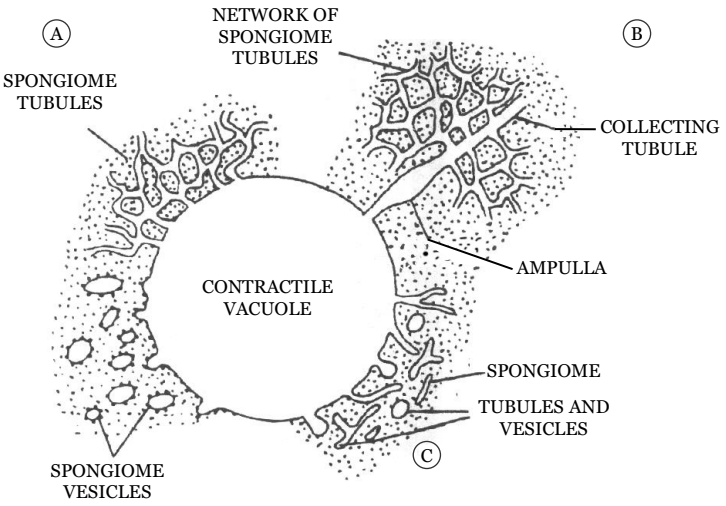
EXCRETORY SYSTEM

INTRODUCTION : The component structural and functional units of the bodies of all organism are cells which have been looked as "miniature chemical factories" because of continuous metabolism taking place in these. It yields certain waste products which are, not only useless, but harmful to the cells and the body. Cells, therefore, throw out these wates, by diffusion, into their surrounding medium. Finally, these wastes are eliminated by the body into its external environment. This is, thus an important vital activity of all organism. It is called excretion.

Besides removing the metabolic wastes and impurities from the blood, the kidney also perform the important function of osmoregulation by regulating the amount of water in body fluids. The normally functioning kidneys produce a large volume of dilute urine when more water is taken, and a small volume of concentrated urine when water intake by the body is poor.

6.1 EXCRETORY ORGANS OF DIFFERENT ORGANISM.

(i) **Protozoans :** In protozoans like Amoeba and Paramecium carbon dioxide and ammonia are mostly excreted out by diffusion through general body surface. It is considered that the contractile vacuoles also play some role in the removal of excretory products.



(ii) **Sponges :** In sponges, the nitrogenous metabolic waste (ammonia) leaves the body in the outgoing water current by diffusion.

Most of the sponges are marine and have no problem of surplus water in their cells. A few sponges lie in hypotonic fresh water and have contractile vacuoles in most of their cells.

(iii) **Coelenterates :** Hydra also lacks special excretory organs. The nitrogenous waste products like ammonia are removed through the general surface of the body by diffusion. Some nitrogenous waste products are also thrown along with indigestible matter through the mouth.

(iv) **Platyhelminthes :** Planaria, liverfluke and tapeworm possess a large number of excretory cells called the flame cells (solenocytes) and long excretory ducts (also called canals of vessels). The flame cells open into the ductules which in turn open into the excretory duct.

Excretory canals are present on each lateral side or the collecting tubules of which one is dorsal and the other ventral. In the last proglottid, they join to form a pulsatile caudal vesicle, which is open to a exterior by excretory pore.

Excretory materials diffuse from the surrounding tissues into the flame cells. Vibrations of the cilia cause these materials to remove in the excretory ducts. The walls of the ducts reabsorb useful substances and remaining excretory materials (*e.g.*, ammonia) are expelled out through the excretory pores.

(v) **Aschelminthes :** The round worms such as *Ascaris* have H-shaped excretory system. It is made up of a single Renette cell. It consists of two longitudinal excretory canals connected anteriorly by a network of transverse canals. A short terminal duct opens outside via excretory pore. Ascaris is excretes both ammonia and urea.

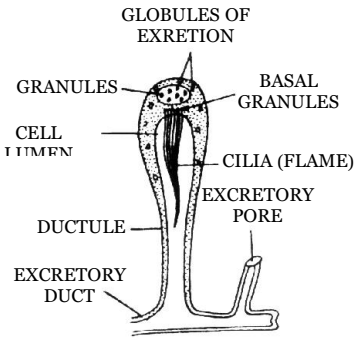


Fig. – Flame cell of Platyhelminthes

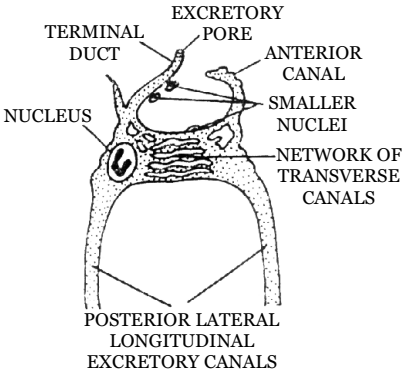


Fig. – Renette cell of Ascaris

(vi) **Annelids :** In annelids like Nereis, earthworm, leech, etc., the tubular coiled structures, the nephridia are excretory organs. A typical nephridium starts from a rounded ciliated funnel, the nephrostome which opens into coelom (body cavity). The nephrostome leads into a nephridial tubule with ciliated cells. A typical nephridium opens outside the body through a small aperture called nephridiopore. However, in earthworm three types of nephridia are found. The septal nephridia situated on the septa (behind 15th segment) and pharyngeal nephridia (in three pairs of bundles in the 4th, 5th, and 6th segments) open into the alimentary canal and pour their excretory materials there. It is an adaptation for conservation of water. The integumentary nephridia (found scattered in the body wall in each segement except the first two segments) open directly on the body surface. Excretory materials help the earthworm in keeping the skin moist for cutaneous respiration.

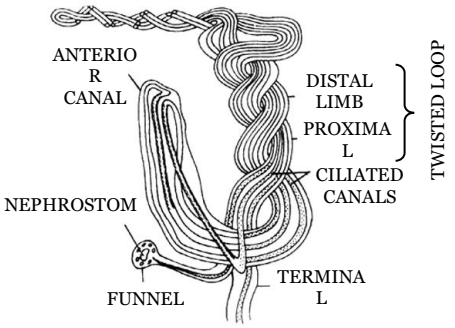


Fig. – Septal nephredium of Earthworm

(vii) **Arthropods :** (a) The excretory system of the adult Prawn (crustacean) consists of a pair of antennary or green glands, a pair of lateral ducts and a single renal sac. Each green gland consists of an end sac, labyrinth (glandular plexus) and bladder. The end sac extracts nitrogenous waste products and

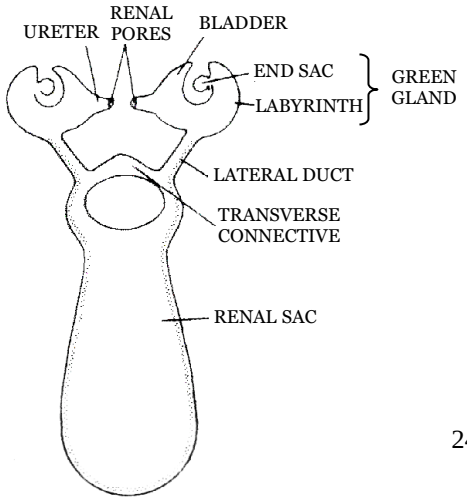


Fig. – Antennary gland of Prawn

excess water from the blood. The excretory fluid is transferred from the sacs to the labyrinth in which useful materials are absorbed and carried to the blood. The remaining excretory fluid called urine, flows from the labyrinth to the bladder. The excretory fluid also comes here from the renal sac. Urine is temporarily stored in the bladders. Later on urine is expelled out through ureters and renal pores.

(b) Most insects, centipedes and millipedes, possess Malpighian tubules as their principal excretory organs. They are fine, spiral or convoluted, thread-like tubules which are attached to the alimentary canal. The distal closed end of each Malpighian tubule float freely in the haemolymph (blood). These tubules extract metabolic wastes like potassium and sodium urate, water and carbon dioxide from the blood. In the Malpighian tubules bicarbonates of potassium and sodium, water and uric acid are formed. A large amount of water and bicarbonates of potassium and sodium are reabsorbed by the cells of Malpighian tubules and then transferred to the blood (haemolymph). Uric acid is carried to the alimentary canal of the insect and is finally passed out through anus.

(c) Spiders and scorpions possess Malpighian tubules or coxal glands or both for excretion.

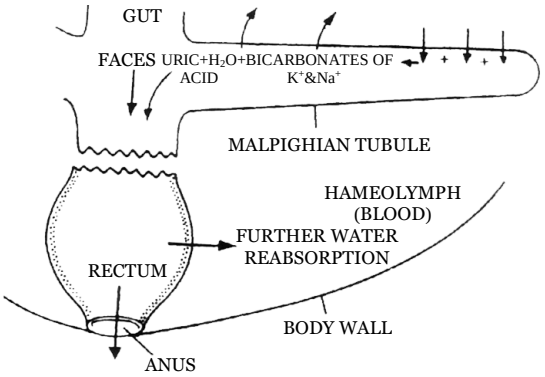


Fig. – Malpighian tubule of insecta

(viii) **Molluscs :** They have one or two pairs of kidneys which discharge excretory matter into the mantle cavity which is finally passed out of the body along with the out flowing water.

(ix) **Echinoderms :** Specialized excretory organs are absent in echinoderms (*e.g.*, Starfish). The excretory products, chiefly ammonia, are eliminated by diffusion through dermal branchae (primitive gills) and tube feet.

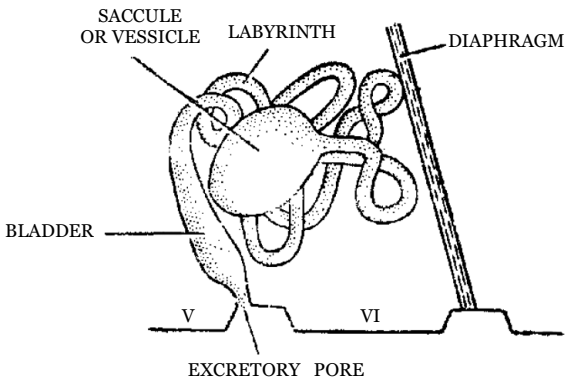


Fig. – Coxal gland or Scorpion

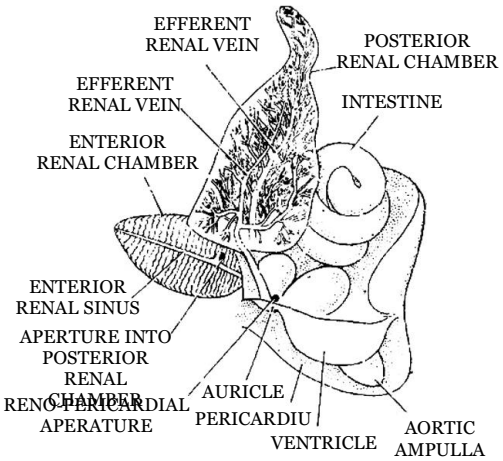


Fig. – Organ of Bojanus (Pila – mollusca)

Excretory organs of different organisms

S.No.	Phylum	Excretory/osmoregulatory Organ/Organelle and principal N_2-waste	Function	Example
I. Invertebrates				
(1)	Protozoa	Contractile vacuole Ammonia	Ammonotelic Osmoregulatory	Amoeba Paramecium
(2)	Porifera	General surface of body	Ammonotelic	Sycon, Leucon
(3)	Coelenterata	Ammonia, General surface of body	Ammonotelic	Hydra
(4)	Platyhelminthis	flame cells (=Solenocytes) form the protonephridial system	Ammonotelic	Taenia, fasciola
(5)	Nematoda	H-shaped excretory organ, Renette cells	Ammonotelic	Ascaris
(6)	Annelida	Nephridial system, (Metameric), various types	Ammonotelic	Pheretima
(7)	Arthropoda			
a.	Class-Insecta	Malpighian tubule (Uric acid)	Uricotelic	Periplaneta
b.	Class crustacea	Antennary (=green) gland Uric acid	Uricotelic	Palaemon
c.	Class Arachnida	Coxal glands Malpighian tubule Hepato pancreas Nephrocytes	Uricotelic	Spider
(8)	Mollusca	(a) Kidney (=organ of Bojanus) or Renal organ (b) Keber's organ Aquatic forms excrete Ammonia Terrestrial forms Excrete uric acid	 Ammonotelic Uricotelic	Pila Pulmonate Mollusc Limax
(9)	Echinodermata	Dermal branchiae (primitive gills) tube feet,	Ammonotelic	Cucumaria Asterias

		body surface (Ammonia)		

6.2 Excretory system of man

Mammalian (human) urinary system consists of a pair of kidneys, a pair of ureter, a urinary bladder and a urethra.

(i) **Kidneys :** The kidneys are dark-red, bean-shaped organs about 11 *cm* long, 5 *cm* wide and 3 *cm* thick, each weight about 150 *gm* in an adult male and about 135 *gm* in adult female. They are placed against the back wall of the abdominal cavity just below the diaphragm, one on either side opposite the last thoracic and first three lumber vertebrae. The lower two pairs of ribs protect them.

The kidneys are covered by peritoneum on the front (ventral) side only. thus, they are retroperitoneal. The right kidney is attached more anterior than the left in rabbit. This asymmetry is just the reverse of that found in man.

In man left kidney occurs at a slightly higher level than the right one, because right side has prominent right liver lobe. In rabbit the condition is little differ due to quadropedilism *i.e.* left kidney is in normal position while the right kidney shift ached to provide place for stomach below it.

In mammals, the kidney is bean-shaped i.e. concavo convex. The center of concave inner surface is called as hilum or hilus which gives out a ureter. From this hilus surface the renal artery enters into the kidney, the renal vein comes out and the renal nerves enter into the kidney.

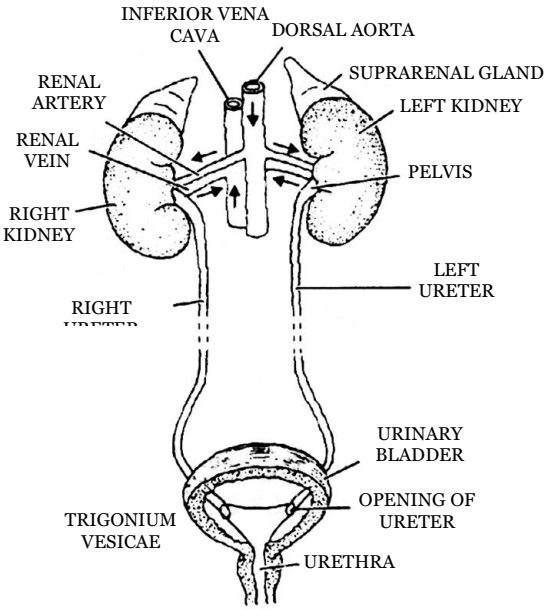


Fig. – Human urinary system

(a) **Structure of kidney :** The kidneys are metanephric in mammals. The kidney is divisible into two parts outer-cortex and inner-medulla.

Renal pyramids or medullary pyramids : The medulla is subdivided into 10 to 12 conical masses – the renal pyramid, each having broad base towards the cortex and a narrow end called renal papilla towards the pelvis.

Renal columns of bertini : Between the pyramids, the cortex extends into the medulla or renal columns of bertini.

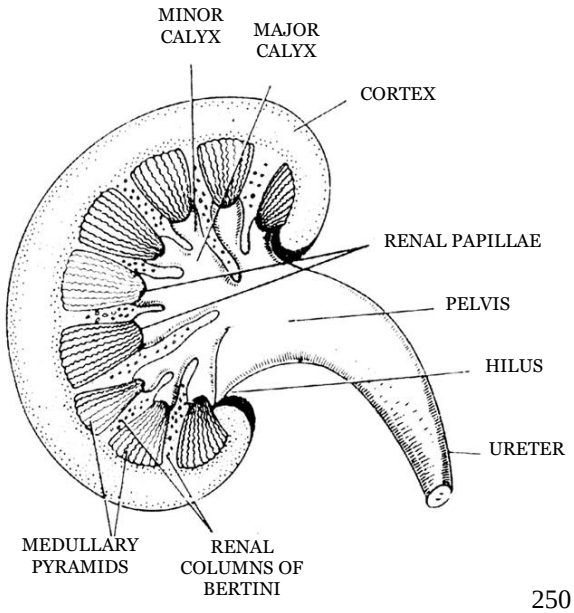


Fig. – H.L.S. of human kidney

Calyx : Each renal papilla projects into the cavity of a minor calyx, minor calyx join to form major calyx. The major calyx open into a wide funnel like structure, the pelvis.

The latter leads into the ureter. In rabbit, the pelvis is unbranched hence, it is without calyx.

In frog ventral surface of each kidney has many ciliated funnels called nephrostomes. They drain wastes from body cavity (coelom) and connect to renal veins in frog or to uriniferous tubules in tadpoles.

Histology of kidney : Histologically a kidney is made of innumerable thin, long, much convoluted tubular units called uriniferous tubule or nephron.

Nephron is the structural and functional unit of kidney. One human kidney may contain about one million (10 lac nephron) nephron (In rabbit each kidney bear about 2 lac nephron). In frog each kidney bears about 2 thousand nephron.

(b) **Structure and types of nephron :** A nephron or uriniferous tubules is made of two parts –

(1) **Malpighian body :** The proximal end of each nephron forms a blind or closed, enlarged and double walled cup, the Bowman's capsules in the cortex. (name Bowman's capsule is based on english physiologist and histologist William Bowman).

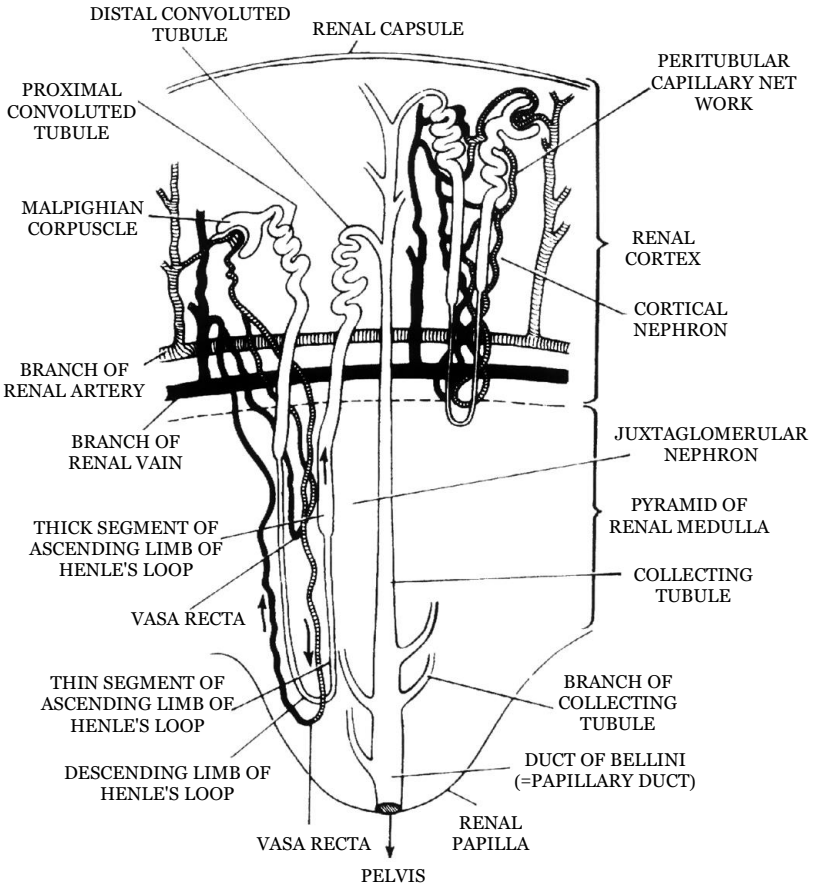


Fig. – Position, structure and blood supply of cortical and juxtamedullary nephrons is a mammalian kidney

Each capsule contains a network of blood capillaries the glomerulus which receives blood through afferent arteriole and the blood comes out through the efferent arteriole .The diameter of the efferent arteriole is comparatively lesser. (Bowman's capsule and glomerulus receives about 20 – 25% of the cardiac out put (blood) at rest.

