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Chapter No-15

Homeostasis

Q1 write short note on homeostasis.

Answer: Homeostasis:

Meaning :- Greek word—"Homeo"—same, "stasis"—standing

Definition :- The ability of an organism to maintain its internal-environment constant or nearly constant is known as homeostasis.

Types of environment :- According to the French - physiologist named—"Claude Bernard", environment may be external or internal. i.e—

1: External environment :- The Surrounding of the - animal is called external-environment.

2: Internal environment :- The fluid around the inner-cells is called internal-environment.

Importance of Homeostasis:

- 1- The homeostasis is the main requirement of an - organism and is necessary for normal body functions.
- 2- The organisms having better homeostatic-system will survive better and adopt in the changing condition.
- 3- Homeostasis contributes in the evolutionary process
- 4- In homeostasis there is a check and balance system which is necessary for normal body functions.
- 5- Such controlling mechanism helps to prevent drastic

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changes within the body of organism.

6- Homeostasis provide independence from variations in the external environment of the organism.

Q2 Explain Mechanism or working of homeostasis.

Answer: Mechanism of Homeostasis:

Introduction :- The condition and components (water, salt, temperature, etc) of the external environment keep on changing continuously but the organisms - resist and try to overcome the effect of these changes by making adjustment in their internal-environment. This occurs with the help of various control system. i.e.-

1: Homeostatic control system: (ETEA-2016)

Definition :- Anything that must be maintained in the body within a normal range must have a system called control-system.

→ The control-system have acquired for the variety of of homeostatic regulation.

Components of control-system:- The homeostatic control system is composed of following 4-components.

1- Stimulus :- It is any change in internal or external environment.

stimulus
↓

Receptor

→

integrator

→

Effector

→Response

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<u>2- Receptor :-</u> Receptor detects changes (stimulus) in the environment and sends information through something to the control centre.		
<u>3- Control centre :-</u> Control-centre collects data or informations and sends orders to the effector for response		
<u>4- Effector :-</u> Effector shows response or opposite - effect to the stimulus.		
<u>Types of control-system :-</u> There are two type of controlsystem		
<u>i: physical control system :-</u> — [Exercise Question]		
<u>Definition :-</u> The controlling mechanism or system of non-Living things or system is called physical control system.		
<u>Components :-</u> physical control system has 4- components		
i.e- Stimulus, sensor, control centre and on/off switch.		
<u>Example :-</u> Temperature control-system of Lab-Incubator.		
<u>Work of physical control system : (incubator) -</u>		
1: In the incubator, thermometer is the receptor (sensor), Thermostat is the control-centre and the heating-coil in it is the effector.		
2: The role of incubator is to provide stable condition or temperature in the Laboratory.		
3: when the temperature of the room decreases (stimulus) than set point, Thermometer (receptor) detects - Changes in temperature and signals the thermostat (control-centre) of incubator which will turn on the		

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heating coil <effector> and temperature will start to rise. 4: when temperature increases (stimulus) than the set point, again thermometer <Receptor> detects the change and will signal the thermostat <control-centre> which will turn off the heating coil <effector> and the temperature start decreasing. <u>ii- Living control system:</u> The Living control-systems work exactly on the — mechanism of physical control system. <u>components :-</u> Living control system has 4-components i.e- stimulus, Receptor, control centre and effector. <u>Example :-</u> Temperature control system of human. <u>Work of Living control system: (Thermoregulation of human)</u> 1: In human, thermoreceptor act as receptor, Hypo- -thalamus is the control-centre and gland and — muscle is the effector. 2: when temperature in the external environment rises or fall <stimulus> than the normal body-temperature, It is detected by thermoreceptors <Receptors> in — Skin, a signal or message is sent to hypothalamus <control-centre>. 3: Hypothalamus sends signal to sweat gland <effector> for cooling and to muscles <effector> for heating.		

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4: This will bring body temperature to normal.		
<u>2: Feedback Mechanism:</u>		
<u>Definition :-</u> The detection of change (stimulus) by the receptors and sending signals by control-system to the effectors for a response is called feedback-mechanism.		
<u>Components :-</u> Feedback-mechanism is also composed of 4-components i.e.- stimulus, receptor, control centre, effector.		
<u>Types :-</u> There are two types of feedback-mechanism. i.e.		
<u>i: Negative Feedback mechanism:</u>		
<u>Definition :-</u> It is the type of feedback mechanism in which the effector-response is opposite to the change (stimulus) in external-environment.		
<u>Importance :-</u>		
1- In general, negative-feedback loops allow systems to self-stabilize.		
2- Negative-feedback is a vital control mechanism for the body's-homeostasis.		
<u>Explanation with example :- (secretion of ADH) -</u>		
1- when deficiency of water (stimulus) occurs in body.		
2- Hypothalamus (control-centre) detected it and - stimulate posterior-pituitary gland (effector) to secrete ADH.		
3- Then ADH increases permeability of distal convoluted tubules and collecting ducts of nephron.		

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4- As a result more water will be reabsorbed so the water level in blood is maintained. 5- After normal water level, the hypothalamus again detect it and slowdown or stop the secretion of ADH through posterior-pituitary-gland. 6- The above example show that the effector response (secretion of ADH) will be on opposite direction to change or stimulus (deficiency of water) is called - negative feedback mechanism. <u>ii: positive feedback mechanism:</u> <u>Definition :-</u> It is the type of feedback mechanism in which the effectors response will be similar or towards the change in external environment. <u>Importance :-</u> positive feedback occurs to increase the change or output, the result of a reaction is amplified to make it occur more quickly. <u>Explanation with example : (child birth) -</u> 1- During child-birth the baby head touches the receptors of cervical-canal or uterus, as a result the posterior pituitary gland secrete oxytocin Hormone. 2- Oxytocin then stimulates the uterine muscles to contract 3- The contraction of uterine wall is acting as stimulus for oxytocin secretion. so more the uterus contract the more will be oxytocin secretion.		

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4- more contraction of uterine wall cause greater pressure against uterine opening, which brings childbirth to completion. 5- The above example show that the effector response <secretion of oxytocin> will be in similar direction to stimulus <uterine contraction> is called positive-feedback mechanism.		
Q3 what is osmoregulation. differentiate between osmoregulators and osmoconformers.		
Answer: Osmoregulation:		
Definition :- osmoregulation is the process of — maintaining salt and water balance (osmotic balance) across membranes within the body. —OR— “osmoregulation is the homeostasis of water and dissolved-salts.”		
Importance of osmoregulation:		
1- Balance of water and salts is very critical to the — health of organism. 2- Life or organism requires a perfect osmoregulation because the cells can not survive without water. 3- Cells swells and burst in excessive gain of water and shrivel and die if there is excessive loss of water. 4- water is needed for metabolism and for the transport of materials in the body.		
Water and solute relation :-		

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<u>Introduction:-</u> water is solvent of the solutes in the cell. Each cell has been adapted to a defined quantity of water (about 70%) in relation to salts in it to perform its functions. Homeostatic mechanisms generally maintain this concentration through osmoregulation.		
<u>Relation: (importance)-</u>		
The balance of water and salts (solute) is very critical to health of organism because -		
1- The water act as medium for biochemical-reactions. Help in transport, Thermoregulation, excretion, digestion, absorption, etc. so it is very important to have a proper balance of water in the body.		
2- Osmoregulation involves the movement of water by osmosis. Therefore a proper balance of solutes (salts) is also important in order to maintain water movement.		
<u>Classification of animals on the basis of osmoregulation:</u>		
The mechanism of osmoregulation is different in different animals because they face different challenges according to their habitats. Animals may be either osmoregulators or osmoconformers with respect to their osmoregulatory characteristics i.e.-		
<u>1: Osmoregulators:</u>		
<u>Definition:-</u> Those animals which maintain a constant internal osmotic-pressure or concentration of fluid are.		

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Known as osmoregulators.		
<u>Need osmoregulation:-</u> These animals need osmoregulation because their body fluid is either hypotonic or — hypertonic as compared to the external-environment.		
<u>Explanation: (characteristics)-</u>		
1: These animals are independent from their external-Env;		
2: Their body fluid-concentration is differs from outside Env;		
3: They discharge excess of water in fresh water — environment and excrete salts in marine environment to keep the water and solutes balance in body by — using energy.		
4: These animals Live in different habitat and environment So they have adapted various ways to maintain — osmotic pressure constant in the body.		
<u>Example :-</u> All chordates except Hag Fish, protists — Such as — Amoeba, paramecium, etc.		
<u>2: Osmoconformer:</u>		
<u>Definition :-</u> Those animals whose internal solute — concentration or body fluid is equal to that of the — external environment are known as osmoconformers.		
<u>no need of osmoregulation:-</u> These animals do not need osmoregulation or in which osmosis is fixed because they have isotonic body fluid with respect to external — environment.		

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<u>Explanation : <characteristics>-</u> 1: These animals body fluids are same <isotonic> to the external environment, even for marine salt water env; 2: These animals thus do not require actively to adjust their internal osmotic state. so they don't need adaptation. 3: There will be no net movement of solvent molecules. <u>Example :-</u> All invertebrate, marine animals, Hog Fishes.		
Q4 Explain the osmoregulation in animals of different habitates or environments.		
<u>Answer : Osmoregulation in diff; animals :</u>		
<u>Introduction :-</u> Animals Living in different environments i.e- marine, fresh-water and territorial environment, - have different adaptations to regulate osmotic balance. i.e-		
<u>1: Fresh water animals:</u>		
<u>osmoregulators :-</u> Almost all of the fresh water - animals are osmoregulators, because such animals - regulate their body osmotic balance <water + salts>.		
<u>Hypertonic bodies :-</u> These animals are generally hypertonic, because they have high solute-concentration in their body fluids as compared to their external-Env;		
<u>Challenges : <problem faced>-</u>		
i- <u>Swelling up :-</u> These animals face the problem of - Swelling up due to the passive-movement of water into		

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their bodies from the surrounding environment.		
<u>ii- loss of salts :-</u> These animals face the continuously loss of body salts to the surrounding fresh-water - environment which has low salt-concentration.		
<u>Need :-</u> Conservation of salt and rid of excess of water.		
<u>Adaptations :-</u> These animals deal with above mentioned problems by having adaptation in their bodies according to particular-environment.		
<u>For example :-</u>		
<u>1- Adaptation in fresh water protozoa :-</u>		
<u>contractile-vacuoles :-</u> Fresh water protozoa (e.g - Amoeba , paramecium , etc) pump out excessive water by a structure called contractile-vacuole.		
<u>2- Adaptation fresh animals :</u>		
<u>i: Dilute urine :-</u> Fresh water fishes remove excess water by producing large volumes of very dilute urine.		
<u>ii: Kidney :-</u> Their kidneys reabsorb the salts that are - required for their osmotic balance.		
<u>iii: Eating food :-</u> They also obtain salts from the food they eat.		
<u>iv: Ionocytes :-</u> Fresh water animals also perform - uptake of salt from the external dilute-medium - with the help of special salt-cells called ionocytes present in the amphibian's - skin and gill of fishes.		

