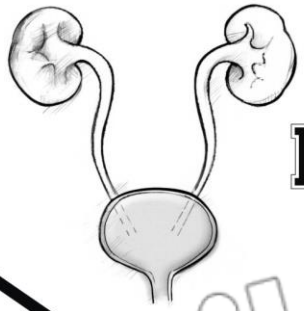


CH# 11 HOMEOSTASIS

11.1 HOMOSTASIS IN PLANTS

LONG QUESTIONS

Q.1 Describe homeostasis in plants. (A.B) **(GRW 2014, LHR 2015, DGK 2015)**

OR

How do the plants excrete extra water and salts form their bodies. (A.B)

(Understanding the Concept Q.2)

Ans: **HOMEOSTASIS IN PLANTS**

Definition:

"The **maintenance** of the **internal conditions** of body at **equilibrium**, despite **changes** in the **external environment**".

Explanation:

Plants **respond** to **environmental changes** and keep their **internal conditions constant** (homeostasis). They apply **different mechanisms** for the homeostasis of water and other chemicals (oxygen, carbon dioxide, nitrogenous materials etc.).

Removal of Carbon Dioxide:

- In **daytime**, the **carbon dioxide produced** during **cellular respiration** is **utilized** in **photosynthesis** and hence it is **not** a **waste** product.
- At **night**, it is **surplus because** there is **no utilization** of carbon **dioxide**. It is **removed** from the tissue cells by **diffusion**.
- In leaves and young stems, carbon dioxide **escapes** out through **stomata**.
- In **young roots**, carbon dioxide **diffuses** through the **general root surface**, especially through **root hairs**.

Removal of Extra Oxygen:

- **Oxygen** is produced in **mesophyll cells** only during **daytime**, as a **by-product** of **photosynthesis.**
- After its **utilization** in **cellular respiration**, the **mesophyll cells remove** the **extra amount** of oxygen through stomata.

Removal of Extra Water:

- Plants **obtain water** from **soil** and it is also **produced** in the **body** during **cellular respiration**. Plants **store large amount** of water in their cells for **turgidity**.
- **Extra water** is **removed** from plant body by **transpiration**.

Transpiration:

- **"The loss of water** from **plant surface** in the form of **vapors** is called **transpiration**".

  At night, transpiration usually does **not occur** because most plants have their **stomata closed**.

Guttation:

- "The **appearance** of **drops of water** on the **tips or edges of leaves** is called **guttation**".

  If there is **high water** content in **soil**, water **enters** the **roots** and is **accumulated** in **xylem vessels**. Some plants such as **grasses force** this water through **special pores**, present at leaf tips or edges, and form drops.

  Guttation Versus Dew:

  Guttation is **not** to be confused with **dew**, which **condenses** from the **atmosphere** onto the **plant surface**.

Removal of Metabolic Wastes:

Plants **deposit** many **metabolic wastes** in their **bodies** as **harmless insoluble materials**.

Examples of Metabolic Wastes:

- **Calcium oxalate** is deposited in the form of **crystals** in the leaves and stems of many **plants** e-g. **In tomato**.
- In **trees** which **shed** their **leaves** yearly, the **excretory products** are **removed** from body during **leaf fall**.
- Other **wastes materials** that are **removed** by some plants are
  - **Resins** (by coniferous trees)
  - **Gums** (by keekar)
  - **Latex** (by rubber plant)
  - **Mucilage** (by carnivorous plant and lady finger) etc.

Resin drops from a cut tree | Lattice being from a tree extracted | Mucilage drops on a carnivorous plant

Figure: Removal of some Wastes in Plants

Q.2 Describe osmotic adjustments in plants. (A.B)

Ans: **OSMOTIC ADJUSTMENTS IN PLANTS**

On the basis of the available **amounts of water and salts**, plants are divided into **three groups**:

- Hydrophytes
- Xerophytes
- Halophytes

Hydrophytes: **(GRW 2014, BWP 2014, DGK 2014)**

Etymology:

Hydro = Water and Phytes = Plants (aquatic plants)

Introduction:

Hydrophytes are the plants which **live completely or partially** submerged in **freshwater**. Such plants **do not** face the **problem of water** shortage.

Environmental Adaptations:

- They have **developed mechanisms** for the **removal of extra water** from their **cells**.
- Hydrophytes have **broad leaves** with a **large number of stomata** on their **upper surface**. This **characteristic** helps them to **remove the extra amount of water.**

Examples:

- **Water lily**
- **Lotus**

Xerophytes: **(LHR 2013, BWP 2014, GRW 2015)**

Etymology:

Xero = Dry and Phytes = Plants (desert plants)

Introduction:
Xerophytes live in **dry environments.**
Environmental Adaptations:
- They possess **thick, waxy cuticle** over their **epidermis**, to **reduce water loss** from internal tissues.
- They have **less number of stomata** to **reduce** the **rate of transpiration.**
- Such plants have **deep roots** to **absorb** maximum **water** from soil.
- Some xerophytes have **special parenchyma cells** in stems or roots in which they **store large quantities of water**. This makes their stems or roots **wet and juicy**, called **succulent organs**.

Example:
- Cacti (Singular: Cactus)

Halophytes: **(BWP 2015)**
Etymology:
Halo = Salt, Phytes = Plants (marine water plants)
Introduction:
Halophytes live in **sea waters** and are **adapted** to **salty environments**.
Environmental Adaptations:
- Salts **enter** in the **bodies** of such plants due to their **higher concentration** in **sea water**.
- **Water** tends to **move out** of their cells into the **hypertonic sea water**.
- When salts enter into cells, plants carry out **active transport** to move and **hold large amount of salt** in vacuoles. Salts are **not allowed** to move out through the semi-**permeable** membranes of **vacuoles**. So the **sap** of vacuoles **remains** even more **hypertonic** than sea water. In this way, **water does not move** out of **cells**.

Example:
- Many sea grasses

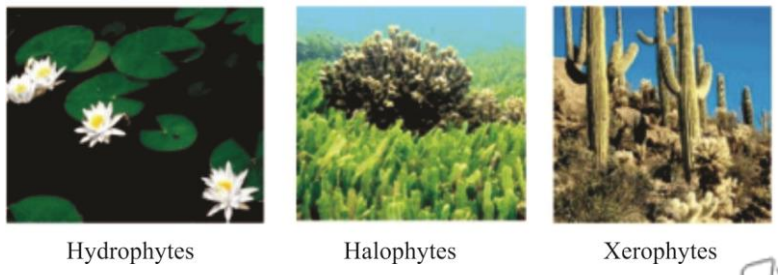


Figure: Three Groups of Plants

11.1 SHORT QUESTIONS

Q.1 Define homeostasis. Give an example. (K.B) **(GRW 2013,16, MTN 2013, 2014, 2015, BWP 2014)**
Ans: **HOMEOSTASIS**
Definition:
"Maintenance of the internal condition of body at equilibrium, despite changes in external environment."
Example:
The core temperature of human body remains at about 37°C despite fluctuation in the surrounding air temperature.

Q.2 Define osmoregulation. Give an example. (K.B) **(GRW 2014, 15, 16, 17 LHR 2015, 17)**
Ans: **OSMOREGULATION**
Definition:
"Maintenance of the amounts of water and salts in body fluids (i.e. blood & tissue fluids)."

Example:
The relative amounts of water and slats in body fluids and inside cells control the processes of diffusion and osmosis, which are essential for the functioning of cells.

Q.3 Define thermoregulation. (K.B) **(GRW 2014, 16, 17, BWP 2014, LHR 2015)**

Ans:

THERMOREGULATION

Definition:
"Thermoregulation is the maintenance of internal body temperature."

