Chapter 6

Excretory Products and their Elimination

Solutions (Set-1)

SECTION - A

School/Board Exam. Type Questions

Very Short Answer Type Questions :

1. Mention the role of Henle's loop.

Sol. Henle's loop primarily helps to maintain osmolar gradient (300 $mOsmL^{-1}$ to 1200 $mOsmL^{-1}$) within the renal interstitium.

2. State the three main processes of urine formation.

Sol. Glomerular filtration, reabsorption and secretion.

3. Name the ions/substances secreted by DCT into the filtrate.

Sol. H^+, K^+ and NH_3 (ammonia)

4. Where is urine temporarily stored in the human body?

Sol. Urine is temporarily stored in urinary bladder in human body.

5. Name the accessory excretory structures in human body other than kidneys.

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

6. Name the substances that are reabsorbed actively during urine formation.

Sol. Substances like glucose, amino acids, Na^+ in the filtrate are reabsorbed actively.

7. In which part of the uriniferous tubule does reabsorption take place?

Sol. Reabsorption occurs in all parts of uriniferous tubule, *i.e.*, PCT, loop of Henle and DCT.

8. What is the maximum magnitude of osmolarity in the inner medulla of kidney?

Sol. 1200 $mOsmL^{-1}$

9. Name the hormones responsible for the reabsorption activities in DCT.

Sol. Aldosterone and vasopressin or ADH.

10. In which type of nephron is the loop of Henle very long and runs deep into the medulla?

Sol. Juxta medullary nephron

Short Answer Type Questions :

11. What is JGA?

Sol. JGA is a special sensitive region formed by cellular modifications in the distal convoluted tubule and the afferent arteriole at the location of their contact.

12. What is the function of ADH/vasopressin?

Sol. ADH facilitates water reabsorption from latter parts of the tubule. It also causes an increase in blood pressure by its constrictory effects on blood vessels.

13. What do you mean by tubular secretion?

Sol. The phenomenon of secretion of metabolic wastes from peritubular capillaries and interstitial fluid into lumen of nephron is called tubular secretion.

14. How does PCT help to maintain the pH and ionic balance of the body fluids?

Sol. PCT helps to maintain the pH and ionic balance of the body fluids by selective secretion of hydrogen ions, ammonia and potassium ions into the filtrate and by absorption of HCO_3^- from it.

15. Mention the structures in the human body responsible for regulation of kidney function.

Sol. The functioning of kidneys is efficiently monitored and regulated by hormonal feedback mechanisms involving the hypothalamus, JGA (Juxtaglomerular Apparatus) and to a certain extent, the heart.

16. In which condition is ADH or vasopressin released from neurohypophysis?

Sol. Osmoreceptors in the body are activated by changes in blood volume, body fluid volume and ionic concentration. An excessive loss of fluid from the body can activate these receptors which stimulate the release of ADH or vasopressin.

17. What is the primary function of sweat?

Sol. The primary function of sweat is to facilitate a cooling effect on the body surface. It also helps in the removal of some waste products such as urea, NaCl etc.

18. What are the major nitrogenous wastes excreted by animals?

Sol. Ammonia, urea and uric acid are the major forms of nitrogenous wastes excreted by the animals.

19. How is ammonia excreted in animals?

Sol. Ammonia, being readily soluble in water, is generally excreted by diffusion across the body surfaces or through gill surfaces (in fishes) as ammonium ions.

20. "The composition of glomerular filtrate and urine is not the same." Comment.

Sol. Glomerular filtrate contains all filterable components of blood. It is extremely dilute having both useful (salts, glucose, amino acids) and waste products. Urine is more concentrated solution of nitrogenous wastes and other excess chemicals. It is produced from glomerular filtrate through reabsorption and secretion.

21. How is ammonia excreted in ureotelic animals?

Sol. Ammonia produced by metabolism is converted into urea in the liver of these animals and released into the blood which is filtered and excreted out by the kidneys.

22. What are the excretory structures of annelids and give their function?

Sol. Nephridia are the excretory structures of annelids. They help to remove nitrogenous wastes and maintain a fluid and ionic balance.

23. Sort the following into actively or passively transported substances during reabsorption : Glucose, amino acids, nitrogenous wastes, Na^+, water.

Sol. **Actively transported :** Na^+, glucose, amino acids

Passively transported : Nitrogenous wastes, water

24. What are the two zones of the kidney? In which zone are the renal pyramids present?

Sol. There are two zones in kidney :

(i) An outer cortex

(ii) Inner medulla

Renal or medullary pyramids are conical masses projecting into calyces. These are found in medulla region of kidney.

25. Where are kidneys located in man?

Sol. Kidneys are reddish brown, bean-shaped structures situated between the level of last thoracic and third lumbar vertebra close to the dorsal inner wall of the abdominal cavity.

26. State the significance of hilum in a kidney.

Sol. Towards the centre of the inner concave surface of the kidney, a notch is present, called hilum. Ureter, blood vessels and nerves enter into kidney through this notch.

27. What is the functional unit of kidney? How many functional units are found in each kidney?

Sol. Functional unit of kidney is nephron. Each kidney has about one million nephrons.

28. (i) What is renal pelvis in a kidney?