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2: Marine animals: (ETEA-2018)

Osmoregulator and osmoconformer:- Marine environment has both osmoregulators and osmoconformers. The osmoregulatory adaptations of these animals are very different from each other.

Challenges: (problems faced)-

i- **loss of water:-** As most of the marine animals are hypotonic (less salt) to their external environment (hypertonic) so they face the problem of loss of water through permeable surfaces.

ii- **excess of salt:-** As they have low concentration of salt in their bodies as compared to external-env; so there is a net inward movement of salts which leads to the accumulation of excess salts in their body.

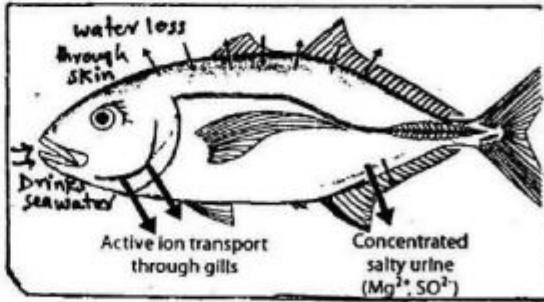
Need:- Conservation of water and get rid of excess of salts.

Adaptations:-

Marine organisms have various adaptations for regulation of osmotic-pressure or balance.

For example:-

1- **Adaptation in marine invertebrates:-** Most marine are osmoconformers means that they maintain their internal environment with respect to external-env;



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<u>2- Adaptation in cartilaginous and jawless fishes :-</u>		
Among the vertebrates, the cartilaginous fishes (such as- shark, rayfish, skates, etc.) and some jawless fishes (such as- Hag fish) are also isotonic with the surrounding sea water and are called osmoconformers.		
<u>3- Adaptation in Bony Fishes: (ETEA-2018, 2019)</u>		
Bony-Fishes are descendents of fresh-water ancestors but later become marine. They are hypotonic (less salt) to surrounding sea-water and are called osmoregulators.		
→ For osmoregulation they have the following adaptations-		
i: <u>Drinking more water :-</u> These fishes have adapted themselves to drink large amount of sea water.		
ii- <u>Concentrated urine :-</u> These fishes excrete concentrated urine and retain more water in body.		
iii- <u>Gill ionocytes :-</u> They remove monovalent ions or salts (such as- Na^+ , K^+ , Cl^-) through the gills ionocytes.		
iv- <u>Kidney :-</u> They remove the divalent ions or salts (such as- Ca^{++} , Mg^{++}) by the kidneys.		
v- <u>Rectal gland :-</u> They also possess salt-excreting organs such as rectal gland which remove salts into the digestive-tract and then eliminate them from the body during egestion.		
vi- <u>Osmotic balance :-</u> Due to above adaptations there is maximum salt excretion and minimum water loss, as		

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a result osmotic balance is maintained in their bodies.		
<u>3: Terrestrial animals:</u>		
<u>Successful groups :-</u> The successful groups of Land animals are— Arthropods among the invertebrates and Reptiles, birds and mammals among the vertebrates, because they have adapted their bodies according to the terrestrial environment and reduce water loss from their bodies.		
<u>Challenges : < problems - faced > -</u> The major problem for terrestrial life or organisms is evaporative loss of water leading to dehydration.		
<u>Need :-</u> Conservation of water.		
<u>Adaptations :-</u> Arthropods and vertebrates have - successfully adapted to terrestrial mode of life.		
<u>For example :</u>		
<u>1- Adaptation in the skin surfaces:-</u> Skin covers body surface therefore water loss is prevented. This surface is of two types i.e.		
<u>i: chitinous cuticle :-</u> In insects < e.g - Arthropods > there is the waxy - exoskeleton or cuticle which reduce water loss by their bodies.		
<u>ii: Keratinized skin :-</u> In most terrestrial vertebrates < e.g - Reptiles, birds, mammals > there are multi-layered and dead Keratinized skin cells which reduce water loss.		

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<u>2: Metabolic adaptations :-</u> Some desert mammals (such as kangaroo rat) survives without drinking-water. they feed on seed of desert-plants containing more carbohydrates which produce metabolic water.		
<u>3: Behavioral adaptations :-</u> Desert mammals are mostly nocturnal i.e.- they come out from their burrows at night in search of food and to avoid daytime heat, and thus prevented themselves from water loss.		
<u>4: Nutritional adaptations :-</u> The lost water is compensated by drinking and eating moist-foods. moreover, metabolic-water is also used by desert animals		
<u>5: Anhydrobiosis :</u> <u>Meaning :-</u> 'An' mean without, 'hydro'-water, 'bio'-life. <u>Definition :-</u> The ability of an organism to tolerate dehydration for a certain peroid of time is known as anhydrobiosis. —OR— "The ability of an organism to Live without water is called anhydrobiosis." <u>Explanation :-</u> Terrestrial animals can tolerate dehydration and it is differs in various animals. <u>For example :-</u> kangaroo rat survives without drinking water. It feeds on seeds of desert-plants containing more carbohydrates which produce metabolic water, that is why kangaroo rat is also called master of		

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water-conservation because they use 90% metabolic water.

Q5 what is excretion. Explain the nature of excretory products in animals to various habitats.

Answer: Excretion:

Definition:- The removal of nitrogenous wastes or metabolic wastes is called excretion.

Explanation:- Metabolism of food (carbohydrate, lipid, protein, etc) occurs in the cell to keep it alive. The products of metabolism are called metabolites. Some metabolites are poisonous and therefore harmful. They must be removed from the body. Such removal of metabolic-waste products is called excretion.

For example:- (ETEA-2008)

The primary nitrogenous waste-product is ammonia, which is very toxic molecule. Some animals excrete ammonia directly, while other animals first convert ammonia into less toxic waste (such as urea or uric acid) and then excrete it.

Nature of excretory products to Habitats:

There are the following relationships of excretory products with the nature of habitat.

1: Ammonia: $\langle \text{NH}_3 \rangle$ - (ETEA-2009)

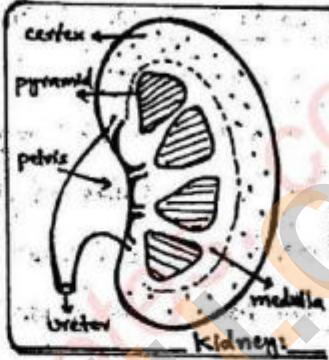
Ammonotelic:- The phenomenon of removal of ammonia

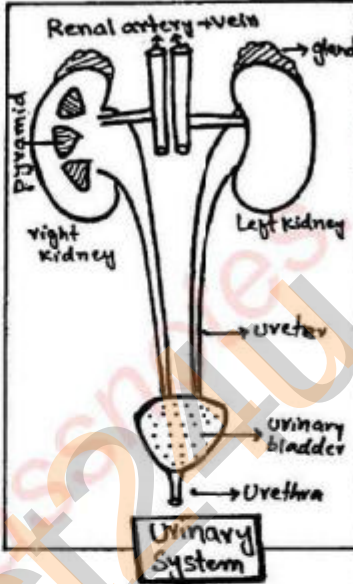
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by cells or organisms is called ammonotelic. <u>Ammonotelic animals</u>:- Animals excreting ammonia are called ammonotelic - animals. <u>Very toxic</u>:- Ammonia is very toxic and dissolves quickly in body fluids. So it must be kept in low concentration in body. <u>Need water for elimination</u>:- To maintain its low - concentration, body requires large volume of water to eliminate it in the urine. about 500 mL water is required to eliminate 1 gram of nitrogen in the form of ammonia (NH_3). <u>Excretory product of aquatic habitat</u>:- Ammonia is the excretory product of the animals inhabiting the aquatic hypotonic environment or fresh water habitat. <u>Example</u>:- most fishes, protozoans, sponges, — coelenterates, echinoderms. <u>2: Urea</u> : $\langle \text{CO}(\text{NH}_2)_2 \rangle$ - (ETEA-2010, 2013) <u>Ureotelic</u>:- The phenomenon of the removing of urea by cells or organisms is called ureotelic. <u>Ureotelic animals</u>:- Animals excreting urea are called ureotelic - animals. <u>less toxic</u>:- In restricted supply of water (e.g. - terrestrial - mammals) ammonia is not the excretory product. It is, therefore, metabolically converted into urea (less toxic substance) by urea cycle. urea is		

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100,000 times less toxic than ammonia.		
<u>Excretory product of terrestrial habitat:-</u> It is the excretory product of terrestrial animals (eg-mammals) due to moderate supply of water in terrestrial env;		
<u>Water required for elimination:-</u> only 50 mL water is required to eliminate 1 gram of nitrogen in the form of urea.		
<u>Example:-</u> Mammals, most amphibians, shark, some bony fishes		
3: Uric acid: $(C_5O_3N_4H_4)$ - (ETEA-2012, 2013, 2019)		
<u>uricotelic:-</u> phenomenon of removing of uric-acid by cells or organisms is called uricotelic.		
<u>Uricotelic animals:-</u> Animals excreting uric-acid are called uricotelic-animals.		
<u>Toxic less :-</u> uric acid is a purine even less toxic than urea and it precipitates from solution. It is least soluble.		
<u>Excretory product of less water habitat:</u>		
In animals, inhibiting environment with acute storage of water supply, required an excretory product like - uric-acid which can be excreted with minimum amount of water.		
<u>Water required for elimination:</u>		
Only 1 mL water is required to eliminate 1 gram of - nitrogen in the form of uric-acid.		
<u>Important for egg laying vertebrates:-</u> Egg laying - vertebrates excrete uric-acid because shell of egg is permeable to gases but not to Liquids. If they would		

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excrete ammonia or urea, then such toxic substances would accumulate inside the shell and would destroy – embryo. However, uric-acid precipitates in a solution inside the shell as a solid-substance and then left – behind when the animal-hatches. <u>Example :-</u> Birds, insects, many reptiles and Land snails.		
Q6 Describe the excretory (urinary) system of human.		
<u>Answer: Excretory system of human:</u>		
<u>Definition :-</u> A system of different organs which help the body to remove wastes is called excretory system.		
<u>Excretory organs :-</u> Skin, Lungs, Liver and Kidney, etc.		
<u>urinary system: (A example of excretory system) -</u>		
<u>Definition :-</u> The organs which form, store, and – remove urine from the body, make a system called Urinary system.		
<u>Components :-</u> Urinary system consists of following components		
<u>1: A pair of kidneys: (ETEA-2016)</u>		
<u>Homeostatic organ :-</u> Kidney is a part of urinary – system. It contributes to homeostasis by forming – urine and remove from the body, thus maintain the balance of salts and water in the blood. Kidneys play role in both in excretion and osmoregulation.		
<u>Number :-</u> Humans are provided with a pair of kidneys.		