Optimum Temperature:
The enzymes of body work best at particular temperature (optimum temperature). Any change in body temperature may affect the functioning of enzymes.

Example:
The core temperature of human body remains at about 37°C despite fluctuation in the surrounding air temperature.

Q.4 Define an excretion. (K.B) **(LHR 2013, GRW 2015, SWL 2015)**

Ans:

EXCRETION

Definition:
"This is the process of homeostasis in which metabolic wastes are eliminated from body to maintain the internal conditions at equilibrium."

Q.5 What is metabolic waste? (K.B)

Ans:

METABOLIC WASTE

Definition:
Metabolic waste means any material that is produced during body metabolism and that may harm the body.

Example:
Resins by coniferous plants and latex by rubber plants.

Q.6 What are succulent organs? (K.B) **(GRW 2017)**

Ans: Page no 32.

Q.7 Define hydrophyte with an examples (K.B) **(LHR 2017, GRW 2016)**

Ans: Page no 31.

Q.8 What is meant by halophyte? (K.B) **(GRW 2016, BWP 2015)**

Ans: Page no 32.

Q.9 How plants remove extra CO_2 from their body? (A.B)

Ans: Page no 30.

Q.10 Differentiate between transpiration and guttation? (K.B) **(LHR 2014, SWL 2015)**

Ans:

DIFFERENTIATION

The difference between transpiration and guttation is as follows:

Transpiration	Guttation
• Transpiration is the loss of water from plant surface in the form of vapors.	• The appearance of drops of water on the tips or edges of leaves is called Guttation.

Q.11 How plants remove metabolic wastes? (A.B)

Ans: Page no 31.

Q.12 Write two characteristics of xerophytes? (K.B)

Ans: Page no 32.

Q.13 Define osmosis. (K.B) **(LHR 2016)**

Ans:

OSMOSIS

Definition:
"Osmosis is the movement of water from hypotonic solutions (less solute concentration) to hypertonic solutions (higher solute concentration), through semipermeable membrane."

Q.14 What is the secondary function of leaf fall? (U.B)

Ans:

SECONDARY FUNCTION OF LEAF FALL

The removal of excretory products is a secondary function of leaf fall. If the leaves are not Sshed, the calcium oxalate just remains as harmless crystals in the leaves.

11.1 MULTIPLE CHOICE QUESTIONS

1. How many grams of glucose are present in one liter of Human blood? (A.B)
(A) 10g (B) 1g
(C) 0.1g (D) 100g

2. Any material that is produced during body metabolism and that may harm the body is called: (U.B)
(A) Guttation (B) Ion
(C) Metabolic waste (D) Oxygen

3. Thermoregulation is essential for : (K.B)
(A) Excretion (B) Enzyme activity
(C) Metabolism (D) both b & c

4. The loss of water from plant surface in the form of vapors is called: (K.B)
(A) Guttation (B) Transpiration
(C) Excretion (D) Thermoregulation

5. _____ is deposited in the form of crystals in the leaves and stems of tomato. (K.B)
(A) Calcium carbonate (B) Calcium silicate
(C) Calcium sulphate (D) Calcium oxalate

6. Plant homeostasis is concerned with concentrations of all of the following, except; (U.B)
(A) Water (B) Carbon dioxide
(C) Nitrogenous waste (D) Chlorophyll

7. The waste product of keekar (K.B)
(A) Resins (B) Gums
(C) Latex (D) Mucilage

8. The CO_2 is removed from cell by: (U.B)
(A) Diffusion (B) Facilitated Diffusion
(C) Filtration (D) Active transport

9. _____ is broad leafed hydrophytes. (U.B) **(LHR 2013, MTN 2015)**
(A) Hydrilla (B) Water lilly
(C) Vallisneria (D) Pistia

10. Example of xerophyte is: (K.B) **(LHR 2013)**
(A) Cactus (B) Pinus
(C) Cycas (D) Sea grasses

11. The waste product of carnivorous plants and lady finger is: (K.B)
(A) Resins (B) Gums
(C) Latex (D) Mucilage

12. Gums is the waste product of: (K.B)
(A) Coniferous trees (B) Keekar
(C) Rubber plant (D) Ladyfinger

13. Secretions which are secreted by conifers are called: (K.B) **(LHR 2014)**
(A) Resins (B) Gums
(C) Latex (D) Mucilage

14. Mucilage is the waste product of: (K.B)
(A) Coniferous trees (B) Keekar
(C) Rubber plant (D) Ladyfinger

15. Excretion is one of the process of _____. (K.B)
(A) Homeostasis (B) Transpiration
(C) Guttation (D) Mutation

16. Oxygen is produced in _____ cells during day time, as a by-product of photosynthesis. (K.B)
(A) Cortex (B) Endodermis
(C) Mesophyll (D) Epidermis

17. In young roots, CO_2 diffuses through the general root surface, especially through_____. (K.B)
(A) Root hairs (B) Root
(C) Xylem (D) Stem

18. Plants store large amount of water in their cells for_____. (A.B)
(A) Flaccid (B) Turgidity
(C) Summer season (D) Winter session

19. The appearance of drops of water on the tips or edges of leaves is called_____. (K.B)
(A) Transpiration (B) Dew
(C) Guttation (D) Evaporation

20. The most common example of hydrophytes: (K.B) **(LHR 2017)**
(A) Sea grass (B) Cactus
(C) Water lily (D) Lady finger

21. Play role in maintaining body temperature: (K.B) **(LHR 2017)**
(A) Lungs (B) Kidney
(C) Skin (D) Ear

11.2 HOMEOSTASIS IN HUMANS

LONG QUESTIONS

Q.1 Describe homeostasis in human. (A.B)

OR

Name the organ which work for homeostasis in human, describe detail of work of any two organs in detailed. **(LHR 2017)**

Ans:

HOMEOSTASIS IN HUMAN

Organs for Homeostasis:

Like other **complex animals**, humans have **highly developed systems** for **homeostasis**. The following are the **main organs** which work for homeostasis.

- **Lungs**
- **Skin**
- **Kidneys**

Lungs:

Lungs **remove excess carbon dioxide** and keep it in **balance**.

- **Maintain** the concentration of **carbon dioxide** in **blood**.
- **Our cells** produce **carbon dioxide** when they perform **cellular respiration**.
- From cells, **carbon dioxide diffuses** into **tissue fluid** and from there into **blood**.
- **Blood** carries **carbon dioxide** to **lungs** from where it is **removed in air.**

ROLES OF SKIN IN HOMEOSTASIS

Definition:

"Outer most **protective layer** around the **body** of higher animals to perform **different vital tasks**".

Figure: Goosebumps

Structure of Skin:

Our skin consists of **two layers**:

- Epidermis
- Dermis

Epidermis:

The **outer protective layer without blood vessels** is called epidermis.

Dermis:

This **inner layer of skin** consists of:

- **Blood vessels**
- **Sensory nerve endings**
- **Sweat glands**
- **Oil glands**
- **Hairs**
- **Fat cells**

Skin as a Thermoregulatory Organ:

Skin performs important **role** in the **regulation of body temperature**.

In Cold:

The **thin layer** of **fat cells** in the **dermis insulates** the body. **Contraction** of **small muscles** attached to hairs forms **'Goosebumps'**. It creates an **insulating blanket** of **warm air**.

In Hot:

Similarly, **skin** helps in providing **cooling effect** when **sweat** is produced **by sweat glands** and **excess body heat** escapes through **evaporation**.

