CHAPTER 19

Excretory Products and Their Elimination

19.0 Introduction

1. Select the option which shows correct matching of animal with its excretory organ and excretory product.

	Animal	Excretory organ	Excretory product
(a)	*Labeo* (Rohu)	Nephridial tubes	Ammonia
(b)	Salamander	Kidneys	Urea
(c)	Peacock	Kidneys	Urea
(d)	Housefly	Renal tubules	Uric acid

(Karnataka NEET 2013)

2. Which one of the following options gives the correct categorization of six animals according to the type of nitrogenous waste they give out?

	Ammonotelic	Ureotelic	Uricotelic
(a)	Pigeon, humans	Aquatic amphibia, lizards	Cockroach, frog
(b)	Frog, lizards	Aquatic amphibia, humans	Cockroach, pigeon
(c)	Aquatic amphibia	Frog, humans	Pigeon, lizards, cockroach
(d)	Aquatic amphibia	Cockroach, humans	Frog, pigeon, lizards

(Mains 2012)

3. Which one of the following characteristics is common both in humans and adult frogs?
(a) Four chambered heart
(b) Internal fertilisation
(c) Nucleated RBCs
(d) Ureotelic mode of excretion *(Mains 2012)*

4. Uricotelic mode of excreting nitrogenous wastes is found in
(a) reptiles and birds
(b) birds and annelids
(c) amphibians and reptiles
(d) insects and amphibians. *(Mains 2011)*

5. The principal nitrogenous excretory compound in humans is synthesised
(a) in kidneys but eliminated mostly through liver
(b) in kidneys as well as eliminated by kidneys
(c) in liver and also eliminated by the same through bile
(d) in the liver, but eliminated mostly through kidneys. *(2010)*

6. Uric acid is the chief nitrogenous component of the excretory products of
(a) earthworm (b) cockroach
(c) frog (d) man. *(2009)*

7. In ornithine cycle, which of the following wastes are removed from the blood?
(a) CO_2 and urea (b) Ammonia and urea
(c) CO_2 and ammonia (d) Urea and urine *(2005)*

8. Uricotelism is found in
(a) mammals and birds
(b) fish and fresh water protozoans
(c) birds, land reptiles and insects
(d) frogs and toads. *(2004)*

9. Conversion of ammonia to urea is done by
(a) ornithine cycle (b) arginine cycle
(c) fumaric cycle (d) citrulline cycle. *(2000)*

10. In ureotelic animals, urea is formed by
(a) Krebs' cycle (b) EM pathway
(c) Ornithine cycle (d) Cori cycle. *(1997)*

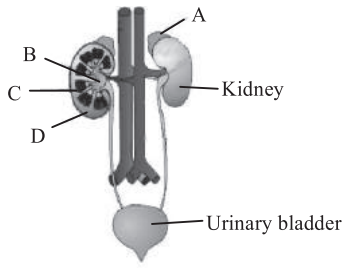
11. The ornithine cycle removes two waste products from the blood in liver. These products are
(a) CO_2 and ammonia
(b) ammonia and uric acid
(c) CO_2 and urea
(d) ammonia and urea. *(1996)*

12. Two examples in which the nitrogenous wastes are excreted from body in the form of uric acid are
(a) birds and lizards
(b) frogs and cartilaginous fish
(c) insects and bony fish
(d) mammals and molluscs. *(1994)*

13. Nitrogenous waste products are eliminated mainly as
(a) urea in tadpole and ammonia in adult frog
(b) ammonia in tadpole and urea in adult frog
(c) urea in both tadpole and adult frog
(d) urea in tadpole and uric acid in adult frog.
(1991)

19.1 Human Excretory System

14. Figure shows human urinary system with structures labelled A to D. Select option which correctly identifies them and gives their characteristic and/ or functions.