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<u>Location :-</u> Kidneys are placed against the back wall of the abdominal cavity just below the diaphragm, one on either side of the vertebral-column, between the last thoracic vertebra and 3rd-lumbar vertebra.		
<u>Right and Left kidney :-</u> The right kidney is a little lower than the left one because of a liver lobe above it.		
<u>Ribs protection :-</u> The upper parts of the kidneys are partially protected by the 11 th and 12 th -ribs.		
<u>Weight :-</u> weight of kidneys are less than 1% of the total body weight. i.e - each weighing about 150 grams.		
<u>Blood supply :-</u> Blood is supplied by renal-artery and is removed by renal veins. Kidney receives 20% blood with each heart-beat or 1.2 Liters per minute.		
<u>Structure of kidney:</u> (ETEA-2019)		
<u>1- External structure : (morphology) -</u>		
<u>protection :-</u> Both the kidneys are protected by a very thin-membrane called renal-peritonium and by some fats		
<u>Colour :-</u> Kidneys are dark red or reddish brown in color.		
<u>Shape :-</u> Kidneys are bean-shaped. The outer surface is convex and the inner surface is concave.		
<u>Size :-</u> Kidneys are about 12cm long, 6cm wide and 4cm thick.		
<u>Hilus :-</u> The depression on concave side of kidney is called hilus or hilum, through which blood vessels and		

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ureter enter the kidney. 2- Internal structure: (anatomy)- In the transvers- section of kidney there are two general region i.e- i: Cortex :- It is the outer darker region of kidney. ii: Medulla :- It is the inner lighter region of kidney. Pyramids :- The medulla contains 10-15 conical structure called Nephron :- Each kidney consists of million of functional units called nephron, which is surrounding by blood capillaries Pelvis :- It is the central-cavity of the kidney which - collects urine from collecting tubules of nephrons and then open into ureter. 2: A pair of ureters : Location and structure :- A pair of narrow, muscular, tubular structure called ureters which arise from the hilus of each kidney and open on the dorsal wall of the urinary bladder. Length :- ureters are about 28 cm long. Function :- They pass urine from the kidneys to the urinary-bladder. 3: urinary bladder : Shape and location :- It is thick, muscular, pear-shaped Sac present in the pelvic region of the abdominal-cavity.		
		

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<u>urine capacity</u> :- It can store - about 0.5 to 1 Liter of urine. <u>Sphincters</u> :- The bladder is - provided with a band (2-rings) of circular muscles called sphincter. When the sphincter-muscles relax then urine will come out of urinary bladder into urethra. Sphincter - muscles are involuntary in babies and voluntary in adults. <u>Micturition</u> :- The act of emptying the bladder due to relaxation of sphincter-muscles is called micturition. <u>4: urethra</u> :- <u>Location and structure</u> :- A narrow, muscular tube - arises from urinary bladder is known as urethra. <u>urethra in male</u> :- In male urethra is about 20cm long and called urino-genital duct because it carries urine as well as semen (sperms). It passes through the penis and opens out at the tip of the penis by urinogenital aperture. <u>urethra in female</u> :- In female it is about 2-3cm long and carries urine only. It open near the front of - vagina by urinary aperture.	 The diagram illustrates the human urinary system. At the top, the 'Renal artery + vein' are shown entering and exiting the kidneys. The 'right kidney' and 'Left kidney' are depicted with internal 'pyramids'. 'Ureters' lead from each kidney to the 'Urinary bladder'. The 'Urethra' is shown exiting the bladder. A box at the bottom is labeled 'Urinary System'.	

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Q7 Describe the structure of nephron.

Answer :- Nephron :

Definition :- Nephrons are the structural and functional units in human kidneys.

Number :- Each kidney contains about one million nephrons.

Structure :- Each nephron has the following parts.

1: Renal corpuscle : <malpighian capsule>

Filtering unit :- It is the initial filtering component of the nephron.

Components :- Renal corpuscle is composed of 2-parts. i.e-

i- Bowman's capsule :-

cup shaped :- one end of nephron is expanded forming a cup-shaped structure called bowman's capsule.

Double walled sac :- Bowman's capsule is double walled sac. both these layers are made up of squamous epithelium.

podocytes :- The cells of bowman's capsule which cover the capillaries of the glomerulus are called podocytes.

ii- Glomerulus :

Ball of capillaries :- Bowman's capsule surrounds a bunch of capillaries called glomerulus. It receives blood from afferent arterioles.

Functions of renal corpuscle :- The pores in the capillaries of glomerulus and the gaps among podocytes are quite large which allow the filtration of any substance. — dissolved in blood plasma. First, such substances will

cross the endothelium of capillaries (glomerulus) to pass into podocytes (Bowman's capsule) but some of the important and large size proteins and nutrients are prevented by basement-membrane of capillaries.

2: Renal tubule : (Nephron-tubule) -

Filterate refinery unit :-

The tubular portion of nephron refines the glomerulus - filtrate by reabsorbs the important substances from urine.

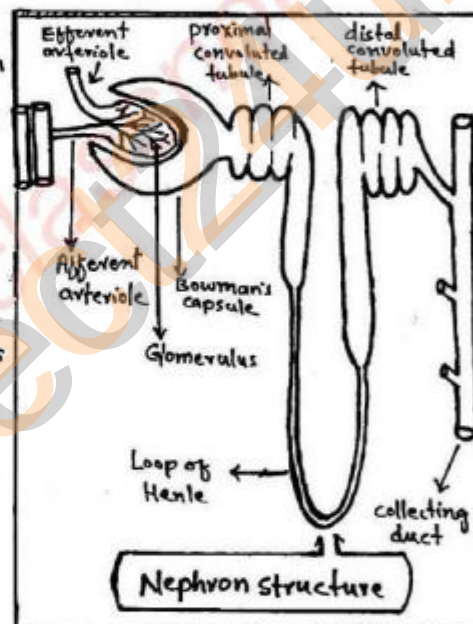
components :- The components of renal tubule are -

i: proximal convoluted tubule:

First part :- It is the first portion of the duct-system of the nephron which leads from Bowman's capsule to the loop of Henle.

Largest part :- It is the largest part of the nephron. The proximal-tubule is lined by epithelial-cells which have large number of microvilli that increase the surface-area for reabsorption.

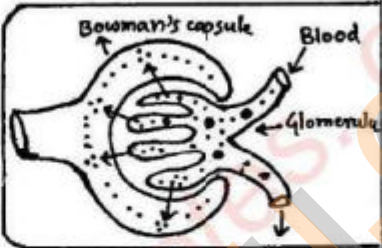
Function :- Reabsorption of various important substances from glomerulus - filtrate occurs in this part of nephron.



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<u>ii- Loop of Henle :-</u>		
<u>U-shaped :-</u> It is U-shaped in structure.		
<u>Narrow part :-</u> It is the narrow part of nephron which descends down into the renal-medulla. It is more prominent in juxtamedullary nephrons.		
<u>Limbs :-</u> Loop of henle has desending and asending Limbs.		
<u>Function :-</u> This part facilitate the reabsorption of water and salts and keep water and salt balance in body.		
<u>iii- Distal convoluted tubule :</u>		
<u>Last part :-</u> It is the last part of duct system of nephron.		
<u>highly coiled portion :-</u> It is expand and highly coiled portion of nephron.		
<u>Urine formation :-</u> It plays an active role in urine formation by moving of wastes or excess molecules from the blood capillaries into the lumen of tubule called tubular-secretion.		
<u>Collecting ducts :-</u> Each distal convoluted-tubule Leads to collecting ducts. The collecting duct system begins in the renal cortex and extends deep into the medulla. finally, collecting-ducts delivers urine into renal-pelvis.		
<u>Blood vessels arrangement around the nephron :</u>		
<u>1: Afferent and efferent arterioles :-</u> Blood enters to Kidney through renal-artery which is divided into afferent-arterioles before entering into glomerulus.		

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Filtered blood Leaves the glomerulus through efferent-arterioles. <u>2: capillaries :-</u> Efferent arterioles divide into two types of capillaries. i.e- i-<u>peritubular capillaries</u>:- peritubular capillaries around the proximal and distal convoluted tubules in the cortex region ii-<u>Vasa recta</u> :- vasa-recta runs antiparallel to the - Loop of hente and collecting ducts in medulla.		
QB write the type of Nephron. <u>Answer :- Types of nephron :-</u> nephrons are classified into two types according to their location. i.e- <u>1: Cortical nephron :-</u> (ETEA-2016) <u>Location:-</u> They are found in the cortex of kidney. <u>Structure:-</u> In cortical-nephron the renal-corpucle is present in superficial renal cortex and have relatively short Loops of hente and well develop filtereting units. <u>%age in kidney:-</u> about 70-80% nephrons in human - kidney are cortical-nephrons. <u>Function:-</u> when more water is available in blood the - cortical-nephron remove the excess water in urine to control blood volume. so they produce dilute urine. <u>2: juxta medullary Nephron :</u> <u>Occurance :-</u> A juxtamedullary nephron is a type of - nephron found only in birds and mammals.		