Skin as an Osmoregulatory and Excretory Organ:

The following **metabolic wastes** are also **removed** in **sweat** through **skin**:

- **Excess water**
- **Salts**
- **Urea**
- **Uric acid**

11.2 SHORT QUESTIONS

Q.1 Which organs of human work for homeostasis? (A.B) **(LHR 2016)**

Ans: Page no 35.

Q.2 How lungs and skin work for homeostasis? (A.B)

Ans: Page no 35.

Q.3 Write the name of two layers of skin? (K.B)

Ans: Page no 36.

Q.4 What are the roles of skin in human body? (A.B) **(LHR 2014)**

Ans: Page no 35

Q.5 How lungs remove CO_2, during cellular respiration? (A.B)

Ans: Page no 35.

Q.6 Why the dogs hang their tongues out and pant? (U.B)

Ans:

PANTING IN DOGS

Dogs hang their tongues out and pant to remove extra metabolic heat from their bodies.

W11.2 MULTIPLE CHOICE QUESTIONS

1. In humans, which organs help in the removal of carbon dioxide? (K.B)
(A) Kidneys (B) Adrenal glands
(C) Liver (D) Lungs

2. The skin perform its role as an organ of : (K.B)
(A) Osmoregulation (B) Excretion
(C) Thermoregulation (D) All of these

3. Which organ helps in providing cooling effect? (U.B)
(A) Kidneys (B) Skin
(C) Liver (D) Lungs

4. Excess body heat escapes through: (U.B)
(A) Transpiration (B) Excretion
(C) Cooling (D) Evaporation

5. Outer protective skin layer without blood vessels is: (K.B)
(A) Epidermis (B) Dermis
(C) Hypodermis (D) Endodermis

6. The outer protective layer of skin contains : (U.B)
(A) Blood vessels (B) Sweat and oil glands
(C) Fat cells (D) Dead cells

7. Which of the following process dogs do to get rid of extra body heat? (U.B)
(A) Transpiration (B) Panting
(C) Cooling (D) Evaporation

11.3 THE URINARY SYSTEM OF HUMANS

LONG QUESTIONS

Q.1 Describe human urinary system. (K.B)

Ans:

HUMAN URINARY SYSTEM

Definition:

"The **excretory system** of human is also called the **urinary system**".

The human urinary system **consists** of the following:

- A pair of kidneys
- A pair of ureters
- A urinary bladder
- A Urethra

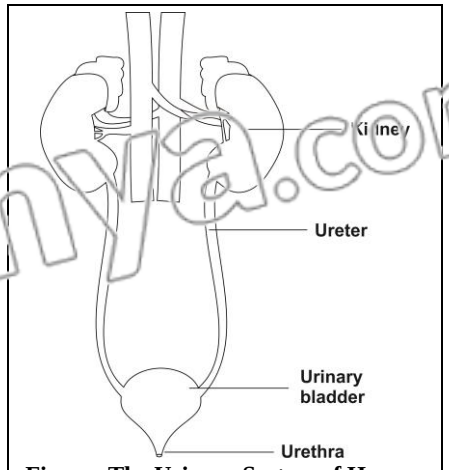


Figure: The Urinary System of Human

Pair of Kidney:

A **pair of kidneys** is present against the **back wall** of **abdominal cavity** just **below diaphragm**, one on **either side** of the **vertebral column**. The kidneys **filter blood** to produce **urine**.

Pair of Ureter:

The ureters **carry urine** from kidneys to the **urinary bladder**.

Urinary Bladder:

The urinary bladder **temporarily stores urine** until it is released from the body.

Urethra:

Urethra is the **tube** that carries **urine** from **urinary bladder** to the **outside** of the body.

Q.2 Describe structure of human kidney. **(LHR 2014, BWP 2014, SWL 2015)**

Ans:

STRUCTURE OF HUMAN KIDNEY

Definition:

"Organ responsible for **filtering the blood** is called **kidney**".

Colour:

The kidneys are **dark-red in colour**.

Shape:

The **kidneys** are **bean shaped**.

Dimensions:

Each **kidney** is **10 cm long**, **5 cm wide** and **4 cm thick.**

Weight:

Each **kidney weighs** about **120 grams**.

Location:

The kidneys are placed against the **back wall** of **abdominal cavity** just **below diaphragm**, one on either side of **vertebral column**. The left kidney is a **little higher** than the **right**. The **concave side** of the kidney **faces vertebral column.**

Protection:

The kidneys are **protected** by the **last two ribs**.

Internal Structure of Kidney:

Each kidney consists of the following structures:

Hilus:

There is a **depression** near the center of the **concave area** of the kidney called **hilus**. This is the area of kidney through which **ureter leaves kidney** and the other **structures enter and leave kidney**:

- **Blood vessels**
- **Lymphatic vessels**
- **Nerves**

The **longitudinal section** of the kidney shows **two regions.**

- Renal cortex
- Renal medulla

Renal Cortex:

Renal cortex is the **outer part of kidney**. It is **dark red in colour.**

Renal Medulla:

Renal medulla is the **inner part** of the kidney. It is **pale red in colour.**

Renal Pyramids:

Renal medulla consists of **several cone shaped areas** called **renal pyramids.**

Renal Pelvis:

Renal pyramids project into a **funnel-shaped cavity** called **renal pelvis**, which is the **base of ureter.**

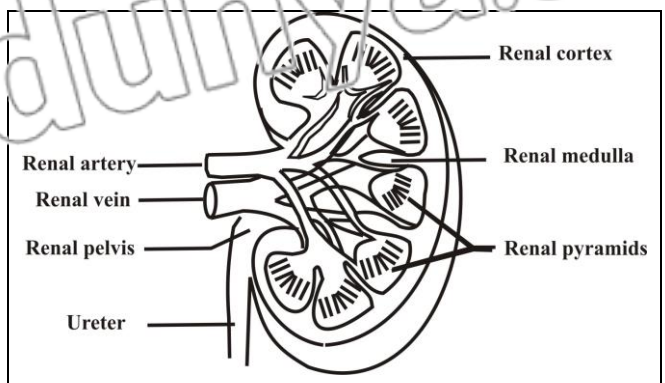


Figure: The Anatomy of a Kidney

Q.3 What is the functional unit of the kidney? Describe its structure and draw label diagram.
(Understanding the Concept Q.3)

OR

What is nephron? Describe its structure and also draw labelled diagram (U.B) (LHR 2017)

Ans:

NEPHRON

Definition:

"The **structural** and **functional unit** of the **kidneys** is called **nephron**". There are over **one million nephrons** in each kidney.

STRUCTURE OF NEPHRON

There are **two parts** of a nephron

- Renal corpuscle
- Renal tubule

Renal Corpuscle:

The renal corpuscle is **not tubular**. It consists of **two parts**. i.e. Glomerulus and Bowman's capsule.

Glomerulus:

It is the **network of capillaries**. The **capillaries** of the **glomerulus arise** from the **afferent arteriole** and **join** to form the **efferent arteriole**.

Bowman's Capsule:

Bowman's capsule is a **cup-shaped structure** that encloses **glomerulus.**

Renal Tubule:

The renal tubule is the **part of nephron** which **starts after Bowman's capsule**. It consists of **three parts**:

- Proximal convoluted tubule
- Loop of henle
- Distal convoluted tubule

Proximal Convoluted Tubule:

The **first portion** of the renal tubule is called **proximal convoluted tubule**.

Loop of Henle:

Next portion of renal tubule is **U-shaped** and is called the **loop of henle**.

Distal Convoluted Tubule:

The **last portion** of the renal tubule is the **distal convoluted tubule**.

