

Excretory Products and their Elimination

Learning & Revision for the Day

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|-----------------------------|---|-------------------------------------|
| • Modes of Excretion | • Osmoregulation and Regulation of Kidney Functions | • Role of Other Organs in Excretion |
| • Human Excretory System | | • Disorders of Excretory System |
| • Urine Formation in Kidney | | |

Excretion is the process of removal of nitrogenous wastes from the body. The organs involved in excretion are called excretory organs. There are different types of excretory products or waste materials in different animals.

Modes of Excretion

There are mainly three types of modes of excretion

- 1. Ammonotelic Excretion** It is found in aquatic animals like protozoans (e.g. *Amoeba* and *Paramecium*), sponges (e.g. *Sycon*), coelenterates (e.g. *Hydra*), aquatic arthropods (e.g. prawn), most aquatic molluscs (e.g. *Pila*), bony fishes (e.g. *Labeo*) and frog's tadpole larva.
 - Ammonia as a waste product is most toxic because of high pH and high solubility in water, so large amount of water is required for its excretion.
 - It is released through general body surface into surrounding water.
- 2. Ureotelic Excretion** It is found in those animals, which can take in water and can retain considerable amounts of urea in their blood.
 - It is a common method of excretion in human, whales, seals, camels, kangaroo, toads, frogs, sharks, etc.
 - Urea formation in liver cells of mammals was studied by **Krebs** and **Henseleit**.
 - Urea is formed in liver by detoxification of ammonia through ornithine cycle and transported in the blood by plasma.
 - A person, who takes large amount of protein in his diet will excrete more urea. A person having no food and water will have more urea in his blood. It requires less water for excretion.

3. **Uricotelic Excretion** It is found in birds, land reptiles (snakes and lizards), insects, snails, etc.

- In this, the main nitrogenous waste is uric acid.
- Uric acid is least soluble in water and is less toxic.
- It is excreted in solid crystal forms and formed from ammonia in the liver of uricotelic animals and Malpighian tubules in insects.

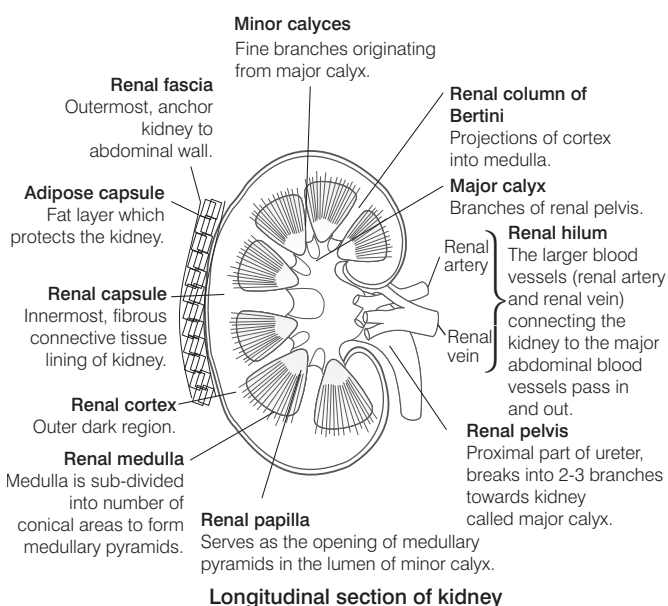
Human Excretory System

It consists of the following parts

1. Kidneys (two)
2. Ureters (two)
3. Urinary bladder (one)
4. Urethra (one)

1. Kidneys

- These are bean-shaped, chocolate brown structures lying in the abdomen, one on each side of the vertebral column just below the diaphragm.
- The left kidney is placed a little higher than the right kidney (but reverse in rabbit).
- Concavity of kidney called hilum or hilus is always inwardly directed.
- These form the urine and control osmotic pressure within the organism with respect to external environment.
- The functions and structure of kidney, with its different parts and their organisation is given in the figure below



NOTE Aorta brings oxygenated blood to kidneys whereas inferior vena cava carries deoxygenated blood from kidneys.

Nephron

It is the structural and functional unit of kidney. These are also called as renal tubules or uriniferous tubules. There are about one million nephrons in each kidney. Each nephron is about 6 cm long.

It is differentiated into four regions

- **Bowman's capsule** is double-walled cup and is lined by thin flat cells called **podocytes**. It contains a group of capillaries called **glomerulus**. Glomerulus in the kidney acts as a dialysing bag.
- **Proximal Convoluted Tubule (PCT)** is highly coiled (convoluted) tubular structure. It is about 12-24 mm in length. Almost whole of vitamins, glucose, amino acids, sodium and potassium, etc., are reabsorbed by active transport.
- **Henle's loop** is U-shaped segment. Loop of Henle is long in mammals and birds, which secrete hypertonic urine, but short in other vertebrates like reptiles, etc.
- **Distal Convoluted Tubule (DCT)** is connected to the collecting duct. In this, active reabsorption of some Na^+ takes place. It is impermeable to H_2O . The DCTs of many nephrons open into a straight tube called collecting duct, where large amounts of water could be reabsorbed.