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<u>Structure :-</u> juxtamedullary nephrons have their renal-corpusele close to the junction of the cortex and medulla. They have long loop of henle which extends deep into the medulla. <u>%age in kidney :-</u> This type of nephron is relatively rare i.e. 20-30% nephrons in kidney are juxtamedullary. <u>Function :-</u> When there is short supply of water or less water in blood, then these nephrons absorb more water from the filtrate and produce concentrated urine. As reabsorption of water occurs mostly in the loop of henle, and we know that juxtamedullary nephrons have long loop of henle with the additional blood capillaries called vasa-recta. So more water is reabsorbed and concentrated urine is produce to regulate water level in blood.		
Q9 Explain excretory function of nephron -OR- How urine formation occurs in Nephron. ?		
<u>Answer : Excretory function of Nephron: (Urine formation)</u>		
<u>Functional unit :-</u> Nephron is functional unit of the kidney which filters the blood, remove wastes in the form of urine.		
<u>process of urine formation :-</u> In nephron urine formation occurs. urine formation involves 3-processes, such as -		

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<u>1: ultrafiltration : <pressure filtration></u>		
<u>Small diameter :-</u> The diameter of efferent arteriole is half as compared to the afferent arteriole.		
<u>Filtration pressure :</u> Due to less or smaller diameter the capillaries offer resistance for the flow of blood. this resistance causes high blood-pressure in glomerulus called filtration pressure.		
<u>Blood filtration :-</u> The glomerulus walls are porous and the fraction of the blood-pressure reaching here provides the filtration-pressure. Therefore the blood passing through the glomerulus is filtered (about 20%) into Bowman's capsule, and produces about 125 ml of filtrate per minute. (or 180 Litres per day.)		
<u>Glomerulus Filtrate:</u> The filtrate which is formed during ultra-filtration is called as glomerulus-filtrate or pressure-filtrate. This filtrate first pass from endothelium of glomerulus capillaries, then from basement-membrane of capillaries and finally from endothelium of Bowman's capsule into lumen of bowman's capsule.		
<u>composition of Filtrate :-</u> Glomerulus-filtrate contains water, glucose, salts, drugs, hormones, vitamins, urea,		

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uric-acid and other nitrogenous wastes.		
<u>2: Selective reabsorption :- (ETEA-2005)</u>		
<u>Average reabsorption :-</u> when glomerular-filtrate - passes along the nephron the useful-substances for the body are reabsorbed because the reabsorption is very selective process. about 125 mL of glomerulus - filtrate is produced per-minute, in which 124 mL is reabsorbed on average.		
<u>i: Reabsorption in proximal convoluted tubules :-</u> over 80% of the glomerular-filtrate is reabsorbed in proximal convoluted tubules.		
<u>For example :-</u> In proximal-portion of nephron all of the glucose, amino-acids, vitamins, hormones and about 80% of the sodium-chloride, and water are reabsorbed.		
<u>ii: Reabsorption in loop of Henle :</u>		
The function of Loop of Henle is to conserve water.		
<u>For example :- (ETEA-2020)</u>		
<u>a- Reabsorption of water :-</u> The wall of descending Limb of Loop of henle is highly-permeable to water, as a - result water is reabsorbed actively here. (about 90%).		
<u>b- Reabsorption of solutes :-</u> The wall of Ascending - Limb of Loop of henle is impermeable to water and permeable for certain ions (solutes) (i.e - Na^+ , Cl^- , K^+ and other ions) are reabsorbed actively here.		

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<u>Counter current multiplier system:-</u> The exchange of - solutes and water in loop of henle of nephron which maintain the concentration of ions in medulla is called counter current multiplier system.		
<u>iii: Reabsorption in distal convoluted tubules:</u>		
From ascending Limb the filtrate come to the distal-convoluted tubule. The distal-convoluted tubules have Osmoregulatory role and also control blood pH by secreting Hydrogen ions (H^+).		
<u>Urine formation:-</u> The filtrate is slightly hypotonic due to high concentration of water. In distal convoluted - tubule, by the action of hormones, the concentration of various salts are adjusted. after the adjustment of contraction of filtrate, then it become urine which passed into the collecting duct.		
<u>iv: Reabsorption in collecting duct:-</u> The wall of collecting duct is impermeable for water and solutes, however, the hormone play important role in reabsorption of water.		
<u>For example: (Role of ADH)-</u>		
when the concentration of water is short or decrease in body, then ADH is secreted by posterior pituitary gland which increases the permeability of walls of collecting ducts and hence water is reabsorbed and the urine becomes concentrated.		

3: Tubular secretion:

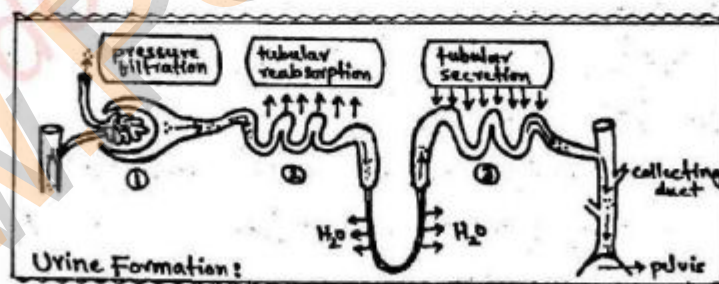
Definition:- It is a active transport in which materials transfer or remove from peritubular-capillaries to renal-tubular lumen.

Why tubular secretion occur:- In tubular-secretion - process only a few substance are secreted, because - these substances are present in great excess or are natural-poisons. To remove these wastes or poisons substances the tubular-excretion occurs.

For example :- most important substances secreted by tubular-secretion are - Hydrogen ions (H^+), potassium (K^+), organic-ions and many drugs.

Body pH : <Acid-base-balance>-

Hydrogen ions (H^+) secretion is important in acid-base balance of the body, as a result the pH of blood is - regulated and homeostasis is maintained.



Q10 Describe the role of Kidney as osmoregulatory organ.

Answer : Kidney as osmoregulatory organ :

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<u>Introduction:-</u> Kidney is an excretory as well as — Osmoregulatory organ. The concentration of body fluid is kept in narrow limit by the kidneys.		
<u>1: control water level:-</u>		
Body maintains the solute-potential of blood at — approximately steady rate. It is done by keeping balance between ^{water} obtained from diet and drinks and its loss in evaporation, sweating, egestion and urination. i.e—		
<u>i- If more water in blood :-</u>		
If the blood contains more water then less water will be reabsorbed from glomerulus filtrate and more urine will be formed. as a result water balance is maintained.		
<u>ii- if less water in blood :-</u>		
if the body is deficient of water then more water will be reabsorbed from the glomerulus- filtrate and less urine will be excreted. as a result water balance is maintained.		
<u>Role of ADH in control of water level: (ETEA-2012)</u>		
ADH is secreted by the posterior-lobe of pituitary — gland. ADH stimulates the reabsorption of water in the distal-portion of nephron.		
<u>For example :</u>		
1: Dehydration of body (i.e- less water in body) , — stimulates the secretion of ADH, which then increases the reabsorption of water. as a result the water —		

Kidney is adapted to conserve water by over 99.5% reabsorption of glomerulus- filtrate.

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level is maintained and concentrated urine is produced. 2: IF the blood is more dilute (i.e.-more water in body) then the secretion of ADH is inhibited (stop). so - the distal part of the nephron fails to reabsorb water and more water is excreted in urine, result diluted urine is produced. 2: control of solute level : (e.g.- Na^+ level) - (ETEA-2020) Kidneys are playing important role in the control of - sodium (Na^+) level in the body or blood. For example :- IF the body has less Sodium level, then more sodium ions will be reabsorbed in the distal - convoluted tubules of nephron in the presence of aldosterone. Role of aldosterone :- It is secreted by the adrenal - cortex of adrenal - gland. It stimulates active reabsorption of sodium in the ascending Limb of Loop of henle and distal convoluted tubules of nephron. 3: Regulate blood pH:- Kidney also maintains the acid-base balance or pH in the body fluid (blood) by excretory acids (i.e.- H^+ ions) in urine while prevents the excessive loss of base. Q11 Write the causes, symptoms and treatment of UTIs. Answer: Urinary Tract infections : (UTIs). Definition :- Any infection that happens anywhere in the		

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urinary tract is called urinary tract infection.

Exception :- Almost all parts of urinary tract can be infected except ureter.

Types :- urinary tract infections are of different types, named according to the site of infection. i.e-

1: Pyelonephritis : < kidney infection >-
Bacterial infection of Kidney is called pyelonephritis. In this type of infection the kidney become damage and thus Kidney failure ensures.

2: cystitis : < bladder infection >- cystitis is the - medical term for inflammation of bladder, caused by a bacterial infection.

3: Urethritis : < urethral infection >- inflammation of urethra is called urethritis. This can cause the urethra to become irritated and inflammed. Both male and female can affected, however female has more chance to get infected.

Causes of UTIs :

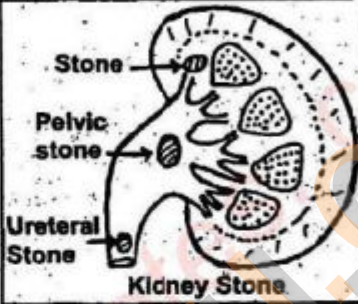
1- most UTIs are caused by bacteria. e.g- E. coli, Staphylococcus, Klebsiella, Entrococci, proteus, etc.

2- They can also caused by Fungi (e.g- candida - albicans, etc) or viruses.

Symptoms of UTIs 1- Some of common symptoms of UTIs are

1: pain in upper back.	2: coming of blood in urine.
3: Rectal pain in male.	4: pelvic pain in female.