(a) C - Medulla - inner zone of kidney and contains complete nephrons.
(b) D - Cortex - outer part of kidney and do not contain any part of nephrons.
(c) A - Adrenal gland - located at the anterior part of kidney. Secrete catecholamines which stimulate glycogen breakdown.
(d) B - Pelvis - broad funnel shaped space inner to hilum, directly connected to loops of Henle.
(NEET 2013)

15. Which one of the following is not a part of a renal pyramid?
(a) Peritubular capillaries
(b) Convoluted tubules
(c) Collecting ducts
(d) Loop of Henle *(Mains 2011)*

16. The basic functional unit of human kidney is
(a) nephridia (b) Henle's loop
(c) nephron (d) pyramid. *(1997)*

17. Which one of the four parts mentioned below does not constitute a part of single uriniferous tubule?
(a) Distal convoluted tubule
(b) Collecting duct
(c) Bowman's capsule
(d) Loop of Henle *(1994)*

18. Proximal and distal convoluted tubules are parts of
(a) seminiferous tubules
(b) nephron
(c) oviduct
(d) vas deferens. *(1990)*

19.2 Urine Formation

19. The net pressure gradient that causes the fluid to filter out of the glomeruli into the capsule is
(a) 50 mm Hg (b) 75 mm Hg
(c) 20 mm Hg (d) 30 mm Hg. *(2005)*

19.3 Function of the Tubules

20. Which of the following statements is correct?
(a) The descending limb of loop of Henle is impermeable to water.
(b) The ascending limb of loop of Henle is permeable to water.
(c) The descending limb of loop of Henle is permeable to electrolytes.
(d) The ascending limb of loop of Henle is impermeable to water. *(NEET 2017)*

21. The part of nephron involved in active reabsorption of sodium is
(a) distal convoluted tubule
(b) proximal convoluted tubule
(c) Bowman's capsule
(d) descending limb of Henle's loop.
(NEET-II 2016)

22. Removal of proximal convoluted tubule from the nephron will result in
(a) no change in quality and quantity of urine
(b) no urine formation
(c) more diluted urine
(d) more concentrated urine. *(2015 Cancelled)*

23. The maximum amount of electrolytes and water (70 – 80 percent) from the glomerular filtrate is reabsorbed in which part of the nephron?
(a) Ascending limb of loop of Henle
(b) Distal convoluted tubule
(c) Proximal convoluted tubule
(d) Descending limb of loop of Henle *(2012)*

24. Which one of the following correctly explains the function of a specific part of the human nephron?
(a) Podocytes : create minute spaces (slit pores) for the filtration of blood into the Bowman's capsule
(b) Henle's loop : most reabsorption of the major substances from the glomerular filtrate
(c) Distal convoluted tubule : reabsorption of K^+ ions into the surrounding blood capillaries
(d) Afferent arteriole : carries the blood away from the glomerulus towards renal vein.
(Mains 2011)

25. 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 per cent of the glomerular filtrate is reabsorbed by the renal tubules.
(d) Ascending limb of loop of Henle is impermeable to electrolytes. *(2010)*

26. Glucose is taken back from glomerular filtrate through
(a) active transport (b) passive transport
(c) osmosis (d) diffusion. *(1993)*

27. Under normal conditions which one is completely reabsorbed in the renal tubule?
(a) Urea (b) Uric acid
(c) Salts (d) Glucose *(1991)*

28. Brush border is characteristic of
(a) neck of nephron
(b) collecting tube
(c) proximal convoluted tubule
(d) all of these. *(1990)*

29. Reabsorption of useful substances from glomerular filtrate occurs in
(a) collecting tube
(b) loop of Henle
(c) proximal convoluted tubule
(d) distal convoluted tubule. *(1989)*

19.4 Mechanism of Concentration of the Filtrate

30. Which of the following factors is responsible for the formation of concentrated urine?
(a) Hydrostatic pressure during glomerular filtration.
(b) Low levels of antidiuretic hormone.
(c) Maintaining hyperosmolarity towards the medullary interstitium in the kidneys.
(d) Secretion of erythropoietin by Juxtaglomerular complex. *(NEET 2019)*

31. If Henle's loop were absent from mammalian nephron, which one of the following is to be expected ?
(a) There will be no urine formation.
(b) There will be hardly any change in the quality and quantity of urine formed .
(c) The urine will be more concentrated.
(d) The urine will be more dilute. *(2003)*

32. Concentration of urine depends upon which organ?
(a) Bowman's capsule
(b) Length of Henle's loop
(c) PCT
(d) Network of capillaries arising from glomerulus *(2000)*

