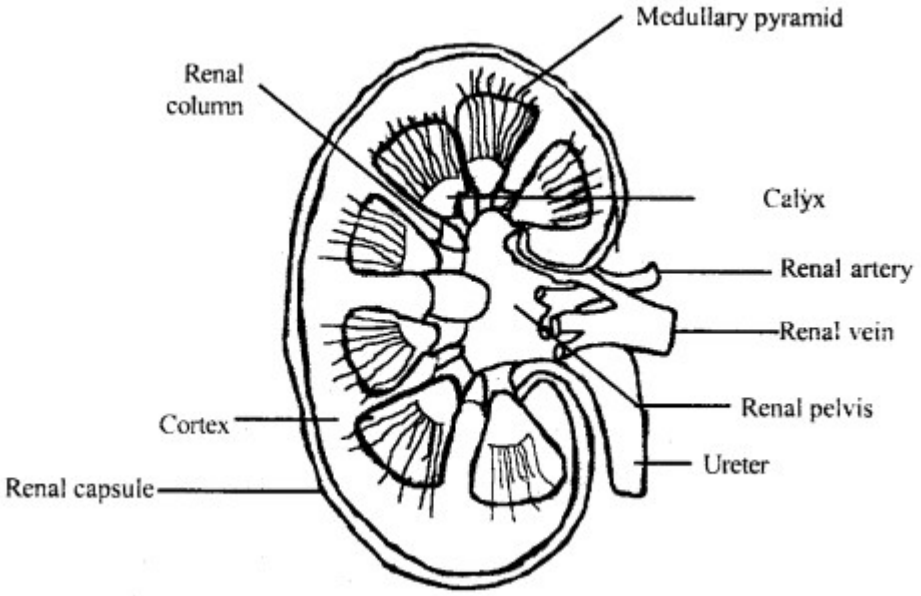
Uriniferous tubules Or nephron of the kidney

4. Answer: Kidney: Kidney is chocolate brown, bean-shaped, large-sized about 10cm long and 5 – 7 cm broad, 3 – 4cm thick flattened, metamorphic. The weight of each kidney is 150 to 170 gm. They are situated against the back wall of the abdominal cavity, just below the diaphragm, between the 12th thoracic and 3rd lumbar vertebrae.

   The outer margin is convex. The inner concave presents a longitudinal opening called the hilum. The renal artery and renal vein respectively enter and leave the kidney through its hilum.

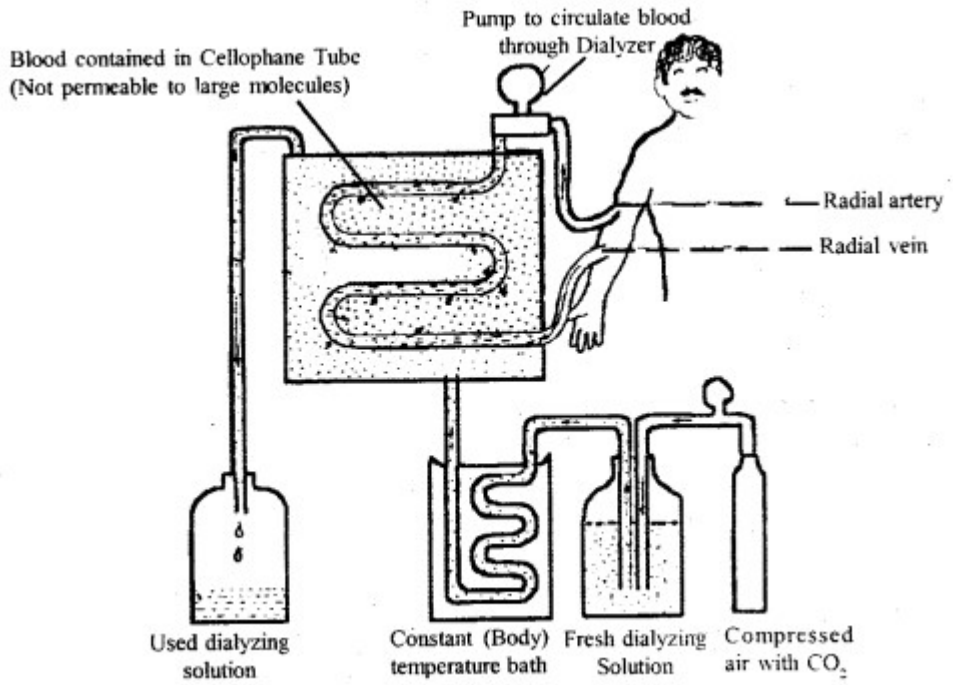
   The two kidneys are slightly asymmetrical in position because the right kidney is slightly at a lower level than the left. Kidneys are held in position by a mass of adipose tissue called Renal fat. These rest against the abdominal muscles. Each kidney is covered on the ventral side by the peritoneum and is thus retroperitoneal in nature.

   Surrounding the kidneys and the renal fat is a sheath of fibro elastic tissue known as renal fascia or capsule. They protect the kidney. The renal fat forms a shock-absorbing cushion. The renal fascia fixes the kidney to the abdominal wall.



Longitudinal section (Diagrammatic of Kidney)

5. Answer: In case of renal failure, an artificial kidney is used for removing excess urea from the blood of the patient by a process called hemodialysis. Blood is taken out from the artery of the patient, cooled to 0°C, mixed with an anticoagulant such as heparin, and then pumped into the apparatus called artificial kidney. In this apparatus, blood flows through channels



Working of artificial kidneys for hemodialysis

bounded by cellophane membrane. The membrane is impermeable to macromolecules but permeable to small solutes. The membrane separates the blood flowing inside the channels from a dialyzing fluid flowing outside the membrane. The wastes like urea, uric acid, and creatinine diffuse from the blood to the dialyzing fluid across the cellophane membrane.

Thus the blood is considerably cleared of nitrogenous waste products without losing plasma proteins. Such a processor separation of macromolecules from small solute particles with the help of a permeable membrane is called dialysis. The blood coming out of the artificial kidney is warmed to body temperature, mixed with an Antiheparin to restore its normal coagulability, and returned to a vein of the patient.

Haemodialysis saves and prolongs the life of many uremic patients.

Assertion Reason Answer-

1. (d) If both Assertion and Reason are false.

   Explanation: Sharks are ureotelic, they are not ammonotelic animals. Ureotelic animals excrete urea instead of ammonia as the major nitrogenous waste product. These include man and all other mammals, terrestrial and semi-aquatic amphibians such as toads and frogs, cartilaginous fishes (elasmobranchs) such as sharks and sting rays. Sharks need to avoid water loss from body, thus they cannot excrete ammonia, as it requires enough water to be eliminated. In order to retain so much urea in their blood, their blood osmotic pressure approaches that of sea water. This minimises water loss from their body to adjust to the concentrated saline water of the sea.

2. (c) If Assertion is true but Reason is false.

   Explanation: Ammonia is a type of the basic nitrogenous catabolite of proteins, that is highly soluble in water and highly toxic to the animal. Therefore, its concentration must be kept very low in the blood. Due to this ammonia should be removed as rapidly from the body as it is formed. A large volume of water is required by the animals to dissolve ammonia and remove it from the body. So, its elimination in urine involves considerable loss of water from the body.