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5: Burning with urination. 6: Cloudy urine. 7: Strong odour to urine. <u>Treatment:-</u> Antibiotics and anti-fungal drugs are used to treat urinary tract infections - (UTIs).		
Q12 Describe various type of kidney stones and their causes and treatment.		
<u>Answer: Kidney stones: (Urinary stones)-</u>		
<u>Definition:-</u> Kidney stones are small, hard crystalline deposits of different salts or substances inside the kidneys or urinary tract.		
<u>Formation of kidney stone:-</u> Calcium-oxalate, calcium-phosphate and uric-acid are precipitated out during urine formation and accumulate later to form stone. This causes obstruction in the urinary tract.		
<u>More susceptible: (Victim)-</u> Anyone may develop a kidney stone, but people with certain diseases and conditions or those who are taking certain medications are more susceptible to the stone development.		
<u>Types: (Chemical nature of stone)-</u> on the basis of chemical nature of stone there are the following 4-types of stones.		
<u>1: Calcium stone: (70% of all stone)-</u> most of kidney		

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Stone are made up of calcium -- along with oxalate or phosphate. 2: <u>Struvite stone</u>: <15-20% of all stone> This type of stone is formed in response to any infection in UTIs. These stone can grow very quickly. 3: <u>uric-acid stone</u>: <5-10% of all stone> - uric-acid is a nitrogen-containing organic-acid. it form crystals and cause stone. This type of stone is form in peoples who don't drink sufficient fluids. 4: <u>cystine stone</u>: <1-3% of all stone> - cystine is an amino-acid. These amino-acid units and become crystalline result form cystine-stone. <u>Causes of kidney stone</u>:- Following are the few - known causes for kidney stone. i- <u>Hypercalcemia</u>:- <u>Definition</u>:- increase in concentration of calcium level in blood is called hypercalcemia. <u>Hypercalcuria</u>:- increased level of Ca^{+2} in urine is known as hypercalcuria. so hypercalcemia causes hypercalcuria which causes stones to form. <u>Factors</u>:- calcium level in blood is increase due to over secretion of parathormone Hormon, which remove more calcium from bones. such over-secretion of -		

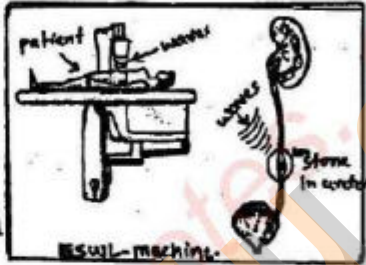
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parathormone is called hyper-parathyroidism. Then such calcium combine with oxalate or phosphate to form stone.		
<u>ii- Hyperoxaluria :</u>		
<u>Definition :-</u> increase in concentration of oxalate in blood is called hyperoxalemia.		
<u>Hyperoxaluria :-</u> when oxalate are excreted through urine in large amount then this condition is called Hyperoxaluria.		
<u>Factors :-</u> peoples who frequently use tomato and - Leafy green vegetable are affected from this type of stone.		
<u>iii- Hyperuricemia:</u>		
<u>Definition :-</u> increase in concentration of uric-acid in blood is called hyperuricemia.		
<u>Hyperuricosuria :-</u> when uric-acid are excreted - through urine in large amount then this condition is - called hyperuricosuria.		
<u>Factors :-</u> This is due to over use of protein (like meat). However, it may also arise due to genetic metabolic disorder like gout, which cause painful swelling of joints at toes.		
<u>Symptoms of Kidney stone :-</u> Kidney stones often cause no pain while they are in the kidneys. Generally they cause severe pain when they enter the pelvis or ureter, stopping the release of urine from the kidney. Some of the common symptoms are given below—		

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1: pain on dorsal side below ribs.	2: Frequent urination.	
3: pain spread on to lower abdomen	4: pain on urination.	
5: cloudy or foul smelling urine.	6: Blood in urine.	
7: persistent urge (wants) to urinate	8: Nausea and vomiting	
9: colour of urine becomes pinkish or reddish.		
<u>Treatment of kidney stone :</u>		
Treatment of kidney stone depend on stone size. i.e.-		
<u>1: Small size stone :-</u>		
Small size stone (i.e.- less than 0.5cm) can easily pass from the kidney by using medication and drinking of more water (at least 8-glasses in a day).		
<u>2: large size stone :-</u> For the treatment of large size stone (i.e.- more than 1cm) the following methods are used.		
i- Lithotripsy ii- surgery.		
<u>i: Lithotripsy: (ETEA-2007)</u>		
<u>Meaning :-</u> Litho mean stone and tripsy mean breaking.		
<u>Definition :-</u> The technique of non-surgical removal of kidney stone is called Lithotripsy.		
<u>Explanation :-</u> This technique is used to break up the stones present in kidney, ureter or gall-bladder. There are several ways to break these stones. The most common methods are		
a: Extracorporeal shock wave Lithotripsy (ESWL). and		
b: percutaneous nephroLithotripsy (PCNL).		

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a: Extracorporeal shock wave Lithotripsy: <ESWL> -

- 1- ESWL method is used for -
treatment of small stones by
using shock-waves.
- 2- The stone inside the kidney is
bombarded with highly concentrated
x-rays or ultrasound waves
generated by a machine called Lithotripter.
- 3- The shock waves break the stone into tiny pieces
or into sand. These tiny pieces or sand are then -
passed out of the body in urine.



The diagram shows a patient lying on a table. A lithotripter machine is positioned above the patient's back, emitting shock waves towards a kidney. Inside the kidney, a stone is shown being broken into smaller pieces. Labels include 'patient', 'shock waves', 'stone in kidney', and 'ESWL-machine'.

b: percutaneous nephrolithotripsy: <PCNL> -

- 1- PCNL is more common and use for removal of large-stone.
- 2- In this procedure first a tube is inserted into the
patient's back into the kidney to create a tract.
- 3- A Scope is run through the tract to directly see the
stone in kidney.
- 4- ultrasound equipment is then inserted to breakup the stone
- 5- while watching the stone through the scope the stone
fragments can be holded with special equipment and
pull through the tract out from the kidney.

2: Surgery :-

If stones are large, branched <stagehorn
shape> and cannot pass easily then the



The diagram shows a kidney with a large, branched stone inside. The stone has multiple points or 'horns' extending into different parts of the kidney. It is labeled 'Stagehorn Stone'.

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patient has to undergo surgery. patients kidney, ureter or urinary bladder is opened and stone are removed.		
Q13 what is renal failure. write its types and causes.		
Answer: Renal Failure : <kidney Failure>-		
Definition :- Renal failure is a medical condition in which the normal functions of kidneys is gradually decreased, as a result they are not able to filter the harmful - nitrogenous - substance which remain in blood.		
Types of renal failure :- There are two types of kidney failure. i.e		
1: Acute kidney Failure:		
Definition :- The sudden lose of kidney-function is - called acute kidney failure.		
Explanation :- In this type of failure the kidney is unable to filter the blood properly. as a result the electrolytes and waste-materials accumulate in the body creating a life-threatening condition. This develops rapidly. This can be fatal and thus it require intensive treatment. However, it is reversible if the health conditions of the patient's are good.		
Causes : <Reasons>-		
1- Blood clots in kidney blood vessels <sudden blockage>.		
2- any damage to the kidney or swelling in the kidney.		
3- cholesterol deposite which block the blood flow.		

- 4- chemotherapy-drugs, antibiotic or other drugs.
- 5- Toxions, Alcohols and heavy metals.
- 6- Autoimmune kidney-diseases (i.e- acute nephritic-syndrome, interstitial nephritis, etc).
- 7- urinary tract blockage or obstruction.
- 8- Infections that directly injure the kidney.
- 9- Acute tubular necrosis.
- 10- Severe or sudden dehydration.

Symptoms of acute renal failure :- The most common -

Symptoms of acute renal failure include -

- 1- Decreased urine output.
- 2- shortness of breath, B.P.
- 3- Fatigue, Nausea, coma.
- 4- Chest pain, Edma, seizures
- 5- Fluid retention, causing swelling in legs, ankles, feet.

2: Chronic Kidney Failure:

Definition :- gradually lose of kidney function is called chronic kidney failure.

Explanation :- This type of renal failure develops - gradually over time often years to decades until the kidney is completely impaired. as a result the dangerous levels of waste and fluid can rapidly build up in the body. At least it reach to very severe and fatal stage called endstage renal disease and uremia (increase urea in blood) treatment is aimed at stopping or slowing down the - progression of the disease.

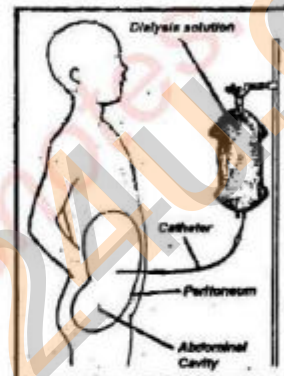
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<u>causes of chronic kidney failure : (Reasons)-</u>		
1- most common cause is diabetes and hypertension.		
2- Over use of analgesics and anti-inflammatory drugs.		
3- long term use of pain killers.		
4- kidney infection (e.g- polycystic kidney disease).		
5- prolong blockage of the urinary tract.		
6- familial tendency may also one of the causes.		
<u>Symptoms of Chronic kidney failure:</u>		
The most common symptoms of chronic kidney disease are-		
1- Blood in urine, high blood pressure and fatigue.		
2- Anemia, Dark urine, decreased mental sharpness.		
3- decrease urine output. swollen feet, hands and ankles.		
4- Insomnia (sleeping problem), itchy-skin, loss of appetite.		
5- more frequent urination, muscle cramps, nausea.		
6- pain on the side or mid to lower back. headaches.		
7- shortness of breath, lose of body weight. etc.		
<u>Treatment of renal Failure:</u>		
Treatment options vary depending upon the type of renal failure or causes. For example-		
1: Acute renal failure needs immediate medical care including dialysis.		
2: Chronic renal failure needs dietary-modication and medications to control diabetes and hypertension.		
3: if chronic renal failure progresses to end-stage renal		

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disease, then renal-dialysis or kidney transportation is necessary to sustain life.		
Q.14 what is renal-dialysis. Explain its types.		
<u>Answer: Renal dialysis:</u>		
<u>Meaning:-</u> Dialysis is a Greek word which means-separation		
<u>Definition:-</u> It is a technique which is used to remove harmful waste products and excess amount of water - from the blood.		
<u>Explanation:-</u> When there is kidney failure in a person, a technique is used to remove waste-products and excessive amount of water from the blood, it is called dialysis. It is an artificial method of blood filtration and purification.		
<u>Types of dialysis:-</u> dialysis are two types. i.e-		
<u>1: peritoneal dialysis:</u>		
<u>Definition:-</u> The type of dialysis in which blood is cleaned from nitrogenous waste in the peritoneal-cavity is - known as peritoneal dialysis.		
<u>Explanation:-</u> peritoneal dialysis is a way to remove waste-products from blood when kidneys can no longer do the job normally. peritoneal-dialysis makes use of a natural-membrane (peritoneum) in the body.		
<u>Peritoneal-cavity:-</u> In the abdomen, the space around		

the alimentary-canal is known as peritoneal-cavity. The walls of peritoneal-cavity are lined by a thin-membrane called peritoneum. The peritoneum has a large number of blood vessels in it.

procedure of peritoneal dialysis:

Catheters :- In this process two - catheters are surgically inserted into the abdominal cavity that serve as the portals through which dialysate <dialysis-fluid> enters and leaves the cavity.