2. Ureters

These are two narrow tubes arising from the hilum. Each of which is about 30 cm in length. These bring the urine downwards and open into urinary bladder.

3. Urinary Bladder

It temporarily stores the urine. Each ureter opens in urinary bladder. It can hold about 0.5-1.0 L of urine. It is absent in birds. In both reptiles and birds, ureters and rectum open into a common sac called cloaca.

4. Urethra

A muscular and tubular structure, which extends from neck of bladder to outside.

In females, this tube is small and serve as a passage of urine only. In males, it is long and function as a common passage for urine and spermatic fluids.

Urine Formation in Kidney

The process of urine formation is called uropoiesis. Urine is formed by mechanism of glomerular filtration, reabsorption and secretion as described below

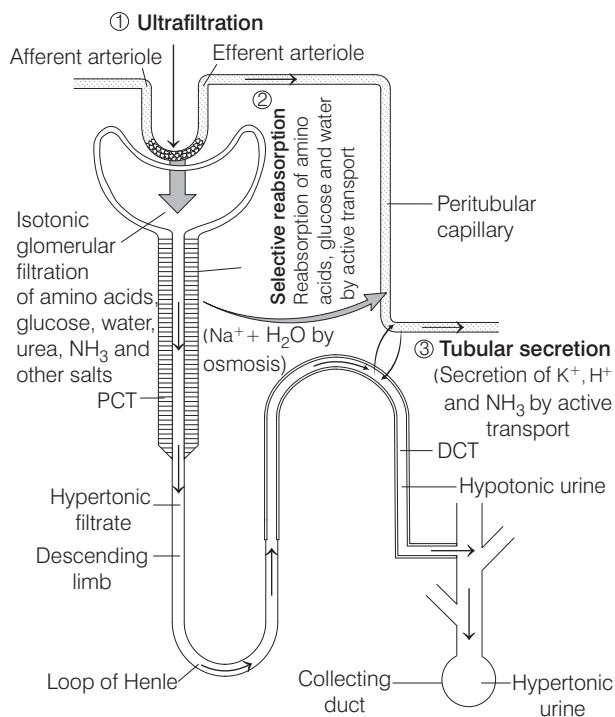
1. **Glomerular Filtration** The glomerular capillary blood pressure causes filtration of blood through three layers, i.e. the endothelium of glomerular blood vessels, the epithelium of Bowman's capsule and a basement membrane between these two layers.

- The epithelial cells of Bowman's capsule called **podocytes** are arranged in an intricate manner so as to leave some minute spaces called filtration slits or slit pores. Blood is filtered very finely through these membranes, so this is also considered as **ultrafiltration**.
- The amount of the filtrate formed by the kidneys per minute is called **Glomerular Filtration Rate (GFR)**, i.e. 125 mL/min, i.e. 180 L/day.
- **Juxta Glomerular Apparatus (JGA)** is a sensitive region formed by cellular modifications in the distal convoluted tubule and the afferent arteriole.
- A fall in GFR can activate the JG cells to release renin, which can stimulate the glomerular blood flow and thereby the GFR back to normal.
- The net driving force, which is responsible for ultrafiltration through glomerular blood capillaries and Bowman's capsule is provided by the difference between hydrostatic pressure at which the blood enters the glomerulus and the sum of those pressure which resist the hydrostatic pressure called **Glomerular Filtration Pressure (GFP)**.

$$GFP = P_b - (P_o + P_c + P_i)$$

$$= 60 - (30 + 10 + 10) = 10 \text{ mm Hg.}$$

2. **Reabsorption** About 99% of the filtrate is usually reabsorbed by the renal tubules. The tubular epithelial cells in nephron carry out this by passive or active mechanisms, e.g. glucose, amino acids, Na^+ , etc., are reabsorbed actively while nitrogenous wastes are absorbed by passive transport.



The process of urine formation

3. **Tubular Secretion** It is opposite to tubular reabsorption. Most substances that enter the tubule by tubular secretion move by active transport. It plays a minor role in function of human kidneys but in animals like marine fishes and desert amphibians, whose nephrons do not have developed glomeruli, urine formation is maintained by the tubular secretion of urea, creatinine and mineral ions.