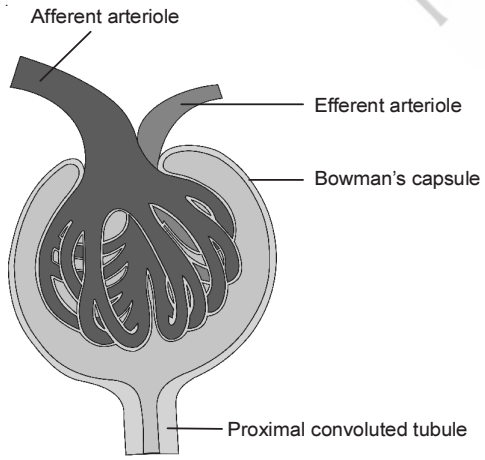
(ii) What are podocytes?

Sol. (i) The broad funnel shaped space in the kidney, inner to the hilum is called renal pelvis.

(ii) Podocytes are epithelial cells located in the visceral layer of Bowman's capsule.

29. Draw a labelled diagram of malpighian body (renal corpuscle).

Sol.



30. Which segments of nephron are located in cortex and in medulla region of kidney?

Sol. The malpighian corpuscle, PCT and DCT of the nephron are situated in the cortical region of the kidney, whereas the loop of Henle is present in the medulla region.

Long Answer Type Questions :

31. What is reabsorption? Mention all the substances that are reabsorbed in different parts of tubules?

Sol. The absorption of useful essential substances from glomerular filtrate by epithelium of uriniferous tubules for transfer to interstitial fluid and peritubular capillaries is called reabsorption. Reabsorption occurs by both active and passive processes.

Reabsorption in proximal convoluted tubule (PCT) : Nearly all of the essential nutrients, and 70–80 percent of electrolytes and water are reabsorbed by this segment.

Reabsorption in Henle's loop : Reabsorption in the ascending limb of loop of Henle is minimum. The descending limb of Henle loop is permeable to water but almost impermeable to electrolytes. The ascending limb of loop of Henle is impermeable to water but allows transport of electrolytes actively or passively.

Reabsorption in distal convoluted tubule (DCT) : Conditional reabsorption of Na^+ and water takes place in this segment. Reabsorption of HCO_3^- also takes place.

Reabsorption in collecting duct : Large amount of water could be reabsorbed. It also allows passage of small amounts of urea into the medullary interstitium to maintain the osmolarity.

32. (i) If the diameter of efferent arteriole is doubled than that of afferent arteriole, what will be the effect observed on glomerular filtration?

(ii) If the prostate gland in old age gets enlarged, what will be the effect on urination?

Sol. (i) Glomerular filtration is based on the narrowness of efferent arteriole as compared to afferent arteriole. If diameter of efferent arteriole is increased, pressure of blood will ultimately decrease, and therefore, glomerular filtration will become slow or be absent.

(ii) Urethra passes through prostate in males. If prostate is enlarged as in old age, urethra gets compressed and urination becomes difficult and painful.

33. How does juxtaglomerular apparatus regulate the kidney function?

Sol. JGA operates multihormonal Renin-Angiotensin-Aldosterone-System (RAAS). The JGA responds to a decrease in blood pressure or blood volume (glomerular blood flow/glomerular blood pressure/GFR) in the afferent arteriole of the glomerulus and can activate JG cells to release an hormone 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 I and further to angiotensin II, which works as a hormone. Angiotensin II increases blood pressure by causing arterioles to constrict. It also increases blood volume in two ways :

(i) By signaling the PCT to reabsorb more NaCl and water.

(ii) By stimulating the adrenal gland to release aldosterone, a hormone that induces the distal parts 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.

34. (i) How is heart involved in regulation of kidney function?

(ii) Discuss the role of ADH in regulation of kidney function.

Sol. (i) ANF (Atrial Natriuretic Factor) released from heart keeps a check on renin-angiotensin mechanism. An increase in blood flow to the atria of the heart can cause the release of Atrial Natriuretic Factor (ANF) which causes vasodilation and thereby decrease the blood pressure.

(ii) An excessive loss of fluid from the body activates the osmoreceptors which stimulate the hypothalamus to release antidiuretic hormone (ADH) or vasopressin from neurohypophysis. ADH facilitates water reabsorption from latter parts of the tubule, thereby preventing diuresis. It also has constrictory effects on blood vessels which causes an increase in blood pressure thereby increasing glomerular blood flow/GFR.

35. Explain micturition reflex.

Sol. Urine formed by the nephron is ultimately carried to the urinary bladder, where it is stored till a voluntary signal is given by the central nervous system (CNS). This signal is initiated by the stretching of the urinary bladder as it gets filled with urine. In response, the stretch receptors on the wall of the bladder send signals to the CNS. The CNS passes on motor messages to initiate the contraction of smooth muscles of the bladder and simultaneous relaxation of the urethral sphincter causing the release of urine. The process of release of urine is called micturition and the neural mechanisms causing it are called the micturition reflex.

36. Mention the role of skin in excretion.

Sol. The sweat (sudorific) and sebaceous glands in the skin can eliminate certain substances through their secretions, *i.e.*, sweat and sebum respectively. Sweat produced by sweat glands is a watery fluid containing NaCl, small amount of urea, amino acids, lactic acid and glucose etc. Though the primary function of sweat is to facilitate a cooling effect on the body surface. It also helps in the removal of some of the wastes mentioned above. Sebum is a waxy protective secretion to keep the skin oily and this secretion eliminates some lipids, such as waxes, sterols, other hydrocarbons and fatty acids.