19.5 Regulation of Kidney Function

33. Which of the following would help in prevention of diuresis?
(a) More water reabsorption due to undersecretion of ADH.
(b) Reabsorption of Na^+ and water from renal tubules due to aldosterone.
(c) Atrial natriuretic factor causes vasoconstriction.
(d) Decrease in secretion of renin by JG cells. *(NEET 2020)*

34. A decrease in blood pressure/volume will not cause the release of
(a) atrial natriuretic factor
(b) aldosterone
(c) ADH
(d) renin. *(NEET 2017)*

35. Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule?
(a) Increase in aldosterone levels
(b) Increase in antidiuretic hormone levels
(c) Decrease in aldosterone levels
(d) Decrease in antidiuretic hormone levels *(2014)*

36. A fall in glomerular filtration rate (GFR) activates
(a) juxtaglomerular cells to release renin
(b) adrenal cortex to release aldosterone
(c) adrenal medulla to release adrenaline
(d) posterior pituitary to release vasopressin. *(Mains 2012)*

37. Which one of the following statements is correct with respect to kidney function regulation?
(a) When someone drinks lot of water, ADH release is suppressed.
(b) Exposure to cold temperature stimulates ADH release.
(c) An increase in glomerular blood flow stimulates formation of angiotensin II.
(d) During summer when body loses lot of water by evaporation, the release of ADH is suppressed. *(Mains 2011)*

38. Angiotensinogen is a protein produced and secreted by
(a) juxtaglomerular (JG) cells
(b) macula densa cells
(c) endothelial cells (cells lining the blood vessels)
(d) liver cells. *(2006)*

39. If excess water passes out from the tissue without being restored by the kidneys, the cells would
(a) burst open and die
(b) take water from the plasma
(c) not be affected at all
(d) shrivel and die. *(1994)*

19.6 Micturition

40. Match the items given in column I with those in column II and select the correct option given below.

	Column I (Function)	**Column II (Part of excretory system)**
A.	Ultrafiltration	(i) Henle's loop
B.	Concentration of urine	(ii) Ureter
C.	Transport of urine	(iii) Urinary bladder
D.	Storage of urine	(iv) Malpighian corpuscle
		(v) Proximal convoluted tubule

	A	**B**	**C**	**D**
(a)	(iv)	(v)	(ii)	(iii)
(b)	(iv)	(i)	(ii)	(iii)
(c)	(v)	(iv)	(i)	(ii)
(d)	(v)	(iv)	(i)	(iii)

(NEET 2018)

41. Human urine is usually acidic because
(a) potassium and sodium exchange generates acidity
(b) hydrogen ions are actively secreted into the filtrate
(c) the sodium transporter exchanges one hydrogen ion for each sodium ion, in peritubular capillaries
(d) excreted plasma proteins are acidic. *(2015)*

42. Which of the following does not favour the formation of large quantities of dilute urine?
(a) Renin
(b) Atrial-natriuretic factor
(c) Alcohol
(d) Caffeine *(2015 Cancelled)*

43. What will happen if the stretch receptors of the urinary bladder wall are totally removed?
(a) Micturition will continue.
(b) Urine will continue to collect normally in the bladder.
(c) There will be no micturition.
(d) Urine will not collect in the bladder. *(2009)*

44. A person who is on a long hunger strike and is surviving only on water, will have
(a) less amino acids in his urine
(b) more glucose in his blood
(c) less urea in his urine
(d) more sodium in his urine. *(2007)*

45. A person is undergoing prolonged fasting. His urine will be found to contain abnormal quantities of
(a) fats (b) amino acids
(c) glucose (d) ketones. *(2005)*

19.8 Disorders of the Excretory System

46. Use of an artificial kidney during hemodialysis may result in
(A) Nitrogenous waste build-up in the body
(B) Non-elimination of excess potassium ions
(C) Reduced absorption of calcium ions from gastro-intestinal tract
(D) Reduced RBC production.
Which of the following options is the most appropriate ?
(a) (A) and (D) are correct.
(b) (A) and (B) are correct.
(c) (B) and (C) are correct.
(d) (C) and (D) are correct. *(NEET 2019)*

47. Match the items given in column I with those in column II and select the correct option given below.

	Column I	**Column II**
A.	Glycosuria	(i) Accumulation of uric acid in joints
B.	Gout	(ii) Mass of crystallised salts within the kidney
C.	Renal calculi	(iii) Inflammation in glomeruli
D.	Glomerular nephritis	(iv) Presence of glucose in urine