Collecting Duct:

The distal convoluted tubules of **many nephrons open** in a **single collecting duct**.

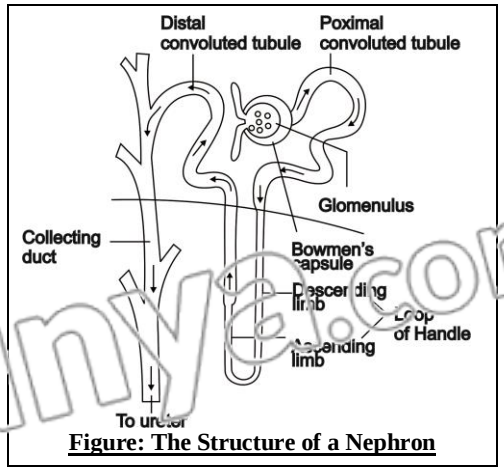


Figure: The Structure of a Nephron

Papillary Ducts:

Many collecting ducts **join together** to form **several hundred papillary ducts** which drain into **renal pelvis**.

Q.4 What steps are involved in formation of urine in kidney (A.B)
(Understanding the Concept Q.4) (LHR 2016)

Ans:

FORMATION OF URINE

There are **two major functions** of kidneys:

- As excretory organs
- As osmoregulartory organs

Kidneys as Excretory Organs:

The main function of kidneys as excretory organs is urine formation, which takes place in the following **three steps**:

- Pressure filtration
- Selective reabsorption
- Tubular secretion

Pressure Filtration: **(GRW 2015)**

This is the **first step**. When **blood enters** the **kidney** via the **renal artery**, it goes to many **arterioles,** and then to the **glomerulus**. The **pressure** of blood is very **high** and so most of the **water, salts**, **glucose** and **urea** of blood is **forced** out of **glomerular capillaries**.

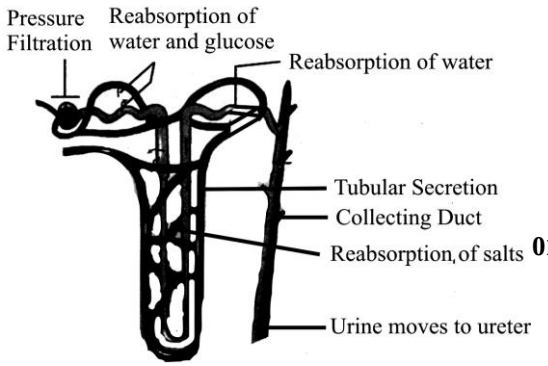


Figure: Functioning of Kidney (Nephron) **015)**

Glomerular Filtrate:

The **material** that passes into the **Bowman's capsule** from the glomerulus after **pressure filtration** is called **glomerular filtrate.**

Selective Reabsorption:

The **second step** is the **selective reabsorption**. In this step **about 99%** of the **glomerular filtrate** is **reabsorbed** into the **blood capillaries** surrounding **renal tubule**. The selective reabsorption occurs through:

- **Osmosis**
- **Diffusion**
- **Active transport**

Proximal Convoluted Tubule:

Some **water** and **most of the glucose** is **reabsorbed** form the **proximal convoluted tubule**. Here, **salts** are **reabsorbed** by **active transport** and then water follows by osmosis.

Loop of Henle:

The **descending limb of loop of Henle** allows the **reabsorption of water** while the **ascending limb of Loop** of Henle allows the **reabsorption of salts**.

Distal Convoluted Tubule:

The **distal convoluted tubule** again allows the **reabsorption of water** into the blood.

Tubular Secretion:

The **third step** is the **tubular secretion**. Different **ions, creatinine, urea etc**. are **secreted** from **blood** into the **filtrate** in renal tubule. This is done to maintain **blood at a normal pH** (7.35 to 7.45).

Urine:

After pressure filtration, selective reabsorption and tubular secretion, the **filtrate** present in **renal tubules** is known as **urine**. It moves into **collecting ducts** and then into **pelvis**.

At the **final stage urine** is only **1%** of the originally filtered volume. The typical **volume** of urine produced by average adult is around **1.4 liters per day.**

Water	95%
Urea	9.3 g/l
Chloride ions	1.87 g/l
Sodium ions	1.17 g/l
Potassium ions	0.750 g/l
Other ions and compounds	Variable amounts

Table: Normal Chemical Composition of Urine (Source: NASA Contractor Report)

Q.5 Along with excretion, kidneys also play role in osmoregulation. Comment on this statement. (A.B) **(MTN 2015) (Understanding the Concept Q.5)**

Ans: **OSMOREGULATORY**

Osmoregulation:

The **regulation** of the concentration of **water and salts in blood** and other **body fluids** is called **osmoregulation**.

Importance:

Kidneys play important **role** in osmoregulation by **regulating the water** contents of **blood**. It is an important process as **excessive loss of water** concentrates the body fluids whereas **excess** intake of water **dilutes** them.

Production of Hypotonic Urine:

When there is **excess water** in body fluids, kidneys form **dilutes** (hypotonic) urine. For this purpose, kidneys filter more water from glomerular capillaries into Bowman's capsule. Similarly, **less water** is **reabsorbed** and **abundant dilute urine** is produced. It brings **down** the volume of **body fluids** to normal.

Production of Hypertonic Urine:

When there is **shortage of water** in body fluids, kidneys filter **less water** from **glomerular capillaries** and the rate of **reabsorption of water** is **increased**. **Less filtration** and **more reabsorption** produce **small amount** of concentrated (hypertonic) **urine**. It **increases** the volume of **body fluids to normal**.

Hormonal Control:

This whole process of kidneys is under **hormone control**.

Q.6 Describe the process of selective reabsorption in the kidney. (U.B)
(Understanding the Concept Q.1)

Ans: **SELECTIVE REABSORPTION**

The second step in urine formation is the selective reabsorption. In this step about 99% of the glomerular filtrate is reabsorbed into the blood capillaries surrounding renal tubule. The selective reabsorption occurs through:

- Osmosis
- Diffusion
- Active transport

Proximal Convoluted Tubule:

Some water and most of the glucose is reabsorbed form the proximal convoluted tubule. Here, salts are reabsorbed by active transport and then water follows by osmosis.

Loop of Henle:

The descending limb of loop of Henle allows the reabsorption of water while the ascending limb of loop of henle allows the reabsorption of salts.

Distal Convoluted Tubule:

The distal convoluted tubule again allows the reabsorption of water into the blood.

Tubular Secretion:

The third step is the tubular secretion. Different ions, creatinine, urea etc. are secreted from blood into the filtrate in renal tubule. This is done to maintain blood at a normal pH (7.35 to 7.45).

Urine:

After pressure filtration, selective reabsorption and tubular secretion, the filtrate present in renal tubules is known as urine. It moves into collecting ducts and then into pelvis.

At the final stage urine is only 1% of the originally filtered volume. The typical volume of urine produced by ab average adult is around 1.4 liters per day.

11.3 SHORT QUESTIONS

Q.1 Enlist the parts of human urinary system. (K.B) **(LHR 2015, 2016, GRW 2015, MTN 2015)**

Ans: Page no 37.

Q.2 How excretory system works in humans? (A.B) **(GRW 2014, MTN 2015)**

Ans: Page no 37.

Q.3 What is renal corpuscle? (K.B) **(DGK 2015)**

Ans: Page no 39.

Q.4 Name the parts of nephron. (K.B) **(LHR 2016)**

Ans: Page no 39.

Q.5 What is tubular secretion? (K.B) **(GRW 2013)**

Ans: Page no 40.

Q.6 How kidneys manage the excess water in body fluid? (U.B)

Ans: Page no 41.