The composite structure of Bowman's capsule and glomerulus is known as Malpighian body or Malpighian corpuscles after the Italian microscopist Marcello Malpighi.

(2) **Tubule :** The tubule is differentiated in to 3 parts P.C.T., Henle's loop and D.C.T.

The Bowman's capsule opens into a proximal convoluted tubule (P.C.T.) the anterior part of the P.C.T. is more coiled where as its posterior part is almost straight. The P.C.T. opens into a Henle's loop. The Henle's loop is a U- shaped structure which has a distinct descending limb and an ascending limb. The ascending limb opens in to the distal convoluted tube. The D.C.T. is a coiled structure. Many D.C.T.

unit to form a collecting duct. The collecting ducts of one pyramid unit to form a duct of Bellini. The duct of Bellini lead into the pelvis part.

Arrangement of nephron : The malpighian body and a part of P.C.T. and D.C.T. are situated in the cortex. Most of the part of P.C.T. and D.C.T., Henle's loop and collecting ducts are found in the medulla.

Vasa recta : The efferent arteriole of juxta-glomerular nephron forms a peritubular capillary system around the Henle's loop which is called vasa recta. Each of the vasa recta makes U turn at the inner most part of the medulla and return to the venous circulation near the junction of medulla and cortex. The efferent arteriole and peritubular capillaries technically constitute a renal portal system. In all amniotes as reptiles, birds and mammals have a renal portal system.

Types of nephron : Nephrons are of two types cortical and juxtamedullary, with regard to their location in the kidney. The cortical nephrons form about 80% to 90% of total nephron. They lie in the renal cortex and have very short loops of Henle that extend only little into the medulla.

The juxta medullary nephron have their Bowman's capsule close to (Juxta) the junction of the cortex and the medulla and have very long loops of Henle, extending deep into the medulla. This type of nephron is present in only birds and mammals. The cortical nephrons control the plasma volume when water supply is normal. The juxtamedullary nephrons regulate the plasma volume when water is in short supply (In advarse condition).

Differences between cortical and Juxtamedullary nephrons

Cortical Nephrons	Juxtamedullary Nephron
1. Form 80% of total nephrons.	1. Form only 20% of total nephrons.
2. Are small in size.	2. Are large in size.
3. Lie mainly in the renal cortex.	3. Have Bowman's capsules in the cortex near its junction with the medulla.
4. Henle's loops are very short and extend only a little into the medulla	4. Henle's loop are very long and extend deep into the medulla.
5. Control plasma volume when water supply is normal.	5. Control plasma volume when water supply is short.

(c) **Histology of nephron**

Glomerulus : Glomerulus is a network of up to 50 parallel branching and anastomosing capillaries covered by endothelium, basement membrane and epithelium made of podocytes which has slit pores that restrict passage of colloids. However, small molecules and water can easily pass through them in to the P.C.T.

Bowman's capsule : The podocytes forming the inner wall of the Bowman's capsule have gaps (about 25 *nm* wide) the slit pores.

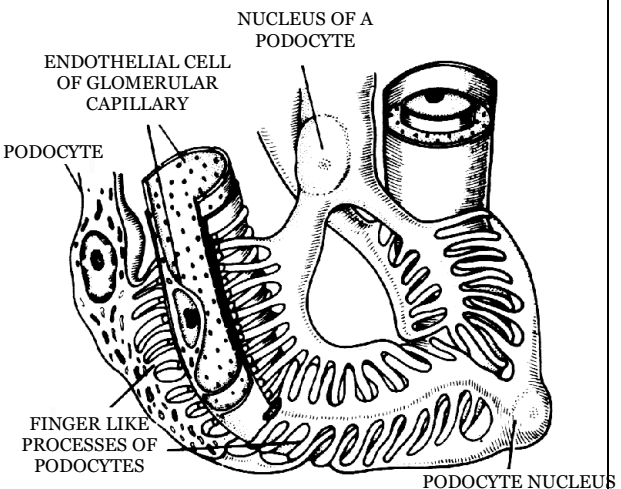


Fig. – A glomerular capillary entwined by processes of three podocytes

The outer wall of the Bowman's capsule consists of unspecialized squamous epithelium (flattened).

Proximal convoluted tube : P.C.T. is made up of simple columnar epithelium. It has microvilli so it is also known as brush border epithelium.

Loop of Henle : The epithelium of descending limb of loop of Henle is very thin and composed of squamous epithelium and ascending limb is lined by cuboidal epithelium. The ascending limb is impermeable to water and permeable to *NaCl*.

Distal convoluted tube : It is made up of cuboidal epithelium which is glandular in nature.

Collecting ducts : The collecting ducts are lined by cuboidal and columnar epithelium in different regions. At intervals, the cuboidal cells are ciliated.

Juxta-glomerular apparatus : This specialized cellular apparatus is located where the distal convoluted tube passes close to the Bowman's capsule and afferent arteriole. Cells of the D.C.T. epithelium in contact with afferent arteriole are denser than other epithelial cells known as maculla densa. Maculla densa has special Lacis cell or Polkisson's cell. These cells secrete renin hormone that modulate blood pressure and thus renal blood flow and G.F.R. are regulated.

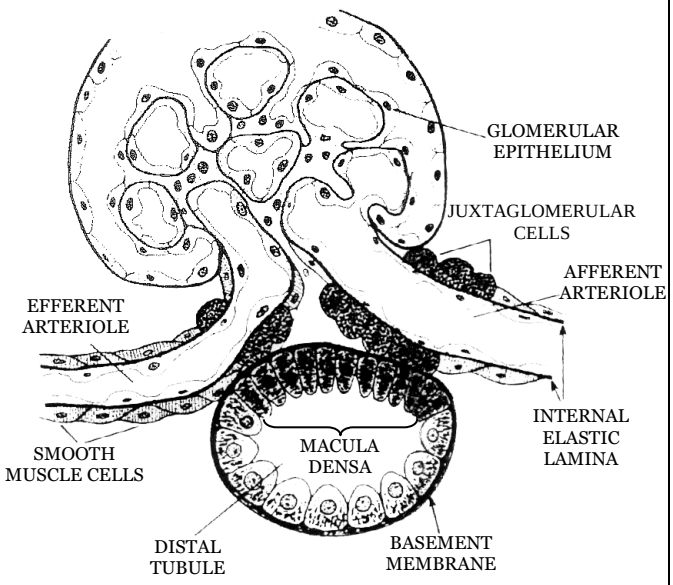


Fig. Juxta glomerular apparatus

(d) **Origin and types of kidneys in different vertebrate :** Kidney tubules (nephrons) arise in the embryo in a linear series from a special part of mesoderm called mesomeare or nephrotome.

Number, complexity and arrangement of Nephrons are differ in different groups of vertebrates. A nephron is differentiated into three parts – peritoneal funnel, tubule and malpighian body. Peritonial funnel (nephrostome) are normally present in embryos and larvae and considered as vestigeal organ of hypothetical primitive kidneys.

Archeonephros kidney : Archeonephros is the name given to the hypothetical primitive kidney of ancestral vertebrate. It is also called as holonephros or complete kidney. (It extended entire length of coelom) It tubules are segmentally arragned and nephrostome is present. Glomerulus is external (without capsule). It duct is called as archeonephric duct. Ex. Larva of myxine.

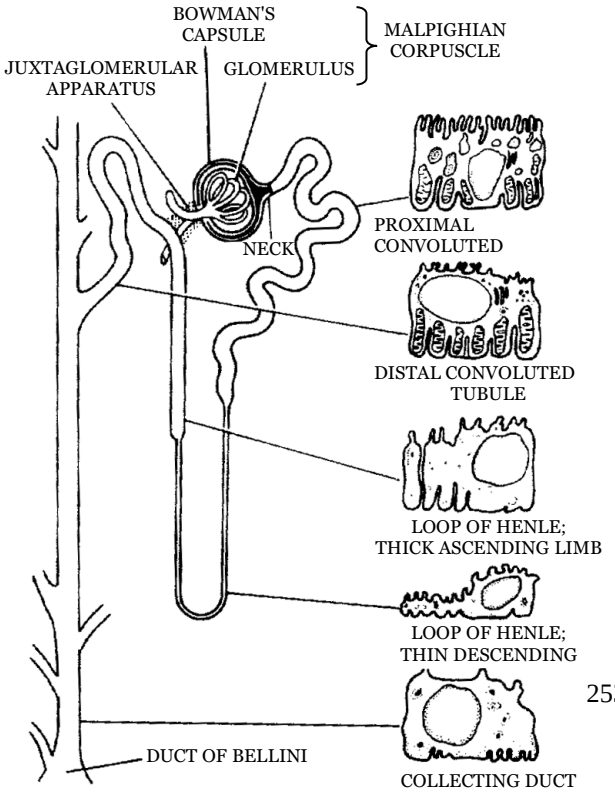


Fig. – Juxtamedullary nephron and epithelial cells in the wall of its various parts

Modern vertebrates exhibits three different kinds of adult kidney Pronephros, Mesonephros and Metanephros.

(1) **Pronephros :** It originates from the anterior part of the nephrotome. It is also termed head kidney due to its anterior position. There are only 3 pronephrine tubule (nephron) in frog embryo, 7 in human embryo, and about 12 in chick embryo which are segmentary arranged. Nephrostome present, glomerulus is external and unite to form glomus in some cases. Duct is pronephric duct or mullerian duct. Pronephros is functional in all embryos and larval stages. It is mostly transitory and soon replaced by the next stage or mesonephros.

Example – Adult myxine and petromyzones (cyclostomes) and some fishes but non urinary and lymphoid in function.

(2) **Mesonephros :** It originates from the middle part of the nephrotome. Duct is mesonephric or Wolffian duct. Nephrostome is absent except some embryos of anamniotes. Example – In amniotes (reptiles, birds and mammals) mesonephros is functional only in the embryos, replaced by metanephros in the adult. In anamniotes (fishes and amphibian) mesonephros is functional in both embryo as well as adults.

Note : ❑ In shark and caeccilians, tubules extend posteriorly throughout the length of coelom. So it is also called posterior or opisthonephric kidney.

❑ In frog mesonephric duct is also known as Bidder's canal which carry sperm and urine both.

(3) **Metanephros :** It originates from the posterior part of the nephrotome. When metanephric tubules develop, all the mesonephric tubules disappear except those associated with the testes in male and forming vasa efferentia. Nephrostome absent. A thin, U-shaped loop of Henle forms between P.C.T. and D.C.T. which is incomplete in Reptiles and Birds and well developed in mammals. Duct is metanephric or ureter. Reproductive duct is separate. The kidney is highly compact which possesses innumerable nephrons. Example – All amniotes – Reptile, Birds and mammal.

(ii) **Ureters :** From the hilum of each kidney emerges a whitish tube the ureter. The ureters are about 28 *cm* long. Their wall consists of transitional epithelium surrounded by a layer of muscle fibres. Openings of the two ureters in the bladder are separate, but closely placed. These are oblique, so that the urine cannot regurgitate into the ureters when the bladder contracts. Peristalsis of ureters also cheeks regurgitation of urine.

(iii) **Urinary bladder and Urethra :** The urinary bladder is pear-shaped which is made up of smooth and involuntary muscles. The muscles is also known as detrusor muscles (muscles that has the action of expelling a substance). The lower part or neck of the bladder leads into the urethra. There is a smooth triangular area, called trigonium vesicae. The lumen of the urinary bladder is lined by transition epithelium which has great power of

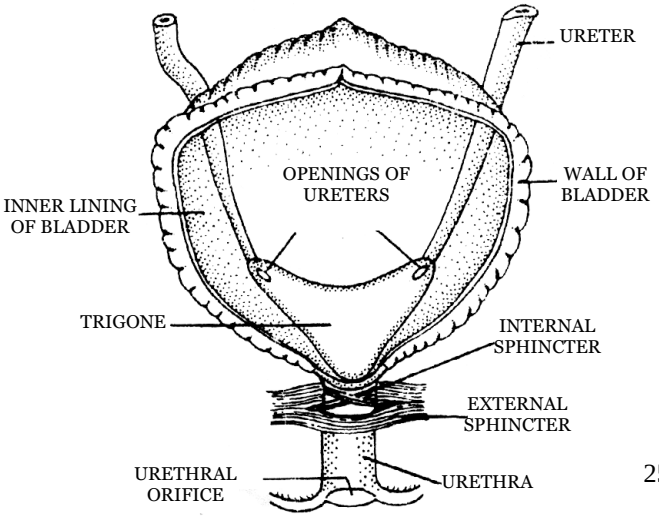


Fig. – Parts of ureters, trigone of the bladder, sphincters and urethra

streaching. The neck of bladder is guarded by two sphincters, inner is involuntary controlled by spinal reflex and outer is voluntary controlled by cerebral cortex. A person feels the sensation of micturation when the quantity of urine in the bladder is about 300 c.c.

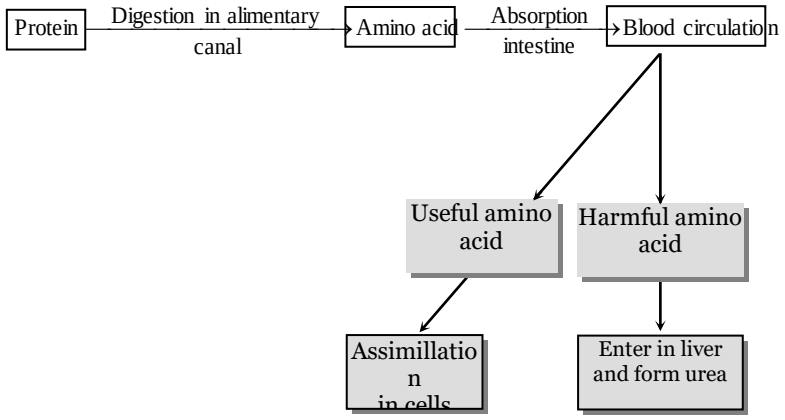
Urethra : The urinary bladder leads into the urethra. In a female, it is quite short, only about 3 to 5 *cm* long, and carries only urine. It opens by urethral orifice, or urinary aperture in the vulva infront of the veginal or genital aperture. In a male urethra is much longer, about 20 *cm* and carries urine as well as spermatic fluid. It passes through the prostate gland and the penis. It opens out at the tip of the penis by urinogenital aperture.

Differences between male and female urethra

Male urethra	Female urethra
1. It is about 20 cm long.	1. It is just 3 – 5 cm long.
2. It has 3 regions : prostatic urethra (3–4 cm), membranous (1 cm) and penial (15 cm)	2. It is not differentiated into regions.
3. It opens out at the tip of the penis by urinogenital aperture.	3. It opens into the vulva by urinary aperture.
4. It carries urine as well as semen to the exterior.	4. It carries only urine to the exterior.
5. It has 2 sphincters.	5. It has a single sphincter.

6.3 PHYSIOLOGY OF EXCRETION

Major nitrogenous excretory substance in frog, rabbit and human is urea, i.e. these are ureotelic animals. The excretory physiology in these animals may be considered under two phases, viz urea synthesis and formation and excretion of urine.



(i) **Synthesis of urea in liver :** Urea is formed in liver by two processes.

(a) Deamination (b) Ornithine cycle

(a) **Deamination :** The amino acid is oxidised using oxygen. This result in removal of the amino group (NH_2) and leaves pyruvic acid. the pyruvic acid can enter the Krebs cycle and be used as a source of energy in cell respiration. The amino group is converted to ammonia (NH_3) during deamination. Deamination is also known as oxidative deamination.

$$\begin{array}{l} CH_3 \\ | \\ CH-NH_2 \\ | \\ COOH \\ (\text{Amino acid}) \end{array} + \frac{1}{2}O_2 \longrightarrow \begin{array}{l} CH_3 \\ | \\ CO \\ | \\ COOH \\ (\text{Pyruvicacid}) \end{array} + NH_3$$

With the help of a number of enzymes and energy of A.T.P. two molecules of ammonia are combined with CO_2 to form urea according to the following cycle.

(b) **Ornithine cycle (Kreb-Henseleit cycle) :** In liver one molecule of CO_2 is activated by biotin and combines with two molecule of NH_2 in the presence of carbamyle phosphate synthatase enzyme (C.P.S.) and 2 ATP to form carbamyle phosphate and one molecule of H_2O release. Carbamyle phosphate react with ornithine and form citrulline. Citrulin combines with another molecule of ammonia and form arginine. Arginine is broken into urea and arnithine in the presence of an enzyme arginase and water.

$$2NH_2 + CO_2 \xrightarrow{\text{Arginase}} \underset{\text{(Urea)}}{NH_2-CO-NH_2} + H_2O$$

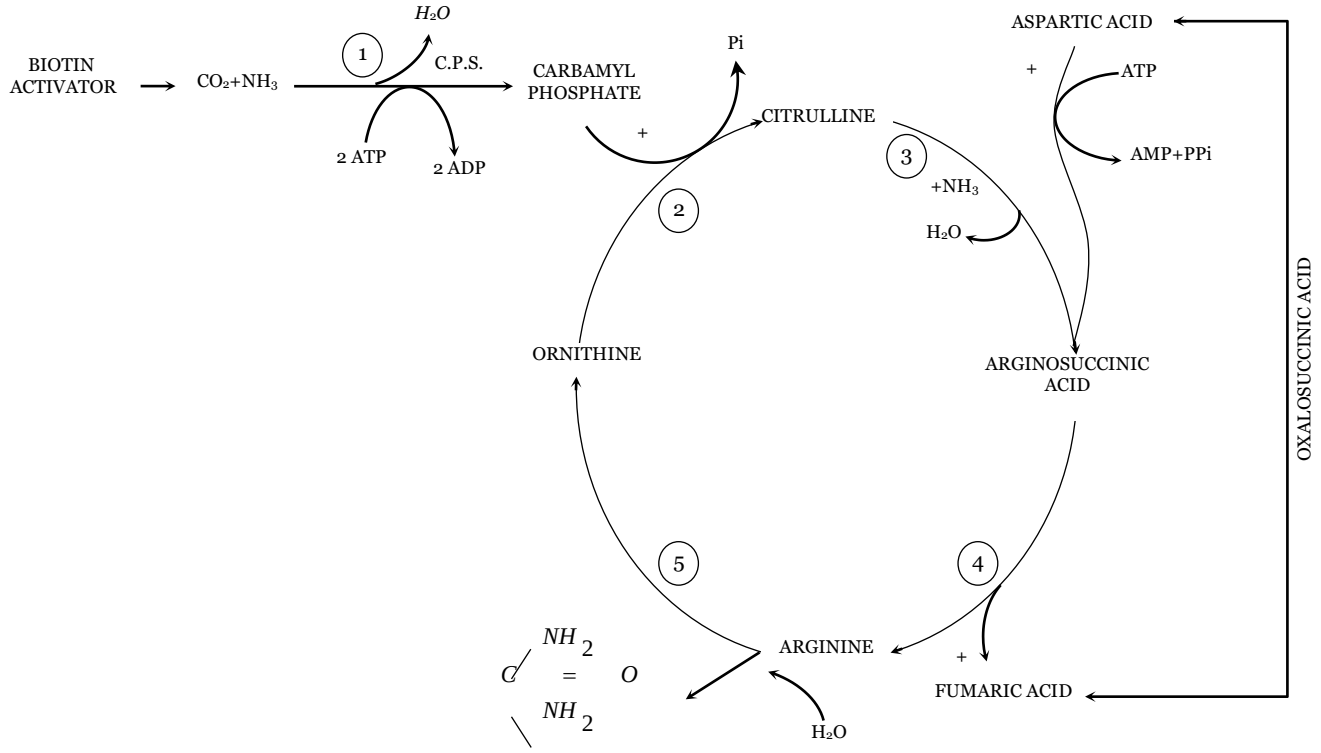


Fig. – Ornithine cycle

Liver cells, thus, continuously remove ammonia and some CO_2 from blood and release urea into the blood. Kidneys continuously remove urea from the blood to excrete it in urine.