37. Write down a note on kidney transplantation.

Sol. If the kidney failure cannot be treated by drugs or dialysis, the patients are advised for kidney transplantation. A donated kidney may come from an anonymous donor who has recently died, or from a living person, usually a relative. The kidney of donor must be a good match for recipient. The more the similarity between the donor the recepient's tissue, the less likely is the immune system of the recipient to reject it. Immune system protects from disease by attacking anything that is not recognised as a normal part of the body. So, the immune system of the recipient will attack a kidney that appears too 'foreign'. Special drugs can help suppress the immune system of the recipient, so it does not reject a transplanted kidney. Modern clinical procedures have increased the success rate of such a complicated technique.

38. (i) Where does selective reabsorption of glomerular filtrate take place?

(ii) What is the excretory matter in *Amoeba*?

(iii) Identify the glands that perform the excretory functions in prawn.

(iv) Expand the following :

(a) ANF

(b) ADH

(c) GFR

(d) DCT

Sol. (i) Selective reabsorption of glomerular filtrate takes place at proximal convoluted tubule (PCT), ascending and descending limb of loop of Henle, distal convoluted tubule (DCT) and collecting duct.

(ii) Excretory matter in *Amoeba* is ammonia (NH_3).

(iii) Excretory functions in prawn is performed by antennal glands or green glands.

(iv) (a) ANF – Atrial natriuretic factor

(b) ADH – Antidiuretic hormone

(c) GFR – Glomerular filtration rate

(d) DCT – Distal convoluted tubule

39. Explain in brief the tubular secretion, an important step of urine formation.

Sol. The phenomenon of secretion of metabolic wastes from tubular cells into filtrate is called tubular secretion. It includes excess of K^+, H^+ and some wastes like hippuric acid, creatinine, drugs, pigments, toxins etc. It is the only mode of excretion in animals which do not have glomeruli, *e.g.*, desert amphibians, marine fishes. Tubular secretion is also an important step in urine formation as it helps in the maintenance of ionic and acid-base balance of body fluids.

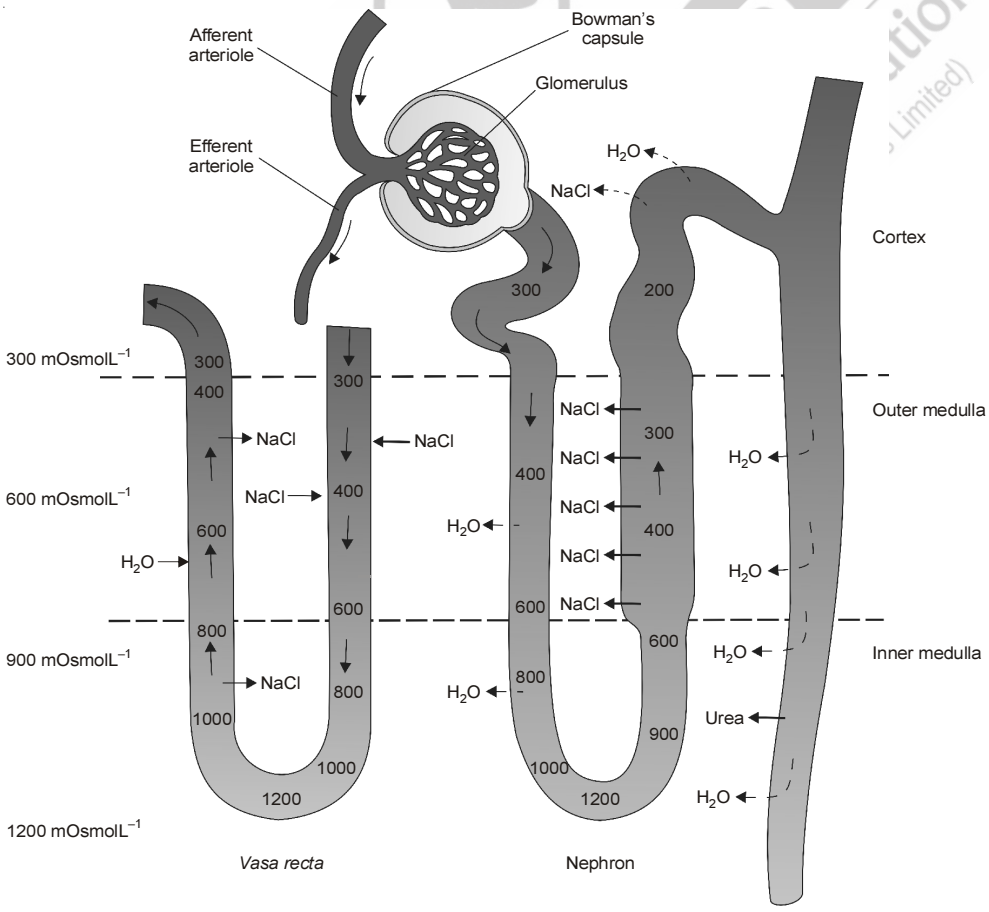
Tubular secretion in PCT : H^+, ammonia etc.

Tubular secretion in DCT : K^+, H^+ and ammonia (NH_3)

Tubular secretion in collecting duct : H^+, K^+

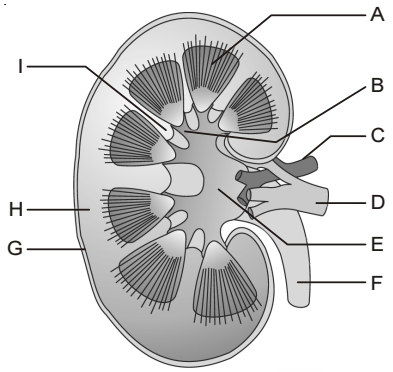
40. Give a diagrammatic representation of a nephron and vasa recta showing counter-current mechanism.