Q.7 What is the function of loop of henle? (A.B)

Ans: Page no 40.

Q.8 Why blood cells and proteins are not filtered through the glomerular capillaries? (U.B)

Ans:

FILTRATION OF BLOOD

Blood cells and proteins are not filtered through the glomerular capillaries because they are relatively larger in size.

Q.9 Why filtration takes place in glomerulus part of nephron? (U.B)

Ans:

FILTRATION IN GLOMERULUS

Filtration takes place in glomerulus part of nephron due to:

- High blood pressure
- Presence of blood capillaries

Walls of glomerulus are porous

Q.10 How kidneys help to control blood pressure? (U.B)

Ans:

BLOOD PRESSURE CONTROL

Kidneys filter salts from blood to excrete salts out of body in the form of urine. It helps in controlling blood pressure.

11.3 MULTIPLE CHOICE QUESTIONS

1. Colour of human kidney: (K.B)

(A) Dark yellow (B) Dark red
(C) Dark Green (D) Purple

2. Tube between kidney and urinary bladder is. (K.B) **(SWL 2015)**

(A) Nephron (B) Urethra
(C) Renal tubule (D) Ureter

3. The tubes that carry urine from kidney are: (K.B) **(SWL 2015)**

(A) Urethra (B) Urinary bladder
(C) Ureters (D) Pelvis

4. Ribs which protect the kidney are: (K.B) **(MTN 2013)**

(A) First two (B) Last two
(C) Middle (D) Last four

5. Organ responsible for filtering the blood is: (K.B) **(LHR 2015, GRW 2017)**

(A) Intestine (B) Brain
(C) Stomach (D) Kidney

6. Which one is correct? (U.B)
(A) The left kidney is little higher than the right
(B) The right kidney is little higher than the left
(C) Both are equally placed
(D) The left kidney is half smaller than the right

7. Approximate weight of a kidney is: (K.B) **(LHR 2014)**
(A) 10 grams (B) 15 grams
(C) 20 grams (D) 120 grams

8. Urine is temporarily stored in : (K.B)
(A) Urethra (B) Urinary bladder
(C) Ureters (D) Pelvis

9. Right kidney is lower than left due to: (K.B)
(A) Diaphragm (B) Stomach
(C) Liver (D) Vertebral column

10. Colour of renal medulla: (U.B)
(A) Dark red (B) Pale red
(C) Dark yellow (D) Dark green

11. The functional unit of kidney: (A.B) **(DGK 2014, BWP 2015)**
(A) Nephron (B) Neuron
(C) Renal pelvis (D) Renal cortex

12. In how many steps urine formation takes place? (K.B)
(A) 1 (B) 2
(C) 3 (D) 4

13. The percentage of urine at final stage to the originally filtered volume: (K.B)
(A) 1% (B) 2%
(C) 3% (D) 4%

14. In urine chemical composition, the percentage of water: (K.B) **(LHR 2016)**
(A) 80% (B) 85%
(C) 90% (D) 95%

15. In urine chemical composition, the amount of urea: (K.B)
(A) 8.9 g/l (B) 9.1 g/l
(C) 9.3 g/l (D) 9.5 g/l

16. In urine chemical composition, the amount of chloride iron: (K.B)
(A) 1.79 g/l (B) 1.83 g/l
(C) 1.85 g/l (D) 1.87 g/l

17. The vessels which take blood towards renal corpuscles : (K.B)
(A) Afferent arteriole (B) Efferent arteriole
(C) Afferent venule (D) Efferent venule

18. The left kidney is little _____ than the right. (K.B)
(A) Lower (B) Higher
(C) Beside (D) Diagonal

19. The concave side of kidney faces _____. (K.B)
(A) Vertebral column (B) Lungs
(C) Pituitary gland (D) Stomach

20 _____ is a cup shaped structure that encloses glomerulus. (K.B)
(A) Bowman's capsule (B) Nerve
(C) Nephron (D) Renal

21. Renal pyramids project into funnel shaped cavity called renal pelvis which is at the base of: (K.B)
(A) Urethra (B) Ureter
(C) Nephron (D) Bladder

22. The renal corpuscle has _____ parts. (K.B)
(A) 4 (B) 5
(C) 3 (D) 2

23. There are over _____ million nephrons in each kidney. (K.B) **(DGK 2015)**
(A) 1 (B) 2
(C) 3 (D) 4

24. Last portion of convoluted tubule in called _____ convoluted tubule. (K.B)
(A) Proximal (B) Distal
(C) Glomerulus (D) Loop of Henle

25. Normal pH of human blood is: (K.B)
(A) 7.00 – 8.00 (B) 6.35 - 6.45
(C) 7.35 – 7.45 (D) 7.30 – 7.40

26. The most of glucose is reabsorbed from : (K.B)
(A) Distal convoluted tubules (B) Proximal convoluted tubules
(C) Ascending loop of Henle (D) Descending loop of Henle

27. Amount of K^+ ions in urine: (K.B)
(A) 0.450 g/l (B) 0.650 g/l
(C) 0.350 g/l (D) 0.750 g/l

28. The typical volume of urine produced by an adult in liter per day is: (K.B) **(GRW 2016)**
(A) 2.4 (B) 1.4
(C) 4.2 (D) 4.1

29. The longitudinal section of kidney shows outer part: (K.B) **(GRW 2017)**
(A) Renal cortex (B) Renal pyramid
(C) Renal medulla (D) Renal pelvis

11.4 DISORDERS OF KIDNEY

LONG QUESTIONS

Q.1 Explain some kidney disorders. (K.B)

Ans:

KINDNEY DISORDERS

There are many different **kidney disorders**. Some of them are:

- **Kidney Stones**
- **Kidney (Renal) Failure**

KIDNEY STONES

Explanation:

When urine becomes **concentrated crystals** of the following **salts** are formed:

- **Calcium oxalate**
- **Calcium phosphate**
- **Ammonium phosphate**
- **Uric acid**

Such **large crystals cannot pass** in urine and form **hard deposits** called **kidney stones**. Most **stones start in kidney**. Some may **travel to ureter** or **urinary bladder**.

Causes:

The **major causes** of kidney stones are:

- **Age**
- **Diet (containing more green vegetables, salts, vitamins C and D)**
- **Recurring urinary tract infections**
- **Less intake of water**
- **Alcohol consumption**

Symptoms:

The **symptoms** of kidney stones include:

- **Severe pain in kidney** or in **lower abdomen**
- **Vomiting**
- **Frequent urination**
- **Foul-smelling urine**
- **Urine with blood and pus**

Treatment:

The **treatment** of kidney stones includes:

- **Excessive water intake**
- **Surgical treatment**
- **Lithotripsy**

Excessive Water Intake:

About 90% of all kidney **stones** can **pass** through the **urinary system** by **drinking plenty of water**.

Surgical Treatment:

In **surgical treatment**, the **affected area** is **opened** and **stone**(s) are **removed**.

Lithotripsy:

Lithotripsy is another **method** for the **removal of kidney stones**. In this method, **non-electrical shock waves** from **outside** are **bombarded** on the **stones** in the urinary system. Waves hit the **dense stones** and break them. Stones become **sand-like** and are **passed** through **urine**.

KIDNEY (RENAL) FAILURE

Definition:

"Kidney failure means a **complete or partial failure** of kidneys to **function**".

