

- The separation and elimination of toxic nitrogenous waste material from the body is called excretion.
- Excretory substances : Ammonia, Urea, Uric acid, creatin, creatinin, phosphate, Hipuric acid etc.
- First excretory substance is Ammonia.
- Due to deproteinization of amino acid resultant ammonia is formed.
- For the solubility of excretory material water is essential, Ammonia > Urea > Uric acid.
- According to consumption of energy formation of excretory substances are in order Uric acid > Urea > Ammonia.
- For the elimination of excretory substances consumption of water and energy is in reciprocal ratio.
- By the types of excretory substances, types of animals.

Ammonotelic animals	Ureotelic animals	Uricotelic animals
• NH_3 dissolve in more water eliminate from the body • Eg → Aquatic insects, bonyfish, amphibian, tad pole, crocodile	In liver $2\text{NH}_3 + \text{CO}_2 \rightarrow$ Formation of urea Normally elimination in form of urine cartilage fish, Adult amphibian, mammals	Less toxic, semisolid, semiliquid, in round shape of pellet or paste excretion Insects, Reptiles, Aves, Terrestrial snail

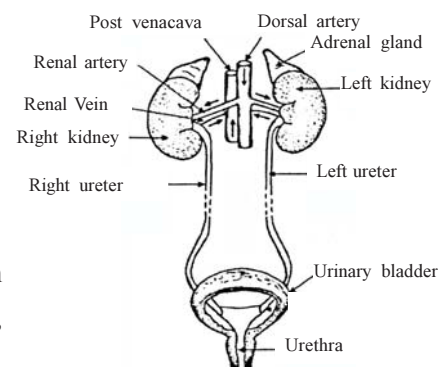
- Type of nitrogenous poisonous substances and its excretion depends on
 (A) Temperature (B) Availability of water (C) Food components (D) Atmosphere
- Poisonous substance ammonia is formed by
 (A) Emulsification of lipid (B) Protein synthesis
 (C) Oxidation of carbohydrates (D) Deamination of aminoacids
- Find the correct option for formation of poisonous substance urea, location and reactants.
 (A) Stomach, $\text{CO}_2 + \text{NH}_2$ (B) Liver, $\text{O}_2 + 2\text{NH}_3$
 (C) Liver, $\text{CO}_2 + 2\text{NH}_3$ (D) Kidney, $\text{CO}_2 + 2\text{NH}_3$
- Find correct option for the uric acid excretion group of organisms.
 (A) Snake - Calotes - Sparrow (B) Osteichthyes - Crocodile - Aquatic insects
 (C) Frog - Man - Reptile (D) Chondrichthyes - Amphibian tadpole - Aquatic insects
- Of the following poisonous substances which one require more amount of water for its solubility ?
 (A) Glycerol (B) Ammonia (C) Urea (D) Uric acid
- Find correct option in descending order for utilization of energy for the formation of excretory substances.
 (A) Frog, Snake, Tadpole (B) Tadpole, Frog, Snake
 (C) Sparrow, Frog, Tadpole (D) Pigeon, Tadpole, Frog

- (7) Organism showing two types of excretion during its life span, find the correct option.
 (A) Osteichthyes (B) Chondrichthyes (C) Amphibia (D) A and B both
- (8) Deamination is
 (A) Reabsorption of amino acids by papillae of intestinal wall from digested food
 (B) Release of CO_2 and NH_2 from dissociation of amino acids
 (C) Formation of NHCO , for linking amino acid with amino acid
 (D) Removal of CO_2 from amino acids by kidney
- (9) What is proper statement for amphibian class ?
 (A) Urea in tadpole and ammonia in adult amphibian.
 (B) Urea in total lifecycle of amphibian animals.
 (C) Ammonia in tadpole and urea in adult frog.
 (D) Uric acid in adult amphibia and ammonia in tadpole.

Answers : (1-B), (2-D), (3-C), (4-A), (5-B), (6-C), (7-C), (8-B), (9-C)

Human Excretory system :

- Main excretory organ-kidney → Colour: Reddish brown
Shape : Bean shape
- Weight : 125 to 170 gm
- Size : ($l : 10 \times b : 5 \times h : 3$) cm
- Location : Both side of vertebral column, in lumber region
12th thoracic vertebra and first two lumber vertebrae, lateral side ($T_{12}L_1L_2$)
- Arrangement : The two kidney are not placed at the same level.
The right kidney is slightly on a lower level than the left. This is due to fact that right side of the abdominal cavity is occupied by liver.



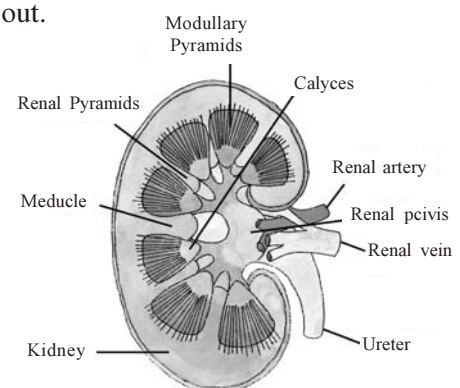
Human Excretory System

External structure :

- Surface : Outer surface convex, inner surface concave.
- Hilum : On concave surface one longitudinal slit like structure is there by which artery, nerve enters inside the hilum, through this slit vein, ureter come out.

Internal structure :

- Cortex : Peripheral area of convex surface dark red and somewhat granular.
- Medulla : Pyrami shaped renal pyramid, area between the cortex and renal pyramid which spread toward the cortex is called column of Bertini.



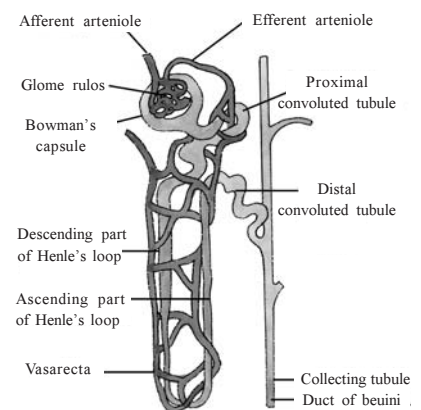
L.S. of Kidney

- (10) Spreading region of cortex
 (A) Renal pyramid (B) Column of bertini
 (C) Calyces (D) Renal pelvis

- (11) Among pair of kidney in human, right kidney is slightly on lower side, because
 (A) diaphragm is slightly lowered towards right side
 (B) right kidney is heavy in weight
 (C) right ureter is very short
 (D) above right kidney, beneath diaphragm largest accessory digestive gland is situated
- (12) Hilum present on the concave surface of kidney
 (A) pure blood by renal artery come out of kidney
 (B) pure blood by renal artery enters into kidney
 (C) pure blood by renal vein enters into kidney
 (D) pure blood by renal vein come out of kidney
 (Hint : pure blood - without nitrogenous poisonous substances)
- (13) Location of kidney
 (A) 11th and 12th thoracic vertebrae and on either side of 1st Sacral vertebrae.
 (B) 12th thoracic vertebrae and either side of first two sacral vertebrae
 (C) either side of first three sacral vertebrae
 (D) either side of last three thoracic vertebrae
- (14) Renal vein transport blood in which direction ?
 (A) Inferior venacava to kidney
 (B) Kidney to inferior venacava
 (C) Inside kidney toward Afferent renal arteriole
 (D) From hind limb to kidney
- (15) In which part of kidney glomerulus is situated ?
 (A) Renal pelvis (B) Renal pyramid (C) Renal cortex (D) Calyces
- (16) In terrestrial organism, excretory substances formed in liver reaches to kidney through which passage ?
 (A) Hepatic vein - hepatic artery - post venacava - heart - renal artery
 (B) Hepatic artery - heart - dorsal aorta -Renal artery
 (C) Hepatic vein - Post venacava - aortic arch - heart - renal artery
 (D) Hepatic vein - post venacava - heart - aortic arch - renal artery

