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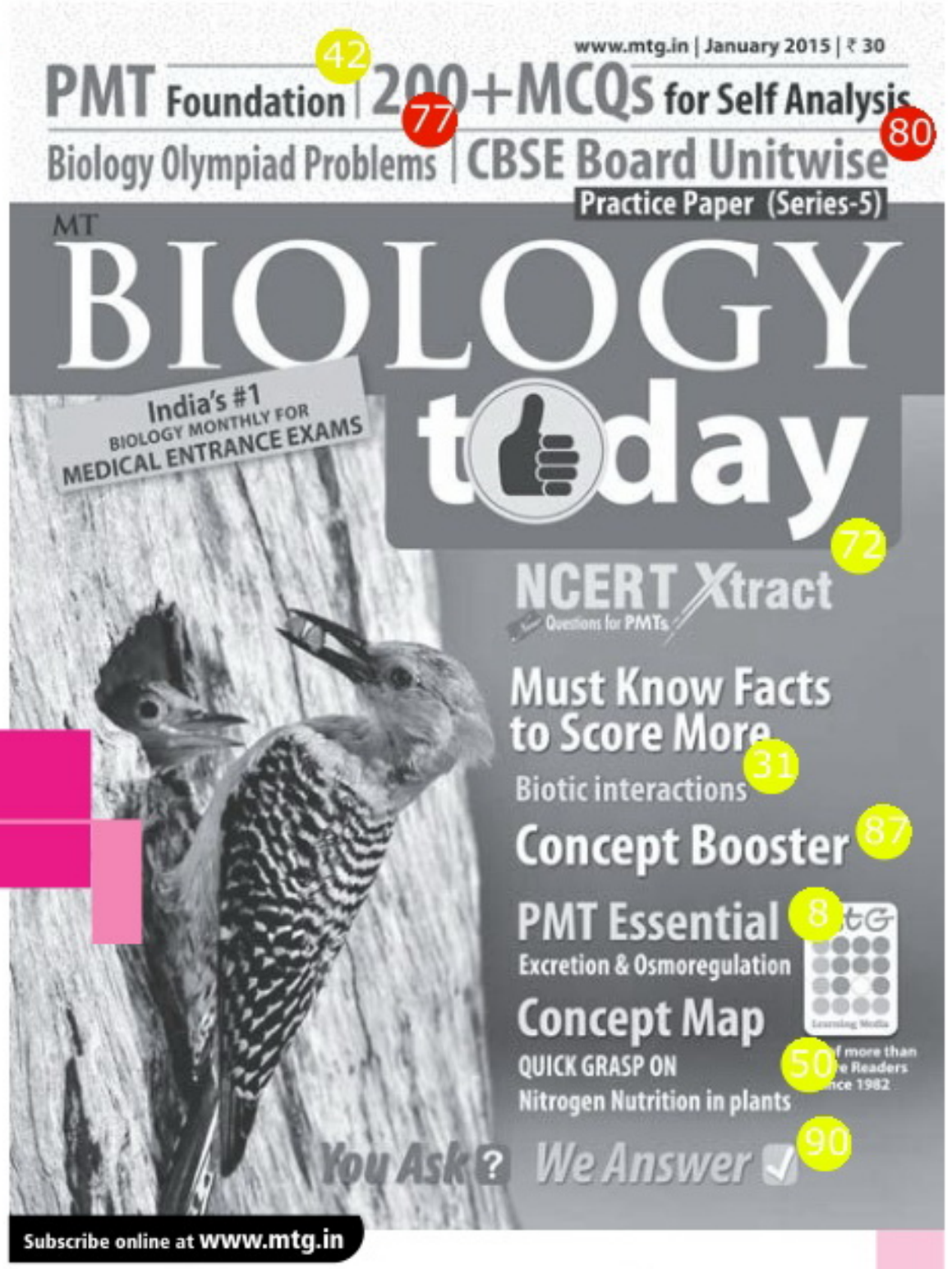
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PMT ESSENTIAL

The content for PMT Biology is very vast and does not allow students to engage in inquiry and develop meaningful knowledge. An *essential topic for PMT* is presented here to enable students grasp the topic, analyse the type of questions appearing in PMTs, and SCORE HIGH.

EXCRETION & OSMOREGULATION

All animals need to regulate water and salts in their environment and eliminate nitrogenous wastes. All these functions are inter-related, but they have different names. Regulation of water and salts is termed **osmoregulation** and elimination of nitrogenous wastes is termed **excretion**. Both excretion and osmoregulation bring about **homeostasis,** which is vital for life.

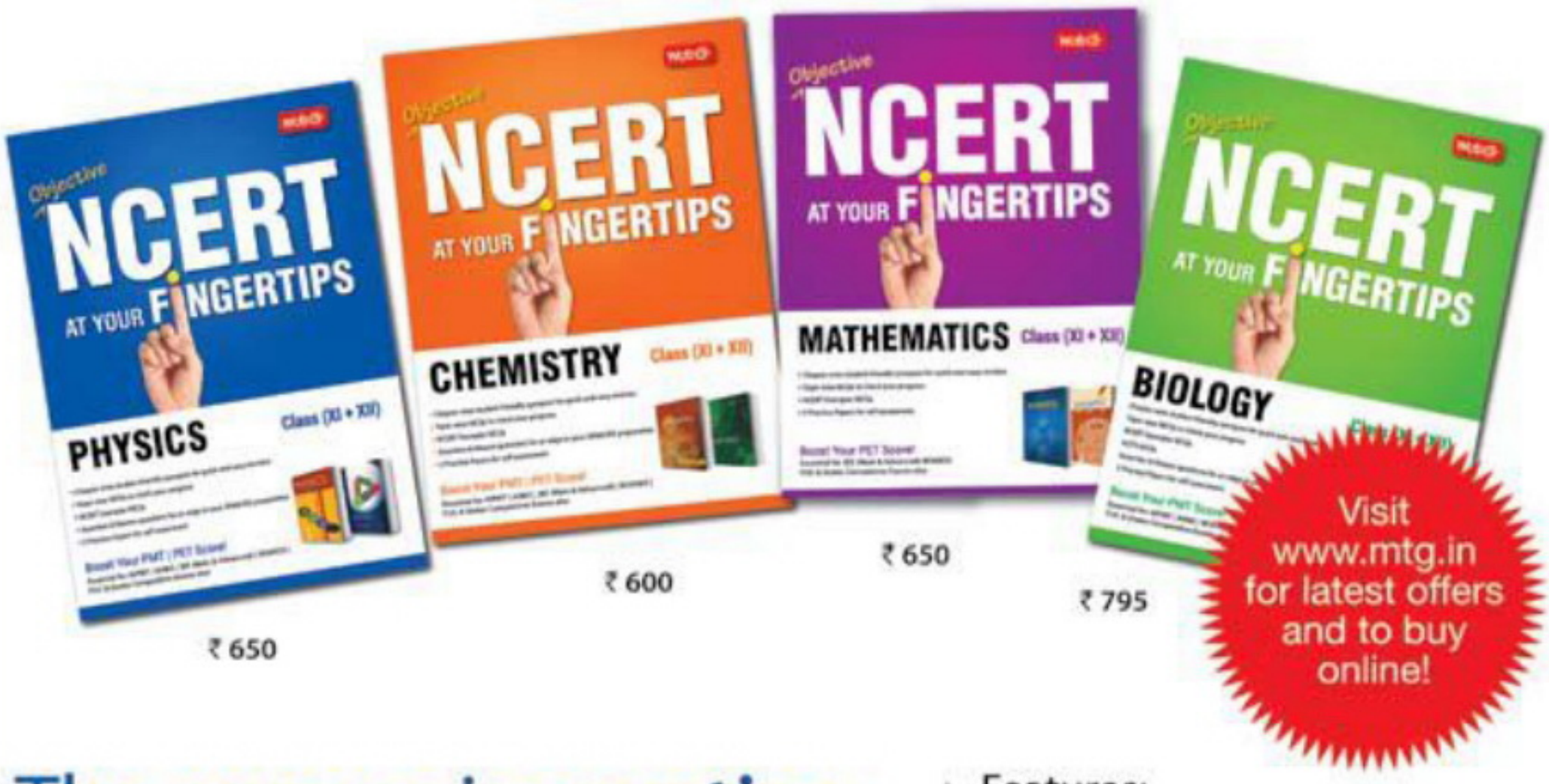
In vertebrates, **kidneys** perform both excretion and osmoregulation, whereas invertebrates have different types of excretory and osmoregulatory organs.

OSMOREGULATION

The regulation of solute movement, and hence, water movement, through osmosis, is known as osmoregulation. Osmosis may be defined as a type of diffusion where the movement of water occurs selectively across a semipermeable membrane. It occurs whenever two solutions, separated by a semipermeable membrane (the membrane that allows water molecules to pass, but not the solutes) differ in total solute concentration, or **osmolarity.** The total solute concentration is expressed as molarity or moles of solute per litre of solution. The unit of measurement for osmolarity is milliosmole per litre ($mOsmolL^{-1}$).

If two solutions have the same osmolarity, they are said to be **isotonic.** When two solutions differ in osmolarity, the solution with higher concentration of solute is called **hypertonic,** while the more dilute solution is called **hypotonic.** If a semipermeable membrane separates such solutions, the flow of water (osmosis) takes place from a hypotonic solution to a hypertonic one.

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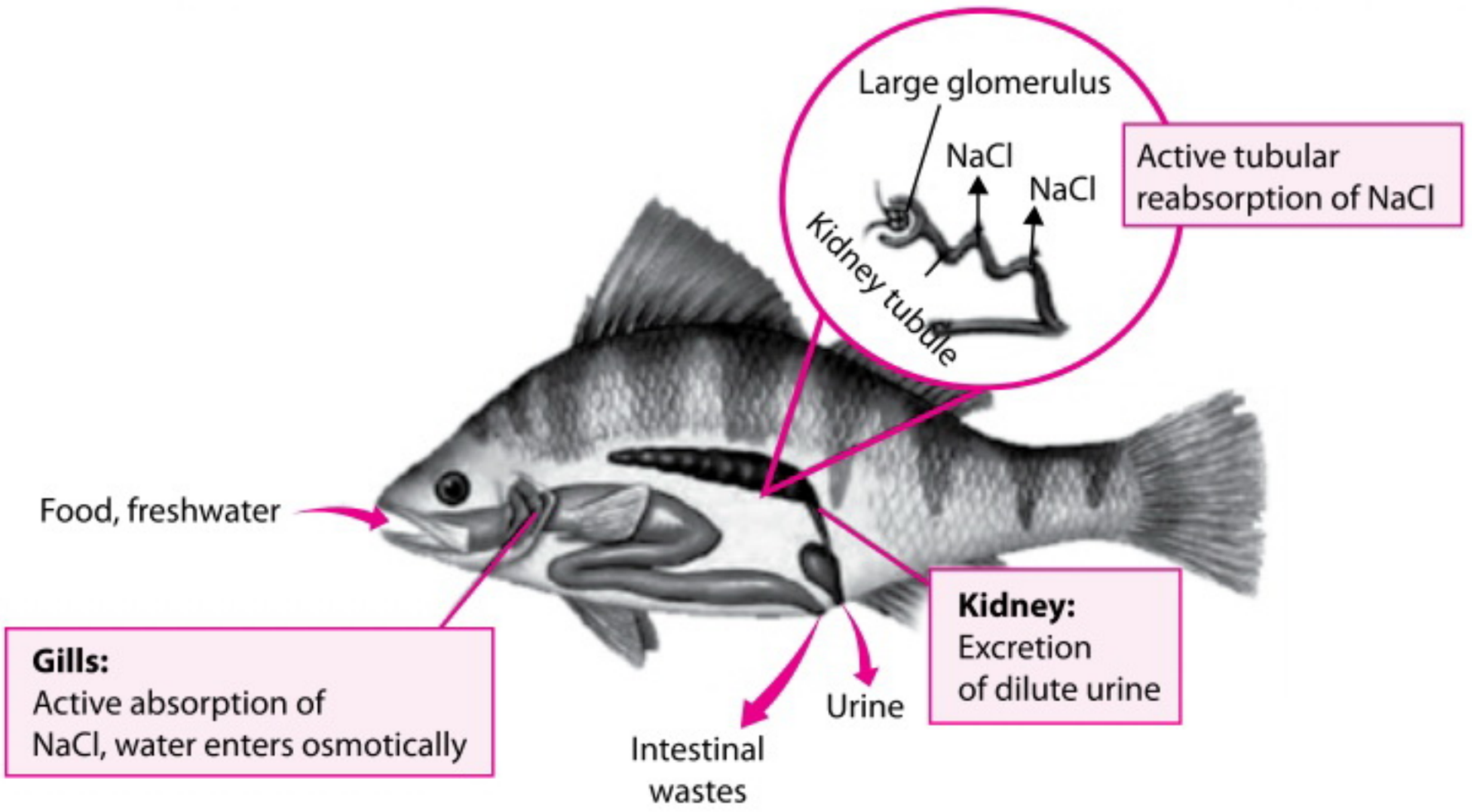
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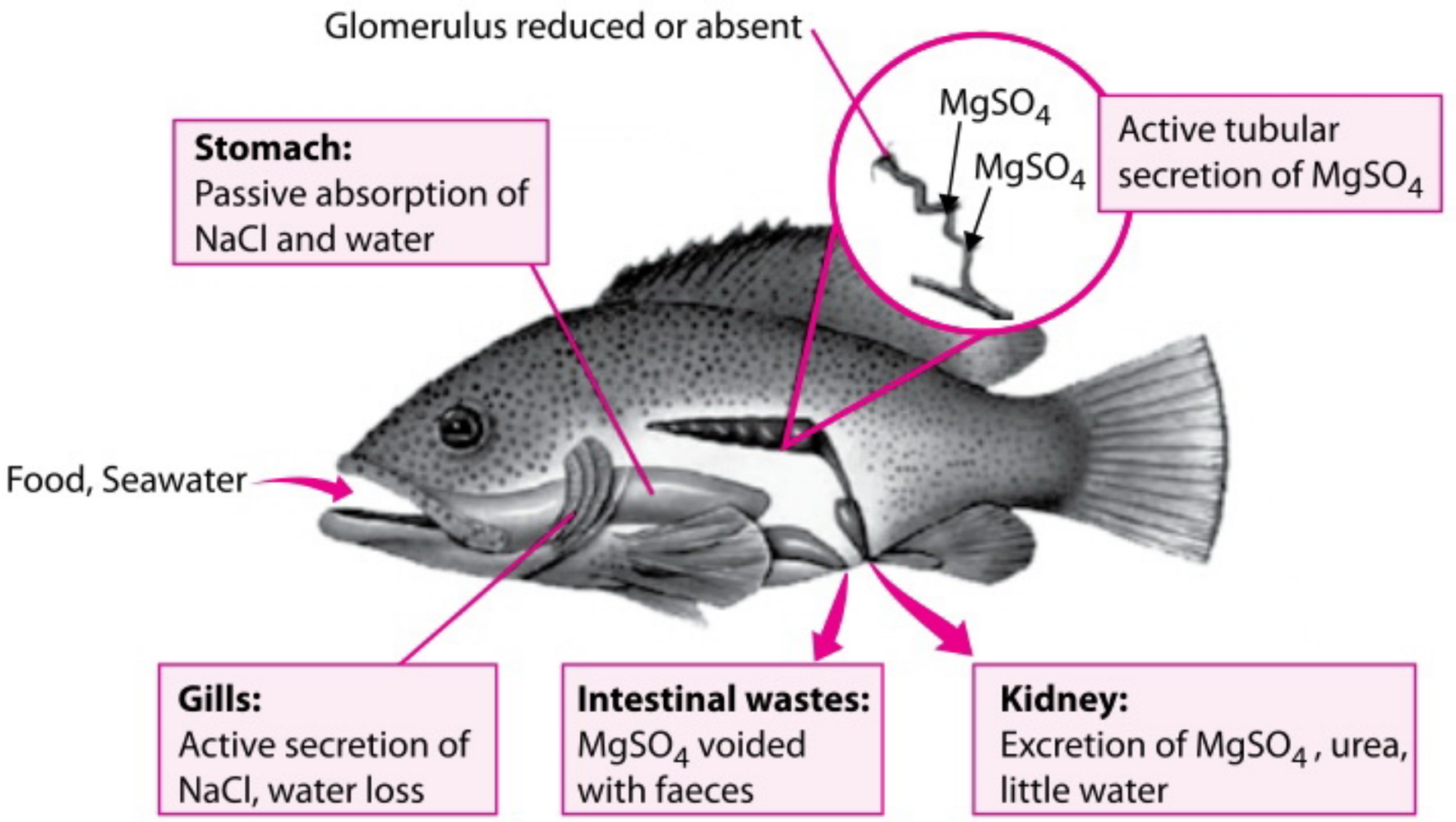
Osmoconformers and osmoregulators

Osmoconformers are the animals that do not actively control the osmotic concentration of their body fluids. They rather change the osmolarity of body fluids according to the osmolarity of the ambient medium. All marine invertebrates and some freshwater invertebrates are strictly osmoconformers. However, hagfish is a vertebrate osmoconformer. Osmoconformers show an excellent ability to tolerate a wide range of cellular osmotic environments.

Freshwater fish

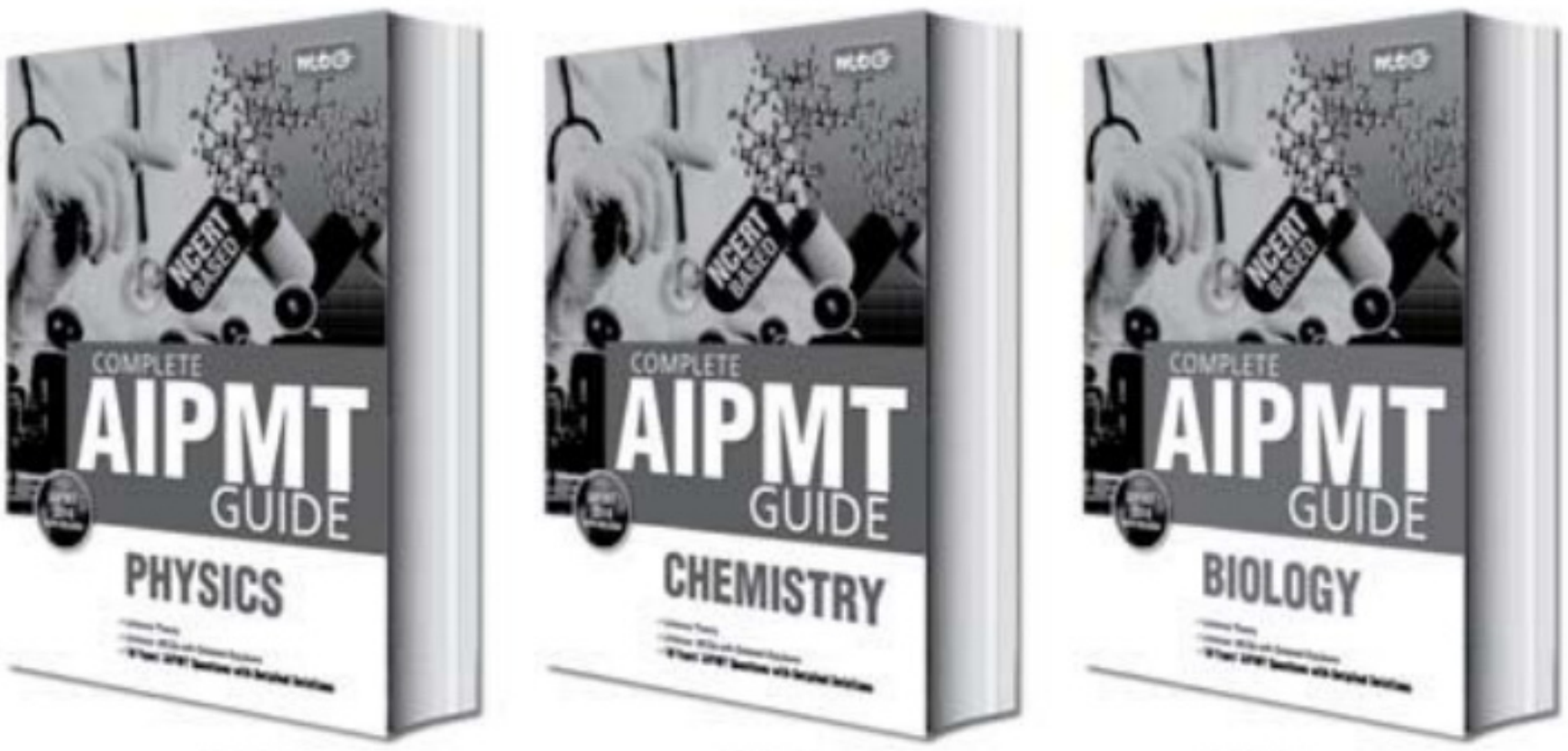


Marine fish



Osmoregulators, on the other hand, are the animals that maintain an internal osmolarity, different from the surrounding medium in which they inhabit. Many aquatic invertebrates are strict or **limited osmoregulators,** *i.e.*, they maintain the composition of the body fluids within a narrow osmotic range. The notable exception, however, are the hagfish (*Myxine* sp., a marine cyclostome fish) and elasmobranchs (sharks and rays).Osmoregulators must either eliminate excess water if they are in a hypotonic medium, or continuously take in water to compensate for water loss, if they are in a hypertonic

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situation. Therefore, osmoregulators have to spend energy to move water in or out, and maintain osmotic gradients by manipulating solute concentrations in their body fluids.

Osmoregulation in freshwater animals

Osmolarity of freshwater is generally much less than 50 $mOsmolL^{-1}$ while the freshwater vertebrates have blood osmolarity in the range of 200 to 300 $mOsmolL^{-1}$. The body fluids of fresh water animals are generally hypertonic to their surrounding environment.

The problems faced by these animals will be:

(i) Loss of body salt to the outside

(ii) Entry of excess of water.

The freshwater animals prevent the net gain of water and net loss of body salts by several means such as:

- Freshwater animals (including freshwater fish) **do not drink water** to reduce the need to expel excess water.
- Protozoa (*Amoeba*, *Paramoecium)* have **contractile vacuoles** that pump out excess water.
- Water uptake and salt loss are minimized by a **specialized body covering** (subcutaneous fat layer of scaleless fish and scales over the body of fish or crocodiles).
- Specialized cells, called **ionocytes** or **chloride cells** in the gill membrane of freshwater fish can import Na^+ and Cl^- from the surrounding water (surrounding water has less than 1mm NaCl and plasma concentration has more than100 mM).

Osmoregulation in marine animals

Seawater usually has an osmolarity of about 1000 $mOsmolL^{-1}$, while osmolarity of human blood is about 300 $mOsmolL^{-1}$. The osmoregulatory problems in marine situation are opposite to those in freshwater environment. Marine bony fish have the body fluids hypotonic to seawater, and thereby, they tend to lose water from the body through permeable surfaces (gill membranes, oral and anal membranes). To compensate for the water loss, marine bony fish drink seawater. However, drinking seawater results in a gain of excess salts. The ionocytes or chloride cells of the gill membrane of marine bony fish help to eliminate excess monovalent ions from the body fluid to the seawater. Divalent cations are generally eliminated with faeces. Hilsa, salmon and other fish that migrate between seawater and freshwater, when in ocean, drink and excrete excess salt through the gill membrane. A number of hormones play a key role in this switching over process.

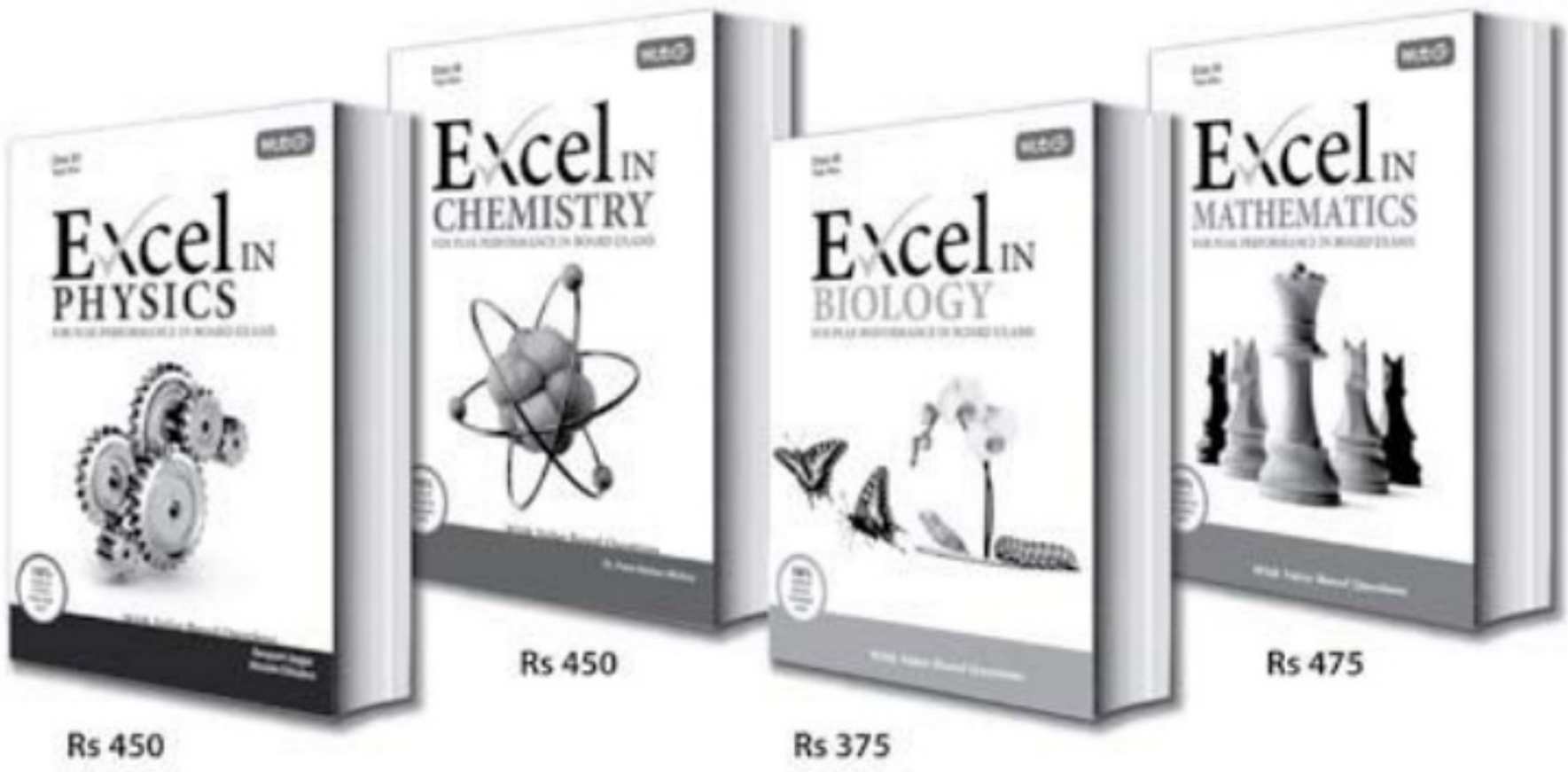
In general, the body fluids of marine invertebrates, ascidians and the hagfish are isosmotic to seawater. In elasmobranchs (sharks and rays) and coelacanths (lobe finned fish), osmolarity of the body fluids is raised by accumulating certain **organic substances (osmolytes).** Retention of osmolytes in body fluids reduces the osmoregulatory challenges. The best known examples of such organic osmolytes are **urea** and **trimethylamine oxide (TMAO).** Body fluids of sharks and coelacanths are slightly hyperosmotic to seawater due to retention of urea and TMAO, but hypotonic to seawater, as they maintain far lower concentration of inorganic ions in the body fluids.

Osmoregulation in terrestrial animals

Land animals are always subject to osmotic desiccation, like the marine animals. Terrestrial air-breathing animals constantly lose water through their respiratory surfaces which may even be fatal. Humans, for example, die if they lose around 12 percent of the body water. Therefore, water loss must be compensated by drinking and eating moist food.

Animals utilise various means to minimise this water loss, such as the waxy coating of the exoskeleton of insects, the shell of the land snails, and the multiple layers of dead, keratinised skin cells covering most terrestrial vertebrates.

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Kangaroo rats, lose so less water, that they can recover 90 percent of the loss by using metabolic water (water derived from different cellular metabolic processes).

Many **desert animals** are nocturnal to avoid the heat of day-time, a behavioural adaptation that minimizes dehydration. **Camels** produce dry faeces and concentrated urine. When water is not available, the camels do not produce urine, but store urea in tissues, and solely depend on metabolic water. When water is available, they rehydrate themselves by drinking upto 80 litres of water in 10 minutes.

EXCRETION

Excretion is the removal of metabolic wastes produced in the body during metabolism of substances like carbohydrates, fats, amino acids or proteins and nucleic acids.

Nitrogenous waste products are of following types:

Ammonia	It is the first metabolic waste of protein metabolism. Ammonia is produced in liver by the process of deamination. It is very toxic and requires large amount of water for its excretion.
Urea	It is a white crystalline solid produced in liver from NH_3 and CO_2. It is comparatively less toxic. If we take more proteins, more urea is excreted out. Normal blood urea level is 18-38 mg/100 mL of blood.
Uric acid	It is produced in liver, and is excreted out in semisolid or crystalline form. Excretion of uric acid in crystalline form is helpful in conservation of body water. Bird droppings (guano) consist of uric acid and phosphate rich faeces.
Xanthine	It is a metabolic waste of nucleotide metabolism, found in spiders and penguins.
Guanine	It is a metabolic waste of nucleotide metabolism, also found in spiders and penguins.
Trimethylamine oxide	It is found in marine bony fish.
Ornithuric acid	It is a specialised excretory product in birds.
Hippuric acid	It is a specialised excretory product in mammals, produced from benzoic acid.
Creatinine	It is produced from creatine phosphate present in muscles. Increased level of creatinine is indicative of kidney damage.

Types of animals based on excretory products

Ammonotelic animals

Most teleost fish (modern bony fish), tadpoles and aquatic insects excrete nitrogenous wastes as ammonia. This phenomenon is referred to as **ammonotelism,** and the concerned animals are called **ammonotelic.** Ammonia molecules are readily soluble in water, so they easily cross the membrane barriers.

In soft-bodied invertebrates, ammonia diffuses out across the whole body surface into the surrounding water. In fish, most of the ammonia (NH_3) is lost as ammonium ions (NH_4^+) across the gill epithelium, and the kidneys play a minor role in ammonia excretion.

Ureotelic animals

Although ammonia excretion works fine in aquatic situation, it is unsuitable for terrestrial situation. Ammonia is very toxic to cellular environment, while urea can be tolerated in a much more concentrated form, because it is 1,00,000 times less toxic than ammonia. For those animals that are under the threat of desiccation, urea excretion or **ureotelism** helps to lose less water while disposing of the nitrogenous wastes.

Mammals, most adult amphibians living on land, and many marine fish and turtles, which face the problem of conserving water in their hypertonic environment are **ureotelic.**

Urea is produced in the liver by a metabolic cycle, called **urea cycle** that combines **ammonia** with **carbon dioxide.** The circulatory system carries urea to the kidneys for elimination. However, in mammals the total amount of urea produced is not excreted immediately. Instead, some portion of it is retained in the kidneys for osmoregulation. It helps to maintain the osmolarity gradient that functions in water reabsorption.

Sharks also produce urea and retain a good amount of it in the blood as a major osmolyte, to balance the osmolarity of the body fluids with the surrounding seawater.

Uricotelic animals

Uric acid excretion, or **uricotelism** enables terrestrial animals to excrete nitrogenous wastes of metabolism with a minimum loss of water. Uric acid is 1000 times less soluble in water than either ammonia, or urea. It can be excreted as a precipitate, after reabsorbing nearly all the water from the urine. Land snails, insects, birds and many reptiles are uricotelic and excrete uric acid. In birds and reptiles, urine is eliminated in a paste-like form along with faeces.

Uricotelism is particularly advantageous to those land vertebrates that lay shelled eggs. Soluble wastes (like ammonia or urea) can pass out of the shell-less eggs, in case of certain fish and amphibians, or maybe carried away by the mother's blood, as in mammalian embryo. However, the shelled eggs of birds and most reptiles possess many fine pores, and are permeable to gases only. If an embryo produced ammonia or urea within the shelled egg, the soluble nitrogenous waste would have accumulated to the level of toxic concentration. Uric acid, on the other hand, precipitates out of the solution and can be stored within the shell as a solid waste, which is left behind, when the egg hatches and the young one emerges,

Tadpole and aquatic amphibians excrete ammonia, while their terrestrial adult forms excrete urea. Most terrestrial reptiles excrete uric acid, but crocodiles excrete ammonia, in addition to uric acid. Aquatic turtles excrete both urea and ammonia. Some tortoises can even modify their nitrogenous wastes when their environment is changed.

Table : Excretory structures/organs of different animals

	Animal groups	Main excretory structures/organs
1.	Protozoans	Plasmalemma or general body surface
2.	Porifera and cnidaria	Plasma membrane of each cell
3.	Platyhelminthes (*Planaria*, liver fluke, tapeworm)	Protonephridia or flame cells
4.	Aschelminthes (Round worms)	H-shaped renette cell
5.	Annelids (*Nereis*, earthworm, leech)	Nephridia
6.	Arthropods (i) Insects, centipedes and millipedes (ii) Crustaceans (*e.g., Prawn*) (iii) Scorpions and spiders	 Malpighian tubules Antennary or green glands Coxal glands
7.	Molluscs (*e.g., Unio*)	Keber's organ and organ of Bojanus
8.	Echinodermates (*e.g.*, Star fish)	No specialised excretory organ
9.	Hemichordates (*e.g., Balanoglossus*)	Proboscis gland
10.	Urochordates	Neural gland
11.	Cephalochordates	Solenocytes
12.	Vertebrates	One pair of kidneys

HUMAN EXCRETORY SYSTEM

In humans, the excretory system consists of a pair of **kidneys**, a pair of **ureters**, a **urinary bladder** and a **urethra.**

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

Each kidney of an adult human measures 10-12 cm in length, 5-7 cm in width, 2-3 cm in thickness, with an average weight of 120-170 g. Towards the centre of the inner concave surface of the kidney is a notch called **hilum** for the ureter, blood vessels and nerves. Inner to the hilum is a broad funnel shaped space called the **renal pelvis** with projections called **calyces.**

The outer layer of kidney is a tough capsule, while inside the kidney, there are two zones, an **outer cortex** and an **inner medulla**. The medulla is divided into a few conical masses, **medullary pyramids** projecting into the calyces (sing.: calyx). The cortex extends in between the medullary pyramids as renal columns called **columns of Bertini.**

Kidney

Each kidney has nearly one million complex tubular structures called **nephrons**, which are the **functional units.** Each nephron consist of two parts - a glomerulus and a renal tubule.

Glomerulus is a tuft of capillaries formed by the afferent arteriole, which is a fine branch of renal artery. Blood from the glomerulus is carried away by an **efferent arteriole**, which further forms vasa recta and drains into the renal vein.

The walls of the afferent and efferent arterioles contain the **renin-secreting juxtaglomerular cells (JG cells).** At this point, the tubular epithelium is modified histologically to form the **macula densa.** The juxtaglomerular cells, the macula densa and the lacis cells (specialised glandular cells present at the vascular angle formed by the afferent and efferent arterioles) are collectively known as the **juxtaglomerular apparatus (JGA).** Juxtaglomerular cells are the site of renin synthesis and secretion, and thus play a critical role in renin-angiotensin system.

The renal tubule has a double walled cup-like structure called **Bowman's capsule**, which encloses the glomerulus. The glomerulus, alongwith the Bowman's capsule, is called the **Malpighian body** or **renal corpuscle.**

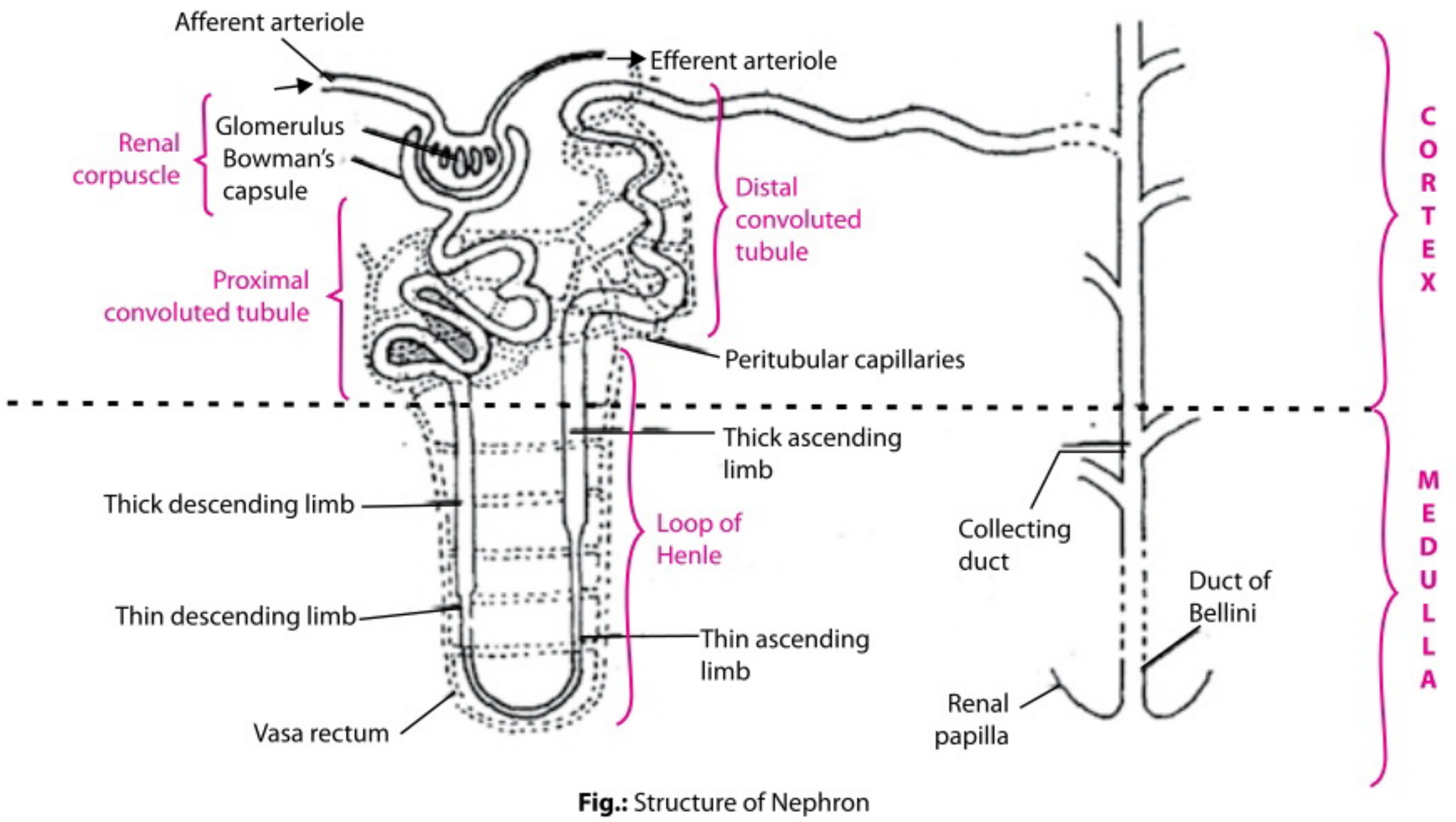


Fig.: Structure of Nephron

The tubule continues further to form a highly coiled network called **proximal convoluted tubule** (PCT). The cells of the proximal convoluted tubule have numerous **brush bordered microvilli,** which increase the surface area, and **mitochondria,** which provide energy for reabsorption of salts by active transport.

A hairpin shaped **Henle's loop** is the next part of the tubule which has a **descending** and an **ascending limb**. Descending limb of loop of Henle is relatively thin and long. It is freely permeable to water and is lined with **squamous epithelial cells;** however, the cells possess sparse microvilli and fewer mitochondria.

Ascending limb of loop of Henle is comparatively thicker and is composed of fl attened **cuboidal epithelium.** It is impermeable to water, but permeable to K^+, Cl^- and Na^+.

The ascending limb continues as another highly coiled tubular region called **distal convoluted tubule** (DCT). The DCTs of many nephrons open into a straight tube called **collecting duct,** many of which converge and open into the **renal pelvis** through **medullary pyramids** in the **calyces.**

The Malpighian corpuscle, PCT and DCT of the nephron are situated in the cortical region of the kidney, whereas the loop of Henle dips into the medulla. In majority of nephrons, the loop of Henle is too short and extends only very little into the medulla. Such nephrons are called **cortical nephron** and are about 85% of the total nephrons. In some of the nephrons, the loop of Henle is very long and runs deep into the medulla. These nephrons are called **juxtamedullary nephrons** and are about 15% of the total nephrons.

The efferent arteriole emerging from the glomerulus forms a fi ne capillary network around the renal tubule called the **peritubular capillaries**. A minute vessel of this network runs parallel to the Henle's loop forming a 'U' shaped **vasa recta.** Vasa recta is absent or highly reduced in cortical nephrons.

Types of kidney

Archinephric kidney or archinephros

It is the basic and ancestral form. Such kidney is found today in larvae of certain cyclostomes (*Myxine*), but does not occur in any adult vertebrate. In the archinephric kidney, glomeruli are only present in some of the posterior tubules.

Pronephric kidney or pronephros

It is the **most primitive excretory organ** that develops in embryonic stage of some vertebrates, corresponding to the fi rst stage of kidney development. It is also called **anterior kidney**. It is a paired organ, consisting of a series of nephrons fi ltering urine from both, the **pericardial fl uids** *via* openings called **nephrostomes,** and **blood** from the **glomerulus.** However, a pronephros is retained throughout life in **adult cyclostomes** and a **few teleost fi shes,** but it is non-urinary and mostly lymphoidal in function.

Mesonephric kidney or mesonephros

The mesonephros **(middle kidney)** serves as the **main excretory organ of aquatic vertebrates** and as a temporary kidney in higher vertebrates. The mesonephros is composed of the **mesonephric duct** (also called the **Wolffi an duct), mesonephric tubules,** and **associated capillary tufts.** A single tubule and its associated capillary tuft is called a **mesonephric excretory unit;** these units are similar in structure and function to nephrons of the adult kidney.

In human males, the mesonephros gives rise to the efferent ductules of the testis, the epididymis, vas deferens, seminal vesicle, and vestigial structures such as the appendix testis, appendix epididymis, and paradidymis.

Mesonephros is functional in fi sh and amphibians, but in reptiles, birds and mammals, it is functional in embryo only.

Metanephric kidney or metanephros

It is the most advanced kidney in which the loop of Henle is present. It is also called posterior kidney, and it is functional in **reptiles, birds & mammals.**

Functions of kidney

- It removes excess of water from the body. **(osmoregulation)**
- It removes nitrogenous wastes such as urea and uric acid from the blood.
- It removes excess of acids and alkalies from the blood to maintain proper pH of blood (about 7.4).
- It maintains proper amount of mineral salts, such as sodium and potassium in the body.
- It eliminates toxic substances, drugs, pigments, excess vitamins from the blood.
- It controls the fl uid balance in the body, therefore, it maintains blood pressure.
- It secretes an enzyme, renin which acts as hormone, and changes plasma protein angiotensinogen into angiotensin II.

Renin *vs* Rennin

Renin is an enzyme secreted, by the kidneys. Rennin is an enzyme secreted by gastric glands, which helps in the digestion of milk protein.

PHYSIOLOGY OF EXCRETION

The excretory process is studied under two headings for easy understanding.

(i) Formation of urea and

(ii) Formation of urine.

Formation of urea

Urea is produced in a series of reactions which take place in the **mitochondrial matrix and cytosol of liver cells.** These reactions are referred to as the **urea cycle.**

During catabolism, proteins break-up into amino acids, which are converted into keto acids with the removal of ammonia (**deamination**). The keto acids enter the Krebs' cycle to yield energy, and carbon dioxide is formed during **decarboxylation**. The ammonia produced, as a result of deamination of proteins, is highly toxic and is soluble in water, so it is quickly changed to urea by **ornithine cycle or Krebs-Henseleit cycle,** which occurs in the mitochondria and cytosol of liver cells.

Ornithine cycle involves the following steps, each catalysed by a specifi c enzyme.

(i) Ammonia combines with CO_2 and forms **carbamoyl phosphate** in the presence of enzyme **carbamoyl phosphate synthase I (CPSI)** of mitochondria consuming two ATPs.