(ii) **Urine formation :** Urine formation occurs in the kidneys. It involves three processes glomerular filtration, reabsorption and tubular secretion.

(a) **Ultra filtration or (Starlin hypothesis)**

(1) It is passive process which takes place from the glomerulus into the Bowman's capsule. The glomerular epithelium has various micropores (diameter = 0.1 μ) which increase the rate of filtration.

(2) The non colloidal part of the plasma as urea, water, glucose, and salts are forced out from the glomerular capillaries into the Bowman's capsule by the high pressure of the blood in the glomerular capillaries. The pressure is high because the glomerular capillaries are narrower than the afferent renal arteries.

(3) The effective filtration pressure that causes ultrafiltration is determined by three pressures.

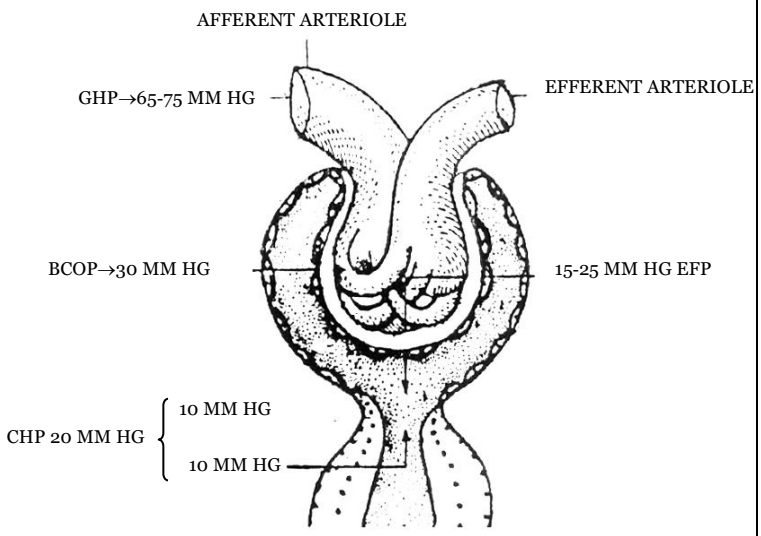


Fig. – Ultra filtration

Glomerular hydrostalic pressure : The G.H.P. is the blood pressure in glomerular capillaries due to the efferent arteriole is narrower than afferent arteriole. It is the chief determinent of effective filtration pressure, *i.e.* the main driving force to cause filtration.

G.H.P. = +70 *mm Hg*.

Blood colloidal osmotic pressure : The B.C.O.P. is the osmotic pressure created in the blood of glomerular capillaries due to plasma proteins (mainly albumin). It resists the filtration of fluid from the capillaries.

B.C.O.P. = – 30 *mm Hg*.

Capsular hydrostatic pressure : C.H.P. is the pressure caused by fluid (filtrate) that reaches into Bowman's capsule and resists filtration.

C.H.P. = –20 *mm Hg*.

Effective filtration pressure : E.F.P. is glomerular hydrostatic pressure minus the colloidal osmotic pressure of blood and capsular hydrostatic pressure.

E.F.P. = G.H.P. – (B.C.O.P. + C.H.P.)

= 70 *mmg* – (30 *mmg Hg* + 20 *mm Hg*)

= 70 – 50

E.F.P. = 20 *mm Hg*

Note :❑ Net opposing filtration pressure (N.O.F.P.) = B.C.O.P.+C.H.P.

= 50 *mm Hg.*

Glomerular filtrate : The plasma fluid that filters out from glomerular capillaries into Bowman's capsule of nephrons is called glomerular filtrate. It is a non colloidal part and possess urea, water, glucose, amino acid, vitamins, fatty acid, uric acid, creatin, creatinine, toxins, salts etc.

R.B.Cs, W.B.Cs platelets and plasma proteins are the colloidal part of the blood and do not filtered out from glomerulus. Glomerular filtrate is isotonic to blood plasma.

Glomerular filtrate or Nephric filtrate = Blood – (Blood cells + Plasma protein)

or

= Blood – (R.B.Cs + W.B.Cs+platelets + plasma protein)

or

= Plasma – Protein

Gomerular filtration rate (G.F.R.) : G.F.R. is the amount of filtrate formed per minute in all nephrons of the paired kidney. There is a sexual difference. In male the rate is 125 *ml*/*min*, in female it is 110 *ml*/*min*. G.F.R. is affected by volume of circulating blood, neural activity, stretch response to pressure of the wall of the arteriole.

180 litre of filtrate is formed per day, out of it, only 1.5 litre of urine is produced per day which is 0.8% of the total filtrate.

Renal plasma flow : About 1250 *ml* (25% of cardiac output or total blood) blood circulates through kidneys each minute and of this blood, about 650 *ml* is the plasma. The latter is called the renal plasma flow (R.P.F.)

R.P.F. = 650 *ml*.

Filtration fraction : This is the ratio of G.F.R. to R.P.F., and it is called filtration fraction.

Filtration fraction = $\frac{G.F.R.}{R.P.F.}$

(b) **Selective reabsorption :** Discovered by Richard and supporters.

P.C.T. : P.C.T. is the pivotal site for reabsorption.

Glucose, amino acid and Na^+, K^+ ions are reabsorbed by active transport.

Cl^- are reabsorbed by passive transport following the positively charged ions.

Active uptake of ions reduces the concentration of the filtrate and an equivalent amount of water passes into the peritubular capillaries by osmosis. (Here 80% water is reabsorbed by passive transport. It is also known as obligatory water reabsorption). Most of the important buffer bicarbonate $\left(HCO_3^-\right)$ is also reabsorbed from the filtrate. P.C.T. absorb nearly 80–90% of filtered bicarbonate. Some urea is reabsorbed by diffusion. The rest reman in the filtrate for removed in the urine.

Henle's loop : See counter current mechanism.

D.C.T. : When the level of plasma water falls, the posterior pituitary lobe release the antidiuretic hormone (ADH) which increases the permeablity of the distal convoluted tubule and the collecting duct to

water. Water is reabsorbed from the filtrate by osmosis and a reduced amount of concentrated urine is produced (Here 13% water is reabsorbed by facultative reabsorption)

The distal convoluted tubule and the collecting duct actively reabsorbed sodium from the filtrate under influence of the adrenal hormone aldosteron which makes their walls permeuble to ions. The reabsorption of Na^+ brings about the uptake of an osmotically equivalent amount of water. But duct of Bellini is relatively impermeable to water. Bicarbonate ions are also reabsorbed in D.C.T.

(c) **Tubular secretion :** It occurs as under –

❑ Creatinine, hippuric acid and foreign substances (pigments, drugs including penicillin) are actively secreted into the filtrate in the PCT from the interstitial fluid. Hydrogen ions and ammonia (NH_3) are also secreted into the PCT.

❑ Potassium, hydrogen, NH_4^+ and HCO_3^- ions are secreted by active transport, into the filtrate in the DCT.

❑ Urea enters the filtrate by diffusion in the thin region of the ascending limb of Henle's loop.

Removal of H^+ and NH_4^+ from the blood in the PCT and DCT helps to maintain the *pH* of the blood between 6 to 8. Any variation from this range is dangerous.

Tubular secretion probably plays only a minor role in the function of human kidneys, but in animals, such as marine fish and desert amphibians which lack glomeruli and Bowman's capsules, tubular secretion is the only mode of excretion. When the blood pressure, and consequently the filtration pressure, drop below a certain level, filtration stops and urine is formed by tubular secretion only.

High threshold substances : Such substances are absorbed almost all. Example – Sugar, amino acids, vitamins etc.

Low threshold substances : They are absorbed in low concentration. Example – Urea, creatinine, phosphate.

Non threshold substances : They are not reabsorbed. Example – Uric acid.

Diuretic substances : Normally, the amount of urine formed depends on the intake of water, dietary constituents, environmental temperature, mental and physiological states of the person. However, there are some substances which increase the volume of urine to be excreted, these substances are called diuretic substances. Exmaple – Tea, Coffee, alcohal etc.

(iii) **Mechanism of urine concentration (Counter current mechanism of urine concentration) :** Mammals form hypertonic urine. The urine is made hypertonic with the help of counter current multiplier system. This process takes place in the Henle's loop and vasa recta and it involves

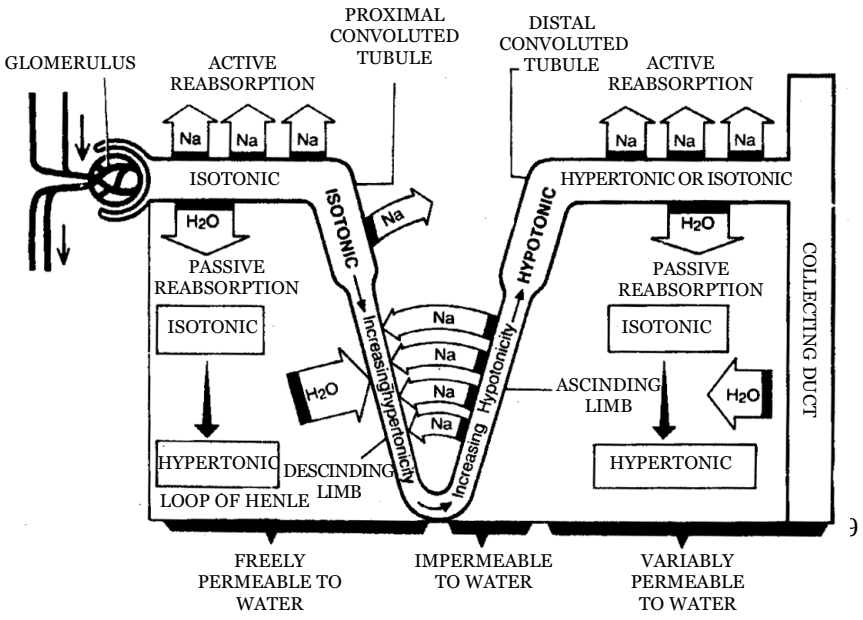


Fig. – Counter current multiplier in Henle's loop

mainly Na^+ and Cl^-. In P.C.T. urine is isotonic. The descending limb of loop of Henle is permeable to water. Its surrounding tissue fluid is hypertonic. Hence, the water moves out and the Na^+ and Cl^- moves in the descending limb by passive transport. Therefore, the filtrate in the descending limb finally becomes hypertonic.

The ascending limb of the Henle's loop is impermeable to the water. The Na^+ and Cl^- moves out by active transport. Hence the filtrate finally becomes hypotonic. The Na^+ and Cl^- re-enter into the descending limb of the Henle's loop. The collecting duct always passes through the hypertonic tissue fluid. Hence, water comes out osmotically making the filtrate hypertonic. Now in collecting duct glomerular filtrate is known as urine. Term urine first time use in collecting duct.

Summary of events occurring in a nephron

Materials transferred	Nephron region	Process involved	Mechanism
1. Glucose, Amino acids, Vitamins, Hormones, Na^+, K^+, Mg^{2+}, Ca^{+2}, H_2O, Urea, Uric Acid, Creatinine, Ketone Bodies.	Bowman's capsule	Glomerular filtration	Ultrafiltration
2. Glucose, Amino Acids, Hormones, Vitamins, Na^+, K^+, Mg^{2+}, Ca^{+2}	Proximal convoluted tubule	Reabsorption	Active transport
3. Cl^-	Proximal convoluted tubule	Reabsorption	Passive transport
4. Water	Proximal convoluted tubule	Reabsorption	Osmosis
5. Urea	Proximal convoluted tubule	Reabsorption	Diffusion
6. H_2O	Narrow region of descending limb of Henle's loop	Reabsorption	Omosis
7. Na^+,K^+,Mg^{+2},Ca^{+2},Cl^-	Narrow region of ascending limb of Henle's loop	Reabsorption	Diffusion
8.Inorganic ions as above	Wide part of ascending limb of Henle's loop	Reabsorption	Active transport
9.H_2O	Distal convoluted tubule, collecting tubule, collecting duct	Reabsorption with ADH Help	Osmosis
10. Na^+	Distal convoluted tubule, collecting tubule, collecting duct	Reabsorption with aldosterone help reabsorption secretion	Active transport

11. Urea	Last part of collecting duct	Reabsorption with aldosterone help reabsorption secretion	Diffusion
12. Creatinine, Hippuric Acid, Foreign substances	Proximal convoluted tubule	Reabsorption with aldosterone help reabsorption secretion	Active transport
13. K^+, H^+	Distal convoluted tubule	Reabsorption with aldosterone help reabsorption secretion	Active transport
14. NH_3	Distal convoluted tubule	Reabsorption with aldosterone help reabsorption secretion	Diffusion
15. Urea	Ascending limb of Henle's loop (Thin part)	Reabsorption with aldosterone help reabsorption secretion	Diffusion

6.4 URINE.

The fluid and dissolved waste substances excreted by the kidneys constitute urine.

Quantity : An adult man normally passes about 1 to 1.8 litres of urine in 24 hours. The volume of urine depends upon (i) the fluid intake, (ii) level of physical activity, (iii) type of food taken and (iv) environmental temperature increase urine output. Less fluid intake and profuse sweating due to heavy physical work and high temperature reduce urine output. Certain substances, such as tea, coffee and alcohol, increase urine output. These are said to be diuretic.

(i) **Physical properties :** Urine is transparent yellowish fluid, its shade depending on its concentration. Its colour is due to a pigment urochrome derived from the breakdown of haemoglobin from the worn-out RBCs. Colour of the urine is altered by certain materials taken such as beet, vitamin B complex and some drugs. It is hypertonic to blood plasma. Its specific gravity ranges between 1.003 and 1.04, being slightly higher than that of water. Its *pH* is 6. It depends on the diet. High protein food

and fruits increase acidity whereas vegetables increase alkalinity. Urine has a characteristic unpleasant odour. If allowed to stand, urea is degraded by bacteria to ammonia which imparts a strong smell to urine.

(ii) **Chemical composition :** Urine consists of water and organic and inorganic substances. Water alone forms about 95% of it, other substances form only 5%. The organic substances are mainly nitrogenous organic compounds include urea, uric acid, creatinine and hippuric acid. Of these, urea is the principal component of human urine. The non nitrogenous organic compounds include vitamin C, oxalic acid, phenolic substances include ammonia, and mineral salts such as chlorides, sulphates and phosphates of sodium, potassium, calcium and magnesium. Sodium chloride is the principal mineral salt of the urine. Urine also contains some other substances, such as pigments and drugs, and some epithelial cells and leucocytes.

(iii) **Abnormal materials :** Presence of proteins (albumins), bile salts, bile pigments, ketone bodies, blood, pus, microbes and more than a trace of glucose in the urine is pathological condition. Presence of glucose, protein, blood, ketone bodies and pus in the urine is called glucosurea, proteinuria, haematuria, ketonuria and pyuria respectively.

(iv) **Renal threshold :** A negligible amount of glucose is present in the urine. The highest concentration of a substances in the blood upto which it is fully reabsorbed from the glomerular filtrate is called its threshold. If its concentration in the blood exceeds its renal threshold, some of the filtered out substance is not reasborbed and is excreted in the urine. For example, the renal threshold of glucose is 180 *mg*. per 100 *ml*. of blood. If its blood level exceeds 180 *mg*., some of the filtered out glucose is not reabsorbed and is passed in urine.

(v) **Conduction of urine and Micturition :** Urine is produced and drained continuously by the nephrons into the renal pelvis. From here, it is carried down the ureters by peristaltic waves into trigonum vesicae and then into the body of the urinary bladder. The bladder serves to store the urine temporarily and also to pass it out at suitable intervals. The process of passing out urine from the urinary bladder is called urination or micturition, As urine collects, the muscular walls of the bladder distend to accommodate it. Distension of its walls stimulates the sensory nerve endings in the bladder wall and this sets up reflexes, which cause an urge to pass out urine. During the discharge of the urine, the bladder and urethral sphincters relax and the smooth muscles of the bladder wall gradually contract. This slowly drives the urine from the bladder through the urethra to the exterior. Reflux of the urine into the ureters is prevented because the terminal parts of the ureters pass obliquely through the bladder wall and are consequently closed when the bladder wall contracts around them. Relaxation and contraction of the urinary bladder are caused by impulses from the sympathetic and parasympathetic nerve fibres.

Micturition may be voluntarily postponed for some time until the pressure in the bladder rises too high to control. Micturition may also be voluntarily achieved even before sufficient urine has accumulated in the bladder. Normally an urge for micturition starts when the bladder is a little more than halffull of urine.