Nephron : Excretory unit :

- Structural and functional unit of kidney.
- Each kidney has approximately 10 lacs nephron.
- Length 3 cm
Diameter : 20 to 30 μ m (Micrometer)
- Excretory unit has two main part
 - (a) malpighian body
 - (b) Uriniferous tubule
- (a) Malpighian body : Glomerulus + Bowman's capsule



Ultrastructure of uriniferous tubule

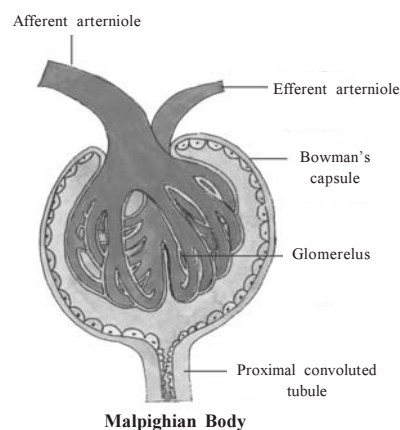
Answers : (10-B), (11-D), (12-D), (13-B), (14-B), (15-C), (16-D)

Blood flow :

- Afferent arteriole - Glomerulus - Efferent arteriole
- Diameter of afferent arteriole is more.
- Diameter of efferent arteriole is less.
- Blood capillaries unilayered thickness micro vessel.

Bowman Capsule :

- Double walled cup like structure
- Towards outer side wall composed by squamous epithelial cells
- Inner side wall some. specific type of epithelial cell are situated which is called podocytes.
- Specific arrangement of cells little bit space among them, is called filtration slits.

**Uriniferous tubules :**

- **PCT - Proximal Convoluted tubule**

Wall of this region, cells having mitochondria and micro villi are present. Tubular lining made up of cuboidal epithelial cells.

Location : In cortex region.

- **Loops of Henle :** U-shaped tubule

Descending loop : Lining made up by flat epithelial cells, permeable for water.

Asecending loop : Its lining made up by cuboidal epithelial cells impermeable for water.

Location : In medulla region.

- **DCT : Distal Convoluted tubule**

It lining made up of cuboidal epithelial cells.

Location : It is situated in Cortex.

- **Transport pathway :** Bowman's capsule - PCT - Loop of Henle - DCT

Collecting duct :

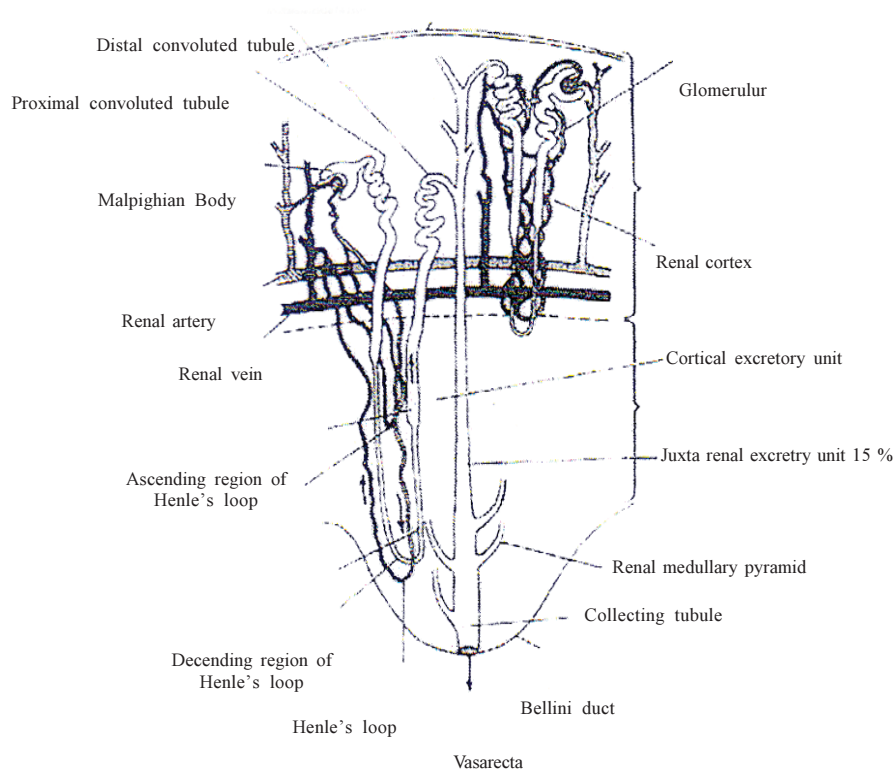
Location : tubule beneath the DCT which is located in pyramid of medulla region

Bellini duct : Many collecting ducts joint and open in large bellini duct.

- Bellini duct opens in renal pelvis.
- Urine formation occur only in nephron. While urine transportation occur only in collecting duct.
- Transporation pathway : Collecting duct - Bellini duct - Renal pelvis - uretar - urinary bladder.

Types of nephron :

Juxta medullary nephron	Cortical nephron
– 15% of total nephron	– 85% of total nephron
– length of Henle's loop is more	– Length of Henle's loop is less
– vasa recta is present	– Vasarecta is absent or less developed
– No or less developed peritubular capillaries	– Development of peritubular capillaries
– Henle's loop situated deep in medulla.	– Limited upto cortex, very less part enlarge in medulla.



Ultrasturcture and types of uriniferous tubule excretory unit

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- (17) State name of cells which by Specific arrangement forms filtration pore in inner wall of Bowman's capsule.
 (A) Squamous epithelium (B) Podocytes (C) ciliated cells (D) Stratified epithelium
- (18) In healthy person, diameter of afferent and efferent arteriole
 (A) Both equal (B) More and less
 (C) Less and more (D) Depending on working capacity of nephron
- (19) Improper, accordance with renal pyramid.
 (A) Convoluted tubule (B) Henle's loop (C) Vasa recta (D) Collecting tubule
- (20) True sequence for transport of excretory substances
 (A) uriniferous tubule - collecting tubule - renal pelvis - duct of bellini
 (B) uriniferous tubule - renal pelvis - collecting tubule - bellini's duct
 (C) uriniferous tubule - bellini's duct - collecting tubule - renal pelvis
 (D) uriniferous tubule - collecting tubule - bellini's duct - renal pelvis
- (21) Its layer is formed by columnar epithelial cells
 (A) PCT (B) DCT
 (C) Ascending region of Henle's loop (D) All of above
- (22) End portion of uriniferous tubule
 (A) DCT (B) collecting tubule (C) duct of bellini (D) ureter
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- (23) Region of renal pelvis is more broad at cortex region because
 (A) Concentration of intercellular fluid is more (B) More amount of Juxta-cortical nephron
 (C) More amount of corical excretory unit (D) More amount of convoluted tubule
- (24) What is true for external excretory unit ?
 (A) It has peritubular capillaries (B) Henle's loop is extended towards medulla
 (C) convoluted tubules are less developed (D) collecting tubules are branched
- (25) Columnar cells with brush border is characteristic of the following.
 (A) PCT (B) Henle's ascending narrow region
 (C) Inner wall of Bowman's capsule (D) Henle's descending narrow region
- (26) Which structures are more in renal pyramid ?
 (A) Malpighian body (B) PCT (C) Henle's loop (D) DCT

Answers : (17-B), (18-C), (19-A), (20-D), (21-D), (22-A), (23-C), (24-A), (25-A), (26-C)

Function of Nephron :

PCT - PCT is lined by cuboidal brush border (having microvilli) epithelium which increases the surface for re-absorption of filtrate.