	A	**B**	**C**	**D**
(a)	(iii)	(ii)	(iv)	(i)
(b)	(i)	(ii)	(iii)	(iv)
(c)	(ii)	(iii)	(i)	(iv)
(d)	(iv)	(i)	(ii)	(iii)

(NEET 2018)

48. A condition of failure of kidney to form urine is called
(a) anuria (b) deamination
(c) uremia (d) none of these. *(1998)*

49. Presence of RBC in urine is
(a) alkaptonuria (b) urothiasis
(c) hematuria (d) proteinuria. *(1988)*

ANSWER KEY

1.	(b)	**2.**	(c)	**3.**	(d)	**4.**	(a)	**5.**	(d)	**6.**	(b)	**7.**	(c)	**8.**	(c)	**9.**	(a)	**10.**	(c)
11.	(a)	**12.**	(a)	**13.**	(b)	**14.**	(c)	**15.**	(b)	**16.**	(c)	**17.**	(b)	**18.**	(b)	**19.**	(c)	**20.**	(d)
21.	(b)	**22.**	(c)	**23.**	(c)	**24.**	(a)	**25.**	(c)	**26.**	(a)	**27.**	(d)	**28.**	(c)	**29.**	(c)	**30.**	(c)
31.	(d)	**32.**	(b)	**33.**	(b)	**34.**	(a)	**35.**	(a)	**36.**	(a)	**37.**	(a)	**38.**	(d)	**39.**	(d)	**40.**	(b)
41.	(b)	**42.**	(a)	**43.**	(a)	**44.**	(c)	**45.**	(d)	**46.**	(d)	**47.**	(d)	**48.**	(a)	**49.**	(c)		

Hints & Explanations

1. (b) : In salamander, kidneys (mesonepheric) are the excretory organs and the excretory matter is urea. In *Labeo*, mesonephric kidney is the excretory organ and excretion is ammonotelic. Peacock has metanephric kidneys with excretory matter being uric acid. In housefly, excretion takes place by Malpighian tubules. Excretory waste is uric acid chiefly.

2. (c)

3. (d) : Excretion of urea is known as ureotelism and the animals which excrete urea are called ureotelic. Ureotelic animals include marine fishes, semi-aquatic amphibians such as frogs and toads, aquatic or semi-aquatic reptiles like turtles, terrapins and alligators, and man and all other mammals. Urea is less toxic and less soluble in water than ammonia. Hence, it can stay for some time in the body. Amphibian tadpole (*e.g.*, tadpole of frog) excrete ammonia but after metamorphosis, frog excretes urea.

4. (a) : Reptiles, birds, land snails and insects excrete nitrogenous wastes as uric acid in the form of pellet or paste with a minimum loss of water and are called uricotelic animals.

5. (d) : The principle nitrogenous excretory compound in humans is urea. Urea is produced in a series of reactions (urea cycle) which take place in the mitochondrial matrix and cytosol of liver cells. Urea cycle (ornithine cycle) is the series of biochemical reactions that converts ammonia, which is highly toxic and carbon dioxide to the much less toxic urea during the excretion of metabolic nitrogen derived from the deamination of excess amino acids. The urea is ultimately excreted in solution in urine.

6. (b) : Cockroach shows uricotelism. Excretion of uric acid is known as uricotelism and the animals which excrete uric acid are called uricotelic. Animals which live in dry conditions have to conserve water in their bodies. Therefore, they synthesise crystals of uric acid from ammonia. Uric acid crystals are non-toxic and almost insoluble in water. Hence, these can be retained in the body for a considerable time. Uricotelic animals include most insects, (*e.g.*, cockroach), land reptiles (*e.g.*, lizards and snakes) and birds.

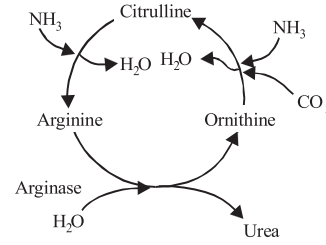
7. (c) : *Refer to answer 5.*

8. (c) : Uricotelism means excretion of uric acid. Uric acid excretion occurs in organisms which develop in an enclosed egg (where water is severely limited) or which normally experience very dry terrestrial environment as adult organisms. Uric acid is discharged as thick paste or as solid pellet. Examples: terrestrial reptiles, birds, insects, gastropod mollusc, etc.