(ii) The carbamoyl phosphate combines with ornithine (amino acid) to form **citrulline** in the presence of enzyme **ornithine trans-carbamoylase.**

(iii) Citrulline combines with aspartic acid to form **argino-succinic acid** in the presence of **arginosuccinate synthetase** enzyme and ATP. The latter, then breaks into **fumaric acid** and **arginine.**

(iv) Arginine then cleaves to form urea and ornithine in the presence of **arginase** enzyme. Ornithine is thus released for reuse in the urea cycle.



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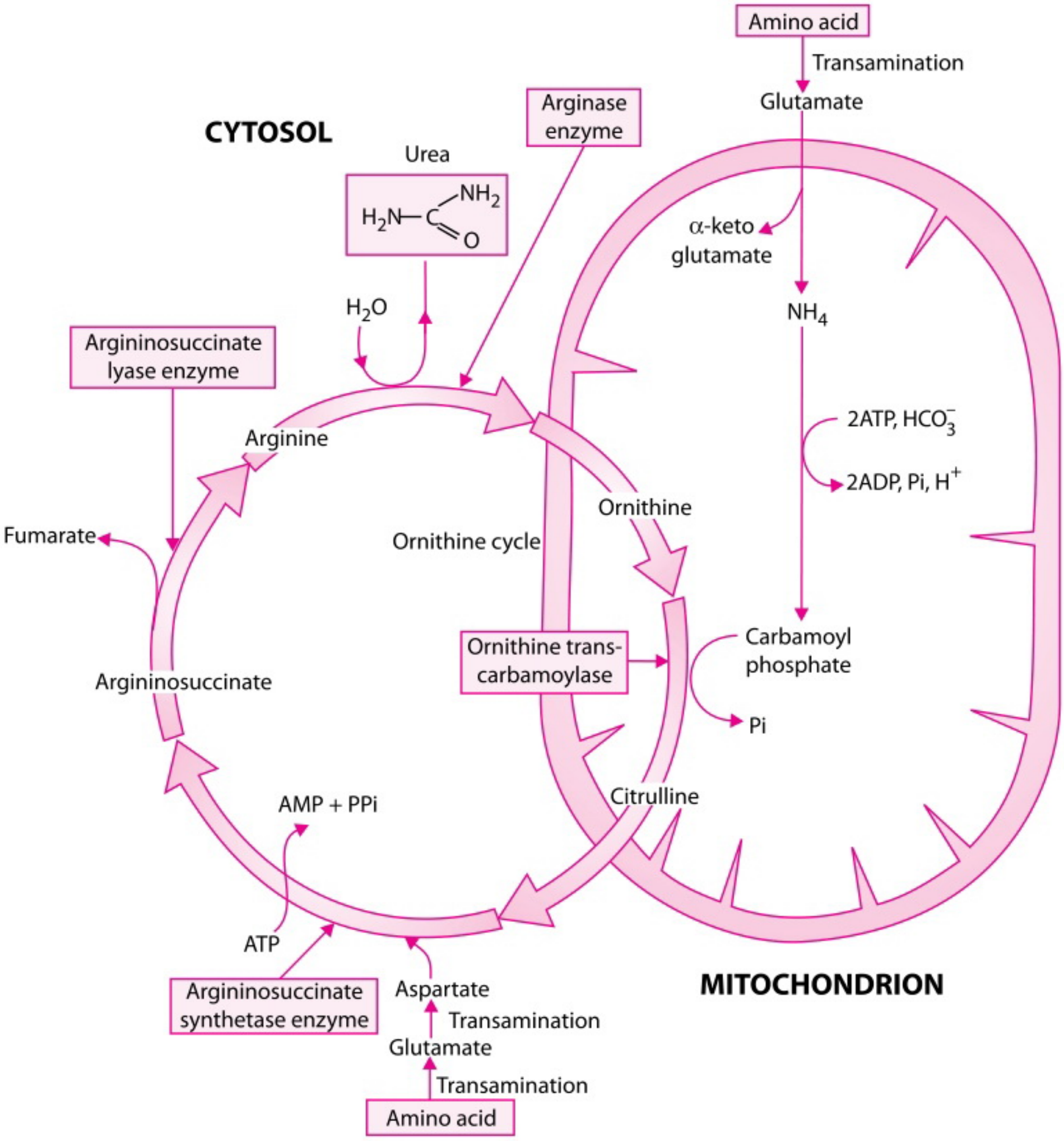


Fig.: Urea cycle

Formation of urine

The formation of urine involves the following processes:

- **Glomerular filtration or ultrafiltration** of the blood plasma by the glomeruli;
- **Selective reabsorption by the tubules** (useful substances such as sugar, salts, water are selectively reabsorbed from the glomerular filtrate to maintain the constant internal environment); and
- **Secretion by the tubules** (the tubules secrete certain substances like urea, uric acid, anions, etc., from the blood into the tubular lumen for excretion into the urine).

Glomerular filtration or ultrafiltration of blood

The first step in urine formation is the filtration of blood, which is carried out by the glomerulus and is called **glomerular filtration.** On an average, 1100-1200 mL of blood is filtered by the kidneys per minute, which constitutes roughly 1/5th of the blood pumped out by each ventricle of the heart, in a minute.

The glomerular capillary blood pressure causes filtration of blood through 3 layers, *i.e.*, the **endothelium of glomerular blood vessels**, the **epithelium of Bowman's capsule** and a **basement membrane between these two layers.**

The epithelial cells of Bowman's capsule called **podocytes** are arranged in an intricate manner so as to leave some minute spaces called **filtration slits** or **slit pores.**

Blood is filtered so finely through these membranes, that almost all the constituents of the plasma, **except the proteins** pass into the lumen of the Bowman's capsule. Therefore, it is considered as a process of **ultrafiltration.**

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

Glomerular filtration occurs because the pressure of the blood flowing in the glomerular capillaries is higher than the pressure of the filtrate in Bowman's capsule. Glomerular filtration does not require any expenditure of energy by kidney cells.

To prevent the glomerular filtration rate from changing, when blood pressure is altered, as a result of exercise or other conditions in the body, a certain degree of **self-regulation** over filtration occurs in the kidney.

Two important intrinsic mechanisms provide autoregulation of glomerular filtration rate:

(a) **Myogenic mechanism:** An increase in blood pressure will tend to stretch the afferent arteriole, which would be expected to increase the blood flow to the glomerulus. The wall of the afferent arteriole, however, responds to stretch by contraction, thus reducing the diameter of the arteriole, and therefore, increasing resistance to flow. This myogenic mechanism, thus, reduces variations in blood flow in case of fluctuations in blood pressure.

(b) **Juxtaglomerular apparatus (JGA) :** This specialised cellular apparatus is located where the distal convoluted tubule passes close to the Bowman's capsule, between the afferent and efferent arterioles. JGA cells secrete enzyme renin, that modulates blood pressure, and thus renal blood flow and GFR are regulated.

Thus, myogenic and juxtaglomerular mechanisms work together to autoregulate the GFR over a wide range of blood pressure. In addition to these, extrinsic neural control also regulates the filtration rate.

Effective filtration pressure (EFP) is the total pressure that promotes filtration. It is determined by the following:

- **GHP (Glomerular hydrostatic pressure)** - It is the blood pressure in the glomerular capillaries due to narrower efferent arteriole, and is the chief determinant of EFP. Its value is about **60 mm Hg.**
- **BCOP (Blood colloidal osmotic pressure)** - It is osmotic pressure in the blood of glomerular capillaries due to the presence of plasma proteins. Its value is about **32 mm Hg.**

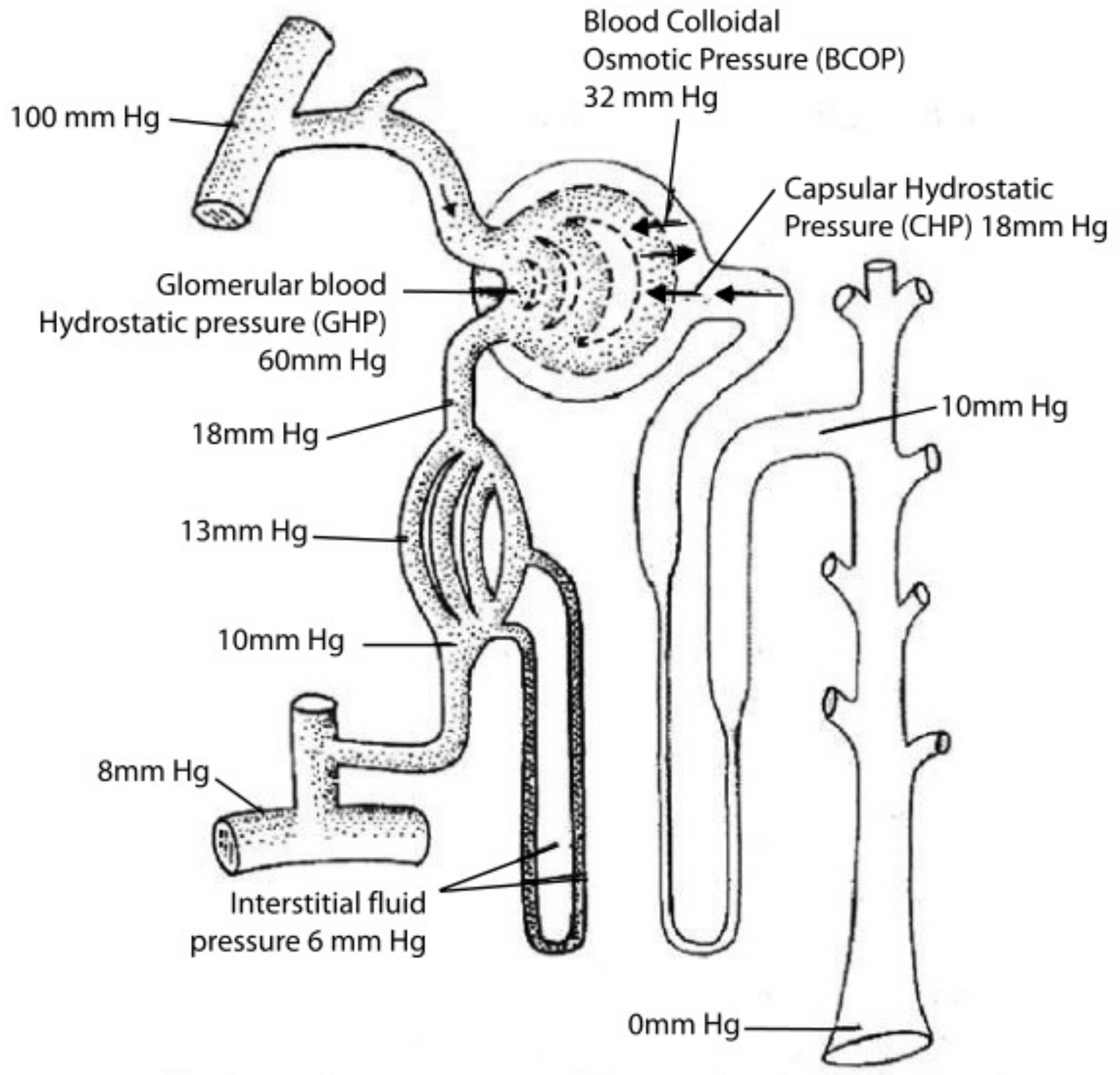


Fig.: Approximate pressures at different points in the vessels and tubules of the functional nephrons and in the interstitial fluid

- **CHP (Capsular hydrostatic pressure)** - It is caused by the fluid or filtrate occupying the Bowman's capsule and resists filtration. Its value is about **18 mm Hg.**
- Hence, **EFP = GHP – (BCOP + CHP) = 60 – (32 + 18) = 10 mm Hg.**

Thus, a pressure of 10 mm Hg causes blood plasma to filter from the glomerulus into the glomerular capsule.

About **1100-1200 mL** of blood circulates per minute through the two kidneys, and out of it **650-700 mL** is plasma. This is called **renal plasma flow (RPF).**

The glomerular filtration rate is **125 mL per minute** or **180 litres/day,** while the filtration fraction is **19.2%.**

$$\text{Filtration fraction} = \frac{\text{Filtrate rate}}{\text{Renal plasma flow}} \times 100$$

$$\frac{125 \text{ mL/min} \times 100}{650 \text{ mL/min}} = 19.2\%$$

Selective tubular reabsorption

Tubular reabsorption is the second process in the formation of urine from filtrate. As a result of tubular reabsorption, much of the filtrate passes out of the nephron tubule and returns to the blood through the peritubular capillaries. As much as 99 percent of the material in the filtrate is reabsorbed, preventing the loss of water, nutrients, and ions from the body. As a consequence of tubular reabsorption, the urine contains mostly waste materials and excess water.

Reabsorption occurs within three regions of the nephron and in the collecting duct, but most of it takes place within the proximal convoluted tubule. The epithelial cells of the proximal convoluted tubule have numerous microvilli, which increase the surface area available for reabsorption.

Depending upon the types of molecules being reabsorbed, movements into and out of epithelial cells occur by **passive transport** or **active transport. Water and urea,** for example, are reabsorbed by **passive transport**, moving from regions of higher concentration to regions of lower concentration (water is reabsorbed by osmosis and urea by simple diffusion). **Glucose** and **amino acids** are reabsorbed by **active transport,** while the **reabsorption of Na^+** occurs by **both passive** and **active transport.** Na^+ moves passively by diffusion from the filtrate into tubule cells, but it is actively transported out of the tubule cells on its way to the **peritubular capillaries.**

Water is reabsorbed in all parts of the tubules, except the ascending limb of loop of Henle. About **70-80% of electrolytes and water are reabsorbed in PCT.** This is called **obligatory water reabsorption.** About **65%** of the glomerular filtrate is normally reabsorbed in the proximal convoluted tubule before reaching the loop of Henle.

Glucose, amino acids, vitamins, hormones, sodium, potassium, chlorides, phosphates, bicarbonates, much of water and some urea from the filtrate are reabsorbed. Sulphates and creatinine are not reabsorbed, while sodium and potassium are reabsorbed by **primary active transport**; glucose and amino acids are reabsorbed by **secondary active transport. The filtrate now becomes isotonic to blood plasma.**

In **descending limb of loop of Henle,** water is reabsorbed due to increasing osmolarity of interstitial fluid, but sodium and other solutes are not reabsorbed here. **The filtrate now becomes hypertonic to blood plasma.**

Ascending limb of loop of Henle is, however, impermeable to water but permeable to K^+, Cl^-, Na^+ and partially permeable to urea. Thus, in the thick **ascending limb of the loop of Henle** sodium, potassium, calcium, magnesium, and chloride are reabsorbed. **The filtrate becomes hypotonic to blood plasma.**

Tubular reabsorption is not recorded in the marine fishes and desert amphibians due to the absence of glomerulus.

In distal convoluted tubules, there is active reabsorption of sodium ions from the filtrate under the influence of **aldosterone** (hormone secreted by cortex of adrenal glands), with associated secretion of potassium and hydrogen

ions, some Cl^- ions are also reabsorbed. Water is reabsorbed here under the influence of **antidiuretic hormone (ADH)** secreted by posterior lobe of pituitary gland. **This makes the filtrate isotonic to blood plasma.**

In **collecting duct,** further reabsorption of water takes place. Now the filtrate becomes more concentrated which makes the filtrate hypertonic to blood plasma. The entire duct is permeable to water. Thus, a considerable amount of water is reabsorbed in the collecting duct under the influence of ADH.

Sodium is reabsorbed in the collecting duct under the influence of **aldosterone.** The filtrate is now called urine. Thus, **urine is hypertonic to blood plasma.**

Renal threshold of a substance is its highest concentration in the blood upto which it is totally reabsorbed from the glomerular filtrate.

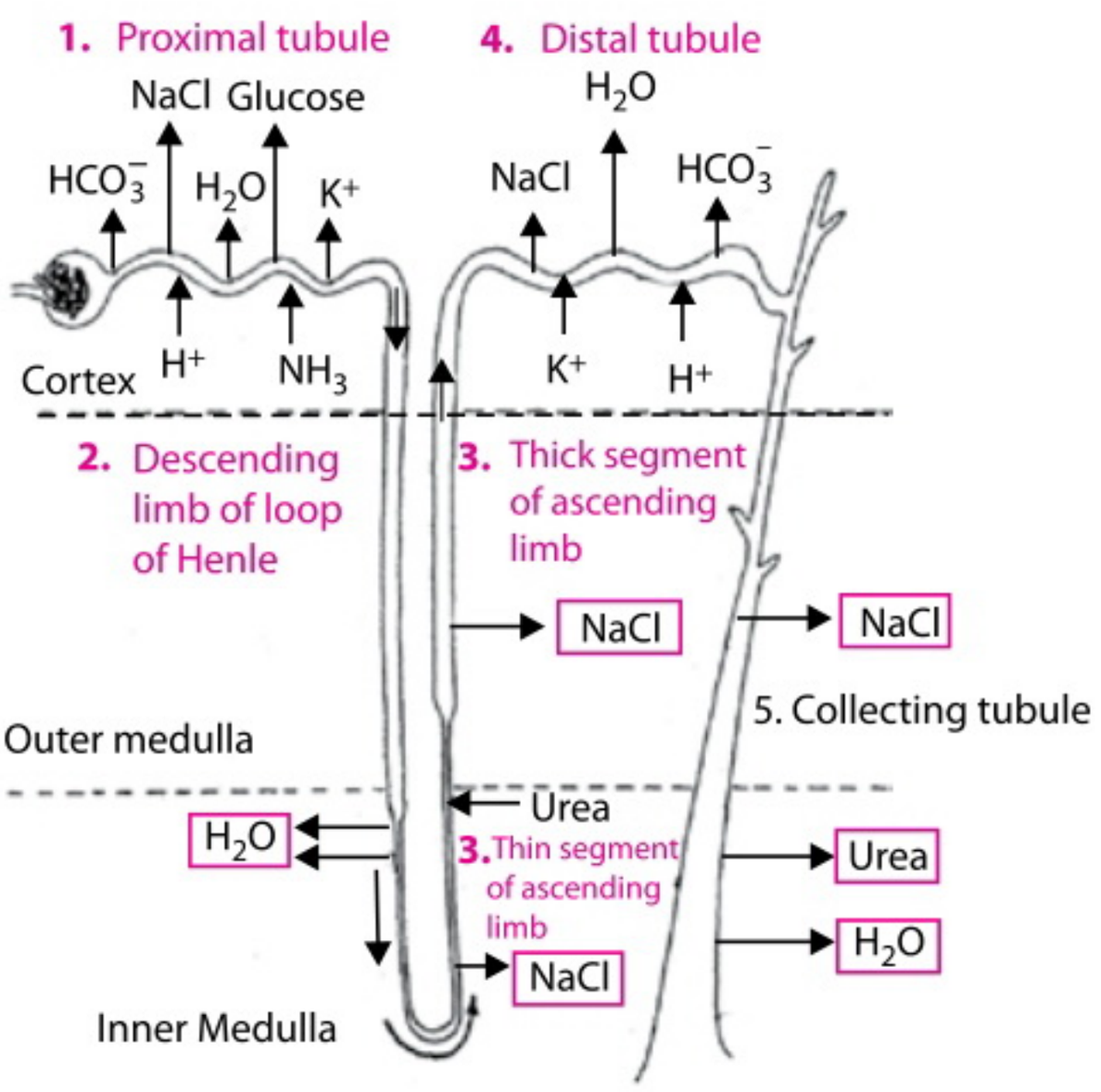


Fig.: Filtration, reabsorption and secretion in various parts of nephron

High threshold substances are almost completely absorbed from glomerular filtrate, *e.g.*, glucose, amino acids, vitamin C, Na^+, water. Glucose has a threshold value of 180 mg/100 mL.

Low threshold substances, in which only a small quantity is reabsorbed are urea, uric acid, xanthine, phosphate while **non-threshold substances** are not at all reabsorbed, *e.g.*, creatinine, hippuric acid, etc.

Tubular secretion or augmentation

Certain chemicals in the blood that are not removed by filtration from the glomerular capillaries are removed by the third process of urine formation called **tubular secretion.** These chemicals are removed from the blood in the peritubular capillaries to the nephron tubule by **both passive and active transport.**

The chemicals removed by tubular secretion include foreign bodies, ions and molecules that are toxic at elevated levels. After entering the proximal or distal convoluted tubules, these chemicals are mixed with the glomerular filtrate and are eliminated from the body with the urine.

Ions removed from the blood by tubular secretion include potassium (K^+), hydrogen (H^+) and ammonium (NH_4^+). The secretion of H^+ is an important way in which kidneys help to control blood pH. In addition to ions, other molecules, such as food preservatives, medicines such as penicillin and metabolic by-products such as creatinine, hippuric acid, etc., are also removed from blood by tubular secretion.

The kidneys also remove harmful drugs such as marijuana, cocaine and heroin by tubular secretion.

Counter current mechanism of urine concentration

Mammals have the ability to produce a **concentrated urine**. The Henle's loop and vasa recta play a significant role in this.

The flow of filtrate in the two limbs of Henle's loop is in opposite directions, and thus forms a **counter current.** The flow of blood through the two limbs of **vasa recta** is also in a counter current pattern.

The proximity between the Henle's loop and vasa recta, as well as the counter current in them helps in maintaining an increasing osmolarity towards the inner medullary interstitium, *i.e.*, from 300 $mOsmolL^{-1}$ in the cortex to about 1200 $mOsmolL^{-1}$ in the inner medulla. This gradient is mainly due to **NaCl** and **urea.**

NaCl is transported by the ascending limb of Henle's loop, which is exchanged with the descending limb of vasa recta. NaCl is returned to the interstitium by the ascending portion of vasa recta.

Small amounts of urea enter the thin segment of the ascending limb of Henle's loop, which is transported back to the interstitium by the collecting tubule.

The above described transport of substances, facilitated by the special arrangement of Henle's loop and vasa recta, is called the counter current mechanism. This mechanism helps to maintain a **concentration gradient** in the medullary interstitium. Presence of such interstitial gradient helps in an easy passage of water from the collecting tubule, thereby, concentrating the filtrate (urine).

Human kidneys can produce urine nearly four times concentrated than the initial filtrate formed.

REGULATION OF KIDNEY FUNCTION

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

Osmoreceptors in the body are activated by changes in blood volume, body fluid volume and ionic concentration.

Antidiuretic hormone (ADH)

An excessive loss of fluid from the body can activate the specific receptors, which stimulate the hypothalamus to release **antidiuretic hormone** (ADH) or **vasopressin** from the neurohypophysis.

ADH facilitates water reabsorption from, the latter parts of the tubule, thereby preventing **diuresis.**

An increase in body fluid volume can 'switch off' the osmoreceptors and suppress the ADH release to complete the feedback.

ADH can also affect the kidney function by the constriction of blood vessels, thus causing an increase in blood pressure. An increase in blood pressure can increase the glomerular blood flow and thereby the GFR.

Alcohol inhibits the release of ADH, while caffeine interferes with ADH action and sodium reabsorption; thus, both these dilute the urine.

Drugs (called **diuretics**) increase the production of dilute urine, and prevent excessive water retention and tissue swelling (**oedema**) that may accompany congestive heart failure, high blood pressure and other conditions.

Due to the **deficiency of ADH**, a disease called **diabetes insipidus** is caused, in which the output of urine may reach 20-25 litres/day instead of normal 1.2-1.8 litres/day. Frequent urination (due to inadequately reabsorbed water from the collecting duct) and thirst are the symptoms of the disease.

Juxtaglomerular apparatus (JGA)

As blood pressure decreases, the cells of the **juxtaglomerular apparatus** release the enzyme **renin** and activate the **renin-angiotensin-aldosterone pathway (RAAS).**

Renin converts **angiotensinogen** into **angiotensin I. Angiotensin converting enzyme (ACE)** then converts angiotensin I into **angiotensin II,** a peptide hormone that is the active form.

Angiotensin II has the following effects:

- Raises blood pressure directly by constricting blood vessels (being powerful vasoconstrictor).
- Increases the synthesis and release of aldosterone.
- Aldosterone causes sodium and water reabsorption by the distal part of the tubules. This also leads to an increase in blood pressure and GFR.
- Stimulates the posterior pituitary to release ADH.

These changes assist in restoring extracellular fluid volume and in stabilizing blood pressure.

ACE inhibitors are sometimes administered to block the production of angiotensin II in persons with elevated blood pressure.

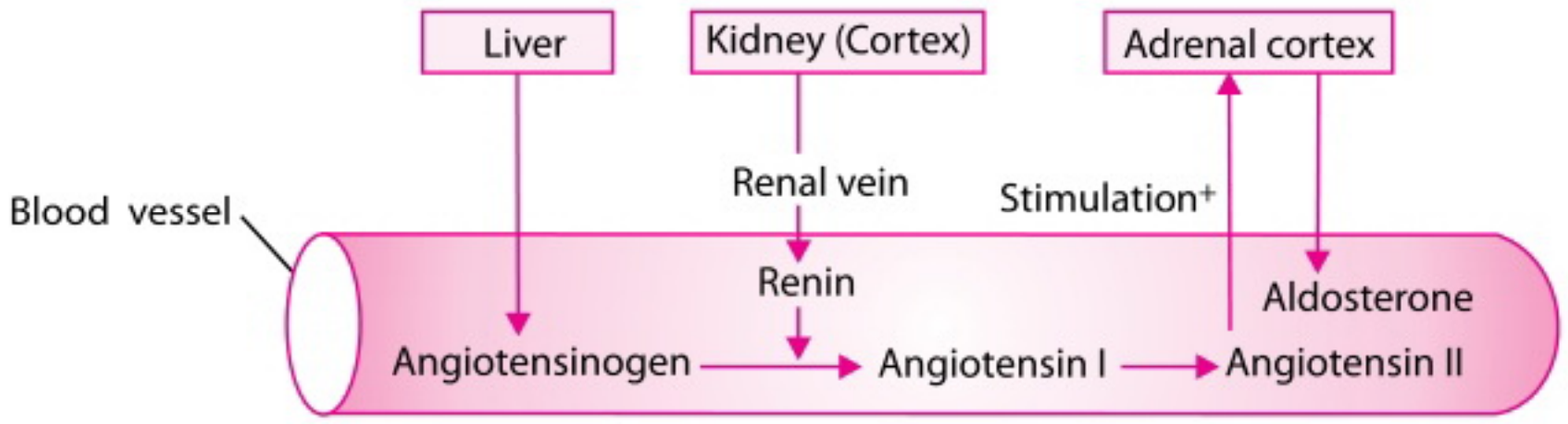


Fig.: Summary of the renin-angiotensin-adosterone system (RAAS)

Atrial natriuretic peptide (ANP)

ANP hormone produced by the **atria of heart,** increases sodium excretion, decreases blood pressure and blood volume. ANP is released into the blood stream in response to stretching of the atrial muscle cells by increased blood volume.

ANP has the following physiological effects:

- Increases **glomerular filtration rate** by dilating afferent arterioles.
- **Inhibits** the collecting ducts from **reabsorbing sodium,** both directly and indirectly (by inhibiting aldosterone secretion).

Atrial natriuretic peptide (ANP) works opposite to RAAS. When there is higher blood volume, ANP inhibits renin secretion by juxtaglomerular cells and ADH by pituitary gland. It inhibits NaCl reabsorption and concentration of urine.

The renin-angiotensin system and ANP function antagonistically in the maintenance of fluid/electrolyte balance and blood pressure.

MICTURITION

The expulsion of urine from the urinary bladder is called **micturition.** It is a reflex process, but, it can also be controlled voluntarily, to some extent.

Urine is carried down the ureters by **peristaltic waves** to the urinary bladder. The terminal part of the ureter acts as a sphincter to prevent reflex. The bladder serves to store urine and release it at intervals.

Normally urinary bladder holds **350–400 mL** of urine. Being distensible, **urinary bladder can hold 700-800 mL of urine.** However, it is extremely painful; rather, pain starts beyond 500 mL.

The act of micturition involves the coordinated contraction of the smooth muscle of the bladder wall, abdominal wall, muscles of the pelvic floor, and relaxation of the internal and external urethral sphincters.

Two reflexes are involved in bladder control:

– **Storage reflex** which permits the bladder to get filled and
– **Voiding reflex** which empties it.

Sympathetic nerve causes **filling of the bladder,** while **Parasympathetic** helps in **emptying** and **somatic (pudendal) nerve is responsible for voluntary control of micturition.**

URINE

Urine is a transparent, amber-coloured, hypertonic fluid with a slightly acidic pH (6.0). The yellow colour of the urine is due to the pigment **urochrome,** which is a breakdown product of haemoglobin from worn out RBCs.

The volume of urine depends upon intake of fluids, external temperature and physical activities (volume is 1 to 2 litres in 24 hours normally but varies to a considerable extent).

The urine, on standing, gives a pungent smell due to conversion of urea into ammonia by bacteria (hence becomes **alkaline**).

Urine normally consists of water–95%; urea–2.6%; uric acid–0.3% (derived from nucleic acid metabolism); salts (NaCl)–1.5%; traces of creatinine, ammonia, creatine, hormones, water soluble vitamins, etc.

Least concentration of urea is found in renal vein as urea is excreted through urine formed in kidney.
Highest concentration of urea is found in hepatic vein as urea is synthesized in liver.

ROLE OF OTHER ORGANS IN EXCRETION

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

Lungs

Our lungs remove large amounts of **CO_2 (18 litres/day)** and also significant quantities of water every day.

Liver

Liver, the **largest gland** in our body, secretes bile-containing substances like bilirubin, biliverdin, cholesterol, degraded steroid hormones, vitamins and drugs. Most of these substances ultimately pass out alongwith digestive wastes.

Skin

The **sweat** and **sebaceous glands** in the skin can eliminate certain substance through their secretions.

Sweat produced by the sweat glands is a watery fluid containing NaCl, small amounts of urea, lactic acid, etc. though the primary function of sweat is to facilitate a cooling effect on the body surface.

Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum. This secretion provides a protective oily covering for the skin.

Intestine

Epithelial cells of colon excrete excess salts of calcium, magnesium and iron along with faeces.

Salivary glands

Heavy metals and drugs are excreted in the saliva.

DISORDERS OF EXCRETORY SYSTEM

Renal calculi (Renal stones)	These are caused by dehydration, excess uric acid formation, excess milk intake, metabolic imbalance, infection and hormonal disturbance. Oxalate crystals develop in the kidneys, while uric acid crystals can develop in various organs in the body. The stones gives rise to severe **colic pain** starting in the back and radiating down to the front of the thigh or the testicle or vulva on that side.
Cystitis	Urinary bladder inflammation is mostly due to bacterial infection. Urine is passed out in small amounts with pain. Cystitis is more common in females due to urethra being short.
Pyelonephritis	It is inflammation of the medullary tissues of kidneys and the ureters in the pelvic region. This disease is usually caused by bacteria that reach the kidney by way of the urethra and ureter.

Glomerulonephritis (Bright's disease)	It can be caused by the advancement of pyelonephritis, by injury to the kidney, by congenital kidney defects or by an allergic reaction to the toxins of bacteria such as streptococci.
Haematuria	Presence of blood in the urine.
Albuminuria	Presence of albumin in urine.
Pyuria	Presence of pus or WBCs in the urine.
Glycosuria	Presence of glucose in urine due to diabetes mellitus.
Alkaptonuria	It is a genetic disease in which homogentisic acid is excreted out in urine.
Ketosis	It is the presence of ketones or acetone bodies in urine due to metabolism of fatty acids instead of glucose during diabetes, starvation and pregnancy.
Uremia	In this condition, there are high concentrations of nitrogenous wastes which include urea, uric acid, and a few less important compounds, such as creatinine. Urea accumulation in blood is comparatively high in uremia.
Diuresis	is a condition in which the excretory volume of urine is increased.
Incontinence	It is the inability to control the release of urine. In children under the age of two, it is due to immaturity of the neural pathway to the external sphincter. In adults it may be due to nerve damage, bladder injury, irritating substances in the urine or emotional stresses.
Oedema	Accumulation of excess fluid in tissues is called oedema. It is an increase in the volume of extracellular (interstitial) fluids without a change in their osmolarity. It is usually caused by an excess of sodium ions, which in turn causes water retention.
Dysuria	is painful urination.
Anuria	Failure of kidney to form urine.
Polyuria	Amount of urine passed out is more than normal.

HAEMODIALYSIS OR ARTIFICIAL KIDNEY

The kidney's main function is to eliminate excess fluid and waste material from blood. When kidneys lose their filtering ability, dangerous levels of fluid and waste accumulate in the body. This condition is known as **kidney (renal) failure.**

In case of kidney failure or renal failure, the patient often receives **haemodialysis** or treatment with **artificial kidney.** The artificial kidney uses the **principle of dialysis** to purify the blood of patients whose own kidneys have failed.

Dialysis is a method of removing toxic substances (impurities or wastes) from the blood after regular intervals, when the kidneys are unable to do so.

Blood drained from a convenient artery is pumped into a dialysing unit after adding an **anticoagulant** like heparin. The unit contains a coiled **cellophane tube** surrounded by a fluid **(dialysing fluid)** having the same composition, as that of plasma, except the nitrogenous wastes. The porous cellophane membrane of the tube allows the passage of molecules based on concentration gradient. As nitrogenous wastes are absent in the dialysing fluid, these substances freely move out, thereby clearing the blood.

The cleaned blood is pumped back to the body through a vein, after adding anti-heparin to it. This method is a boon for thousands of uremic patients all over the world.

Kidney transplantation is the relatively permanent method in the correction of acute renal failures (kidney failure), by replacement of defective kidney. A **functioning kidney** is used in transplantation from a donor, preferably a close relative, to minimise its chances of rejection by the immune system of the host.

POWER EXERCISE

New MCQs

1. Which of the following statements is false ?
   (a) ADH helps in water elimination making urine hypotonic.
   (b) Protein free fluid is filtered from blood plasma into the Bowman's capsule.
   (c) Glucose is actively reabsorbed in the proximal convoluted tubule.
   (d) Henle's loop plays an important role in concentrating the urine.

2. Normal desire for micturition is felt when the amount of urine collected in bladder is
   (a) 25–50 mL (b) 50–100 mL
   (c) 350–400 mL (d) 700–800 mL.

3. Diuresis is the condition in which
   (a) the excretory volume of urine increases
   (b) the excretory volume of urine decreases
   (c) the kidneys fail to excrete urine
   (d) the water balance of the body is disturbed.

4. Mark the wrong match
   (a) Bowman's capsule - Glomerular filteration
   (b) DCT - Absorption of glucose
   (c) Henle's loop - Concentration of urine
   (d) PCT - Absorption of Na^+ and K^+ ions

5. Podocytes are the cells present on
   (a) outer wall of Bowman's capsule
   (b) inner wall of Bowman's capsule
   (c) neck of nephron
   (d) wall of glomerular capillaries.

6. Ornithine cycle involves the utilization of
   (a) ammonia and oxygen
   (b) carbon dioxide and ammonia
   (c) carbon dioxide and glucose
   (d) glucose and oxygen.

7. Hippuric acid, creatinines and ketones are added to urine through
   (a) selective reabsorption
   (b) glomerular filtration
   (c) tubular secretion
   (d) both (b) and (c).

8. Two examples in which the nitrogenous waste are excreted from body in the form of uric acid are
   (a) birds and lizards
   (b) frogs and bony fishes
   (c) insects and bony fishes
   (d) mammals and molluscs.

9. Uric acid crystals gets deposited in small joints to produce
   (a) rheumatoid arthritis (b) gout
   (c) osteoarthritis (d) bursitis.

10. Which of the following statements is correct?
   (a) Malpighian corpuscles and glomerulus constitute the Bowman's capsule.
   (b) Renal corpuscle and glomerulus constitute Malpighian corpuscle.
   (c) Bowman's corpuscles and Malpighian tubules constitute the glomerulus.
   (d) Bowman's capsule and glomerulus together constitute renal corpuscle.

Exam Section

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

2. In micturition
   (a) urethra relaxes (b) ureter relaxes
   (c) ureter contracts (d) urethra contracts.
   (DPMT 1999, 2004, Manipal 1997)

3. Which one of the following four secretions is correctly matched with its source, target and nature of action?

Secretion	Source	Target	Action
(a) Gastrin	Stomach lining	Oxyntic cells	Production of HCl
(b) Inhibin	Sertoli cells	Hypothalamus	Inhibition of secretion of gonadotropin releasing hormone
(c) Entero-kinase	Duodenum	Gall bladder	Release of bile juice
(d) Atrial Natriuretic Factor (ANF)	Sinu atrial node(SAN) M-cells of Atria	Juxta-glomerular apparatus (JGA)	Inhibition of release of renin

(AIIMS 2005, Manipal 1997)

4. Which one of the following statements is correct with respect to salt water balance inside the body of living organisms ?
(a) When water is not available camels do not produce urine but store urea in tissues.
(b) Salmon fish excretes lot of stored salt through gell membrane when in freshwater.
(c) *Paramecium* discharges concentrated salt solution by contractile vacuoles.
(d) The body fluids of freshwater animals are generally hypotonic to surrounding water.

(AIIMS 2005)

5. Glucose is mainly absorbed in
(a) P.C.T (b) D.C.T.
(c) Henle's loop (d) nephron.

(AFMC 2005)

6. In the ascending limb of the loop of Henle the maximum osmotic difference that can be created by the Na-K pump is approximately
(a) 100 mOsmol/L (b) 200 mOsmol/L
(c) 300 mOsmol/L (d) 400 mOsmol/L.

(AMU 2008)

7. Vasopressin released from the neurohypophysis is mainly responsible for
(a) facultative reabsorption of water through Henle's loop
(b) obligatory reabsorption of water through Bowman's capsule
(c) facultative reabsorption of water through DCT
(d) obligatory reabsorption of water through PCT.

(Karnataka 2008)

8. Which of the following is correct ?
(a) Water reabsorption in descending limb of loop and collecting duct occur under similar conditions.
(b) Sodium reabsorption in ascending limb of loop and collecting duct occur under similar conditions.
(c) Water reabsorption in descending limb of loop and collecting duct occur under different conditions.
(d) Water reabsorption in descending limb and sodium reabsorption in ascending limb of loop occur under similar conditions.

(AMU 2009)

9. Which one of the following statements in regard to the excretion by the human kidneys is correct?
(a) Descending limb of loop of Henle is impermeable to water.
(b) Distal convoluted tubule is incapable of reabsorbing HCO_3^-.
(c) Nearly 99 per cent of the glomerular filtrate is reabsorbed by the renal tubules
(d) Ascending limb of loop of Henle is impermeable to electrolytes.

(AIPMT Prelims 2010)

10. In which one of the following organisms its excretory organs are correctly stated?
(a) Humans – Kidneys, sebaceous glands and tear glands
(b) Earthworm – Pharyngeal, integumentary and septal nephridia
(c) Cockroach – Malpighian tubules and enteric caeca
(d) Frog – Kidneys, skin and buccal epithelium

(AIPMT Mains 2010)

11. Compare the statements A and B.
Statement A : When the urine moves through the descending limb, it become hypertonic and as it passes through the ascending limb of Henle's loop it becomes hypotonic.
Statement B : The descending limb is permeable to sodium ions, while the ascending limb is impermeable to sodium ions.
(a) Statement A is correct and B is wrong
(b) Statement A is wrong and B is correct
(c) Both statements A and B are wrong
(d) Both statements A and B are correct.

(Karnataka 2010)

12. The average quantity of urea excreted in urine by man per day is
(a) 1–5 gm (b) 25–30 mg
(c) 1–1.5 litres (d) 80 gm
(e) 100–500 mg.

(Kerala 2010)

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

(AIPMT Prelims 2011)

14. Effective filtration pressure in glomerulus is caused due to
(a) powerful pumping action of the heart
(b) secretion of adrenaline

(c) afferent arteriole is slightly larger than efferent arteriole
(d) vacuum develops in proximal convoluted tubule and sucks the blood.

(Karnataka 2011)

15. Select the correct statement.
(a) The juxta medullary nephrons have reduced Henle's loop.
(b) Vasa recta is well developed in cortical nephrons.
(c) The PCT and DCT are situated in the medulla of the kidney.
(d) The glomerulus encloses the Bowman's capsule.
(e) The ascending limb of the Henle's loop extends as the DCT.

(Kerala 2011)

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

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

(AIPMT Mains 2012)

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

(AIPMT Mains 2012)

18. Choose the wrong statement.
(a) In ureotelic organisms, ammonia is not a product of metabolism.
(b) In mammals some amount of urea may be retained in the kidney matrix of ureotelics to maintain osmolarity.
(c) In fishes, kidneys do not play any significant role in the removal of ammonium ions.
(d) Urea and uric acid are less toxic than ammonia.
(e) Ammonia is readily soluble and can diffuse easily.

(Kerala 2012)

19. Which one of the following is correct for a normal human?
(a) pH of urine is around 8.
(b) On an average, 25-30 mg of urea is excreted *via* urine.
(c) Presence of ketone bodies in urine is an indicator of diabetes mellitus.
(d) Glycosuria can be treated with hemodialysis.
(e) Relaxation of smooth muscles of bladder and simultaneous contraction of urethral sphincter causes release of urine.

(Kerala 2012)

20. Fresh water bony fishes maintain water balance by
(a) excreting a hypotonic urine
(b) drinking small amount of water
(c) excreting salt across their gills
(d) excreting wastes in form of uric acid.

(BHU 2012)

21. Juxtaglomerular cells secrete A when there is a fall in B ion concentration.
Choose the correct pair labelled as A and B.
(a) A : Renin B : Chloride
(b) A : Carbonic anhydrase B : Sodium
(c) A : ATPase B : Potassium
(d) A : Renin B : Sodium

(K-CET 2013)

22. Functional kidney of mammals is
(a) archinephros type (b) ophisthonephros type
(c) pronephros type (d) metanephros type.

(AMU 2013)

23. Which of the following is true for excretion in humans?
(a) Glucose and amino acids are reabsorbed in PCT by simple diffusion.
(b) DCT is impermeable to water.
(c) On an average, 25-30 mg of urea is excreted out per day.
(d) Maximum reabsorption occurs in the loop of Henle.

(AIIMS 2013)

Assertion & Reason

The following questions consist of two statements each : assertion (A) and reason (R). To answer these questions, mark the correct alternative as directed below :

(a) If both A and R are true and R is the correct explanation of A.
(b) If both A and R are true but R is not the correct explanation of A.
(c) If A is true but R is false.
(d) If both A and R are false.

1. **Assertion :** Tubular secretion removes foreign bodies, ions and molecules from the body.
   Reason : As much as 99 percent of the material in the filtrate is reabsorbed from the body because of tubular secretion.
2. **Assertion :** The Henle's loop and vasa recta play a significant role in producing a concentrated urine.
   Reason : The counter current arrangement of Henle's loop and vasa recta helps in this.
3. **Assertion :** Antidiuretic hormone (ADH) controls the amount of water in the urine.
   Reason : ADH determines the permeability of the collecting duct to water.
4. **Assertion :** Uricotelism is advantageous to the egg-laying land vertebrates.
   Reason : Uric acid is readily soluble in water.
5. **Assertion :** Glomerular filtration requires expenditure of energy by kidney.
   Reason : Glomerular filtration occurs because pressure in the glomerular capillaries is lower than the pressure in Bowman's capsule.

Short Answer Type Questions

1. How do fresh water animals prevent the net gain of water and net loss of body salts?
2. What are the two important intrinsic mechanisms to autoregulate glomerular filtration rate?
3. Read the following passage and fill it with correct words/ terms.
   Renin converts _____ into _____. _____ then converts angiotensin I to _____, a peptide hormone which raises blood pressure and increases the synthesis and release of aldosterone. Aldosterone causes _____ and _____ reabsorption by distal part of the tubules. This leads to an increase in blood pressure and GFR.

ANSWERS

Part - I

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

Part - II

1. (d)	2. (a)	3. (d)	4. (a)	5. (a)
6. (a)	7. (c)	8. (a)	9. (c)	10. (b)
11. (a)	12. (b)	13. (a)	14. (c)	15. (e)
16. (c)	17. (a)	18. (a)	19. (b)	20. (a)
21. (d)	22. (d)	23. (c)		

Part - III

1. (c) 2. (a) 3. (a) 4. (c) 5. (d)

Part - IV

1. The freshwater animals prevent the net gain of water and net loss of body salts by several means such as:

(i) Freshwater animals (including freshwater fishes) do not drink water to reduce the need to expel excess water.

(ii) Protozoa (*Amoeba, Paramoecium)* have contractile vacuoles that pump out excess water.

(iii) Water uptake and salt loss are minimized by a specialized body covering (subcutaneous fat layer of scaleless fish and scales over the body of fish or crocodiles).

(iv) Specialized cells, called ionocytes or chloride cells in the gill membrane of freshwater fishes can import Na^+ and Cl^- from the surrounding water.

2. Two important intrinsic mechanisms provide autoregulation of glomerular filtration rate:

(a) Myogenic mechanism: An increase in blood pressure will tend to stretch the afferent arteriole, which would be expected to increase the blood flow to the glomerulus. The wall of the afferent arteriole, however, responds to stretch by contraction, thus reducing the diameter of the arteriole, and therefore, increasing to resistance to flow. This myogenic mechanism, thus, reduces variations in flow to the glomerulus in case of fluctuations in blood pressure.