- The PCT also helps to maintain a constant balance in body fluid by the secretion of H^+ and by reabsorption of the buffer HCO_3^- from the filtrate.
- The filtrate is isotonic blood plasma.
- Absorption of essential nutrients.

Descending Henle's loop : Permeable for water, impermeable for electrolytes, filtrate more concentrated than blood plasma.

Ascending Henle's loop

Impermeable for water, permeable for electrolytes (Diffusion and active transport)

When electrolytes enters from Henle's loop to medulla filtrate becomes dilute.

DCT

Reabsorption of water, HCO_3^-

From efferent arteriole absorption of excretion secretion occur in lumens of DCT.

Na^+ K^+ balance is maintained.

Collecting duct :

- From the DCT urine passes from here and reabsorption of water in huge amount, Urine becomes concentrated.
- pH and Ionic balance by secretion of H^+ and K^+ and elimination occurs.
- End portion of collecting tubule is permeable for urea. So it diffuses in medulla. Therefore concentration of Urine is maintained.

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- (27) Characteristic of endothelial cells of proximal convoluted tubule

- (A) flat cells (B) cuboidal with brush border
 (C) many layered (D) columnar
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- (28) Process occurring in PCT to maintain pH of body fluid
 (A) Secretion of H^+ and HCO_3^-
 (B) Reabsorption of H^+ and secretion of HCO_3^-
 (C) Reabsorption of H^+ and HCO_3^-
 (D) Secretion of H^+ and reabsorption of HCO_3^-
- (29) Descending region of Henle's loop is mainly impermeable for
 (A) electrolytes (B) water (C) both A and B (D) None
- (30) Filtrate is diluted in ascending region of Henle's loop because
 (A) electrolytes from interstitial medullary fluid enters ascending region
 (B) more water from interstitial medullary fluid enters ascending region
 (C) from ascending region only electrolytes diffuses or actively transported in interstitial fluid
 (D) more secretion of ADH
- (31) State correct option, with reference to X, Y, Z
 Statements -
 X - urine gets more concentrated in distal convoluted tubule
 Y - urea come out of DCT
 Z : uric acid and ammonia secreted from DCT
 (A) X, Y, Z are true, Y and Z are explanation for X.
 (B) X and Y are true, Z is False, Y is explanation for X.
 (C) X and Z are true, Y is False Z is reason for X.
 (D) X true, Y and Z wrong.

Answers : (27-B), (28-D), (29-A), (30-C), (31-C)

Urine formation :

Three phases :

(1) Glomerular filtration (2) Selective reabsorption and (3) Tubular secretion

(1) **Glomerular filtration :**

- For the filtration process, kidney per minute average 1100 to 1200 ml blood gain.
- Pressure filtration process occur in glomerulus.
- Filtration of blood occur by micro membrane.

In filtrate water, essential substances and excretory substances etc. are present.

GFR : (Glomerular filtration rate)

- Every minute from both kidney by all the excretory units forms amount of filtrate which enter in PCT. or The quantity of filtrate formed per minute in all nephrons of both the kidneys is called glomerular filtration rate.
- 125 ml/ minute is the GFR for healthy man.

(2) Selective reabsorption :

99% amount of filtrate reabsorption occur in PCT

= GFR : 1 minute $\rightarrow$ 125 ml, 60 minute $\rightarrow$ 7500 ml or 7.5 lit, 24 hour $\rightarrow$ 180 lit
(24×7.5) l, per day filtrate $\rightarrow$ 18 li.

Everyday amount of urine release average 1.5 li.

(180 l $\rightarrow$ 1.5 l = 99%)

Reabsorptionable substances : Water, glucose, amino acid, vitamins, NaHCO_3 etc.

(3) Tubular Secretion :

- Substances which are not reabsorbed in PCT, passes towards the descending loop.
- H^+ , K^+ , NH_4^+ like substances are secreted in the PCT.
- Moreover in malpighian body the substances which are not filtered pass through efferent arteriole and such substances are ammonia, urea, uric acid, antibodies like penicillin etc. secreted in DCT.
- In PCT and Henle's loop absorption of water can occur, so urine become concentrated.
- When the filtrate passes through DCT and collecting duct, water is also reabsorbed and urine becomes concentrated.

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- (32) State the volume of blood entering into both kidney for filtration.
(A) 0.125 liter (B) 180 liter (C) 1.5 liter (D) 1.1 to 1.2 liter
- (33) In healthy person, volume of filtrate per minute passes through neck of malpighian body ?
(A) 125 ml (B) 75 ml (C) 1250 ml (D) 1500 ml
- (34) To maintain ionic balance of body fluid, tubular cells secrete
(A) uric acid (B) ammonia (C) penicillin (D) A and C both
- (35) Organisms in which, Henle's loop length is very less in excretory unit urine of such organism is
(A) isotonic (B) hypotonic (C) hypertonic (D) more concentrated
- (36) In normal condition which of the following substance is absorbed totally in PCT ?
(A) Urea (B) Salts (C) Glucose (D) Uric acid
- (37) In healthy person components present filtrate formed due to pressure filtration, find true group from the following
(A) Water, glucose, vitamins, sodium bicarbonate (B) Water, glucose, urea, uric acid, penicillin
(C) Water, salt, uric acid, penicillin (D) Water, vitamins, vasopressin, uric acid
- (38) Out going Blood flow is slow in malpighian tubule than blood entered because
(A) efferent arteriole is unilayered and has very narrow lumen
(B) afferent arteriole diameter is narrower than efferent arteriole
(C) afferent arteriole lumen is broader than efferent arteriole
(D) both afferent and efferent arteriole has same diameter but amount of blood capillaries are more

Answers : (32-D), (33-A), (34-B), (35-B), (36-C), (37-A), (38-C)

Mechanisms of Concentration of the filtrate : (Counter current)

- For the concentration of urine the kidney has a mechanism that is known as concentration mechanism.
- Aves and mammals have ability for urine excretion (More concentrated than blood).
- For this they have evolved a counter current mechanism, for conservation of water.
- Henle's loop and vasa recta (capillary in the form of loop) play a significant role in it.
- The flow of filtrate in the two limbs of Henle's loop is in opposite direction which forms a counter current.
- The flow of blood in the two limbs of vasa recta is also in opposite direction and thus forms a counter current.
- Thus these two counter current systems play an important role in concentrating urine.
- The proximity between the vasa recta and loop of Henle and the counter current in them help in maintaining an increasing Osmolarity towards the inner medullary interstitial fluid. i.e. from 300 mOsmol⁻¹ the cortex to about 1200 mOsmol/L in the inner medulla.

Participant units of counter current :

(1) Henle's loop :

- When the filtrate passes through the ascending limbs of the Henle's loop, it loses Na⁺, Cl⁻ by diffusion in its narrow region to the interstitial fluid in the renal medulla and Na⁺ and Cl⁻ ions by active transport in its wide region of the ascending limbs.
- The water so drawn enters the vasa recta and is transported away.
- The interstitial fluid in the medulla is nearly as concentrated as the urine leaving the collecting duct.