9. (a) : *Refer to answer 5.*

10. (c) : Urea is formed of two molecules of ammonia and one molecule of CO_2. During catabolism, proteins break up into amino acids. The amino acids are converted into keto-acids (such as α-keto-glutaric acid) with the removal of ammonia (deamination). The keto-acid enters the Krebs cycle to yield energy. Carbon dioxide is formed during decarboxylation.

Ornithine (amino acid) combines with one molecule of NH_3 and CO_2 producing citrulline (amino acid) and water. Citrulline combines with another molecule of ammonia and forms arginine (essential amino acid) and water. Arginine is broken into urea and ornithine in the presence of an enzyme arginase and water. Thus the cycle is repeated. This is called urea or ornithine or Krebs'-Henseleit cycle after the names of its discoverers.



Most of the urea is produced in the liver. The liver cells continuously release urea into the blood and kidneys withdraw it from the blood to excrete it in urine.

11. (a)

12. (a) : Birds and lizards are uricotelic. Uricotelic animals are those that excrete nitrogenous waste in the form of uric acid. It is being insoluble in water, does not require water for its elimination. Frogs and cartilaginous fish are ureotelic, that is they excrete nitrogenous waste in the form of urea. The main excretory matter of insects is uric acid and of bony fish is ammonia (ammonotelic). Molluscs may be ammonotelic or uricotelic. Mammals are ureotelic (excretory matter is urea).

13. (b) : Ammonia is highly soluble in water, so in aquatic animals, *e.g.*, tadpole of frog, the nitrogenous waste products are excreted in the form of ammonia. In terrestrial animals, *e.g.*, adult frog, these wastes are excreted in the form of urea.

14. (c) : In the given figure, A is adrenal gland which secretes two catecholamines; adrenaline (epinephrine) and noradrenaline (norepinephrine). Adrenaline increases the conversion of glycogen to glucose providing quick energy for "fight or flight" response. B is renal pelvis which is a sac like cavity of the kidney leading to ureters, is not directly connected to loop of Henle. C is medulla, the inner region of kidney containing loop of Henle, collecting ducts and ducts of Bellini. D is cortex which has proximal and distal convoluted tubules and contains Malpighian corpuscles.

15. (b) : The medulla of kidney is divided into a number of conical areas, the medulla pyramids or renal pyramids. Peritubular capillaries, loop of Henle and collecting ducts lie in the medulla (renal pyramids) while convoluted tubules lie in the cortex of kidney.

16. (c) : A nephron is a unit of structure and function in a kidney. A kidney contains about a million nephrons, each approximately 3 cm. long. A nephron is a long tubule differentiated into four regions having different anatomical features and physiological role : Bowman's capsule, proximal convoluted tubule (PCT), loop of Henle, and distal convoluted tubule (DCT). The latter opens into one of the collecting ducts. Nephridia are the excretory organs of annelids.

17. (b) : *Refer to answer 16.*

18. (b)

19. (c) : Walls of glomerular capillaries and Bowman's capsule are very thin and are semi-permeable due to the presence of pores in the former and slit-pores in the latter. They allow water and small molecules in the blood to pass through them. Fluid containing these materials is forced out of the glomerular capillaries into the Bowman's capsule by the high pressure of the blood in the glomerular capillaries. This pressure is about 70 mm Hg in man. The fluid tends to move in the reverse direction due to (i) the osmotic pressure of plasma proteins in the glomerular capillaries, and (ii) hydrostatic pressure of the fluid in the urinary tubule. These pressures in man are about 30 mm Hg and 20 mm Hg respectively. The net force moving the fluid from the glomerular capillaries, called the filtration pressure, is 70 – (30 + 20) or 20 mmHg.

20. (d) : Descending limb of loop of Henle is permeable to water but almost impermeable to electrolytes. Ascending limb of loop of Henle is impermeable to water but permeable to electrolytes.