Sol.



Diagrammatic representation of a nephron and vasa recta showing counter current mechanism

41. Label the diagram (from A to I) given below.



Sol. A – Medullary pyramid

B – Calyx

C – Renal artery

D – Renal vein

E – Renal pelvis

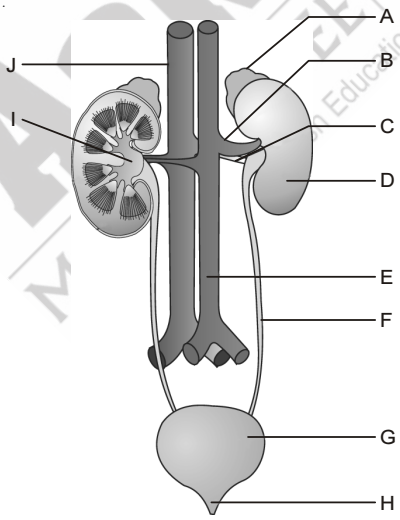
F – Ureter

G – Renal capsule

H – Cortex

I – Renal column

42. Label the diagram (from A to J) given below.



Sol. A – Adrenal gland

B – Renal artery

C – Renal vein

D – Kidney

E – Dorsal aorta

F – Ureter

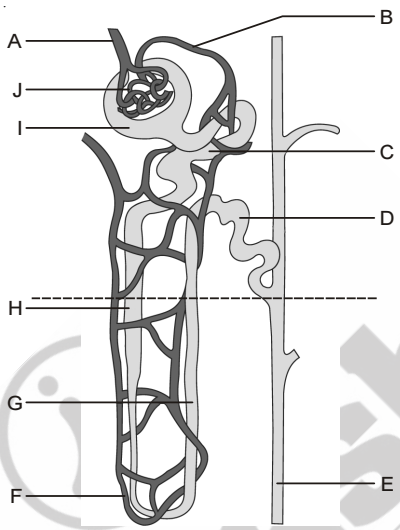
G – Urinary bladder

H – Urethra

I – Pelvis

J – Inferior vena cava

43. Label the diagram (from A to J) given below.



Sol. A – Afferent arteriole

B – Efferent arteriole

C – Proximal convoluted tubule

D – Distal convoluted tubule

E – Collecting duct

F – Vasa recta

G – Ascending limb of loop of Henle

H – Descending limb of loop of Henle

I – Bowman's capsule

J – Glomerulus

44. Give answer in one word.

(i) Presence of glucose in urine

(ii) Presence of ketone bodies in urine

(iii) Accumulation of urea in blood

(iv) Another name of vasopressin

(v) Excretory product from kidneys of a reptile.

Sol. (i) Glycosuria

(ii) Ketonuria

(iii) Uremia

(iv) ADH (Antidiuretic hormone)

(v) Uric acid

45. Describe the structure of a nephron with a well-labelled diagram.

Sol. Structure of a nephron : Each nephron has two parts – the glomerulus and the renal tubule.

(i) **Glomerulus :** It is a tuft of capillaries formed by the afferent arteriole which is a fine branch of renal artery. Blood from the glomerulus is carried away by an efferent arteriole.

(ii) **Renal tubule :** It begins with Bowman's capsule.

Bowman's capsule : It is blind double-walled cup-shaped structure. The two walls of Bowman's capsule are inner visceral and outer parietal.

The visceral layer (inner wall) consists of flat squamous epithelial and specialised podocytes in the remaining part.

The parietal layer (outer wall) consists of flat squamous epithelium. The space between the two layers of Bowman's capsule is called lumen or capsular space.

Glomerulus along with Bowman's capsule is called malpighian body or renal corpuscle.

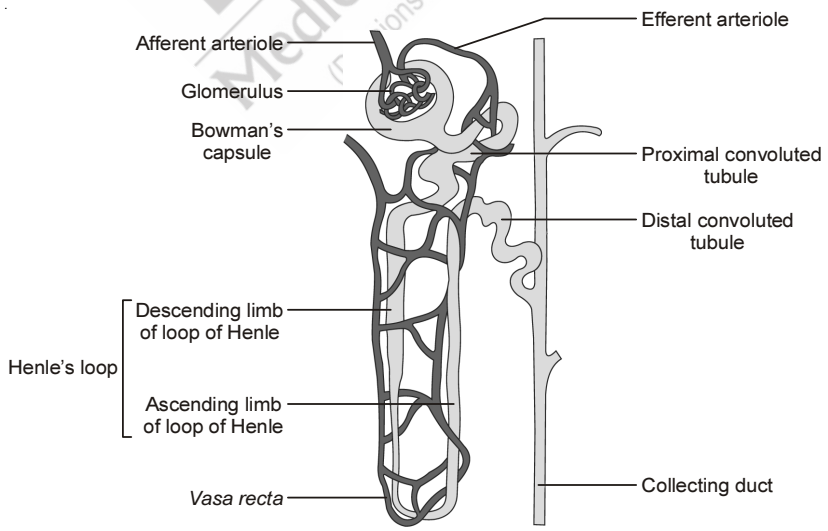
Proximal convoluted tubule (PCT) : Bowman's capsule leads PCT. It is present in cortex and lined by cuboidal epithelium having brush border. The cells contain abundant mitochondria.

Loop of Henle : It is hairpin loop like tubular part consisting of descending and an ascending limb.

Distal convoluted tubule (DCT) : The ascending limb of Henle's loop continue as DCT.