Causes:

Following are the **causes** of kidney failure:

- **Leading causes**
- **Other causes**

Leading Causes:

- **Diabetes mellitus**
- **Hypertension**

Other Causes:

- **Sudden interruption** in **blood supply** to kidneys
- **Drug overdoses**

Symptoms:

The **main symptoms** of kidney failure are:

- **High level of urea**
- Other **wastes in blood** which can result in the following **symptoms**
  - **Vomiting**
  - **Nausea**
  - **Weight loss**
  - **Frequent urination**
  - **Blood in urine**
- **Excess fluids** in body may also cause **swelling of legs**, feet and face
- **Shortness of breath**

Treatment:

The **kidney failure** is treated with the following:

- **Dialysis**
- **Kidney Transplant**

Q.2 Explain different treatments of kidney failure. (A.B)

Ans:

TREATMENTS OF KIDNEY FAILURE

The kidney failure is **treated** with the following:

- Dialysis
- Kidney Transplant

DIALYSIS

Definition:

"The **cleaning of blood** by **artificial ways** is called dialysis".

Methods of Dialysis:

There are **two methods** of dialysis

- Peritoneal Dialysis
- Haemodialysis

Peritoneal Dialysis:

In this type of dialysis, the **dialysis** fluid is **pumped** for a **time** into the **peritoneal cavity** which is the space around **gut**. This cavity is **lined** by **peritoneum**. Peritoneum contains **blood vessels**.

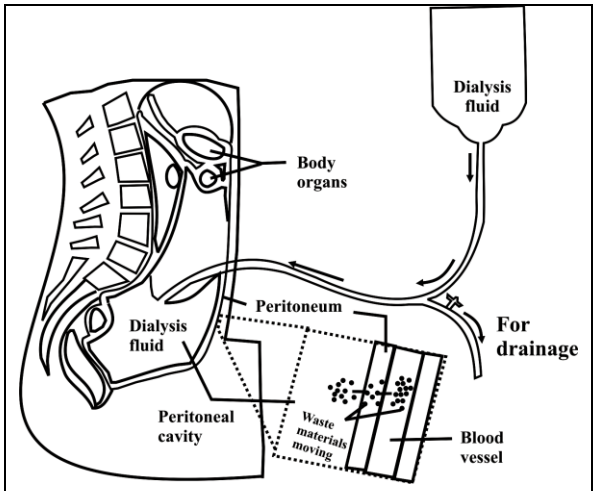


Figure: Peritoneal Dialysis

Extraction of Waste Materials:

When we place dialysis fluid in **peritoneal cavity, waste materials** from **peritoneal blood vessels** diffuse into the **dialysis fluid**, which is then **drained out**.

Duration:

This type of dialysis can be performed at **home**, but must be done **every day**.

Haemodialysis:

In haemodialysis, patient's **blood** is **pumped** through an **apparatus** called **dialyzer**. The **dialyzer** contains **long tubes**, the **walls** of which act as **semi-permeable membranes.**

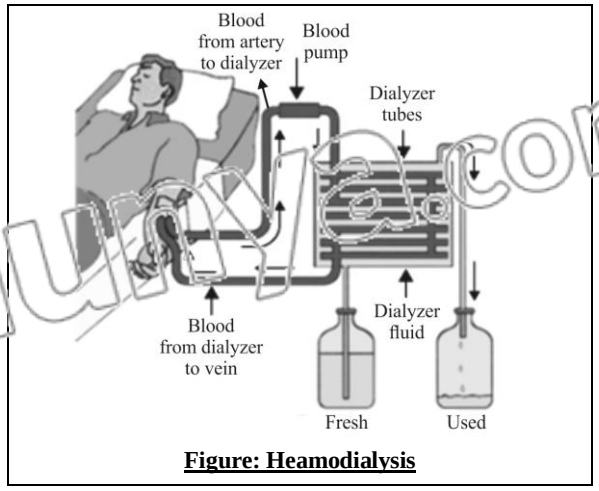


Figure: Heamodialysis

Extraction of Waste Materials:

Blood flows through the **tubes** while the **dialysis fluid** flows **around the tubes**. Extra **water and wastes** move from blood into the **dialysis fluid**. The **cleansed blood** is then **returned back** to body.

Duration:

The haemodialysis **treatments** are typically given in **dialysis centres three times per week**.

KIDNEY TRANSPLANT

Definition:

"The **replacement** of patient's **damaged kidney** with a **donor's healthy kidney** is called kidney transplant."

End Stage Renal Failure:

Dialysis needs to be **repeated after every few days** and is unpleasant for patients and attendants. Another treatment for the **end-stage kidney** failure is **kidney transplantation**.

Kidney Donors:

Kidney may be **donated** by a **deceased donor** or **living donor**. The **donor may** or **may not be a relative** of the **patient**.

Tissue Matching:

Before transplant, the **tissue proteins** of **donor** and **patient** are **matched**.

Transplantation:

The **donor's kidney** is **transplanted** in **patient's body** and is connected to the **patient's blood** and **urinary system**.

Average Life Time of Transplanted Kidney:

The **average lifetime** for a **donated kidney** is **ten** to **fifteen years**.

Failure of Transplanted Kidney:

When a **transplant fails**, the **patient may** be given a **second kidney transplant**. In this situation, the **patient is treated** through **dialysis** for **some intermediary time**.

Problems After Kidney Transplant:

Problems after a **transplant** may include:

- **Transplant rejection**
- **Infections**
- **Imbalances in body salts which can lead to**
  - **Bone problems**
  - **Ulcers**

11.4 SHORT QUESTIONS

Q.1 What are kidney stones? (K.B) **(LHR 2014, 17, GRW 2016, 17)**

OR

What are the causes of kidney stones? (U.B)

Ans: Page no 44.

Q.2 What are symptoms of kidney stone? (U.B)

Ans: Page no 44.

Q.3 What are treatments of kidney stone? (A.B)

Ans: Page no 44.

Q.4 What is lithotripsy? (A.B) **(LHR 2016, 17)**

Ans: Page no 45

Q.5 Define kidney failure. What are the causes of kidney failure? (K.B)

Ans: Page no 45.

Q.6 What are symptoms of kidney failure? (U.B)

Ans: Page no 45.

Q.7 What are the treatments of a kidney failure? (A.B)

Ans: Page no 45.

Q.8 Define dialysis. What are its types? (K.B) **(LHR 2013, 16)**
Ans: Page no 46.
Q.9 Define kidney transplant. (K.B) **(GRW 2014)**
OR
What is meant by kidney transplant? (K.B) **(GRW 2017)**
Ans: Page no 46.
Q.10 What are the problem after kidney transplant? (U.B)
Ans: Page no 46.
Q.11 What are the contributions of Abu Nasr-al-Farabi? (K.B)
Ans:

CONTRIBUTION OF ABU NASR-AL-FARABI

Abu Nasr-al-Farabi (872-951 AD) was a prominent scientist who wrote many books that contained information about kidney diseases.

Q.12 What are the contributions of Al. Zahrawi? (K.B)
Ans:

CONTRIBUTION OF AL. ZAHRAWI

The genius Abul-al-Qasim Al-Zahrawi (known as Albucasis: 936-1013 AD) is considered to be Islam's greatest surgeon who invented many surgical procedures including the surgical removal of stones form the urinary bladder. His encyclopedia, Al-Tasrif ("The Method") contained over 200 surgical medical instruments he personally designed.