(b) Juxtaglomerular apparatus (JGA) : This specialised cellular apparatus is located where the distal convoluted tubule passes close to the Bowman's capsule between the afferent and efferent arterioles. JGA cells secrete enzymes like renin that modulate blood pressure, and thus renal blood flow and GFR are regulated.

3. Angiotensinogen, Angiotensin-I, Angiotensin converting enzyme (ACE), Angiotensin-II, Sodium, Water.



HIGH YIELD FACTS



Class XII

Biotic Interactions

- In nature animals, plants and microbes do not, and cannot live in isolation, but interact in various ways to form a biological community.
- Even a plant species, which makes its own food, cannot survive alone; it needs soil microbes to break down the organic matter in soil and return the inorganic nutrients for absorption.
- The living organisms live together and influence each other's life. As in nature, no organism is free from the effect of other living beings.
- This leads to **biotic interactions** among different species.
- The existence of other species is crucially important for getting food and shelter, and for meeting other necessities.
- Interdependency may exist between species of widely different kinds and sizes.
- The interaction among individuals of the same species is known as **intraspecific interaction** and among the organisms of different species is termed as **interspecific interaction**.
- Interspecific interactions could be beneficial, detrimental or neutral (neither harmful nor beneficial) to one or both of the species.
- For **beneficial interactions** a **'+' sign** is assigned, **'–' sign** is assigned for detrimental interactions and **'0'** for **neutral interactions**.
- Various types of population interactions are summarized in the table given on next page.

Analysis of various PMTs from 2009-2014

	2009	2010	2011	2012	2013	2014
AIPMT/NEET	–	2	–	2	2	–
AIIMS	–	–	–	–	–	2
AMU	1	–	–	–	–	–
Kerala	–	1	1	2	–	1
K.CET	–	–	–	–	–	1
J & K	–	–	–	1	–	–

Table : Types of population interactions

Interaction	Species A	Species B	Nature of interaction
With positive effect			
Mutualism	+	+	Beneficial to both, obligatory
Proto-cooperation	+	+	Beneficial to both, not obligatory
Commensalism	+	0	Commensal benefitted, other unaffected
With negative effect			
Parasitism	+	–	Parasite (usually small) benefitted, host harmed
Predation	+	–	Predator (generally larger) kills and feeds on prey
Competition: Direct interference type	–	–	Direct inhibition of each species by the other
Competition: Resource use type	–	–	Indirect inhibition when common resource is in short supply
Amensalism	–	0	One inhibited, other unaffected

- The population interactions can be broadly divided into two types– **positive interactions** and **negative interactions**.
- Two principles regarding these interactions are :

(1) In the evolution and development of ecosystems, negative interactions tend to be minimized in favour of positive symbiosis that enhances the survival of the interacting species.

(2) Recent or new associations are more likely to develop severe negative co-actions than are older associations.

POSITIVE INTERACTIONS

- Associations between populations of two species which result in positive effects on one or both of the populations are referred to as positive interactions.
- Accordingly, positive interactions are of different types as **mutualism (symbiosis), proto-cooperation and commensalism.**

Mutualism

- It is the mutual beneficial relationship between individuals of two different species where none are capable of living separately.
- The terms **mutualism** and **symbiosis** are used as synonyms.
- The association is obligatory *i.e.*, necessary for existence of both partners.
- The symbiotic relationship maybe for food, shelter, substratum or transport. The two symbionts or partners maybe in close contact with their tissues intermingled, or one partner may live within the cavity of the other, or attached to its surface.

Mutualism with continuous contact

- Mutualism with continuous contact is often a permanent type of relationship in which two symbionts are in close contact and are physiologically interdependent on each other. The common examples of mutualism are lichens, symbiotic nitrogen fixers, mycorrhiza, zoochlorellae etc.

Plant relationships

Lichens

- The lichens are composed of a matrix formed by a fungus **(mycobiont)** within which cells of alga **(phycobiont)** are embedded.

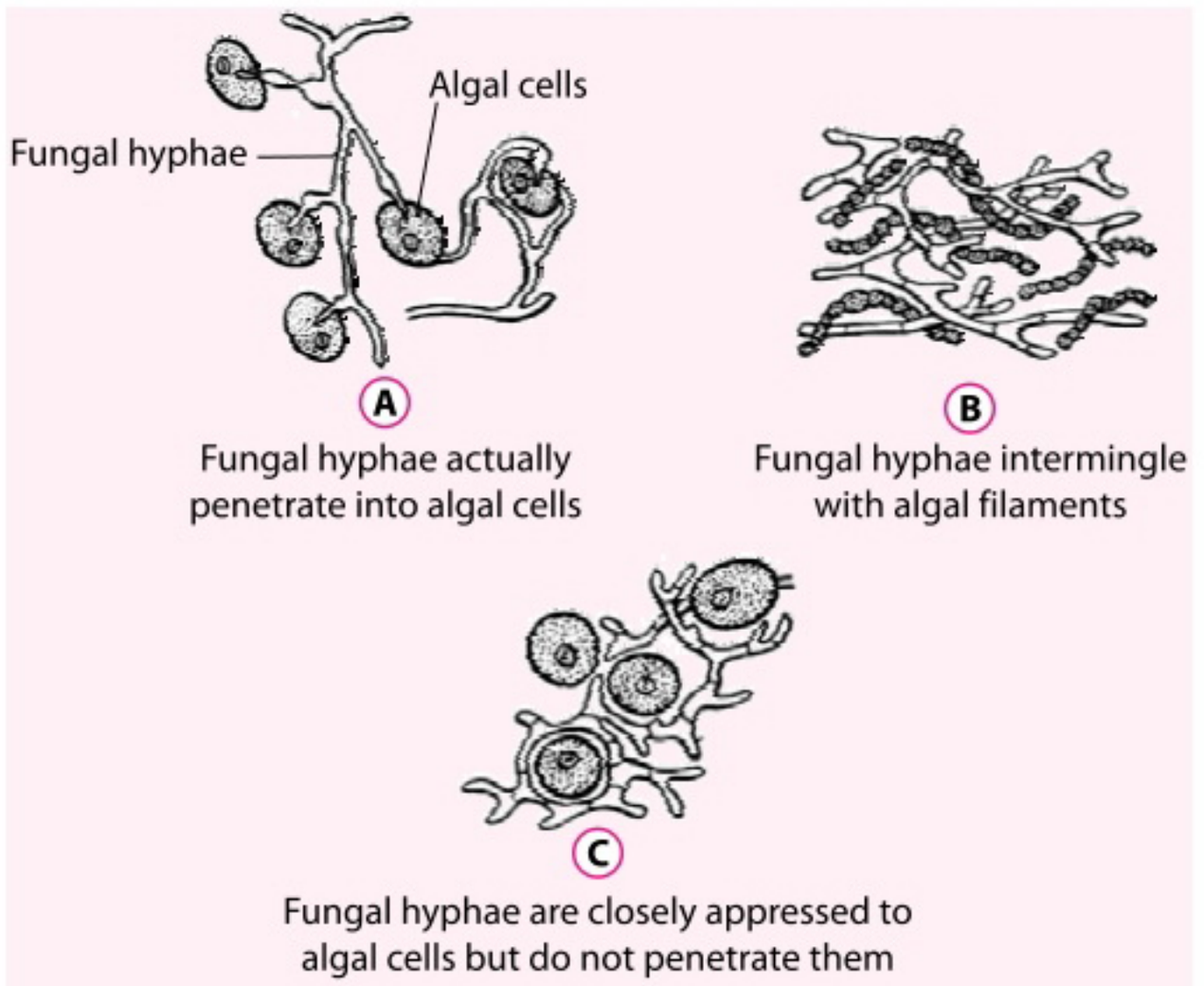


Fig.: A trend in evolution from parasitism to mutualism in the lichens. In some primitive lichens, the fungi actually penetrate the algal cells, as in diagram **A.** In the more advanced species, the two organisms live in greater harmony for mutual benefit, as in diagrams **B** and **C**.

- The alga depends upon the fungus for water, minerals, fixation and protection, whereas the fungus receives carbohydrates prepared by the alga.
- Lichens are usually classified as 'single species' even though they are composed of two unrelated species.
- Lichens are also interesting, because within the group, one sees evidence of evolution from parasitism to mutualism, as illustrated in the figure.

Symbiotic nitrogen fixers

- Another well known example of mutualism is furnished by the nitrogen fixing bacteria of the genus *Rhizobium.*
- These bacteria form nodules in the roots of leguminous plants and obtain food and shelter from the plants. In return the bacteria fix the gaseous nitrogen and pass it onto the host.
- Root nodules of legumes, *Alder* and *Casuarina*, leaf nodules of *Ardisia*, coralloid roots of *Cycas*, water fern *Azolla* etc. are other important examples of mutualistic N_2-fixation.

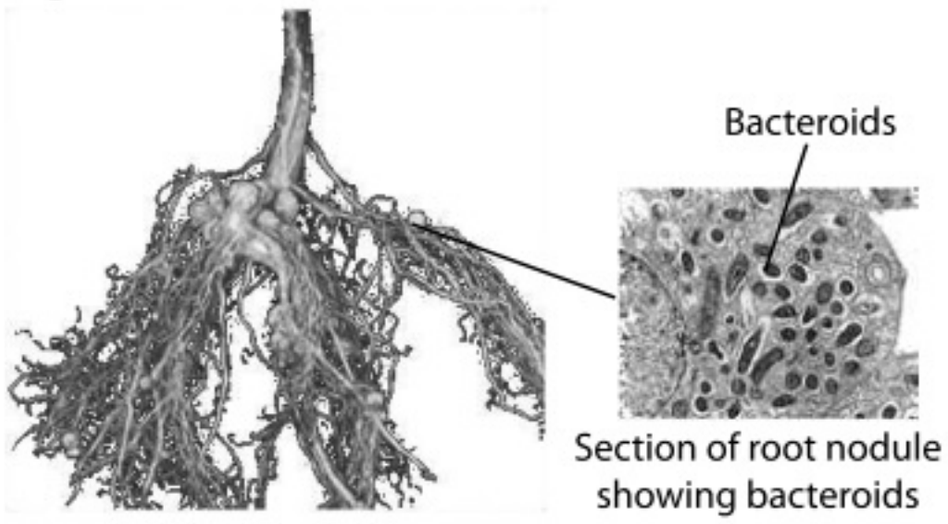
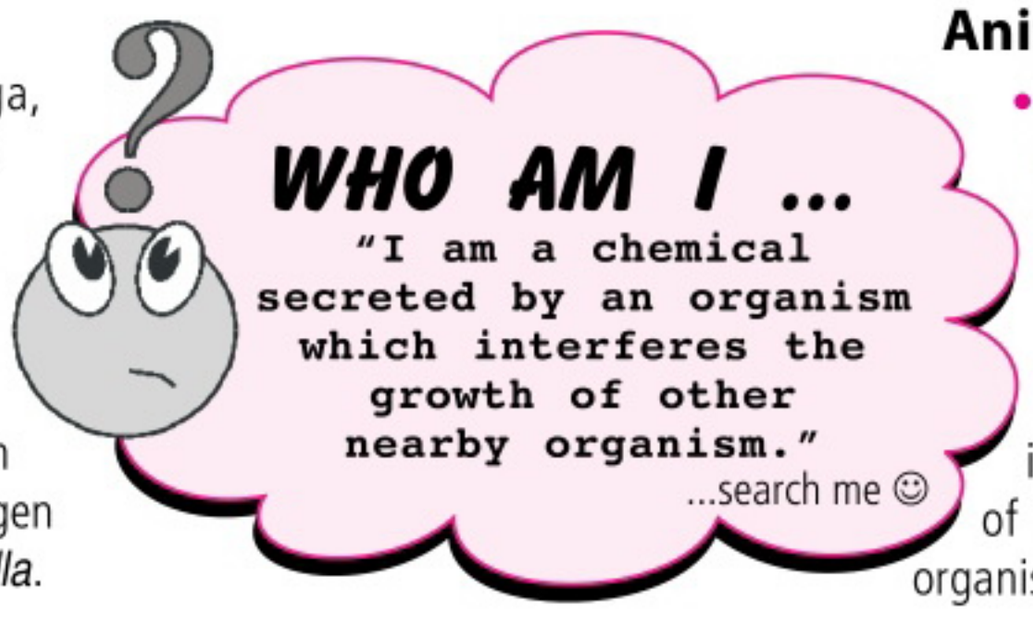


Fig.: Root system of a legume showing nodule in a section

Zoochlorellae and zooxanthellae

- Some unicellular plants, especially green algae, known as zoochlorellae or brown algae called zooxanthellae live symbiotically in the outer tissues of certain sponges, coelenterates, molluscs and worms.
- Algae are photosynthetic and produce nitrogenous compounds beneficial to hosts, and in exchange, they obtain materials released by metabolism of host animals.
- The unicellular green alga, *Chlorella vulgaris* lives within the gastrodermal cells of *Hydra*.
- Alga, through photo-synthesis, provides food and oxygen to *Hydra*, which in turn provides shelter, nitrogen wastes and CO_2 to *Chlorella*.

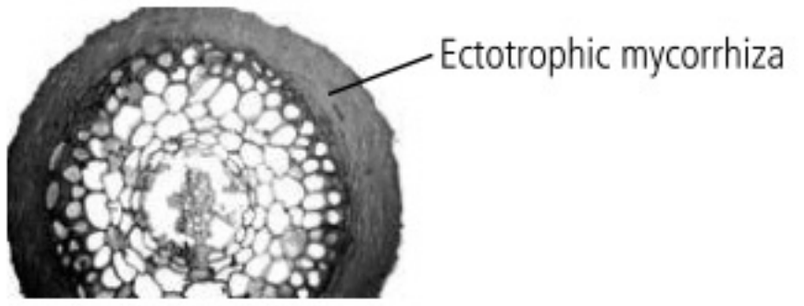


- Similar relationship exists between the alga, *Zoochlorella* and a planarian, *Convoluta roscoffensis*.

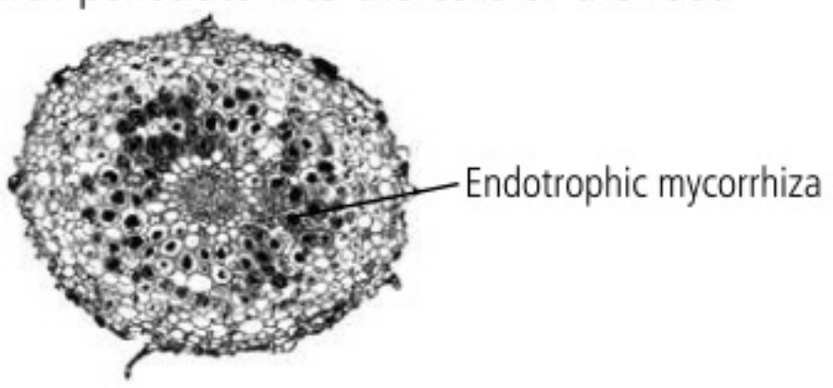
Mycorrhizae

- Association between fungal hyphae and roots of higher plants is called mycorrhiza which is also a type of mutualism.
- Mycorrhizae increase the ability of the plant to extract minerals from the soil. In return, fungi are provided with shelter and photosynthate by the plant.
- Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development.
- Mycorrhizae can be of different types as:

1. **Ectotrophic mycorrhizae**, mostly basidiomycetes, which form root-like extensions that grow out from the cortex of the root.



2. **Endotrophic mycorrhizae**, mostly phycomycetes, which penetrate into the cells of the root.



3. **Peritrophic (or extramatrical) mycorrhizae**, which form mantle or clusters around the roots, but mycelia do not penetrate the epidermis of the root.

- These are thought to be very important in creating a favourable chemical "rhizospheric environment" that transforms insoluble, or unavailable, minerals to a form that can be taken up by the roots.

Animal relationships

- Some symbionts live in cavities of their hosts, rather than in their tissues.
- **Ruminants** and other animals living on a diet high in cellulose are unable to digest it without the enzymatic action of cellulase, produced by micro-organisms in their intestine.

- **Termites** can digest wood only with the aid of a special type of flagellate protozoan (*Trichonympha*) that lives in their guts.
- **Termites** cannot digest cellulose of wood, but the protozoans digest cellulose for termites, and in return obtain food and shelter from the termite.

Mutualism without continuous contact

- In mutualism without continuous contact, partners or symbionts are rarely attached to each other, and if so, it is only for a short duration.
- Though both the partners are benefitted from each other but the nutritional need is primary, at least for one of the species.

Plant animal relationships

- The most fascinating examples of mutualism are found in plant-animal relationships.
- Plants need the help of animals for pollinating their flowers and dispersing their seeds.
- Animals get rewards in the form of pollen and nectar for pollinators and juicy and nutritious fruits for seed dispersers.
- Plant-animal interactions often involve **co-evolution** of the mutualists, that is, the evolution of the flower and its pollinator species are tightly linked with one another.
- In many species of **fig trees,** there is a relationship with the pollinator species of **wasp.**
- It means that a given fig species can be pollinated only by its partner wasp species, and not other species.
- The female wasp uses the fruit not only as an oviposition (egg laying) site but uses the developing seeds within the fruit for nourishing its larvae.
- The wasp pollinates the fig inflorescence, while searching for suitable egg-laying sites.
- In return for the favour of pollination, the fig offers the wasp some of its developing seeds as food for the developing wasp larvae.

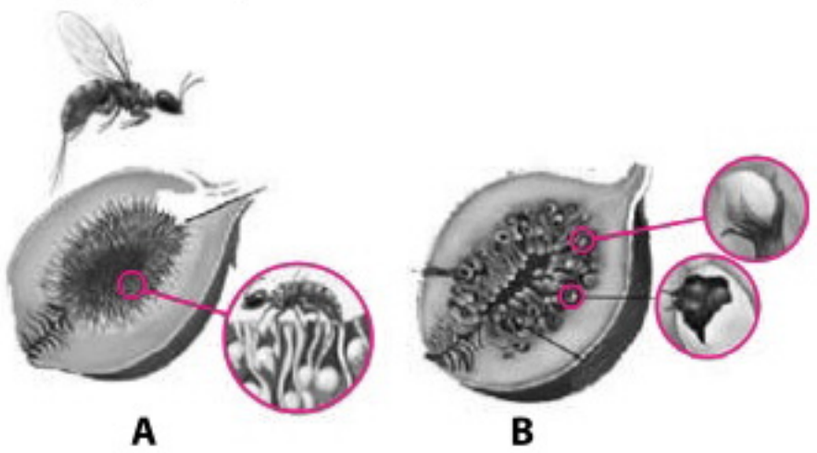


Fig.: Mutual relationship between fig. and wasp **A.** Female wasp laying eggs in unripe fig, thereby pollinating it **B.** Wasp larvae in galls from which emerge wingless male wasps and winged female wasps.

- **In orchids,** there is a relationship with pollinator insects (bees and humble bees).
- The Mediterranean orchid *Ophrys* employs **sexual deceit** to get pollination done by a species of bee.
- One petal of its flower bears an uncanny resemblance to the female of the bee in size, colour and markings.
- The male bee is attracted to what it perceives as a female, **pseudocopulates** with the flower, and in that process pollinates the flower.
- If the female bee's colour patterns change even slightly for any reason during evolution, pollination success will be reduced, unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.



Fig.: A pollinator on orchid flower

Scavenging

The act of feeding by an animal on the remains of dead animals and other refuse is called **scavenging.** It is a direct food relationship in which an animal feeds on other animals which have died naturally, or have been killed by another animal. Such animals are called **natural scavengers,** or **saprobionts.**

Scavenging is highly beneficial in nature:

- It provides food to many animals
- It clears the space for other organisms
- It improves the environment, and
- It prevents wastage of food.

Vultures feed on carcases, hyena and jackals take scraps of prey left by lions, while ants consume dead insects and other dead organic matter. Some omnivores, such as crows, are also scavengers, taking discarded food and dead animals.

Proto-cooperation

- In this association the two organisms are mutually benefitted by each other, but the association is non-obligatory, *i.e.*, not necessary for their existence. For example crocodile bird (*Pluvianus aegyptius*) enters the open mouth of crocodile and rids the latter of leeches.
- Association between hermit crab (*Eupagurus prideauxi*) and sea anemone (*Adamsia palliata*) is considered proto-cooperaton but recent studies indicate it to be a mutualistic association.

- Sea anemone is sedentary while hermit crab is free swimming.
- In their long history, hermit crabs have developed the habit of sheltering themselves within the empty gastropodan shells of molluscs.
- Young hermit crabs often pick up a young sea anemone to get attached to their shell, and they become partners for life.
- As the crab grows bigger, it outgrows its shelter and has to find a new one.
- However, in their association, the growth of the crab and the anemone keep pace with each other, and the crab has no need to change its shell, as more and more of it is sheltered by the anemone.
- As the crab moves in search of food, the anemone is brought into contact with a greater supply of food and the crab is protected from its predators by the anemone's stinging cells.
- Thus, both the animals are mutually benefitted by each other.

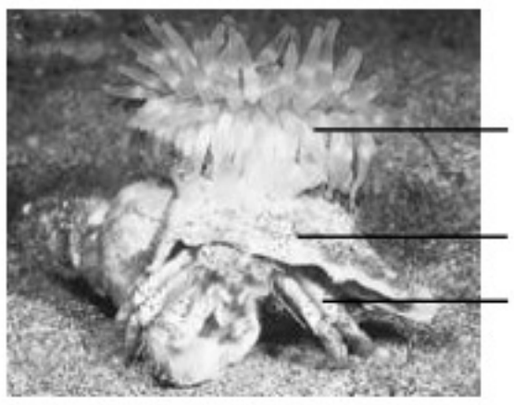


Fig.: Association between sea anemone and hermit crab (proto-cooperation)

Commensalism

- In this type of interaction, two or more animals live together without any physiological dependence between them, and one gets the benefit from the association, while the other is neither benefitted nor harmed.
- The common examples of commenalism include epiphytes, lianas etc.
- Many **epiphytes,** for example, orchids, bromeliads and certain hygroscopic plants are found growing on the branches and in the forks of trees.
- These epiphytes use the trees only for attachment and manufacture their own food by photosynthesis.
- In epiphytes, there is a special layer-**velamen** over the root surface. The cells of the velamen can take up abundant water rapidly from the atmosphere.

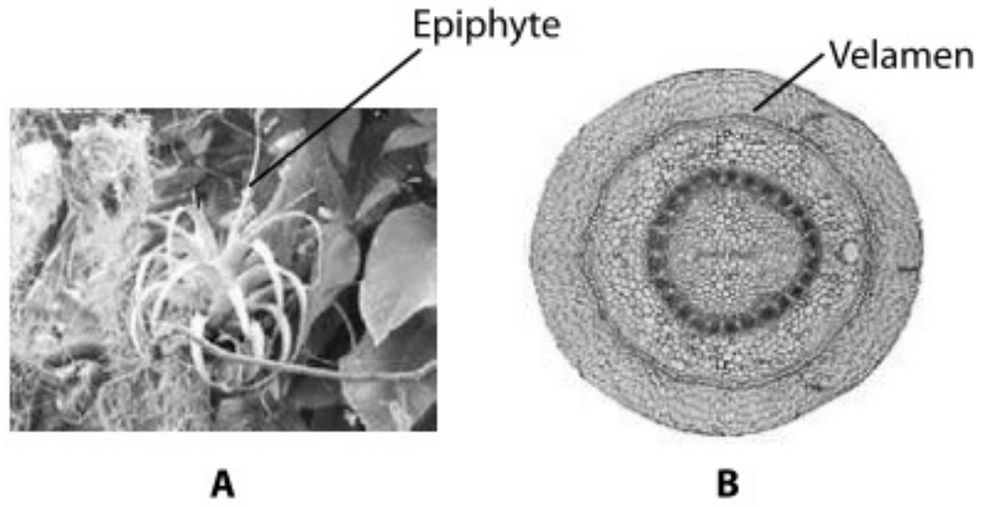


Fig.: Association between an epiphyte and higher plant.
A. an epiphyte orchid growing on the branch of another plant.
B. T. S. of aerial root of orchid showing velamen

- Some plants live as attached epiphytes on the surface of animals, *e.g.*, green alga that grows on the long, grooved hair of the sloth.
- Abundance of alga gives green colour to the host sloth. It is advantageous to the sloth in concealing itself on the trees.
- **Barnacles** growing on the back of a whale is another example of commensalism.
- **Lianas** are vascular plants rooted in the ground and maintain erectness of their stems by making use of other objects for support.
- In this manner, lianas are able to get better light. They maintain no direct nutritional relationship with the trees upon which they grow, thus exhibiting commensalism.
- Another example of commensalism is the interaction between **sea anemone**, that has stinging tentacles and the **clown fish** that lives among them.
- The fish gets protection from predators which stay away from the stinging tentacles.
- The anemone does not appear to derive any benefit by hosting the clown fish.

Intext Practice Questions

1. Give two examples of zoochlorella and state the advantage of this relationship.
2. Why are epiphytes called commensals?
3. Why do you think the relationship between hermit crab and sea anemone is an example of proto-cooperation and not mutualism?

NEGATIVE INTERACTIONS

- Negative interactions are the interactions between two populations which result in negative effects on the growth and survival of one or both of the populations.
- These can be of different types as–**amensalism, competition, parasitism** and **predation.**

Amensalism

- Amensalism is an interaction between two living individuals of different species in which an organism does not allow the other organism to grow or live near it.
- Inhibition is achieved through the secretion of chemicals called **allochemics**.
- **Antibiosis** is the production of such secretions by an organism which are harmful (antagonistic) to other organisms.
- **Bacteria**, **actinomycetes** and **fungi** produce a number of **antimicrobial substances** which are widespread in nature.
- Fungi produce different kinds of antibiotic substances such as **penicillin**, **streptomycin**, **aureomycin** etc. which are helpful in destroying the **pathogenic bacteria**.
- *Microcystis*, a blue green alga, produces a toxic substance, the **hydroxylamine,** which causes the death of fish and cattle that drink the water of that pond.
- The secretion by plants, of chemicals (such as phenolic and terpenoid compounds) that inhibit the growth or germination of other plants, with which they are competing, is referred to as allelopathy.
- **Smoother crops** do not allow weeds to grow, for example sorghum, sunflower, barley.
- Sacred basil (*Ocimum sanctum*, vern. Tulsi) does not allow other plants to flourish nearby.
- *Convolvulus arvensis* inhibits germination of wheat seeds.
- *Tagetes* kills soil nematodes while walnut (*Juglans regia*) produces allochemic **juglone** for preventing growth of apple, tomato, alfalfa, etc.
- Antagonistic substances are also reported in some algae, as for example in cultures of *Chlorella vulgaris*, a substance accumulates which inhibits the growth of the diatom, *Nitzschia frustirulum*.
- Substances produced by senescent cultures of *Chlorella* and, *Navicula* and *Scendesmus*, inhibit the filter feeding of *Daphnia* in laboratory.

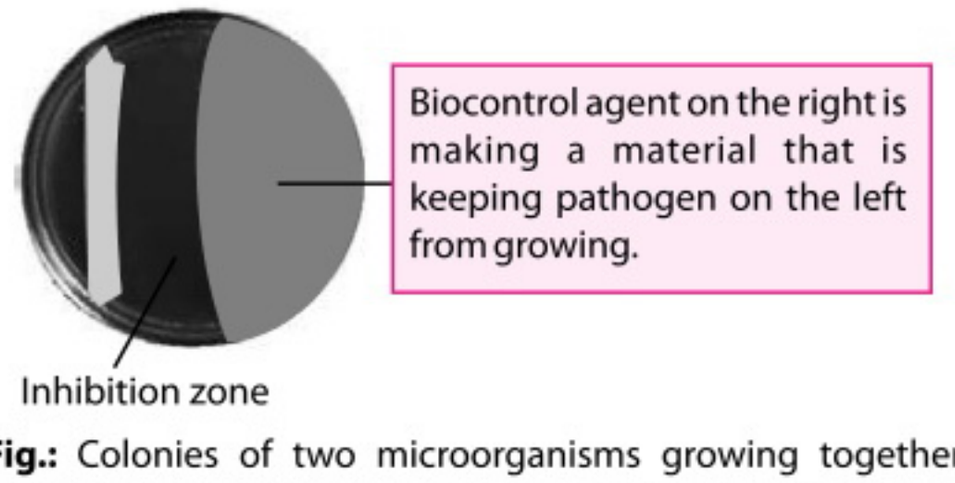


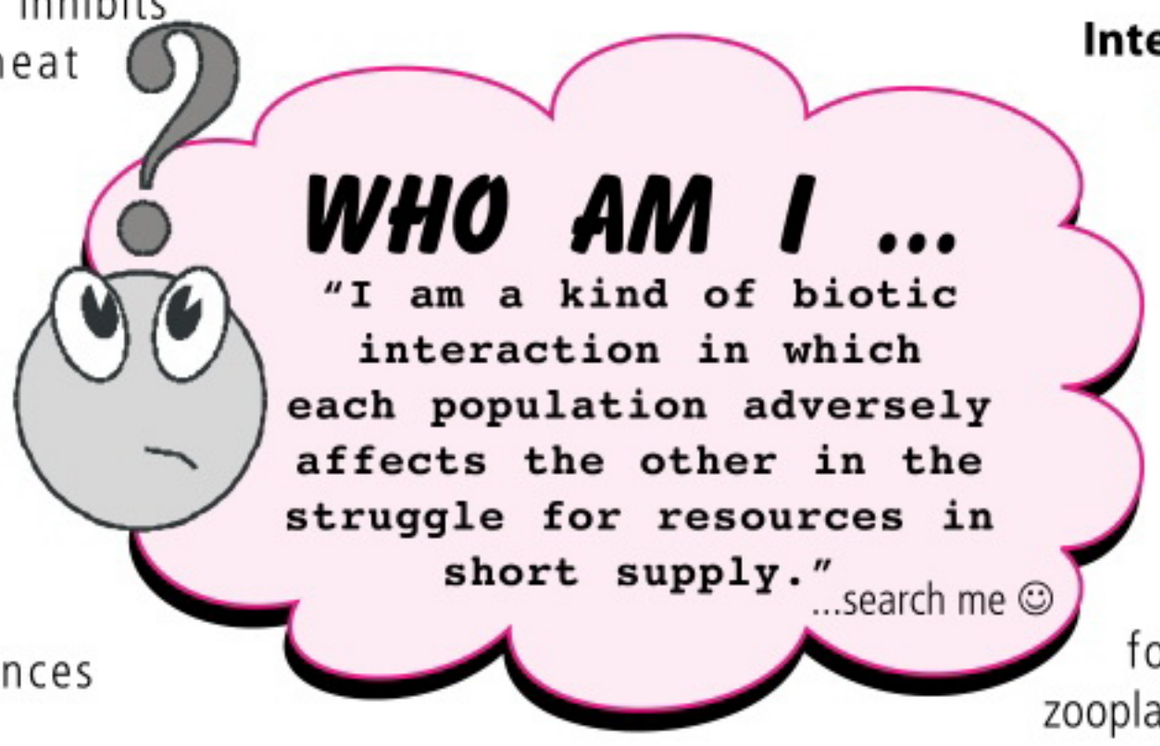
Fig.: Colonies of two microorganisms growing together in Petri dish where the growth of one is being inhibited by another in the inhibition zone between two (antibiosis).

Competition

- It is a rivalry between two or more organisms for obtaining the same resources.
- Competition between individuals of the same species is called intraspecific (=intranecine) competition, while that between individuals of different species is termed as interspecific (= internecine) competition.

Intraspecific competition

- **Cannibalism** (eating members of the same species) reduces this competition, for example, snakes, scorpions.
- Establishment of **territories** in animals occurs in such competition by pushing out the extra number, securing shelter, mate and even food for the rest.
- Density dependent reduction in natality, parental care, aggregations and dominance-subordination are methods to reduce intraspecific competition and to protect interest of individuals.



Interspecific competition

- The severity of competition depends upon similarity in the requirement of food and shelter.
- In some shallow South American lakes, visiting flamingoes and resident fishes compete for their common food, zooplanktons in the lake.

Gause's Principle (Competitive Exclusion Principle)

- The tendency for competition to bring about an ecological separation of closely related, or otherwise similar species is known as the competitive exclusion principle (Hardin, 1960).
- This phenomenon is also called as **Gause's principle** (after Gause, 1934).
- It states that an ecological niche cannot be simultaneously and completely occupied by established populations of more than one species.
- Two or more species with closely similar niche requirements cannot exist indefinitely in the same area, as sooner or later they come into competition for possession of it.
- The results of one of Gause's original experiments are illustrated by the example of two closely related ciliate protozoans, *Paramecium caudatum* and *Paramecium aurelia.*
- When in separate culture, these organisms exhibited typical sigmoid population growth.
- However, when both protozoans were placed in the same culture, *P. aurelia* alone survived after 16 days.
- In this case, neither organism attacked the other or secreted harmful substances.
- *P. aurelia* populations simply had more rapid growth rate (higher intrinsic rate of increase) and thus "out-competed" *P. caudatum* for the limited amount of food under the existing conditions.
- The **Abingdon tortoise in Galapagos Islands** became extinct, within a decade after goats were introduced on the island, apparently due to the greater browsing efficiency of the goats.
- Another evidence for the occurrence of competition in nature comes from what is called **competitive release.**
- A species whose distribution is restricted to a small geographical area, because of the presence of a competitively superior species, is found to expand its distributional range dramatically, when the competing species is experimentally removed.
- **Connell's elegant field experiments** showed that on the rocky sea coasts of Scotland, the larger and competitively superior barnacle *Balanus* dominates the intertidal area, and excludes the smaller barnacle *Chathamalus* from that zone.
- However, if population of *Balanus* is reduced, competition is released and *Chathamalus* increases in number. The phenomenon is called **competitive release.**
- In general, herbivores and plants appear to be more adversely affected by competition than carnivores.
- Thus, it is seen that in Gause's 'Competitive Exclusion Principle' two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one is eliminated eventually. This may be true if **resources are limiting,** but not otherwise.
- More recent studies do not support such gross generalisations about competition.
- While they do not rule out the occurrence of interspecific competition in nature, they point out that species facing competition might evolve mechanisms that promote co-existence rather than exclusion.
- One such mechanism is **'resource partitioning'**.
- If two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or different foraging patterns.
- **Mac Arthur** showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities.

Table : Differences between intraspecific and interspecific competition

Intraspecific competition	Interspecific competition
It is competition among individuals of the same species.	The competition is amongst the members of different species.
The competition is for all the requirements.	The competition is for one or a few requirements.
The competing individuals have similar type of adaptation.	The competing individuals have different types of adaptations.
It is more severe due to similar needs and adaptations.	It is less severe as the similar needs are a few and the adaptations are different.

Parasitism

- It is a relationship between two living organisms of different species, in which one organism called parasite obtains its food directly from another living organism called host.
- The parasite is smaller as compared to its host. It spends a part, or whole of its life, on or in the body of the host.

- Many parasites have evolved to be **host-specific** (they can parasitise only a single species of host) in such a way that both host and the parasite tend to **co-evolve**.
- If the host evolves special mechanisms for rejecting or resisting the parasite, the parasite has to evolve mechanisms to counteract and neutralise them, in order to be successful with the same host species.
- In accordance with their life styles, parasites evolved **special adaptations** such as the **loss of unnecessary sense organs, presence of adhesive organs** or **suckers** to cling onto the host, **loss of digestive system** and **high reproductive capacity.**
- The life cycles of parasites are often complex, involving one or two **intermediate hosts** or **vectors** to facilitate parasitisation of its primary host.
- The **human liver fluke** (a trematode parasite) depends on two intermediate hosts (a snail and a fish) to complete its life cycle.
- The **malarial parasite** needs a vector (mosquito) to spread to other hosts.
- Parasites may reach the host through contact with infected hosts, contaminated food and water, animal bites and direct entry.
- Parasites have different types of adaptations called **parasitic adaptations,** to reach their hosts, live in contact with them and obtain their requirements. **Holdfasts, haustoria** (in ectoparasites), **suckers, hooks** and **spines** (for attachment in endoparasites), **resistant covering, resistant eggs** or **cysts**, formation of **antienzymes, anaerobic respiration, degeneration of unwanted organs** (*e.g.*, digestive glands in *Ascaris*, digestive tract in *Taenia*) are some of the **parasitic adaptations**.

Types of parasites

- Parasites are of various types such as :

(i) Non pathogenic : Do not cause any disease, for example *Entamoeba coli.*

(ii) Pathogenic : They cause diseases, for example *Taenia solium, Vibrio cholerae, Clostridium tetani.*

(iii) Temporary parasite : An organism that spends only a part of its life cycle on the host, for example leech, bed bug.

(iv) Permanent parasite : Lives in contact with host throughout its life and is transferred to a new host through infective eggs, as cysts or directly, for example *Ascaris, Entamoeba*, lice.

(v) Endoparasite lives inside the body of host and is widespread in nature. Most of endoparasites spend a part of their life cycle in another host. Their life cycle is more complex, because of their extreme specialisation.

(vi) Ectoparasites live on the surface of the host. They suck blood (in case of animals), or juice (in case of plants) or feed on living and dead tissues.
- The most familiar examples of this group are the lice on humans and ticks on dogs.
- Many marine fish are infested with **ectoparasitic copepods.**

- *Cuscuta*, a parasitic plant that is commonly found growing on hedge plants, has lost its chlorophyll and leaves in the course of evolution.
- *Cuscuta* derives its nutrition from the host plant which it parasitises.
- **Brood parasitism** in birds is a fascinating example of parasitism in which the parasitic bird lays its eggs in the nest of its host and lets the host incubate them.
- During the course of evolution, the eggs of the parasitic bird have evolved to resemble the host's eggs in size and colour, to reduce the chances of the host bird detecting the foreign eggs, and ejecting them from the nest.
- Laying eggs by cuckoo (koel) in crow's nest is an example of brood parasitism.

(vii) Hyperparasite is the parasite which lives on another parasite, for example some bacteriophages, *Cicinnobolus cesatii* (on powdery mildew), bacterium *Pasteurella pestis* in *Xenopsylla cheopsis* (Rat flea) an ectoparasite of rat.

Table : Some types of plant parasites

Types	Examples
Total stem parasite	*Cuscuta*
Partial stem parasites	*Viscum album, Loranthus*
Total root parasites	*Orobanche, Conopholis, Rafflesia*
Partial root parasites	*Santalum album, Thesium*

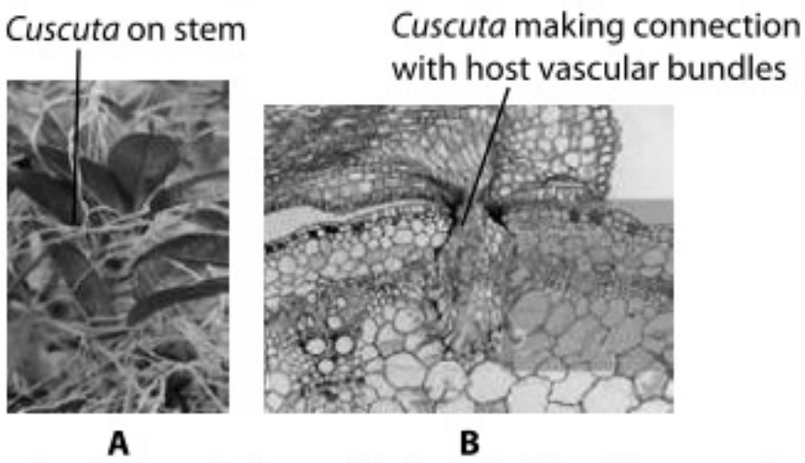


Fig.: A total stem parasite (parasitism). **A.** Dodder *(Cuscuta sp)*. a total stem parasite twinning the host stem, **B.** T.S. of the host plant showing parasite.

Predation

- The typical predator is a free living organism that catches, kills and devours individuals of other species.
- Predation differs from parasitism in the sense that the parasite that lives on or in its host derives nourishment without usually killing it, while the predator kills and devours its prey.
- Almost all the animals are predatory, but a few plants are also predatory.
- **Carnivorous plants (insectivorous plants)** provide very interesting examples of predation.
- The sundew plant, *Drosera*, entraps insects in a sticky fluid secreted by the hair present on its round reddish leaves.
- The pitcher-shaped leaves of the pitcher plant (*Nepenthes*) contain a watery liquid that serves as death trap for the insects.
- The bladderwort, *Utricularia*, has bladder-like leaves which open suddenly when planktonic organisms (insects or minute crustaceans) come in contact with the trigger bristles and are killed and digested.
- Prey species have evolved **various defences** to lessen the impact of predation.
- Some species of insects and frogs are cryptically-coloured (**camouflaged**) to avoid being detected easily by the predator.
- Some species are **poisonous** and therefore avoided by the predators.
- For plants, herbivores are the predators. Nearly 25 percent of all insects are known to be **phytophagous** (feeding on plant sap and other parts of plants).
- The problem is particularly severe for plants because, unlike animals, they cannot run away from their predators.
- Plants therefore have evolved an astonishing variety of **morphological** and **chemical defences** against herbivores.
- **Thorns and spines** (*Acacia*, *Cactus*, etc.) are the most common morphological means of defence.
- Many plants produce and store **chemicals** that make the herbivore sick when they are eaten, inhibit feeding or digestion, disrupt its reproduction or even kill it.
- The plant *Calotropis* produces highly poisonous **cardiac glycosides**, so that cattle and goats, do not browse on it, and avoid it.
- A wide variety of chemical substances that we extract from plants on a commercial scale (**nicotine, caffeine, quinine, strychnine, opium,** etc.) are produced by them actually as **defences** against grazers and browsers.

Importance of Predation

- Predation is nature's way of transferring the energy fixed by plants to higher trophic levels.
- Besides acting as 'conduits' for energy transfer across trophic levels, predators play other important roles of keeping the prey populations under control.
- **A rise in predator population will reduce prey population,** which in turn will cause reduction in the population of predators due to starvation and emigration.
- A rise in herbivores will result in overgrazing, shortage of herbage and ultimately reduction in herbivore population.
- Biological control methods adopted in agricultural pest control are based on the ability of the predator to regulate prey population.
- Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species.
- In the rocky intertidal communities of the American Pacific Coast the starfish *Pisaster* is an important predator.
- In a field experiment, when all the starfish were removed from an enclosed intertidal area, more than 10 species of invertebrates became extinct within a year.

Intext Practice Questions

4. Distinguish between competitive release and competitive exclusion.
5. How do the predators help in maintaining species diversity?
6. What is resource partitioning? How does it prevent competition?

SPEED PRACTICE

1. Match the following.

Population Interaction	Example
1. Predation	A. *Cuscuta* and hedge plants
2. Commensalism	B. *Balanus* and *Chathamalus*
3. Parasitism	C. Cactus and moth
4. Competition	D. Orchid and mango

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

2. Which of the following statements is false regarding predators?
(a) Predators keep prey populations under control.
(b) Predators help in maintaining species diversity in a community.
(c) If a predator is not efficient, then the prey population would become extinct.
(d) Herbivores (predators) have a greater advantage since the plants cannot run away to avoid predation.

3. Barnacles growing on the back of whale is an example of
(a) mutualism (b) commensalism
(c) parasitism (d) amensalism.

4. Match the following and choose the correct combination from the options given below.

Column-I (Population interaction)	Column-II (Examples)
A. Mutualism	1. Ticks on dogs
B. Commensalism	2. *P. caudatum and P. aurelia*
C. Parasitism	3. Sparrow and earthworm
D. Competition	4. Epiphyte on a mango branch
E. Predation	5. Orchid *Ophrys* and bee

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

5. An example of endomycorrhiza is
(a) *Nostoc* (b) *Glomus*
(c) *Agaricus* (d) *Rhizobium.*

6. Which one of the following is not a parasitic adaptation?
(a) Development of adhesive organs
(b) Loss of digestive organs
(c) Loss of reproductive capacity
(d) Loss of unnecessary sense organs

7. Which of the following statements is incorrect?
(a) Lichen, an association of fungus and algae is an example of mutualism.
(b) Those epiphytes which use other plants for support only and not for water or food supply are examples of commensalism.
(c) Sea anemone on hermit crab is an example of proto-cooperation.
(d) Mutualism, proto-cooperation, commensalism cannot be included under symbiosis.