- NOTE**
- Urine is a pale yellow coloured fluid due to the presence of urochrome pigment.
 - It is acidic (average pH 6.0) in nature and is slightly heavier than water. It has a faint aromatic odour due to uric acid.
 - Daily urine output in normal adult is 1.5-1.8 L.
 - Chemical composition of urine is water 95-96%, urea 2%, salt 2% (NaCl , chloride) and some other substances like uric acid, creatinine, etc., 0.4%.

Osmoregulation and Regulation of Kidney Functions

In humans, the kidneys play an important role in osmoregulation. Osmotic pressure of the blood influences many cellular activities, therefore, the amount of H_2O in the body fluids must be regulated.

- In case, the volume of body fluids falls below the normal, glomerular filtration slows down due to decrease in blood pressure and filtration pressure in the glomerular capillaries. This stimulates the posterior pituitary lobe to release **ADH (Antidiuretic Hormone)**.
- The ADH increases the reabsorption of water in the Distal Convoluted Tubule (DCT) and the collecting duct. Less filtration and more reabsorption of water lead to the discharge of small amount of hypertonic urine. This raises the volume of body fluids to the normal.
- Reabsorption of sodium is controlled by a hormone **aldosterone** produced by the cortex of adrenal glands.
- A reduction in the level of Na^+ stimulates JGA apparatus to form a protein called **renin**. Renin acts as an enzyme, which converts plasma protein angiotensinogen into angiotensin.
- Reabsorption of Na^+ brings about the uptake of an osmotically equivalent amount of water. Absorption of sodium and water increases the blood volume and pressure.
- Thus, the **Renin Angiotensin Aldosterone System (RAAS)** maintains homeostasis and kidneys regulate body fluid osmoregulation by controlling amount of water with the help of the hormone ADH and sodium with the help of aldosterone and proteins by renin and angiotensin.
- An increase in blood flow to the atria of the heart can cause the release of **Atrial Natriuretic Factor (ANF)**. ANF can cause vasodilation (dilation of blood vessels) and thereby decreases the blood pressure. ANF mechanism keeps check on the renin-angiotensin mechanism.

Role of Other Organs in Excretion

- Lungs, liver and skin also help in excretion in addition to kidneys.
- **Lungs** remove about 18 L/hour of CO_2 and major quantities of water vapour everyday.
- **Liver** secretes bilirubin, biliverdin, cholesterol, degraded steroid hormones, vitamins and drugs, which pass out along with digestive juices (bile).
- **Skin** eliminates certain wastes with sweat, such as NaCl, some urea, lactic acid, etc. Sebaceous glands in skin eliminate substances like sterols, hydrocarbons and waxes through sebum.

Disorders of Excretory System

Some disorders of excretory system are as follows

1. **Diabetes Insipidus** It is a condition characterised by excessive thirst and excretion of large amounts of severely diluted urine, with reduction of fluid intake having no effect on the concentration of urine. The common DI is caused by the deficiency of Arginine Vasopressin (AVP) also known as Antidiuretic Hormone (ADH).
2. **Uremia** It 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 or some mechanical obstruction.
 - Urea poisons the cells at high concentration. The high concentration of non-protein nitrogen like urea, uric acid, creatinine exists in blood due to kidney failure.
3. **Renal Failure** It is the partial or total inability of kidneys to carry out excretory function.
 - It is caused by tubular injury, bacterial toxins, inflammation, etc.

- It is also called as kidney failure.

4. **Renal stones or Renal calculi** It is also called as kidney stones. Excessive hormonal imbalance, uric acid formation, milk intake, dehydration, metabolic disturbances, etc., lead to formation of renal stones or renal calculi.
5. **Nephritis** It is inflammation of renal pelvis, calyces and interstitial tissues due to local bacterial infection.
 - Inflammation affects the counter-current mechanism and the victim fails to concentrate urine.
 - Symptoms are back pain and frequent and painful urination.

NOTE • Dysuria is painful urination.

- Polyuria is unusually large amounts of urine.
- Phenylketonuria is the presence of increased level of phenylalanine in blood. It is a genetic disorder.

Artificial Kidney

- Artificial kidney called **haemodialyser** is a machine that is used to filter the blood of a damaged kidney. This process is called **haemodialysis**.
- Haemodialysis is the separation of small molecules from large molecules in a solution by interposing a semipermeable membrane between the solution and water.
- In this, blood of the patient is pumped from one of the arteries into the cellophane tube after cooling it to 0°C and mixing with an anticoagulant (heparin).
- Pores of the cellophane tube allow urea, uric acid, creatinine, excess salts, etc., to diffuse from the blood into the surrounding solution. Thus, blood is purified and then pumped into a vein of the patient.
- Plasma proteins remain in the blood as the pores of the cellophane are too small to permit the passage of large molecules.

DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

1 In ureotelic animals, urea is formed by the

- (a) Ornithine cycle
- (b) Cori's cycle
- (c) Krebs' cycle
- (d) EMP pathway

2 Which are not ureotelic ?

- (a) Mammals
- (b) Terrestrial amphibians
- (c) Aquatic insects
- (d) Birds/snake

3 Excretion of nitrogenous waste product in semisolid form occurs in

- (a) ureotelic animals
- (b) ammonotelic animals
- (c) uricotelic animals
- (d) amniotes

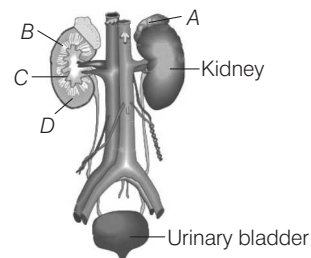
4 Conversion of ammonia into amino acid is called

- (a) nitrification
- (b) ammonification
- (c) denitrification
- (d) deamination

- 5** Select the set of animals which consists exclusively of animals showing dual secretion (ammonotelic as well as ureotelic).
- Spiders and birds
 - Earthworm and lung fishes
 - Fishes and mammals
 - Gastropods and insects
- 6** Ammonia is changed to uric acid in the liver of
- ammonotelic animals
 - uricotelic animals
 - ureotelic animals
 - ornithotelic animals
- 7** In the birds, faeces is actually the black part. The white part is a substance called
- urea
 - ammonia
 - uric acid
 - faecal material and urea
- 8** An advantage of excreting nitrogenous wastes in the form of uric acid is that
- uric acid can be excreted in almost solid form
 - the formation of uric acid requires a great deal of energy
 - uric acid is the first metabolic breakdown product of acids
 - uric acid can be excreted through the lungs
- 9** In humans, the waste products of nucleotide metabolism are excreted as
- ammonia
 - uric acid
 - urea
 - amino acid
- 10** Which of the following statements is false?
- Urea is more toxic than ammonia
 - Ammonia is converted to urea in liver
 - Ammonia is produced in body cells by the metabolism of proteins
 - Fluid collected in Bowman's capsule is called glomerular fluid
- 11** Mammalian kidney is
- mesonephric
 - pronephric
 - metanephric
 - None of these
- 12** The position of kidney is
- interperitoneal
 - retroperitoneal
 - intraperitoneal
 - None of these
- 13** Bowman's capsule is constituent of
- renal artery
 - ureter
 - uriniferous tubule
 - renal portal vein
- 14** Bowman's capsules are all embedded in
- hilum of kidney
 - cortex of kidney
 - pyramids of kidney
 - medulla of kidney
- 15** The main function of pyramids of kidney is to
- contain collecting tubules of kidney
 - direct the urine to flow in ureter
 - support the openings of collecting canals
 - store fats and protein

- 16** What is incorrect about kidney ?
- Peripheral cortex and central medulla
 - Blood enters glomerulus through efferent arterioles
 - Malpighian corpuscles occur in cortex
 - Concave part of kidney is called hilum
- 17** Number of nephron of a kidney is equal to
- sum of Bowman's capsules and glomeruli
 - sum of Bowman's capsules and Malpighian corpuscles
 - double the number of Bowman's capsule
 - number of Bowman's capsules
- 18** Figure shows human urinary system with structures labelled A to D. Select option which correctly identifies them and gives their characteristics and/or functions.

→ NEET 2013



- B – Pelvis – broad funnel-shaped space inner to hilum, directly connected to loops of Henle
 - C – Medulla – inner zone of kidney and contains complex nephrons
 - D – Cortex – outer part of kidney and does not contain any part of nephrons
 - A – Adrenal gland – located at the anterior part of kidney, secrete catecholamines, which stimulate glycogen breakdown
- 19** Which one of the following statements is incorrect?
- The medullary zone of kidney is divided into a few conical masses called medullary pyramids projecting into the calyces
 - Inside the kidney the cortical region extends in between the medullary pyramids as renal pelvis
 - Glomerulus along with Bowman's capsule is called the renal corpuscle
 - Renal corpuscle, Proximal Convolved Tubule (PCT) and Distal Convolved Tubule (DCT) of the nephron are situated in the cortical region of kidney
- 20** Podocytes are the cells, which are present on
- neck of nephron
 - the wall of Bowman's capsule
 - outer wall of loop of Henle
 - wall of glomerular capillaries
- 21** Removal of proximal convoluted tubule from the nephron will result in
- more diluted urine
 - more concentrated urine
 - no change in quality and quantity of urine
 - no urine formation