Collecting duct : The DCTs of many nephrons open into a straight tube called collecting duct.

The efferent arteriole forms a fine capillary network around the renal tubule called peritubular capillaries. A minute vessel of this network runs parallel to Henle's loop forming U-shaped vasa recta.



SECTION - B

Model Test Paper

Very Short Answer Type Questions :

1. Which limb of loop of Henle is impermeable to water?

Sol. Ascending limb of loop of Henle.

2. Name the part of the uriniferous tubule (nephron) which is influenced by ADH.

Sol. Distal convoluted tubule.

3. What is Malpighian body?

Sol. Glomerulus and Bowman's capsule are collectively called malpighian body.

4. Where do the nephrons discharge their filtrate?

Sol. Collecting duct

5. Where is urea formed in the human body?

Sol. Liver

Short Answer Type Questions :

6. Both the thin and thick segments of the ascending limb of Henle's loop transport NaCl out to the interstitial fluid. What is the difference in their respective mode of transport?

Sol. From thin segment of ascending limb of loop of Henle – By diffusion (passive transport).

From thick segment of ascending limb of loop of Henle – By active transport.

7. Name the basic nitrogenous waste of birds. In what form it is eliminated from the body? What is the advantage of such type of excretion?

Sol. Uric acid, in the form of pellet or paste; conservation of water.

8. (i) What is loop of Henle?

   (ii) How does a shark (a cartilaginous fish) differ from a teleost (bony fish) in the chemical nature of nitrogenous excretory wastes?

Sol. (i) Loop of Henle is hairpin like tubular part of nephron that lies between PCT and DCT and it dips into renal medulla.

   (ii) Shark excretes urea as nitrogenous waste, while teleost fish excrete ammonia.

9. Which layers form filtration membrane in a nephron?

Sol. Filtration membrane is formed by three layers :

   (i) The endothelium of glomerular blood vessels.

   (ii) The epithelium of Bowman's capsule.

   (iii) A basement membrane between these two layers.

10. Name the excretory organs present in the following animals.

    (i) Earthworm

    (ii) Man

    (iii) Flatworm

    (iv) *Branchiostoma*

Sol.

	Animals	**Their excretory organs**
(i)	Earthworm	Nephridia
(ii)	Man	Kidneys
(iii)	Flatworm	Flame cells or protonephridia
(iv)	*Branchiostoma* (*Amphioxus*)	Protonephridia

11. Only land animals excrete nitrogenous waste as uric acid. Give scientific reason.

Sol. It is so because land animals live in conditions of water scarcity and uric acid can be excreted in nearly solid form thereby conserving body water.

Short Answer Type Questions :

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

Sol. Vasopressin is also called antidiuretic hormone (ADH). It decreases the loss of water in the urine by increasing the reabsorption of water in the distal convoluted tubule.

13. (i) Which enzyme converts angiotensinogen into angiotensin I?

    (ii) Where urine is temporarily stored in the human body?

    (iii) How much amount of urea is excreted out per day by an adult human?

Sol. (i) Renin

    (ii) Urinary bladder

    (iii) On an average, 25–30 g of urea is excreted out per day by an adult human.

14. What is the source of renin? When is it released? Give its function.

Sol. Renin is secreted by Juxtaglomerular cells (JG cells) of Juxtaglomerular apparatus (JGA). It is secreted when there is fall in glomerular blood flow/glomerular blood pressure/GFR. Renin converts angiotensinogen in blood to angiotensin I.

15. (i) State the characteristics of urine in Diabetes mellitus.

    (ii) What is the average pH of urine formed in an adult human?

Sol. (i) Urine of a person suffering from diabetes mellitus show presence of glucose (Glycosuria) and ketone bodies (Ketonuria).

    (ii) The average pH of urine is 6.0.

16. Name the parts which play an important role in counter current mechanism. Why have birds and mammals evolved counter current mechanism to excrete hypertonic urine?

Sol. Loop of Henle and vasa recta play an important role in counter current mechanism.

Birds and mammals, being terrestrial animals, have to conserve water. Therefore, counter current mechanism has developed in them which ensures excretion of hypertonic urine from their bodies.

17. Write down the functions of following :

(i) Urinary bladder

(ii) Ureter

(iii) Urethra

Sol. (i) **Urinary bladder :** It temporarily stores urine.

(ii) **Ureter :** Conduct urine from kidney to urinary bladder.

(iii) **Urethra :** It conducts urine in female and both urine and semen in male.

Long Answer Type Questions :

18. Fill in the blanks with appropriate words :

(i) Glomerulonephritis is the inflammation of _____ of kidney.

(ii) Malfunctioning of kidneys can lead to accumulation of _____ in blood, a condition called _____.

(iii) _____ is the largest gland of our body.

(iv) The amount of filtrate formed by the kidneys per minute is called _____.

(v) _____ is the functional unit of kidney.