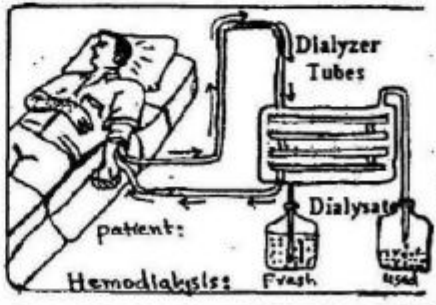
Dialysate :- In peritoneal-dialysis a sterile and - cleaning solution called dialysate flows through the - catheter into abdomen.

Dwell time :- The solution stays in abdomen for a - prescribed period of time known as dwell time.

Diffusion :- During this dwell time, waste, chemicals, and extra fluid in blood pass from tiny blood-vessels <capillaries> in the lining of abdominal cavity - <peritoneum> into the dialysis solution.

Collecting bag :- when the dwell-time is over, the solution along with waste products is drawn from blood and any excess fluid drains into a sterile collecting bag.

Exchange :- The process of filling and then draining

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the dialysate into and out of the abdominal-cavity is called an exchange. <u>Time required:-</u> This process requires about one hour and it is repeated the next day. <u>Advantage of peritoneal dialysis:-</u> peritoneal dialysis may be the better option if — 1: The patient can not tolerate the rapid changes of fluid-balance associated with hemodialysis. 2: patient want to minimize the disruption of dialy activities and work or travel easily- (mobility)- <u>2: Hemodialysis: (ETEA-2010)</u> <u>Meaning:-</u> Hemodialysis means — cleaning the blood. <u>Definition:-</u> The type of dialysis in which blood is cleaned with the help of artificial kidney (dialyzer) outside the body of patient is called Hemodialysis. <u>Explanation:-</u> In Hemodialysis, a machine filters wastes, salts and fluid from blood are used when kidneys are no longer health enough to do this work normally. <u>procedure of Hemodialysis:</u> <u>Dialyzer:-</u> A filter which acts as an artificial-kidney to clean blood is called dialyzer. It - contains a artificial semi-permeable membrane which		
		 The diagram illustrates the hemodialysis process. A patient is shown lying in a bed, connected to a dialyzer machine via tubes. The machine is labeled 'Dialyzer Tubes'. Below the machine, there are two containers: one labeled 'Fresh' and another labeled 'Used'. The entire setup is labeled 'Hemodialysis'.

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allow selected material to pass through it from blood of patient.		
<u>Catheters</u> :- During hemodialysis two needle are inserted into arm of patient through the access. each needle is attached to a flexible plastic-tube that connects to a dialyzer.		
<u>Starting</u> :-		
Through one tube, blood from an blood-vessel in the arm of the patient is pumped slowly into the dialyzer. urea and other waste-materials are diffuse from the blood into the dialysate fluid. The filtered blood returns to body - arm through the second tube.		
<u>Time required</u> :- The patient uses kidney machine or dialyzer for two or three-times in a week. It takes - about 4-5 hours.		
<u>Risks and complications</u> :- many nephrologists feel that hemodialysis is more effective than peritoneal-dialysis but still it has many side effects like-		
1- A drop in blood pressure is a common side effect of hemodialysis, particularly if patient have diabetes. 2- muscle-cramps during hemodialysis are common. 3- many people who undergo hemodialysis have itchy skin. 4- Blood vessels injury and chance of infection (like-hepatitis, HIV) are more. 5- microscopic damage to blood cells also occur - during hemodialysis.		

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Q15 Describe the kidney-transplantation.

Answer: Kidney transplantation:

Definition:- The replacement of a damage kidney with a healthy donor kidney is known as kidney transplantation.

—OR—

The implantation of kidney from a donor person to a person whose kidney have no longer function properly through surgery is called kidney transplantation.

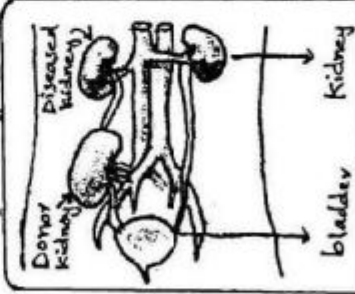
First kidney transplantation :-

The first successful kidney transplantation took place b/w identical twin brothers in 1954. a transplanted kidney can expect to live 5 to 20 years or longer with relatively normal kidney function.

procedure of kidney transplantation:- The surgeon make an incision in body of recipient and then place the donated kidney in its correct place i.e- in lower abdomen. The vessels of donated-kidney are kept connected to the blood vessels in the lower abdomen of recipient body. The ureter of the new kidney is now connected to bladder of recipient body.

Removal of diseased kidney:- 2

→ In majority cases the diseased kidney is not removed from recipient body and remained there, however —



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during extreme-condition (such as - Sever infections or cancer) it can be removed.		
<u>Immuno-suppressant drugs</u>:- After the kidney - transplantation the immuno-suppressant drugs are given to keep immune-system suppress from attacking the new kidney.		
<u>Donor-Recipient match</u>:- Both donor and recipient persons must possess the following similarities, otherwise the donated kidney will be rejected by recipient body.		
<u>1- same blood group</u>:-		
Both, donor and recipient must have same blood group. But the Rh factor (i.e +ve or -ve) of blood does not matter in a transplant.		
<u>2- Same Leukocytes antigen: (HLA)</u>- Both, donor and recipient have same Human Leukocytes antigen (HLAs) which are proteins on the surface of leukocytes (WBCs) responsible for MHC-protein in human which regulate immune system in human. There are six HLAs.		
<u>For example</u>:- For kidney transplantation, donor and recipient must match 3-HLA or more HLAs. The more the matching HLAs the more successful will be - transplantation and more will be chances of survival.		
<u>3- Negative cross match</u>:		
The donor's blood must not initiate an —		

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antibody-response with recipient-bloods. This is called negative cross match. A negative cross match means that the recipient has not responded to the donor and there transplantation is safe. <u>Risks and complications :-</u> Some of the complications which occurs during kidney transplantation are given below - 1: Bleeding 2: infection. 3: initial Lack of function of the new Kidney. 4: Blockage of the blood vessels to the new Kidney. 5: Leakage of urine or blockage of urine in the ureter. 6: Because the transplanted kidney is lower in the - abdomen than the native kidneys, it lacks the protection of the rib-cage and is more exposed to injury. 7: The medications used to prevent or treat rejection have side effects.		
Q16 what is thermoregulation. classify animals on the basis of thermoregulation. <u>Answer: Thermoregulation:</u> <u>Definition :-</u> The ability of an organism to maintain - internal - temperature of body is called Thermoregulation. — OR — “The maintenance of internal temperature within a		

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rang that allows the cells to function efficiently is called as thermoregulation. <u>Importance or Need of thermoregulation:</u> The function of all organs and chemical-reactions of the body taking place at a specific temperature. - Variation in temperature causes disturbance in various functions and metabolic-reactions. <u>For example :-</u> 1: Variation in temperature can effect the rate of enzyme activity. 2: This direct effects the health and growth of animals. 3: Temperature may also affect the geographical - distribution of animals and plants. 4: when heat stress is severe or prolonged, it may alter organ function and even kill the animals. <u>Classification of animals on the basis of thermoregulation:</u> According to body-temperature, animals are divided into two groups. i.e- 1: <u>poikilotherms</u> : < cold blooded > - <u>Definition:-</u> Those animals which cannot maintain their body temperature and it can be changed according to - surrounding is called poikilothermic animals or cold blooded. <u>Example :-</u> Invertebrates, fishes, Amphibians, reptiles. 2: <u>Homeotherms</u> : < warm blooded > - (ETEA-2007, 2008)		

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<u>Definition</u> :- Those animals which maintain their body temperature in constant and cannot change with surrounding changes temperature is called Homeothermic animals or warm blooded. <u>Example</u> :- Birds and Mammals. <u>Difficulties in old classification</u> :- many poikilotherms can maintain their body temperature and some homeotherms do not maintain their body temperature, so the terms poikilotherms and homeotherms are now changed into ectothermic-animals and endothermic-animals. i.e- <u>classification of animals on the basis of heat production</u>: Animals gain heat from two sources i.e- from metabolism and external environment (Sun). According to this classification animals are divided into 3-groups. i.e- <u>1: Ectotherms</u> : <u>Definition</u> :- Those animals which mainly absorb heat from their surrounding-environment and change their body temperature with surrounding temperature are called ectotherms <u>Reason</u> :- The endocrine system of ectotherms is not well developed so such animals are not capable to generate enough heat during metabolism. so in order to fulfill their temperature needs they will be dependent on external env. <u>Example</u> :- Invertebrates, fishes, Amphibians and reptiles. <u>2: Endotherms</u> :- (ETEA-2015)		

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<u>Definition:-</u> Those animals which obtain heat from their own metabolism and maintain a constant internal body temperature are called endotherms. <u>Reason:-</u> The endocrine system of endotherms is well-developed, result such animals can generate sufficient heat from metabolic activities, so they can not dependent on external temperature. <u>Example:-</u> Flying insects, great white shark, birds, polar bear. <u>3: Heterotherms.</u> <u>Definition:-</u> Those animals which are capable to produce varying degree of endothermic heat but generally they do not regulate their body temperature within a narrow range are called heterothermic-animals. <u>For example:</u> i: <u>Bat:-</u> Metabolism and temperature of bat is elevated <high> when they are flying actively, However as they rest, they reduce their metabolism and temperature. ii- <u>Humming birds:-</u> Humming birds spent much of the day time in locating and feeding nectar to increase metabolism and heat, but at night humming birds enter into a sleep like condition and their body temperature becomes equal to external temperature.		