→ CBSE-AIPMT 2015

- 22** Loop of Henle is meant for absorption of
(a) potassium (b) glucose (c) water (d) CO_2
- 23** Hyperosmotic urine secretion depends upon
(a) width of Bowman's capsule
(b) length of loop of Henle
(c) length of proximal convoluted tubules
(d) length of distal convoluted tubules
- 24** Henle's distal convoluted tubule is permeable to
(a) K^+ ions (b) Na^+ ions
(c) Cl^- ions (d) All of these
- 25** Which determines the ability of a mammal to concentrate its urine ?
(a) Number of nephrons
(b) Length of proximal convoluted tubules
(c) Length of collecting ducts
(d) Size of glomerulus
- 26** Filtration occurs in
(a) Bowman's capsule (b) glomerulus
(c) Malpighian body (d) ureter
- 27** Amount of glomerular filtrate formed per day is
(a) 50 L (b) 180 L (c) 250 L (d) 1000 L
- 28** Reabsorption of chloride ions from glomerular filtrate in kidney tubule occurs by
(a) active transport (b) diffusion
(c) osmosis (d) Brownian movement
- 29** In nephrons, there is complete absorption of
(a) urea (b) salt (c) glucose (d) water
- 30** The process of secretion of metabolic wastes by tubular cells into the filtrate is known as
(a) tubular secretion (b) glomerular secretion
(c) countercurrent (d) Both (a) and (c)
- 31** The yellow colour of urine is due to
(a) urochrome (b) bilirubin
(c) biliverdin (d) xanthophyll
- 32** pH of human urine is
(a) 9 (b) 6 (c) 4 (d) 3
- 33** Urine is concentrated in loop of Henle in
(a) descending limb
(b) thick ascending limb
(c) hairpin bend between descending and ascending limbs
(d) area between ascending limb and distal convoluted tubule
- 34** Which of the following statements is correct ? → NEET 2011
(a) The ascending limb of loop of Henle is impermeable to water
(b) The descending limb of loop of Henle is impermeable to water
(c) The ascending limb of loop of Henle is permeable to water
(d) The descending limb of loop of Henle is permeable to electrolytes
- 35** Which one is not present in nephric filtrate?
(a) Penicillin (b) Amino acids
(c) Vitamins (d) Water
- 36** In which of the following regions of a nephron, does maximum reabsorption of useful substances take place?
(a) Henle's loop
(b) Glomerulus
(c) Proximal convoluted tubule
(d) Distal convoluted tubule
- 37** The part of nephron involved in active reabsorption of sodium is → NEET-II 2016
(a) distal convoluted tubule
(b) proximal convoluted tubule
(c) Bowman's capsule
(d) descending limb of Henle's loop
- 38** Which is the principal site for concentration of urine?
(a) Loop of Henle (b) Glomerulus
(c) PCT (d) DCT
- 39** Human urine is usually acidic because → CBSE-AIPMT 2015
(a) sodium transporter exchanges one hydrogen ion for each sodium ion, in peritubular capillaries
(b) excreted plasma proteins are acidic
(c) potassium and sodium exchange generates acidity
(d) hydrogen ions are actively secreted into the filtrate
- 40** Which segment of renal tubule is permeable to water but nearly impermeable to salts ?
(a) Descending limb of Henle's loop
(b) Proximal convoluted tubule
(c) Ascending limb of Henle's loop
(d) Distal convoluted tubule
- 41** Glomerular filtrate is
(a) blood minus blood corpuscles and plasma protein
(b) blood minus corpuscles
(c) mixture of water, ammonia and corpuscles
(d) urine
- 42** Which one of the following components of urine in a healthy human does not differ much in concentration from that of blood plasma ?
(a) NH_4^+ (b) K^+
(c) Na^+ (d) SO_4^{2-}
- 43** Concentration of inorganic salts in normal urine of a human being is
(a) 0.15% (b) 0.25%
(c) 1.5% (d) 2.5%
- 44** The reabsorption of ions by tubules of kidney is enhanced by
(a) cortisol
(b) aldosterone
(c) calciferol
(d) erythropoietin