Urine constituants in man (in gram)

1.	Total volume	1,200 *ml* – per 24 *h*
2.	Water	1,140 *ml*
3.	Total solids	50 *gm*
4.	Glucose	0
5.	Protein	0
6.	Ketones	0
7.	Urea	30 *gm*
8.	Creatinine	1.6 *gm*
9.	Creatine	0.1 *gm*
10.	Hippuric acid	0.7 *gm*
11.	Urobilinogen	0.4 *mg*
12.	Porphyrins	50 – 300 μg
13.	Uric acid	0.7 *gm*
14.	*NaCl*	15.0 *gm*
15.	*K*	3.3 *gm*
16.	*Ca*	0.3 *gm*
17.	*Mg*	0.1 *gm*
18.	*Fe*	*0.1 gm* 0.2 0.005 *gm*
19.	SO_4	2.5 *gm*
20.	PO_4	2.5 *gm*

- *pH* of urine = 6
- Yellow colour of urine is due to Urochrome pigment.
- volume of urine is one day = 1 litre – 1.5 litre per day
- Specific gravity = 1 – 1.04

Urine constituants in man (in %)

1.	Water	96%
2.	Urea	2%
3.	Uric acid	0.2%
4.	NH_3	0.25%
5.	Creatinine	0.5%

6.	Hippuric acid	0.025%
7.	Salt	1 %

6.5 HORMONAL CONTROL OF RENAL FUNCTION

Hormonal controls of the kidney function by negative feedback circuits can be identified :

(i) **Control by antidiuretic hormone (ADH) :** ADH, produced in the hypothalamus of the brain and released into the blood stream from the pituitary gland, enhances fluid retention by making the kidneys reabsorb more water. The release of ADH is triggered when osmoreceptors in the hypothalamus detect an increase in the osmolarity of the blood above a set point of 300 mosm L^{-1}. In this situation, the osmoreceptor cells also promote thirst. Drinking reduces the osmolarity of the blood, which inhibits the secretion of ADH, thereby completing the feedback circuit.

(ii) **Control by Juxtaglomerular apparatus (JGA) :** JGA operates a multihormonal Renin-Angiotensin-Aldosterone System (RAAS). The JGA responds to a decrease in blood pressure or blood volume in the afferent arteriole of the glomerulus and releases an enzyme, renin into the blood stream. In the blood, renin initiates chemical reactions that convert a plasma protein, called angiotensinogen, to a peptide, called angiotensin II, which works as a hormone. Angiotensin II increases blood pressure by causing arterioles to constrict. It also increases blood volume into ways : firstly, by signaling the proximal convoluted tubules to reabsorb more *NaCl* and water, and secondly, by stimulating the adrenal gland to release aldosterone, a hormone that induces the distal convoluted tubule to reabsorb more Na^+ and water. This leads to an increase in blood volume and pressure, completing the feedback circuit by supporting the release of renin.

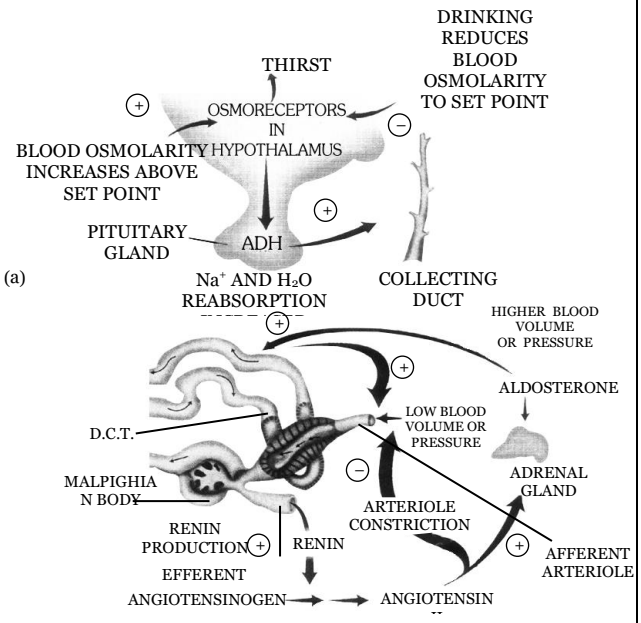


Fig. – Regulation of renal function by feedback circuits : (a) control by ADH: (b) Control by RAAS

(iii) **Parathormone :** The hormone increases blood Ca^{++} (Hypercalcium) and decreases PO_4 accordingly, it increases absorption of Ca^+, increases excretion of PO_4.

(iv) **Thyrocalcitonin :** It increases excretion of Ca^{++} in the kidney.

(v) **Prostaglandin :** The renal pyramids produce fatty acids of prostaglandins (P.G.) which participates in blood pressure regulation.

(vi) **Erythropoiotin :** It is secreted by juxtaglomerular apparatus and plays an important role in erythropoiosis (blood production).

Differences between Rennin and Renin

S.No.	Rennin	Renin
1.	It is secreted by peptic (zymogen) cells of gastric glands into the stomach.	It is secreted by specialised cells in the afferent arterioles of the kidney cortex.
2.	Its secretion is stimulated by food.	Its secretion is stimulated by a reduction of Na^+ level in tissue fluid
3.	It is secreted as an inactive form prorennin which is activated to rennin by *HCl.*	It is secreted as renin.
4.	It is a proteolytic enzyme.	It is a hormone that acts as an enzyme
5.	It helps in the digestion of milk protein casein.	It converts the protein angiotensinogen into angiotensin.

6.6 Homeostatic regulatory functions of kidneys

By continuously eliminating metabolic wastes and other impurities, and even the surplus quantity of useful materials from blood plasma in the form of urine, kidneys play a vital role in homeostasis. Kidneys also operate certain other homeostatic regulatory mechanisms. Proper maintenance of the internal environment is knows as homeostasis. All regulatory functions of kidneys can be enumerated as follows –

(i) **Osmoregulation :** Being the universal solvent, water is the actual vehicle in ECF to transport materials between various parts of body. Water volume in ECF tends to vary considerably due to several reason, such as drinking, perspiration, diarrhoea, vomiting, etc. As described in previous pages, the kidneys maintain the water balance in ECF by diluting or concentrating urine.

(ii) **Regulation of osmotic pressure :** Osmolality of cytoplasm is mainly due to proteins and potassium and phosphate ions, whereas that of the ECF is mainly due to sodium, chloride and bicarbonate ions. Inspite of marked difference in chemical composition, the two fluids – intracellular (cytoplasm) and extracellular (interstitium) – must be isotonic, because if ECF becomes hypotonic, cells will absorb water, swell retaining apropriate number, mainly of sodium and chloride ions, kidneys maintain the normal osmolality of ECF.

(iii) **Regulation of *pH* :** Concentration of hydrogen ions ($NaH_2\ PO_4$) in ECF is to be regulated at a constant value usually expressed as *pH* (minus log of H^+). The normal *pH* of ECF is about 7.4. A low *pH*, i.e. a high H^+ concentration causes acidosis, while a high *pH*, i.e. a low H^+ concentration causes alkalosis. Both of these conditions severely affect cellular metabolism. Several special control systems, therefore, operate in the body to prevent acidosis and alkalosis. These system are called acid-base buffer system. Kidneys play a key role in maintenance and operation of these systems. Further, the kidneys regulate hydrogen ion concentration in ECF by excreting acidic or basic urine.

(iv) **Regulation of electrolyte concentrations in ECF :** The kidneys regulate, not only the total concentrations of water and electrolytes in ECF, but also the concentrations of individual electrolytes separately. This regulation is complex and is accomplished by tubular reabsorption and secretion under the control of hypothalamic and adrenal hormones.

(v) **Regulation of RBC-count in blood :** In oxygen deficiency (hypoxia), kidneys secrete an enzyme into the blood. This enzyme reacts with plasma globulin to form erythropoietin. The latter substance stimulates bone marrow to produce more RBCs for enhancing O_2-intake in lungs.

(vi) **Regulation of renal body flow :** See (R.A.A.S.).

6.7 Excretory products in different organisms.

(i) **Waste products of protein metabolism**

(a) **Amino acids :** These are end products of protein digestion absorbed into the blood from small intestine. Certain invertebrates, like some molluscs (*eg Unio, Limnae, etc.*) and some echinoderms (*eg* Asterias) excrete excess amino acids as such. This is called aminotelic excretion or aminotelism.

(b) **Ammonia** $\left(NH_4^+ \text{ or } NH_3\right)$ **:** In most animals, excess amino acids are deaminated, i.e. degraded into their keto and ammonia groups. The keto groups are used in catabolism for producing ATP, whereas ammonia is excreted as such or in other forms. Ammonia is highly toxic and highly soluble in water. Its excretion as such, therefore, requires a large amount of water. That is why, most of the aquatic arthropods, bony and freshwater fishes, amphibian tadpoles, turtles, etc excrete ammonia. This type of excretion is called ammonotelic excretion or ammonotelism.

(c) **Urea** $CO\left(NH_2\right)_2$ **:** This is less toxic and less soluble in water than ammonia. Hence, it can stay for some time in the body. Many land vertebrates (adult amphibians, mammals) and such aquatic animals which cannot afford to lose much water (*e.g.* elasmobranch fishes), turn their ammonia into urea for excretion. This type of excretion is called ureotic excretion or ureotelism.

(d) **Uric acid :** Animals living in dry (arid) conditions, such as land gastropods, most insects, land reptiles (snakes and lizards), birds *etc* have to conserve water in their bodies. These, therefore, systhesize crystals of uric acid from their ammonia. Uric acid crystals are nontoxic and almost insoluble in water. Hence, these can be retained in the body for a considerable time before being discharged from the body. Uric acid is the main nitrogenous excretory product discharged in solid form. This excretion is called uricotelic excretion or uricotelism.

(e) **Trimethylamine oxide :** Certain marine molluscs, crustaceans and teleost fishes first form trimethylamine from their ammonia by a process known as methylation. Then, the trimethylamine is oxidised to trimethylamine oxide for excretion.This oxide is soluble in water, but nontoxic.

(f) **Guanine :** Spiders typically excrete their ammonia in the form of guanine. Some guanine is also formed in amphibians, reptiles, birds and earthworms. It is insoluble in water. Hence, no water is required for its excretion.

(ii) **Wasteproducts of nucleic acid metabolism :** As a result of nucleic acid digestion, nitrogenous organic bases – purines (adenine and guanine) and pyrimidines (cytosine, thymine and uracil) – are absorbed from intestine into the blood. Most of these are excreted out. About 5% of the total excretion of body accounts for these substances. In man, purines are changed to uric acid for excretion. In most other mammals, nitrogenous organic bases are excreted in the form of allantoin. Insects, amphibians, reptiles and birds also excrete these bases in the form of uric acid. Some freshwater molluscs and crustacean arthropods excrete these in the form of ammonia.

(iii) **Some sundry excretory substances (Others excretory products)**

(a) **Hippuric and ornithuric acids :** Sometimes food of rabbit and other mammals may contain traces of benzoic acid, or this acid may be formed in small amounts during fat metabolism. It is highly toxic. As it is absorbed in blood, it is combined with glycine and changed into less toxic hippuric acid for excretion. In birds, benzoic acid is combined with ornithine and changed into ornithuric acid for excretion.

(b) **Creatine and creatinine :** Muscle cells contain molecules of creatine phosphate, which are high energy molecules and serve for storage of bioenergy like ATP. It is synthesised by 3 amino acids (G.A.M.) (Glycine, Argenine and Methionine). Excess amount of this phosphate is, however, excreted out as such, or after being changed into creatinine.

Differences between ammonotelism, ureotelism and uricotelism

S.No.	Ammonotelism	Ureotelism	Uricotelism
1.	Means excretion of nitrogenous waste mainly as ammonia.	Means excretion of nitrogenous waste mainly as urea.	Means excretion of nitrogenous waste mainly as uric acid.
2.	Uses very little energy in forming ammonia.	Uses more energy in producing urea.	Uses far more energy in producing uric acid.
3.	Its product is very toxic.	Its product is less toxic.	Its product is least toxic.
4.	Causes considerable loss of body's water.	Causes less loss of body's water.	Causes least loss of body's water
5.	Occurs in aquatic animals.	Occurs in aquatic as well as land animals.	Occurs in land animals.
6.	Examples : *Amoeba, Scypha, Hydra, Earthworm, Unio, Prawn, Salamander, Tadpole*	Examples : Earthworm, Cartilaginous fishes, frog, turtles, alligators, mammals	Examples : Insects, land crustaceans, land snails, land reptiles birds.

	or frog, bonyfish.	(man).	
7.	Animals excreting NH_3 are called ammoniotelic.	Animals excreting urea are termed uroetelic.	Animals excreting uric acid are called uricotelic.

6.8 DISORDERS OF KIDNEYS

(i) **Artificial kidney :** Artificial kidney, called haemodialyser, is a machine that is used to filter the blood of a person whose kidneys are damaged. The process is called haemodialysis. It may be defined as the separation of small molecules (crytalloids) from large molecules (colloids) in a solution by interposing a semipermeable membrane between the solution and water (dialyzing solution). It works on the principle of dialysis, i.e. diffusion of small solute molecules through a semipermeable membrane (G. *dia* = = through, *lyo* = separate). Haemodialyser is a cellophane tube suspended in a salt-water solution of the same composition as the normal blood plasma, except that no urea is present. Blood of the patient is pumped from one of the arteries into the cellophane tube after cooling it to 0^oC and mixing with an anticoagulant (heparin). Pores of the cellophane tube allow urea, uric acid, creatinine, excess salts and excess H^+ ions to diffuse from the blood into the surrounding solution. the blood, thus purified, is warmed to body temperature, checked to ensure that it is isotonic to the patient's blood, and mixed with an antiheparin to restore its normal clotting power. It is then pumped into a vein of the patient. Plasma proteins remain in the blood and the pores of cellophane are too small to permit the passage of their large molecules. The use of artificial kidney involves a good deal of discomfort and a risk of the formation of blood clots. It may cause fever, anaphylaxis, cardiovascular problems and haemorrhage. Kidney transplant is an alternative treatment.

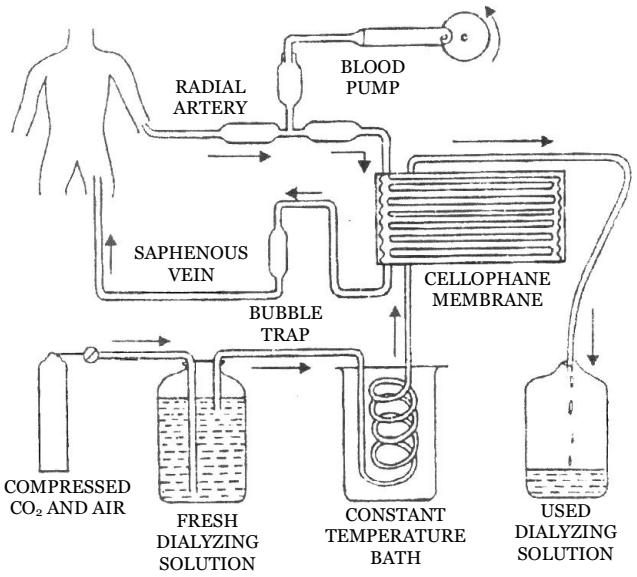


Fig. – Flow of blood through an artificial kidney for haemodialysis

C.A.P.D. : Continuous ambulatory peritoneal dialysis.

(ii) **Kidney (Renal) Transplantation**

Meaning : Grafting a kidney from a compatible donor to restore kidney functions in a recipient suffering from kidney failure is called renal transplantation.

History : First kidney transplant was performed between identical twins in 1954 by Dr. Charles Hufnagel, a Washington surgeon, India's first kidney transplant was done on December 1, 1971 at Christian Medical College, Vellore, TamilNadu. The recipient was a 35 years old person Shaninughan.

Eligibility : All patients with terminal renal failure are considered eligible for kidney transplantation, except those at risk from another life-threating disease.

Donors : A living donor can be used in a kidney transplant. It may be in identical twin, a sibling, or a close relative. If the living donors are not available, a cadaveric donor may be used (cadaver is a dead body). Over half of the kidney transplants are from cadavers.

Success rate : A kidney transplant from an identical twin, called isogeneic graft or isograft, is always successful. A renal transplant from a sibling or a close relative or a cadaver, termed allogeneic graft or homograft, is usually successful with the use of an immunosupressant that prevents graft rejection by body's immune response. Many renal transplant recipients are known to have retained functional grafts for over 20 years. Earlier, renal transplantation was limited to patients under 55 years. Now, however, with better techniques, kidney grafting has been done in selected patients in the 7^{th} decade of life.

Pretransplant preparation : It includes haemodialysis to ensure a relatively normal metabolic state, and provision of functional, infection-free lower urinary tract.

Donor selection and kidney preservation : A kidney donor should be free of hypertension, diabetes, and malignancy. A living donor is also carefully evaluated for emotional stability, normal bilateral renal function, freedom from other systematic disease, and histocompatibility. Cadaveric kidney is obtained from previously healthy person who sustained brain death but maintained stable cardiovascular and renal function. Following brain death, kidneys are removed as early as possible, flushed with special cooling solutions, such as mannitol and stored in iced solution. Preserved kidneys usually function well if transplanted within 48 hours.

Recipient-Donor Matching : Recipient and donor are tested for 3 factors :

- **Blood groups :** Recipient's blood group should be compatible with donor's blood group.
- **Human leucocyte antigen (HLA) :** It is a genetic marker located on the surface of leucocytes. A person inherits a set of 3 antigens from the mother and three from the father. A higher number of matching antigens increases the chances that the kidney graft will last for a long time.
- **Antibodies :** Small samples of recipient's and donor's blood are mixed in a tube. If no reaction occurs, the patient will be able to accept the kidney.

Transplant procedure : Transplantation is done under general anaesthesia. Operation takes 3 or 4 hours. Cut is given in the lower abdomen. Donor's kidney is transplanted retroperitonealy in the iliac fossa. Artery and vein of new kidney are connected to the iliac artery and vein of the recipient. Ureter of the new kidney is connected to the urinary bladder of the recipient. Often the new kidney starts producing urine as soon as blood flows through it, but sometimes it may take a few weeks before it starts working**.** A week's stay in the hospital is necessary to recover from surgery, and longer if there are complications.

The new kidney takes over the work of two failed kidneys. Unless they are causing infection or high blood pressure, the old kidneys are left in place.

Immunosupression : Immunosupression means to depress the immune response of the recipient to graft rejection. Prophylactic immunosuppressive therapy is started just before or at the time of renal transplantation. An ideal immunosuppressant suppress immunity against foreign tissue but maintains immunity against infection and cancer. The drug, named cyclosporin, in such an immunosupressant. Use of antiserum to human lymphocytes is equally useful. It destroys T-cell mediated immune responses, but spares humoral antibody responses.

(iii) **Kidney diseases**

Pyelonephritis : It is an inflammation of renal pelvis, calyces and interstitial tissue (*G.pyelos* = trough, tub; *nephros* = kidney; *itis* = inflammation). It is due to local bacterial infection. Bacteria reach here *via* urethra and ureter. Inflammation affects the countercurrent mechanism, and the victim fails to concentrate urine. Symptoms of the disease include pain the back, and frequent and painful urination.

Glomerulonephritis : It is the inflammation of glomeruli. It is caused by injury to the kidney, bacterial toxins, drug reaction, *etc.* Proteins and R.B.Cs pass into the filtrate.

Cystitis : It is the inflammation of urinary bladder (*G.kystis* = bladder, *–itis* = inflammation). It is caused by bacterial infection. Patient has frequent, painful urination, often with burning sensation.

Uremia : Uremia is the presence of an excessive amount of urea in the blood. It results from the decreased excretion of urea in the kidney tubules due to bacterial infection (nephritis) or some mechanical obstruction. urea poisons the cells at high concentration.