Sol. (i) Glomeruli

(ii) Urea, uremia

(iii) Liver

(iv) Glomerular filtration rate (GFR)

(v) Nephron

19. Draw a diagram of nephron and label the following parts.

(i) Afferent arteriole

(ii) Efferent arteriole

(iii) Glomerulus

(iv) Bowman's capsule

(v) Malpighian body

(vi) Descending limb of loop of Henle

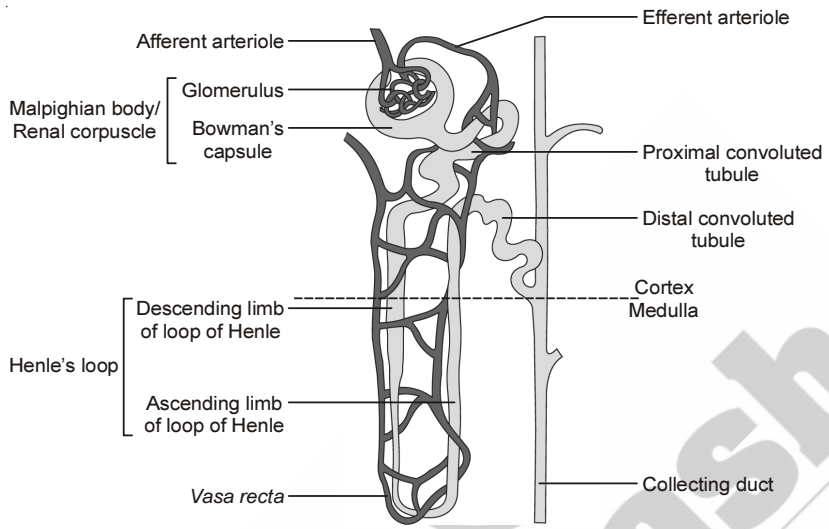
(vii) Ascending limb of loop of Henle

(viii) Vasa recta

(ix) Proximal convoluted tubule

(x) Distal convoluted tubule

Sol.



20. Explain in brief the mechanism of urine formation.

Sol. Urine formation involves three main processes : (i) Glomerular filtration, (ii) Reabsorption and (iii) Secretion.

(i) **Glomerular filtration :** The first step in urine formation is the filtration of blood, which is carried out by the glomerulus and is called glomerular filtration. On an average, 1100–1200 mL of blood is filtered by the kidneys per minute which constitute roughly $1/5^{th}$ of the blood pumped out by each ventricle of the heart in a minute. 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 so finely through these membranes, that almost all the constituents of the plasma except the proteins pass into the lumen of the Bowman's capsule. Therefore, it is considered as a process of ultrafiltration.

The amount of filtrate formed by the kidneys per minute is called glomerular filtration rate (GFR). GFR in a healthy individual is approximately 125 mL/minute, *i.e.*, 180 litres per day.

The kidneys have built-in mechanisms for the regulation of glomerular filtration rate. One such efficient mechanism is carried out by juxtaglomerular apparatus (JGA). JGA is a special sensitive region formed by cellular modifications in the distal convoluted tubule and the afferent arteriole at the location of their contact. 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.

(ii) **Reabsorption :** A comparison of the volume of the filtrate formed per day (180 litres/day) with that of the urine released (1.5 litres), suggest that nearly 99 percent of the filtrate has to be reabsorbed by the renal tubules. This process is called reabsorption. The tubular epithelial cells in different segments of nephron perform this either by active or passive mechanisms. For example, substances like glucose, amino acids, Na^+, etc., in the filtrate are reabsorbed actively, whereas the nitrogenous wastes are absorbed by passive transport. Reabsorption of water also occurs passively in the initial segments of the nephron.

(iii) **Secretion :** During urine formation, the tubular cells secrete substances like H^+, K^+ and ammonia into the filtrate. Tubular secretion is also an important step in urine formation as it helps in the maintenance of ionic and acid-base balance of body fluids.

❑ ❑ ❑

Solutions (Set-2)

Objective Type Questions

(Human Excretory System)

1. The most toxic nitrogenous waste excreted by many bony fishes, aquatic amphibians and aquatic insects is

(1) Ammonia (2) Urea (3) Uric acid (4) Both (2) and (3)

Sol. Answer (1)

The most toxic waste excreted by many bony fishes, aquatic amphibians and aquatic insects is ammonia; urea is comparatively less toxic and uric acid is least toxic.

2. In crustaceans, the excretory functions are performed by

(1) Antennal glands (2) Green glands (3) Both (1) and (2) (4) Malpighian tubules

Sol. Answer (3)

In crustaceans, excretory functions are performed by antennary or green gland.

3. Among following, which is the largest gland of our body?

(1) Liver (2) Lung (3) Brain (4) Stomach

Sol. Answer (1)

Liver is the largest digestive gland of the body.

4. Malpighian body or renal corpuscle is composed of glomerulus along with

(1) Collecting duct (2) DCT

(3) Bowman's capsule (4) Loop of Henle

Sol. Answer (3)

Malpighian body or Renal corpuscle = Glomerulus + Bowman's capsule

5. Least toxic nitrogenous waste among the following is

(1) Urea (2) Uric acid

(3) Ammonia (4) More than one option is correct

Sol. Answer (2)

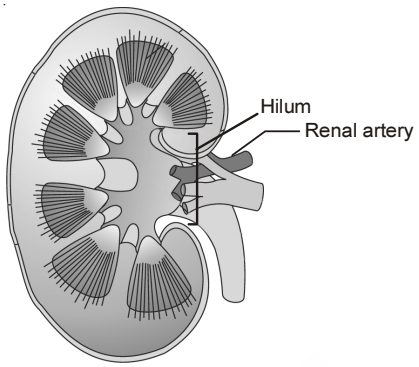
Ammonia > Urea > Uric acid

6. The part through which arteries and veins enter or leave the kidney is called

(1) Hilum (2) Renal papilla (3) Major calyces (4) Minor calyces

Sol. Answer (1)

A depression where arteries and veins enter and leave body organ is known as hilum.