8. Match Column-I with Column-II and select the correct option from the codes given below.

Column-I	Column-II
A. Ladybird beetles feeding on insects	(i) Mutualism
B. Barnacles growing on the back of a whale	(ii) Predation
C. Wasp pollinating the fig inflorescence	(iii) Competition
D. Lice living on skin of humans	(iv) Commensalism
	(v) Parasitism

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

9. Which out of the following is a partial stem parasite?
(a) *Viscum* (b) *Cuscuta*
(c) *Santalum* (d) *Rafflesia*

10. Which one of the following is most appropriately defined?
(a) Host is an organism which provides food to another organism.
(b) Amensalism is a relationship in which one species is benefitted whereas the other is unaffected.
(c) Predator is an organism that catches and kills other organism for food.
(d) Parasite is an organism which always lives inside the body of other organism and may kill it.

11. Which of the following interactions will not promote co-evolution?
(a) Interspecific competition
(b) Commensalism
(c) Mutualism
(d) Parasitism

12. When two similar species live in the same area, they may evolve to become more different in order to
(a) drive the other species to extinction
(b) reduce competition
(c) use up the other species' resources
(d) reduce genetic variation.

13. Two species competing for the same resource can avoid competition by choosing different habits. This phenomenon is called _____ and was supported by _____.
(a) competitive exclusion, Gause
(b) competitive exclusion, Hardin
(c) resource partitioning, Gause
(d) resource partitioning, Mac Arthur

14. Most interacting populations are
(a) mutualistic (b) symbiotic
(c) co-evolved (d) parasitic.

15. According to the competitive exclusion principle, developed in 1934 by the Russian biologist G. F. Gause, two species cannot remain in the same community if they have the same
(a) taxonomy (b) niche
(c) habitat (d) food requirements.

16. Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition?
(a) *Azotobacter* (b) *Aspergillus*
(c) *Glomus* (d) *Trichoderma*

17. Parasitism is an interaction between two species in which
(a) both the species are harmed
(b) both the species are benefitted
(c) one species is benefitted and the other is neither benefitted nor harmed
(d) one species is benefitted and the other is harmed.

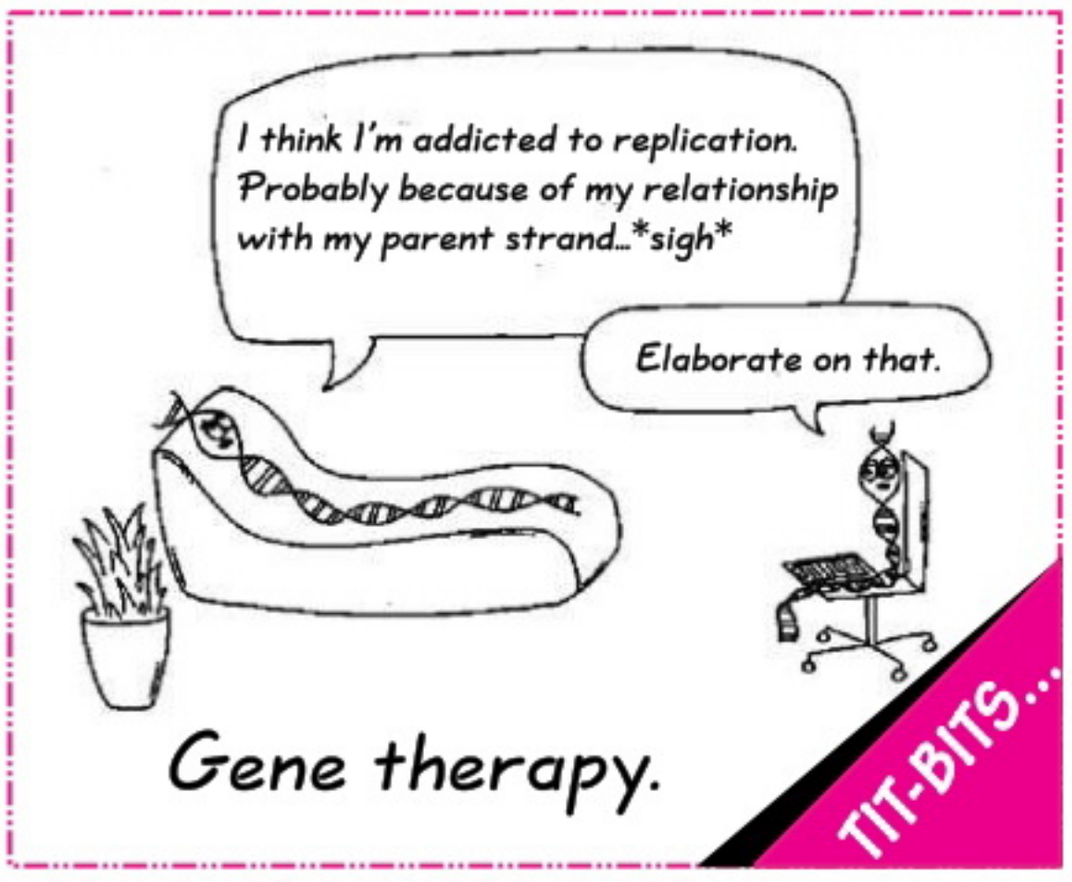
18. A phenomenon when parasite parasitizes is known as
(a) hyperparasitism
(b) parasitoids
(c) monoxenous parasitism
(d) polyxenous parasitism.

19. When both partners/components are affected negatively, the nature of interaction is
(a) commensalism (b) predation
(c) competition (d) amensalism.

20. An association between two individuals or populations where both are benefitted and where neither can survive without the other is
(a) commensalism (b) amensalism
(c) proto-cooperation (d) mutualism.

ANSWER KEY

1.	(a)	2.	(c)	3.	(b)	4.	(d)	5.	(b)
6.	(c)	7.	(d)	8.	(a)	9.	(a)	10.	(c)
11.	(b)	12.	(b)	13.	(d)	14.	(c)	15.	(b)
16.	(c)	17.	(d)	18.	(a)	19.	(c)	20.	(d)



PMT FOUNDATION Class-11

Maximise your chance of success and your seat in AIPMT and other PMTs by reading this column. This section is specially designed to optimise your preparation by practising more and more. It is a unitwise series having chapterwise question bank, allowing you to prepare systematically and become more competent.

- Recall question or single concept question – indicated by a single finger.
- Application question or question which requires 2 or 3 concepts to solve - indicated by 2 fingers.
- Application question or question which requires 3 or more concepts - indicated by 3 fingers.

UNIT-V : HUMAN PHYSIOLOGY

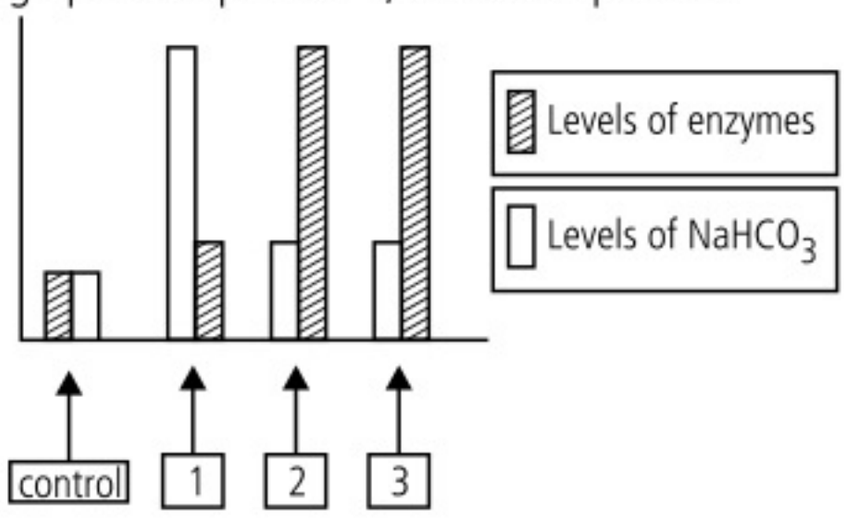
CHAPTER-16 : DIGESTION AND ABSORPTION

Multiple Choice Questions

1. Which of the following statements is incorrect?
(a) Brunner's glands are submucosal.
(b) Irregular folds of gastric mucosa are rugae.
(c) Glisson's capsule is the connective tissue sheath of hepatic lobule.
(d) Mesothelium or serosa lies in close proximity to the circular layer of muscularis.

2. Which one of the following pairs of food components in humans reaches the stomach totally undigested ?
(a) Starch and fat
(b) Fat and cellulose
(c) Starch and cellulose
(d) Protein and starch

3. Effect of some compounds (present in partially digested food) on pancreatic secretion is depicted in the bar graph. Compounds 1, 2 and 3 represent:



	1	2	3
(a)	Acid	Fat	Salt
(b)	Salt	Peptone	Fat
(c)	Acid	Fat	Peptone
(d)	Pepsin	Acid	Fat

4. Which of the following inhibits gastric HCl secretion during a meal?
(a) Stimulation of the parasympathetic nerves to the enteric nervous system
(b) The sight and smell of food
(c) Distension of the duodenum
(d) Distension of the stomach

5. Match Column-I with Column-II and select the correct option from the codes given below.

	Column-I (Sphincter)	Column-II (Location)
A.	Sphincter of ani-internus	(i) Opening of hepato-pancreatic ampulla into duodenum
B.	Cardiac sphincter	(ii) Between duodenum and posterior stomach
C.	Sphincter of Oddi	(iii) Guarding the terminal part of alimentary canal
D.	Ileocaecal sphincter	(iv) Between oesophagus and anterior stomach
E.	Pyloric sphincter	(v) Between small intestine and large intestine

(a) A-(iii), B-(ii), C-(iv), D-(i), E-(v)
(b) A-(ii), B-(v), C-(i), D-(iv), E-(iii)
(c) A-(iii), B-(iv), C-(i), D-(v), E-(ii)
(d) A-(iv), B-(iii), C-(i), D-(ii), E-(v)

6. Fill in the blanks in the following table by selecting the correct option.

Hormone	Source	Target organ	Action
Gastrin	Mucosa of pyloric stomach	**(i)**	1. Stimulates secretion of gastric juice. 2. Constricts cardiac sphincter.
(ii)	Duodenal epithelium	Stomach	1. Slows gastric contraction to delay its emptying. 2. Stops secretion of gastric juice.
Cholecy-stokinin	**(iii)**	Pancreas, Gall bladder	1. Release of enzymes in pancreatic juice. 2. Release of bile from gall bladder.
Entero-crinin	Intestinal epithelium	Small Intestine	**(iv)**

	(i)	(ii)	(iii)	(iv)
(a)	Small intestine	Duocrinin	Intestinal epithelium	Release of mucus from Brunner's gland
(b)	Stomach	Villikinin	Mucosa of pyloric stomach	Accelerates movements of villi
(c)	Stomach	Entero-gastrone	Duodenal epithelium	Release of enzymes from crypts of Lieberkuhn
(d)	Gall bladder	Secretin	Duodenal epithelium	Release of enzymes in pancreatic juice

7. Identify, whether the given nutrients are absorbed by active transport, simple diffusion or facilitated transport.
I. Glucose
II. Fructose
III. Vitamin K
IV. Amino acids
Choose the correct option accordingly.

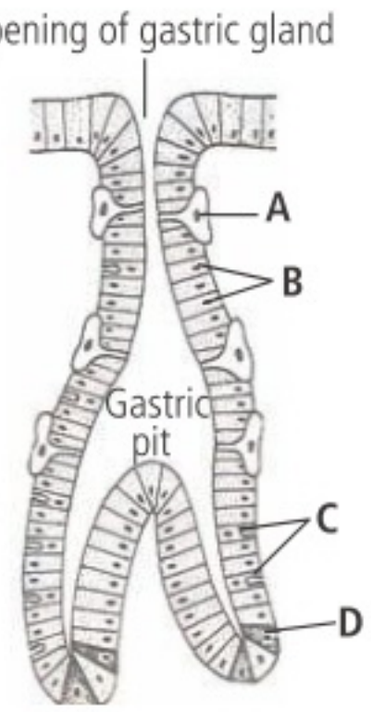
(a) I- Active transport
II- Active transport
III- Facilitated transport
IV- Simple diffusion

(b) I - Facilitated transport
II- Simple diffusion
III- Active transport
IV- Active transport

(c) I- Active transport
II- Facilitated transport
III- Simple diffusion
IV- Active transport

(d) I - Simple transport
II- Simple transport
III- Facilitated transport
IV- Active transport

8. Examine the figure of gastric glands given below and identify the labelled parts A to D.



	A	B	C	D
(a)	Oxyntic cell	Chief cell	Mucous cell	Argentaffin cell
(b)	Argentaffin cell	Oxyntic cell	Mucous cell	Chief cell
(c)	G-cell	Chief cell	Mucous cell	Argentaffin cell
(d)	Oxyntic cell	G-cell	Mucous cell	Chief cell

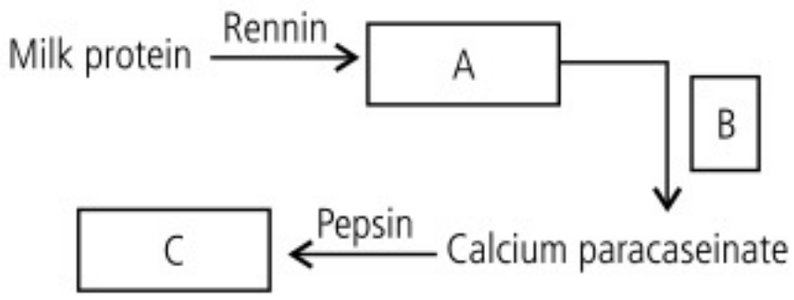
9. Go through the following statements regarding the absorption of nutrients. Identify whether they are true or false; then choose the correct option accordingly.
I. Absorption of monosaccharides, alcohol, some water and medicines like asprin occurs in the stomach.
II. Fatty acids cannot be absorbed directly.
III. Glycerol can reach into the blood and lymph directly.
IV. Maximum absorption of water (90%) takes place in the small intestine.
V. Large intestine and mouth are not the site of absorption.
(a) I, II and IV are true while III and V are false
(b) I, II, III are true while IV and V are false
(c) II, III and IV are false while I and V are true
(d) I and II are false while III, IV and V are true.

10. Go through the following statements regarding the absorption of fats. Find correct and incorrect statements and choose an option accordingly from the codes given below.

I. Micelles and chylomicrons are concerned with the absorption of fats.
II. Chylomicrons are water soluble droplets of fat which contain triglycerides, sterol and phospholipids.
III. Micelles are water soluble droplets of fatty acids and glycerol which are formed by the action of bile pigments on fats and glycerol.
IV. Chylomicrons, the protein coated small vesicles are released from the intestinal cells into the blood stream by lacteals.

(a) II and IV are correct while I and III are incorrect
(b) I, III and IV are correct, while II is incorrect
(c) I, II and IV are correct while III is incorrect
(d) IV and I are correct while II and III are incorrect.

11. Complete the given equation and choose the correct option accordingly.



(a) A - Casein, B - Ca^{2+}, C - Peptones
(b) A - Ca^{2+}, B - Peptones, C - Casein
(c) A - Paracasein, B - Ca^{2+}, C - Peptones
(d) A - Ca^{2+}, B - Paracasein, C - Peptones

12. During prolonged fasting, in what sequence are the following organic compounds used up by the body?

(a) First carbohydrates, next fats and lastly proteins
(b) First fats, next carbohydrates and lastly proteins
(c) First carbohydrates, next proteins and lastly lipids
(d) First proteins, next lipids and lastly carbohydrates.

13. Match the following nutrition/vitamin deficiencies in column-I with causes/deficiencies in column-II and choose the correct option from the answer key.

Column-I		**Column-II**
A. Kwashiorkor	p.	Iron
B. General Anaemia	q.	Menadione
C. Dermatitis	r.	Protein
D. Calciferol	s.	Pyridoxine
E. Bleeding	t.	Osteomalacia

(a) A - p, B - t, C - q, D - r, E - s
(b) A - q, B - r, C - s, D - p, E - t
(c) A - r, B - p, C - s, D - t, E - q
(d) A - r, B - s, C - p, D - t, E - q

14. Which of the following controls the peristaltic movement of the intestine?

(a) Sacral plexus
(b) Brachial plexus
(c) Discoidal plexus
(d) Auerbach's plexus

15. Which of the given options are true for beri-beri?

1. A crippling disease prevalent among the native population of sub-Saharan Africa.
2. A deficiency disease caused by lack of thiamine (vitamin B_1).
3. A nutritional disorder in infants and young children when the diet is persistently deficient in essential protein.
4. Occurs in those countries where the staple diet is polished rice.
5. The symptoms are pain from neuritis, paralysis, muscle wasting, progressive oedema, mental deterioration and finally heart failure.

(a) 2, 4 and 5 (b) 1, 2 and 4
(c) 1, 3 and 5 (d) 2, 3 and 5

True or False

16. Muscularis is formed by smooth muscles usually arranged into an outer circular and inner longitudinal layer.

17. Rennin is a proteolytic enzyme found in gastric juice of infants which helps in digestion of milk proteins.

18. The mucus and bicarbonates in the gastric juice help in lubrication and protection of mucosal epithelium from excoriation by concentrated hydrochloric acid.

19. Carbohydrates in the chyme are hydrolysed by pancreatic amylase into monosaccharides.

20. The lymph vessels ultimately release the absorbed substances into the body cells.

21. About 60% of starch is hydrolysed in the mouth by the enzyme salivary amylase into disaccharide-maltose.

22. The parietal or oxyntic cells secrete hydrochloric acid and intrinsic factor, which is essential for absorption of vitamin B complex.

23. Saliva is mainly produced by three pairs of salivary glands — the parotids, the sub-maxillary and submandibular.

24. Liver is the largest gland, situated in the abdominal cavity, just below the diaphragm.

25. Peptic or chief cells secrete the proenzyme pepsinogen.

Match The Columns

26. Match Column-I with Column-II and select the correct option from codes given below.

Column-I		Column-II
A. Electrolytes	(i)	Goblet cells
B. Insulin	(ii)	Argentaffin cells
C. Somatostatin	(iii)	Beta cells
D. Glucagon	(iv)	PP cells
E. Pancreatic polypeptide	(v)	Alpha cells
F. Mucus	(vi)	Enterocytes
G. Secretin	(vii)	Delta cells

27. Match Column-I with Column-II and select correct options from codes given below. There can be more than one match for items in Column I.

Column-I		Column-II
A. Pancreas	(i)	Sodium glycocholate
B. Bile salts	(ii)	Peyer's patches
C. Small intestine	(iii)	Filiform
D. Papillae	(iv)	Zymogenic cells
E. Stomach	(v)	Duct of Wirsung
F. Liver	(vi)	Glisson's capsule
G. Bile pigments	(vii)	Bilirubin
	(viii)	Duct of Santorini
	(ix)	Biliverdin
	(x)	Kupffer cells
	(xi)	Valves of Kerkring
	(xii)	Oxyntic cells
	(xiii)	Fungiform
	(xiv)	Sodium taurocholate

Passage Based Questions

28.(A) Complete the given passage with appropriate words or phrases.

(i) and (ii) being insoluble, cannot be absorbed into the blood. They are first incorporated into small droplets called (iii), which move into the intestinal mucosa. They are re-formed into very small protein coated fat globules called (iv), which are transported by the (v) in the villi.

(B) Correct the errors, wherever present in the given table.

Macro-nutrient	Gross calorific value Kcal/gm	Physiologic value Kcal/gm
Carbohydrate	4	4.1
Protein	4.45	4
Fat	9.65	9

Assertion & Reason

In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, mark the correct answer as :

(a) if both A and R are true and R is the correct explanation of A

(b) if both A and R are true but R is not the correct explanation of A

(c) if A is true but R is false

(d) if both A and R are false.

29. **Assertion :** Gastric amylase contributes little to digestion of carbohydrates.

Reason: The action of gastric amylase is inhibited by highly acidic conditions.

30. **Assertion :** Stem cells are undifferentiated cells that are present in the epithelium of the gastric glands.

Reason : They increase in number when the gastric epithelium is damaged.

31. **Assertion :** Enamel is the hardest substance of the human body.

Reason : It covers the external surface of the tooth.

32. **Assertion :** Auerbach's plexus controls the secretion of intestinal juice.

Reason : Meissner's plexus controls the peristalsis in alimentary canal.

33. **Assertion :** Liver helps kidneys in maintaining body fluid osmoregulation.

Reason : Liver produces angiotensinogen, which is converted to angiotensin II by rennin.

34. **Assertion :** Obstruction of hepatic or bile duct due to gall stones etc. results in obstructive jaundice.

Reason : In this disease, the bile is absorbed into the liver causing yellowing of eyes and skin.

35. **Assertion :** Brunner's glands are found only in the mucosa of the duodenum.

Reason : They secrete abundant mucus and intestinal juice rich in enzymes.

36. **Assertion :** Secretin was the first hormone to be discovered by scientists.

Reason : It increases bile and gastric secretion.

37. **Assertion :** Glucose and galactose are absorbed by active transport in stomach and jejunum.

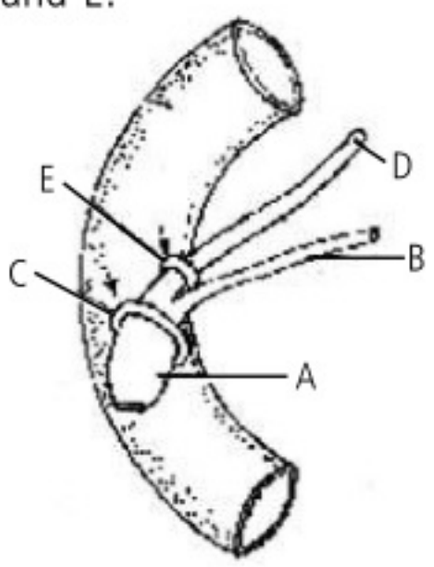
Reason : The most rapidly transported monosaccharide is glucose with galactose running a close second.

38. **Assertion :** Sodium is absorbed from small intestine by active transport.

Reason : This process is coupled to the movement of potassium.

Figure Based Questions

39. Refer to the given figure. Identify the labelled parts A, B, C, D and E.



40. Fill in the given blanks using the letters assigned above of different structures. You may use appropriate phrases, where required.

The cystic duct and common hepatic duct join to form (i), which passes downwards posteriorly to join (ii) to form (iii), also called (iv). Its opening is guarded by (v). (vi) surrounds the opening of (vii), before it is joined with the (viii).

CHAPTER-17 : BREATHING AND EXCHANGE OF GASES

Multiple Choice Questions

1. People living at sea level have around 5 million RBC per cubic millimeter of their blood whereas those living at an altitude to 5400 metres have around 8 million. This is because at high altitude
   (a) people eat more nutritive food, therefore more RBCs are formed
   (b) people get pollution-free air to breathe and more oxygen is available
   (c) atmospheric O_2 level is less and hence more RBCs are needed to absorb the required amount of O_2 to survive
   (d) there is more UV radiation which enhances RBC production.

2. Although much CO_2 is carried in blood, yet blood does not become acidic, because
   (a) it is absorbed by the leucocytes
   (b) it combines with water to form H_2CO_3 which is neutralized by Na_2CO_3
   (c) CO_2 transport and blood buffers play an important role in it
   (d) it is continuously diffused through the tissues and is not allowed to accumulate.

3. Which one of the following statements is incorrect?
   (a) The principle of countercurrent flow facilitates efficient respiration in gills of fishes.
   (b) The residual air in lungs slightly decreases the efficiency of respiration in mammals.
   (c) The presence of non-respiratory air sacs, increases the efficiency of respiration in birds.
   (d) In insects, circulating body fluids serve to distribute oxygen to tissues.

4. When temperature decreases oxy - Hb curve will become
   (a) more steep (b) straight
   (c) parabola (d) all of these.

5. What is the approximate normal composition of alveolar air?
   (a) 14% oxygen, 5% carbon dioxide, 75% nitrogen
   (b) 21% oxygen, 2% carbon dioxide, 77% nitrogen
   (c) 16% oxygen, 3% carbon dioxide, 81% nitrogen
   (d) 10% oxygen, 8% carbon dioxide, 82% nitrogen.

6. At rest body produces CO_2 at the rate of
   (a) 100 cc/min (b) 200 cc/min
   (c) 400 cc/min (d) 600 cc/min.

7. With reference to human respiration, which is correct?
   (a) Pulmonary ventilation is equal to alveolar ventilation.
   (b) Alveolar ventilation is less than pulmonary ventilation.

(c) Alveolar ventilation is more than pulmonary ventilation
(d) Pulmonary ventilation is less than alveolar ventilation.

8. If alveolar ventilation is 4200 mL/min, respiratory frequency is 12 breaths per minute, and tidal volume is 500 mL, what is the anatomical-dead-space ventilation?
(a) 1800 mL/min
(b) 6000 mL/min
(c) 350 mL/min
(d) 1200 mL/min

9. Human beings have a significant ability to maintain and moderate the respiratory rhythm to suit demands of the body. For it we have
(i) Respiratory rhythm centre in medulla – R
(ii) Pneumotaxic centre in pons – PT
(iii) Chemosensitive area in medulla – C_1
(iv) Peripheral chemoreceptors in aortic arch and carotid artery– C_2

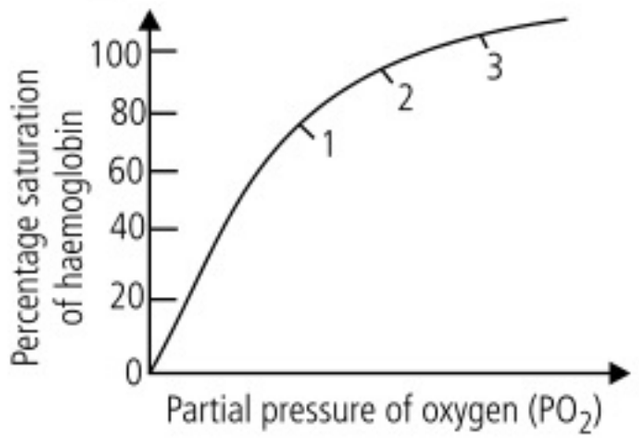
Find out the correct path for regulation of respiration.
(a) $C_2 \rightarrow R \rightarrow PT \rightarrow C_1$

(b)
$$\begin{array}{l} PT \rightarrow R \leftarrow C_2 \\ \qquad\quad \uparrow \\ \qquad\quad C_1 \end{array}$$

(c)
$$\begin{array}{l} C_1 \rightarrow PT \rightarrow C_2 \\ \qquad\quad \uparrow \\ \qquad\quad R \end{array}$$

(d)
$$\begin{array}{l} PT \rightarrow C_2 \rightarrow C_1 \\ \qquad\quad \uparrow \\ \qquad\quad R \end{array}$$

10. The graph given shows an oxygen dissociation curve for haemoglobin.



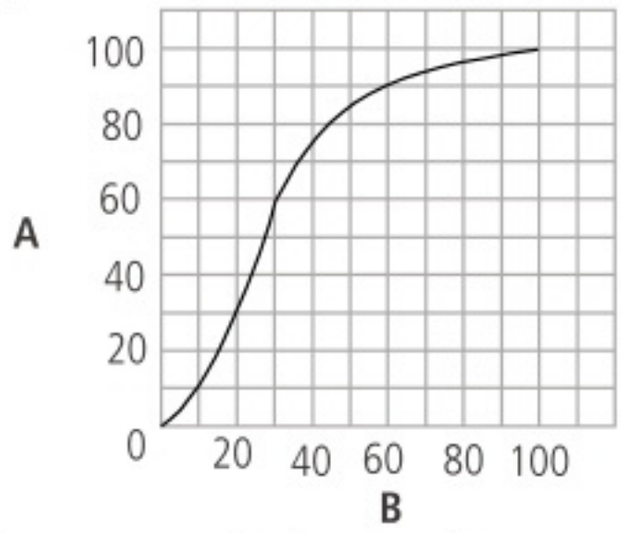
Where in the body will haemoglobin be saturated at the percentages shown at points 1, 2 and 3 on the graph?

	Left ventricle	Pulmonary vein	Vena cava
(a)	1	2	3
(b)	2	1	3
(c)	2	3	1
(d)	3	2	1

11. After taking a long deep breath we do not respire for some seconds due to
(a) more CO_2 in blood (b) more O_2 in blood
(c) less CO_2 in blood (d) less O_2 in blood.

12. Foetal haemoglobin has X affinity for oxygen than that of mother's haemoglobin during gestation. X is
(a) same
(b) higher
(c) lower
(d) lower affinity earlier but higher later.

13. Which of the following is incorrect about the given graph?



(a) The curve is called oxygen dissociation curve.
(b) The part 'A' represents percentage saturation of haemoglobin with oxygen.
(c) The part 'B' represents partial pressure of carbon dioxide.
(d) This curve is highly useful in studying the effect of factors like pCO_2, H^+ concentration, etc.

14. Haldane effect plays more important role in promoting carbon dioxide transport than that of the Bohr's effect in promoting oxygen transport because
(a) oxyhaemoglobin is a stronger acid which donates hydrogen ion (H^+) which in turn displace carbon dioxide from blood
(b) carbaminohaemoglobin is a stronger acid which splits into hydrogen ion (H^+) and bicarbonate (HCO_3^-)
(c) carbon dioxide reacts with water to form carbonic acid that lowers the pH in tissue
(d) carbon dioxide is less soluble in venous blood than in arterial blood.

15. Inspiration occurs when there is a negative pressure in the lungs with respect to atmospheric pressure. This negative pressure is achieved when
(a) intrapulmonary pressure is less than the atmospheric pressure
(b) intrapulmonary pressure is greater than the atmospheric pressure
(c) intrapulmonary pressure is equal to the atmospheric pressure
(d) intrapleural pressure becomes more than the intra alveolar pressure.

True or False

16. The PO_2 and PCO_2 in the deoxygenated blood and in the tissues is same, that is 40mm Hg and 45 mm Hg respectively.
17. Nearly 200 mL of air remains in the lungs even after a forcible expiration, which is called RV or residual volume.
18. The factors favourable for dissociation of oxygen from oxyhaemoglobin are high PCO_2, low PO_2 and low H^+ concentration.
19. Receptors associated with aortic arch and carotid artery can recognize changes in CO_2 and H^+ concentration.
20. Every 100 mL of oxygenated blood can deliver around 4 mL of oxygen to the tissues under normal physiological conditions.
21. RBCs can transport about 97 percent of oxygen as well as 20-25 percent of carbon dioxide.
22. Although solubility of CO_2 is 20-25 times higher than that of O_2, the amount of CO_2 that diffuses through diffusion membrane, per unit difference in partial pressure is the same as that of O_2.
23. IC increases as a result of increase in IRV.
24. A decrease in pulmonary volume decreases the intrapulmonary pressure to less than the atmospheric pressure, which causes air from outside to rush inside.
25. The conducting part of the respiratory system transports the atmospheric air to alveoli, clears it from foreign particles, removes excess moisture and brings it to body temperature.

Match The Columns

26. Match Column-I with Column-II and select the correct option from the codes given below.

Column-I	Column-II
A. TV	(i) 1000-1100 mL
B. IRV	(ii) 3000-3500 mL
C. ERV	(iii) 1500-1600 mL
D. RV	(iv) 2200-2500 mL
E. IC	(v) 2500-3000 mL
F. EC	(vi) 1100-1200 mL
G. FRC	(vii) 500 mL

27. Match Column-I with Column-II and select correct options from codes given below. There can be more than one match for items in Column-1.

Column-I	Column-II
A. Larynx	(i) Adam's apple
B. TLC	(ii) Squamous epithelium
C. Occupational lung disease	(iii) Excess smoking
D. Hamburger phenomenon	(iv) 3500-4500 mL
E. VC	(v) VC + RV
F. Emphysema	(vi) Fibrosis
G. Alveoli	(vii) Carbonic anhydrase
	(viii) Chloride shift
	(ix) Byssinosis
	(x) 5000-6000 mL
	(xi) Thyroid cartilage
	(xii) TV + ERV + IRV
	(xiii) Oxygen therapy
	(xiv) Surfactant

Passage Based Questions

28.(A) Complete the given passage with appropriate words or phrases.

Oxygen in the inhaled air is nearly _(i)_, in alveolar air, it is _(ii)_, while in exhaled air, it is _(iii)_.

Carbon dioxide in the inhaled air is _(iv)_, in alveolar air is _(v)_, while in the exhaled air, it is _(vi)_.

(B) Read the passage and correct the errors, wherever present.

In tissues, PO_2 blood is 45mm Hg, that of interstitial fluid is 45mm Hg, while in cells around, it is 32mm Hg. The blood leaving the tissue capillaries has PO_2 equal to 45mm Hg. However, nearly 50-55% of haemoglobin is still in oxygenated form.

Assertion & Reason

In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, mark the correct answer as :

(a) if both A and R are true and R is the correct explanation of A

(b) if both A and R are true but R is not the correct explanation of A

(c) if A is true but R is false

(d) if both A and R are false.

29. **Assertion :** The thoracic chamber is formed dorsally by the vertebral column, ventrally by the sternum, laterally by the ribs and on the lower side by the dome-shaped diaphragm.

Reason : The anatomical setup of lungs in thorax is such that any change in the volume of lungs will be reflected in the thoracic cavity.

30. **Assertion:** The diaphragm, intercostal muscles and abdominal muscles play an important role in inspiration.

Reason : The contraction of the phrenic muscles, external intercostal muscles and abdominal muscles help in inspiration.

31. **Assertion :** TV or tidal volume is the volume of air inspired or expired during normal breath.

Reason : Both TLC and VC include TV.

32. **Assertion :** Mammals have negative pressure breathing.

Reason : It allows them to eat and breathe at the same time.

33. **Assertion :** In human males, lateral movement of thorax constitutes 25% of breathing, while abdominal movement accounts for 75% of breathing.

Reason : In human females, the entire breathing is through lateral movement of thorax.

34. **Assertion :** The quantities of air the lungs can receive, hold or expel under different conditions are called pulmonary volumes, while the combination of 2 or more pulmonary volumes are called pulmonary capacities.

Reason : All pulmonary volumes and capacities are about 20-25 percent less in women.

35. **Assertion :** According to Bohr's effect, an increase in carbon dioxide in the blood causes oxygen to be displaced from the haemoglobin.

Reason : All the factors which shift oxygen haemoglobin dissociation curve to the left increase Bohr's effect.

36. **Assertion :** According to Haldane effect, binding of oxygen with haemoglobin tends to displace carbon dioxide from the blood.

Reason : It is quantitatively far more important in promoting CO_2 transport than the Bohr effect in promoting O_2 transport.

37. **Assertion :** The dorsal respiratory group (DRG) present in the dorsal portion of medulla oblongata mainly causes expiration.

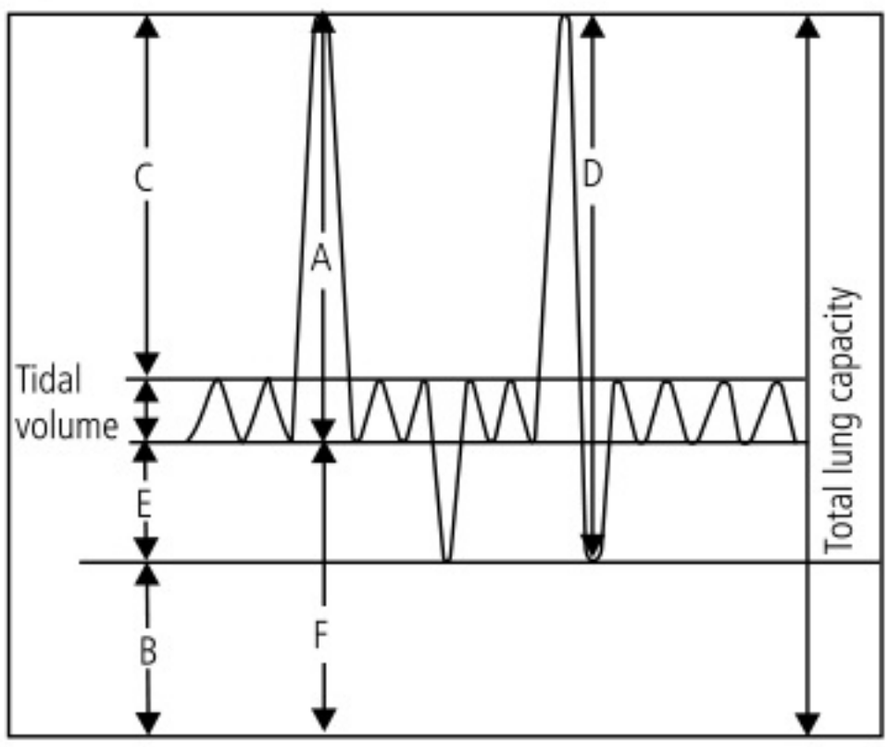
Reason : The ventral respiratory group (VRG) on the ventrolateral part of medulla oblongata mainly controls inspiration.

38. **Assertion :** After strenuous exercise, the amount of oxygen consumed is enormously high.

Reason : A part of this oxygen is used for reformation of glucose from lactic acid accumulated in muscles during exercise.

Figure Based Questions

39. Refer to the figure below and identify the labelled parts - A, B, C, D, E and F.



40. Fill in the blanks using the letters above.

1. The maximum volume of air, a person can breathe in after a forced expiration, is called (i) .
2. TLC includes (ii) and (iii) .
3. (iv) is forced inspiration.
4. (v) is forced expiration.
5. (vi) is TLC minus (vii) .

CONCEPT MAP

NITROGEN NUTRITION IN PLANTS

Nitrogen is one of the most important nutrient required for proper growth of the plants as it is present in the compounds like proteins, amino acids, alkaloids, vitamins, enzymes, chlorophyll and nucleic acids. Its deficiency causes chlorosis and stops cell division and elongation thus retards growth.

Atmospheric nitrogen

- It is available in atmosphere in high amount (78%) in the form of (dinitrogen gas, N_2).
- It is the most critical element for plant growth.

Nitrogen fixation

- Plants directly cannot absorb N_2 from air because its acquistion from atmosphere requires breaking of an exceptionally stable triple covalent bond between two nitrogen atoms ($N \equiv N$).
- Thus, it must be **'fixed'** into utilizable forms *i.e.*, ammonia (NH_3) or nitrate (NO_3^-).

Abiological nitrogen fixation

- Abiological fixation occurs naturally or by industrial processes.
- **Natural fixation** occurs by electric discharge, ozonisation and combustion.
- Different types of oxides of nitrogen are formed, which ultimately come to the soil by the means of mixing with rain water.

$$N_2 + O_2 \xrightarrow{\text{Electric discharge}} 2NO_2 \text{ (Nitrogen oxide)}$$

$$2NO + 2[O] \xrightarrow[\text{Ozonisation}]{\text{Electric discharge}} 2NO_2$$

$$2NO + 3[O] \xrightarrow{\text{Ozonisation}} N_2O_5$$

$$H_2O + 2NO \rightarrow HNO + HNO_2$$

$$H_2O + 2NO_2 \rightarrow HNO_2 + HNO_3$$

$$H_2O + N_2O_5 \rightarrow 2HNO_3$$

- **Industrial fixation** involves production of ammonia by directly mixing nitrogen with hydrogen (from water) under high pressure and temperature.
- Various fertilisers are produced industrially to provide nitrogen to the plants.

Biological nitrogen fixation

- It is the major source of nitrogen fixation and is done by prokaryotes (bacteria and cyanobacteria), either free living (asymbiotic) or symbiotic.
- **Asymbiotic nitrogen fixation** is done by free living bacteria like *Azotobacter, Klebsiella*, etc. and cyanobacteria like *Anabaena, Nostoc* and *Trichodesmium.*
- **Symbiotic nitrogen fixation** is done by symbiotic prokaryotes inside the body of their plant hosts. *Nostoc*, *Anabaena* and *Anthoceros* etc. are symbiotic nitrogen fixing cyanobacteria, whereas *Rhizobium* and *Frankia* etc. are symbiotic nitrogen fixing bacteria.
- *Rhizobium* (in legume) and *Frankia* (in non legume plants) can fix nitrogen in anaerobic conditions by nodule formation.
- **Nodules** require cooperation of ***nod, nif*** and ***fix*** gene clusters of bacteria for their formation.
- Roots of the legume secrete chemical attractants **(flavonoids and betaines).** Bacteria collect over the root hairs and release *nod* factors that cause curling of root hair around the bacteria.
- An infection thread enclosing bacteria is constructed by the root cells in response to the infection. When it reaches deep in the cortex, it bursts and the rhizobia are engulfed into membrane enclosed **symbiosomes** within the cytoplasm.
- Synthesis of **auxin** from cortical cells and cytokinin from associating bacteria stimulate nodule formation. Bacteria form irregular polyhedral structures *i.e.*, **bacteroids** inside nodules.
- The legume host supplies nitrogenase, the nitrogen fixing enzyme which is strongly inhibited by oxygen. **Leghaemoglobin** (Lb) an oxygen scavenger is present in nodules which protects nitrogenase.

Assimilation of nitrate

- Nitrate is the most important source of nitrogen to the non legume plants. It is not used by plants as such but is stepwise reduced to the level of ammonia before being incorporated into organic compounds.
- Firstly **nitrate reductase,** an inducible enzyme (having molybdoflavoprotein) favours the formation of reduced nitrite in the presence of reduced coenzyme.

$$NO_3^- + NAD(P)H + H^+ + 2e^- \xrightarrow[\text{FAD/FMN}]{\text{Nitrate reductase}} NO_2^- + H_2O + NAD(P)$$

- Then an enzyme **nitrite reductase** (metalloflavoprotein containing copper and iron) favours the formation of nitrite under reduced condition.

$$2NO_2^- + 7NAD(P)\,H + 7H^+ \xrightarrow[\text{Ferrodoxin}]{\text{Nitrite reductase}} 2NH_3 + 4H_2O + 7NAD(P)^+$$

- Formed ammonia is not liberated. It combines with acid to form amino acids and is utilised in making various types of nitrogenous compounds (*As discussed under 'Assimilation of ammonia'*).

Mechanism of biological nitrogen fixation

- It requires :
  (i) $FMNH_2$, $NADPH_2$ etc. as reducing power
  (ii) Nitrogenase and hydrogenase enzymes
  (iii) ATP as source of energy
  (iv) Compound for trapping released ammonia
  (v) Leaghaemoglobin for protection of nitrogenase from O_2
  (vi) Presence of non haeme iron protein ferrodoxin as electron carrier
  (vii) Presence of cofactors CoA, TPP, Pi, Mg^{2+}, Co and Mo etc
- The overall reaction is shown as :

$$N_2 + 8e^- + 8H^+ + 16\,ATP \longrightarrow \underset{\text{(Ammonia)}}{2NH_3} + 2H^+ + 16\,ADP + 16\,Pi$$

Nitrification

- Ammonia thus produced gets readily converted to nitrates by various microorganisms.
- It takes place in two steps. First ammonia is oxidised to nitrites and then nitrites are oxidised to nitrates by different microorganisms.

$$2NH_3 + 3O_2 \xrightarrow[\text{Aspergillus flavus}]{\text{Nitrosococcus, Nitrosomonas}} 2NO_2^- + 2H^+ + 2H_2O + \text{Energy}$$

$$2NO_2^- + O_2 \xrightarrow[\text{Nitrocystics}]{\text{Nitrobacter, Penicillium}} 2NO_3^- + \text{Energy}$$

- Bacteria performing nitrification are **chemoautotrophs** which utilise the energy released during the reaction for the synthesis of organic substances.

Assimilation of fixed nitrogen

- Plants get fixed nitrogen from the two sources– symbiotic and asymbiotic.
- In case of symbionts, the **ammonia** is taken up by host immediately and assimilated; while in case of free living nitrogen fixers the fixed nitrogen is released by their death and decay in the form of **nitrates** through **ammonification** and **nitrification.**

Ammonification

- Decay causing organisms *e.g., Bacillus ramosus, B. vulgaris,* and actinomycetes convert dead bodies of microorganisms as well as other soil organic matter (excreta and dead body of other animals) into organic acid and ammonia.

$$\text{Protein} \xrightarrow{H_2O} \underset{\text{(Amino acid)}}{R - NH_2} \xrightarrow{H_2O} \underset{\text{(Organic acid)}}{ROH} + \underset{\text{(Ammonia)}}{NH_3}$$

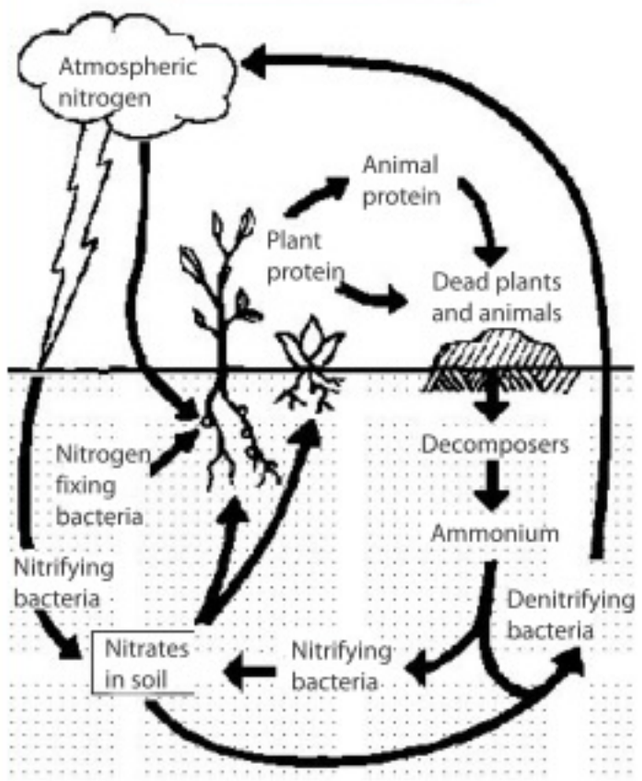
Denitrification

- In anaerobic condition, some microbes reduce nitrates to gaseous compounds of nitrogen which release from the soil.

$$2NO_3^- \rightarrow 2NO_2^- \rightarrow 2NO \rightarrow N_2O \rightarrow N_2$$

- Denitrification is mainly carried out by *Pseudomonas denitrificans, Thiobacillus denitrificans* and *Micrococcus denitrificans.*
- It depletes the soil of an important nutrient and causes acidification and leads to the solubilisation of harmful metals. Dentrification has a role in nitrogen cycle as it supplies nitrogen to its reservoir pool, the atmosphere.