Kidney stone (Renal calculus) : It is formed by precipitation of uric acid or oxalate. It blocks the kidney tubule. It causes severe pain (renal colic) in the back, spreading down to thighs. The stone may pass into the ureter or urinary bladder and may grow, and cause severe pain of blackade. When in bladder, the patient experiences frequent and painful urination and may pass blood in the urine. Surgery may be needed to remove stone and relieve pain.

Kidney (Renal) failure (RF) : Partial or total inability of kidneys to carry on excretory and salt-water regulatory functions is called renal or kidney failure. Result kidney failure leads to (*i*) uremia, i.e., an excess of urea and other nitrogenous wastes in the blood (*G.ouron* = urine, *haima*-blood); (*ii*) Salt-water imbalance; and (*iii*) stoppage of erythropoietin secretion.

Causes : Many factors can cause kidney failure. Among these are tubular injury, infection, bacterial toxins, glomerulonephritis (inflammation of glomeruli) arterial or venous obstruction, fluid and electrolyte depletion, intrarenal precipitation of calcium and urates, drug reaction, heammorrhage, etc.

6.9 Accessory excretory organs

(i) **Skin :** Many aquatic animals, such as Hydra and starfish, excrete ammonia into the surrounding water by diffusion through the body wall. In land animals, the skin is often not permeable to water. This is an adaptation to prevent loss of body's water. Mammalian skin retains a minor excretory role by way of its sudoriferous, or sweat, glands and sebaceous, or oil glands.

(a) **Sweat gland :** Sweat glands pass out sweat. The latter consists of water containing some inorganic salts (chiefly sodium chloride) and traces of urea and lactic acid. It also contains very small amounts of amino acids and glucose. Sweat resulting from heavy muscular exercise contains a lot of

lactic acid. The latter is produced in the muscles by glycolysis. Loss of salt by sweating produces no immediate problem because water is also lost, and the salt concentration of body fluids is not much changed. However, taking a lot of water after heavy sweating dilutes the tissue fluid, causing 'electrolyte imbalance'. This may cause muscle cramps. A dilute salt solution should be taken in case of heavy sweating.

(b) **Sebaceous glands :** Oil glands pass out sebum that contains some lipids such as waxes, sterols, other hydrocarbons and fatty acids.

(ii) **Lungs :** Carbon dioxide and water are the waste products formed in respiration. Lungs remove the CO_2 and some water as vapour in the expired air. Lungs have access to abundant oxygen and oxidise foreign substances, thus causing detoxification and also regulate temperature.

(iii) **Liver :** Liver changes the decomposed haemoglobin of the worn-out red blood corpuscles into bile pigments, namely, bilirubin and biliverdin. These pigments pass into the alimentary canal with the bile for elimination in the faeces. The liver also excretes cholesterol, steroid hormones, certain vitamins and drugs *via* bile. Infected or damaged liver does not remove bile pigments which accumulate in the blood and cause jaundice. The bile pigments impart yellowish tinge to the skin and mucosa (known as jaundice). Liver deaminates the excess and unwanted amino acids, producing ammonia, which is quickly combined with CO_2 to form urea in urea or ornithine cycle. Urea is less toxic than ammonia. It is removed by the kidneys.

(iv) **Large intestine :** Epithelial cells of the colon transfer some inorganic ions, such as calcium, magnesium and iron, from the blood into the cavity of the colon for removal with the faeces.

(v) **Saliva :** Heavy metals and drugs are excreted in the saliva.

(vi) **Gills :** Gills remove CO_2 in aquatic animals. They also excrete salt in many bony fish.

6.10 Osmoregulation

The regulation of solute movement, and hence, water movement, which follows solutes by osmosis, is known as osmoregulation. Osmosis may be defined as a type of diffusion where the movement of water occurs selectively across a semipermeable membrane. It occurs whenever two solutions, separated by semipermeable membrane (the membrane that allows water molecules to pass but not the solutes) differ in total solute concentrations, or osmolarity. The total solute concentration is expressed as molarity or moles of solute per litre of solution. The unit of measurement for osmolarity is milliosmole per litre (mosm L^{-1}). If two solutions have the same osmolarity, they are said to be isotonic. When two solutions differ in osmolarity, the solution with higher concentration of solute is called hypertonic, while the more dilute solution is called hypotonic. If a semipermeable membrane separates such solutions, the flow of water (osmosis) takes place from a hypotonic solution to a hypertonic one.

Osmoconformers are the animals that do not actively control the osmotic condition of their body fluids. They rather change the osmolarity of body fluids according to the osmolarity of the ambient medium. All marine invertebrates and some freshwater invertebrates are strictly osmoconformer. Osmoconformers show an excellent ability to tolerate a wide range of cellular osmotic environments.

Osmoregulators, on the other hand, are the animlas that maintain internal osmolarity, different from the surrounding medium in which they inhabit. Many aquatic invertebrates are strict or limited osmoregulators. Most vertebrates are strict osmoregulators, i.e. they maintain the composition of the body fluids within a narrow osmotic range. The notable exception, however, are the hagfish (Myxine sp., a marine cyclostome fish) and elasmobranch fish (sharks and rays).

Osmoregulators must either eliminate excess water if they are in hypotonic medium or continuously take in water to compensate for water loss if they are in a hypertonic situation. Therefore, osmoregulators have to spent energy to move water in or out and maintain osmotic gradients by manipulating solute concentrations in their body fluids.

(i) **Water and solute regulation in freshwater environment :** Osmolarity of freshwater is generally much less than 50 mosm L^{-1} while the freshwater vertebrates have blood osmolarities in the range 200 to 300 mosm L^{-1}. The body fluids of freshwater animals are generally hypertonic to their surrounding environment. Therefore, freshwater animals constantly face two kinds of osmoregulatory problems : they gain water passively due to osmotic gradient, and continuously lose body salts to the surrounding medium of much lower salt content.

However, the freshwater animals prevent the net gain of water and net loss of body salts by several means, Protozoa (*Amoeba, Paramoecium*) have contractile vacuoles that pump out excess water. Many others eliminate water from the body by excreting large volume of very dilute urine. As a general rule, animals do not drink water, including freshwater fish do not drink water to reduce the need to expel and salt loss are minimised by a specialised body covering (subcutaneous fat layer of scaleless fish and scales over the body of fish or crocodile). Freshwater animals have remarkable ability to take up salts from the environment. The active transport of ions takes place against the concentration gradient. Specialised cells, called ionocytes or chloride cells in the gill membrane of fresh water fish can import Na^+ and Cl^- from the surrounding water containing less than 1mM *NaCl*, when their plasma concentration of *NaCl* exceeds 100 mM.

(ii) **Water and solute regulation in marine environment :** Sea water usually has an osmolarity of about 1000 mosm L^{-1}. Osmolarity of human blood is about 300 mosm L^{-1}. The osmoregulatory problems in marine situation are opposite to those in freshwater environment. Marine bony fish have the body fluids hypotonic to seawater, and thereby, they tend to lose water from the body through permeable surfaces (gill membranes, oral and anal membranes). To compensate for the water loss, marine bony fish drink seawater. However, drinking seawater results in a gain of excess salts. The ionocytes or chloride cells of the gill membrane of marine bony fish help to eliminate excess monovalent ions from the body fluid to the seawater. Divalent cations are generally eliminated with faeces. Hilsa, salmon and other fish that migrate between seawater and freshwater, when in ocean, drink and excrete excess salt through the gill membrane. A number of hormones play a key role in this switching over process.

In general, the body fluids of marine invertebrates, ascidians and the hagfish are isotonic to seawater. In elasmobranch fish (sharks and rays) and coelocanths (lobefin fish), osmolarity of the body fluids is raised by accumulating certain organic substances (osmolytes). Retention of osmolytes in body fluids reduces the osmoregulatory challenges. The best known examples of such organic osmolytes are

urea and trimethylamine oxide (TMAO). Body fluids of sharks and coelocanths are slightly hyperosmotic to seawater due to retention of urea and TMAO while hypoionic to seawater as they maintain far lower concentration of inorganic ions in the body fluids.

(iii) **Water and solute regulation in terrestrial environment :** Land animals are always subject to osmotic desiccation, like the marine animals. Air-breathing animals constantly lose water through their respiratory surfaces. However, animals utilise various means to minimise this water loss. Good examples are the waxy coatings of the exoskeletons of insects, the shell of the land snails and the multiple layers of dead, keratinised skin cells covering most terrestrial vertebrates. Despite such protective measures, a considerable amount of water is lost through oral, nasal and respiratory surfaces. This may even be fatal for the animal concerned. Humans, for examples, die if they lose around 12 per cent of the body water. Therefore, water loss must be compensated by drinking and eating moist food. Desert mammals are well adapted to minimise water loss. Kangaroos rats, for example, lose so little water that they can recover 90 percent of the loss by using metabolic water (water derived from different cellular metabolic processes.) The nasal countercurrent mechanism for conserving respiratory moisture is also important. Behavioural adaptations, such as nervous and hormonal mechanisms that control thirst, are important osmoregulatory mechanisms in terrestrial animals. Many desert animals are nocturnal to avoid the heat of day-time, another important behavioural adaptation that minimises dehydration. The camels, however, reduce the chance of overheating by orienting to give minimal surface exposure to direct sunlight. They produce dry faeces and concentrated urine. When water is not available, the camels do not produce urine but store urea in tissues and solely depend on metabolic water. When water is available, they rehydrate themselves by drinking up to 80 litres of water in 10 minutes.

Important Tips

- **Anuria –** Failure of kidney to form urine.
- **Oligourea** – is less urine output.
- **Cystitis –** Inflammation of urinary bladder.
- **Filtration fraction –** Ratio between GFR (glomerular filtration rate) and RPF (renal plasma flow).
- **Gout –** Painful great toe (arthiritis) due to deposition of uric acid.
- **Haematuria –** Presence of blood cells in urine.
- **Oedema –** Increased volume of interstitial fluid.
- **Polynephritis –** Inflammation of large number of nephrons.
- **Renal stone –** Stone formation in the nephrons of kidney due to accumulation of mainly calcium oxalates some phosphates and uric acid.
- **Trimethylamine –** Excretory product of marine teleosts (bony fishes).
- **Uraemia –** High concentration of urea (about 10 times) in blood.
- **Chloragogen cells –** Found in coelomic fluid of earthworm and are analogous (functionally similar) to human liver as are excretory in function.
- **Contractile vacuole –** Osmoregulatory apparatus of fresh-water protozoans like Amoeba,

Parmaecium etc. So contractile vacuole is functionally analogous to vertebrate kidney.

- **Glomerulonephritis –** Chronic inflammation of glomeruli due to streptococcal infection.
- **Aminoaciduria –** Urine with amino acids like cystine, glycine, etc.
- **Polyuria –** Increased urine volume.
- **Allantoin and allantoic acid** are nitrogenous excretory products formed during embryonic development of amniotes with shelled eggs. Allantoin is also called embryonic waste by allantoic acid is stored in allantois foetal membrane.
- Chances of infection of urinary tract are more in women due to shroter urethra.
- **Urate cells –** These are excretory cells of fat body of insects. These store excretory waste permanently called storage excretion.
- **Bright disease –** Characterised by nephritis caused by streptococal infection.
- **Ptosis –** Displacement of kidney.
- **Dysuria –** Painful urination.

Certain animals are both ammonotelic and ureotelic e.g. Ascaris, earthworm, lung fish (African toad), etc.

- **Aminotelism –** Expelling of amino acids as nitrogenous waste e.g. molluscs like Unio, Echinoder like Asterias, etc.
- Chordate with flame cells is Branchiostoma (also called Amphioxus).
- **Nocturia –** Increased volume of urine at night.
- **Abnormal constituent of urine –** (i.e. Not present in normal condition)

1. **Protein –** If protein is present in urine it may be due to infection or injury in kidney. (Mainly albumin is filtered)
2. **Blood –** Due to infection and injury of kidney blood may appear in urine.
3. **Sugar –** In diabetes mellitus sugar appear in urine.
4. **Bile of bile pigment –** In jaundice bile pigment appear in urine.
5. **Ketone bodies –** In starvation and diabetes. Ketone bodies appear in urine.

- **Diabetes mellitus –** Sugar appear in urine due to hyposecretion of insulin.
- **Diabetes incipidus –** Tasteless more urine passing due to hyposecretion of A.D.H.

ASSIGNMENT

EXCRETION AND EXCRETORY WASTE PRODUCTS

Basic Level

1. Which one is not correct

(a) Humans – Uriotelic (b) Birds – Uricotelic

(c) Lizards – Uricotelic (d) Whale – Ammonotelic

2. Which of the following are uricotelic animals

(a) Rohu and frog (b) Lizard and crow

(c) Camel and frog (d) Earthworm and eagle

3. Uric acid is formed in human from

(a) Purines (b) Proteins (c) Glucose (d) Pyrimidines

4. Excretion of nitrogenous waste products in semisolid form occur in

(a) Ureotelic animals (b) Ammonotelic animals (c) Uricotelic animals (d) Amonites

5. The phenomenon which represent terrestrial mode (dry habitat) of life is

(a) Ammonotelism (b) Ureotelism (c) Urecotelism (d) All the above

6. Aquatic reptiles are

(a) Ammonotelic (b) Ureotelic over land (c) Ureotelic (d) Ureotelic in water

7. Ammonia is the chief excretory substance in

(a) Camel and whale (b) Cartilaginous fishes (c) Whale and porpoise (d) Fresh water fishes

8. The chief nitrogenous waste in urine of rabbit or terrestrial mammals is

(a) Urea (b) Uric acid (c) Ammonia (d) None

9. Trimethylamine is excreted by

(a) Fresh water fishes (b) Marine teleosts (c) Amphibians (d) Molluscs

10. Urea in human urine is derived from the break down of

(a) Glucose (b) Amino acids (c) Fats (d) Uric acid

11. Which of the following nitrogenous substance is highly toxic

(a) Urea (b) Uric acid (c) Amino acid (d) Ammonia

12. Those animals which excrete a large amount of NH_3 are

(a) Terrestrial (b) Egg laying (c) Amphibious (d) Aquatic

13. Biliverdin and bilirubin are excreted mainly alongwith

(a) Urine (b) Faeces (c) Sweat (d) Vitamins

14. In aquatic organisms, the end product of nitrogen exchange is

(a) Urea (b) Nitrogen (c) Ammonia (d) Allantois

15. For hypertonicity, urea is retained in

(a) Man (b) Amphibians (c) Birds (d) Elasmobranchs

16. Excretion means

(a) Removal of useless substances and substances present in excess

(b) Formation of those substances which have some role in the body

(c) Removal of such substances which have never been part of the body

(d) All of these

17. Which of the following is the nitrogenous waste

(a) Creatinine (b) Creatine (c) Guanine (d) All the above

18. The least toxic nitrogen waste of urine is

(a) Ammonia (b) Allantois (c) Urea (d) Uric acid

19. Excretory product of mammals is

(a) Urea (b) Uric acid (c) Ammonia (d) All

20. Fresh water bony fishes maintain water balance by

(a) Excreting a hypotonic urine (b)Excreting salt across their gills

(c) Drinking small amount of water (d)Excreting wastes in the form of uric acid

21. N_2 waste in the form of uric acid is excreted by

(a) Amoeba (b) Dogfish (c) Rabbit (d) Crow

22. Excretory product of terrestial mosquito is

(a) Urea (b) Uric acid (c) Ammonia (d) Amino acids

23. Which one is the most soluble in water

(a) Uric acid (b) Urea (c) Fatty acid (d) Casein

24. Aquatic amphibians are ammonotelic in

(a) Larval stage (b) Immature stage (c) Adult stage (d) Both 'a' and 'c'

25. Unio is

(a) Ammonotelic (b) Ureotelic (c) Uricotelic (d) Aminotelic

26. Waste matter dropped by sea birds as fertilizer is called

(a) Worm castings (b) Faeces (c) Guano (d) Humus

27. Ascaris is

(a) Ammonotelic (b) Ureotelic (c) Uricotelic (d) Both (a) and (b)

28. In the birds faeces, faeces is actually the black part. The white part is a substance called

(a) Urea (b) Ammonia

(c) Uric acid (d) Faecal material and Urea

29. Identify the ammonotelic animal

(a) Cuttle fish (b) Dog fish (c) Frog (d) Human

Advance Level

30. A man takes large amount of protein. He is likely to excrete more amount of

(a) Water (b) Glucose (c) Urea and uric acid (d) Salts

31. Marine teleosts, undergoing putrefaction, emit sharp characteristic foul odour, which is due to the production of

(a) Trimethylamine (b) Hydrogen sulphide

(c) Ammonia (d) Lactic acid

32. Which of the following is a metabloic waste of protein metabolism

(a) NH_3, urea and CO_2 (b) Urea, Oxygen and N_2

(c) Urea, ammonia and alanine (d) Urea**,** ammonia and creatinine

33. Two examples in which the nitrogenous wastes are excreted from body in the form of uric acid are

(a) Birds and lizards (b) Mammals and mollusc

(c) Insects and bony fishes (d) Frogs and cartilaginous fishes

34. Shifting of ammonotelism to ureotelism is seen in

(a) Fishes (b) Frog (c) Protopterus (d) Snake

35. In the mammalian embryo the excretory material is stored in

(a) Placenta (b) Bladder (c) Embryonic membranes (d)Allantois

36. Waste products of adenine and guanine metabolism are excreted by man as

(a) Ammonia (b) Urea (c) Uric acid (d) Allantois

37. An advantage of excreting nitrogenous wastes in the form of uric acid is that

(a) Uric acid can be excreted in almost solid form

(b) The formation of uric acid requires a great deal of energy

(c) Uric acid is the first metabolic breakdown product of acids

(d) Uric acid may be excreted through the lungs

38. Which group of the following contains the final excretory product

(a) Ornithine, cytosin, citruline (b) Allantois**,** hippuric acid**,** ornithinic acid

(c) Creatine, creatinine, citruline (d) Trimethyl aminoxide, citruline, arginine

39. Uricotelism is a method of conserving

(a) Na^+ and K^+ (b) Space (c) Water (d) Energy

40. Higher concentration of urea is found in the urine of

(a) Carnivorous mammals (b)Herbivores (c) Phytoplankton feeders (d)Saprophagous

EXCRETORY ORGANS OF DIFFERENT ORGANISM

Basic Level

41. Opening of rectum in frogs is termed as
(a) Cloa (b) Cloaca (c) Coccyx (d) None of these

42. Green glands, present in some arthropods, help in
(a) Respiration (b) Excretion (c) Digestion (d) Reproduction

43. Which one is the excretory organ in the following
(a) Archaeocyte (b) Choanocyte (c) Pinacocyte (d) Solenocyte

44. Which one of the following is associated with osmoregulation in amoeba
(a) Endoplasm (b) Mitochondria (c) Contractile vacuole (d) Plasma membrane

45. Excretion in cockroach takes place by
(a) Nephridium (b) Coxal glands (c) Parotid gland (d) Malpighian tubules

46. Funnel-like ciliated pits on the ventral side of the kidney in frog are knows as
(a) Nephridiopores (b) Nephrostomes (c) Nephrotomes (d) Coelomostomes