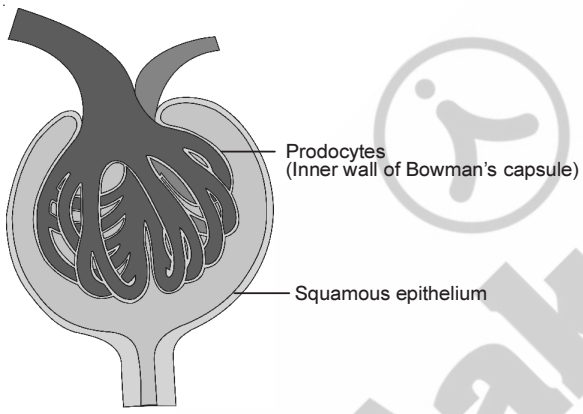


7. Podocytes occur in

(1) Glomerular capillaries (2) Neck region of nephron

(3) Inner wall of Bowman's capsule (4) Outer wall of Bowman's capsule

Sol. Answer (3)



8. Loop of Henle is found in

(1) Green gland (2) Malpighian tubule (3) Neuron (4) Nephron

Sol. Answer (4)

Loop of Henle is found in nephron of the kidney of reptiles, birds and mammals.

9. Nitrogenous wastes are produced in our body by metabolism of

(1) Carbohydrates (2) Proteins (3) Lipids (4) Vitamins

Sol. Answer (2)

Nitrogenous wastes are the products of protein and nucleic acid metabolism.

10. Human beings are

(1) Uricotelic (2) Ureotelic (3) Ammonotelic (4) Both (2) and (3)

Sol. Answer (2)

Ureotelic – Human beings

Uricotelic – Insects, birds

Ammonotelic – Tadpole

11. Uric acid is the excretory product of

(a) Cockroach (b) Sparrow

(c) Terrestrial reptiles (d) Man

(1) (a) and (d) (2) (b) and (d)

(3) (a), (b) and (c) (4) (a), (c) and (d)

Sol. Answer (3)

Uric acid : Insects, birds and terrestrial reptiles.

12. Kidneys are reddish brown, bean-shaped structures situated between the levels of _____ thoracic and _____ lumbar vertebrae.

(1) 11^{th}; 1^{st} (2) 12^{th}; 3^{rd}

(3) 10^{th}; 2^{nd} (4) 12^{th}; 5^{th}

Sol. Answer (2)

Kidneys are located between 12^{th} thoracic and 3^{rd} lumbar vertebra and is covered by peritoneum only on the front i.e. fused with the body wall. This arrangement is known as retroperitoneal arrangement.

(Urine Formation)

13. On an average, how much urea is excreted out per day by an adult human?

(1) 25–30 g (2) 15–20 g

(3) 35–40 g (4) 40–45 g

Sol. Answer (1)

25–30 g of urea is excreted in urine per day. While normal blood urea level is 18–38 mg/100 ml.

14. An adult human excretes, on an average _____ litres of urine per day.

(1) 1 to 1.5 (2) 2 to 2.5

(3) 2.5 to 3 (4) 3 to 3.5

Sol. Answer (1)

Urine :

- 1–1.5 L/day on an average
- pH = 6.0
- Yellow coloured, watery
- 25–30 g of urea is excreted out / day

15. All are performed in a nephron, except

(1) Filtration

(2) Secretion

(3) Urea synthesis

(4) Reabsorption

Sol. Answer (3)

Urea synthesis occurs in the hepatocytes of **liver** via **Ornithine cycle**.

16. Which is the first step of urine formation?

(1) Ultrafiltration (2) Tubular secretion

(3) Selective secretion (4) Tubular reabsorption

Sol. Answer (1)

Ultrafiltration is the first step of the urine formation. The blood is filtered inside the glomerular capsule.

Filtrate = Blood – [Formed elements + Proteins]

Filtrate = Plasma – Blood protein

17. What is the osmolarity of the filtrate at the hairpin bend of loop of Henle in a human?

(1) 300 $mOsmL^{-1}$ (2) 1200 $mOsmL^{-1}$

(3) 600 $mOsmL^{-1}$ (4) 800 $mOsmL^{-1}$

Sol. Answer (2)

Osmolarity of the filtrate at the hair pin bend of loop of Henle – 1200 $mOsmL^{-1}$.

(Functions of the Tubules)

18. Nearly all of the essential nutrients, and 70–80% of electrolytes and water are reabsorbed in the

(1) PCT (2) Henle's loop

(3) DCT (4) Collecting duct

Sol. Answer (1)

PCT : This is known as obligatory reabsorption.

19. Which of the following component of blood is **not** a part of nephric filtrate?

(1) Water (2) Glucose

(3) Urea (4) Plasma proteins

Sol. Answer (4)

Plasma proteins are not filtered out during ultrafiltration in the glomerular capsule.

Filtrate = Plasma – Plasma proteins.

20. The main function of loop of Henle is

(1) Blood filtration (2) Urine formation

(3) Water conservation (4) Both (1) and (2)

Sol. Answer (3)

Loop of Henle, serves as the main function of conservation of water by countercurrent mechanism.

21. Maximum water reabsorption occurs in

(1) DCT (2) PCT

(3) Collecting duct (4) Descending limb of loop of Henle

Sol. Answer (2)

70–80% of electrolytes, all of the nutrients and most of the water are reabsorbed in the proximal convoluted tubule (PCT). This is obligatory reabsorption.