(2) Vasa Recta :

- The walls of the vasa recta are made up of endothelial cells and are freely permeable to water, urea and ions.
- Blood flows from ascending capillary towards water is drawn out by the process of osmosis from the blood and there will be an increase in the concentration of the interstitial fluid by diffusion of urea and Na⁺ and Cl⁻ enters the blood plasma.
- As the blood enters in the ascending capillary towards the renal cortex, the reverse condition occurs.
- It means water re-enters the blood plasma while urea and Na⁺ and Cl⁻ drawn out due to a decrease in the concentration of interstitial fluid.
- The counter current exchange in the vasa recta :
 - (A) Prevent the loss of Na⁺ and Cl⁻ ions, from the renal medulla and
 - (B) helps to maintain concentration gradient in the renal medulla.
- Certain urea diffuses from the last part of the collecting duct into interstitial fluid, to increase density which increased water re-absorption from the bottom of Henle's loop as well as from collecting duct.
- The function of counter - current mechanism is to maintain high concentration surrounding nephrons and collecting ducts.

- Thus hypertonic urine is produced in human. Thus urine produced is nearly four times concentrated than the initial filtrate formed.

$$(300 \text{ mOsmol}^{-1} \rightarrow 1200 \text{ mOsmol}^{-1})$$

mOsmol^{-1} = Osmolarity in milli osmosmol per litre.

Chemical composition of urine :

Water	95%	Creatinine	0.3%
Urea	2.6%	Ammonia	0.3%
Electrolytes	2%	Hipuric acid	0.3%
Uric acid	0.3%		

- **Urochrome** : By presence of this pigment Urine is pale yellow in colour.
- **Daily** : 25-30 gm urea is excreted.

- (39) Counter current mechanism means
- (A) direction of blood flow in glomerulus
 (B) in both regions of the loop, flow of filtrate is in same direction
 (C) flow of urine in collecting tubule
 (D) in both regions of the loop, flow of filtrate is in opposite direction
- (40) How is Osmosis of interstitial fluid present in renal medulla maintained ?
- (A) With the help of counter current (B) Due to proximity of Henle's loop and vasa recta
 (C) Due to proximity of PCT and vasa recta (D) A and B Both
- (41) Current of osmolarity is formed by which substance ?
- (A) Urea (B) NaCl (C) A and B both (D) NH_3
- (42) True sequence of blood (mOsmol^{-1}) in descending capillary
- (A) $900 \rightarrow 600 \rightarrow 400$ (B) $400 \rightarrow 600 \rightarrow 900$
 (C) $200 \rightarrow 400 \rightarrow 600$ (D) $600 \rightarrow 400 \rightarrow 200$
- (43) True sequence of urine (mOsmol^{-1}) flowing in collecting tubule
- (A) $300 \rightarrow 400 \rightarrow 600 \rightarrow 900 \rightarrow 1200$ (B) $1200 \rightarrow 700 \rightarrow 400 \rightarrow 200 \rightarrow 100$
 (C) $1200 \rightarrow 900 \rightarrow 600 \rightarrow 400 \rightarrow 300$ (D) None of above
- (44) State the true sentence, related with uriniferous tubule
- (A) Na^+ and Cl^- flow from interstitial fluid into descending Henle's loop
 (B) Na^+ and Cl^- flow from Henle's descending region into interstitial fluid and then into vasa recta
 (C) Na^+ and Cl^- flow from Henle's ascending region to interstitial fluid and then enters vasa recta
 (D) Na^+ and Cl^- flows from vasa recta to interstitial fluid and from then Henle's ascending region

- (45) Function of counter current
 (A) to prepare hypertonic urine
 (B) to prepare isotonic compare to blood urine
 (C) maintain more concentration of nearby excretory unit and collecting tubule
 (D) maintain more concentration in adjoining excretory unit and vasa recta
- (46) To increase density of interstitial fluid of renal pyramid which substance diffuse from last portion of collecting tubule ?
 (A) NaCl (B) HCO_3^- (C) H_2O (D) Urea
- (47) mOsmol $^{-1}$ of blood entering in vasa recta is comparing interstitial fluid ?
 (A) more (B) less (C) isotonic (D) A and B both

Answers : (39-D), (40-D), (41-C), (42-B), (43-A), (44-C), (45-C), (46-D), (47-B)

Regulation of kidney function :

- The function of the kidney is efficiently monitored and regulated by hormonal feed back mechanisms.
- Regulated by hormonal feed back mechanisms mainly by hypothalamus, pituitary, JGA (Juxta Glomerular Appartus) and heart at certain extent.
- When water is abundant in the body tissue kidney excretes large quantity of dilute urine.
- When body tissues are short of water small quantity of concentrated urine is excreted.
- The regulation of water and solute content of the body fluid by kidney is known as osmoregulation.
- Change in ionic concentration, blood volume and volume of body fluid activate the Osmoreceptor in the body.
- Excessive loss of fluid from the body activates these receptors which stimulate the hypothalamus to release antidiuretic hormone (ADH or vasopressin) from the posterior pituitary.
- ADH facilities water absorption from posterior parts of the tubules and thus prevents diuresis.
- An increase in volume of body fluid can switch off the osmoreceptors and suppress the ADH release to complete the feed back.

Micturition

- Urine formed and drained continuously by the nephrons is ultimately carried out by the ureters by peristaltic movement and then carried into urinary bladder.
- The function of bladder is to store urine temporarily till a voluntary signal is given by central nervous system (CNS). The signal initiates the stretching of the urinary bladder as it is filled with urine.
- In response, the stretch receptors on the walls of the bladder send signals to the CNS.
- The CNS passes messages to indicate the contraction of smooth muscle of the bladder and relaxation of the urethral sphincter surrounding the opening of the bladder which causes release of urine.
- Thus the release of urine from bladder is called micturition or urination and the neural mechanisms causing micturition is known as the micturition reflex.
- contraction and relaxation of the bladder are caused by impulses from the sympathetic and parasympathetic nerve fibres.
- An adult man excretes on an average 1 to 1.5 litres of urine per day.

Properties of urine : The normal urine is a light yellow coloured and slightly characteristic odour; pH : 6.0 (slightly acidic)