47. The loop of Henle is most highly developed in
(a) Fresh water fishes (b) Salamanders (c) Desert lizards (d) Mammals

48. The excretory organ in Platyhelminthes is
(a) Nephridium (b) Flame cells (c) Coxal gland (d) Malpighian tubule

49. Kidney is not distinguished into cortex and renal medulla in
(a) Camel (b) Rabbit (c) Man (d) Frog

50. The nephrostomes in the kidney are functionable in
(a) Rabbit (b) Tadpole (c) Adult frog (d) Young rabbit

51. The functional kidney of frog tadpole is
(a) Archinephros (b) Pronephros (c) Mesonephros (d) Metanephros

52. Kidney of amniotes is
(a) Pronephros (b) Mesonephros (c) Opisthonephros (d) Metanephros

53. The flame cell system of helminthes work
(a) To remove ammonium ions (b) To remove urea
(c) To regulate *pH* (d) For osmoregulation

54. The kidneys in amphibians are derived from
(a) Ectoderm (b) Endoderm (c) Mesoderm (d) a and c

55. Frog's kidneys for communication with the coelom has
(a) Nephridiopores (b) Septal nephridia (c) Nephrostomos (d) Renal pores

56. Which organ of earthworm is analogous to our kidney
(a) Clitellum (b) Nephridium (c) Ovary (d) Testis

57. The nephrostomes are functional in the kidneys of

(a) Man (b) Rabbit (c) Frog (d) Lizard

58. Bidder's canal is found in

(a) Kidney of frog (b) Testis of frog (c) Kidney of mammal (d) Ovary of mammal

59. In marine teleost fishes Na^+ and Cl^- ions are excreted by

(a) Gills (b) Kidneys (c) Neuromast organs (d) Scroll valve

60. In ancestral vertebrates, the kidneys is called

(a) Aglomerular type (b) Glomerular type (c) Metanephric type (d) Mesonephric type

61. Fishes control the amount of salts in the body by partly absorbing and excreting salts with the

(a) Gills (b) Integument (c) Kidney (d) Scales

62. Intestinal excretory organes of *Pheretima* has a function of

(a) Locomotion (b) Respiration

(c) Water balance (d) Excretion of nitrogenous waste

63. Excretory organ of crustaceans are

(a) Uriniferous tubules (b) Green gland (c) Coxal gland (d) Malpigian tubules

64. Which system is H shaped is *Ascaris*

(a) Respiratory (b) Nervous (c) Reproduction (d) Excretory

65. Malpighian tubules are

(a) Excretory organs of insects (b) Excretory organs of frog

(c) Endocrine glands of insects (d) Respiratory organs of insects

66. Function of crustacean green gland is

(a) Digestion (b) Excretion (c) Respiration (d) Reproduction

67. Renal gland is the excretory organ of

(a) Annelida (b) Echinodermata (c) Crustaceans (d) Mollusca

68. Antennary glands are excretory organs of

(a) Spiders (b) Crustaceans (c) Mollusca (d) Echinodermata

69. Excretory system of housefly is

(a) Flame cells (b) Keber's organ (c) Nephridia (d) Malphigian tubules

70. In *Amoeba*, NH_3 is excreted by

(a) Food vacuole (b) Contractile vacuole (c) Plasma membrane (d) All of these

71. Chloragogen cells in *Pheretima* are specialized for

(a) Nutrition (b) Excretion (c) Reproduction (d) Respiration

72. The excretory organ in liverfluke is

(a) Flame cell (b) Nephridia (c) Malphigian tubes (d) Green glands

73. The probable function of contractile vacuole is to

(a) Remove salts only (b) Remove excess water

(c) Remove undigested food particles (d) Transport water

74. Yellow cells, surrounding the intestine of the earthworm is helpful in

(a) Digestion (b) Respiration (c) Excretion (d) Reproduction

75. In Annelids excretory organs are

(a) Nephridia (b) Malpighian tubules (c) Green glands (d) Kidneys

76. In adult Frog, the kidney is

(a) Pronephros (b) Opisthonephros (c) Mesonephros (d) Metanephros

77. In Prawn, excretion is carried out by

(a) Nephrons (b) Malpighian tubules (c) Flame cells (d) Green glands

78. Green glands are excretory organs of

(a) Moths (b) Scorpions (c) Spiders (d) Cray fishes

79. Flame cells are excretory organs of

(a) Prawn (b) Planaria (c) Silver Fish (d) Hydra

80. In *Amoeba*, NH_3 is excreted through

(a) Food vacuole (b) Plasma membrane (c) Contractile vacuole (d) All the above

81. Which one of the following is the simplest excretory organ

(a) Alveoli (b) Epidermis (c) Lung (d) Tubule

82. Coxal glands are excretory organs in

(a) Spiders and scorpions (b)Insects (c) Annelids (d) Molluscs

83. A nephron does not have loop of Henle in

(a) Frog (b) Man (c) Rabbit (d) Dog

84. Function of contractile vacuole in protozoa is

(a) Digestion of food (b) Locomotion

(c) Osmoregulation (d) Uptake of oxygen from water

85. Protonephridia are present in platyhelminthes and metanephridia in

(a) Nematodes (b) Arthropoda (c) Annelids (d) Platyhelminthe only

86. The nephrons in frog open into

(a) Ureter (b) Bidder's canal (c) Coelom (d) Collecting tubes

87. Function of contractile vacuole in *Paramecium* or *Amoeba* is

(a) Locomotion (b) Digestion of food (c) Osmoregulation (d) Respiration

88. Chloragogen cells of earthworm are similar to the organ of vertebrate's

(a) Pancreas (b) Lung (c) Kidney (d) Spleen

89. Nephrostome is a component of

(a) Septal nephridia (b) Integumentary nephridia

(c) Pharyngeal and septal nephridia (d) Pharyngeal and integumentary nephridia

90. Malpighian tubules remove excretory products from

(a) Haemolymph (b) Alimentary canal (c) Both (d) None of these

91. Entamoeba differs from Amoeba in the absence of

(a) Pseudopodia (b) Plasmalemma (c) Contractile vacuole (d) Both 'a' and 'b'

92. Excretory system of Ascaris is

(a) V shaped (b) H shaped (c) Y shaped (d) None

93. Osmoregulation in fresh water protistans is done by

(a) Contractile vacuole (b) Labopodia (c) Pseudopodea (d) Nucleus

94. In Entamoeba histolytica there are

(a) Single contractile vacuole (b) No contractile vacuole

(c) Many contractile vacuole (d) Depends on concentration of water

95. Metanephric kidney is found in

(a) Lizards (b) Pigeon (c) Human (d) All of these

96. Henle's loop is short or absent in

(a) Lizards (b) Birds (c) Placentals (d) Metatherians

97. Which of the following vertebrates have nasal glands which excrete salt

(a) Duck bill platypus (b) Sea gulls (c) Crocodiles (d) Alligators

Advance Level

98. Excretory products of mammal's embryo are eliminated out of

(a) Placenta (b) Amniotic fluid (c) Allantois (d) Ureter

99. Excretory system of Ascaris lumbricoides is made up of

(a) 4 cells (b) Many cells (c) One cell (d) Two cells

100. Correct order of excretory organs in Cockroach, Earthworm and Rabbit respectively

(a) Skin, malpighi tubules, kidney (b) Malpighi tubules**,** nephridia**,** kidney

(c) Nephridia, malpighi tubule, kidney (d) Nephridia, kidney, green gland

101. Malpighian tubules remove excretory products from

(a) Haemolymph (b) Alimentary canal (c) Both (a) and (b) (d) None of these

102. One of the following does the same work as is done by nephridia in earthworm

(a) Flame cells in liverfluke (b) Myotomes in fish

(c) Statocysts in prawn (d) Parotid gland in toad

103. Green glands are excretory in function which are found in

(a) Spiders (b) Moths (c) Scorpions (d) Cray fishes (Prawn)

104. Similar structure (in function) to human kidney in amoeba is

(a) Nucleus (b) Contractile vacuole (c) Plasmodesmata (d) Plasma membrane

105. The kidneys resemble the contractile vacuoles of protozoans in

(a) Expelling out excess of water (b)Expelling out glucose

(c) Expelling out urea and uric acid (d)Expelling out salts

106. The excretion in *Entamoeba* histolytica takes place by

(a) Contractile vacuole (b) General body surface (c) Food vacuoles (d) None of these

107. Sea Gulls excrete salts through

(a) Liver (b) Lungs (c) Urine (d) Nasal gland

108. The ureters of opisthonephric kidneys represents

(a) Wolffian ducts in male (b) Mullerian duct in female

(c) Wolffian duct in both sexes (d) Both *a* and *b*

109. Number of uriniferous tubules in opisthonephric kidneys of frog are

(a) 1 million (b) 2 million (c) 2 thousand (d) 8 thousand

110. The number of excretory pores that open outside when the last proglottid of the tapeworm is separated is/are

(a) Four (b) Three (c) Two (d) One

111. Most commonly kidney of adult reptiles are

(a) Mesonephric (b) Metanephric (c) Pronephric (d) Opisthonephric

112. Urinary bladder is not found in

(a) Snakes (b) Crocodiles (c) All birds except one (d) All above

113. Septal nephridia of earthworm found in which segment

(a) 3, 4, 5 (b) Behind 15^{th} segment (c) 5, 6, 7 (d) 6, 7, 8

114. Pharyngeal nephridia of earthworm occur in segment

(a) 3, 4, 5 (b) 4**,** 5**,** 6 (c) 5, 6, 7 (d) 6, 7, 8

115. Identify the correctly matched pair

(a) Starfish **–** No special excretory organ (b) H – shaped excretory organ – Nereis

(c) Green glands – Excretory organ of scorpion (d) Coxial gland – Excretory organ of mollusces

116. Which animal excretes urea in dry conditions and ammonia when water situations are optimum

(a) Desert rat (b) Camel (c) Lizards (d) Earthworm

117. Identify the animal which is ammonotelic as larva but becomes ureotelic after metamorphosis

(a) Herdmania (b) Balanoglossus (c) Frog (d) Eel

118. Largest Henle's loop is found in

(a) Fresh water fish (b) Rabbit (c) Desert mouse (d) Humans

EXCRETORY ORGANS IN MAN

Basic Level

119. The proximal convoluted tubule has a brush border which is due to

(a) Microvilli (b) Minute hairs (c) Endothelium (d) Folded tubes

120. The Malpighian corpuscle lies in the

(a) Medulla (b) Liver (c) Cortex (d) Pelvis

121. The collecting tubules lead into ducts called

(a) Tertiary duct (b) Duct of Bellini (c) Henle's loop (d) Bowman's duct

122. In the kidney of the rabbit, the Loop of Henle is the part of

(a) Glomerulus (b) Collecting duct (c) Bowman's capsule (d) Uriniferous tubule

123. Each human kidney has nearly

(a) 10,000 nephrons (b) 50,000 nephrons (c) 1,00,000 nephrons (d) 1 million nephrons

124. The vessel leading blood (containing nitrogenous waste) into the Bowman's capsule is known as

(a) Afferent arteriole (b) Efferent arteriole (c) Renal artery (d) Renal vein

125. Maximum absorption of water in mammals is in

(a) Lungs (b) Skin (c) Kidneys (d) Small intestine

126. Human kidney has

(a) Ciliated nephron (b) No loop of Henle

(c) Mesonephric duct (d) Glomeruli concentrated in the cortex

127. What will happen if one kidney of a person is removed

(a) He will still survive and remain normal (b) He will die due to blood poisoning

(c) Urea will go on accumulating in blood (d) Urination will stop

128. Which one is not the function of kidney

(a) Osmoregulation (b) Acidbase balance (c) Salt balance (d) Urea synthesis

129. In mammalian kidney Henle's loop is present in

(a) Cortex (b) Caput epididymus (c) Medulla (d) Ureter

130. Dialysis is used when the patient suffers from

(a) Heart failure (b) Liver failure (c) Lung failure (d) Kidney failure

131. Volume of urine is regulated by

(a) Aldosterone (b) Aldosterone, ADH and testosterone

(c) Aldosterone and ADH (d) ADH alone

132. The kidneys of adult mammals are

(a) Opisthonephros (b) Pronephros (c) Mesonephros (d) Metanephros

133. The blood leaving the kidney is significantly lower in

(a) O_2 (b) Glucose (c) Urea (d) CO_2

134. In man, the kidneys are

(a) Archinephros (b) Pronephros (c) Mesonephros (d) Metanephros

135. Uremia is a disease related to the

(a) Failure of ADH secretion (b) Excess of ADH secretion

(c) Failure of kidney (d) Low blood pressure

136. The term haematuria is used to describe

(a) Internal bleeding (b) Blood in urine (c) Blood cancer (d) Blood poisoning

137. Which of the following is not a function of kidneys

(a) Regulation of blood pressure (b)Removal of urea

(c) Regulation of acidity of fluids (d) Secretion of antibiotics

138. Urine output is reduced by

(a) Oxytocin (b) *ACTH* (c) *LH* (d) Vasopressin

139. In rabbit, the urinary bladder opens into

(a) Uterus (b) Urethra (c) Ureter (d) Vestibule

140. Kidneys of mammals are present on either side of vertebral column at the level of

(a) 10^{th} thoracic to 3^{rd} lumbar vertebrae (b) 12^{th} thoracic to 5^{th} lumbar vertebrae

(c) 12^{th} thoracic to 3^{rd} lumbar vertebrae (d) 10^{th} thoracic to 5^{th} lumbar vertebrae

141. Loop of Henle is concerned with

(a) Excretory system (b) Reproductive system (c) Nervous system (d) Muscular system

142. Presence of RBC in urine is known as

(a) Proteinuria (b) Alkaptonuria (c) Hematuria (d) Uraethiasis

143. The artificial kidney is designed according to the principle of

(a) Hydrolysis (b) Dialysis (c) Lysis (d) Secretion

144. The main function of pyramids of kidney is to

(a) Contain collecting tubules of kidney (b) Direct the urine to flow in ureter

(c) Support the openings of collecting canals (d) Store fats and protein

145. Diuretic substances are

(a) Tea (b) Coffee (c) Alcohol (d) All the above

146. Diabetes is a disease in which the urine contains

(a) Sugar (b) Salt (c) Fat (d) Protein

147. Proximal and distal convoluted tubules are parts of a

(a) Nephron (b) Oviduct (c) Vas deferens (d) Caecum

148. All Bowman's capsules of the kidney are found in

(a) Cortex (b) Medulla (c) Pelvis (d) None of these

149. Other function performed by kidney apart from excretion is

(a) Osmoregulation (b) Temperature regulation

(c) Hormonal regulation (d) Spermatogenesis

150. The glomeruli are confined to the

(a) Medulla (b) Calyces (c) Cortex (d) Renal capsule

151. *ADH* influences water permeability in the

(a) Proximal tubule (b) Distal tubule (c) Collecting tubule (d) Both (a) and (b)

152. Vital, morphological and physiological units of vertebrate or mammalian kidney are

(a) Ureter (b) Nephrons (c) Seminiferous tubules (d) Nephridia

153. The function of kidney in mammals is to excrete

(a) Excess salts**,** urea and excess water

(b) Excess salts, excess water and excess amino acids

(c) Excess water, urea and amino acids (d) Excess urea, salt and excess water

154. Haemodialysis helps in the patient having

(a) Uremia (b) Anaemia (c) Diabetes (d) Goitre

155. Loop of Henle is found in

(a) Lung (b) Liver (c) Neuron (d) Nephron

156. In absence of *ADH*, the disease caused is

(a) Diabetes mellitus (b) Diabetes insipidus (c) Oliguria (d) Acromegaly

157. The hormone secreted by kidney is

(a) Gastrin (b) Secretin (c) Erythropoietin (d) Aldosterone

158. Which type of kidneys are found in amphibian

(a) Holonephric (b) Mesonephric (c) Pronephric (d) Metanephric

159. Which one of the following body functions is not performed by kidneys

(a) Excretion (b) Osmoregulation

(c) Regulation of blood volume (d) Destruction of dead blood corpuscles

160. The basic functional unit of human kidney is

(a) Nephron (b) Pyramid (c) Nephridia (d) Henle's loop

161. Duct of Bellini opens on

(a) Collecting duct (b) Ureter (c) Renal papilla (d) *DCT*

162. Bowman's capsule is a part of

(a) Uriniferous tubule (b) Renal artery (c) Renal portal vein (d) Ureter

163. Blood dialyser is called

(a) Artificial lung (b) Artificial kidney (c) Artificial heart (d) Artificial brain

164. Cortical nephrons are ….. in number to juxtamedullary nephrons

(a) More (b) Less

(c) Equal (d) Depends on species to species

165. A condition of failure of kidney to form urine is called

(a) Deamination (b) Entropy (c) Anuria (d) None of these

166. Micrococcus ureae converts

(a) Urea into uric acid (b) Urea into ammonia

(c) Urea into ammonium carbonate (d) Ammonia into urea

167. The proper maintenance of the internal environment is known as

(a) Homeostasis (b) Metastasis (c) Peristasis (d) Diastasis

168. Bowman's capsule and glomerulus together constitute

(a) Nothing (b) A nephron (c) Malpighian corpuscle (d) Nephric corpuscle

169. Urinary excretion of *Na* is regulated by

(a) Anterior pituitary (b) Posterior pituitary (c) Adrenal cortex (d) Adrenal medulla

170. Kidney crystals are solid clusters of

(a) Calcium nitrate and uric acid (b) Phosphate and uric acid

(c) Calcium carbonate and uric acid (d) Calcium metabisulphite and uric acid

171. The position of kidneys are

(a) Inter-peritoneal (b) Retroperitoneal (c) Intraperitoneal (d) None of these

172. The two kidneys lie (In human)

(a) At the level of ovaries (b)At the same level

(c) Left kidney at a higher level than the right one

(d) Right kidney at a higher level than the left one

173. Length of female urethra is

(a) 15*cm* (b) 10 *cm* (c) 4 *cm* (d) 2 *cm*

174. In mammalian kidney renal pyramids are seen in

(a) Cortex (b) Medulla (c) Pelvis (d) Hilus

175. Renals columns of Bertini are found in the kidney of man for the collection of

(a) Blood (b) Salt water (c) Urine (d) None of these

176. The term haematuria is used to describe

(a) Internal bleeding (b) Blood in urine (c) Blood cancer (d) Blood poisoning

177. In human beings, gout is caused by

(a) Deficiency of iodine (b) Excessive secretion of thyroid

(c) Excessive liberation of uric acid (d) Deposition of uric acid

178. The urine of a man suffering from diabetes insipidus is

(a) Sweaty and watery (b) Sweaty and thick

(c) Tasteless and watery (d) Tasteless and thick

179. Proteinuria is a disease in which the material excreted in urine is/are

(a) Fructose (b) Lactose

(c) Serum albumin and globulin (d) Acetoacetic acid and acetone

180. Which one of the following is a disease of kidney

(a) Bright's disease (b) Addison's disease (c) Parkinson's disease (d) Graves disease