NITROGEN CYCLE



Assimilation of ammonia

- Ammonia is **toxic** to plants and thus is readily converted to amino acids.
- The primary pathway for this conversion involves sequential actions of glutamine synthetase and glutamate synthetase *i.e.*, **catalytic amidation.**

$$\text{Glutamate} + NH_4^+ + ATP \xrightarrow[\text{synthetase}]{\text{Glutamine}} \text{Glutamine} + ADP + Pi$$

$$\text{Glutamine} + \alpha\text{-Ketoglutaric acid} + NAD(P) \xrightarrow[\text{synthetase}]{\text{Glutamate}} 2\ \text{Glutamate} + NAD(P)$$

- In an alternative pathway, glutamate dehydrogenase catalyses a reversible reaction that synthesises glutamate *i.e.*, **reductive amination.**

$$\alpha\text{- Ketoglutaric acid} + NH_4^+ + NAD(P)H \xrightarrow[\text{dehydrogenase}]{\text{Glutamate}} \text{Glutamate} + H_2O + NAD(P)$$

- Once assimilated into glutamate, nitrogen is incorporated into other amino acids *via* **transamination** reactions catalyzed by **aminotransferases.** *E.g.,*

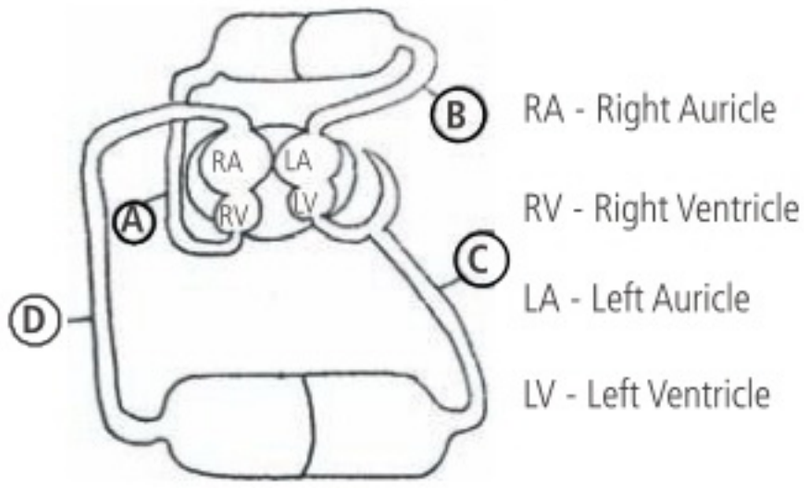
$$\text{Glutamic acid} + \text{Oxaloacetic acid} \xrightarrow[\text{aminotransferase}]{\text{Glutamate aspartate}} \alpha\text{-Ketoglutaric acid} + \text{Aspartic acid}$$

- **Amides** (principally asparagine or glutamine) are generally used as a medium of translocation and storage of nitrogen because of their stability and high nitrogen to carbon ratio. In some legumes *e.g.,* soyabean, **ureides** (allantoin, allantonic acid and citrulline) are used for the purpose.
- The proteins through food chain get converted into animal proteins. By death and decay of both plant and animal organic matter (ammonification and nitrification) the nitrogen cycle continues in the environment.

CHAPTER-18 : BODY FLUIDS AND CIRCULATION

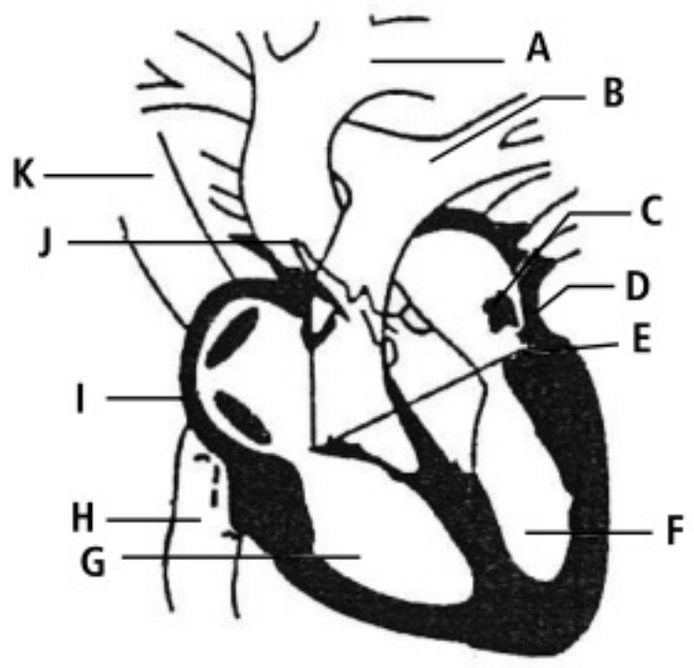
Multiple Choice Questions

1. In the figure given below, which blood vessel represents vena cava?



(a) C (b) D
(c) A (d) B

2. The given figure shows the vertical section of human heart. Identify the parts labelled as A to K.



(a) A-Aorta, B-Pulmonary vein, C-Pulmonary arteries, D-Left ventricle, E-Semilunar valves, F-Left auricle, G-Right auricle, H-Superior vena cava, I-Right ventricle, J-Tricuspid valves, K-Inferior vena cava
(b) A-Aorta, B-Pulmonary artery, C-Pulmonary veins, D-Left auricle, E-Tricuspid valves, F-Left ventricle, G-Right ventricle, H-Inferior vena cava, I-Right auricle, J-Semilunar valves, K - Superior vena cava
(c) A-Aorta, B-Superior vena cava, C-Inferior vena cava, D-Right ventricle, E-Tricuspid valves, F-Right auricle, G-Left auricle, H-Pulmonary vein, I-Right ventricle, J-Semilunar valves, K-Pulmonary artery
(d) A-Aorta, B-Superior vena cava, C-Inferior vena cava, D-Left ventricle, E-Semilunar valves, F-Left auricle, G-Right auricle, H-Pulmonary artery, I-Right ventricle, J-Tricuspid valves, K-Pulmonary vein.

3. Identify the following type of blood cells and mark the correct option.



	A	B	C	D	E
(a)	Monocyte	Eosinophil	Neutrophil	Basophil	Blood platelets
(b)	Monocyte	Basophil	Neutrophil	Blood platelets	Eosinophil
(c)	Basophil	Blood platelets	Monocyte	Eosinophil	Neutrophil
(d)	Basophil	Blood platelets	Eosinophil	Neutrophil	Monocyte

4. Match Column-I with Column-II and select the correct option from the codes give below.

Column-I	Column-II
A. Factor II	(i) Thromboplastin
B. Factor III	(ii) Prothrombin
C. Factor VIII	(iii) Hageman factor
D. Factor XII	(iv) Antihaemophilic globulin

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

5. Which one of the following statements is correct with regard to the principle of safe blood transfusion?
(a) The donor's red blood corpuscles should not contain antibodies against the recipient's serum.
(b) The recipient's serum should not contain antigens against the donor's antibodies.
(c) The recipient's serum should not contain the antibodies against the red blood corpuscles of the donor.
(d) The recipient's red blood corpuscles should not contain antibodies against the donor's antigen.

6. In which of the following situations, there is a risk factor for children acquiring erythroblastosis foetalis?
(a) Mother is Rh –ve and father is Rh –ve
(b) Mother is Rh –ve and father is Rh +ve
(c) Mother is Rh +ve and father is Rh +ve
(d) Mother is Rh +ve and father is Rh –ve

7. The problem of electrical discontinuity caused in the normal heart by the connective tissue separating the atria from the ventricles is solved by
(a) coordinating electrical activity in the atria with electrical activity in the ventricles by connecting them *via* the bundle of His

(b) having the A-V node function as a secondary pacemaker
(c) having an ectopic pacemaker
(d) coordinating electrical activity in the atria with electrical activity in the ventricles by connecting them *via* the vagus nerve.

8. During acute myocardial infarction which of the following changes occurs in the ECG ?
(a) Flattened T wave
(b) Depressed ST segment
(c) Elevated ST segment
(d) Increased length of PQ interval

9. Match Column-I with Column-II and select the correct option from the codes given below.

Column-I		Column-II
A. Heart failure	(i)	Heart muscle is suddenly damaged by an inadequate blood supply
B. Cardiac arrest	(ii)	Chest pain due to inadequate O_2 reaching the heart muscles
C. Heart attack	(iii)	Atherosclerosis
D. Coronary artery disease (CAD)	(iv)	Heart not pumping blood effectively enough to meet the needs of the body
E. Angina pectoris	(v)	Heart stops beating

(a) A-(iv), B-(v), C-(i), D-(iii), E-(ii)
(b) A-(v), B-(iv), C-(i), D-(iii), E-(ii)
(c) A-(iv), B-(v), C-(i), D-(ii), E-(iii)
(d) A-(v), B-(iv), C-(ii), D-(iii), E-(i)

10. If the heart sound recording and ECG recordings are superimposed then the first heart sound would occur
(a) at the P wave
(b) just after the P wave
(c) just before the QRS complex
(d) just after the QRS complex.

11. Match the common names of diseases listed under column-I with their medical terms listed under column-II; choose the answer which gives the correct combination of the alphabets of the two columns.

Column-I (Common name)		Column-II (Medical terms)
A. Blood clotting in small capillaries	p.	Rhinitis
B. Valve defects	q.	Stenosis
C. Hay fever	r.	Parkinson's diseases
D. Paralysis	s.	Coronary thrombosis.

(a) A = s, B = q, C = p, D = r
(b) A = r, B = s, C = q, D = p
(c) A = q, B = s, C = r, D = p
(d) A = s, B = p, C = r, D = q.

12. Which of the following carries blood rich in food materials, such as glucose and amino acids, from intestine to liver?
(a) Dorsal aorta (b) Renal portal vein
(c) Mesenteric artery (d) Hepatic portal vein

13. A heart murmur indicates a defective
(a) sinoatrial node (b) atrioventricular node
(c) bundle of His (d) heart valve.

14. Human blood maintains homeostasis in the internal environment of the body by
(a) replenishment of nutrients and oxygen and elimination of metabolic wastes from the extracellular fluid
(b) replenishment of oxygen and elimination of CO_2
(c) maintenance of blood sugar level and conversion of aminoacids into urea and destruction of wornout RBCs
(d) maintenance of ion concentration in the blood and body fluids by eliminating nitrogenous wastes.

15. During ventricular systole
(a) oxygenated blood is pumped into the pulmonary artery and deoxygenated blood is pumped into the artery
(b) oxygenated blood is pumped into the aorta and deoxygenated blood is pumped into the pulmonary vein
(c) oxygenated blood is pumped into the pulmonary vein and deoxygenated blood is pumped into the pulmonary artery
(d) oxygenated blood is pumped into the aorta and deoxygenated blood is pumped into the pulmonary artery.

True or False

16. Systole represents contraction and diastole represents expansion or distension of heart chambers.

17. Ebstein's disease is a congenital downward displacement of the bicuspid valve into the left ventricle.

18. P wave represents depolarisation of atria as blood is pumped into the atria.

19. Heart failure leads to congestion of the lungs.

20. Eosinophils resist infections, and are associated with allergic reactions.

21. In amphibians and reptiles, the left atrium receives deoxygenated blood to gills/lungs/skin and the right atrium gets the oxygenated blood.

22. The first heart sound, lubb or S_1 is less loud, low pitched with a frequency of 25-45 cycles/second.

23. 30% of ventricular filling is passive, while 70% of blood is pumped into ventricles during the systole.

24. Blood pressure is inversely related to the rate of heart beat.

25. The cardiac output of an athlete will be much higher than that of an ordinary man.

Match The Columns

26. Match Column-I with Column-II and select the correct option from codes given below.

Column-I	Column-II
A. RBC	(i) Megakaryocytes
B. WBC	(ii) Calcium ions
C. Blood platelets	(iii) Prothrombin
D. Factor IV	(iv) Oedema
E. Factor II	(v) Fibrinogen
F. Factor I	(vi) Rouleaux
G. Albumin	(vii) Diapedesis

27. Match Column-I with Column-II. There may be more than one correct matches for items in Column-I.

Column-I	Column-II
A. Left ventricle	(i) Cardiac apex
B. Pulmonary circulation	(ii) Moderator band
C. Neutrophils	(iii) Aorta
D. Right ventricle	(iv) Barr body
E. Basophils	(v) Histamine
F. Eosinophils	(vi) Detoxification
G. Systemic circulation	(vii) Mitral valve
	(viii) Lungs
	(ix) Inflammation
	(x) Lysosomes
	(xi) Phagosomes
	(xii) Veins
	(xiii) Pulmonary veins
	(xiv) Tricuspid valve

Passage Based Questions

28.(A) Complete the given passage with appropriate words or phrases.

1. Lengthening of (i) interval or increase in distance between (ii) and (iii) spikes is due to inflammation or infection of conducting bundles in the region of atria and (iv) node.
2. Enlarged (v) and (vi) waves are signs of myocardial infarction.

(B) Correct the errors, wherever present, in the given lines.

Blood is slightly acidic with pH 6.8. It forms 55% of the total ECF or 16-18% of the total body weight.

Assertion & Reason

In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, mark the correct answer as :

(a) if both A and R are true and R is the correct explanation of A
(b) if both A and R are true but R is not the correct explanation of A
(c) if A is true but R is false
(d) if both A and R are false.

29. **Assertion :** Dupp is produced during ventricular diastole.
Reason : It is given out during closure of pulmonary and aortic valves.

30. **Assertion :** Human heart is myogenic, as it generates its own electrochemical impulse.
Reason : It is not under any neural or endocrine control.

31. **Assertion :** Veins are usually superficial and 64% of body blood is present in veins.
Reason : Arteries are deep seated usually and contain 16% of the total blood.

32. **Assertion :** Arteriosclerosis is a group of degenerative diseases characterised by hardening of arteries due to thickening and loss of elasticity of the arterial walls.
Reason : Atherosclerosis is also considered to be a type of arteriosclerosis.

33. **Assertion :** In single circulation, blood moves through heart only once, during completion of whole circuit in the body.
Reason : Only the oxygenated blood flows through heart.

34. **Assertion :** Roughly 8% of arterial blood passes into brain.
Reason : Brain represents 2% of body weight, but consumes nearly 20% of oxygen and glucose consumed by the body.

35. **Assertion :** In human beings, erythrocytes have an average life span of 120 days.

Reason : The aged erythrocytes attract auto-antibodies, after which, they are attacked by macrophages in the sinusoids of liver and spleen.

36. **Assertion :** Haemoglobin is iron-containing respiratory pigment and is a conjugated protein.

Reason : The globin part is made of four polypeptides, while heme consists of 4 ferric ions of iron.

37. **Assertion :** The blood volume decreases while standing in erect posture.

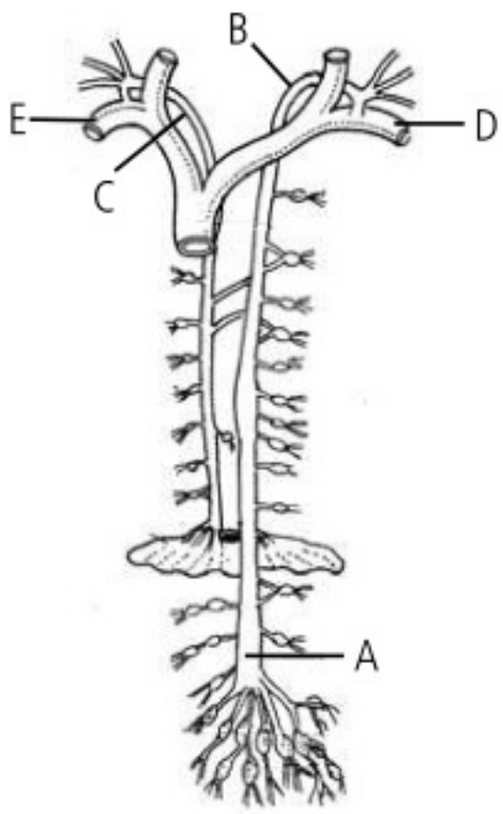
Reason : The decrease in blood volume in erect posture can be upto 15%.

38. **Assertion :** In the first ten days of a new born, a large number of red blood corpuscles are destroyed.

Reason : This is one of the causes of jaundice in new borns.

Figure Based Questions

39. Refer to the figure given below and identify A, B, C, D and E.



40. Fill in the blanks using given letters and appropriate words / phrases.

(a) The lymphatic vessels of left side unite to form (i) . This duct begins at the (ii) , which is a sac-like dilation situated in front of the (iii) and (iv) lumbar vertebrae. It discharges its lymph into the (v) .

(b) The lymphatic vessels of the right side of thorax, head and neck unit to form (vi) which discharges its lymph into (vii) .

CHAPTER-19 : EXCRETORY PRODUCTS AND THEIR ELIMINATION

Multiple Choice Questions

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

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

3. Fresh water bony fishes maintain water balance by
   (a) excreting a hypotonic urine
   (b) drinking small amount of water
   (c) excreting salt across their gills
   (d) excreting wastes in form of uric acid.

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

5. Which of the following is correct ?
   (a) Water reabsorption in descending limb of loop and collecting duct occur under similar conditions.
   (b) Sodium reabsorption in ascending limb of loop and collecting duct occur under similar conditions.
   (c) Water reabsorption in descending limb of loop and collecting duct occur under different conditions.
   (d) Water reabsorption in descending limb and sodium reabsorption in ascending limb of loop occur under similar conditions.

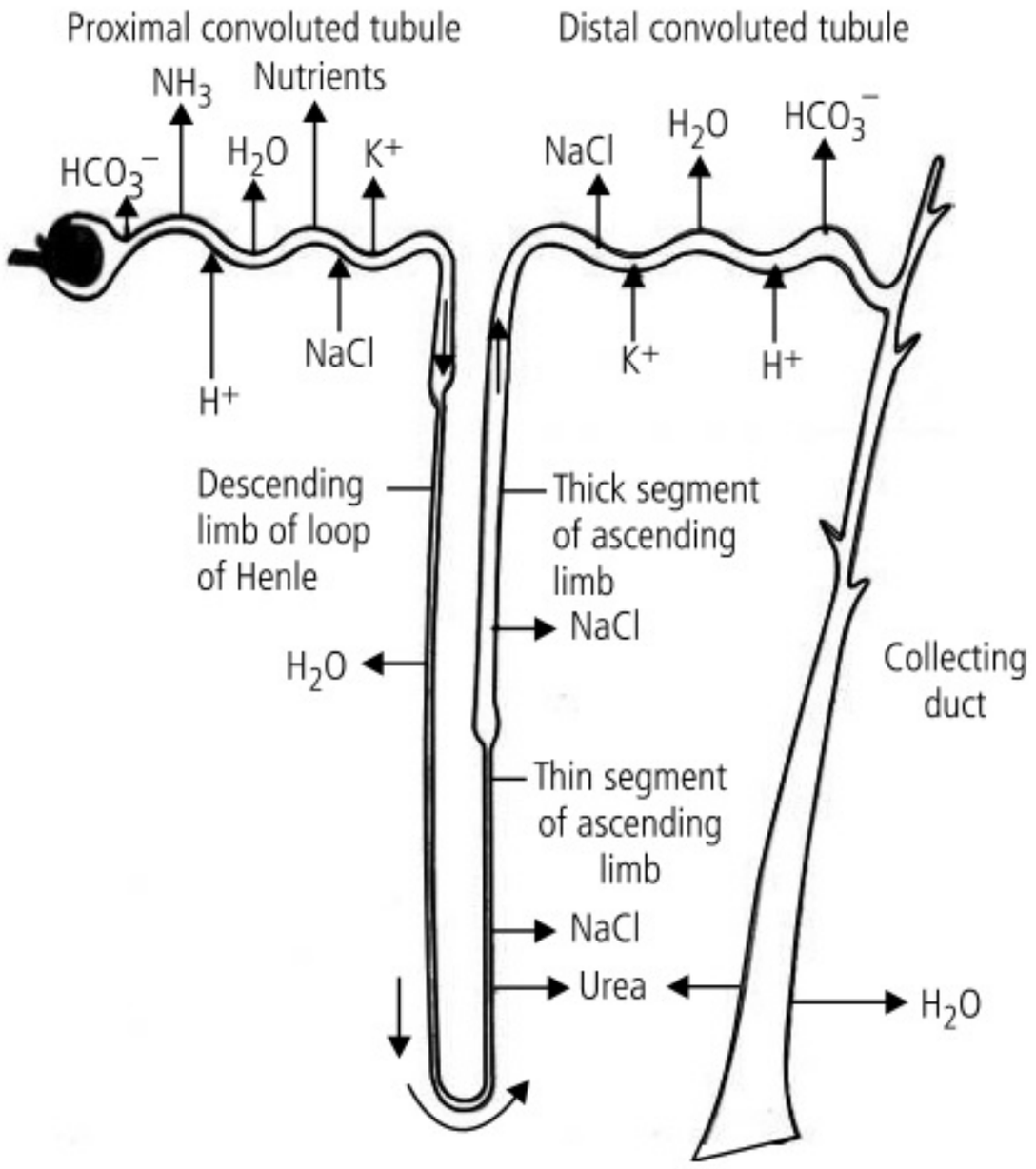
6. The presence of arginase confirms that
   (a) urea cycle is operating
   (b) urea cycle may be operating
   (c) arginine is being converted into ornithine
   (d) arginine is being converted into citrulline.

7. An X-ray of the lower abdomen shows a shadow in the region of the ureter suspected to be an ureteric calculus. A possible clinical symptom would be
(a) acute renal failure (ARF)
(b) anuria and haematuria
(c) motor aphasia
(d) chronic renal failure (CRF).

8. Reabsorption of chloride ions (Cl^-) from the glomerular filtrate, in the kidney tubule of mammal, is carried out by
(a) osmosis (b) active transport
(c) diffusion (d) Brownian movement.

9. The net filtration present in the glomerulus of the kidney is
(a) 70 mm Hg (b) 35 mm Hg
(c) 25 mm Hg (d) 10 mm Hg.

10. The given figure shows reabsorption and secretion of major substances at different parts of the nephron. The movement of which of the following substances is wrongly depicted?



(a) NaCl and K^+ at DCT
(b) NaCl and NH_3 at PCT
(c) NaCl at ascending limb of loop of Henle
(d) H_2O at descending limb of loop of Henle

11. Select the correct option representing the parts of nephron that respectively absorb (i) glucose, (ii) amino acids, (iii) inorganic ions (Na^+, K^+, Cl^-), and (iv) urea in maximum.

	(i)	(ii)	(iii)	(iv)
(a)	DCT	Descending limb of loop of Henle	DCT	DCT
(b)	DCT	Descending limb of loop of Henle	PCT	DCT
(c)	PCT	PCT	PCT	Ascending limb of loop of Henle
(d)	PCT	DCT	DCT	Ascending limb of loop of Henle

12. Juxtaglomerular apparatus is made up of
(a) juxtaglomerular cell, macula densa and lacis cell
(b) juxtaglomerular cell, Purkinje cell and chief cell
(c) juxtaglomerular cell, lacis cell and myoepithelial cell
(d) juxtaglomerular cell, macula densa and argentaffin cell.

13. Pick the odd ones in each of the following groups and select the correct option.
(i) Renal pelvis, Medullary pyramid, Renal cortex, Renal papilla
(ii) Afferent arteriole, Henle's loop, Vasa recta, Efferent arteriole
(iii) Glomerular filtration, Antidiuretic hormone, Hypertonic urine, Collecting duct
(iv) Proximal convoluted tubule, Distal convoluted tubule, Henle's loop, Renal corpuscle

	(i)	(ii)	(iii)	(iv)
(a)	Renal pelvis	Henle's loop	Collecting duct tubule	Distal convoluted tubule
(b)	Renal papilla	Afferent arteriole	Antidiuretic hormone	Henle's loop
(c)	Medullary pyramid	Efferent arteriole	Hypertonic urine	Proximal convoluted tubule
(d)	Renal cortex	Vasa recta	Glomerular filtration	Renal corpuscle

14. Select the correct option representing the excretory organs present in (i) earthworm, (ii) centipede, (iii) prawn, and (iv) flatworm.

	(i)	(ii)	(iii)	(iv)
(a)	Malpighian tubules	Flame cell	Nephridia	Green gland
(b)	Flame cell	Green gland	Malpighian tubules	Nephridia
(c)	Nephridia	Malpighian tubules	Green gland	Flame cell
(d)	Green gland	Nephridia	Flame cell	Malpighian tubules

15. Which one of the following statements is incorrect?
(a) The medullary zone of kidney is divided into a few conical masses called medullary pyramids projecting into the calyces.
(b) Inside the kidney the cortical region extends in between the medullary pyramids as renal pelvis.
(c) Glomerulus along with Bowman's capsule is called the renal corpuscle.
(d) Renal corpuscle, proximal convoluted tubule (PCT) and distal convoluted tubule (DCT) of the nephron are situated in the cortical region of kidney.

True or False

16. Ornithine cycle operates in the kidney cells in which ammonia formed from deamination of amino acids reacts with carbon dioxide and phosphate of ATP to form carbamoyl phosphate.
17. Amniotes have an anterior kidney called metanephros.
18. Loops of Henle are longer in birds and mammals for producing hypertonic urine.
19. Creatinine has high molecular weight and is the breakdown product of adenosine triphosphate.
20. Tubular secretion takes place by active transport and increases the volume of glomerular filtrate.
21. Kidney functions are controlled by negative feedback circuits involving ADH, RAAS and ANF.
22. Urine is hypertonic and nearly four times more concentrated than blood plasma.
23. Hepatic vein has highest concentration of urea, whereas renal vein has the least concentration of urea.
24. Epithelial cells of large intestine excrete Ca, Mg and Fe into the lumen of intestine, along with faecal matter.
25. Ammonia is generally excreted by diffusion across the body surface and gill surface in the gaseous form.

Match The Columns

26. Match Column-I with Column-II and select the correct option from the codes given below.

Column-I	Column-II
A. Urea	(i) Starfish
B. Amino acids	(ii) Marine bony fish
C. Guanine	(iii) Locust
D. T.M.A.O	(iv) Frog
E. Ammonia	(v) Freshwater bony fish
F. Malpighian tubule	(vi) Shark
G. Bidder's canal	(vii) Spider

27. Match Column-I with Column-II and select correct options from codes given below. There can be more than one match for items in Column-1.

Column-I	Column-II
A. Urethra	(i) Renin
B. Ornithine cycle	(ii) Arginine
C. JG cells	(iii) Duct of Bellini
D. Collecting duct	(iv) Prostatic
E. PCT	(v) Primary active transport
F. Counter current system	(vi) Loop of Henle
G. DCT	(vii) Aldosterone
	(viii) Vasopressin
	(ix) Vasa recta
	(x) Renal medulla
	(xi) Citrulline
	(xii) Erythropoetin
	(xiii) Membranous
	(xiv) Secondary active transport

Passage Based Questions

28.(A) Complete the given passage with appropriate words or phrases.
(i) in blood pressure due to (ii) in blood volume stimulates cells of cardiac atria to secrete (iii) . This inhibits release of (iv) by (v) thereby inhibiting reabsorption of (vi) and (vii) by DCT and collecting tubule.

(B) Read the passage and correct the errors, wherever present.
The rise in blood pressure due to increase in blood volume will stimulate the glomerular cells to release angiotensin II, which converts angiotensin II to angiotensinogen and further to angiotensin I.

Assertion & Reason

In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, mark the correct answer as :
(a) if both A and R are true and R is the correct explanation of A
(b) if both A and R are true but R is not the correct explanation of A
(c) if A is true but R is false
(d) if both A and R are false.

29. **Assertion :** Kidneys regulate blood pressure through secretion and non-secretion of renin.

Reason : Renin converts angiotensinogen to angiotensin, which increases Na^+ reabsorption, thereby raising the blood pressure.

30. **Assertion:** pH of urine is acidic, but becomes alkaline on standing.

Reason : Consumption of fruits and proteinaceous diet increases the acidity, whereas consumption of vegetables decreases acidity.

31. **Assertion :** Renal threshold of glucose is 180 mg/100 mL of blood.

Reason : If this level exceeds, glucose will not be reabsorbed and is excreted in urine.

32. **Assertion :** Sebaceous glands eliminate sterols, hydrocarbons and waxes through sebum.

Reason : This secretion provides a protective oily covering for the skin.

33. **Assertion :** ANF mechanism acts as a check on the renin-angiotensin mechanism.

Reason : ANF causes vasodilation and thereby decreases the blood pressure.

34. **Assertion :** Albuminuria refers to the occurrence of albumin or serum proteins in urine.

Reason : It occurs due to inflammation of glomeruli, when the size of filtration slits increase.

35. **Assertion :** Tubular reabsorption is not recorded in marine fishes and desert amphibians.

Reason : This is due to the absence of glomerulus.

36. **Assertion :** Ascending limb of loop of Henle is called diluting limb.

Reason : It is impermeable to water, but loses NaCl to interstitial fluid.

37. **Assertion :** Blood vessels of the kidney are innervated by nerve fibers of the sympathetic nervous system.

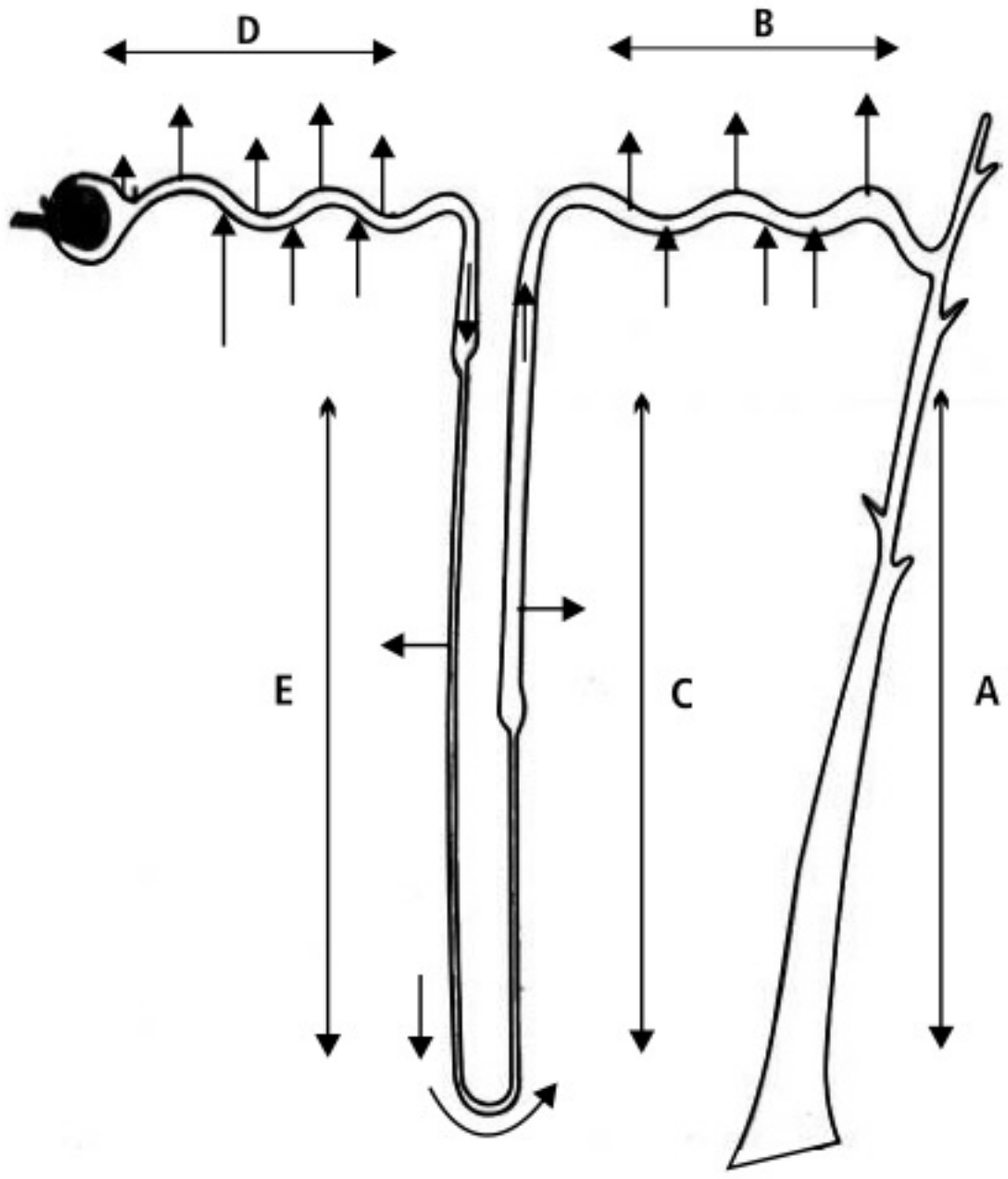
Reason : When activated, the nerve fibers bring constriction of renal arteries and cause decrease in blood flow as well as glomerular filtration rate.

38. **Assertion :** Reabsorption of Na^+, K^+ and Ca^{2+} occurs through primary active transport.

Reason : Glucose and amino acids are reabsorbed through secondary active transport.

Figure Based Questions

39. Refer to the figure below and identify the labelled parts - A, B, C, D and E.

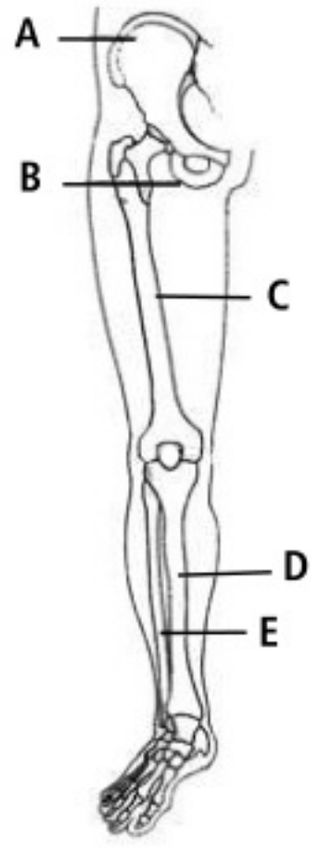


40. In the given figure, marked A to E, identify the main areas for the following processes of urine formation:
    i. Reabsorption of NaCl
    ii. Secretion of H^+
    iii. Reabsorption of HCO_3^-
    iv. Secretion of K^+
    v. Reabsorption of H_2O
    vi. Secretion of NH_3

CHAPTER-20 : LOCOMOTION AND MOVEMENT

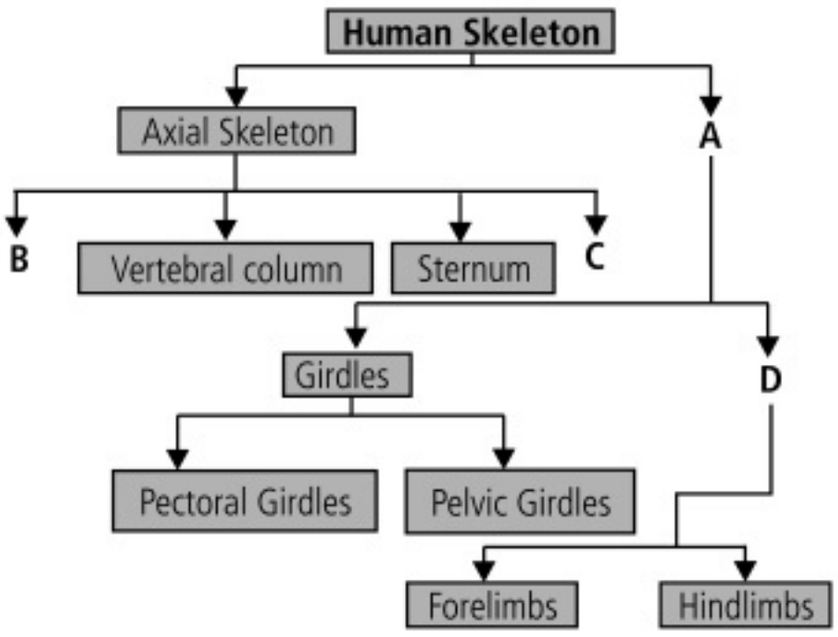
Multiple Choice Questions

1. The figure showing part of right pelvic girdle and lower limb bones is given here. Identify the parts labelled as A to E and select the correct option.



	A	B	C	D	E
(a)	Sacrum	Pubis	Patella	Metatarsal	Fibula
(b)	Ilium	Ischium	Femur	Tibia	Fibula
(c)	Ilium	Ischium	Femur	Fibula	Tibia
(d)	Ischium	Ilium	Patella	Tibia	Tarsal

2. Study the following flowchart and fill up the blanks by selecting the correct option.



	A	B	C	D
(a)	Thoracic skeleton	Limbs	Skull	Ribs
(b)	Appendicular skeleton	Skull	Ribs	Limbs
(c)	Appendicular skeleton	Limbs	Ribs	Skull
(d)	Lumbar skeleton	Limbs	Skull	Ribs

3. Which of the following correctly characterizes a "fast-oxidative" type of skeletal muscle fibre?
(a) Few mitochondria and high glycogen content
(b) Low myosin ATPase rate and few surrounding capillaries
(c) Low glycolytic enzyme activity and intermediate contraction velocity
(d) High myoglobin content and intermediate glycolytic enzyme activity

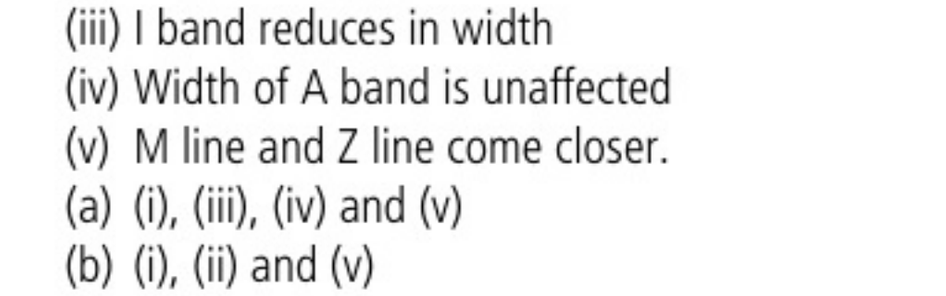
4. Match column-I with Column-II and select the correct option from the codes given below.

	Column-I		Column-II
A.	Saddle joint	(i)	Metacarpo-phalangeal joint
B.	Gliding joint	(ii)	Carpometacarpal joint of thumb
C.	Hinge joint	(iii)	Between tarsal bones
D.	Ellipsoid joint	(iv)	Knee joint

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

5. If a stimulus, several times greater than the threshold stimulus, is provided to a muscle fibre, it will
(a) contract with a larger force
(b) contract with a smaller force
(c) contract with the same force
(d) undergo tetany.

6. Which of the following is correct regarding changes in muscle fibre from relaxed to contracted state in the given figure?



Two sarcomeres

(a) The length of the thick and thin myofilaments has changed.
(b) Length of both anisotropic and isotropic band has changed.
(c) The myosin cross-bridges move on the surface of actin and the thin and thick myofilaments slide past each other.
(d) Length of the sarcomere remains same.

7. During muscular contraction, which of the following events occur?
(i) H-zone disappears
(ii) A band widens
(iii) I band reduces in width
(iv) Width of A band is unaffected
(v) M line and Z line come closer.
(a) (i), (iii), (iv) and (v)
(b) (i), (ii) and (v)
(c) (ii), (iv) and (v)
(d) (i), (ii) and (iii)

8. Paget's disease is caused by
(a) prolonged deficiency of vitamin D in adults
(b) abnormal bone resorption by abnormal osteoclasts
(c) excess alkaline phosphatase
(d) excess production and abnormal organization of collagen.

9. Gout is a disease that affects the joints and leads to arthritis. It is associated with an abnormality of
(a) pyrimidine metabolism
(b) purine metabolism
(c) fat metabolism
(d) protein metabolism.

10. Which of the following is a sesamoid bone ?
(a) Pterygoid
(b) Patella
(c) Presphenoid
(d) Palatine

11. In hurdle race, what is the major energy source of the leg muscle ?
(a) Preformed ATP
(b) Glycolysis
(c) Pyruvate and lactate
(d) Oxidative metabolism

12. Which is not true in muscle contraction?
(a) Actin and myosin make actomyosin.
(b) Phosphate reserve comes from phosphocreatine.
(c) Chemical energy is converted into mechanical energy.
(d) Mechanical energy is converted into chemical energy.

13. If a muscle undergoes rapid contraction and relaxation, the sarcoplasmic reticulum extension
(a) requires constant plugging in and out of Ca^{2+}
(b) rapid synthesis of myosin
(c) do not require energy
(d) all of the above.

14. What will happen if ligaments are torn ?
(a) Bones will move freely at joint and no pain.
(b) Bone will be less movable at joint and painful.
(c) Bone will become unfixed.
(d) Bone will become fixed.

15. The peg like process in the axis that allows the rotatory movement of the skull is
(a) atlas
(b) odontoid process
(c) condyles
(d) synovial capsule.

True or False

16. The globular head of myosin is an inactive ATPase enzyme, with binding sites for ATP and active sites for actin.

17. Mechanism of muscle contraction is best explained by the sliding filament theory, which states that contraction of muscle fibre takes place by the sliding of thick filaments over the thin filaments.

18. During muscle shortening, 'I' bands get reduced, but 'A' bands retain their length.

19. Actin filaments are more numerous, and six of them surround a myosin filament.

20. Single unit muscles are compact muscles where the individual cells are joined together by gap junctions *e.g.*, skin.

21. The cardiac muscle cells produce a prohormone peptide for reducing blood pressure.

22. Scapula is a large triangular bone situated in the ventral part of the thorax, between the second and the seventh ribs.

23. The largest muscle of the human body is quadriceps femoris while the longest is gluteus maximus.

24. Oscordis is the bone present in the heart of deer.

25. Elbow joint is an example of hinge as well as pivot joint.

Match The Columns

26. Match Column-I with Column-II and select the correct option from codes given below.

Column-I	Column-II
A. Thoracic vertebrae	(i) 7
B. Gout	(ii) IgM
C. Pivot	(iii) 5
D. Ball and socket	(iv) Monoaxial
E. RA	(v) Polyaxial
F. Lumbar vertebrae	(vi) 12
G. Cervical vertebrae	(vii) Uric acid

27. Match Column-I with Column-II and select correct options from codes given below. There can be more than one match for items in Column-1.

Column-I	Column-II
A. Carpals	(i) Polarisation
B. Resting potential	(ii) Actin binding site
C. HMM	(iii) Calcium binding
D. Action potential	(iv) Depolarisation
E. Sternum	(v) Capitate
F. Troponin	(vi) ACh
G. Tarsals	(vii) Xiphoid
	(viii) Talus
	(ix) Troponin/Tropomyosin binding
	(x) Manubrium
	(xi) ATP binding site
	(xii) Calcaneum
	(xiii) Sodium pump
	(xiv) Hamate

Passage Based Questions

28.(A) Complete the given passage with appropriate words or phrases.

Each thin filament is made of two (i) helically wound to each other. Each (ii) is a polymer of monomeric (iii). Two filaments of another protein (iv) also run close to (v) throughout its length. A complex protein (vi) is distributed at regular intervals on the (vii).

(B) Read the passage and correct the errors, wherever present.

Densely stained M line bisects the I bands. A sarcomere has, therefore, one I band and two half A bands. The central part of each A band has a variable Z line. T tubules of mammalian striated muscle fibers occur at the junction of M and I band.

Assertion & Reason

In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, mark the correct answer as :

(a) if both A and R are true and R is the correct explanation of A

(b) if both A and R are true but R is not the correct explanation of A

(c) if A is true but R is false

(d) if both A and R are false.