- 45** The process of maintaining osmotic and ionic concentrations of body fluids is known as
 (a) excretion (b) osmoregulation
 (c) homeostasis (d) Both (a) and (b)
- 46** Which one of the following is also known as antidiuretic hormone ?
 (a) Oxytocin (b) Vasopressin
 (c) Adrenaline (d) Calcitonin
- 47** Volume of urine is regulated by
 (a) aldosterone
 (b) aldosterone and ADH
 (c) aldosterone, ADH and testosterone
 (d) ADH
- 48** Which of the following activates JG cells to release renin?
 (a) Increase in glomerular filtration rate
 (b) Passage of urea into medullary interstitium
 (c) Atrial natriuretic factor
 (d) Fall in glomerular filtration rate
- 49** Which of the following is both osmoregulator as well as nitrogenous product?
 (a) Ammonia (b) Urea
 (c) Uric acid (d) All of these
- 50** We can produce a concentrated/dilute urine. This is facilitated by a special mechanism. Identify the mechanism.
 (a) Reabsorption from PCT
 (b) Reabsorption from collecting duct
 (c) Reabsorption/secretion in DCT
 (d) Countercurrent mechanism in Henle's loop/vasa recta
- 51** A decrease in blood pressure/volume will not cause the release of
 → NEET 2017
 (a) renin (b) atrial natriuretic factor
 (c) aldosterone (d) ADH
- 52** Which of the following causes decrease in blood pressure?
 (a) Renin (b) Angiotensin
 (c) ANF (d) None of these
- 53** Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule?
 → CBSE-AIPMT 2014
 (a) Increase in aldosterone levels
 (b) Increase in antidiuretic hormone levels
 (c) Decrease in aldosterone levels
 (d) Decrease in antidiuretic hormone levels
- 54** Which one of the following statements is correct with respect to salt water balance inside the body of living organisms?
 (a) When water is not available camels do not produce urine but store urea in tissues
 (b) Salmon fish excretes lot of stored salt through gill membrane when in freshwater
 (c) *Paramecium* discharges concentrated salt solution by contractile vacuoles
 (d) The body fluids of freshwater animals are generally hypotonic to surrounding water
- 55** Which of the following statements is incorrect?
 (a) ADH prevents conversion of angiotensinogen in blood to angiotensin
 (b) Aldosterone facilitates water reabsorption
 (c) ANF enhances sodium reabsorption
 (d) Renin causes vasodilation
- 56** Kidneys are not the only organs of excretion, their work is supplemented by
 (a) liver (b) skin
 (c) intestine (d) All of these
- 57** Which one is an accessory excretory organ?
 (a) Liver (b) Stomach
 (c) Testis (d) Heart
- 58** The conversion of a protein waste, ammonia into urea, occurs in
 (a) kidneys (b) lungs (c) intestine (d) liver
- 59** A large quantity of which one of the following is removed from our body by lungs?
 (a) Only CO₂ (b) Only H₂O
 (c) CO₂ and H₂O (d) NH₃
- 60** The condition in which kidneys fail to conserve water leading to water loss and dehydration due to impaired ADH synthesis or release is
 (a) Grave's disease
 (b) Addison's disease
 (c) diabetes insipidus
 (d) cretinism
- 61** The main cause of diabetes insipidus is
 (a) deficiency of ADH
 (b) increase in amount of ADH
 (c) eating excess sugar
 (d) None of the above
- 62** Uremia is the occurrence of
 (a) blood in urine
 (b) excess of urea in blood
 (c) excess of sugar in blood
 (d) deficiency of sugar
- 63** A condition of failure of kidney to form urine is called
 (a) deamination (b) nocturia
 (c) anuria (d) dysuria
- 64** Uric acid gets deposited in small joints to produce
 (a) rheumatoid arthritis (b) gout
 (c) osteoarthritis (d) bursitis
- 65** If a man is starving and also without beverages there will be
 (a) more urea in blood (b) less urea in blood
 (c) more uric acid in blood (d) less urea in urine

66 Haematuria means

- (a) RBCs in the urine
- (b) WBCs in the urine
- (c) Both (a) and (b)
- (d) large amount of urine

67 Kidney stones are crystals of

- (a) sodium chloride
- (b) silica
- (c) calcium oxalate
- (d) potassium chloride

68 In Bright's disease (nephritis), occurs

- (a) local bacterial infection
- (b) hypotonic urine
- (c) painful urination
- (d) All of the above

69 Glomerulonephritis is

- (a) bleeding of glomeruli of kidney
- (b) the absence of glomeruli of kidney
- (c) inflammation of glomeruli of kidney
- (d) inflammation of PCT of kidney

70 In a dialysing unit, the dialysing fluid has a similar composition as the plasma except

- (a) proteins
- (b) electrolytes
- (c) hormones
- (d) nitrogenous wastes

71 Match the following columns.

Column I	Column II
A. Ammonia	1. Land invertebrate
B. Urea	2. Birds
C. Uric acid	3. Diabetes
D. Uric acid deposition in joints	4. Aquatic invertebrates
	5. Gout

Codes

- | | |
|-------------|-------------|
| A B C D | A B C D |
| (a) 1 2 3 4 | (b) 4 5 2 1 |
| (c) 4 1 2 5 | (d) 1 2 4 5 |

72 Match the following columns.

→[NEET 2018]

Column I	Column II
A. Ultrafiltration	1. Henle's loop
B. Concentration of urine	2. Ureter
C. Transport of urine	3. Urinary bladder
D. Storage of urine	4. Malpighian corpuscle
	5. Proximal convoluted tubule

Codes

- | | |
|-------------|-------------|
| A B C D | A B C D |
| (a) 5 4 1 2 | (b) 4 1 2 3 |
| (c) 4 5 2 3 | (d) 5 4 1 3 |

Directions (Q. Nos. 73-76) In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the correct answer as

- (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion
- (b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
- (c) If Assertion is true, but Reason is false
- (d) If both Assertion and Reason are false

73 Assertion Ureotelism occurs when there is excess availability of water.

Reason Elasmobranchs are ureotelic.