(Mechanism of Concentration of Filtrate)

22. Structure of Vasa recta is

(1) L-shaped (2) U-shaped

(3) S-shaped (4) V-shaped

Sol. Answer (2)

Vasa recta is U-shaped in which blood flows in opposite direction to the flow of the filtrate in the loop of Henle.

23. We can produce highly concentrated urine facilitated by a special mechanism called

(1) Reabsorption from PCT

(2) Reabsorption from collecting duct

(3) Reabsorption/secretion in DCT

(4) Counter current mechanism in Henle's loop/vasa recta

Sol. Answer (4)

Countercurrent mechanism : The arrangement of loop of Henle and the vasa recta in which opposite direction of flow of the filtrate and blood respectively facilitates increasing osmolarity towards the inner medullary interstitium from 300 $mOsmL^{-1}$ in the cortex to about 1200 $mOsmL^{-1}$ in the inner medulla.

24. Glucose and amino acids in the filtrate are reabsorbed by tubular epithelial cells through

(1) Active transport

(2) Passive transport

(3) Both (1) and (2)

(4) Osmosis

Sol. Answer (1)

Glucose and amino acids in the filtrate are reabsorbed in the proximal convoluted tubule via active transport.

25. The cause of glomerular filtration is

(1) Osmosis (2) GFP

(3) Hemodialysis (4) Acidic pH

Sol. Answer (2)

Glomerular filtration pressure (GFP) which is 10 mmHg

GFP = GHP – (BCOP + CHP)

= 60 – (30 + 20)

= 10 mmHg

26. In which segment of the nephron, is reabsorption minimum?

(1) Proximal convoluted tubule (PCT) (2) Distal convoluted tubule (DCT)

(3) Ascending limb of loop of Henle (4) Desending limb of loop of Henle

Sol. Answer (3)

Reabsorption is maximum in the PCT while reabsorption is minimum in ascending limb of the loop of Henle.

(Regulation of Kidney Function, Micturition and Role of other Organs in Excretion)

27. Which of the following is also known as antidiuretic hormone?

(1) Oxytocin (2) Vasopressin

(3) Adrenaline (4) Aldosterone

Sol. Answer (2)

Vasopressin is also known as ADH (antidiuretic hormone)

28. Which one is the vasoconstrictor?

(1) ANF (2) Renin

(3) Angiotensin-II (4) Histamine

Sol. Answer (3)

Vasoconstrictors : Angiotensin II

Vasodilators : ANF, histamine

Renin is also known as angiotensinogenase which catalyses the conversion of inactive angiotensinogen to angiotensin-II ultimately.

29. Hormone responsible for the absorption of water in DCT is

(1) ADH (2) ACTH

(3) Oxytocin (4) Insulin

Sol. Answer (1)

ADH(antidiuretic hormone) is secreted by neurosecretory cells of hypothalamus which is released from posterior pituitary.

30. Aldosterone stimulates the reabsorption of

(1) Na^+ ions

(2) K^+ ions

(3) Glucose

(4) Ca^{2+} ions

Sol. Answer (1)

Aldosterone is the hormone secreted by adrenal cortex and is helpful in the absorption of Na^+ from renal tubules, thereby increasing the Na^+ ion concentration in the blood.

31. Micturition involves removal of

(1) Faecal matter

(2) NH_3

(3) Urea

(4) Urine

Sol. Answer (4)

Micturition : Voiding of urine form the urinary bladder.

Defaecation / Egestion : Removal of faecal matter

Deamination : Removal of NH_3

32. The excretory structure of *Amphioxus* (Cephalochordate) is

(1) Flame cell/Protonephridia

(2) Coxal gland

(3) Malpighian tubules

(4) Green gland

Sol. Answer (1)

- Flame cells/Protoncphridia – *Amphioxus* (Cephalochordates)
- Coxal gland – Crustaceans
- Malpighian tubules – Insects
- Green gland – Crustaceans

33. Blood which leaves liver and moves towards heart has higher concentration of

(1) Bile (2) Oxygen

(3) RBCs (4) Urea

Sol. Answer (4)

Blood that leaves liver and passes to the heart has high concentration of urea because urea is synthesised in the hepatocytes.

34. Which of the following is excretory product of liver?

(1) Carbon dioxide (2) Bilirubin

(3) Biliverdin (4) More than one option is correct

Sol. Answer (4)

Bilirubin and biliverdin are the excretory product of the liver formed by the destruction of Haemoglobin which are secreted in the bile.

35. Sweat contains

(1) NaCl (2) Lactic acid

(3) Small amount of urea (4) All of these

Sol. Answer (4)

Sweat contains :

- Salt *e.g.*, NaCl
- Lactic acid
- Small amount of urea

36. What is the amount of CO_2 removed by humans lungs per min?

(1) 20 ml

(2) 200 ml

(3) 180 ml

(4) 125 ml

Sol. Answer (2)

Our lungs excrete 200 ml/min of CO_2.

(Disorders of the Excretory System)

37. As compared to plasma, all are the constituents of dialysis fluid, **except**

(1) Na^+ (2) K^+ (3) Cl^- (4) Urea

Sol. Answer (4)

Urea is absent in the dialysing fluid because urea needs to be excreted out of the blood while other constituents are present in the dialysing fluid i.e. the electrolytes.

38. The condition of accumulation of urea in blood is termed as

(1) Uremia (2) Diuresis

(3) Glycosuria (4) Haematuria

Sol. Answer (1)

Uremia : Condition of accumulation of urea in the blood.

Diuresis : Increased excretion of urine.

Glycosuria : Excretion of glucose in the urine.

Haematuria : Presence of blood in the urine.

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