29. **Assertion :** Lifting of a book involves the flexing movement over elbow joint and represents the second order lever.

Reason : Here, the end of the arm with the load functions as the force, while the elbow joint functions as a fulcrum and triceps attached to ulna as resistance.

30. **Assertion:** Vertebrae in birds are heterocoelous.

Reason : They are saddle shaped with concavo-convex centra.

31. **Assertion :** Spongy bone has irregular, intersecting plates or trabeculae forming the matrix.

Reason : Spongy bone is richly vascularised.

32. **Assertion :** The two bones of fore or lower arm are radius and ulna.

Reason : Both bones are curved, with radius towards the side of the little finger, and ulna towards the thumb.

33. **Assertion :** Pelvic girdle is an irregular trough shaped bony complex consisting of two halves called innominates or coxals.

Reason : Innominates are joined together by freely movable pubic symphysis.

34. **Assertion :** Humerus and femur develop through calcification or ossification of cartilage.

Reason : Parietal and frontal develop in the dermis of skin as thin plates.

35. **Assertion :** Deficiency of dystrophin protein causes muscular dystrophy.

Reason : Dystrophin relays nerve impulses to the endoplasmic reticulum for release of Ca^{2+}.

36. **Assertion :** White muscle fibres are thick, broad and perform strenuous contractions.

Reason : They contain large number of mitochondria.

37. **Assertion :** Cori's cycle drains out lactic acid formed in muscle fibers, to prevent muscle fatigue.

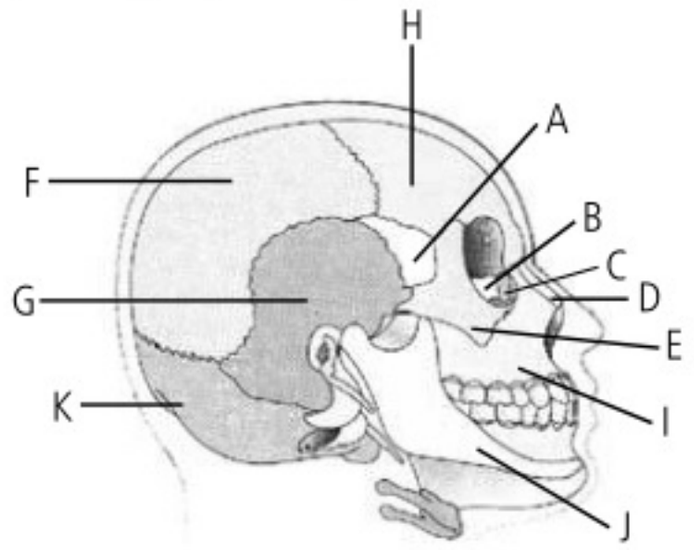
Reason : It regenerates glycogen and replenishes glucose to muscles.

38. **Assertion :** Increase in intensity of stimulus does not increase the contraction of the muscles.

Reason : Individual muscle fibers do not follow 'All or none law'.

Figure Based Questions

39. In the given figure, identify the bones A to K.



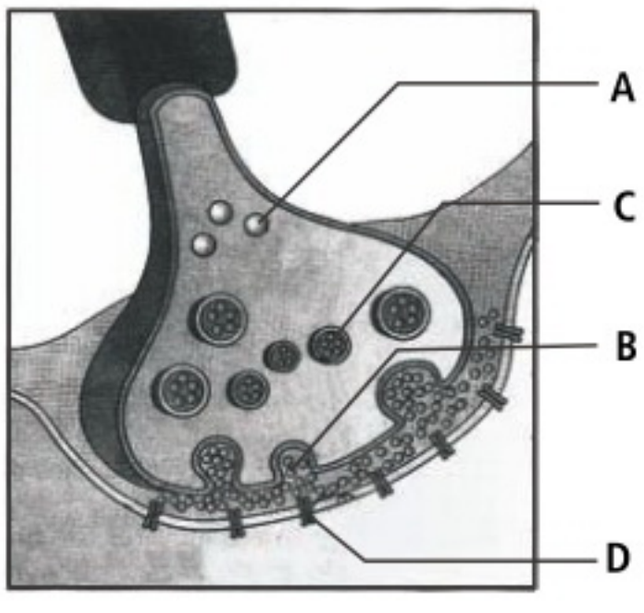
40. **(a)** Using the figure above, write down the letters for the bones of the cranium.

(b) Using the letters above, write down the letters for the facial bones.

CHAPTER-21 : NEURAL CONTROL AND COORDINATION

Multiple Choice Questions

1. The given diagram shows axon terminal. Select the option that correctly matches the steps in transmission of impulses (list i – vii) with the labellings (A – D) in diagram.



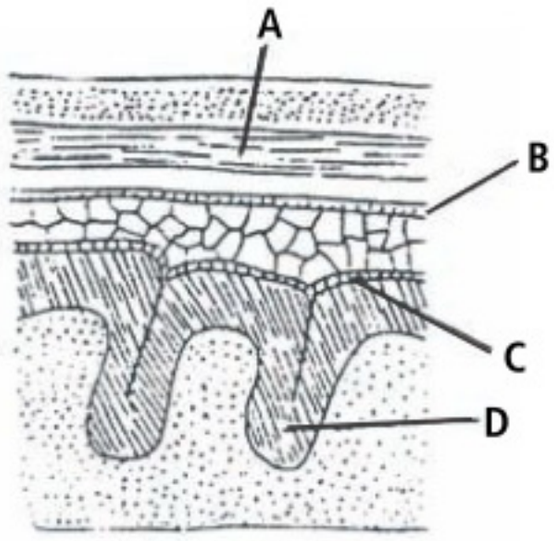
(i) Chemicals called neurotransmitters are released in the synaptic cleft through ion channels.
(ii) When an impulse arrives at the axon terminal, it stimulates the movement of synaptic vesicles.
(iii) Neurotransmitters are endocytosed into the neurons.
(iv) The ion channels close with the binding of neurotransmitters to their specific receptor vesicles.
(v) Synaptic vesicles move towards the membrane where they fuse with the plasma membrane.
(vi) Neurotransmitters are released in the synaptic cleft.
(vii) The released transmitters bind to their specific receptors on postsynaptic membrane.

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

2. Read the following five statements (i) to (v) regarding left cerebral hemisphere and select the option that correctly states the true (T) and false (F) statements.
(i) It receives most modalities of sensory information from the right side of the body.
(ii) It is usually larger than the right cerebral hemisphere.
(iii) It is the dominant cerebral hemisphere in most individuals.
(iv) It is connected to the right cerebral hemisphere by the corpus callosum.
(v) It contains the main areas for the understanding and production of speech in most individuals.

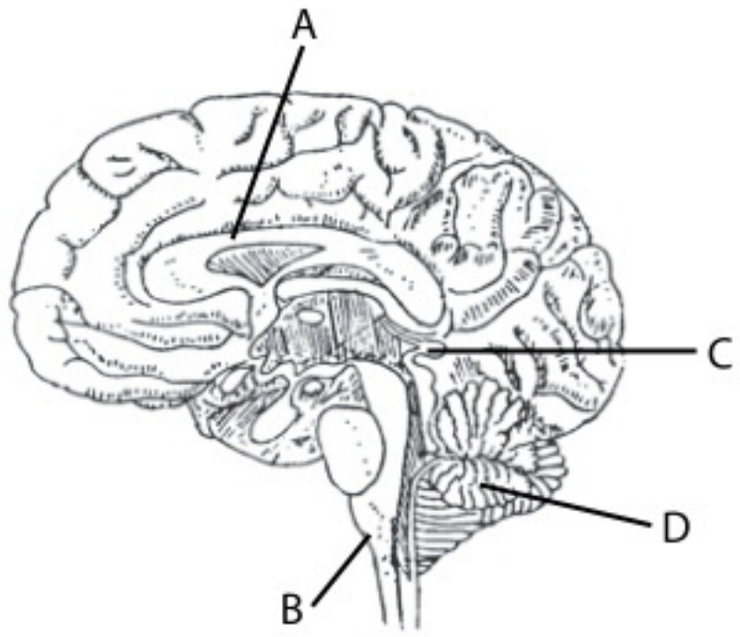
	(i)	(ii)	(iii)	(iv)	(v)
(a)	T	T	F	F	F
(b)	F	T	T	F	T
(c)	T	F	T	T	T
(d)	F	F	T	T	T

3. The given figure shows a section of brain. Identify the parts labelled as A, B, C and D and match them with the names (i – vii) given below.
(i) Arachnoid membrane
(ii) Subdural space
(iii) Duramater
(iv) Bone
(v) White matter
(vi) Grey matter
(vii) Piamater



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

4. Following is the figure of a saggital section of a human brain. Match the labelled parts with the respective statements given below and select the correct option.
(i) Consists of fibre tracts that interconnect left and right hemispheres
(ii) Secretes a hormone melatonin
(iii) Alcohol interferes with the function of this part
(iv) Contains centres which control respiration, cardiovascular reflexes and gastric secretions.



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

5. While travelling to higher altitudes, people can feel pain in the ear and dizziness. Which part, among the following is involved?
(a) Cochlea, ear ossicles
(b) Tympanic membrane
(c) Eustachian tube, utricle, saccule and semicircular canals
(d) None of the above

6. If a patient suffers a stroke that destroys the optic tract on the right side of the brain, which of the following visual defects will result ?
(a) There will be no vision in the left eye, but vision will be normal in the right eye.
(b) The patient will not perceive images of objects striking the left half of the retina in the left eye.
(c) The patient will not perceive images of objects striking the right half of the retina in the right eye.
(d) Neither eye will perceive objects in the right side of the patient's field of view.

7. Two neurons, A and B, synapse onto a third neuron, C. If neurotransmitter from A opens ligand-gated channels permeable to Na^+ and K^+ and neurotransmitter from B opens ligand-gated Cl^- channels, which of the following statements is true ?
(a) An action potential in neuron A causes a depolarization in neuron B.
(b) An action potential in neuron B causes a depolarization in neuron C.
(c) Simultaneous action potentials in A and B will cause hyperpolarization of neuron C.
(d) Simultaneous action potentials in A and B will cause less depolarization of neuron C than if only neuron A fired an action potential.

8. Which of the following is an example of conditioned reflex?
(a) Hand withdraws when pierced with a needle
(b) Eyes close, when anything enters into them
(c) During digestion, food goes forward in alimentary canal
(d) Trained dog salivates when you ring a bell

9. Read the given statements and select the correct ones.
(i) Autonomic neural system transmits impulses from the CNS to the voluntary organs and striated muscles of the body.
(ii) Unmyelinated nerve fibres do not have Schwann cells which form the myelin sheath.
(iii) Axonal membrane of a neuron, when not conducting any impulse, is comparatively more permeable to potassium ions (K^+) than to sodium ions (Na^+).
(iv) A synapse is formed by the membranes of a pre-synaptic neuron and a post synaptic neuron.
(a) (i) and (ii) (b) (ii) and (iii)
(c) (iii) and (iv) (d) (i) and (iv)

10. During the transmission of nerve impulse through a nerve fibre, the potential on the inner side of the plasma membrane has which type of electric charge?
(a) First positive, then negative and continue to be negative
(b) First negative, then positive and continue to be positive
(c) First positive, then negative and again back to positive
(d) First negative, then positive and again back to negative

11. The function of vagus nerve innervating the heart is to
(a) initiate the heart beat
(b) reduce the heart beat
(c) accelerate the heart beat
(d) maintain constant heart beat.

12. Refractory period comes in between
(a) resting potential and depolarization
(b) depolarization and repolarization
(c) action potential and depolarization
(d) two cycles of impulse conduction.

13. Column-I lists some disorders associated with brain. Column-II lists the causes for these disorders. Match the two columns and identify the correct option from those given

Column - I	Column - II
A. Epilepsy	p. Degeneration of neurons in the cerebral cortex
B. Alzheimer's disease	q. Irregular electrical disease in the neurons
C. Parkinson's disease	r. Decreased production of acetylcholine
D. Huntington's chorea	s. Degeneration of dopamine releasing neurons
	t. Formation of blood clots in the brain.

(a) A - t, B - s, C - r, D - p
(b) A - q, B - r, C - p, D - s
(c) A - q, B - r, C - s, D - p
(d) A - q, B - s, C - r, D - p

14. Under prolonged starvation, brain receives energy from
(a) carbohydrates
(b) fats
(c) proteins
(d) acetoacetate.

15. The nerve fibres that emerge from the taste bud pass to the brain stem through the
(a) olfactory and trigeminal nerves
(b) auditory and trigeminal nerves
(c) facial, glossopharyngeal and vagus nerves
(d) olfactory and abducens nerves.

True or False

16. Stapes is the smallest bone in the body and its foot plate covers fenestra ovalis.
17. The scala vestibuli and scala tympani are filled with endolymph and connected with each other through helicotrema.
18. Rhodopsin is composed of a protein called scotopsin and an aldehyde of vitamin A called retinal.
19. Less energy is required for saltatory conduction than for conduction along a nonmyelinated neuron.
20. Reflex action is important for survival of an organism and protects us from harmful situations.
21. Vagus nerve is the longest cranial nerve controlling visceral movements such as peristalsis, sound production, respiratory movements and heart beat.
22. Wernicke's area is located in both the right and left temporal lobes, and plays an important role in understanding speech and writing words.
23. Hypothalamus is the 'thermostat' of the body and keeps the body temperature at roughly 37°C.
24. The post-ganglionic fibers of both sympathetic and parasymphathetic neural system are cholinergic.
25. A sub threshold stimulus is unable to generate a nerve impulse, due to 'all or none' principle.

Match The Columns

26. Match Column-I with Column-II and select the correct option from codes given below.

Column-I	Column-II
A. Macula lutea	(i) Diencephalon
B. Anterior choroid plexus	(ii) Craniosacral
C. Sympathetic nervous system	(iii) Medulla
D. Trigeminal nerve	(iv) Geniculate ganglion
E. Facial nerve	(v) Gasserian ganglion
F. Parasympathetic nervous system	(vi) Thoracolumbar
G. Posterior choroid plexus	(vii) Fovea centralis

27. Match Column-I with Column-II and select correct options from codes given below. There can be more than one match for items in Column-1.

Column-I	Column-II
A. Cerebellum	(i) Mamillary bodies
B. Macula	(ii) Gyri
C. Organ of Corti	(iii) DA
D. Pinna	(iv) Utricle
E. Neurotransmiiter	(v) Cells of Hensen
F. Cerebral cortex	(vi) Helix
G. Limbic system	(vii) Cells of Claudius
	(viii) Saccule
	(ix) Arbor vitae
	(x) Septal nuclei
	(xi) Lobule
	(xii) Sulci
	(xiii) Golgi cells
	(xiv) NO

Passage Based Questions

28.(A) Complete the given passage with appropriate words or phrases.
Certain components of the (i), and (ii) constitute the limbic system. Its main components are (iii), which are present behind the infundibulum; (iv) which are scattered masses of grey matter; (v) which is almond shaped and located in the tip of the temporal lobe; (vi) which roughly resembles the sea horse and is located inside the temporal lobe, and (vii), which are located within the sepal area formed by the regions under corpus callosum and paraterminal gyrus.

(B) Read the passage and correct the errors, wherever present.
Pacinian corpuscles occur in the epidermis and are responsible for touch; while Krause's corpuscles are located in the papillary layer of dermis, just below epidermis, and respond to touch. Ruffini's corpuscles are excited by cold, while Meissner's corpuscles respond to heat.

Assertion & Reason

In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, mark the correct answer as :
(a) if both A and R are true and R is the correct explanation of A
(b) if both A and R are true but R is not the correct explanation of A
(c) if A is true but R is false
(d) if both A and R are false.

29. **Assertion :** In myelinated nerve fibers, Schwann cells form myelin sheath around the axon.

Reason : Myelinated nerve fibers are found in autonomic and somatic neural systems.

30. **Assertion:** Basal ganglia are the scattered masses of grey matter, submerged in the subcortical substance of cerebral hemispheres.

Reason : Parkinson's disease occurs due to the damage of the basal ganglia.

31. **Assertion :** Purkinje cells are among the most complex of all neurons.

Reason : These flask shaped cells lie in the middle layer of cerebrum.

32. **Assertion :** Sympathetic neural system constricts arteries and raises blood pressure.

Reason : It also speeds peristalsis and increases activity of the digestive tract.

33. **Assertion :** There are certain reflex actions in which an individual does not have any knowledge of the reflex actions.

Reason : Peristalsis of alimentary canal and beating of the heart are examples of such reflex actions.

34. **Assertion :** At an electrical synapse, there is continuity between the presynaptic and postsynaptic neurons.

Reason : The continuity is provided by tight junctions between the two neurons.

35. **Assertion :** In Alzheimer's disease (AD) patients, there is loss of neurotransmitter, ACh.

Reason : Drugs that inhibit AChE improve alertness in the patients.

36. **Assertion :** Nocieceptors respond to potentially damaging stimuli that result in pain.

Reason : Overstimulation of any receptor is painful, and over time, it starts functioning as nocieceptors.

37. **Assertion :** Cristae are present in the ampullae of semicircular canals.

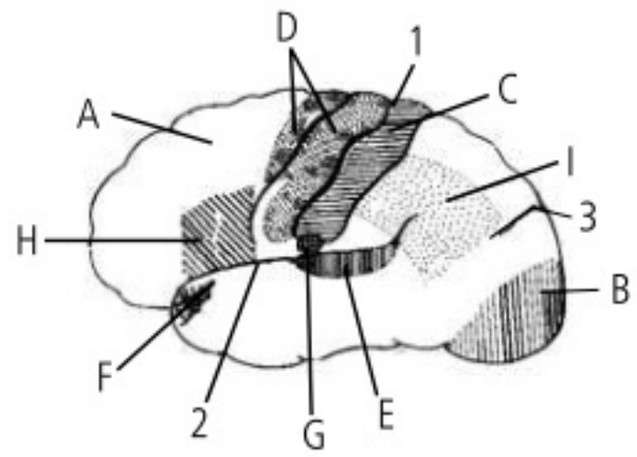
Reason : Each crista contains calcareous ear stones called otolith.

38. **Assertion :** In an action potential, the interior of neuron is electropositive and the exterior is electronegative.

Reason : There is an active sodium potassium pump operating.

Figure Based Questions

39. In the given figure, identify the areas marked A to I.

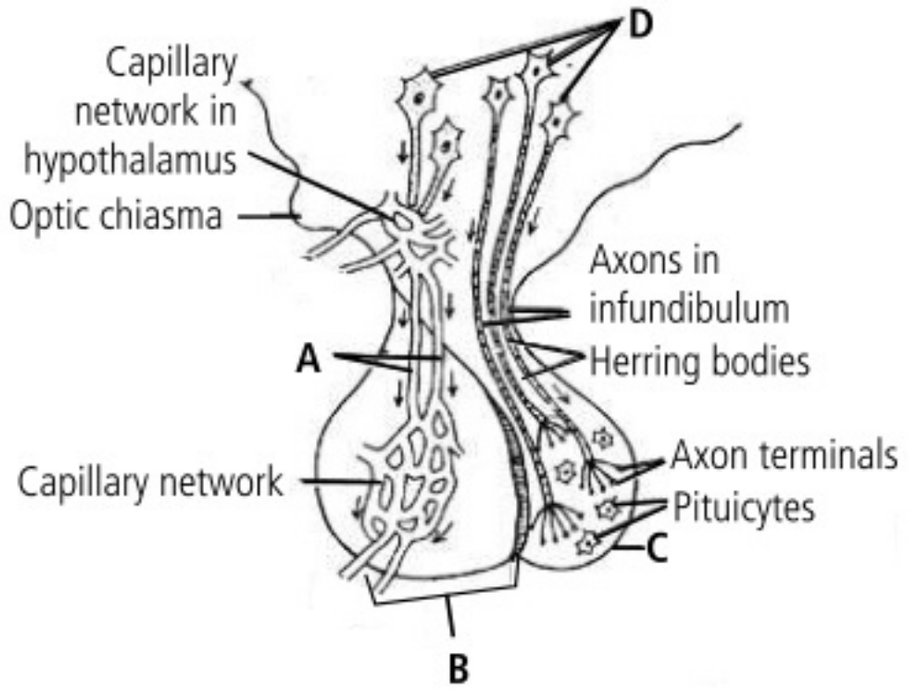


40. Observe the figure again and identify 1, 2 and 3.

CHAPTER-22 : CHEMICAL COORDINATION AND INTEGRATION

Multiple Choice Questions

1. Refer to the given figure of pituitary gland and select the correct options for the question that follows.



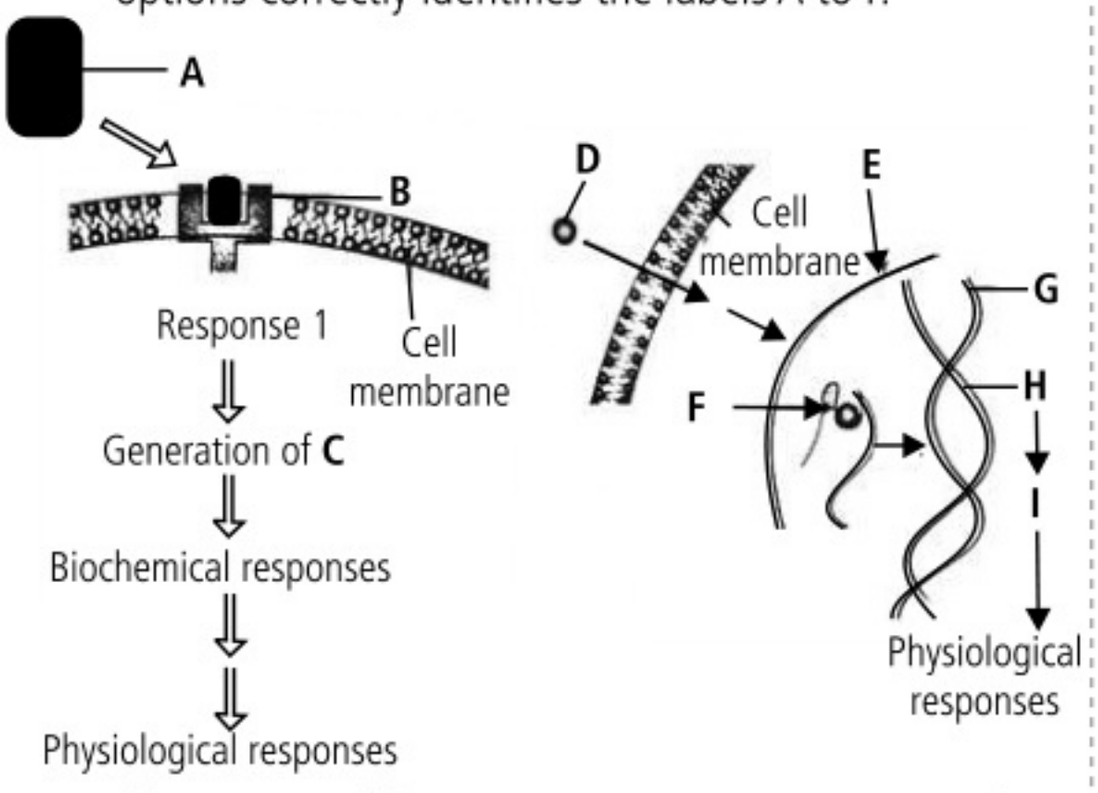
What will be the effect if part C is been removed?
(a) Oxytocin and ADH will not be synthesized.
(b) Oxytocin and ADH will be synthesized but could not be stored.
(c) Only synthesis of oxytocin will occur.
(d) Only synthesis of ADH will occur.

2. Select the correct matching of a hormone, its source and function.

	Hormone	Source	Function
(a)	Vasopressin	Posterior pituitary	Increases loss of water through urine
(b)	Norepinephrine	Adrenal medulla	Increases heart beat, rate of respiration and alertness
(c)	Glucagon	β-cells of islets of Langerhans	Stimulates glycogenolysis
(d)	Prolactin	Posterior pituitary	Regulates growth of mammary glands and milk formation in females

3. A patient of diabetes mellitus excretes glucose in urine even when he is kept on a carbohydrate free diet. It is because
   (a) fats are catabolised in adipose tissues to form glucose
   (b) amino acids are catabolised in kidney to form glucose
   (c) amino acids are discharged in blood stream from liver
   (d) glycogen from muscles is released in blood stream.

4. The given diagram represents the mechanism of action for two categories of hormones. Which of the following options correctly identifies the labels A to I?



   (a) A - Steroid hormone, B - Receptor, C - Secondary messenger, D - Non-steroid hormone, E - Nucleus, F - Hormone-receptor complex, G - Genome, H - *m*RNA, I - Protein
   (b) A - Non-steroid hormone, B - Receptor, C - Secondary messenger, D - Steroid hormone, E - Nucleus, F - Hormone-receptor complex, G - Genome, H - *m*RNA, I - Protein
   (c) A - Steroid hormone, B - Receptor, C - Primary messenger, D - Non-steroid hormone, E - Nucleus, F - Hormone-receptor complex, G - Genome, H - *m*RNA, I - Protein
   (d) A - Steroid hormone, B - Enzyme, C - Secondary messenger, D - Non-steroid hormone, E - Nucleus, F - Hormone-receptor complex, G - Genome, H - *m*RNA, I - Protein

5. The source of somatostatin is same as that of
   (a) thyroxine and calcitonin
   (b) insulin and glucagon
   (c) somatotropin and prolactin
   (d) vasopressin and adrenaline.

6. Identify from the following, a hormone produced by the pituitary gland in both males and females but functional only in females.
   (a) Vasopressin
   (b) Relaxin
   (c) Prolactin
   (d) Somatotropic hormone

7. What is correct to say about the hormone action in humans?
   (a) Glucagon is secreted by β-cells of islets of Langerhans and stimulates glycogenolysis.
   (b) Secretion of thymosin is stimulated with aging.
   (c) In females, FSH first binds with specific receptors on ovarian cell membrane.
   (d) FSH stimulates the secretion of estrogen and progesterone.

8. Which one of the following is not the function of insulin?
   (a) Increases the permeability of cell membrane to glucose
   (b) Increases the oxidation of glucose in the cells
   (c) Initiates the conversion of glycogen to glucose
   (d) Initiates the formation of hepatic glycogen from excess of glucose

9. Match Column-I with Column-II and select the correct option from the codes given below.

	Column-I		Column-II
A.	ANF	(i)	Regulates blood calcium levels
B.	MSH	(ii)	Decreases blood pressure
C.	GIP	(iii)	Pigmentation
D.	TCT	(iv)	Inhibits gastric secretion

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

10. Estrogen and testosterone are steroid hormones, and most likely bind to
   (a) membrane ion channels
   (b) enzyme-linked membrane receptors
   (c) G-protein coupled membrane receptors
   (d) cytoplasmic receptors.

11. Prostaglandins have no role in
   (a) inflammatory and allergic reactions
   (b) blood clotting
   (c) smooth muscle contraction
   (d) conduction of nerve impulses.

12. A man is admitted to a hospital. He is suffering from an abnormally low body temperature, loss of appetite and extreme thirst. His brain scan would probably show a tumour in
(a) cerebellum
(b) hypothalamus
(c) medulla oblongata
(d) pons.

13. In the homeostatic control of blood sugar level, which organs function respectively as modulator and effector?
(a) Liver and islets of Langerhans
(b) Hypothalamus and liver
(c) Hypothalamus and islets of Langerhans
(d) Islets of Langerhans and hypothalamus

14. Rapid increase in the blood sugar level of a patient can be immediately reduced by
(a) injecting insulin intravenously
(b) injecting insulin intramuscularly
(c) administering glucagon intravenously
(d) consuming large quantities of insulin tablets.

15. Which of the following endocrine gland stores its secretions in the extracellular space before discharging it into the blood?
(a) Pancreas (b) Adrenal
(c) Testis (d) Thyroid

True or False

16. T_4 is more active and several times more potent than T_3.
17. Deficiency of iodine leads to thyroid enlargement.
18. Excess of PTH causes demineralisation and softening of bones resulting in osteoporosis.
19. Cortisol is used for treatment of allergy as it causes production of lymphocytes to suppress allergy.
20. Adrenal medulla forms about 75% of adrenal gland and is simply an extension of the sympathetic nervous system.
21. The dairy owners inject synthetic oxytocin or pitocin, into their cows and buffaloes, to increase milk yield.
22. Calcitriol is the active form of calciferol.
23. Leukotrienes (LTs) are mediators of allergic as well as inflammatory responses.
24. All hormones regulate gene expression or chromosome function by the interaction of hormone-receptor complex with the genome.
25. The pituitary hormones oxytocin and ADH are synthesized in the hypothalamus.

Match The Columns

26. Match Column-I with Column-II and select the correct option from codes given below.

Column-I	Column-II
A. Cortisol	(i) Adrenal medulla
B. Glucagon	(ii) PTH
C. Chromaffin cells	(iii) Stress hormone
D. Oxyphil cells	(iv) Glucocorticoids
E. Zona fasciculata	(v) Emergency hormone
F. Epinephrine	(vi) Mineralocorticoids
G. Zona glomerulosa	(vii) Anti-insulin

27. Match Column-I with Column-II and select correct options from codes given below. There can be more than one match for items in Column-1.

Column-I	Column-II
A. Pancreas	(i) Antidiuretic effect
B. Pitressin	(ii) D cells
C. Kidney	(iii) Cushing's syndrome
D. Parathyroid	(iv) Erythropoietin
E. Small intestine	(v) Collip's hormone
F. Adrenal cortex	(vi) GIP
G. Thyroid	(vii) C cells
	(viii) Thyrocalcitonin
	(ix) Calcitriol
	(x) VIP
	(xi) Calcitonin
	(xii) Pressor effect
	(xiii) F cells
	(xiv) Conn's syndrome

Passage Based Questions

28.(A) Complete the given passage with appropriate words or phrases.

(i) is secreted by the (ii) of brain, (iii) cells of islets of Langerhans in the pancreas and (iv) cells of digestive tract. It inhibits secretion of (v) from anterior lobe of pituitary.

(B) Read the passage and correct the errors, wherever present.

Cushing's syndrome is caused by excess of mineralocorticoids and sexcorticoids. It is also caused by tumour of adrenal cortex. Its symptoms include high blood sugar, high K^+ plasma, high Na^+ plasma and increased urinary Na^+.

Assertion & Reason

In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, mark the correct answer as :

(a) if both A and R are true and R is the correct explanation of A

(b) if both A and R are true but R is not the correct explanation of A

(c) if A is true but R is false

(d) if both A and R are false.

29. **Assertion :** Simmond's disease is characterised by premature ageing and dry, wrinked skin.

Reason : It is caused due to atrophy of anterior lobe of pituitary gland.

30. **Assertion:** Melatonin concentration in the blood rises in the evening through the night, and drops to a low around noon.

Reason : It is believed to act as a 'biological clock' and produce circadian rhythms.

31. **Assertion :** Insulin is an anabolic hormone.

Reason : It promotes protein synthesis from amino acids.

32. **Assertion :** Pregnant women generally experience increase in shoe size.

Reason : It is due to the secretion of relaxin by the placenta, during pregnancy.

33. **Assertion :** Excessive development of male mammary glands is called gynaecomastia.

Reason : Deficiency of testosterone in later life may cause gynaecomastia.

34. **Assertion :** Sexual pseudoprecocity in girls is due to tumours of ovaries and adrenal glands resulting in excess secretion of oestrogen.

Reason : It is characterised by breast formation, early appearance of pubic hair, maturation and discharge of ova.

35. **Assertion :** Pineal gland starts to calcify at the time of puberty resulting in brain sand.

Reason : Brain sand is believed to be indicative of increased secretory activity.

36. **Assertion :** Thymus gland weighs about 10-15 gm at birth, continues to grow till puberty-becoming 30-40 gm and then undergoes atrophy at mid-adult life, weighing only about 10gm.

Reason : Hassall's corpuscles in the thymus are responsible for its atrophy.

37. **Assertion :** Prostaglandins (PGs) cause contraction of smooth muscles.

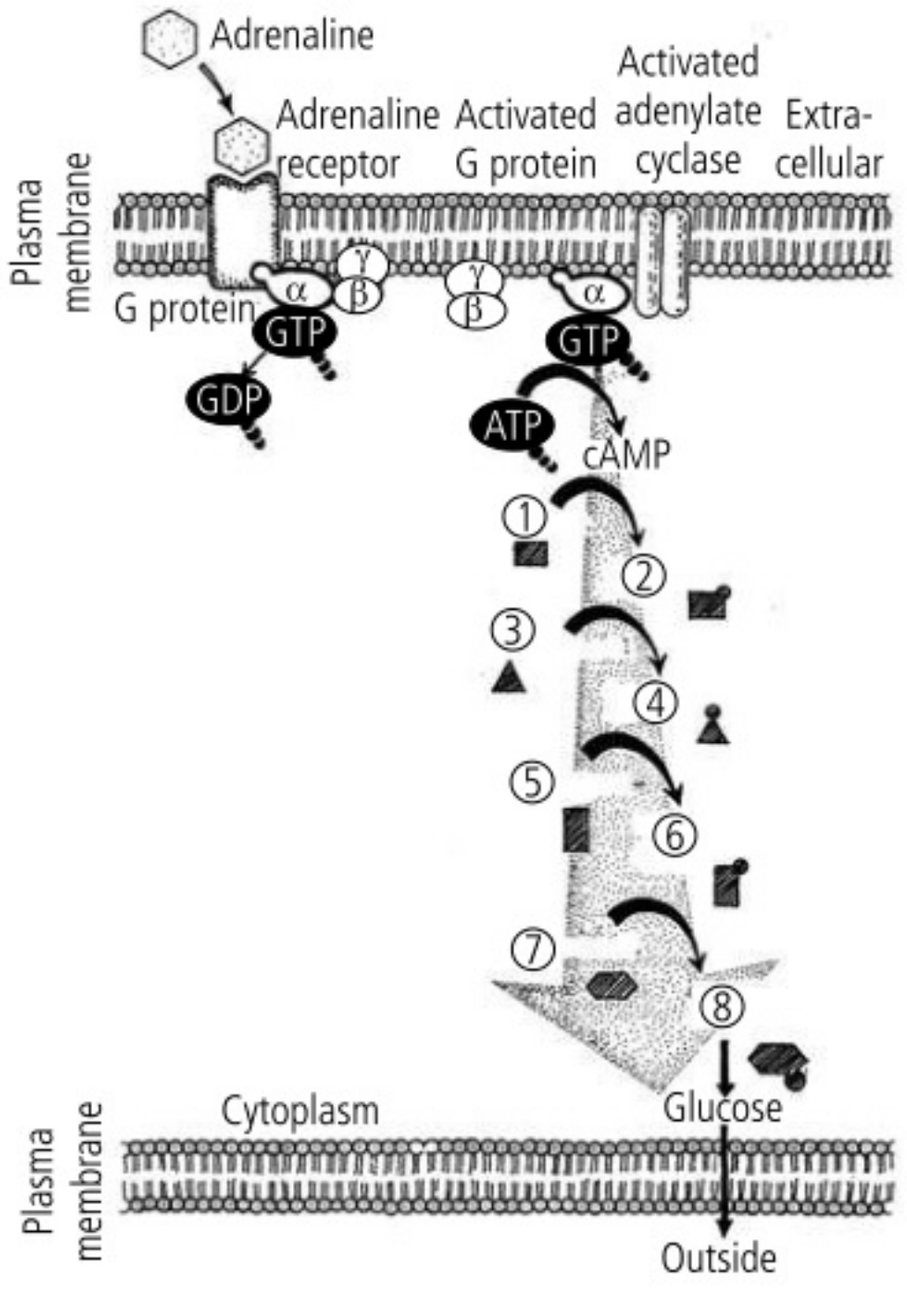
Reason : They cause contraction of uterine muscles to facilitate ascending of sperms into fallopian tubes.

38. **Assertion :** A hormone which stimulates pituitary to secrete its hormone is called trophic hormone.

Reason : The thyrotrophic hormone stimulates pituitary to secrete its hormone.

Figure Based Questions

39. In the given figure, showing role of cAMP in hormone action, identify ① to ⑧.



40. State the level of amplification at the following stages.

(i) At ② :

(ii) At ④ :

(iii) At ⑥ :

(iv) At ⑧ :

SOLUTIONS

CHAPTER-16 : DIGESTION AND ABSORPTION

1. (d) 2. (b) 3. (c) 4. (c) 5. (c)
6. (c) 7. (c) 8. (a) 9. (a) 10. (b)
11. (c) 12. (a) 13. (c) 14. (d) 15. (a)

16. **False.** Muscularis is formed by smooth muscles usually arranged into an inner circular and an outer longitudinal layer.

17. **True** 18. **True**

19. **False.** Carbohydrates in the chyme are hydrolysed by pancreatic amylase into disaccharides.

20. **False.** The lymph vessels ultimately release the absorbed substances into the blood stream.

21. **False.** Only 30% of starch is hydrolysed in the mouth.

22. **False.** Intrinsic factor is essential for absorption of vitamin B_{12} only.

23. **False.** The three pairs of salivary glands are parotids, sub-maxillary or submandibular and sublingual.

24. **True** 25. **True**

26. A-(vi), B-(iii), C-(vii), D-(v), E-(iv), F-(i), G-(ii)

27. A-(v, viii), B-(i, xiv), C-(ii, xi), D-(iii, xiii), E-(iv, xii), F-(vi, x), G-(vii, ix)

28.(A) (i) Fatty acids, (ii) glycerol, (iii) micelles, (iv) chylomicrons, (v) lymph vessels or lacteals.

(B)

Macro-nutrient	Gross calorific value Kcal/gm	Physiologic value Kcal/gm
Carbohydrate	4.1	4
Protein	5.65	4
Fat	9.45	9

29. (a) 30. (b) 31. (c) 32. (d) 33. (c)
34. (c) 35. (d) 36. (c) 37. (c) 38. (c)

39. A - Hepatopancreatic ampulla
B - Main pancreatic duct
C - Sphincter of Oddi
D - Bile duct
E - Sphincter of Boyden

40. (i) D; (ii) B; (iii) A; (iv) ampulla of Vater; (v) C; (vi) E; (vii) D; (viii) B.

CHAPTER 17 : BREATHING AND EXCHANGE OF GASES

1. (c) 2. (c) 3. (d) 4. (a) 5. (a)
6. (b) 7. (b) 8. (a) 9. (b) 10. (c)
11. (c) 12. (b) 13. (c) 14. (a) 15. (a)

16. **True**

17. **False.** Residual volume is 1100 mL to 1200 mL.

18. **False.** It is increase in H^+ concentration and decrease in pH.

19. **True**

20. **False.** It is 5mL of oxygen transported to the tissues under normal physiological conditions.

21. **True**

22. **False.** CO_2 diffuses 20 times faster than oxygen.

23. **True**

24. **False.** An increase in thoracic volume decreases the pressure resulting in negative pressure.

25. **False.** It adds moisture and humidifies the air.

26. A-(vii), B-(v), C-(i), D-(vi), E-(ii), F-(iii), G-(iv)

27. A-(i, xi), B-(v, x), C-(vi, ix), D-(vii, viii), E-(iv, xii), F-(iii, xiii), G-(ii, xiv)

28.(A) (i) 20.84%, (ii) 13.6%, (iii) 15.7%, (iv) 0.03-0.04%, (v) 5.3%, (vi) 3.6-4.0%.

(B) In tissues, PO_2 blood is ~~45mm Hg~~ 95mm Hg, that of interstitial fluid is ~~45mm Hg~~ 40mm Hg, while in cells around, it is ~~32mm Hg~~ 23mm Hg. The blood leaving the tissue capillaries has PO_2 equal to ~~45mm Hg~~ 40mm Hg. However, nearly ~~50-55%~~ 70-75% of haemoglobin is still in oxygenated form.

29. (c) 30. (c) 31. (b) 32. (a) 33. (c)
34. (b) 35. (c) 36. (b) 37. (d) 38. (a)

39. A - Inspiratory capacity
B - Residual volume
C - Inspiratory reserve volume
D - Vital capacity
E - Expiratory reserve volume
F - Functional residual capacity

40. 1. (i) (D); 2. (ii) (D) (iii) B; 3. (iv) C; 4. (v) E; 5. (vi) D; (vii) B

CHAPTER 18 : BODY FLUIDS AND CIRCULATION

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

11. (a) **12.** (d) **13.** (d) **14.** (d) **15.** (d)

16. **True**

17. **False.** It is due to displacement of tricuspid valve into right ventricle.

18. **False.** P wave represents depolarisation which leads to contraction of both atria.

19. **True** **20.** **True**

21. **False.** Left atrium receives oxygenated blood from gills/ lungs/skin and right atrium gets deoxygenated blood from body.

22. **True**

23. **False.** 70% of blood enters passively in ventricles without being pumped.

24. **True** **25.** **True**

26. A-(vi), B-(vii), C-(i), D-(ii), E-(iii), F-(v), G-(iv)

27. A-(i, vii), B-(viii, xiii), C-(iv, xi), D-(ii, xiv), E-(v, ix), F-(vi, x), G-(iii, xii)

28.(A) (i) PQ, (ii) P, (iii) R, (iv) AV, (v) Q, (vi) R.

(B) Blood is slightly ~~acidic~~ alkaline with pH ~~6.8~~ 7.4. It forms ~~55%~~ 30-35% of the total ECF or ~~16-18%~~ 6-8% of the total body weight.

29. (a) **30.** (c) **31.** (b) **32.** (b) **33.** (c)
34. (b) **35.** (a) **36.** (c) **37.** (b) **38.** (a)

39. A-Cisterna chyli B-Thoracic duct
C-Right lymphatic duct D-Left subclavian vein
E-Right subclavian vein

40. **(a)** (i) B; (ii) A; (iii) first, (iv) second, (v) D
(b) (vi) C; (vii) E

CHAPTER-19 : EXCRETORY PRODUCTS AND THEIR ELIMINATION

1. (c) **2.** (d) **3.** (a) **4.** (a) **5.** (a)
6. (c) **7.** (b) **8.** (c) **9.** (d) **10.** (b)
11. (c) **12.** (a) **13.** (d) **14.** (c) **15.** (b)

16. **False.** It operates mostly in liver cells.

17. **False.** Amniotes have a posterior kidney called metanephros.

18. **True**

19. **False.** It is breakdown product of phospho-creatinine.

20. **True** **21.** **True** **22.** **True** **23.** **True** **24.** **True**

25. **False.** It is excreted as ammonium ions (NH_4^+)

26. A-(vi), B-(i), C-(vii), D-(ii), E-(v), F-(iii), G-(iv)

27. A-(iv, xiii), B-(ii, xi), C-(i, xii), D-(iii, x), E-(v, xiv), F-(vi, ix), G-(vii, viii)

28.(A) (i) increase, (ii) increase (iii) ANF or atrial natriuretic factor (iv) Renin (v) JGA, (vi) Na^+, (vii) water.

(B) The ~~rise~~ decrease/fall in blood pressure due to ~~increase~~ decrease/fall in blood volume will stimulate the ~~glomerular cells~~ juxtaglomerular cells / JG cells to release ~~angiotensin II~~ renin, which converts ~~angiotensin II~~ angiotensinogen to ~~angiotensinogen~~ angiotensin I and further to ~~angiotensin I~~ angiotensin II.

29. (a) **30.** (b) **31.** (a) **32.** (b)
33. (b) **34.** (a) **35.** (a) **36.** (a)
37. (a) **38.** (d)

39. A-Collecting duct; B-Distal convoluted tubule;
C-Ascending limb of loop of Henle;
D-Proximal convoluted tubule;
E-Descending limb of loop of Henle.

40. (i) B, C, D; (ii) B,D; (iii) B, D; (iv) B, D;
(v) A, B, D, E; (vi) B, D.

CHAPTER-20 : LOCOMOTION AND MOVEMENT

1. (b) **2.** (b) **3.** (d) **4.** (b) **5.** (c)
6. (c) **7.** (a) **8.** (b) **9.** (b) **10.** (b)
11. (c) **12.** (d) **13.** (a) **14.** (b) **15.** (b)

16. **False.** It has active ATPase enzyme.

17. **False.** It is the sliding of thin filaments over thick filaments.

18. **True** **19.** **True**

20. **False.** Skin is multi-unit smooth muscle, while ureter is single unit.

21. **True**

22. **False.** It is located in the dorsal part of thorax.

23. **False.** The longest is quadriceps femoris, while the largest is gluteus maximus.

24. **True** **25.** **True**

26. A-(vi), B-(vii), C-(iv), D-(v), E-(ii), F-(iii), G-(i)

27. A-(v, xiv), B-(i, xiii), C-(ii, xi), D-(iv, vi), E-(vii, x), F-(iii, ix), G-(viii, xii)

28.(A) (i) F (filamentous) actins, (ii) F actin, (iii) G (globular) actin, (iv) Tropomyosin, (v) F actin, (vi) Troponin, (vii) Tropomyosin.