74 Assertion Mammals, living in deserts contain more concentrated urine.

Reason They contain very long loop of Henle in their nephrons.

75 Assertion The renal tubule is the site of reabsorption of substances.

Reason The renal tubule is the site of secretion of substances.

76 Assertion Phenylketonuria results in the presence of phenylalanine acid in urine.

Reason Phenylketonuria is a recessive hereditary disease caused by body's failure to oxidise an amino acid phenylalanine to tyrosine, because of defective enzyme.

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

- 1 A man takes large amount of proteins. He is likely to excrete a greater amount of
 - (a) urea
 - (b) uric acid
 - (c) sugar
 - (d) None of these
- 2 Kidney of amniotes belongs to which of the following?
 - (a) Pronephros
 - (b) Mesonephros
 - (c) Metanephros
 - (d) Archaenephros
- 3 If kidneys fail to reabsorb water, the tissues would
 - (a) remain unaffected
 - (b) shrink and shrivel
 - (c) absorb water from blood plasma
 - (d) take more O_2 from blood
- 4 If the diameter of afferent renal arteriole is decreased and that of efferent renal arteriole is increased, the ultrafiltration will
 - (a) be faster
 - (b) be slower
 - (c) not take place
 - (d) take place with the same speed
- 5 Select the correct pathway for the passage of urine in humans.
 - (a) Renal vein → Ureter → Bladder → Urethra
 - (b) Collecting tubule → Ureter → Bladder → Urethra
 - (c) Pelvis → Medulla → Bladder → Urethra
 - (d) Cortex → Medulla → Bladder → Urethra
- 6 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
- 7 The body cells in cockroach discharge their nitrogenous waste in the haemolymph mainly in the form of
 - (a) ammonia
 - (b) potassium urate
 - (c) urea
 - (d) calcium carbonate
- 8 A person, who is on a long hunger strike and is surviving only on water, will have
 - (a) more sodium in his urine
 - (b) less amino acid in his urine
 - (c) more glucose in his blood
 - (d) less urea in his urine
- 9 The principal nitrogenous excretory compound in humans is synthesised in
 - (a) kidney but eliminated mostly through liver
 - (b) kidney as well as eliminated by kidneys
 - (c) liver and also eliminated by the same through bile
 - (d) the liver, but eliminated mostly through kidneys
- 10 A person is undergoing prolonged fasting. His urine will be found to contain abnormal quantities of
 - (a) fats
 - (b) ketones
 - (c) amino acids
 - (d) glucose
- 11 Which one of the following statements in regard to the excretion by the human kidneys is correct?
 - (a) Descending limb of loop of Henle is impermeable to water
 - (b) Distal convoluted tubule is incapable of reabsorbing HCO_3^-
 - (c) Nearly 99% of the glomerular filtrate is reabsorbed by the renal tubules
 - (d) Ascending limb of loop of Henle is impermeable to electrolytes
- 12 Ciliated funnels on the ventral side of the kidney of frog are
 - (a) Bidder's organs
 - (b) nephrostomes
 - (c) ostia
 - (d) corpora adipose
- 13 If we remove the pressure receptors from the urinary bladder wall then
 - (a) there 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
- 14 Which are the components of ornithine cycle ?
 - (a) Ornithine, citrulline and alanine
 - (b) Ornithine, citrulline and arginine
 - (c) Ornithine, alanine and fumaric acid
 - (d) Ornithine, citrulline and fumaric acid
- 15 Diameter of the renal afferent vessel is
 - (a) same as that of efferent
 - (b) smaller than that of efferent
 - (c) larger than that of efferent
 - (d) there is no efferent vessel
- 16 The presence of arginase confirms that the
 - (a) urea cycle is operating
 - (b) urea cycle may be operating
 - (c) arginine is being converted into ornithine
 - (d) arginine is being converted into citrulline
- 17 Choose the incorrect statement regarding urine formation.
 - (a) Filtration is non-selective process performed by glomerulus
 - (b) Glomerular capillary blood pressure causes filtration of blood through three layers
 - (c) GFR in a healthy individual is approximately 125 mL/min
 - (d) Ascending limb of Henle's loop is impermeable to water but allows transport of electrolytes actively or passively

- 18** In juxtamedullary nephrons,
 (a) vasa recta is prominent
 (b) loop of Henle is long
 (c) loop of Henle runs deep into the medulla
 (d) All of the above
- 19** 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

- 20** Towards the centre of the inner concave surface of the kidney a notchA..... is present. It leads to a funnel-shaped.....B..... .