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Q17 Describe thermoregulation in human.

Answer: Thermoregulation:

Definition:- The maintenance of internal temperature within a range that allows the cells to function efficiently is called thermoregulation.

Core body temperature :-

Definition :- The temperature of body below the skin and subcutaneous tissues is called core body temp; .

For example :- core body temperature should be — maintained in narrow range i.e. 36.4°C — 37.3°C .

Thermogenesis :

Definition :- The process of production of heat energy in the body is called thermogenesis.

Sources and control :- Respiratory metabolism is major source of heat energy in human body. This energy is — mainly released by breakdown of carbohydrates and fats. The thermogenesis process is regulated by nervous — system and hormones (endocrine system).

Types of thermogenesis :- There are 2-types of thermogenesis. i.e.

1: Shivering thermogenesis :

Definition :- It is the heat-production caused by the repeated stimulation of voluntary muscles.

Heat production :- shivering thermogenesis can increase heat-production upto 5-times of the existing heat.

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<u>Example :-</u> Rubbing hands.		
<u>2: Non shivering thermogenesis :</u>		
<u>Definition :-</u> The process of production of heat due to increased metabolic activities is called non-shivering - thermogenesis.		
<u>Explanation :-</u> Non-shivering thermogenesis is the heat production caused by the high metabolic rate. in this process hormones are involved.		
<u>For example :-</u> Thyroxin is a thyroid hormone which - increases metabolic rate, as a result in heat production for long term while adrenaline is adrenal hormone which causes short term increases in metabolic activity.		
<u>1-Thermoregulation when warm :</u>		
<u>Heat loss :-</u> Human have the following strategies for lowering or maintaining constant internal temperature during warm.		
<u>i: Radiation :-</u> about 50% of the total heat is lost due to radiation in human body.		
<u>ii: Vasodilation :-</u> During hot-season certain blood - vessels or arterioles become dilated (increase diameter) as a result more blood flows toward skin to release - more heat. ← (ETEA-2020)		
<u>iii: Evaporation :-</u> Evaporation is another mechanism of heat loss because water is continuously lost from -		

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human skin due to evaporation.		
<u>iv: Sweating:-</u> Due to sweating partial control of heat loss is possible.		
<u>v: less urination:-</u> less urination also regulate body temp;		
<u>vi: Breathing:-</u> Exhalation mechanism also helps in controlling of body temperature by lost excessive heat with outgoing air.		
<u>vii: Conscious action:-</u> we wear light coloured or white clothes or move into shade to cool down. we also use cold-drink or cold-food to control heat. Bathing is also a conscious mechanism to regulate body-temperature.		
<u>2-Thermoregulation when cool:-</u>		
<u>Heat Conservation:-</u> During cold-season human - adapt the following strategies for maintaining constant internal temperature.		
<u>i: Insulator layer:-</u> A fatty layer in the hypodermis of skin provides insulation and is very significant to - conserve heat. Additional fat-layer on vital organs such as kidney, heart and reproductive organs also help in heat conservation and protecting from cooling.		
<u>ii: vasoconstriction:-</u> (ETEA-2018) During cold season the diameter of some arteries which supplies blood to skin become reduced, resulting in less - blood transport to skin and loss of heat is reduced.		
<u>iii: Hair: < Goose bumps>-</u> Human hair acts as		

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insulating-system and decreases the heat loss. thus body-heat is retained. <u>Goose pimples or goose bumps</u> :- At the base of hair, follicle is a smooth-muscle called hair-erector-muscle. contraction of this muscle pulls the hair upright (erected). This occurs involuntarily when the body is over cooled. In human, it produces - goose pimples or goose bumps (roughness of skin) which trapped more air among hairs and so more heat is conserved. <u>iv : Shivering</u> :- The increase in the rate of heat production by increased muscles contraction by movement or - shivering, also help in heat conserved in cool season. <u>v : Reduced sweat production</u> :- Reduce or no sweating decreases the heat loss by evaporation. <u>vi : more urination</u> :- During overcooling, urge to - urination arises. The volume of urine is increased to regulate body temperature. <u>vii : Conscious action</u> :- we put on more and warm clothes. we use heaters and take exercise to keep us - warm. we also eat hot food and use hot drink to control heat loss consciously. <u>3- Role of the hypothalamus in thermoregulation:</u> <u>Homeostatic system</u> :- Humans have well developed System of heat regulation. Hypothalamus, thermoreceptors		

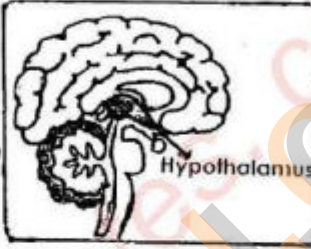
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and effectors make a complex homeostatic system which maintains body temperature.

Explanation: (ETEA-2015, 2019, 2020)

1: Thermostat of body :-

Hypothalamus is a brain part which is called thermostat of body, that control body core-temperature, called temp; controlling centre



2: Thermoreceptors :- Skin contains hot and cold - thermoreceptors. when there occurs slight change in external-temperature, thermoreceptors in skin detects it and send message to hypothalamus for analysis.

3: Effector response :-

After making the decision, hypothalamus then transmit the message to the effectors (such as muscles and glands) which work accordingly either to increase or decrease temperature of the body.

Role in thermoregulation: <of Hypothalamus>

1- In hot season :- In hot season the hypothalamus closes all system of heat conservation. It makes arrangement for the release of heat-energy from the body. Such as —

- dilation of blood vessels <vesodilation>.
- Excretion of water through skin by sweat glands.
- decreases metabolic activities.

2- In winter <cold> season :- In cold season the —

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hypothalamus closes all system of heat loss. The retains in the body and heat is produced by different physiological processes are activate. Such as - i: Vasoconstriction to decrease blood flow to the skin, to reduce heat loss. ii: inhibit sweating. iii: increased metabolic activities. iv: inhibit panting <quick breaths>.		
Q18 what is Fever or pyrexia.		
Answer: Fever : < pyrexia > -		
Definition:- when the core -temperature of the body is increased beyond a set point or normal is called fever.		
Explanation: <Hyperthermia> -		
The core body temperature of human beings is 37°C or 98.6°F. when it becomes higher than this temperature it is called Fever or hyperthermia.		
cause of fever: <pyrogen> - The main causes of fever is the viral. or bacterial infection. These germs or neutrophils <WBCs> in blood vessels produce chemical substances <such as toxins or chemicals> called pyrogens. These pyrogen directly affect the hypothalamus and increases the temperature set-point, as a result the body temp; ₂ arises.		
Advantages of fever:-		
1: Fever helps to kills the germs by providing unfavourable		

conditions in the body.

- 2: it indicates any abnormal condition in the body or infection.
- 3: Fever helps in stimulating the protection-mechanisms against the pathogen.
- 4: It also causes the production of large number of immune cells.

Treatment of fever: (medication)-

Antipyretic drugs (such as - aspirin and paracetamol) lower the set-point and provide relief from unpleasant symptoms of fever.

End

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Exercise		
Exercise MCQs		
A . Multiple Choice Questions (MCQs). 1. The term homeostasis can be defined as: a) Maintaining the body in a fixed and uniform state. b) inability of the body in a react to changes. c) Keeping or maintaining a near to constant internal environment. d) Changing the external environment to accommodate the body's needs. 2. When the body needs to conserve water, antidiuretic hormone is secreted, and the kidneys produce concentrated urine. This is an example of----- a) negative feedback b) vasoconstriction c) reabsorption d) osmosis 3. Identify in the following an example of positive feedback? a) Blood sugar rises, which causes the body to release insulin, which lowers blood sugar b) Oxytocin causes uterine contractions, which cause more release of oxytocin c) Blood pressure rises, which causes vasodilation to lower blood pressure d) Hunger causes metabolism to slow down, which reduces hunger 4. Terrestrial animals like kangaroo rat survive even without drinking water since a) They don't require water for their metabolic process b) They can retain excessive water in their body during raining season. c) They feed on carbohydrate-rich seeds which can provide them with metabolic water d) They are anhydrobiotic organisms 5. Which of the following is most directly responsible for concentrating urine in the kidney? a) Proximal convoluted tubule b) Glomerulus c) Loop of Henle d) Bowman's capsule 6. The proximal tubule of the nephron is the primary location for the reabsorption of which of the following blood filtrates? a) Proteins b) Sodium c) Glucose d) Fats 7. The thick ascending loop of Henle is primarily responsible for what function? a) Potassium secretion b) Proton secretion c) Water reabsorption d) Sodium reabsorption 8. Antidiuretic hormone acts in what part of the kidney to increase water reabsorption a) Distal tubule b) Proximal tubule c) Loop of Henle d) Collecting duct 9. In a body shifts in water-solute balance are managed primarily by		

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a) respiratory system	b) urinary system				
c) endocrine adjustments	d) circulatory system				
10. Physiologically is the most important mechanism for water loss from the body is :					
a) excretion in urine	b) sneezing				
c) sweating	d) elimination in feces				
11. Normally the process which exerts the greatest control over the water balance of an individual is:					
a) sweating.	b) kidney function.				
c) evaporation through the skin.	d) respiratory loss.				
12. Which of the following does NOT dispose of a type of waste directly to the environment					
a) digestive system	b) respiratory system				
c) circulatory system	d) urinary system				
13. The most toxic substances routinely found in the blood are metabolites of what type of molecules?					
a) proteins	b) carbohydrates				
c) nucleic acids	d) Fats				
14. Which of the following is the last structure that urine passes through during its excretion from body?					
a) distal tubule	b) urethra				
c) urinary bladder	d) ureter				
15. The process during which potassium and hydrogen ions and some toxic substances are put into urine is called					
a) tubular secretion.	b) reabsorption.				
c) filtration.	d) counter current multiplication.				
16. Kidney health is described in terms of					
a) the number of kidney stones.	b) rate of filtration.				
c) water retention.	d) blood clot				
17. In case of overheating, the body temperature is regulated by:					
a) more sweating and more urination	b) more sweating and less urination				
c) less sweating and more urination	d) less sweating and less urination				
18. An animal that warms itself mainly by absorbing heat from its surroundings is known as					
a) homoeothermic	b) ectotherm				
c) endotherm	d) none of them.				
Answer: (key)					
1-c	2-a	3-b	4-c	5-c	6-c
7-d	8-d	9-b	10-a	11-b	12-c
13-a	14-b	15-a	16-b	17-b	18-b