11.4 MULTIPLE CHOICE QUESTIONS

1. What are the leading causes of kidney failure? (A.B)

(A) Diabetes mellitus and hypertension (B) Hypertension only
(C) Diabetes mellitus only (D) Drug overdoses

2. The haemodialysis treatment is given in dialysis centers _____ times per week. (A.B)

(A) 4 (B) 3
(C) 2 (D) 1

3. Diabetes and hypertension are leading causes of _____ failure. (K.B)

(A) Lung (B) Kidney
(C) Liver (D) Stomach

4. Major causes of kidney stones are: (A.B)

(A) Age (B) diet
(C) Less water intake (D) All of these

5. Date of death of Abu Nasr al-Farabi: (K.B)

(A) 950 AD (B) 951 AD
(C) 952 AD (D) 953 AD

6. Al-tasrif was written by: (K.B)

(A) Abu Nasir Al- Farabi (B) Abu Musa Ashari
(C) Abu Usman umer Aljahiz (D) Abu al Qasim Al-Zaharawi

7. The main symptom/symptoms of kidney failure is: (U.B) **(LHR 2013)**

(A) Weight loss (B) Frequent urination

(C) Vomiting (D) All of these

8. How many surgical medical instruments were personally designed by Abu al-Qasim Al-Zahrawi: (K.B)

(A) Less than 200 (B) 200

(C) Over 200 (D) 150

9. A method for the removal of kidney stone is: (A.B) **(LHR 2013)**

(A) Peritoneal dialysis (B) Haemodialysis

(C) Kidney transplant (D) Lithotripsy

10. Swelling of legs, feet and face and shortness of breath are the symptoms (U.B)

(A) Diarrhoea (B) Constipation

(C) Kidney failure (D) Kidney stones

11. The replacement of the patient's damaged kidney with the donor's healthy kidney is called: (K.B)

(A) Heart transplant (B) Kidney transplant

(C) Liver transplant (D) Brain transplant

12. Average life time of donated kidney: (U.B)

(A) Five to ten years (B) Ten to fifteen years

(C) Twelve to twenty years (D) Two to five years

13. Problems after kidney transplant include: (U.B)

(A) Transplant rejection (B) Infections

(C) Imbalance in body salts (D) All of these

14. There are _____ methods of dialysis. (K.B)

(A) 2 (B) 3

(C) 4 (D) 5

15. Abu Nasr al Farabi was born in: (K.B)

(A) 800 AD (B) 870 AD

(C) 850 AD (D) 872 AD

16. Abu Al-Qasim Al-Zahrawi died in: (K.B)

(A) 1011 AD (B) 1013 AD

(C) 1015 AD (D) 1012 AD

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

11.1 HOMEOSTASIS IN PLANTS

1	B	**2**	C	**3**	D	**4**	B	**5**	D	**6**	D	**7**	B	**8**	A	**9**	B
10	A	**11**	D	**12**	B	**13**	A	**14**	D	**15**	A	**16**	C	**17**	A	18	B
19	C	**20**	C	**21**	C												

11.2 HOMEOSTASIS IN HUMANS

1	D	**2**	C	**3**	B	**4**	D	**5**	A
6	D	**7**	B						

11.3 URINARY SYSTEM OF HUMANS

1	B	**2**	D	**3**	C	**4**	B	**5**	D	**6**	A
7	D	**8**	B	**9**	C	**10**	B	**11**	A	**12**	C
13	A	**14**	D	**15**	C	**16**	D	**17**	A	**18**	B
19	A	**20**	A	**21**	B	**22**	D	**23**	A	**24**	B
25	C	**26**	B	**27**	D	**28**	B	**29**	A		

11.4 DISORDERS OF KIDNEY

1	A	**2**	B	**3**	B	**4**	D	**5**	B	**6**	A	**7**	D	**8**	C
9	D	**10**	C	**11**	B	**12**	B	**13**	D	**14**	A	15	D	16	B

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. The human urinary system consists of: (K.B)
(a) Rectum, lungs, kidneys, ureters (b) Kidneys, ureters, urinary bladder
(c) Skin, liver, lungs, kidneys (d) Kidneys, ureters, urinary bladder, urethra

2. Which organ is responsible for filtering the blood? (K.B)
(a) Intestine (b) Brain
(c) Stomach (d) Kidney

3. The tube between kidney and urinary bladder is the: (K.B)
(a) Ureter (b) Urethra
(c) Renal tubule (d) Nephron

4. 'Body balance' of water, salts, temperature and glucose is termed as: (K.B)
(a) Excretion (b) Tubular secretion
(c) Homeostasis (d) Re-absorption

5. Which is the correct order for the path taken by urine after it leaves the kidneys? (U.B)
(a) Urethra, bladder, ureters (b) Bladder, ureters, urethra
(c) Ureters, bladder, urethra (d) Bladder, urethra, ureters

6. What is the function of the ureter? (A.B)
(a) To store urine (b) To carry urine from the kidney to the bladder
(c) To carry urine out of the body (d) To remove waste from the blood

7. What waste products are excreted by kidneys? (U.B)
(a) Urea, water & salts (b) Salts, water and carbon dioxide
(c) Urea & water (d) Urea & salts

8. The two main functions of sweat are: (A.B)
(a) To keep the body cool and to remove excess proteins
(b) To keep the body warm and to filter the blood
(c) To filter the blood and to remove waste products
(d) To remove waste products and to cool the body

9. Which would NOT be present in the filtrate entering the Bowman's capsule of nephron? (K.B)
(a) Water (b) Calcium ions
(c) Blood cells (d) Urea

10. During peritoneal dialysis, the waste materials move from: (U.B)
(a) The abdomen to the dialysis fluid
(b) The dialysis fluid to the peritoneum blood vessels
(c) The peritoneum blood vessels to the dialysis fluid
(d) The dialysis fluid to the abdomen

ANSWER'S KEY

1	d	2	d	3	a	4	c	5	c
6	b	7	a	8	d	9	c	10	c

SHORT QUESTIONS

1. What are the major organs involved in homeostasis in human body? State the roles of each of these organs. (K.B)

Ans:

ORGANS WORK FOR HOMEOSTASIS

Like other complex animals, humans have highly developed systems for homeostasis. The following are the main organs which work for homeostasis.

Lungs:

Lungs remove excess carbon dioxide and keep it in balance.

- Maintain the concentration of carbon dioxide in the blood.
- Our cells produce carbon dioxide when they perform cellular respiration.
- From cells, carbon dioxide diffuses into tissue fluid and from there into blood.
- Blood carries carbon dioxide to lungs from where it is removed in air.

Skin:

Skin performs role in the maintenance of body temperature and also removes excess water and salts.

Kidneys:

Kidneys filter excess water, salts, urea, uric acid etc. from the blood and from urine.

2. Identify and label the following: diagram (K.B)

Ans:

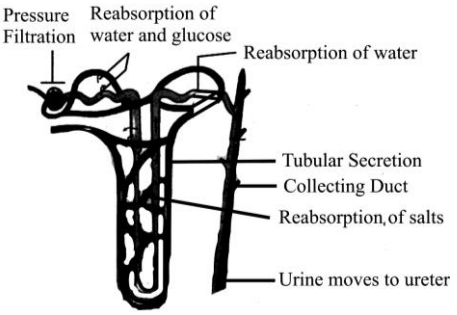


Figure: Functioning of Kidney (Nephron)

UNDERSTANDING THE CONCEPT

1. Describe the process of selective reabsorption in the kidneys. (K.B)

Ans: See the LQ.6 (Topic 11.3)

2. How do the plants excrete extra water and salts from their bodies? (A.B)

Ans: See the LQ. 1 (Topic 11.1)

3. What is the functional unit of the kidney? Describe its structure and draw labelled diagram (K.B)

Ans: See the LQ.3 (Topic 11.3)