181. One of the following is not kidney disorder

(a) Pyelitis (b) Oedema (c) Bright's disease (d) Paget's disease

182. Paget's disease is

(a) Malfunctioning of kidney (b) Malfunctioning of ureter

(c) Malfunctioning of all excretory organs (d) Yellow urine formed

183. Human kidney measures

(a) 10 $cm \times 5\ cm \times 9\ cm$ (b)2 $cm \times 4\ cm \times 5\ cm$

(c) 15 $cm \times 10\ cm \times 20\ cm$ (d) 5 $cm \times 10\ cm \times 25\ cm$

184. Human kidney is

(a) Oval in shape (b) Vesicular (c) Bean shaped (d) Cylindrical in shape

185. Blood vessels, nerves and ureter enter the kidney at a point called

(a) Renal pyramid (b) Renal cortex (c) Hilus (d) Renal medulla

186. How many litres of blood is filtered in the kidney of man per 24 h

(a) 2500 ml (b) 100 litres (c) 500 litres (d) 1800 litres

187. The output of urine in a person suffering from diabetes insipidus per day is

(a) 1.8 l (b) 2.5 l (c) 30 – 40 l (d) 5 l

Advance Level

188. Which of the following influences the activity of kidney

(a) Gonadotrophins (b) Vasopressin

(c) Vasopressin and adrenalin (d) Thyroxine

189. The state of equilibrium in the body with respect to various functions and to the chemical composition of fluids and tissues is called

(a) Haemostasis (b) Homeosis (c) Homology (d) Homeostasis

190. The extraction of urine from blood takes place through

(a) Glomerulus (b) Bowman's capsule (c) Henle loop (d) Pelvis

191. Vasopressin is related with

(a) Dilution of urine (b) Quick digestion (c) Concentration of urine (d)Slow heart beat

192. In Bright's disease (Nephritis)

(a) The amount of urea in blood increases (b) Blood comes out along with urine

(c) Kidney stones are developed (d) All the above

193. Reabsorption of useful substances back into the blood from the filtrate in a nephron occurs in

(a) Proximal convoluted tubule (b) Loop of Henle

(c) Distal convoluted tubule (d) Collecting duct

194. Diabetes is related to

(a) Excretion of glucose in urine (b) Increase in blood glucose level

(c) Increase in micturition (d) All of these

195. Match the following

'A'	'B'
A. Loop of Henle	1. Carries blood into the kidney
B. Renal artery	2. Area where a considerable amount of reabsorption takes place
C. Proximal convoluted tubule	3. Main area of secretion
D. Glomerulus	4. Filtration of blood
E. Distal convoluted tubule	5. Plays a role in concentration of urine

The correct pairing sequence is

(a) 5**,** 1**,** 2**,** 4**,** 3 (b) 5, 1, 2, 3, 4 (c) 1, 5, 3, 4, 2 (d) None of these

196. Podocytes are the cells present in

(a) Bowman's capsule (b) Loop of Henle

(c) Duct of Bellini (d) Distal convoluted tubule

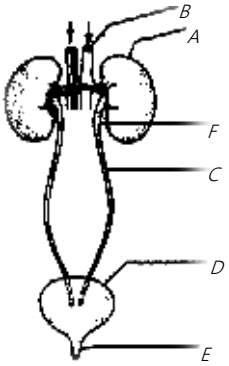
197. Isothenuria is

(a) Large amount of urea is present in urine

(b) Urine has osmolarity similar to that of plasma

(c) Inflammation of nephrons (d) Inflammation of urinary bladder

198. In the diagram of excretory system of human beings given below, different parts have been indicated by alphabets; choose the answer in which these alphabets have been correctly matched with the parts which they represent



(a) A = Kidney**,** B = Abdominal aorta**,** C = Ureters**,** D = Urinary bladder**,** E = Urethra**,** F = Renal pelvis

(b) A = Kidney, B = Abdominal aorta, C = Urethra, D = Urinary bladder, E = Ureters, F = Renal pelvis

(c) A = Kidney, B = Renal pelvis, C = Urethra, D = Urinary bladder, E = Ureters, F = Abdominal aorta

(d) A = Kidney, B = Abdominal aorta, C = Urethra, D = Urinary bladder, E = Renal pelvis, F = Ureters

199. What is the characteristic of metanephric kidney

(a) Hypotonic urine production (b) Excess secretion of uric acid

(c) Loop of Henle (d) Hormone production

200. Urinary bladder is absent in

(a) Lizards (b) Snakes (c) Crocodiles (d) All the above

201. Renin is secreted by

(a) Cortex (b) Medulla (c) Juxta glomerular cells (d) Podocytes

202. Early state of kidney disease, indicated by passage of more urine at night is

(a) Oliguria (b) Nocturia (c) Anuria (d) None of these

203. Primary role of cortical nephrons is

(a) Water reabsorption (b) Sodium reabsorption (c) (a) and (b) both (d) None of these

204. *"Columns of Bertini"* in the kidney of mammals are formed as the extension of

(a) Medulla into cortex (b) Cortex into medulla (c) Medulla into pelvis (d) Pelvis into ureter

205. Angiotensinogen is converted into angiotensin by

(a) Parathyroid hormone (b)Androgen (c) Aldosterone (d) Renin

206. Which one of the four parts mentioned below does not constitute a part of a single uriniferous tubule

(a) Bowman's capsule (b) Distal convoluted tubule (c)Loop of Henle (d) Collecting duct

207. A kidney stone is

(a) Blockage by fats (b) Deposition of sand in kidney

(c) A salt such as oxalate crytallised in pelvis (d) Blockage by proteins

208. The retroperitoneal kidney is

(a) Kidney of fish

(b) Kidney covered by peritoneum on ventral side

(c) Kidney covered by peritoneum on dorsal side

(d) Kidney uncovered by peritoneum on dorsal side

209. Urinary bladder is vascularized by

(a) Lingual artery (b) Vesicular artery (c) Carotid artery (d) Coronary artery

210. A vertebrate kidney develops from

(a) Nephrostomes (b) Endoderm (c) Nephrons (d) Nephrotomes

211. Basic and ancestral type of kidney in vertebrates is known as

(a) Pronephros (b) Mesonephros (c) Metanephros (d) Holonephros

212. Area cribrosa is the apex of the renal papilla, it opens directly into

(a) Major calyx (b) Minor calyx (c) Bowman's capsule (d) Ureter

213. Which one do not filter out from blood to Bowman's capsule in glomerular ultrafiltration

(a) Amino acid (b) Polypeptide (c) Glucose (d) Fatty acid

214. Tubules of kidney are derivatives of

(a) Ectoderm (b) Endoderm (c) Mesoderm (d) Both (a) and (b)

215. Vasa recta are blood capallaries around the

(a) Proximal convoluted tubule (b) Loop of Henle

(c) Distal convoluted tubule (d) Collecting tubule

216. Cells named podocytes occur in the wall of

(a) Neck region of nephrons (b)Glomerular capillaries

(c) Outer wall of Bowman's capsules (d) Inner wall of Bowman's capsules

217. Pars recta is

(a) Proximal convoluted tubule (b) Henle's loop

(c) Distal convoluted tubule (d) Collecting duct

218. Juxtaglomerular apparatus contains all the following except

(a) Granular cells (b) Macula densa

(c) Agranular Poikissen cells (d) Duct of Bellini

219. If Henle's loop were absent from mammalian nephron, which of the following is to be expected

(a) The urine will be more dilute

(b) There will be no urine formation

(c) There will be hardly any change in the quality and quantity of urine formed

(d) The urine will be more concentrated

220. Pregnant woman can suffer with

(a) Glycosariya (b) Gout (c) *Hb* and urea (d) Nephritis

221. If the kidney shifts from its normal place, it is

(a) Nephritis (b) Ptosis (c) Nephrosis (d) Diuresis

222. Nephrotic syndrome is

(a) Obstructive disorder of kidney

(b) Decreased arterial pressure in kidney

(c) A collection of signs and symptoms that accompany various glomerular disorders

(d) All of these

PHYSIOLOGY OF EXCRETORY

Basic Level

223. Passive transport occurs in the case of

(a) Cations (b) Chloride ions (c) (a) and (b) both (d) None of these

224. Studies of selective reabsorption was made in man by

(a) A.N. Richards and J.T. Wearn (b) J.T. Wearn and C. Ludwig

(c) C. Ludwig and A.N. Richards (d) A.N. Richards

225. Active transport takes place in absorption of

(a) Sodium chloride (b) Bicarbonate ions (c) Amino acids (d) All of these

226. Ornithine is converted into citrulline by an enzyme

(a) Glutamic dehydrogenase (b) Aspartic glutamic transaminase

(c) Carbamyl phosphate synthetase (d) Ornithine carbamyl transferase

227. In the distal convoluted tubule of the nephrons

(a) Sodium reabsorption requires energy (b) Secretion of patassium ions does not requires energy

(c) Water reabsorption does not requires energy (d) Both (a) and (c)

228. Which of the following enzymes, helps in the production of urea

(a) Uricase (b) Urease (c) Arginase (d) None of these

229. What will be the EFP, if BCOP is – 30, CHP is – 20 and GHP is +70

(a) +20 *mm Hg* (b) +30 *mm Hg* (c) +60 *mm Hg* (d) +120 *mm Hg*

230. The high threshold substances are

(a) Glucose, sodium and protein (b) Glucose and amino acids

(c) Urea, uric acid and protein (d) Glucose, sodium and urea

231. Negative nitrogen balance means

(a) No nitrogen is utilized (b) Nitrogen intake exceeds excretion

(c) Nitrogen intake is less than nitrogen excretion (d) Nitrogen intake equals excretion

232. Ornithine cycle is related to

(a) Respiration (b) Nutrition (c) Excretion (d) Digestion

233. The glomerular hydrostatic pressure exerted by the capillaries is

(a) +32 *mm Hg* (b) +50 *mm Hg* (c) +75 *mm Hg* (d) +80 *mm Hg*

234. Which of the following substances is totally reabsorbed through renal tubules

(a) *Na* (b) H_2O (c) *K* (d) $C_6H_{12}O_6$

235. Which is mismatched

(a) Bowman's capsule – Glomerular filteration (b) PCT – Absorption of Na^+ and K^+

(c) *DCT* – Absorption of glucose (d) None of these

236. The end product of ornithine cycle is

(a) Urea (b) Ammonia (c) Uric acid (d) Carbon dioxide

237. Active transport is

(a) Formation of *ATP* (b) Against the gradient using *ATP*

(c) Along gradient without using *ATP* (d) Against the gradient without using *ATP*

238. Reabsorption in the tubules of nephrons occurs by the process of

(a) Osmosis (b) Diffusion (c) Filtration (d) Active transport

239. Mechanism of uric acid excretion in a nephron is

(a) Osmosis (b) Diffusion (c) Secretion (d) Ultrafiltration

240. In ureotelic animals, urea is formed by

(a) Ornithine cycle (b) Coris cycle (c) Krebs cycle (d) EMP pathway

241. Henle's loop is found in

(a) Seminiferous tubules of frog (b) Seminiferous tubules of rabbit

(c) Nephron of mammals (d) Nephron of frog

242. Filteration takes place in

(a) Malpighian capsule (b) Bowman's capsule (c) Glomerulus (d) Collecting tubule

243. Reabsorption of substances according to the needs of body is called

(a) Obligatory reabsorption (b)Facultative reabsorption

(c) Glomerular reabsorption (d) None of these

244. Permeability of wall of collecting tubules is regulated by

(a) Renin (b) ADH (c) Aldosterone (d) Testosterone

245. What for the ascending limb of loop of Henle is permeable

(a) Glucose (b) NH_3 (c) Na^+ (d) Water

246. The plasma resembles in its composition to the filtrate produced by the glomerulus except the presence of

(a) Glucose (b) Chloride (c) Amino acids (d) Proteins

247. Surplus of amino acids are broken down to form urea in

(a) Kidney (b) Sweat gland (c) Spleen (d) Liver

248. In fever too much of sugar may increase the elimination in urine of

(a) Glucose (b) Uric acid (c) Phosphates (d) Fructose

249. Which of the following cycles in liver is mainly responsible for the synthesis of urea

(a) Citruline cycle (b) Krebs cycle (c) Nitrogen cycle (d) Ornithine cycle

250. Filteration into the kidney tubule is accomplished by means of

(a) Active transport by renal tubule (b) Hydrostatic blood pressure in glomerulus

(c) An osmotic potential gradient (d) Secretion by renal tubule

251. In which part of excretory system of mammals can you first use the term 'urine' for contained fluid

(a) Bowman's capsule (b) Loop of Henle (c) Collecting tubule (d) Urinary bladder

252. The amount of the original filtrate volume which is reabsorbed by the time the tubular fluid enters the Henle's loop is approximately

(a) 75**%** (b) 90% (c) 85% (d) 95%

253. Which one of the following blood vessels in mammals would normally carry the largest amount of urea

(a) Hepatic portal vein (b) Hepatic vein (c) Renal artery (d) Hepatic artery

254. Which one of the following substances is actively secreted into the glomerular filtrate of the kidney tubule

(a) Potassium ions (b) Amino acids (c) Sodium ions (d) Chloride ions

255. The blood constituents that remain unchanged is quantity after circulating through the kidney are

(a) Urea and glucose (b) Glucose and proteins (c) Urea and proteins (d) Urea and uric acid

256. The amount of liquid filtered by glomeruli of kidney in a 24 hours period is

(a) 170 litres (b) 100 litres (c) 200-250 cc (d) 500-1000 cc

257. The glomerular filtrate contains

(a) Blood minus cells and proteins (b) Blood minus cells

(c) Blood minus proteins (d) Plasma minus cells and proteins

258. What causes the liquid part of the blood to filter out from the glomerulus into the renal tubule

(a) Osmosis (b) High (hydrostatic) pressure (c)Diapedesis (d) Dialysis

259. Reabsorption of glucose from the glomerular filtrate in the kidney tubule is carried out by

(a) Active transport (b) Osmosis (c) Brownian movement (d)Diffusion

260. In arginine cycle urea is synthesised when CO_2 and NH_3 combines with

(a) Arginine (b) Ornithine (c) Citruline (d) All of these

261. In distal convoluted tubule of the nephrons

(a) *Na* reabsorption requires energy (b) Secretion of *K* ions does not require energy

(c) Water reabsorption requires energy (d) Ammonia is secreted

262. The substance which is completely reabsorbed from the filtrate in the renal tubule under normal condition is

(a) Urea (b) Salt (c) Glucose (d) Water

263. The glomerular filtration rate in a normal adult is nearly

(a) 200 ml / minute (b) 250 ml / minute (c) 120 ml / minute (d) 170 ml / minute

264. The conversion of NH_3 into urea occurs in

(a) Intestine (b) Spleen (c) Kidney (d) Liver

265. The liquid which is collected in the cavity of Bowman's capsule is

(a) Concentrated urine (b) Blood plasma minus blood proteins

(c) Glycogen and water (d) Sulphates and water

266. In the kidney, glucose is mainly absorbed in

(a) Loop of Henle (b) Proximal convoluted tubules

(c) Distal convoluted tubules (d) Bowman's capsule

267. Filtration pressure in human kidneys is about

(a) +15 *mm Hg* (b) +70 *mm Hg* (c) +45 *mm Hg* (d) +55 *mm Hg*

268. Ultrafiltration takes place in

(a) Blood capillaries (b) Tissue fluid (c) Glomerulus (d) Urinary bladder

269. Separation of amino acid into amino and carboxyl group is known as

(a) Deamination (b) Excretion (c) Amination (d) Egestion

270. Transamination process takes place in

(a) Liver (b) Kidney (c) Heart (d) All the above

271. Difference between glomerular filtrate and blood plasma is of

(a) Proteins (b) First is concentrated and second is dilute

(c) First is white and second is yellow (d) Difference of potassium

272. Loop of Henle is meant for absorption of

(a) Potassium (b) Glucose (c) Water (d) CO_2

273. The glomerular filtrate consists of

(a) Urea, sodium chloride, fibrinogen and water

(b) Glucose, amino acids, urea, oxytocin and calcitonin

(c) Both (a) and (b) (d) Urea**,** glucose**,** salts and water

274. Urea cycle in liver was discovered by

(a) Bowman and Krebs (b) Bayliss and Sterling

(c) Krebs and Henseleit (d) Landsteiner and Weiner

275. Which one of the following pair of waste substances is removed from blood in ornithine cycle

(a) CO_2 and urea (b) Ammonia and urea

(c) CO_2 and ammonia (d) Urea and sodium salt

276. Which one of the following is likely to accumulate in a dangerous proportion in the blood of a person whose kidney is not working properly

(a) Lysine (b) Ammonia (c) Sodium chloride (d) Urea

277. Glucose and 80% water is absorbed in

(a) Proximal convoluted tubule (b) Loop of Henle

(c) Distal convoluted tubule (d) Collecting tubule

278. Sodium, water and phosphate reabsorption is maximum in

(a) Loop of Henle (b) Proximal tubule (c) Distal tubule (d) Collecting tubule

279. The portion of nephron which is relatively impermeable to water is

(a) Collecting tubule (b) Duct of Bellini

(c) Distal tubule (d) Asscending limb of loop of Henle

280. High threshold substances are the substances which can be

(a) Ultrafiltered in the glomerulus (b) Excreted by the nephrons

(c) Secreted actively (d) Reabsorbed actively

281. Ornithine cycle refers to the sequence of reactions take place in the

(a) Oral cavity (b) Liver (c) Pancreas (d) Stomach

282. In man, the urea is mainly produced in

(a) Liver (b) Kidneys (c) Gall bladder (d) Spleen

283. At which stage of ornithine cycle arginase is used

(a) Arginine – Ornithine (b)Ornithine – Citruline

(c) Fumaric acid – Arginine (d) Arginine **–** Urea

284. In glomerulus of rabbit

(a) Afferent glomerular capillary is wider than efferent glomerular capillary

(b) Afferent glomerular capillary is narrower than efferent glomerular capillary

(c) Afferent glomerular arteriole is narrower than the efferent glomerular arteriole

(d) Afferent glomerular arteriole is wider than the efferent glomerular arteriole

285. Urea is derived from

(a) Fats (b) Amino acids (c) Carbohydrates (d) Uric acid

286. Normal odour of human urine is

(a) Aromatic (b) Like bitter almond (c) Like pineapple (d) Like decaying fruit

287. Secretion of urine is called

(a) Diuresis (b) Micturition (c) Parturition (d) None of these

288. The anterior half of the proximal convoluted tubule is the site of

(a) Diuresis (b) Action by ADH

(c) Reabsorption of glucose (d) Action of aldosterone

Advance Level

289. Which feature enables the mammalian kidney to concentrate urine in the medullary region

(a) Maintaining a high osmotic pressure in the tissues between the tubules

(b) Rapid removal of sodium ions from the medullary tissues

(c) Rapid flow of blood through the medulla

(d) High oxidative metabolism of medullary cells

290. In which of the following ways does the blood leaving the glomerulus of a mammalian kidney tubule differ from the blood entering the glomerulus