Identify A and B.

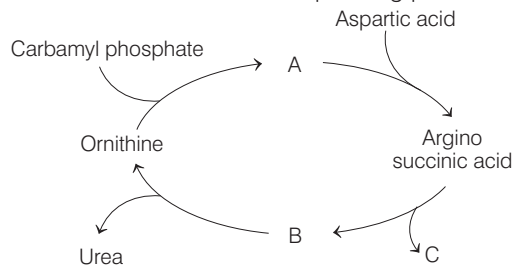
- (a) A–calyces, B–renal fascia
 (b) A–columns of Bellini, B–renal capsule
 (c) A–hilum, B–renal pelvis
 (d) A–hilum, B–renal fascia
- 21** The retroperitoneal kidney is
 (a) kidney of fish
 (b) kidney covered by peritoneum on ventral side
 (c) kidney covered by peritoneum on dorsal side
 (d) kidney uncovered by peritoneum on either sides

- 22** The correct match is

- | | |
|------------------|---|
| I. DCT | – Secretion of H^+ and K^+ ions |
| II. Henle's loop | – Reabsorption of glucose, water and Na^+ ions |
| III. Podocytes | – Attached to parietal layer of Bowman's capsule |
| IV. JGA | – Rise in glomerular blood pressure activates it to release renin |

- (a) Only III (b) Only II
 (c) Only II and III (d) Only IV

- 23** In the skeletal form of ornithine cycle given below, some intermediate products are indicated by alphabets. Choose the answer in which these alphabets are properly matched with the name of corresponding products.



- (a) A – Citrulline, B – Fumaric acid, C – Arginine
 (b) A – Citrulline, B – Arginine, C – Fumaric acid
 (c) A – Arginine, B – Succinic acid, C – Fumaric acid
 (d) A – Citrulline, B – Arginine, C – Succinic acid

- 24** Read the following statements and choose the correct option.

- I. Ascending limb of Henle's loop is permeable to water.
 II. Tubular cells secrete substances like H^+ , K^+ and ammonia into the filtrate.
 III. There is maximum reabsorption in Henle's loop.
 IV. Conditional reabsorption of Na^+ occurs in DCT.
 V. PCT helps in maintaining the ionic balance of the body fluids.

- (a) I, IV and V are correct (b) II, III and V are correct
 (c) III, IV and V are correct (d) II, IV and V are correct

- 25** 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 filtrate is absorbed in the uriniferous tubules
 (c) glucose of the blood is not filtered in the glomerulus
 (d) the normal blood sugar is fructose

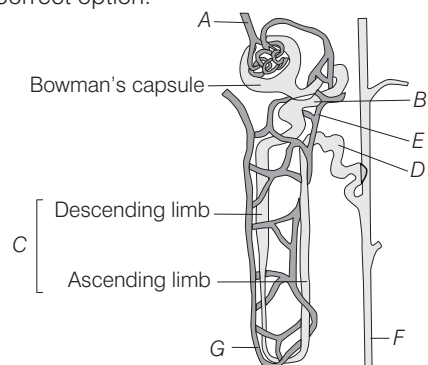
- 26** Consider the following four statements (I-IV) regarding kidney transplant and select the two correct ones out of these.

- I. Even, if a kidney transplant is proper, the recipient may need to take immunosuppressants for a long time.
 II. The cell-mediated immune response is responsible for the graft rejection.
 III. The B-lymphocytes are responsible for rejection of the graft.
 IV. The acceptance or rejection of a kidney transplant depends on specific interferons.

The two correct statements are

- (a) II and III (b) III and IV (c) I and III (d) I and II

- 27** Study the given structure and match A, B, C, D, E, F and G with correct option.



- (a) A – Afferent arteriole, B – Proximal convoluted tubule, C – Henle's loop, D – Distal convoluted tubule, E – Peritubular capillaries, F – Collecting duct, G – Vasa recta
 (b) A – Efferent arteriole, B – PCT, C – Henle's loop, D – DCT, E – Peritubular capillaries, F – Collecting duct, G – Vasa recta
 (c) A – Afferent arteriole, B – Peritubular capillaries, C – Henle's loop, D – DCT, E – PCT, F – Collecting duct, G – Vasa recta
 (d) A – Afferent arteriole, B – Henle's loop, C – Collecting duct, D – PCT, E – DCT, F – Peritubular capillaries, G – Vasa recta