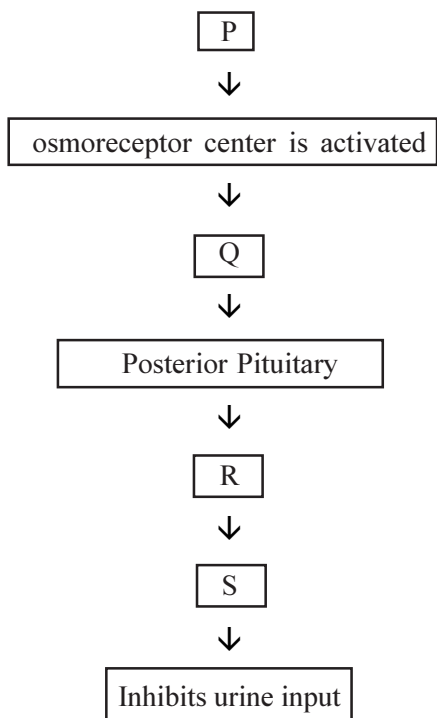
- ratio of substances

Urea	:	30 gms	Creatinine	:	1.2 gms
Ammonia	:	1.2 gm	Uric acid	:	1 gm

- (48) Which of the following hormone increases permeability of collecting tubule ?
 (A) GH (B) LH (C) ACTH (D) ADH
- (49) In absence of ADH
 (A) concentrated urine released (B) increase in dilute urine
 (C) kidney is inactivated (D) more urea is formed
- (50) Urine emptied in renal pelvis, first of all enters
 (A) bellini tubule (B) urinogenital tract (C) ureter (D) urinary bladder
- (51) Which of the following organ is not associated with formation or removal of nitrogenous poisonous substance ?
 (A) Lungs (B) Liver (C) Skin (D) Kidney
- (52) Urine formation is continuous process but removal of urine is not continuous because
 (A) restriction muscles around ureter.
 (B) urine is stored temporarily in bellini's duct.
 (C) wall of urinary bladder is formed of striated.
 (D) aperture of urinary bladder, opening in urinogenital passage is closed by restriction muscle, which relaxes under the effect of message by CNS.
- (53) State pH of human urine.
 (A) 7.35 (B) 4.5 (C) 5.2 (D) 6.0
- (54) Contraction and relaxation of urinary bladder is by nerve impulses of which nerve fibre?
 (A) Brain (B) Spinal cord
 (C) Both A and B (D) Sympathetic and para sympathetic n. system
- (55) Change in which of the following makes osmo - receptor centers of the body active?
 (A) Change in the volume of bodyfluid (B) Amount of above
 (C) Ionic concentration (D) All of above
- (56) State the origin place for vassopressin hormone
 (A) kidney (B) adrenal gland (C) hypothalamus (D) post pituitary gland
- (57) When is ADH secretion is inhibited ?
 (A) Decrease in volume of body fluid (B) Body fluid volume is normal
 (C) More urea is synthesized (D) All of above
- (58) State the hormone which make urine hypertonic and blood hypotonic.
 (A) ADH (B) Adrenalin (C) Glucagon (D) Sterols

59. During expulsion of urine, muscles of wall of urinary bladder and passage of urinogenital tract opening into urinary bladder, muscles surrounding it shows
- (A) relaxation, relaxation (B) relaxation, contraction
(C) contraction, contraction (D) contraction, relaxation
60. In the chart showing regulation of urine formation what is indicated by P, Q, R, S ?

Kxo :



- (A) P = Increases H_2O in the body
Q = Hypothalamus
R = Inhibits secretion of ADH
S = Inhibits reabsorption from post region of tubule
- (B) P = Decreases H_2O in body
Q = Hypothalamus
R = ADH secreted
S = H_2O is reabsorbed from post part of tubule
- (C) P = Decreases H_2O in body
Q = Hind brain
R = Starts secretion of ADH
S = Reabsorption of H_2O from anterior region of tubule
- (D) None of the above

Answers : (48-D), (49-B), (50-C), (51-A), (52-D), (53-D), (54-D), (55-D), (56-D), (57-B), (58-A), (59-D), (60-B)

Role of other organs in excretion :

- Other than kidneys, skin, lungs and liver help in the elimination of excretory wastes.

Skin :

- Many aquatic animals like starfish and Hydra excrete ammonia into surrounding water through skin by diffusion.
- In Mammals :
- Sebaceous glands discharge waxes, sterols, fatty acids and hydro carbon which is collectively known as sebum. It lubricates the hair and preventing drying up of skin and wetting of hair.
- While sweat gland secretion is watery and stimulated by increase in body temperature. The secretion consists of water, salts mainly NaCl, urea, lactic acid, little amino acids, which are discharged on the surface of skin.
- **Lungs :** About 18 litres of CO_2 and about 400 ml of water per day are removed by human lungs.

- **Saliva** : Drugs, heavy metals and probably small amounts of nitrogenous waste could be eliminated.

Disorders of the excretory system : An excessive amount of urea in the blood.

- Due to bacterial infection (nephritis) or some mechanical obstruction excretion of urea by kidney decreases.
- Due to this disease kidney can fail.

Treatment : Haemodialysis

- **Method** : In treatment of haemodialysis or artificial kidney dialyser unit of patient blood and dialysing fluid are in contact to each other.
 - Patients' blood and dialyzer fluid passes to both sides through semi permeable membrane.
 - By the process of osmosis from the blood of patient urea is filtered in dialyzer fluid.
 - Keep Isotonic solution approximately as dialyzer fluid and blood plasma (which is maintained).
 - But percentage of urea in dialyzer fluid necessary to maintain.
 - From the patient body by the blood pump from any one artery, blood is pumped out and supplied towards the dialyzer unit, in that added heparin and keep it at 0°C temperature for the cooling.
 - When passes through the cellophane duct. Excretion can occur from the blood, urea, uric acid, creatinine and excessive salts come in dialyzer fluid by Osmosis and blood becomes pure.
 - Now in this blood added with anti heparine and then pumped back into vein of the patient enter in patient.

A : Unit of thermoregulator,

B : Pump

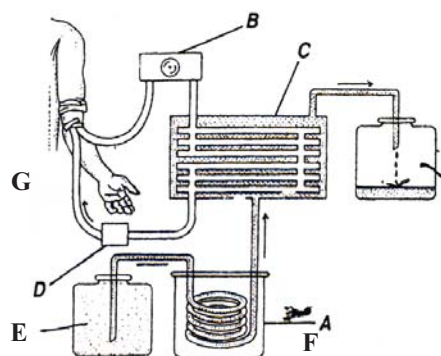
C : Dialyzer unit

D : Bubble strip

E : Dialyzer fluid

F : Waste fluid

G : vein



Kidney failure :

- Partial or total inability of kidney to carry excretory functions is known as kidney failure.
- **Causes**: Infection tubular injury, bacterial toxin, drug reaction etc.
- **Treatment** : Dialysis (Three times in a week)

Renal calculi :

- It blocks the kidney tubules / nephron.
- **Causes** : Stones or insoluble masses of crystalized salts formed by oxlate or uric acid precipitation formed in the kidney stone.
- **Symptoms** : Severe back pain. The stone may pass into urinary bladder and cause severe pain.
- **Treatment** : Surgery may be done to remove stone.

Nephritis :

- It is an inflammation of renal pelvis interstitial tissue and calyces. It is due to bacterial infection. Bacteria reach kidney via urethra and ureter. Inflammation effects the counter current mechanism disease. Back-pain and painful and frequent urination are its symptoms.
- Glycosurea : Presence of sugar in urine.

Oligourea : less formation of urine

Haematuria : Blood cells presence in urine.

Anuria : Very less production of urine in urine formation, thus kidney failure can occur.

Dysuria: Painful micturition.

-
- (61) Substances which required to be removed, what is their amount in Dialyzing fluid ?
(A) More (B) Less
(C) Zero (D) Same as that of blood plasma
- (62) Find correct option for the structure of sebum.
(A) Wax, Hydrocarbon, Fatty Acid, Uric acid
(B) Urea, Lactic acid, some Amino acids, Salt
(C) Fatty acids, Sterols, Water, Salt
(D) Wax, Sterols, Fatty acid, Hydrocarbon
- (63) State the components of sweat secreted from sweat gland.
(A) Lactic acid, Amino acid, H₂O, Urea, NaCl
(B) H₂O, Urea, Amino acid, Fatty acid
(C) NaCl, Sterols, Wax, Fatty acid, Hydrocarbon
(D) Amino acid, Lactic acid, Sterols, Wax, H₂O
- (64) State function of sebum
(A) hair becomes soft (B) prevents dryness of skin
(C) keeps hair moist (D) all of above
- (65) State the amount of daily excreted CO₂ by lungs.
(A) 1.8 litre (B) 18 litre (C) 180 ml (D) 0.18 litre
- (66) Of the following, inactivation of which organ requires haemodialysis ?
(A) Kidney (B) Urinary bladder (C) Ureter (D) Renal pelvis
- (67) Which of the following component is absent in liquid used in dialyzing unit ?
(A) Glucose (B) Urea (C) Salt (D) Water
- (68) More amount of urea is found during laboratory test of blood, so doctor may diagnosed which disease ?
(A) Nephritis (B) Uremia (C) Diahorrea (D) Aneuria
- (69) Which crystals are responsible for stone formation in kidney ?
(A) Calcium chloride (B) NaCl (C) Calcium oxalate (D) Na₂CO₃
- (70) In the last stage of haemodialysis process, before pumping blood into the body which substance is added ?
(A) Heparin (B) Histamine (C) Antihistamine (D) Antineparin
-

- (71) Burning sensation during which of the following disease affect the process of counter current mechanism ?
 (A) Uremia (B) Atherosclerosis (C) Nephritis (D) Hypertension
- (72) Find improper pair.
 (A) Stone - Acute pain, if enters in urinary bladder
 (B) Nephritis - Frequent urine release/explusion
 (C) Failure of kidney - Inability for total excretory function
 (D) Uremia - Increase amount of urea in urine
- (73) Presence of blood in urine is termed as
 (A) ketoneuria (B) oligourea (C) haematuria (D) glycosurea
- (74) What is correct for haemodialysis ?
 (A) Liquid components of dialyzing fluids are similar to blood plasma but it has more amount of urea
 (B) Antiheparin is mixed in pure blood.
 (C) Filtered blood is allowed to enter in patient's artery through pump.
 (D) Haemodialysis is blessing for the patient of kidney stone.