21. (b) : From the Bowman's capsule, a glomerular filtrate enters the proximal convoluted tubule. Absorption of selected materials takes place from the filtrate into the blood of the peritubular capillaries or vasa recta. It is termed the tubular reabsorption. Reabsorption involves both passive and active transport across the tubular epithelium. About 65 per cent of the glomerular filtrate is normally reabsorbed in the proximal convoluted tubule before reaching the loop of Henle. Glucose, amino acids, vitamins, hormones, sodium, potassium, chlorides, phosphates, bicarbonates, much of water and some urea from the filtrate are absorbed. Sodium and potassium are reabsorbed by primary active transport.

22. (c) **23. (c)**

24. (a) : The visceral layer of Bowman's capsule surrounds the glomerulus and is composed of special type of cells, the podocytes. The podocytes are so called because they possess foot like processes (projection), the pedicels. The space between pedicels are called slit pores (= filtration slits) through which the glomerular filtrate filters.

25. (c) : Urine formation involves three main processes namely, glomerular filtration, reabsorption and secretion, that takes place in different parts of the nephron. A comparison of the volume of the filtrate formed per day (180 litres per day) with that of the urine released (1.5 litres), suggest that nearly 99 percent of the filtrate is reabsorbed by the renal tubules. The descending limb of loop of Henle is permeable to water but almost impermeable to electrolytes. The ascending limb is impermeable to water but allows transport of electrolytes actively or passively. Conditional reabsorption of Na^+ and water takes place in distal convoluted tubule. It is also capable of reabsorption of HCO_3^-.

26. (a) : Glucose is taken back from the glomerular filtrate by the proximal convoluted tubule by active transport.

27. (d) : The cells lining the proximal convoluted tubule are well adapted for reabsorption of materials from the filtrate. They have abundant mitochondria and bear numerous microvilli on the free side thus giving brush border appearance. The cells reabsorb entire glucose, amino acids, most of the inorganic ions, much of the water as well as some urea from the filtrate.

28. (c) **29. (c)**

30. (c) : The counter current mechanism helps to maintain a concentration gradient in the medullary interstitium. The proximity between the Henle's loop and vasa recta, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium, *i.e.*, from 300 $mOsmolL^{-1}$ in the cortex to about 1200 $mOsmolL^{-1}$ in the inner

medulla. This gradient is mainly caused by NaCl and urea. Presence of such interstitial gradient helps in an easy passage of water from the collecting tubule thereby concentrating the filtrate (urine).

31. (d) : Reabsorption is a process by which useful constituents of glomerular filtrate are returned into the blood streams. It occurs in convoluted tubules (proximal convoluted tubule) as well as loop of Henle. Basically loop of Henle, in association with vasa rectae, plays an important role in the counter current mechanism (the process which makes urine hypertonic, *i.e.*, more concentrated). Therefore, if Henle's loop was absent from mammalian nephron the urine will be more dilute.

32. (b) : Concentration of urine depends upon the length of Henle's loop. Loop of Henle is the hairpin shaped section of a kidney tubule situated between the proximal and distal tubules in the nephron. It consists of a thin descending limb which is permeable to water and a thick ascending limb which is impermeable to water, complex movements of ions and water across the walls of the loop enable it to function as a countercurrent multiplier, resulting in the production of concentrated urine in the collecting duct.

33. (b) : Aldosterone acts mainly at the renal tubules and stimulates the reabsorption of Na^+ and water and excretion of K^+ and phosphate ions. Thus, aldosterone helps in prevention of diuresis.

34. (a) : Atrial natriuretic factor (ANF) is responsible for lowering of blood pressure and volume. The walls of the atria of the heart release ANF in response to an increase in blood volume and pressure. It opposes regulation by RAAS. It inhibits release of renin from JGA thereby inhibiting NaCl reabsorption by the collecting duct and reduces aldosterone release from adrenal gland.

35. (a) : Aldosterone is a hormone secreted by the outer layer of the adrenal gland (cortex part). Decreased blood volume and interstitial fluid level, results in decreased blood pressure, trigger aldosterone secretion. When aldosterone is present in the blood, reabsorption of Na^+ in the filtrate is increased by the epithelial cells of the collecting duct. Retaining Na^+, raises the osmotic pressure of the blood and reduces water loss from the body. When aldosterone is absent, some Na^+ remains in the filtrate and is excreted with the urine.

36. (a) : The amount of the 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 come back to normal.