4. What steps are involved in the formation of urine in the kidneys? (A.B)

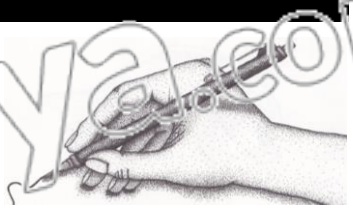
Ans: See the LQ.4 (Topic 11.3)

5. "Along with excretion, kidneys also play role in osmoregulation." Comment on this statement. (U.B)

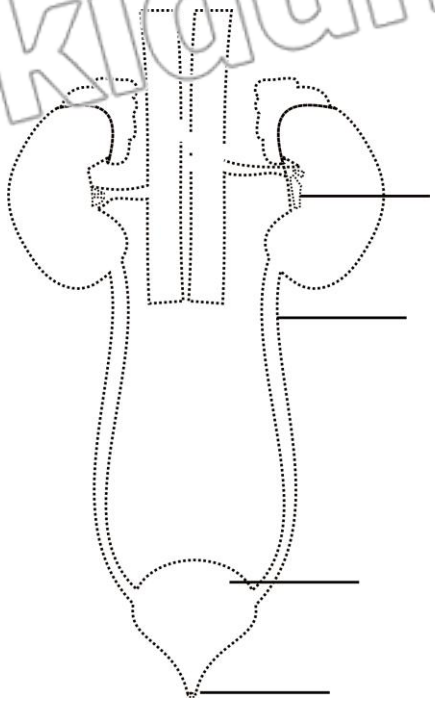
Ans: See the LQ.5 (Topic 11.3)

ASSIGNMENT

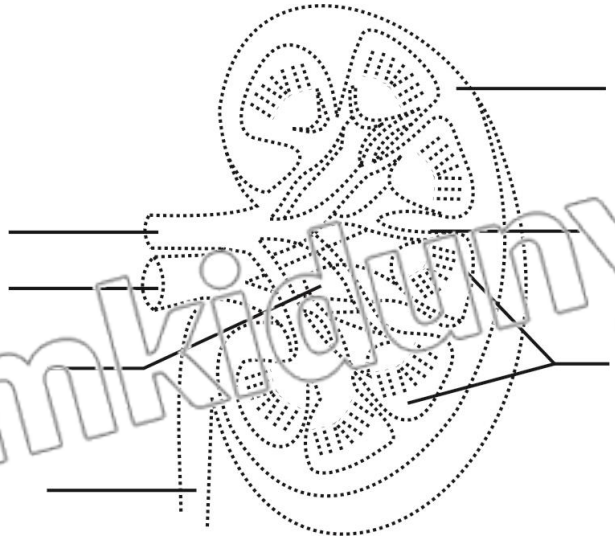
PRACTICE DIAGRAM & LABEL



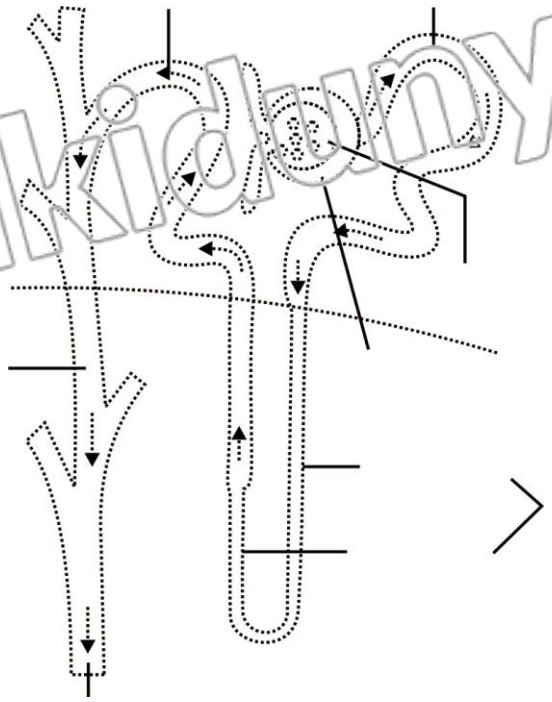
URINARY SYSTEM OF HUMANS



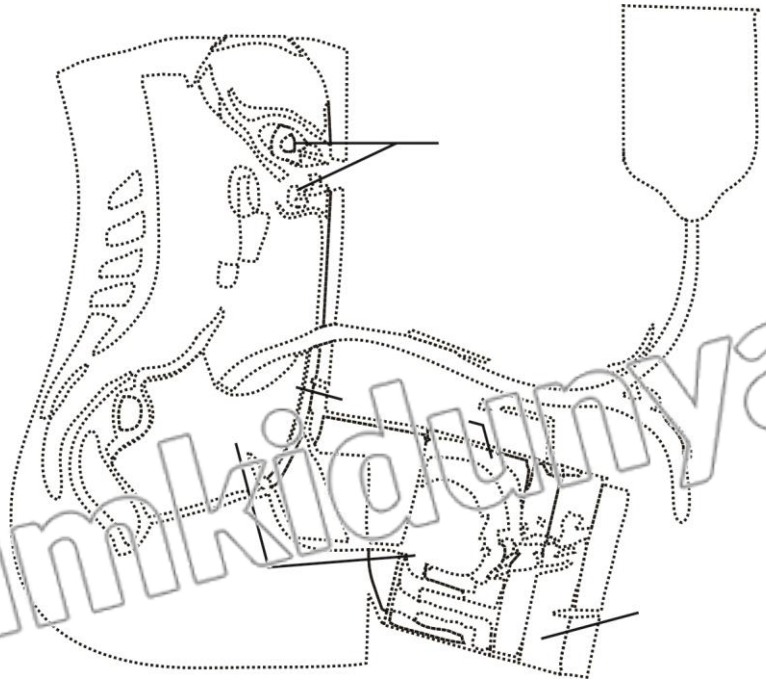
ANATOMY OF A KIDNEY



STRUCTURE OF A NEPHRON



PERITONEAL DIALYSIS



CUT HERE

SELF TEST

Time: 40 min **Marks: 25**

Q.1 Four possible answers A, B, C and D to each question are given, mark the correct answer. **(6×1=6)**

1. The waste product of keekar: (K.B)

(A) Resins **(B)** Gums

(C) Latex **(D)** Mucilage

2. Excess body heat escapes through: (K.B)

(A) Transpiration **(B)** Excretion

(C) Cooling **(D)** Evaporation

3. Which one is correct? (U.B)

(A) The left kidney is little higher than the right

(B) The right kidney is little higher than the left

(C) Both are equally placed

(D) The left kidney is half smaller than the right

4. The renal corpuscle has _____ parts. (K.B)

(A) 4 **(B)** 5

(C) 3 **(D)** 2

5. A method for the removal of kidney stone is: (A.B) **(LHR 2013)**

(A) Peritoneal Dialysis **(B)** Haemodialysis

(C) Kidney transplant **(D)** Lithotripsy

6. The replacement of the patient's damaged kidney with the donor's healthy kidney is called: (K.B)

(A) Heart transplant **(B)** Kidney transplant

(C) Liver transplant **(D)** Brain transplant

Q.2 Give short answers to following questions. **(5×2=10)**

(i) Differentiate between transpiration and guttation. **(U.B)**

(ii) Write two characters of xerophytes? **(K.B)**

(iii) How lungs remove CO_2, during cellular respiration? **(K.B)**

(iv) Name the parts of nephron. **(K.B)**

(v) What are symptoms of kidney failure? **(U.B)**

Q.3 Answer the following questions in detail. **(5+4=9)**

(a) Describe Human urinary system. **(K.B)**

(b) Write few roles of skin in homeostasis. **(A.B)**

NOTE: Parents or guardians can conduct this test in their supervision in order to check the skill of the students.