Answers : (61-C), (62-D), (63-A), (64-D), (65-B), (66-A), (67-B), (68-B), (69-C), (70-D), (71-C), (72-D), (73-C), (74-B)

True - False (T - F) type questions

Of the following sentences which true or false option is correct choose it.

- (75) (1) Collecting tubules unite to form renal pyramids.
 (2) Collecting tubules transports and synthesizes urine.
 (3) Descending region of Henle's loop is formed of cuboidal epithelial cells.
 (4) Ascending region of Henle's loop formed of flat epithelial cells.
 (A) FTFF (B) FTTT (C) TFFT (D) FFTT
- (76) Given Statement
 (1) If length of Henle's loop is less urine is more concentrated.
 (2) Secretion in the tubule is in PCT of uriniferous tubule.
 (3) Medicinal Substances and H⁺ are reabsorbed.
 (4) PCT layer is formed of squamous epithelium.
 (A) FFFF (B) FFTT (C) TFFT (D) TTTF
- (77) Given Statement
 (1) In human body ammonia from urea is formed in the liver.
 (2) Aves, snail and osteichthyes are uricotelic organisms.
 (3) Left kidney is slightly higher than right kidney.
 (4) Layer of PCT is formed of squamous epithelium.
 (A) FFFF (B) FFTT (C) TFFT (D) TTTF

(78) Given Statement

- (1) Micturition is reflex action but partially controlled voluntary.
- (2) Human can release hypertonic or hypotonic urine as per requirement of body.
- (3) Skin helps in removal of nitrogenous excretory substances.
- (4) H_2O , Na^+ and HCO_3^- reabsorbed in DCT.

(A) FTFF (B) FTTT (C) TTTT (D) FFTF

(79) Given Statement

- (1) Liquid concentration 400 mosmol $^{-1}$ in descending capillary's outer side.
- (2) Ascending capillary's has liquid concentration 600 mosmol $^{-1}$, present in the middle part of renal medulla.
- (3) Filtrate concentration is 1200 mosmol $^{-1}$ in Henle's loop, towards curved region of medulla in uriniferous tubule.
- (4) Filtration concentration in DCT is 300 mosmol $^{-1}$.

(A) FFTT (B) TFFT (C) TFFT (D) TTTT

A - Statement, R - Reason type questions

Select answer of following questions from the options given below.

(A) A and R true, R is explanation of A.

(B) A and R true, but R is not explanation of A.

(C) A is true, R is false.

(D) A is false, R is true.

(80) Statement A : NH_3 Synthesized in the body, is to be removed in same or another form

Reason R : NH_3 is not soluble in water.

(A) (B) (C) (D)

(81) Statement A : Vasopressin increases permeability of H_2O in DCT.

Reason R : In absence of Vasopressin there is decrease in reabsorption of H_2O and dilute urine increases.

(A) (B) (C) (D)

(82) Statement A : Mammalian animals living in desert, has concentrated urine.

Reason R : Length of Henle's loop is very less in these animals.

(A) (B) (C) (D)

(83) Statement A : In human of the excretory substances are soluble in H_2O .

Reason R : Water is non-essential reactant.

(A) (B) (C) (D)

(84) Statement A : During physiological process of excretion, deamination process occurs in liver.

Reason R : Ammonia links with O_2 and converted into urea in liver.

(A) (B) (C) (D)

(85) Statement A : Water utilized for the removal of excretory substances and energy, both are in reciprocal proportion.

Reason R : Ammonia is less poisonous, its removal require less energy.

(A) (B) (C) (D)

(86) Statement A : Reabsorption is essential after microfiltration.

Reason R : Filtration through glomerulus has similar component as that of blood plasma.

(A) (B) (C) (D)

- (87) Statement A : In descending region of Henle's loop urine become hypertonic, whereas in ascending region urine is hypotonic.
Reason R : Ascending region is impermeable where as descending region is impermeable for Na^+ .
(A) (B) (C) (D)
- (88) Statement A : Blood pressure is very high in capillaries of glomerulus.
Reason R : Blood capillary is very narrow comparing to afferent arteriole.
(A) (B) (C) (D)
- (89) Statement A : Increasing osmolarity of interstitial fluid of medulla is maintained.
Reason R : Both counter current sytem are closely linked.
(A) (B) (C) (D)
- (90) Statement A : Presence of urea in urine increases in uremia.
Reason R : Dialysis is essential in the patient of uremia.
(A) (B) (C) (D)
- (91) Statement A : Urea is less poisonous comparing uric acid.
Reason R : Synthesis of urea utilizes less energy than uric acid.
(A) (B) (C) (D)

Answers : (75-D), (76-A), (77-B), (78-C), (79-B), (80-C), (81-B), (82-C), (83-C), (84-B), (85-C), (86-A), (87-A), (88-A), (89-A), (90-D), (91-D)

- (92) Match a the proper pair.

Column - I	Column - II	I	II	III
(I) Aves	(P) uricotelic	(A) P	Q	R
(II) Adult amphibian	(Q) ureacotelic	(B) P	R	Q
(III) Aquatic insects	(R) Ammonotelic	(C) R	P	Q
		(D) Q	R	P

- (93) Match the proper pair.

Column - I	Column - II
(I) PCT	(P) Reabsorption of HCO_3^- and Na^+
(II) Ascending region of Henle's loop	(Q) Secretion of Penicillin and NH_3
(III) Descending region of Henle's loop	(R) Filtrate, is hypertonic than blood plasma
(IV) DCT	(S) Filtrate, is hypertonic than blood plasma

I	II	III	IV
(A) Q	S	R	P
(B) Q	R	S	P
(C) R	Q	S	P
(D) P	Q	R	S

(94) Match the proper pair

Column - I	Column - II	I	II	III	IV	V
(I) Uremia	(P) more protein in urine	(A) R	T	Q	S	P
(II) Haematuria	(Q) more ketone in urine	(B) S	R	Q	T	P
(III) Ketonuria	(R) presence of blood cells in urine	(C) Q	S	P	T	R
(IV) Glycosuria	(S) presence of glucose in urine	(D) T	R	Q	S	P
(V) Protinuria	(T) presence of urea in blood					

(95) Match the proper pair.

Column - I	Column - II	I	II	III	IV	V
(I) Osmoreceptors	(P) microfilter aperture	(A) S	R	T	P	Q
(II) Podocytes	(Q) counter current structure	(B) Q	T	S	P	R
(III) Vasarecta	(R) dializer unit	(C) T	P	Q	S	R
(IV) Peritubular blood capillary	(S) external excretory unit	(D) R	S	Q	P	T
(V) Cellophane tube	(T) stimulates hypothalamus					

Answers : 92-A), (93-B), (94-D), (95-C)

Give answers, in reference to figure given below Question 96 to 98.