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Short Questions		
Q1: - maintaining the body at fairly constant level ensure healthy living. justify the statement by giving...example		
Answer: Homeostasis:		
<u>Definition:-</u> maintaining the body at fairly constant level ensure healthy living is called Homeostasis.		
<u>Explanation:-</u> The conditions and components (i.e. H_2O , salts, temperature, etc.) of the external environment keeps on changing continuously but the organisms resist and try to overcome the effect of these changes by making adjustment in their internal-environment.		
<u>Importance of homeostasis: (with examples)-</u>		
Homeostasis is necessary for living organism because-		
1: Homeostasis is necessary for normal body function.		
2: It enables an organism to get rid of waste products.		
3: It maintains a constant level of salt, water and temp;		
4: In homeostasis there is check and balance system - which is necessary in the body for normal function.		
5: Such controlling mechanism helps to prevent drastic - changes within the body of organism.		
Q2: - In what way positive feedback can be harmful at times		
Answer:- Harmful positive feedback:		
<u>Introduction:-</u> There is no feedback mechanism which is		

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harmful but positive feedback mechanism which is needed within homeostasis, sometime become harmful for organism homeostasis. <u>For example:-</u> 1: During high fever the positive feedback causes a metabolic change which can push the fever higher & higher. 2: Sometime the body temperature can reach to extremes of 45°C (113°F) due to positive feedback, at which cellular-proteins denature, thus causing metabolism to stop, resulting in death. 3: Sometime the breath-air has very high CO_2-content, resulting the positive feedback faster the breathing rate, which cause more CO_2 in blood. 4: due to positive feedback, if extra releasing hormones are released there can be chances of some malfunction. Q3:- Define the term anhydrobiosis. <u>Answer:-</u> See Question-4 (write only last Topic of Q-4). Q4:- How regulation of blood flow to skin is meaningful to maintain body temperature. <u>Answer:-</u> Regulation of blood flow to skin in thermoregulation our skin regulates our body temperature through - blood vessels and through the process of sweating. i.e. 1: <u>Vasodilation</u>:- <writeth from Question No-17>. 2: <u>Vasoconstriction</u>:- <write from Question No-17>.		

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Q5:	- why juxtamedullary nephrons are more imp; in osmoregulation	
	<u>Answer:-</u> See function of juxtamedullary nephron in Question No-8. < write only function>.	
Q6:	- state the role of ADH in controlling the proper concentration of urine.	
	<u>Answer :-</u> See Question No-10. <write only Role of ADH in control of water level >.	
Q7:	- How do some terrestrial mammals become so resistant that they are able to survive without drinking water.	
	<u>Answer:</u> Metabolic adaptation in terrestrial animals:	
	Some terrestrial mammals become so resistant or adapted that they are able to survive without drinking H ₂ O.	
	<u>Explanation :-</u> <see anhydrobiosis explanation of Q-4 only>	
	<u>For example :-</u> <see anhydrobiosis example - in Q-4 only>	
Q8:	- what is the benefit of ESWL over PCNL.	
	<u>Answer:</u> Advantage of ESWL : <over PCNL>-	
	1: The primary advantage of ESWL is that, it is completely non-invasive method in which no skin cutting is required to treat the stone. instead, the energy from shock waves is used to breakdown the stone into small pieces.	
	2: ESWL is typically an outpatient procedure and shorter hospital stays--method.	
	3: The overall success of ESWL is higher than 90% for	

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Stone-clearance and easier to recover. 4: ESWL Leads to less complications and are safer method. Q9:- why is the excretion of uric-acid advantageous to birds and reptiles. <u>Answer:- Advantages of uric-acid excretion:-</u> mammals excret urea, while birds, reptiles and some terrestrial invertebrates produce uric-acid as waste. producing uric-acid instead of urea is advantageous because it is less toxic and reduce water loss and the subsequent need for water, because such animals living in less water habitat. <u>For example:-</u> only 1mL water is required to eliminate 1gram of uric-acid. Long Questions Q1:- Explain the working of feedback-system in a living body and compare it with a non-living physical feedback system. <u>Answer:-</u> see Question-2 (write control system and its types) Q2:- Describe different parts of urinary system of human with main emphasis on their role in excretion. <u>Answer:-</u> see Question No-6. Q3:- Describe the challenges and osmoregulatory adapt; of osmoconformers and osmoregulators in marine env;. <u>Answer:-</u> see Question-4 (write only marine animals).		

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Q4:	— Describe the role of Kidney as osmoregulatory organ.	
	<u>Answer</u> :- See Question No-10.	
Q5:	— what is renal failure. Describe its types and causes.	
	<u>Answer</u> :- see Question No-13.	
Q6:	— Explain the procedure of peritoneal and hemodialysis.	
	<u>Answer</u> :- See Question No-14.	
Q7:	— Describe various type of kidney stones and their causes.	
	<u>Answer</u> :- See Question No-12.	
End		

chapter-15	118	ETEA-MCQs
Previous Entry Test MCQ's of Biology Chapter No -15: (Homeostasis)		
2005 ETEA		
1. The glucose is reabsorbed by the: (a) Proximal convoluted tubule of nephron (b) Distal convoluted tubule of nephron (c) Glomerulus (d) Bowman's capsule		
2007 ETEA		
2. Lithotripsy is a technique to: (a) Remove kidney stones without surgery (b) Remove kidney stones with surgery (c) Treat kidney with medicines (d) Remove appendix		
3. Which one of the following is a homeothermic animal: (a) Uromastix (b) Salamander (c) Sea horse (d) Kangaroo		
4. Death occurs if level of glucose in blood falls to: (a) 60 (b) 50 (c) 40 (d) 30		
2008 ETEA		
5. Which one of the following is homeothermic animal? (a) Uromastrix (b) Salamander (c) Sea horse (d) Kangaroo		
6. The major and immediate nitrogenous waste product of protein metabolism is: (a) Urea (b) Uric acid (c) Creatinine (d) Ammonia		
2009 ETEA		
		7. Ammonia is formed during digestion in: (a) Liver (b) Stomach (c) Small intestine (d) Large intestine
		2010 ETEA
		8. Urea formation occurs in: (a) Kidney (b) Liver (c) Spleen (d) Lungs
		9. A machine that works like kidney for the removal of nitrogenous wastes from the blood is called: (a) Lithotripsy (b) Hemometer (c) Dialyzer (d) None of them
		10. When the kidney fails to form urine the condition is called: (a) Nephritis (b) Nephrosis (c) Ptosis (d) Anuria
		2011 ETEA
		11. The conversion of carbonate to urea is: (a) Slow and exothermic (b) Fast and exothermic (c) Slow and endothermic (d) Fast and endothermic
		12. Malpighian tubules convert nitrogenous waste into: (a) Urine (b) Ammonia (c) Uric acid (d) Urea
		2012 ETEA
		13. The target organ for vasopressin is: (a) Heart (b) Liver (c) Stomach (d) Kidneys
		14. Surplus amino acid in the body are broken down to form urea in: (a) Spleen (b) Kidney (c) Liver (d) Pancreas
		15. The least toxic excretory product is:

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ETEA-MCQs

a) Ammonia b) Urea
c) Uric acid d) Fatty acid

2013 ETEA

16. Urea formation occurs in:

a) Kidney b) Liver
c) Spleen d) Lungs

17. The birds excrete:

a) Ammonia b) Urea
c) Uric acid d) Acetic acid

2015 ETEA

18. Human body thermostat is -----

a). medulla b). medulla oblongata
c). body fluid d). hypothalamus

19. Which of the following animal is not endothermic:

a). salamander b). great white shark
c). polar bear d). butterfly

2016 ETEA

20. Each kidney of human being is weighing about:

a) 140 grams b) 160 grams
c) 130 grams d) 150 grams

21. The number of cortical nephrons are...

a) 70 - 80 % b) 80 - 90 %
c) 60 - 70 % d) 60 - 80 %

22. Which of the following are components of homeostatic mechanism...?

a) Receptors, Regulators, Effectors
b) Receptors, Integrator, Effectors
c) Sensors, Brain, Effectors
d) All of the above

2018 ETEA

23. A condition called goose pimples are caused by:

(a) Overcooled body (b) Bacteria
(c) Environmental changes
(d) Pollution

24. Which of the following is not isotonic to sea water?

(a) Myxine (b) Skates
(c) Sharks (d) Teleost

25. Mg^{++} and Ca^{++} are excreted in fishes through:

(a) Kidney (b) Gills
(c) Skin (d) All of them

2019 ETEA

26. Some marine fishes possess salt excreting organ known as:

(a) Thyroid gland (b) Pituitary gland
(c) Adrenal gland (d) Rectal gland

27. _____ regulate the body temperature.

(a) Hypothalamus (b) Thalamus
(c) Hippocampus (d) Amygdala

28. The inner surface of a kidney has a deep notch called:

(a) Renal pelvis (b) Hilus
(c) Medulla (d) Pyramid

29. The least toxic excretory product is:

(a) Ammonia (b) Urea
(c) Uric acid (d) Fatty acid

2020 ETEA

30. In humans, the temperature regulation control center is located in

a. Kidneys b. Brain
c. Lungs d. Liver

Key: -

1.a	2.a	3.d	4.d	5.d	6.d
7.a	8.b	9.c	10.d	11.c	12.c
13.b	14.c	15.c	16.b	17.c	18.d
19.a	20.d	21.a	22.d	23.a	24.d
25.a	26.d	27.a	28.b	29.c	30.b

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