(B) Densely stained ~~M~~ Z lines bisect the I bands. A sarcomere has, therefore, one A band and two half ~~A~~ I bands. The central part of each A band has a

variable ~~Ƶ~~ H or Hensen's line. T tubules of mammalian striated muscle fibers occur at the junction of ~~M~~ A and I band.

29. (d) 30. (a) 31. (c) 32. (c)
33. (c) 34. (b) 35. (a) 36. (c)
37. (b) 38. (d)

39. A-Sphenoid; B-Ethmoid; C-Lacrimal; D-Nasal; E-Zygomatic; F-Parietal; G-Temporal; H-Frontal; I-Maxilla; J-Mandible; K-Occipital.

40. **(a)** A, B, F, G, H, K
(b) C, D, E, I, J

CHAPTER-21 : NEURAL CONTROL AND COORDINATION

1. (c) 2. (c) 3. (c) 4. (d) 5. (c)
6. (c) 7. (d) 8. (d) 9. (c) 10. (d)
11. (b) 12. (b) 13. (c) 14. (d) 15. (c)

16. **False.** It covers fenestra rotunda.

17. **False.** Perilymph is present in scala vestibuli and scala media.

18. **True** 19. **True** 20. **True** 21. **True**

22. **False.** Wernicke's area is located in the left temporal lobe.

23. **True**

24. **False.** The preganglionic fibers of both sympathetic and parasympathetic are cholinergic.

25. **False.** Two or more sub-threshold stimuli, when applied simultaneously, can cause contraction due to summation.

26. A-(vii), B-(i), C-(vi), D-(v), E-(iv), F-(ii), G-(iii)

27. A-(ix, xiii), B-(iv, viii), C-(v, vii), D-(vi, xi), E-(iii, xiv), F-(ii, xii), G-(i, x)

28.(A)(i) Cerebrum, (ii) Diencephalon, (iii) Mamillary bodies, (iv) Basal ganglia, (v) Amygdala, (vi) Hippocampus, (vii) Septal nuclei.

(B) ~~Pacinian corpuscles~~ Merkel's discs occur in the epidermis and are responsible for touch; while ~~Krause's corpuscles~~ Meissner's corpuscles are located in the papillary layer of dermis just below epidermis, and respond to touch. ~~Ruffin's corpuscles~~ Krause's corpuscles are excited by cold, while ~~Meissner's corpuscles~~ Ruffini's corpuscles respond to heat.

29. (c) 30. (b) 31. (c) 32. (c)
33. (b) 34. (c) 35. (b) 36. (b)
37. (c) 38. (c)

39. A-Promotor area; B - Visual area; C - Postcentral sensory area; D - Precentral motor area; E - Auditory area; F-Olfactory area; G-Taste area; H-Motor speech area; I-Sensory speech area.

40. 1. Central sulcus 2. Lateral cerebral sulcus
3. Association area

CHAPTER-22 : CHEMICAL COORDINATION AND INTEGRATION

1. (b) 2. (b) 3. (a) 4. (b) 5. (b)
6. (c) 7. (c) 8. (c) 9. (d) 10. (d)
11. (d) 12. (b) 13. (c) 14. (a) 15. (d)

16. **False.** T_3 is more active and potent than T_4.

17. **True** 18. **True**

19. **False.** It causes suppression or inhibition of lymphocytes.

20. **False.** It forms 25% of the adrenal gland.

21. **True**

22. **False.** It is the cholecalciferol or vitamin D_3.

23. **True**

24. **False.** It is the steroid hormones through intracellular receptors.

25. **True**

26. A-(iii), B-(vii), C-(i), D-(ii), E-(iv), F-(v), G-(vi)

27. A-(ii, xiii), B-(i, xii),C-(iv, ix), D-(v, xi), E-(vi, x), F-(iii, xiv), G-(vii, viii)

28.(A)(i) SS or Somatostatin, (ii) Hypothalamus, (iii) Delta cells, (iv) Argentaffin, (v) Somatotropin.

(B) ~~Cushing's syndrome~~ Addison's disease is caused by ~~excess~~ deficiency of mineralocorticoids and ~~sexcorticoids~~ glucocorticoids. It is also caused by ~~tumour~~ destruction of adrenal cortex. Its symptoms include ~~high~~ low blood sugar, high K^+ plasma, ~~high~~ low Na^+ plasma and increased urinary Na^+.

29. (a) 30. (a) 31. (a) 32. (a)
33. (b) 34. (c) 35. (b) 36. (c)
37. (a) 38. (d)

39. ① - Inactive protein kinase A; ② - Active protein kinase A; ③ - Inactive phosphorylase kinase; ④ - Active phosphorylase kinase; ⑤ - inactive glycogen phosphorylase; ⑥ - Active glycogen phosphorylase; ⑦ - Glycogen; ⑧ - Glucose 1-phosphate.

40. (i) 10^2 (ii) 10^4 (iii) 10^6 (iv) 10^8.

NCERT Xtract

New

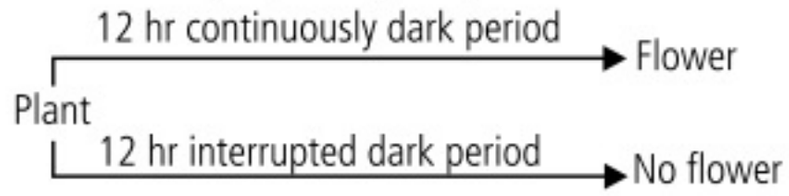
Questions for PMTs

Plant Growth and Development

1. A primary root grows from 5 cm to 19 cm in a week. Calculate the actual growth rate (AGR) and relative growth rate (RGR) over the period.

	AGR	RGR
(a)	14 cm	2.8
(b)	14 cm	3.8
(c)	3.8 cm	14
(d)	24 cm	2.8

2. In which category will you place this flower?



Choose the correct option.

(a) SDP (b) LDP
(c) DNP (d) L-SDP

3. Which of the following is correct match for Column I and Column II?

	Column - I		Column - II
A.	*Xanthium*	(i)	Its flower opens at higher temperature
B.	*Crocus*	(ii)	Earlier and higher yield of crop can be obtained by keeping its seeds at low temperature between 1 to 10°C
C.	Millet	(iii)	Growth regulator can be obtained from one part of it
D.	Coconut	(iv)	It produces flower, when period of light available is less than critical period
		(v)	It is an example of photonasty
		(vi)	It produces flower, when period of light available is more than critical period

(a) A - (iv), B - (ii), C - (vi), D - (i)
(b) A - (vi), B - (i), C - (ii), D - (iii)
(c) A - (iv), B - (i), C - (ii), D - (iii)
(d) A - (iv), B - (v), C - (vi), D - (i)

4. Which one is the example of dedifferentiation?

(a) Precambium and vascular cambium
(b) Cork cambium and interfascicular cambium
(c) Cork cambium and vascular cambium
(d) Procambium and cork cambium

5. Match the following column.

	Column - I	Column - II
A.	Human urine	(i) Cytokinin
B.	*Gibberella fujikori*	(ii) Auxin
C.	Herring sperm DNA	(iii) Ethylene
D.	Ripening fruit	(iv) ABA
E.	Aging leaves of plants	(v) GA

(a) A - (ii), B - (iii), C - (iv), D - (v), E - (i)
(b) A - (ii), B - (v), C - (i), D - (iii), E - (iv)
(c) A - (i), B - (ii), C - (iii), D - (iv), E - (v)
(d) A - (v), B - (iv), C - (iii), D - (ii), E - (i)

6. In the expression, $W_1 = W_0e^{rt}$ (exponential growth), W_1, W_0, r, t represents.

	W_0	W_1	r	t
(a)	Initial size	Final size	Growth rate	Time of growth
(b)	Final size	Initial size	Growth rate	Time of growth
(c)	Final size	Initial size	Growth rate	Time of dividing
(d)	Initial size	Final size	Growth rate	Time of dividing

7. Which of the above mentioned PGR are acidic in nature? Choose the correct option accordingly.

I. Auxin II. Cytokinin
III. GA IV. ABA
(a) I and II (b) I, III and IV
(c) I, II and III (d) I, II, III and IV.

8. Temperature required for vernalisation is
   (a) 5°C to 10°C
   (b) 5°C to 15°C
   (c) 0°C to 5°C
   (d) 3°C to 17°C.

9. The phytohormone which induces triple response is
   (a) IAA (b) ABA
   (c) GA_3 (d) C_2H_4.

10. The common biosynthetic inhibitor of gibberellic acid is
   (a) rosic acid
   (b) jasmonic acid
   (c) citric acid
   (d) lactic acid.

11. Gibberellic acid induces flower
   (a) in short day plants under long day conditions
   (b) in day-neutral plants under dark conditions
   (c) in some gymnospermic plants only
   (d) in long day plants under short day conditions.

12. Differentiation of shoot is controlled by
   (a) high auxin : cytokinin ratio
   (b) high cytokinin : auxin ratio
   (c) high gibberellin : auxin ratio
   (d) high gibberellin : cytokinin ratio.

13. Plasticity in plant growth means that
   (a) plant roots are extensible
   (b) plant development is dependent on the environment
   (c) stems can extend
   (d) none of the above.

14. Match the following:

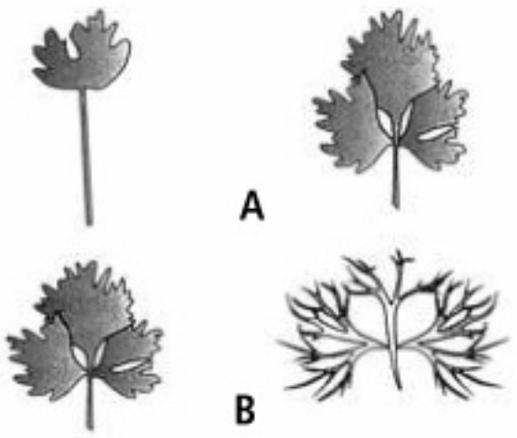
Column - I	Column - II
A. IAA	(i) Coconut milk
B. ABA	(ii) Bolting
C. Ethylene	(iii) Stomatal closure
D. GA	(iv) Weed-free lawns
E. Cytokinins	(v) Ripening of fruits

   (a) A-(iv), B-(iii), C-(v), D-(ii), E-(i)
   (b) A-(v), B-(iii), C-(iv), D-(ii), E-(i)
   (c) A-(iv), B-(i), C-(iv), D-(iii), E-(ii)
   (d) A-(v), B-(iii), C-(ii), D-(i), E-(iv)

15. To increase sugar production in sugarcanes, they are sprayed with
   (a) IAA (b) cytokinin
   (c) gibberellin (d) ethylene.

16. Which of the following hormones does not occur naturally in plants ?
   (a) GA (b) ABA
   (c) 2, 4-D (d) IAA

17. Diagram A and B indicate the shape of leaves in larkspur and buttercup respectively. Which of the given options is correct for A and B?



   (a) The juvenile and adult leaves of larkspur differ in size due to genetic and plant growth regulator factors.
   (b) Both leaves of buttercup differ in size due to genetic and intercellular factors.
   (c) Both larkspur and buttercup leaf size variation is due to habitat plasticity.
   (d) None of the above.

18. Parthenocarpic development of fruit is brought about by
   (a) NAA, 2-T (b) 2, 4-D
   (c) NAA, 2, 4-D (d) 2, 4, 5-T.

19. To speed up the malting process in brewing industry the growth hormone used is
   (a) auxin (b) gibberellin
   (c) kinetin (d) ethylene.

20. Which among the following is not a function of cytokinins?
   (a) Essential for cytokinesis during cell division
   (b) Delays the senescence of leaves
   (c) Helps in fruit ripening
   (d) Helps to overcome apical dominance

21. The most abundant naturally occurring plant hormone is
   (a) indole-3 acetic acid (b) ABA
   (c) cytokinin (d) IBA.

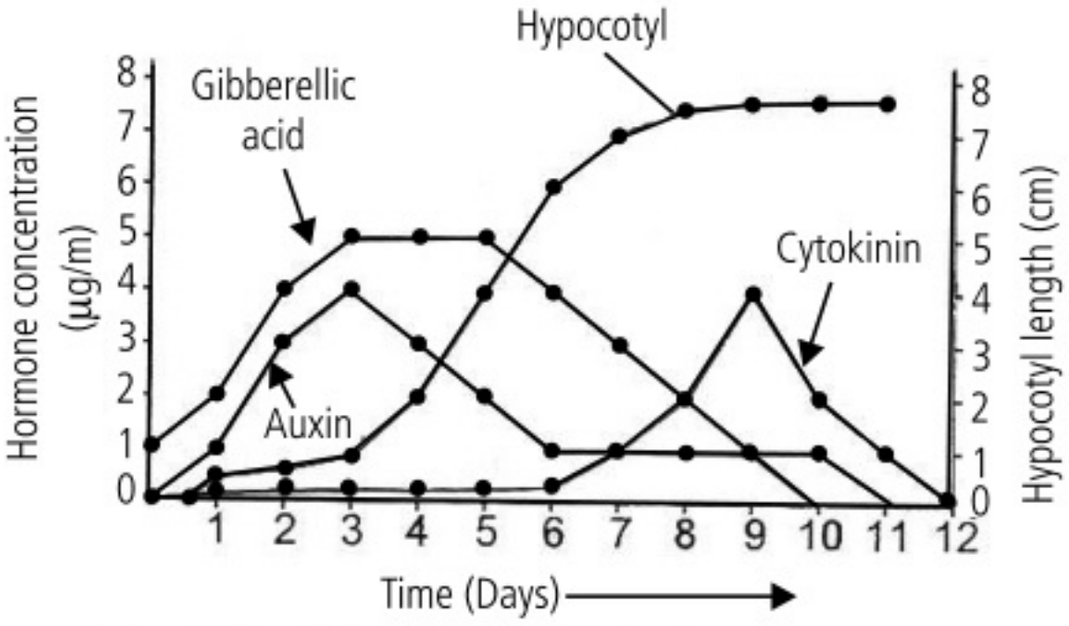
22. In plants, auxin synthesis occurs in
   (a) cortex (b) phloem cells
   (c) xylem cells (d) root and shoot tips.

23. Cytokinins are mostly
   (a) glucosides (b) phenolics
   (c) amino-purines (d) organic acids.

24. Cytokinins help to produce all except
(a) new leaves
(b) chloroplast in leaves
(c) lateral shoot growth and adventitious shoot formation
(d) rooting on cut stem.

25. Natural cytokinins are synthesized in regions where rapid cell division occurs. Such regions are
(a) root apices
(b) developing shoot buds
(c) young fruits
(d) all of these.

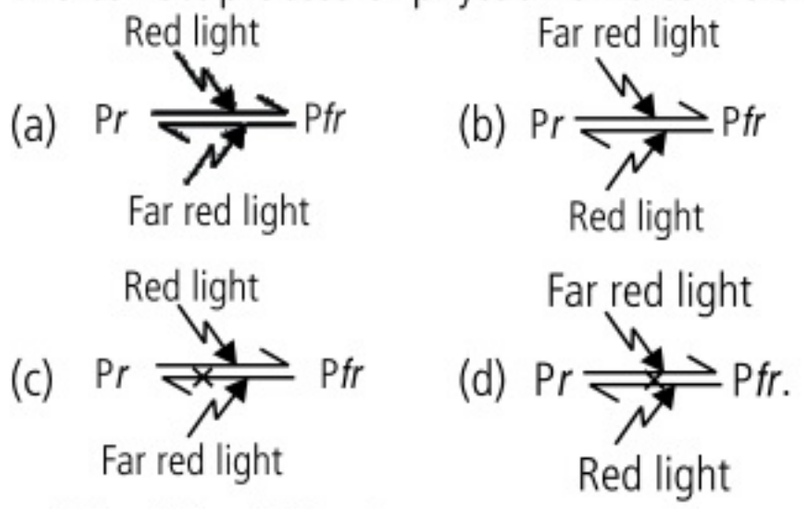
26. Plant hormones play a role in regulating seed germination. The graph shows changes in hormone concentrations (left axis) and hypocotyl growth (right axis) over time for moong bean. Which hormone(s) most likely regulates hypocotyl (bean sprout) growth during moong bean germination?



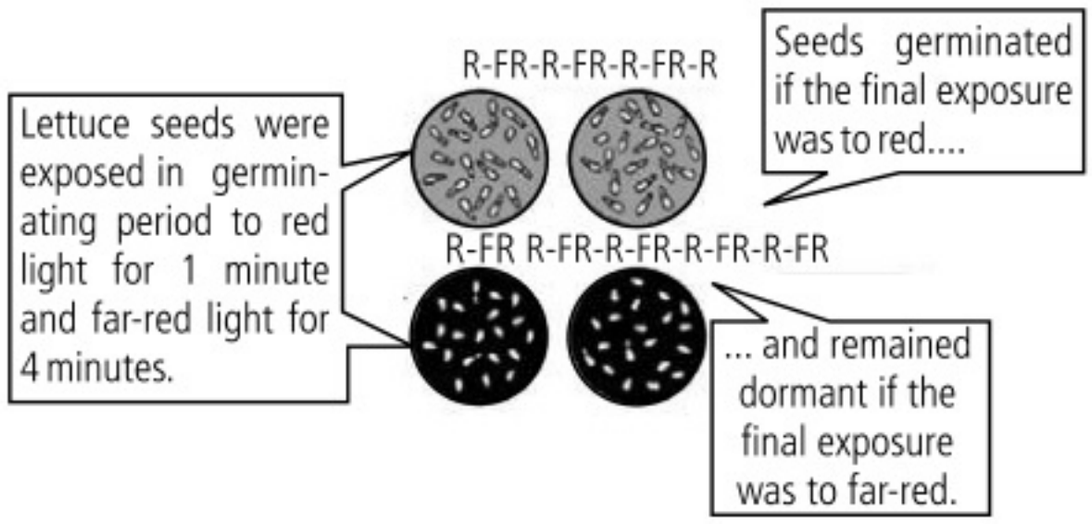
(a) Gibberellic acid (b) Auxin
(c) Cytokinin alone (d) Both (a) and (b)

27. A store placed a large basket of fruit containing oranges and unripe bananas by the cash register. There were too many bananas to fit in the basket, so they put the rest in the back room. The next day, the bananas in the basket had ripened, but the ones in the back room had not. What is the most likely explanation?
(a) The heat in the store had accelerated the ripening process.
(b) The cytokinins in the oranges diffused into the bananas where the two fruits touched each other and triggered the bananas to ripen.
(c) The auxin in the oranges diffused into the bananas where the two fruits touched each other and triggered the bananas to ripen.
(d) The oranges had released ethylene into the air, which triggered the bananas to ripen.

28. The correct process of phytochrome conversion is

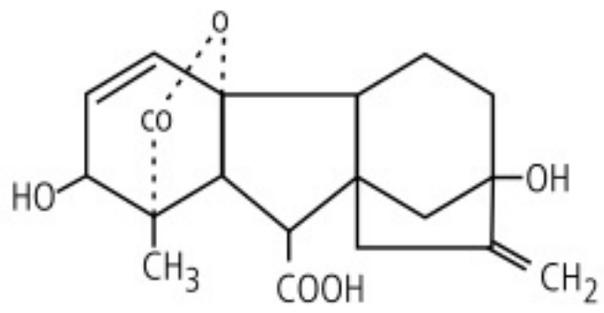


29. Which of the following statements are true about the experiment shown in the figure ?



(a) The red light inhibits seed germination.
(b) The photoreceptor is cryptochrome.
(c) The active form is the red-light absorbing form.
(d) None of these.

30. Select the correct option regarding the phytohormone to which the given molecular structure belongs.



(a) The hormone promotes femaleness in most flowers.
(b) The hormone promotes apical dominance.
(c) The hormone usually decreases the size of stem, leaves, flowers and fruits.
(d) The hormones breaks seed dormancy by synthesis of certain enzymes.

31. A young dicot seedling (*e.g.*, soyabean) is laid horizontally on a surface and is subjected to gravity stimulus. The shoot bends in upward direction and the root bends in downward direction. Which out of the following is the possible reason for this movement?
(a) Redistribution of auxins throughout the seedlings is responsible for the stimulatory unequal growth in shoots and roots.

(b) Redistribution of cytokinins throughout the seedlings is responsible for the stimulatory unequal growth in roots and shoots.
(c) Redistribution of auxins in roots and cytokinins in shoots is responsible for stimulatory unequal growth.
(d) Redistribution of auxins in shoots and cytokininis in roots is responsible for stimulatory unequal growth.

32. Match List I with List II and select the correct answer by using the codes given below the lists.

List I	List II
A. Low concentrations of ABA	1. Germination promoter
B. Kinetin	2. Dormancy breaker
C. Chloroethanol	3. Germination inhibitor
D. Gibberellins	4. Induction of sprouting in potato tuber

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

33. Plastochronic changes are more discernible in
(a) root apex (b) shoot apex
(c) leaf apex (d) all of the above.

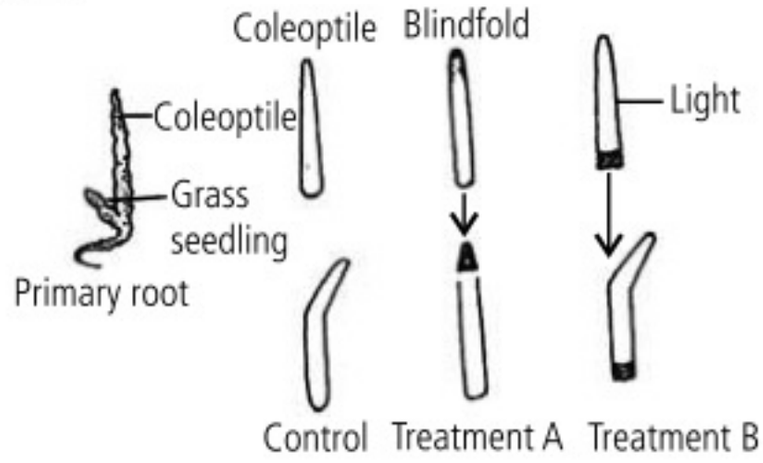
34. If a dark period of a short day plant is interrupted by a flash of light, it will
(a) flower immediately
(b) produce many flowers
(c) produce abnormal flowers
(d) not produce flowers.

35. Which of the following is incorrectly matched?
(a) Explant → Excised plant part used for callus formation
(b) Cytokinin → Root initiation in callus
(c) Somatic embryo → Embryo produced from a vegetative cell
(d) Anther culture → Haploid plants



HIGHER ORDER THINKING SKILLS QUESTIONS (HOTS)

36. Charles Darwin and his son, Francis experimented with phototropism of grass seedlings by placing a metal foil blindfold over different parts of the seedling's coleoptile. A simplified version of their results is shown below. Which of the following statements best explains their results?



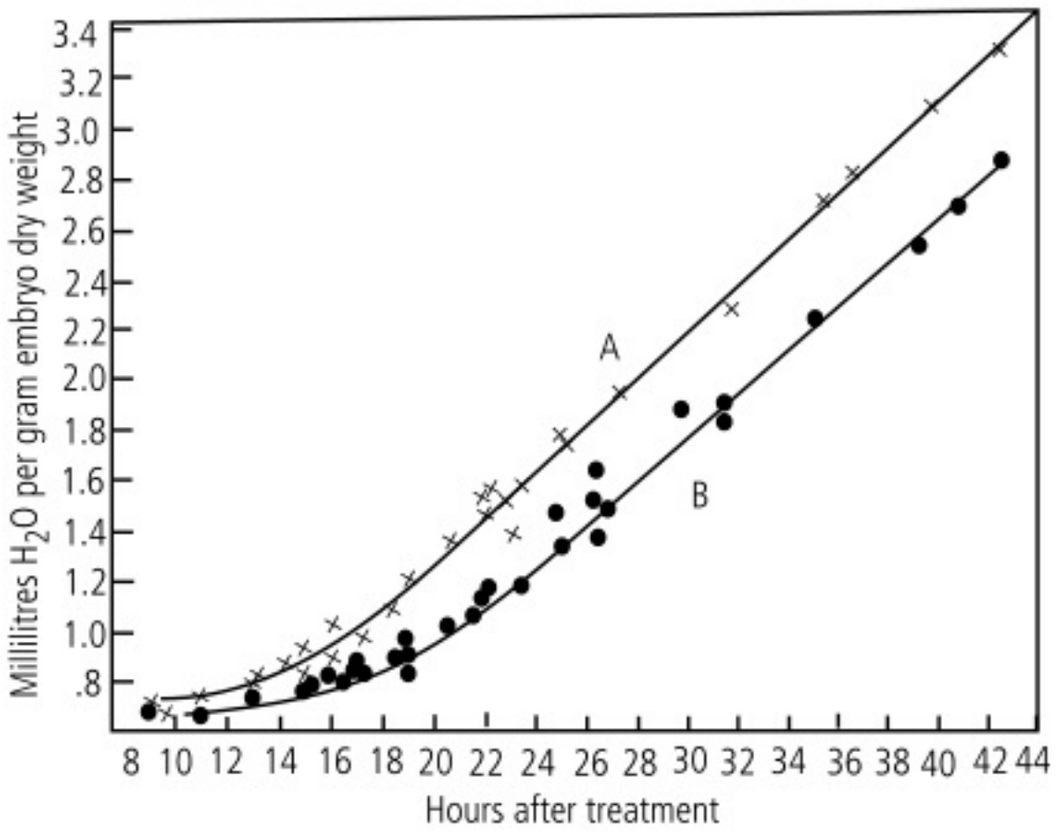
(a) The light signal is perceived a few millimetres below the tip, and these cells cause the coleoptile to grow toward the light.
(b) Both the seedling root and coleoptile perceive and respond to light in the same manner.
(c) A chemical messenger must travel from the base of the coleoptile to the tip.
(d) The light signal is perceived at the tip of the coleoptile, but the growth response occurs a few millimetres below the tip.

37. In 1926, the Japanese biologist Eiichi Kurosawa showed that the bakanae ("foolish seedling") disease of rice was caused by a substance produced by the fungus *Gibberella fujikori*. The substance was named gibberellin and was shown to cause elongation of stem tissues. Which of the following statements about gibberellin is false?
(a) Pea plants carrying the dwarf mutation would be expected to have higher levels of gibberellin in their stems than normal plants.
(b) If gibberellin is applied to the stems of dwarf pea plants, the stems elongate so that plant reach normal height.
(c) Dwarf pea plants have a mutation in the gibberellin biosynthetic pathway.
(d) Normal pea plants respond to gibberellin by growing even taller.

38. Which of the given statements is not true w.r.t. Cholodny-Went model?
(a) Acceleration of growth on shaded side accompanies retardation of growth on the irradiated side.

(b) Illumination from one side causes transport of auxin towards the shaded side.
(c) Auxin differential accounts for the growth differential observed in plants.
(d) Auxin movement is polar, being basipetal in both stem and root.

39. Given below is graph showing the growth of lettuce embryos in darkness, red and far red light. Identify the correct statements pertaining to A and B on the basis of the given graph.



(a) A shows the growth in darkness, while B refers to growth in far red light.
(b) A shows growth in red light, while B shows growth in darkness.
(c) A represents growth in darkness, while B represents growth in red light.
(d) A represents growth in far red light, while B represents growth in red light.

40. X and Y are two phytohormones. Given below are statements pertaining to them.
On the basis of the given statements, identify the correct code w.r.t. to X and Y.
(i) X causes abscission, but does so, much less effectively than exogenous Y.
(ii) X has no direct role in abscission, but causes premature senescence, which in turn promotes production of Y.
(iii) It is Y and not X, which is the initiator of the actual abscission process.
(a) X refers to ABA and Y refers to ethylene.
(b) X refers to ethylene and Y refers to ABA.
(c) X refers to ABA and Y refers to dormin.
(d) Given information is inadequate.

ANSWER KEY

1.	(a)	**2.**	(a)	**3.**	(c)	**4.**	(b)	**5.**	(b)
6.	(a)	**7.**	(b)	**8.**	(c)	**9.**	(d)	**10.**	(b)
11.	(d)	**12.**	(b)	**13.**	(b)	**14.**	(a)	**15.**	(c)
16.	(c)	**17.**	(b)	**18.**	(c)	**19.**	(b)	**20.**	(c)
21.	(a)	**22.**	(d)	**23.**	(c)	**24.**	(d)	**25.**	(d)
26.	(d)	**27.**	(d)	**28.**	(a)	**29.**	(d)	**30.**	(d)
31.	(a)	**32.**	(c)	**33.**	(b)	**34.**	(d)	**35.**	(b)

Higher Order Thinking Skills Questions (HOTS)

36.	(d)	**37.**	(a)	**38.**	(d)	**39.**	(b)	**40.**	(a)

Contributed by : Sourav Mahapatra, West Bengal

SOLUTIONS TO DECEMBER 2014 CROSSWORD

A	R	C	H	E	G	O	N	I	U	M	B	E	L	■
B	I	O	T	I	N	E	U	T	R	O	P	H	I	L
S	O	M	A	T	I	C	C	H	O	R	O	I	D	A
A	M	P	U	L	L	A	E	Y	T	P	I	N	R	C
P	R	O	G	E	N	Y	L	M	I	H	K	G	O	T
O	O	S	P	O	R	E	L	U	F	O	I	E	S	A
A	N	T	I	G	E	N	U	S	E	G	L	S	O	T
P	A	S	T	E	U	R	S	C	R	E	O	T	P	I
A	M	P	H	I	B	I	A	U	A	N	T	I	H	O
V	E	N	A	T	I	O	N	L	D	O	H	O	I	N
D	I	A	L	Y	S	I	S	A	U	M	E	N	L	Y
P	R	O	M	O	T	E	R	R	L	E	R	■	A	M
A	M	P	H	I	O	X	U	S	A	■	M	■	■	P
J	U	R	A	S	S	I	C	A	R	P	A	L	■	H
A	R	T	E	R	Y	U	N	I	P	O	L	A	R	■

Crossword Feedback

- **Sattwik Sindhu, West Bengal (*Winner of November month crossword*)**
  The 'Crossword' is very well compiled; covering a variety of topics on the syllabus. Students appearing for competitive examinations will surely be benefited by solving it. I personally admire this attempt from the MTG authority.
- **Nikhil Garg, Bhiwani (HR)**
  This crossword helps me a lot in quick review of whole of my syllabus. So, it is the best type of crossword I had ever seen.
- **Shrikrishna Bhat, Karnataka**
  The crossword really helps to improve our knowledge, please continue this.
- **Parth Jakasamiya, Gujarat**
  Crossword kicks my mind and it is best way to gain knowledge.
- **Pratriti Jain, U.P.**
  I love to solve the crossword published every month.

PRACTICE PROBLEMS 2Q15

Biology Olympiad

1. Which one of the following is made up of only one type of macromolecule?

(a) Virus (b) Plasmid
(c) Ribosome (d) Nucleosome

(INBO 2009)

2. A recessive allele in homozygous condition causes dwarfism. In a mainland population, this condition is known to occur in 1 out of 1000 individuals. Among the tribal population of 12,000 individuals living on a nearby island, this condition is known to occur in 1 in14 individuals. All these individuals are descendents of 30 people who migrated from the mainland to the island. This is an example of

(a) bottleneck effect (b) founder effect
(c) non-random mating (d) natural selection.

(INBO 2009)

3. In recombinant DNA technology, a promoter sequence helps in

(a) modifying the transgene
(b) integration of foreign gene in host DNA
(c) recognising and cutting the specific gene
(d) expressing the transgene at right time and place.

(NSEB 2009-10)

4. A plant biochemist received a specimen from a fellow scientist who noticed that the plant's stomata are closed during the day. The biochemist observed that radioactive carbon in the form of carbon dioxide, fed to the plant at night, was first found in organic acids that accumulate in the vacuole. During the day it moved to sugars being manufactured in the chloroplast. What was the conclusion of the biochemist?

(a) The plant fixes carbon by crassulacean acid metabolism (CAM).
(b) The plant is a C_4 plant.
(c) The plant is a C_3 plant.
(d) The plant is using mitochondria as chloroplasts.
(e) The carbon fixation reactions occur in different cells.

(IBO 2002)

5. What is the correct sequence of events during immunological responses to viral infection?

Code

1. Natural killer cell activation
2. Antibody production
3. Cytotoxic T cell activation
4. Virus invasion

Time ⟶

(a) 4, 2, 3, 1
(b) 1, 4, 3, 2
(c) 3, 2, 1, 4
(d) 4, 1, 3, 2
(e) 4, 3, 2, 1

(IBO 2002)

6. In a plant, genes A, B and C control the flower colour, height and position of the flowers, respectively. Study the following genotypes and corresponding phenotypes:

AA ⟶ red flower,
aa ⟶ white flower,
Aa ⟶ pink flower,
B– ⟶ tall plant,
bb ⟶ dwarf plant
C– ⟶ axillary flower and
cc ⟶ terminal flower,

If AabbCC and aaBbCc are crossed, what proportion of plants would be tall, have pink and axillary flowers in the progeny?

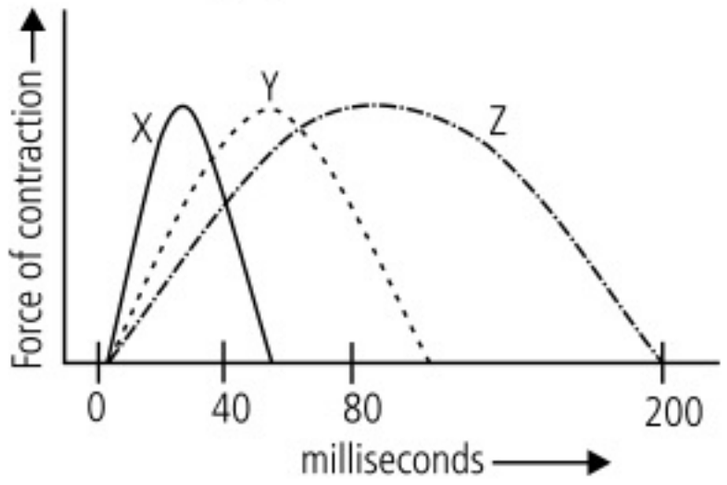
(a) 25% (b) 50%
(c) 75% (d) 100%

(INBO 2013)

7. Consider three different types of mammalian skeletal muscles:

(i) Ocular muscle
(ii) Soleus muscle (involved in continual support of body against gravity)
(iii) Gastrocnemius muscle (involved in velocity of limb movements)

Muscle contraction properties of these muscles are depicted in the graph.

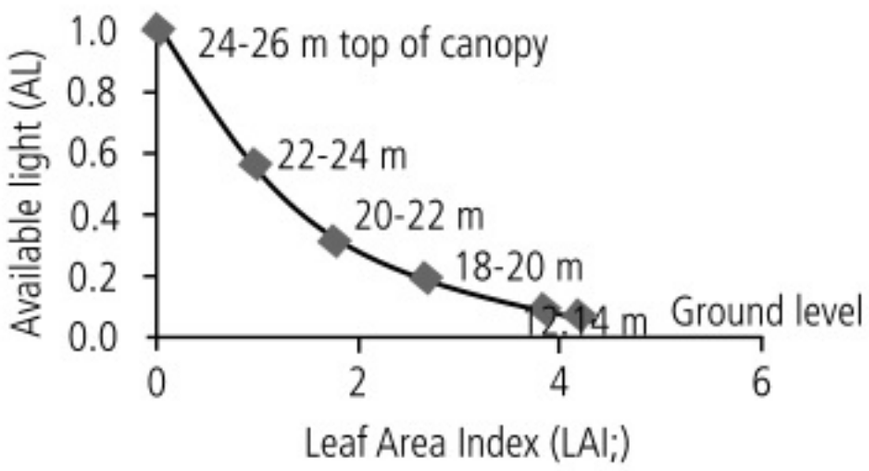


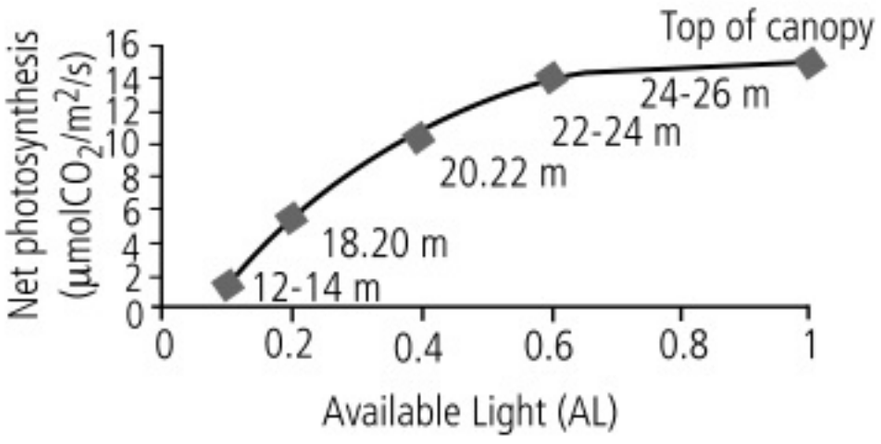
The muscles represented by X, Y and Z are

(a) X:(i) Y:(ii) Z:(iii) (b) X:(ii) Y:(i) Z:(iii)
(c) X:(iii) Y:(ii) Z:(i) (d) X:(i) Y:(iii) Z:(ii)

(INBO 2012)

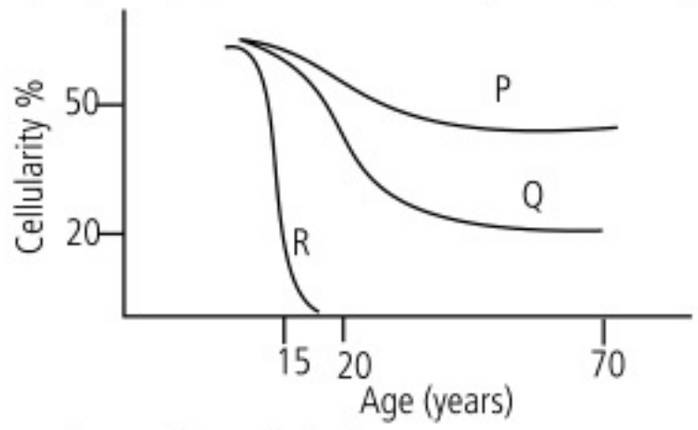
8. The following figures show the relationship between the available light as a proportion of photosynthetically active radiation (PAR) at the top of the canopy and leaf area index (LAI). They also show the relationship between net photosynthesis and available light. Which of the following statements would be true for these figures?





(a) The quantity of PAR is highest at the top of the canopy.
(b) A major fraction of total photosynthesis occurs at the top of the canopy.
(c) There is a linear positive correlation between LAI and net photosynthesis.
(d) The decrease in the intensity of light in the lower part of the canopy is fully compensated by larger leaves. *(INBO 2013)*

9. Relative rates of red blood cell production in the bone marrow of different bones at different ages are shown in the graph. P, Q and R are likely to be, respectively

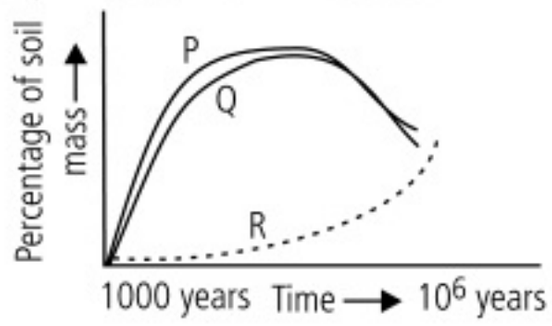


(a) vertebra, rib and tibia
(b) femur, carpal and rib
(c) tibia, fibula and femur
(d) radius, sternum and carpal. *(INBO 2009)*

10. A piece of skull showing a thecondont and diphyodont dentition was discovered in a cave. It must be of which of the following animals ?

(a) Salamander (b) Monitor lizard
(c) Man (d) Platypus *(NSEB 2009-10)*

11. Soil formation is a slow and continuous process. Following graph indicates soil composition over time. In this graph P, Q and R must be:



(a) P: Biomass Q: Clay R: Humus
(b) P: Humus Q: Biomass R: Clay
(c) P: Clay Q: Humus R: Biomass
(d) P: Biomass Q: Humus R: Clay *(INBO 2012)*

12. Which of the following animals are likely to have more esters of unsaturated fatty acids in the cell membranes?

(i) Cold blooded animals
(ii) Warm blooded animals living in cold climate
(iii) Warm blooded animals living in hot climate

(a) (i) and (ii) (b) (ii) and (iii)
(c) only (i) (d) only (ii) *(NSEB 2009)*

13. All Ca^{2+} in the physiologically balanced salt solution, in which a nerve muscle preparation was kept, had got precipitated. On stimulating the nerve you would expect

(a) stronger contraction of skeletal muscle
(b) no contraction of skeletal muscle
(c) muscle going into titany
(d) contraction of skeletal muscle after a time lapse.

(NSEB 2014)

14. Read the following description of a plant cell type. "These are elongated tapering cells with cross walls, secondary thickenings with pits and are dead at maturity".
Which of the following is the correct statement about the function of cells described?
(a) They are the main food conducting cells of flowering plants.
(b) They are the main water conducting cells of flowering plants.
(c) They serve to protect the plants and retard water loss.
(d) They conduct water in all vascular plants.
(INBO 2012)

15. Which of the following is closer to the centre of a woody stem?
(a) Vascular cambium (b) Primary phloem
(c) Secondary phloem (d) Secondary xylem
(e) Primary xylem *(IBO 2002)*

16. Kiran was born with 6 toes on each foot, a dominant trait called polydactyly, due to the allele D. Two of her five siblings and her mother have extra digits but not her father. The genotypes of Kiran and her mother respectively are
(a) DD and DD (b) Dd and Dd
(c) Dd and DD (d) DD and Dd.
(NSEB 2009)

17. A student while studying the anatomy of leaves of four specimens (P - S), observed the following characters:
P. Reticulate venation and no bundle sheath.
Q. Parallel venation and bundle sheath containing chloroplasts.
R. Reticulate venation and bundle sheath containing chloroplasts.
S. Parallel venation and bundle sheath without chloroplasts.
Identify the type of plants.
(a) P and R are C_4 dicots, while Q and S are C_4 monocots.
(b) P and R are C_3 dicots, while Q and S are C_3 monocots.
(c) P and S are C_3 dicot and monocot, respectively, while Q and R are C_4 monocot and dicot, respectively.
(d) P and S are C_4 dicot and monocot, respectively, while Q and R are C_3 monocot and dicot, respectively.
(INBO 2013)

18. A few statements about the mechanism of evolution are made. Mark the correct statements.
(i) Evolution occurs at the individual level as well as population level.
(ii) As changes in the gene pool occur, a population evolves.
(iii) Mutation is the driving force of evolution and it leads to change in a gene pool of population.
(iv) Genetic drift is the change in the gene pool that occurs in a small population due to adaptation.
(v) Assortative mating can cause an increase in homozygous individuals and changes the allele frequencies in the population.
(a) (i) and (ii) (b) (ii) and (iii)
(c) (i), (iv) and (v) (d) (i), (ii), (iii) and (v)
(INBO 2013)

19. Papain is a whole dried product obtained from the latex of unripe green papaya fruit. It is used in food industries, confectionary, meat and brewing industries because
(a) it contains proteolytic enzyme and other components useful for product manufacture.
(b) it adds sweetness to products.
(c) papain is antibiotic and kills contaminating microorganisms.
(d) all of the above. *(INBO 2002)*

20. Following are some statements regarding the primary and secondary antibody response in humans. All the statements are correct except
(a) lag period (time between the introduction of antigen and appearance of antibodies in blood) in primary response is longer than that in secondary response.
(b) predominant iso-type produced in primary response is IgM while that in secondary response is IgG.
(c) primary antibodies have a higher affinity for antigen as compared to secondary antibodies.
(d) thymus independent antigens produce only IgM type of antibodies in both primary and secondary response. *(INBO 2002)*

ANSWER KEY

1.	(b)	**2.**	(b)	**3.**	(d)	**4.**	(a)	**5.**	(d)
6.	(a)	**7.**	(d)	**8.**	(a)	**9.**	(a)	**10.**	(c)
11.	(d)	**12.**	(a)	**13.**	(b)	**14.**	(d)	**15.**	(e)
16.	(b)	**17.**	(c)	**18.**	(b)	**19.**	(a)	**20.**	(c)

ANSWERS *WHO AM I ...*

1. Allochemics Pg. 33
2. Competition Pg. 36

CBSE BOARD 2015

UNITWISE PRACTICE PAPER

SERIES- 5

- Organisms and Populations
- Ecosystem
- Biodiversity and Conservation
- Environmental Issues

GENERAL INSTRUCTIONS

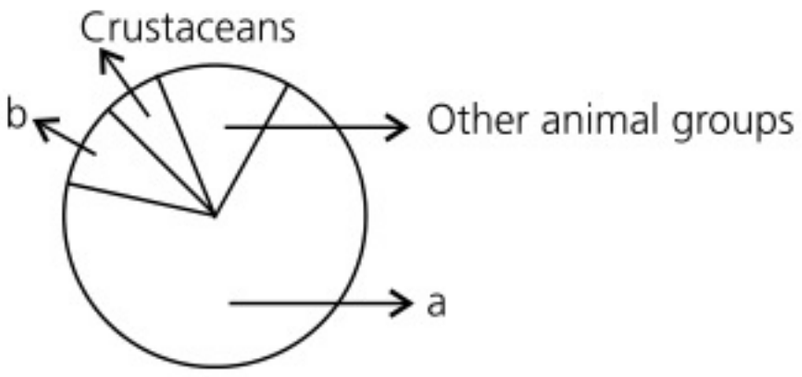
(i) All questions are compulsory.