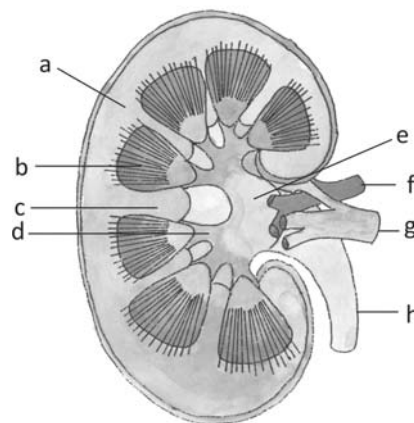


Figure 1

(96) In the given figure in part labelled as mention osmolarity L^{-1} of entered excretory fluid.

- (A) 300 (B) 600 (C) 900 (D) 1200

(97) Mention amount of excretory substance in h region of given diagram.

- (A) More (B) Less (C) Nil (D) Not sure

(98) In the given diagram I contraction of which region, stores excretory fluid in temporary storage place ?

- (A) e (B) f (C) g (D) h

Answers : (96-D), (97-C), (98-A)

- (99) In the given diagram - 2 which labelled region at the time of urine expulsion due to neurostimulation sequentially show contraction and relaxation ?

(A) e, f
(B) f, g
(C) g, f
(D) f, e

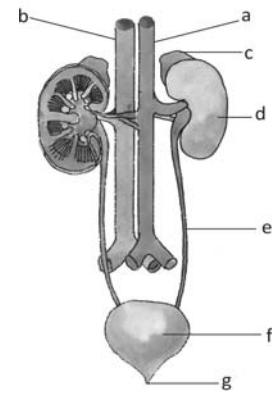


Figure 2

- (100) In which labelled part of diagram-3 pressure filtration takes place ?

(A) p
(B) q
(C) r
(D) s

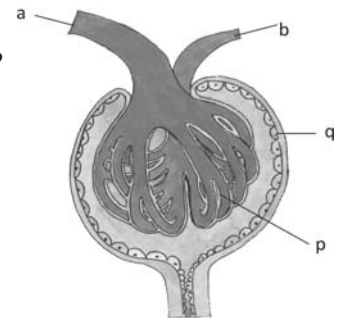


Figure 3

For a 101 to 103 select proper option with reference to diagram show below.

- (101) In the given diagram-4, d labelled part formed of which of the following cells ?

(A) Columnar epithelium
(B) Brush border cells
(C) Squamous epithelium
(D) Cuboidal epithelium

- (102) In the given diagram - 4, mention the concentration of filtrate mOsmol^{-1} passing through labelled part f.

(A) 400 (B) 200 (C) 600 (D) 900

- (103) In the above shown diagram - 4, find the correct option for process occurring in labelled part 'e'.

(A) Helps in concentration NaCl in filtrate.
(B) Electrolytes spread from here into renal medulla.
(C) Filtrate become isotonic to blood plasma.
(D) Here urine become hypertonic and removed in ureter.

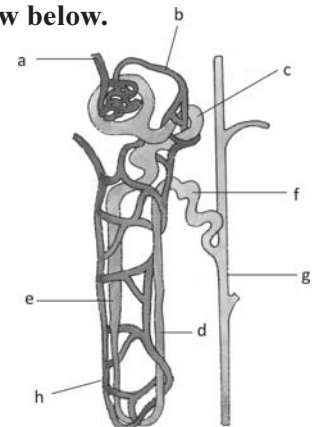


Figure 4

Answers : (99-C), (100-A), (101-D), (102-B), (103-A)

Summary for NEET PMT

Water regulation:

- **Homeostatic situation :** Maintenance of stable stage.
- Homeostate process is important for normal life. Which maintain metabolic process at specific rate.
- Loss of 12 part of body fluid causes man die. By drinking water and taking water content diet water stress can be reduced or complementry.
- Kangaroo-rat loss very little amount of water because their metabolic fluid covered the 90% of water loss.
- When camel do not get water, it can go for micturition but it stored urea on basis of metabolic fluid in tissue when camel get water, approximately it drinks water in only 10 minute and do rehydrosis.

Homeostasis word proposed by walter canon.

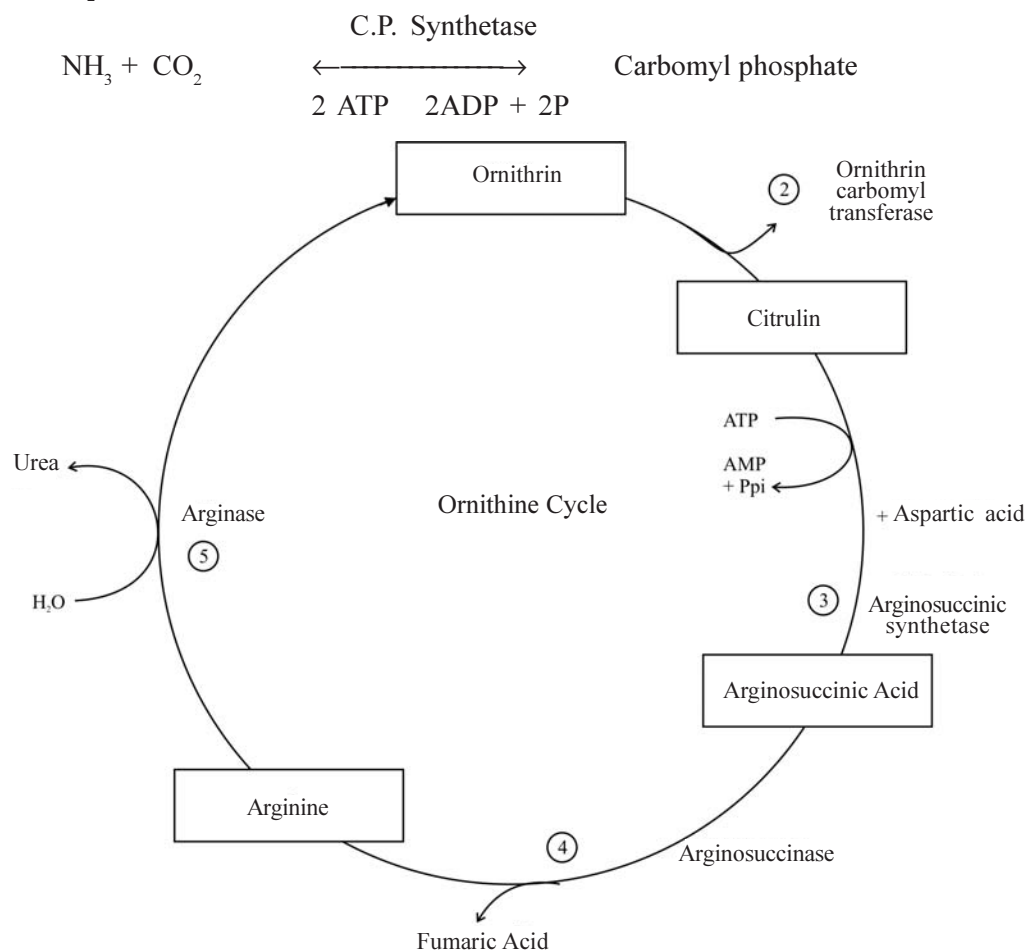
Elimination of excretory substances :

Urea is produce from liver by the ureacycle which take place in liver.