(a) It has a lower concentration of plasma proteins

(b) It contains fewer corpuscles per unit volume

(c) It has a lower concentration of crystalloids (d) It has a higher concentration of crystalloids

291. The filtrate passing from Malpighian capsules into the renal tubules in a healthy person contains

(a) Urates, glucose and water only (b) Ammonia, urea, uric acid and proteins

(c) Urea, sugar, water and ammonia (d) Urea**,** glucose**,** salts**,** amino acids and water

292. Which one of the following statements is not correct

(a) Network of blood vessels paralleling the loop of Henle is called as vasa rectae

(b) In proximal convoluted tubule water**,** glucose**,** amino acids and vitamin *C* are absorbed without the utilization of energy

(c) Ascending part of loop of Henle is impervious to water

(d) Fresh water fishes eliminate hypotonic urine in order to get rid off excess of water

293. Facultative reabsorption of *NaCl* is regulated by

(a) Aldosterone hormone (b)Antidiuretic hormone (c)Parathormone (d) All of these

294. Some structural features that make Malpighian corpuscles effective filtration membrane is / are

(a) The capillaries of the glomeruli have many more pores than other capillaries

(b) Endothelial cells lining the glomerular capillaries are very much flattened

(c) The efferent renal arteriole is smaller in diameter than the afferent renal arteriole

(d) All of these

295. High blood pressure is maintained in glomeruli than in other capillaries because

(a) The variability of the diameters of arterioles causes higher resistance to blood flowing out of the glomeruli than to out of the capillaries

(b) Glomeruli has low hydrostatic pressure than capillary

(c) Capillary has less diameter than glomeruli (d)All of these

296. Ornithine an amino acid is found

(a) As an intermediate of urea synthesis (b)As an intermediate of methonine metabolism

(c) As a major fraction of the connective tissue (d)In bile salts

297. In the kidney, the formation of urine involve the following processes arranged as

(a) Glomerular filtration**,** reabsorption and tubular secretion

(b) Reabsorption, filtration and secretion

(c) Secretion, absorption and filtration

(d) Filtration, secretion and reabsorption

298. The Bowman's capsule is

(a) A part of uriniferous tubule and is the site of filtration of various blood constituents during the formation of urine

(b) A part of uriniferous tubule and is the site of reabsorption of water and glucose

(c) Present in the liver and is the site of secretion of the bile juice

(d) The normal blood sugar is fructose

299. The urine of man under normal conditions does not contain glucose because

(a) Glucose in the glomerular filtrate is converted into glycogen

(b) Glucose in the glomerular filtrates is absorbed in the uriniferous tubules

(c) Glucose of the blood is not filtered in the glomerulus

(d) The normal blood sugar is fructose

300. Liquid part of the blood having undergone ultrafiltration from the glomerulus and reaching Bowman's capsule normally would not contain

(a) Sugar (glucose) (b) Sodium chloride (c) Creatinine (d) Albumin

301. What is "renal threshold"

(a) At which all the substances are reabsorbed actively

(b) The highest concentration of substances upto which it is totally reabsorbed from glomerular filtrate

(c) At which no substance is filtered in the glomerulus

(d) At which the filtration of a substance starts

302. Deamination is a process in which

(a) Poisonous urea is removed from the blood and it occurs in kidney

(b) Amino acid is absorbed from the digested food and it occurs in intestinal villi

(c) Amino acid combines with ammonia to form protein

(d) Amino acids are broken down to release CO_2 and NH_3

303. A severe fall in blood pressure disturbs the function of kidneys and reduces

(a) Glomerular filtration (b) Reabsorption of useful substances

(c) Renal filtration (d) Secretion of nitrogenous waste

304. Choose the correct statement for biosynthesis of urea

(a) Uric acid is starting material for biosynthesis of urea

(b) Urea is synthesized inside lysosomes

(c) Urea cycle enzyme are located inside mitochondria

(d) Urea is synthesized in kidney

305. Filtration fraction is the ratio of

(a) O_2 and CO_2 (b) HCO_3 and H_2CO_3 (c) *GFR* and *RPF* (d) *Hb* and HbO_2

306. Which one do not filter out from blood to Bowman's capsule in glomerular ultrafiltration

(a) Amino acids (b) Polypeptide (c) Glucose (d) Fatty acids

307. If Henle's loop were absent from mammalian nephron, which of the following is to be expected

(a) The urine will be more dilute

(b) There will be no urine formation

(c) There will be hardly any change in the quality and quantity of urine formed

(d) The urine will be more concentrated

308. Which of the following is correct

(a) Afferent arteriole is narrower than efferent arteriole

(b)Afferent venule is narrower than efferent venule

(c) Efferent arteriole is narrower than afferent arteriole

(d) Efferent venule is narrower than afferent venule

309. A patient who excretes large quantity of sodium in urine has

(a) Diseased adrenal medulla (b) Diseased adrenal cortex

(c) Diseased thymus (d) Diseased parathyroid

310. Potassium

(a) Ions are reabsorbed in the proximal convoluted tubules

(b) Transport is primarily by diffusion

(c) Reabsorption in tubules in insulin dependent

(d) Transport depends on Na^+ transport

311. Counter-current mechanism operates in

(a) Vasa rectae and Henle's loop (b) Henle's loop

(c) Proximal convoluted tubule (d) Distal convoluted tubule

312. The counter-current multiplier system changes the isotonic glomerular filtrate into

(a) Hypertonic urine (b) Hypotonic urine (c) Isotonic urine (d) None of these

313. When a person is suffering from poor renal reabsorption then which of the following will not help in the maintenance of blood volume

(a) Decreased glomerular filtration (b) Increased ADH secretion

(c) Decreased arterial pressure in kidney (d) Increased arterial pressure in kidney

314. Water reabsorption in the distal parts of kidney tubules is regulated by

(a) STH (b) TSH (c) ADH (d) MSH

315. Due to insufficient filtration in the Bowman's capsule, all are likely to happen except

(a) Accumulation of fluid in the body (b) Increase in blood pressure

(c) Increase in blood urea level (d) Loss of glucose through urine

316. The appearance of albumin in the urine is most likely due to

(a) Increase in the blood pressure (b) Decrease in the blood osmotic pressure

(c) Damage to the Malpighian corpuscles (d) Damage to the proximal convoluted tubules

317. The absorption of Na^+ and secretion of K^+ by the nephron is under the control of hormone

(a) ADH (b) Corticosterone (c) Aldosterone (d) Progesterone

318. If excess water passes out from the tissue without being restored by the kidneys, the cells would

(a) Not be affected at all (b)Shrivel and die

(c) Burst open and die (d)Take water from the plasma

319. Reabsorption of chloride ions (Cl^-) from the glomerular filtrate in the kidney tubule of mammal is

(a) Osmosis (b) Diffusion

(c) Active transport (d) Brownian movement

320. The process of urea formation from excess of amino acid and bile pigment formation from haemoglobin of degrading RBCs occur in

(a) Urea in liver and bile pigment in kidneys

(b) Urea in kidneys and bile pigment in pancreas

(c) Urea in kidneys and bile pigment in liver (d) Liver

321. In comparison to blood plasma, percentage of glucose in glomerular filtrate is

(a) Higher (b) Equal (c) Lower (d) Nil

322. Transamination is

(a) Transfer of an amino group from an alpha amino acid to an alpha-keto acid

(b) Removal of amino group from an amino acid resulting in ammonia formation

(c) Synthesis of uric acid from ammonia

(d) All of these

323. The ornithine cycle removes two waste products from the blood in liver. These products are

(a) Ammonia & uric acid (b) CO_2 and NH_3 (c) CO_2 and urea (d) Ammonia and urea

324. Which of the following is a non-threshold substances for renal reabsorption

(a) Vitamin *C* (b) Keto acid (c) Creatinine (d) Amino acid

325. A substance not secreted by renal tubule is

(a) Ammonia (b) Creatine (c) Glucose (d) Potassium ions

326. Which of the following amino acids are present in ornithine cycle

(a) Aspartic acid and glutamic acid (b) Glycine and methionine

(c) Arginine and ornithine (d) Ornithine and valine

327. Glomeruli fail to filter from plasma

(a) Glucose (b) Globins (c) Lipids (d) Both (b) and (c)

328. The ornithine cycle is absent in

(a) Mammals (b) Frogs (c) Teleosts (d) Elasmo branches

329. The urination becomes voluntary when urine comes in

(a) Pelvis (b) Ureter (c) Urinary bladder (d) Urethra

330. Hyperosmotic urine secreted depends upon

(a) Width of Bowman's capsule (b) Length of loop of Henle

(c) Length of proximal convoluted tubules (d) None of these

331. Mechanism of uric acid excretion, in a nephron is by

(a) Osmosis (b) Diffusion (c) Secretion (d) Ultrafiltration

332. Which of the following harmful substance found in blood are changed into harmless by ornithine cycle

(a) CO_2 and $NH_2 - CO - NH_2$ (b) CO_2 and NH_3

(c) NH_3 and $NH_2 - CO - NH_2$ (d) NH_3 and Uric acid

333. Glomerular filtrate will not contain normally

(a) Glucose (b) *NaCl* (c) Creatinine (d) Albumin

334. Filtrate is isotonic in

(a) Proximal convoluted tubule (b) Descending loop of Henle

(c) Ascending limb of loop of Henle (d) Both proximal and distal convoluted tubule

335. Percentage of which will increase in blood if liver becomes functionless

(a) Urea (b) Uric acid (c) Amino acid (d) Proteins

336. Who was first to point out the presence of orginase in the liver or ureotelic animals

(a) Krebs (b) Hanseleit (c) Clementi (d) Both (a) and (b)

337. Which of the following amino acids does not contribute in the synthesis of creatine

(a) Histidine (b) Methionine (c) Glycine (d) Arginine

338. Which one is not formed in urea cycle

(a) Arginine (b) Tyrosine (c) Citrulline (d) Ornithine

339. If a person is suffering from disease of muscular dystrophy, he will eliminate one of the following in large amount in his urine

(a) Sulphates (b) Glucose (c) Creatine (d) Water

340. Normal desire for micturition is felt when the amount of urine collected in bladder is

(a) 25 – 50*ml* (b) 50 – 100 *ml* (c) 350 – 400 *ml* (d) 700 – 800 *ml*

341. The cholera patients are provided with saline drips. Why ?

(a) *NaCl* is important constituents of our blood, Which maintains the RBCs and helps proteins to dissociate

(b) Na^+ ions help to retain water in the body and selective transport through plasma membrane

(c) Cl^- ions help in formation of *HCl* in stomach

(d) Cl^- ions are essential components of blood plasma

342. Assertion **:** During the physiology of excretion deamination does not take place in liver cells.

Reason **:** Deamination is a process to make use of excess of amino acids which cannot be incorporated into the protoplasm.

(a) If both the (A) and the (R) are true and the (R) is a correct explanation of the assertion.

(b) If both the (A) and (R) are ture but the (R) is not a correct explanation of the (A)

(c) If the (A) is true and the (R) is false

(d) If the (A) is false but the (R) is true

343. Choose the correct statement for biosynthesis of urea

(a) Uric acid is starting material for biosynthesis of urea

(b) Urea is synthesized inside lysosomes

(c) Urea cycle enzyme are located inside mitochondria

(d) Urea is synthesized in kidney

344. Obligatory reabsorption of glomerular filtrate occurs in

(a) Collecting tubules (b) Henle's loop

(c) Proximal convoluted tubule (d) Distal convoluted tubule

345. Identify the correct statement

(a) Glomerular filtrate in the Henle's loop and blood in the vasa recta flow in opposite direction in the two limbs of the loop

(b) Diuresis is controlled by adrenaline

(c) Aldosterone promotes excretion of Na^+ and K^+

(d) Vasopressin enhances glomerular filtration

346. Angiotensionogen is secreted by

(a) Juxtaglomerular cells of nephron (b) Adrenal cortex

(c) Liver (d) Bone marrow

347. Identify the pair that does not match

(a) Presence of blood in urea – haematuria

(b) Abnormal concentration of glucose in blood – glycosuria

(c) Presence of ketone bodies in urine – ketoneuria (d) Black water – Presence of pus in urine

348. Identify the false statement

(a) Degradation of haemoglobin of RBC in liver produces bilirubin and biliverdin

(b) Deamination of amino acids is an important step in urea formation in liver

(c) Mammalian kidney does not have osmoregulatory function

(d) Nephron is the basic unit of mammalian kidney

349. Which of the following statement is correct

(a) Efferent arteriole leaving the renal corpuscles contains maximum amount of urea

(b) The fluid in the collecting tubule of nephron can be called urine

(c) The term urine can be used only for the fluid present in ureter

(d) The most correct use of the term urine is the fluid present in urinary bladder

URINE AND NECESSARY EXCRETORY ORGANS

Basic Level

350. The most important function of perspiration is to

(a) Excrete salts only (b) Regulate the water and salts content

(c) Regulate the body temperature (d) Excrete water only

351. In public urinals, the urine on standing gives a pungent smell, due to

(a) Conversion of both urea and uric acid into ammonia

(b) Conversion of uric acid into ammonia by ornithine cycle

(c) Conversion of urea into ammonia by bacteria (d) None of these

352. In micturition

(a) Urethra relaxes (b) Ureter contracts (c) Ureter relaxes (d) Urethra contracts

353. In what way is the liver involved in excretion

(a) It converts glycogen into glucose (b) It converts urea into urine

(c) It excretes bile pigments (d) It converts urea into uric acid

354. Excretion of bile pigments in urine indicates

(a) Addison's disease (b) Anaemia (c) Diabetes (d) Jaundice

355. Urine is acidic in nature as it contains

(a) HCl (b) H_2SO_4 (c) NaH_2PO_4 (d) HNO_3

356. Stool of a person contains whitish grey colour due to malfunction of

(a) Liver (b) Spleen (c) Kidney (d) Pancreas

357. Workers in deep mines usually suffer from dehydration because

(a) Water is lost due to evaporation (b)Water is lost due to defecation

(c) Water is lost in the form of sweat (d) Water is lost along with salts in the form of sweat

358. The yellow colour of normal urine is mainly due to

(a) Uroerythrin (b) Urobillin (c) Urochrome (d) Urea

359. *pH* value of human urine is

(a) 7.5 (b) 4.5 (c) 6.0 (d) 2.0

360. Diuresis is a specific pathological condition which leads to

(a) Increased volume of urine excretion (b) Decreased volume of urine excretion

(c) Increased glucose excretion (d) Decreased electrolyte concentration

361. Urine becomes cloudy when

(a) Alkalinity increases (b) Alkalinity decreases

(c) There is an bacterial infection (d) (b) and (c) both

362. The yellow colour of urine of the vertebrates is due to

(a) Cholesterol (b) Urochrome (c) Uric acid (d) Melanin

363. Substance which is finally excreted in the urine

(a) Amino acid (b) Urea (c) Glucose & Glycogen (d) Uric acid

364. Stale urine smells like ammonia because

(a) It changes into NH_3 (b) Its bacterial decay produces NH_3

(c) It forms ammonium carbonate (d) All of these

365. The urine of man suffering from *Diabetes insipidus* is

(a) Sweaty and watery (b) Sweaty and thick

(c) Tasteless and watery (d) Tasteless and thick

366. A man excretes about ……. urine in 24 hours

(a) 1 litre (b) 1.5 litres (c) 2 litres (d) 2.5 litres

367. A person feels the sensation of micturition when the quantity of urine in the bladder is about

(a) 100 cc (b) 200 cc (c) 300 cc (d) None of these

368. Elimination of insoluble calcium phosphate is the function of

(a) Kidney (b) Liver (c) Skin (d) Large intestine

369. Which one has nothing to do with nitrogenous excretion

(a) Skin (b) Kidneys (c) Liver (d) Lungs

370. Besides urination, another important activity in which water is substantially lost from body is

(a) Salivation (b) Defaecation (c) Expiration (d) Inspiration

Advance Level

371. Kidneys are not the only organs of excretion; their work is supplimented by

(a) Lungs (b) Large intestine (c) Skin (d) Liver

372. Human urine is invariably acidic because

(a) The blood entering the kidney is acidic

(b) Kidneys selectively filter out the acidic substances of blood into urine

(c) Kidneys secrete acids to keep urine acidic

(d) Urine is made acidic in urinary bladder

373. Why do we pass more urine in wet and cold season

(a) Impairment of water absorption by nephrons (b) Kidney becomes more active

(c) Sweating is much reduced (d) ADH secretion is increased

374. The control centres of micturition lies in

(a) Cortex (b)Hypothalamus

(c) Brain stem and spinal centres (d) All of these

375. If we remove the pressure receptors from the urinary bladder wall

(a) Their will be no micturition (b) Micturition will continue

(c) There will be no collection of urine in bladder (d) Urine will collect in the bladder

376. A person who is starving, that is not having food, water and beverages will have

(a) More urea in his blood (b)Less urea in his urine

(c)Less fats in his urine (d) More glucose in his blood

377. Protein rich diet brings about relatively no change in one of the following constituents of urine

(a) Urea (b) Creatinine (c) Uric acid (d) Ammonium salts

378. All of the following are present in sweat except

(a) Lactic acid (b) Urea (c) Calcium (d) Uric acid

ANSWER

ASSIGNMENT (BASIC AND ADVANCE)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
d	b	a	c	c	c	d	a	b	b	d	d	b	c	d	a	d	d	a	a
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
d	b	b	a	d	c	d	c	a	c	a	d	a	b	d	c	a	b	c	a
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
b	b	d	c	d	b	d	b	d	b	c	d	d	c	c	b	c	a	a	a
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
a	d	b	d	a	b	d	b	d	c	b	a	b	c	a	c	d	d	b	b
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
b	a	a	c	c	d	c	c	a	a	c	b	a	b	d	a	b	a	c	b
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
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121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
b	d	d	a	c	d	a	d	c	d	c	d	c	d	c	b	d	d	b	c
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
a	c	b	a	d	a	a	a	a	c	b	b	a	a	d	b	c	b	d	a
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
c	a	b	a	c	b	a	c	c	b	b	c	c	b	d	b	d	c	c	a
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
b	c	a	c	c	d	d	c	d	b	c	d	a	d	a	a	b	a	c	c
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
c	b	c	b	d	d	c	b	b	d	d	b	b	c	b	d	b	d	a	a
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
b	c	b	a	d	d	d	c	a	b	c	c	c	d	c	a	b	d	d	a
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260

c	a	b	b	c	d	d	a	d	b	c	a	b	a	b	a	c	b	a	b
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
a	c	c	d	b	b	a	c	a	a	a	c	d	c	c	d	a	b	b	d
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
b	a	d	d	b	a	b	c	a	c	d	b	a	d	a	a	a	a	b	d
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
b	d	a	c	c	b	a	c	b	a	a	a	d	c	d	c	c	b	b	d
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
b	a	b	c	c	c	d	c	c	b	c	b	d	a	c	c	a	b	c	c
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
b	d	c	c	a	c	d	c	b	c	c	a	c	d	c	a	d	c	c	a
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378		
a	b	b	b	c	b	c	d	d	c	c	b	c	d	a	b	d	c		

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