37. (a) : Antidiuretic hormone (ADH) or vasopressin increases the reabsorption of water in the distal convoluted tubule, collecting tubules and collecting ducts of the nephrons of the kidneys. As a result, the reabsorption of water from the glomerular filtrate is increased. When someone drinks lot of water, requirement of absorption of water decreases, so ADH release is suppressed.

38. (d) : Juxtaglomerular cells secrete an enzyme renin into blood. Renin changes plasma protein angiotensiongen to a peptide called angiotensin II. It increases the blood volume : (i) by inducing proximal convoluted tubules to reabsorb more NaCl and water (ii) stimulates the adrenal glands to release a hormone, called aldosterone which induces the distal convoluted tubule to absorb more Na^+ and water. Angiotensinogen is an α-globulin protein produced by liver. Renin serves as an enzyme in the conversion of the plasma protein angiotensinogen into angiotensin. This protein stimulates the adrenal cortex to produce aldosterone which acts on the cells of the ascending limb of the loop of Henle and increases the rate of reabsorption of Na^+. Reabsorption of Na^+ brings about the uptake of an osmotically equivalent amount of water. Absorption of sodium and water increases blood volume and pressure.

39. (d) : Kidney's main function is to maintain water balance in blood plasma by reabsorbing water. If the excess amount of water will move out of tissue without being restored in kidneys, cell will shrivel due to dehydration and ultimately die.

40. (b) **41. (b)**

42. (a) : Juxtaglomerular cells secrete an enzyme renin into blood. Renin changes plasma protein angiotensiongen to a peptide called angiostensin 11. It increases the blood volume : (i) by inducing proximal convoluted tubules to reabsorb more NaCl and water (ii) stimulates the adrenal glands to release a hormone called aldosterone which induces the distal convoluted tubule to absorb more Na^+ and water.

43. (a) : Micturition is the expulsion of urine from the urinary bladder. Sensory stretch receptors are responsible for the stretch reflex. If these are removed then autonomic nervous system control will not be there and bladder will always remain full and frequently pass urine into urethra. So, micturition will continue.

44. (c) : A person who is on a long hunger strike and is surviving only on water, will have less urea in his urine. Urea, also called carbamide, is an organic chemical compound which essentially is the waste produced when the body metabolizes protein. Manufactured in the liver by breaking down protein or amino acids and ammonia, the kidneys transfer urea from the blood to the urine. The average person excretes about 30 grams of urea a day. During total starvation with no food being eaten, the body must rely on its own tissues to provide the essential mixture of fuels to sustain life. Under conditions of starvation, enzyme levels rise as proteins are degraded and amino acid carbon skeletons are used to provide energy, thus increasing the quantity of nitrogen that must be excreted in the form of urea.

45. (d) : Under fasting conditions which are associated with high rate of fatty acid oxidation, the liver produces large amount of ketone bodies *viz.* acetoacetate, β-hydroxybutyrate and acetone. The normal level of ketone blood level is 0.2 mmol/L. Presence of excess ketone bodies in urine is termed as ketonuria.

46. (d) : When kidneys are completely damaged and do not function, patient often receive hemodialysis (treatment with artificial kidney). The patient is connected to the machine by a tube attached to an artery often the radial artery. Blood from the artery is pumped into a tube that runs through the dialyser. The dialyser is filled with dialysing fluid which contains the same quantities of electolytes and nutrients as normal plasma but contains no waste products. The cellophane tube (a tube bounded by thin membrane) is kept in the dialysing fluid. The membrane of the cellophane tube is impermeable to blood cells and proteins but permeable to urea, uric acid, creatinine and mineral ions. So, these wastes diffuse from the blood to the dialysing fluid across the cellophane membrane.

However, since both kidneys are non-functional thus absorption of Ca^{2+} from small intestine will be affected as coversion of vitamin D to calcitriol will not take place which is needed for calcium absorption from small intestine(GI tract). Erythropoietin production will also be affected, thus RBC production will be reduced.

47. (d)

48. (a) : Anuria is the complete suppression of urine formation by the kidney. In this case most of the nephrons are destroyed. Uremia is the presence of an excessive amount of urea in the blood. Deamination is the removal of ammonia from amino acids.

49. (c) : Presence of RBCs in the blood is known as hematuria. Alkaptonuria is the excretion of large amount of alkapton in urine which when comes in contact with air turns black. Proteinuria is the presence of proteins in the blood.