- Shark, for the maintenance of osmolarity of the omolarity equilibrium in surrounding marine water, body fluid, retains some of the urea which produced in it. So here urea act as a osmotic substances.

Ornithine Cycle :

It is also known as kreb -Henslet cycle. In this cycle two molecules of NH_3 act with the 1 molecule of CO_2 as a result urea can form.



Formation of urea in liver

Tri Methylamine Oxide (TMO) :

- In several animals by the methylalous process ammonia is converted into tri-methyl amine and oxidised and form trimethyl amine oxide which is eliminated. It is soluble in water and non-poisonous. e.g. Some marine molluscan. Crustacean, marine animals which have tail.
- **Gaunine** : In spiders ammonia is Converted in guanine. Its structure is like uric acid. It is not soluble in water. Excretion is in the form of crystal.
- **Allantoin** : Mostly mammals, converted purines and pyrimidines to allantoin. In man purines converted into uric acid form for excretion and pyrimidine excreted in form of alaline and isobutyric acid.
- **Hipuric acid** : In mammal Benzoic acid + Glycine = Hipuric acid
- In Aves Benzoic acid + Ornithin - ornituroic acid
- **Creatine** : Absence in normal urine.

New born body, pregnant woman, feeder woman, in their urine it present. In liver, amino acid - creatine.

Regulation of kidney function by feedback pathways :

- (1) Regulation by ADH
- (2) Regulation by JGA

Regulation by JGA :

- Multi hormone renin angiotensin alsosterone system is controlled by JGA.
 - When decreases in blood volume or blood pressure in arterioles of glomerulus of JGA blood pressure and volume of blood can decrease due to release in blood stream of renin.
 - Renin induce chemical process.
 - Angiotensinogen is converted into Angiotensin-II protein in blood plasma which act as a hormone.
 - By the angiotensin - II increases the blood pressure by the contraction of arterioles. It increases the blood pressure by two way.
- (1) By the signals of PCT reabsorbs NaCl and water.
 - (2) Induce the adrenal grand to releases hormone aldosterone in which more Na⁺ and water reabsorbs.
- These processes increases blood pressure and blood volume.
 - **ANF (Atrial Natriuretic Factor):**
 - When blood volume and blood bressure increases after that wall of artery of heart release ANF which keeps the enlargement of blood vessels and decreases pressure.
 - ANF also stop the renin secretion from kidney.

Questions for NEET

- (104) If liver is removed from person, which of the following component increases ?
(A) Uric acid (B) Urea (C) Ammonia (D) CO₂
- (105) Uric acid is synthesized from where in human ?
(A) Pyrimidine (B) Purine (C) Protein (D) Pentosesugar
- (106) Of the following organism, which shows green gland as excretory organ ?
(A) Spider (B) Cockroach (C) Honeybee (D) Lobster
- (107) If person observe fasting for prolonged period urine has more amount of
(A) glucose (B) amino acids (C) lipid (D) ketones
- (108) State the net value of pressure in malpighian body during pressure filtration.
(A) 30 mm Hg (B) 20 mm Hg (C) 50 mm Hg (D) 75 mm Hg
- (109) Urea is transported by
(A) RBC (B) WBC (C) Thrombocytes (D) Blood plasma
- (110) In which direction excretory substances are transported from malpighian body ?
(A) Intestine (B) Rectum (C) PCT (D) DCT
- (111) Who regulates secretion of Na⁺ by urine ?
(A) Ant. Pituitary (B) Post Pituitary (C) Adrenal cortex (D) Adrenal medulla
(Hint - Adrenal cortex is origin for aldosterone hormone)
- (112) Yellow colour of urine in vertebrate animals is due to
(A) urea (B) uric acid (C) urochrome (D) ammonia
- (113) Urea is synthesized by which of the following cycle ?
(A) Kreb's cycle (B) Ornithine cycle (C) Citracin cycle (D) Arginine cycle
- (114) In healthy person after transport of blood from kidney, amount of which substances remain unchanged ?
(A) Amino acids and glucose (B) Urea and glucose
(C) Urea and uric acid (D) Uric acid and amino acid
- (115) Reason for Diabetes insipidus
(A) less secretion of vasopressin (B) deficiency of insulin
(C) more secretion of Insulin (D) secretion of ADH
- (116) How many NH₃ molecules are required for synthesis of 1 mol. of urea ?
(A) 1 (B) 2 (C) 3 (D) 4
- $$\text{[Hint : CO}_2 + 2\text{NH}_3 \rightarrow \text{H}_2 - \overset{\text{O}}{\parallel}{\text{C}} - \text{NH}_3 \text{]}$$
- (117) Which of the following is included in RAAS ?
(A) Angiotensin (B) Aldosterone (C) Renin (D) All of above
- (118) Function of Renin hormone.
(A) Dissociation (B) Decreases blood pressure
(C) Causes relaxation of blood capillaries (D) Stimulates corpus luteum

- (119) Where is Angiotensin - 1 is synthesized ?
 (A) Pancreas (B) Liver (C) JGA (D) Kidney
- (120) For activation of angiotensinogen to angiotensin, responsible
 (A) dil. HCl (B) Caesin (C) Renin (D) Hipuric acid
- (121) State the synthesis of main excretory substance and its removal in human.
 (A) Synthesized in kidney, removed by liver (B) Synthesized and removed in kidney
 (C) Synthesized in liver and removed by kidney (D) Synthesized and removed by liver
- (122) If GFR Decreases
 (A) Renin is secreted from JGA (B) Aldosterone is secreted from adrenal cortex
 (C) Adrenalin is secreted from adrenal medulla (D) ADH is secreted from post. pituitary
- (123) Place of origin of renin hormone
 (A) Renal medulla (B) Collecting tubule (C) JGA (D) Renal pelvis
- (124) Which of the following is not observed in external excretory unit ?
 (A) Bowman's capsule (B) DCT (C) Vasa recta (D) Renal pelvis
- (125) Which of the excretory unit is affected by aldosterone ?
 (A) PCT (B) DCT
 (C) Bellini's tubule (D) Post part of collecting tubule
- (126) Who regulates reabsorption of salts filtered from glomerulus ?
 (A) Oxytocin (B) ADH (C) Glucocorticoid (D) Mineralocorticoid
- (127) Marine tailed organisms, during degradation produces strong foul smell, it is due to excretory substance ?
 (A) ammonia (B) trimethyl amine (C) lactic acid (D) hydrogen sulphide
- (128) Osteichthyes of Fresh water, osmoregulates by
 (A) excreting hypotonic urine
 (B) chlorine cells present in gills, excrete salts
 (C) drinks water frequently
 (D) excrete excretory substance in the form of uric acid
- (129) Which of the following sentence is true for regulation of kidney function ?
 (A) Effect of cold climate stimulates ADH secretion.
 (B) When some one drinks more water ADH is not released.
 (C) Increase in blood flow in glomerulus stimulates synthesis of angiotensin II.
 (D) During summer when due to transpiration body loses more amount of water. ADH is not released.
- (130) hormone is secreted by kidney.
 (A) Gastrin (B) Secretin (C) Erythropoietin (D) Aldosterone
- (131) Blood capillaries entering in Bowman's capsule are called
 (A) renal artery (B) renal vein (C) efferent arteriole (D) afferent arteriole

Answers : (104-C), (105-B), (106-D), (107-D), (108-B), (109-D), (110-D), (111-C), (112-C), (113-B), (114-A), (115-A), (116-B), (117-D), (118-A), (119-B), (120-C), (121-C), (122-A), (123-C), (124-C), (125-B), (126-D), (127-B), (128-A), (129-B), (130-C), (131-D)