(ii) This question paper consists of five Sections A, B, C, D and E. Section A contains 5 questions of one mark each. Section B is of 5 questions of two marks each, Section C is of 12 questions of three marks each. Section D is of 1 question of four marks and Section E is of 3 questions of five marks each.

(iii) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.

(iv) Wherever necessary, the diagrams drawn should be neat and properly labelled.

SECTION - A

1. How do herbs and shrubs survive under the shadow of big canopied trees in forests?
2. What do you mean by standing crop and standing state?
3. 

Name the unlabelled areas 'a' and 'b' of the pie chart (given above) representing the global biodiversity of invertebrates showing the proportionate number of species of major taxa.
4. What percentage of global warming is contributed by the following gases?
(i) Carbon dioxide **(ii)** Chlorofluorocarbons
(iii) Nitrous oxide **(iv)** Methane
5. Mention the information that the health workers derive by measuring BOD of a water body.

SECTION - B

6. What is resource partitioning? Give an example.
7. Plot a logistic growth curve. Describe nature's carrying capacity for a species in a particular habitat.
8. Can the pyramid of energy become inverted in any ecosystem? Justify.

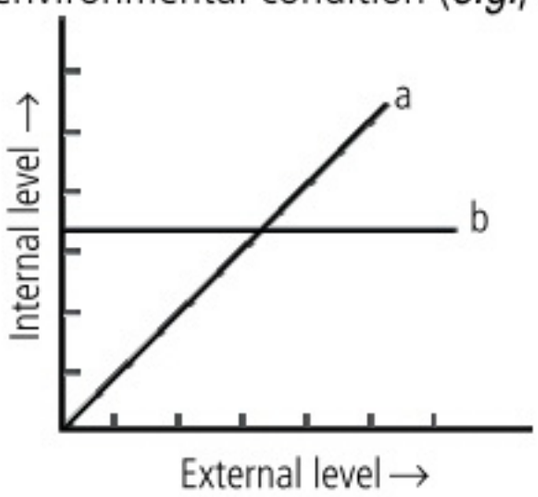
OR

Why a food chain maximally contains 4 or 5 trophic levels and not more?

9. How many hot spots have been identified by Myers? How many hot spots have been identified till now? What is the total percentage of earth's land area covered by these hot spots?
10. What is brown air? Give two harmful effects of this air on humans. How is grey air different from brown air?

SECTION - C

11. The following graph represents the organismic response to certain environmental condition (*e.g.*, temperature) :



(i) Which one of these, 'a' or 'b' depicts conformers?

(ii) What does the other line graph depict?

(iii) How do these organisms differ from each other with reference to homeostasis?

12. Describe various reproductive strategies that organisms have evolved in relation to a particular set of selective pressures.

13. A species is introduced into a new habitat with favourable environment. What kind of population growth does it undergo on a long term basis? Describe briefly.

14. Name the type of interaction in each of the following.

(i) Ladybird beetles (*Coccinella*) feeding on insect pests.

(ii) Barnacles growing on the back of a whale.

(iii) Wasp pollinating the fig inflorescence.

(iv) Lice living on skin of humans.

(v) Superior barnacle (*Balanus*) dominating the rocky sea coasts of Scotland and excluding the smaller barnacle (*Chathamalus*).

(vi) An orchid growing as an epiphyte on a mango branch.

OR

State the difference between the first trophic levels of detritus food chain and grazing food chain.

15. Construct a pyramid of biomass starting with phyto-planktons. Label 3 trophic levels. Is the pyramid upright or inverted? Why?

16. Name the pioneer species on a bare rock. How do they help in establishing the next type of vegetation? Mention the type of climax community that will ultimately get established.

17. Who proposed 'rivet popper hypothesis'? Explain the theory briefly.

18. What is the meaning of the term 'Ecosystem Services'? Can it be useful for increasing ecological concerns in public?

19. Alien species are a threat to native species. Justify taking examples of an animal and a plant alien species.

20. In a water body surrounded by an agricultural land extensively supplied with fertilizers, what changes will be observed in population of fishes and algae? Give reasons.

21. DDT content in the water of a lake that supplies drinking water to the nearby villages, is found to be 0.003 ppm. The kingfishers of that area reported to have 2 ppm of DDT. Why has the concentration increased in these birds? What harm will this cause to the bird population? Name the phenomenon.

22. Discuss the causes and effects of carbon dioxide fertilization on plants.

SECTION - D

23. Khyati attended a seminar conducted in his school on 'Biodiversity and Conservation.' In the evening, she insists her father who is very much fond of hunting wild animals, not to go for hunting again, to which her father objects.

(i) In such a case, who wins your support — Khyati's concern for the safety/conservation of biodiversity or her father's objection. Justify your answer giving reasons.

(ii) Suggest any three steps to be taken to conserve biodiversity.

SECTION - E

24. Describe the process of natural ageing of a lake.

OR

(i) Explain the causes of global warming.

(ii) How does global warming pose a threat to the coastal area of the earth? Explain.

25. Different types of organisms show interactions of various kinds. Name and briefly explain the interaction existing between:

(i) Algae and fungi in lichens

(ii) Herbivores and plants.

OR

List the different steps and state their role in the process of decomposition in an ecosystem.

26. (i) The great German naturalist and geographer Alexander von Humboldt observed that within a region, species richness increases with increasing explored area, but only upto a limit.

How do you draw a graph for species-area relationship? Also describe the equations related with the curves.

(ii) What is the significance of the slope of regression in a species-area relationship?

(iii) How do ecologists estimate the total number of species present in the world?

OR

The world is facing accelerated rates of species extinction, largely due to human intervention. 'The Evil Quartet' is the sobriquet used to describe the four major causes of species extinction. Explain them giving suitable examples.

SOLUTIONS

1. Herbs and shrubs survive under the shadow of big canopied trees in forests as they are perfect shade

tolerant plants showing better growth in lower level of light intensity and are arranged in different strata according to their shade tolerance.

2. Standing state is the amount of biogenetic or inorganic materials present in the abiotic environment at any time. Standing crop is the amount of living material present in a unit area of an ecosystem or biome.

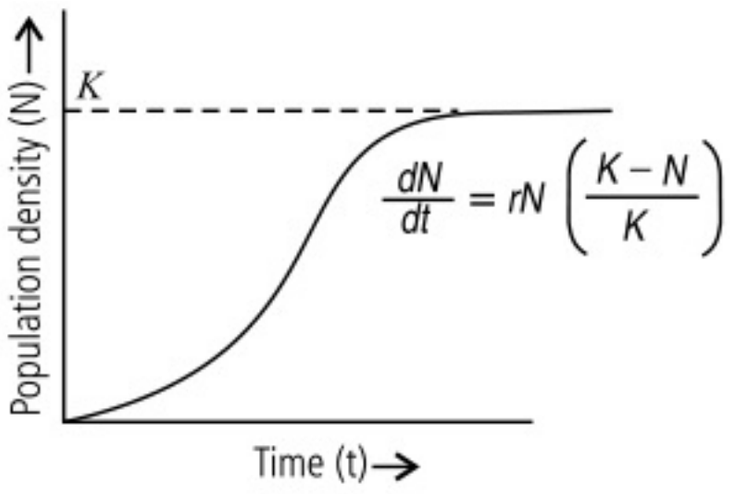
3. (a) Insects
(b) Molluscs.

4.(i) 60 % - Carbon dioxide
(ii) 14 % - Chlorofluorocarbons (CFCs)
(iii) 6 % - Nitrous Oxide
(iv) 20 % - Methane

5. BOD refers to biochemical oxygen demand. It measures the rate of uptake of oxygen by microorganisms to oxidise organic matter present in water. By measuring BOD health workers can find out the level of organic content (impurity) in water.

6. Resource partitioning means that if two species compete for the same resource, they could avoid competition by choosing different times for feeding or different foraging patterns, *e.g.*, five closely related species of warblers living on the same tree have been shown to co-exist and avoid competition due to behavioural differences in their foraging activities.

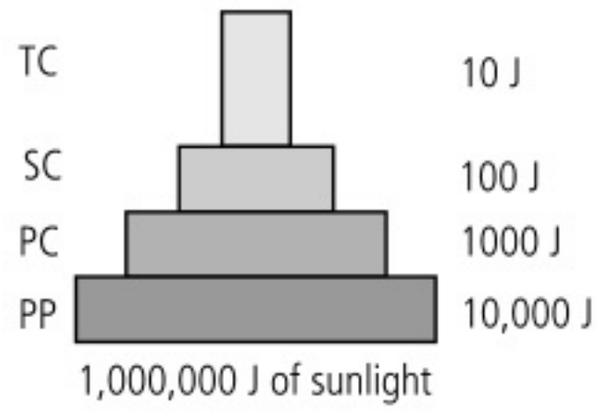
7.



where r = intrinsic rate of natural increase
In nature, a given habitat has enough resources to support a certain number of individuals (N) of a population, beyond which no further growth is possible. This limit is called nature's carrying capacity (K) for that species in that habitat. Nature's limited resources limit the carrying capacity for a species in a particular habitat.

8. No, the pyramid of energy can never be inverted or reversed as there is always a gradual decrease in the energy content at successive trophic levels from the producers to various consumers. Gradual decrease occurs because the transfer of energy follows 10 per cent law *i.e.*, only 10 percent of the energy is transferred to each trophic level from the lower trophic level.

OR



Trophic level is a step or division of food chain which is characterised by the method of obtaining its food. Energy goes on decreasing with each and every trophic level, *i.e.*, energy of the producers > primary consumers > secondary consumers > tertiary consumers. If the fourth trophic level (TC) can get only 10 J energy, then trophic level above it will get only a meagre quantity of 1 J, thus it limits the number of trophic levels in a food chain to 4 or 5 usually.

9. Myers (1988) initially identified 12 hotspots with 14% of plant species in an area of only 0.2%. Four more hotspots were added by Myers (1991). Till now 34 hotspots have been identified. These hotspots cover less than 2% of land surface.

10. Brown air is photochemical smog in areas with intense solar radiation. It is formed at high temperature due to still air, emission of nitrogen oxides and hydrocarbons from automobile exhausts and solar energy. In humans, brown air causes irritation of eyes and lung diseases. Grey air is formed in areas with lesser solar radiation when smog formation is incomplete.

11. (i) Line 'a' depicts conformers.

(ii) The line graph 'b' depicts regulators.

(iii) Regulators are able to maintain homeostasis by physiological means which ensures constant body temperatures. On the contrary, conformers do not have the ability to maintain homeostasis, instead their body temperature changes with the atmospheric temperature.

12. Under a particular set of selection pressures, organisms evolve towards the most efficient reproductive strategies.

The reproductive strategies employed are :

(i) Some organisms breed only once in their life time, *e.g.*, bamboo, Pacific salmon fish.

(ii) Some breed many times during their life time, *e.g.*, birds and mammals.

(iii) Some organisms produce a large number of small-sized offsprings, *e.g.*, oysters, pelagic fishes.

(iv) Some produce a small number of large sized offsprings, *e.g.*, birds, mammals.

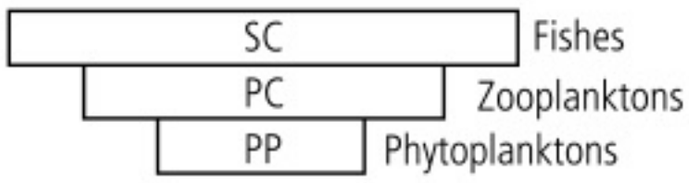
13. When a species is introduced into a new habitat having favourable environment (unlimited resources) it undergoes exponential growth. It has two phases-lag and log phase. In lag phase, species shows poor growth as trying to establish in the new environment. After its establishment, species shows maximum growth in the log or exponential phase.

14. **(i)** Predation
(ii) Commensalism
(iii) Mutualism
(iv) Parasitism
(v) Competition
(vi) commensalism

OR

Grazing food chain consists of producers, consumers and decomposers. Producers constitute the first trophic level. They are autotrophic living green plants which can manufacture their own food through photosynthesis utilizing inorganic raw materials and sunlight. In a detritus food chain detritivores and decomposers constitute the first trophic level. Decomposers are the saprophytes, chiefly bacteria and fungi that break down the complex compounds of dead organisms into simple inorganic substances.

15. Pyramid of biomass starting with phytoplanktons will be for an aquatic ecosystem. It can be drawn as follows:



The pyramid of biomass in aquatic ecosystems is generally inverted because the biomass of fishes far exceeds that of phytoplanktons.

16. The pioneer species on a bare rock is usually lichens. They secrete lichen acid and carbonic acids to corrode rock surface, helping in slow weathering and soil formation. These later pave way to some very small plants like bryophytes (mosses), which are able to take hold in the small amount of soil. The climax community that will ultimately get established is forest. Type of climax community depends upon the climate.

17. Rivet popper hypothesis was proposed by Paul Ehlrich which explains the effect of reduction in biodiversity. The theory compares aeroplane to an ecosystem and rivets to the number of species. Removal of (species) rivets by passengers may not affect flight safety in the beginning but over a period of time the aeroplane will become dangerous to fly. Similarly, the loss of species leads to ecosystem imbalance affecting the latter adversely.

18. The products of ecosystem processes which have environmental, aesthetic and indirect economic value are named as ecosystem services *e.g.*, plant cover protects the soil from drastic changes in temperature, absorbs polluting gases, causes settling of suspended particulate matter, protects the land from floods, etc. Robert Constanza and his colleagues have put the value of ecosystem services to 33 trillion dollars. It is nearly twice the global GNP of 18 trillion dollars. 50% of it is for protection of soil, prevention of floods and mitigating droughts. The value is 10% each for nutrient cycling and recreation. It is 6% each for climate regulation and habitat for wildlife.

These estimations can help general public to understand that loss of ecological balance may lead to such a drastic economic loss. Thus as a result, ecological concern will increase in general public.

19. Alien species are a threat to native species when they become invasive and cause decline or extinction of indigenous species. For example, the introduction of African Catfish *Clarias gariepinus* for aquaculture purposes is posing a threat to the indigenous Catfishes in our rivers. Similarly, introduction of invasive weed species like carrot grass (*Parthenium*), *Lantana* and water hyacinth (*Eichhornia*) caused environmental damage and posed threat to our native species. Also, introduction of Nile Perch into Lake Victoria in East Africa led to extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake.

20. In such a water body, fish population will decline while algal population will increase. The reason for it is eutrophication of the water body. Eutrophication is excessive growth of algae, plants and animals in water bodies due to the nutrient enrichment particularly with nitrogen and phosphorus. It is caused by agricultural run-off containing a large amount of fertilizers *i.e.*, nutrients. These nutrients support algal growth. Large algal population consume oxygen from water during

night for respiration. Lack of oxygen causes death of fishes and other aquatic organisms.

21. This has happened because DDT is a toxic substance. It cannot be excreted or metabolised and is thus passed on to the next higher trophic level. During the transfer along food chain its concentration in tissue increases. This is why its highest concentration is found in fish eating bird kingfisher which occupies the highest trophic level. This will result in thinning of egg shells, premature breaking and killing of embryos further leading to decline in bird population.
The phenomenon is biological amplification (Bio-magnification).

22. The causes of carbon dioxide fertilization include deforestation, changes in land use and excessive combustion of fossil fuels and biomass.
The effects of carbon dioxide fertilization on plants are increase in rate of photosynthesis, decrease in stomatal conductance and reduced transpiration. There will be greater root growth, more mycorrhizal development and increase in N_2 fixation in root nodules so that plant will grow more successfully in regions of water scarcity and nutrient poor soils.

23. (i) I will support Khyati's concern for the conservation of biodiversity. It has taken millions of years of evolution to accumulate the rich diversity of plants and animals in nature, but we could lose all that wealth if the present rates of species losses continue. Biodiversity provides countless direct economic benefits to human beings (such as food, drugs, various industrial products, etc.). Also, biodiversity play a major role in many ecosystem services that nature provides.

(ii) (a) The wild life should be protected in natural habitats as well as in artificial habitats under human control, such as zoological parks and botanical gardens.

(b) The threatened species should be given preference over others in the conservation programme. Among these, the endangered species should get priority over the vulnerable species, and the latter over the rare species. The species which are the sole representative of their genus or family should be paid special attention.

(c) The life supporting systems (air, water, shelter, land) should be properly managed and conserved. This will provide suitable habitats to the wild organisms.

24. In a young lake the water is cold and clear, supporting little life. With time, streams draining into the lake introduce nutrients such as nitrogen and phosphorus, which encourage the growth of aquatic organisms. As the lake's fertility increases, plant and animal life flourish rapidly and organic remains begin to be deposited on the lake bottom. Over the centuries, as silt and organic debris pile up, the lake grows shallower and warmer, with warm water organisms replacing those that thrive in a cold environment. Marsh plants take roots in the shallows and begin to fill in the original lake basin. Eventually, the lake gives way to large masses of floating plants, finally converting into land. This process of natural ageing of lake by nutrient enrichment of its water is called natural eutrophication.

OR

(i) The main causes of global warming are :
(i) Deforestation
(ii) Rise in the concentration of greenhouse gases (CO_2, CH_4, CFCs, N_2O).
(iii) Burning of fossil fuels
(iv) Rise in industrial wastes and pollutants.

(ii) The global warming will raise the sea level due to melting of glaciers. A rise of even half a meter in sea level will be disastrous as thousands of islands and several important cities of the world and coastal areas will be submerged. Coastal salt marshes and estuaries, wet lands, drylands, fresh water supplies, fisheries, fish breeding areas and other types of wildlife will undergo extinction.

25. (i) Mutualism is type of interaction found between algae and fungi in lichen. Lichen is a composite entity which is formed jointly by an intimate mutualistic relationship between alga and a fungus. The fungus provides fixation, water, minerals and shelter to the alga. In return alga provides food to the fungus.

(ii) Herbivores and plants show predator-prey relationship, where plants are the prey and herbivores are predators. The typical predator is a free living organism that catches, kills and devours individuals of other species. Such type of interaction is termed predation.

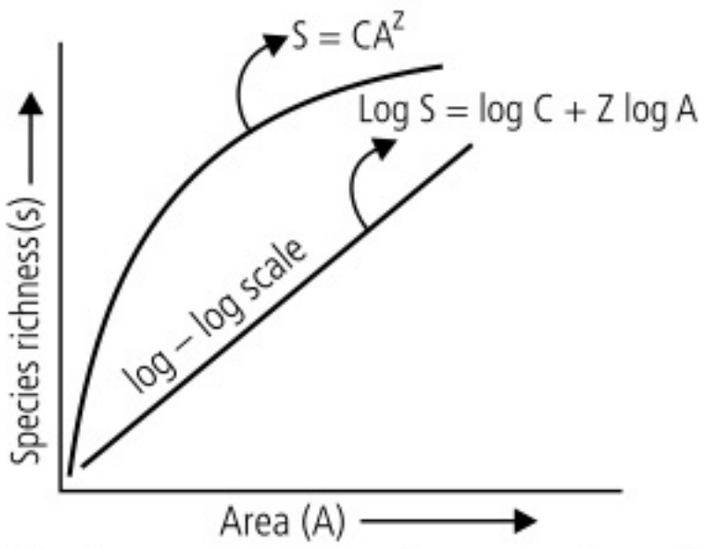
OR

The process by which the decomposers break down complex organic remains (dead plants, animal remains and excretions) into inorganic substances like carbon dioxide, water and nutrients is called decomposition. The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation.

Detritivores (*e.g.*, earthworm) break down detritus into smaller particles. This process is called fragmentation.
By the process of leaching, water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. The process is called as catabolism. All the above steps in decomposition operate simultaneously on the detritus. Humification and mineralisation also occur during decomposition in the soil.

Humification leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. Being colloidal in nature it serves as a reservoir of nutrients. Release of inorganic nutrients from detritus occurs by the process known as mineralisation.

26. (i)



Relationship between species richness and area for a wide variety of taxa (angiosperms, birds, bats, freshwater flies) comes out to be a rectangular hyperbola, represented by equation $S = CA^z$.
On a logarithmic scale, the relationship is a straight line represented by equation:
$\log S = \log C + Z \log A$
where
S = Species richness
A = Area
Z = slope of the line (regression coefficient)
C = Y - intercept.

(ii) Slope of regression or regression coefficient makes it easier to measure species richness along an area. For a limited area like, a country, it gives a constant value of 0.1 to 0.2 irrespective of the taxonomic group or region. It remains amazingly similar for all those small regions. On the contrary, for large areas like the entire continents, it is in the range of 0.6 to 1.2.

(iii) Ecologists estimate the total number of species present in the world by comparing species richness of some exhaustively studied groups between any two regions (tropics, temperate or polar regions). Species richness, as a measure of diversity, has been used by many ecologists. Species density or the number of species per m^2 is most commonly used to measure species richness. Species abundance and species proportional abundance based indices are some other alternative approaches to the measurement of diversity.

OR

'The evil quartet' *i.e.*, four major causes of species extinction are:
(i) Habitat loss and fragmentation.
(ii) Over-exploitation.
(iii) Alien species invasion.
(iv) Co-extinction.

(i) Habitat loss and fragmentation: Loss of habitat results in annihilation of plants, microorganisms and forcing out of animals which in alien lands die out after some time. Fragmentation of habitats (*i.e.*, large habitats broken into small fragments) results in disruption of complex interactions amongst species, destruction of species in the cleared regions, annihilation of species restricted to deeper undisturbed parts of forests and decreased biodiversity in the habitat fragments. Animals requiring large territories (*e.g.*, mammals, birds) are badly affected. Migrating animals would go astray and get killed.

(ii) Over-exploitation: Excessive exploitation of a species reduces the size of its population so that it becomes vulnerable to extinction. Dodo, Passenger Pigeon, three subspecies of Tiger and Steller's Sea Cow have become extinct in the last 500 years due to over-exploitation by humans.

(iii) Alien species invasions: When alien species are introduced inadvertently for economic or other purposes, some of them become invasive and result in decline or extinction of indigenous species. *Eichhornia crassipes*, *Lantana camara* and *Parthenium hysterophorus* are the examples of such alien plant species, which when introduced in our country posed a threat to the native plant species.

(iv) Co-extinctions: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. *E.g.*, when a host fish species becomes extinct, all the parasites exclusively found on it will also become extinct.



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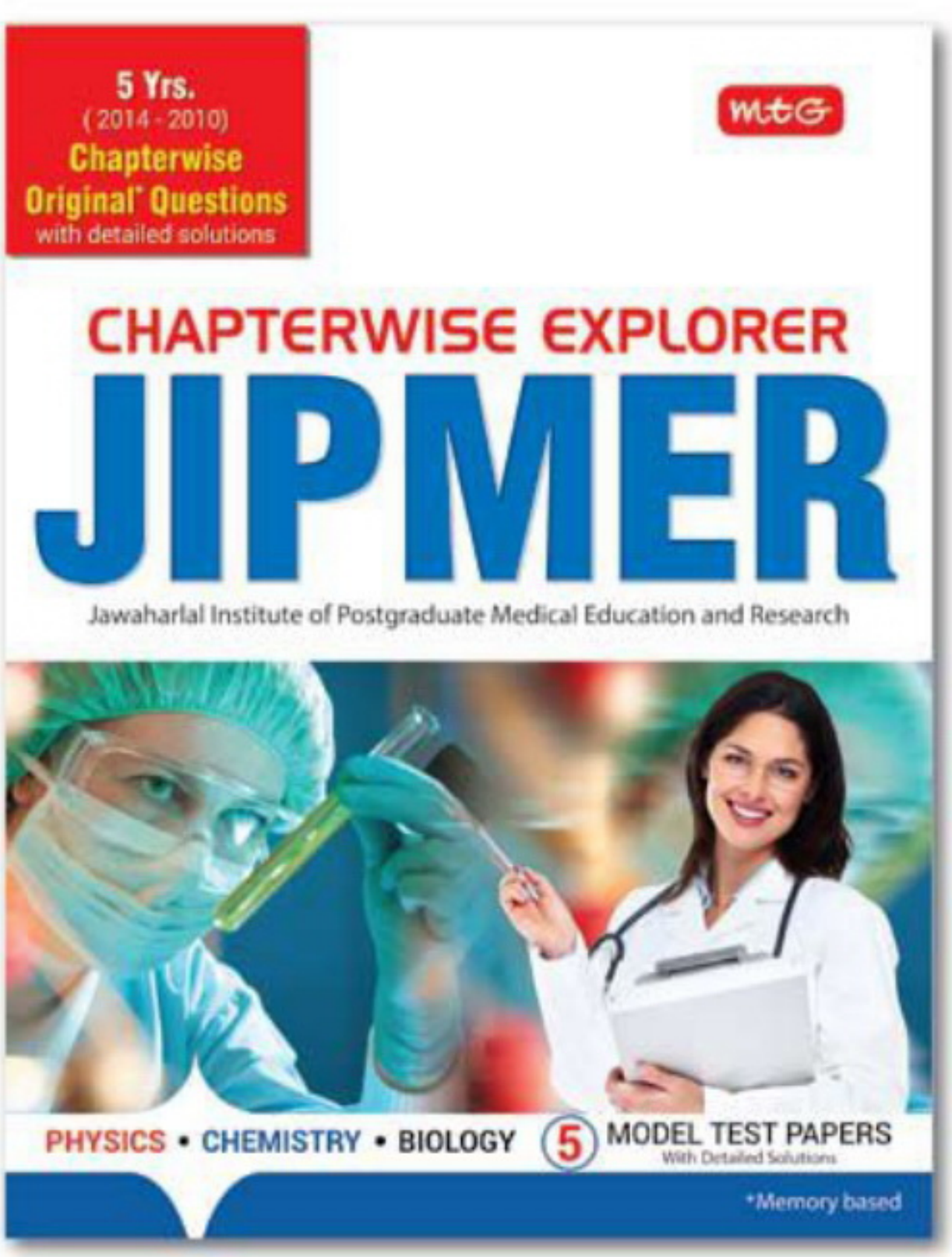
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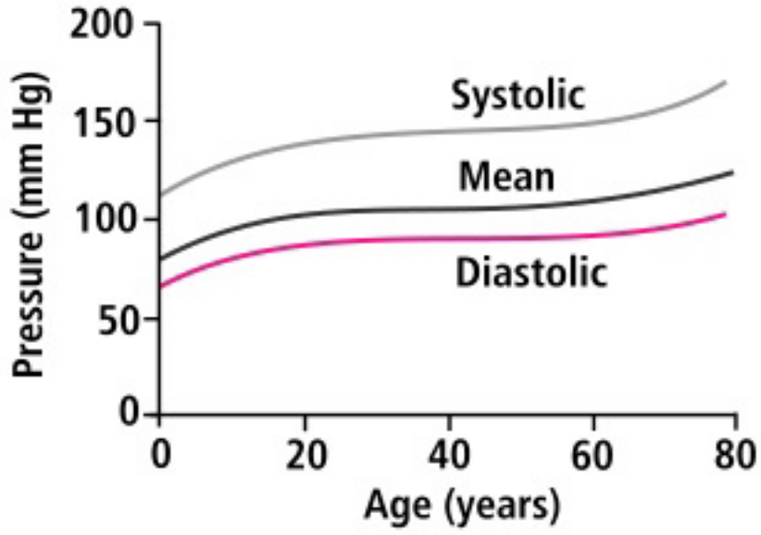
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CONCEPT booster

Concept booster reviews, reinforces and boosts your key biological concepts with a powerful structure. This section identifies the subject areas which need clear understanding of concepts for various exams and prepares you for the same by providing analytical questions with relevant hints and detailed solutions.

1. **The graph shows the approximate normal systolic, mean and diastolic arterial pressure at different ages.**



i. **Why mean arterial pressure is not equal to the average of systolic and diastolic pressure?**

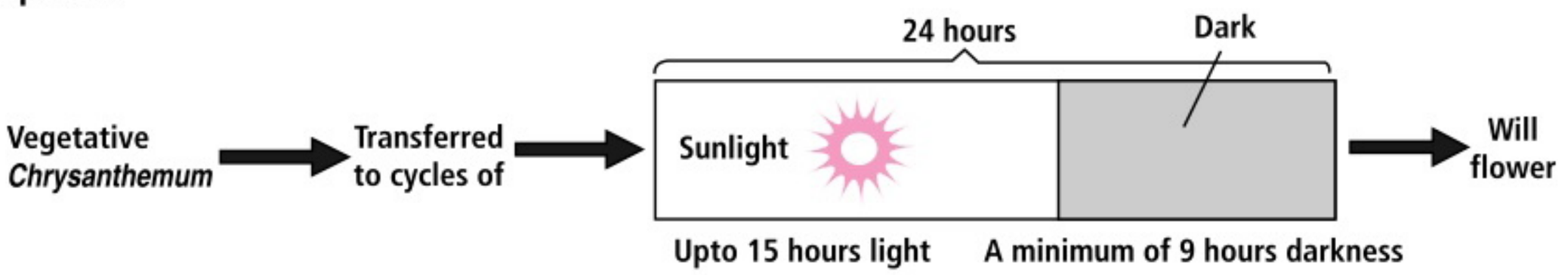
Mean arterial pressure is the average of the arterial pressures measured millisecond by millisecond over a period of time.

---

ii. **From the graph find out which pressure is slightly extra gets increased beyond the age of 60 years and why?**

---

2. ***Chrysanthemum*** **is a short-day plant. The figure shows flowering pattern in** ***Chrysanthemum*** **species.**



i. **What will happen to flowering in** ***Chrysanthemum*****, if the dark period is interrupted by flash of light?**

Short-day plants are really long-night plants.

---

ii. **What will happen to flowering, if a dark period is introduced into the light period?**

---

3. The Michaelis constant K_M values of various enzymes are given in table.

Enzyme	Substrate	K_M (μM)
Chymotrypsin	Acetyl-L-tryptophanamide	5000
Lysozyme	Hexa-N-acetylglucosamine	6
β-Galactosidase	Lactose	4000
Threonine deaminase	Threonine	5000
Carbonic anhydrase	CO_2	8000
Penicillinase	Benzylpenicillin	50
Pyruvate carboxylase	Pyruvate HCO_3^- ATP	400 1000 60
Arginine-*t*RNA synthetase	Arginine *t*RNA ATP	3 0.4 300

The K_M value for an enzyme depends upon the particular substrate and on environmental conditions such as pH, temperature and ionic strength.

i. What can you deduce from K_M value?

K_M is equal to the substrate concentration at which reaction rate is half its maximal value.

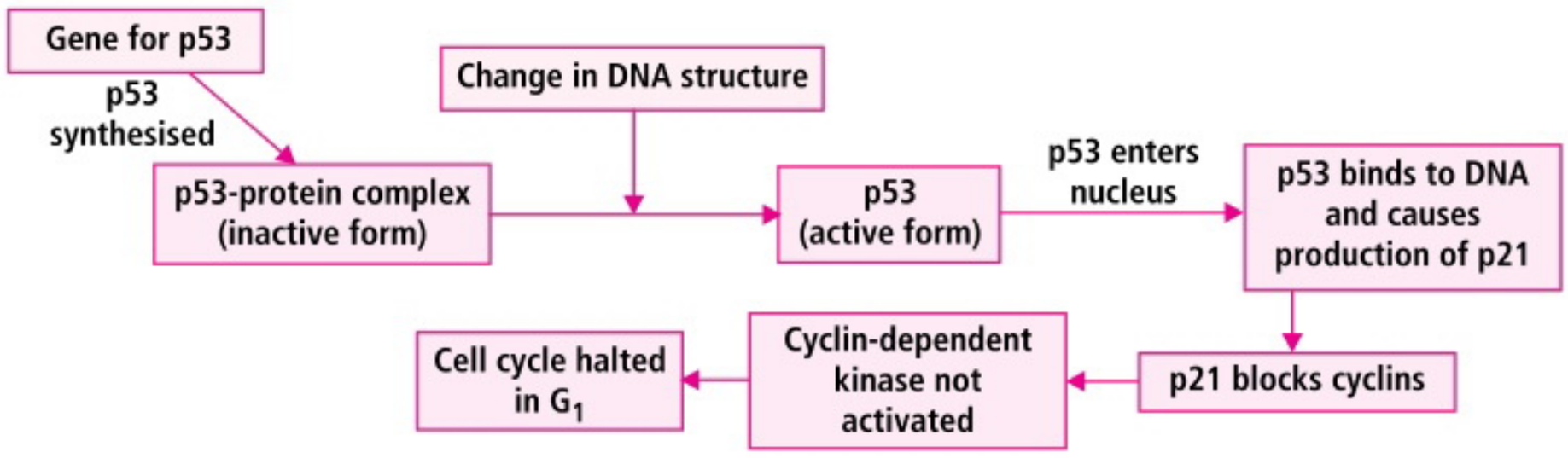
ii. We know $K_M = \frac{k_{-1} + k_2}{k_1}$.

Find the K_M, if k_{-1} is much greater than k_2.

---

4. During the first phase of the cell cycle, G_1, there is a crucial cell-cycle checkpoint that a cell must pass to begin the process that leads to cell division. If changes in the structure of DNA are detected during G_1, the cell cycle is halted until DNA is repaired.

p53 gene located on chromosome 17 codes for p53 and is known as a tumour suppressor gene. Mutations of one of the two p53 gene cause a hereditary disorder known as Li-Fraumeni syndrome. The given figure is a simplified flow chart showing the sequence of events that occur after a change in the structure of DNA is detected.



i. What is a tumour suppressor gene?

---

ii. Suggest why only the active form of p53 can enter the nucleus?

---

iii. Using the information in the given figure, explain how mutation of p53 gene could lead to cells continuing to divide, even after a change in the structure of DNA is detected?

SOLUTIONS

1. **(i)** It is because the arterial pressure remains nearer to diastolic pressure than to systolic pressure during the greater part of the cardiac cycle. Therefore, the mean arterial pressure is determined about 60 per cent by the diastolic pressure and 40 per cent by the systolic pressure. We can also see from the graph that mean pressure at all ages is nearer to the diastolic pressure than to the systolic pressure.

(ii) The extra increase in systolic pressure usually occurs beyond the age of 60 years. It occurs due to thickening and hardening of arteries which results in atherosclerosis.

2. **(i)** *Chrysanthemum* will not flower because short day plants require a continuous critical dark period, which must be exceeded. This critical dark period is called skotoperiod. If a plant is exposed to even a flash of light (red usually 660 nm) before acheiving a critical dark period, flowering is prevented. It is called light break reaction.

(ii) *Chrysanthemum* will flower because in short day plants, interruption of light period by dark period does not inhibit flowering.

3. **(i)** The K_M is the concentration of substrate at which half the active sites are filled. Thus, K_M provides a measure of the substrate concentration required for significant catalysis to take place. Secondly, K_M also tells us the rate constants of individual steps in the catalytic reaction.

(ii) Under such circumstances, the ES complex dissociates to E and S much more rapidly than product is formed.

So, $K_M \approx \frac{k_{-1}}{k_1}$ ... (i)

The dissociation constant of the ES complex

$$K_{ES} = \frac{[E]\,[S]}{[ES]} = \frac{k_{-1}}{k_1} \quad \text{... (ii)}$$

So From (i) and (ii) $K_M = K_{ES}$

So K_M is equal to dissociation constant of the ES complex, if k_2 is much smaller than k_{-1}. At this condition, K_M is a measure of the strength of the ES complex.

4. **(i)** The tumour suppressor gene encodes protein that prevent uncontrolled cell division. In the inactive form, p53 forms a p53-protein complex and in the active form, p53 is not longer attached to the protein.

(ii) It is because active p53 is not complexed with the protein and small enough to pass through nuclear pore.

(iii) It occurs due to non functional p53 synthesized and unable to recognise and bind to DNA. No p21 synthesized, cyclins are not blocked, and they can activate cyclin-dependent kinases.
Cell cycle is not halted and goes beyond G_1, progresses into S phase of interphase, DNA replication continues, and cell continues into cellular division.

Important Exam Dates 2015

West Bengal JEE	18th April and 19th April
MGIMS Wardha	19th April
Kerala PMT	22nd April and 23rd April
AIPMT	3rd May
COMEDK	10th May
AIIMS	1st June

YOU ASK WE ANSWER



We are pleased to invite queries from our readers. This section will answer your queries.

Q.1.Why do we dream?

–Sonali, Assam

Ans. Dreams are a succession of images, ideas, emotions and sensations that occur involuntarily in the mind during certain stages of sleep. The content and purpose of dreams have been a topic of scientific speculation. Dreams mainly occur in the rapid eye movement (REM), the stage of sleep when brain activity is high, and resembles that of being awake. Dreams have been thought to serve as a connection to the unconscious mind. We all dream, though the frequency in which dreams are remembered varies from person to person. They are actually accidental side effects of activated circuits in the brain stem and stimulation of the limbic system that is involved with emotions, sensation and memories. Allan Hobson calls it the "activation synthesis theory". Freud thought that the subject matter of dreams is deeply meaningful. They can reveal wishes or emotions, which we had not realized. Dreams are a kind of "temporary storage", area of consciousness where we hold memories, before we move them from short term to long term storage.

Q.2.Is there any possibility of artificial fertilisation in seeded plants? If yes, explain it.

–Md Inzemam Alam, Bihar

Ans. Artificial fertilization is a broader term which also includes dusting of a desired pollen onto the stigma of the selected plant, in order to carry out fertilization and subsequent development. What we are concerned here is the possibility of *in vitro* fertilization in plants.

Yes, *in vitro* fertilization in seeded plants is possible, but upto a limited extent. In seed plants (angiosperms and gymnosperms), isolation of gametes is a tough process because they are encased in the parental tissues.

The first step towards controlled fusion of the egg and sperm was achieved by culturing unpollinated receptive ovules of poppy in a nutrient medium and dusting them with viable pollen grains. Pollen tube formation, fertilisation etc., proceeded normally and seeds with endosperm and embryo were obtained. (Kanta *et al*, 1962). Subsequently this technique called 'test tube fertilization' was refined to obtain seeds from a variety of flowering plants, often only remotely related, by overcoming interspecific and intergeneric barriers and self incompatibility (Senkteler, 1990).

Now, techniques have been developed to isolate sperm cells from pollen grains, and the female gametes from the maternal tissues. Sperm cells can be released from pollen grains after their rupture by osmotic shock in the fusion medium. Egg cells are isolated by enzyme treatment (pectinase, pectolyase, hemicellulase and cellulase) followed by mechanical isolation. *In vitro* fusion of sperm cells with egg cells is achieved by electrofusion, or in Ca^{2+} containing media. Regeneration of the sperm egg fusion products into fertile plants, is obtained using feeder cells.

Maize was the first plant studied for *in vitro* fertilisation. Development of a successful *in vitro* egg-sperm fusion system in maize was followed by formulation of a procedure of isolation of central cells, and the fusion of sperm and polar fusion nuclei of maize. The fusion produced typical endosperm tissue and demonstrated that *in vitro* double fertilisation is possible.

The major benefit of *in vitro* fusion is that fertilization can be directly visualized and manipulated. Isolated cells can also be collected for molecular studies. The first currently detectable cellular event that takes place after gametic fusion is an increase in the concentration of cytosolic Ca^{2+}. An influx of extracellular Ca^{2+} may contribute to this cytosolic increase.

U.Grossniklaus and his group recently suggested that the whole parental genome is actually transiently silenced after fertilization, and that embryogenesis and endosperm development is mainly under maternal control. The possibility of preferential fertilization of one sperm with the egg cell has been suggested from studies performed in maize and *Plumbago zeylanica*.

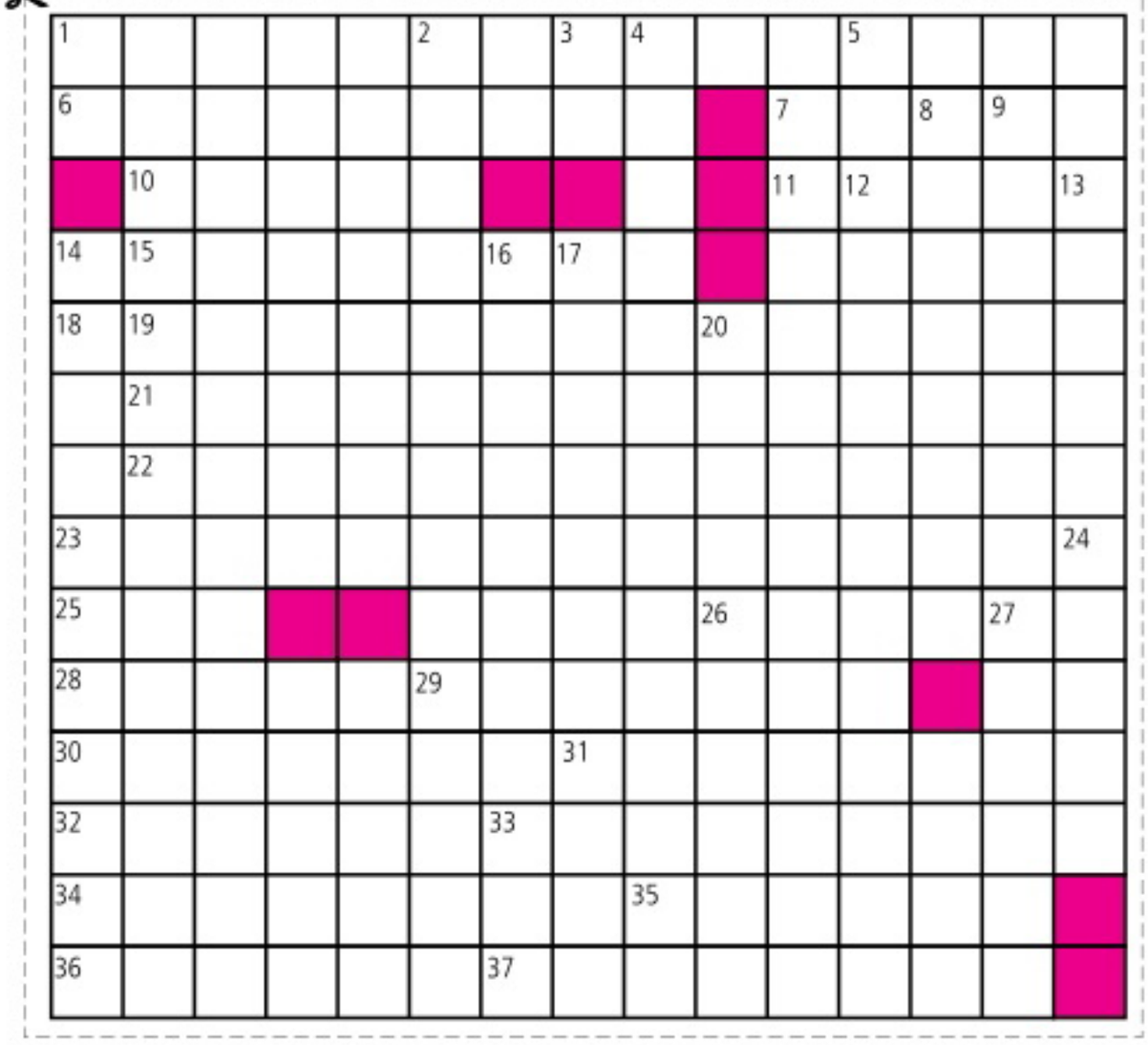
In vitro fertilization may now be used to test if the two male gametes from same pollen grain can fuse with egg cell or not.

A micro-manipulation method for artificial fertilization in *Torenia* sp. is also possible, where intraspecific sperm cells injection is inserted into the embryo sac.

CROSSWORD

Readers can send their answer with complete address by 10th of every month to win exciting prizes.
Winners' name with their valuable feedback will be published in next issue.

Cut Here



ACROSS

1. A small opening, in the surface of a plant ovule through which the pollen tube passes prior to fertilization. (9)
3. It is the most abundant animal phospholipid and also occurs in higher plants, but rarely in microorganisms. (8)
6. A simple embryonic leaf in seed-bearing plants. (9)
7. A detached shoot or bud united or to be united with a growing plant. (5)
10. A star-like arrangement of microtubules radiating from a centrosome. (5)
12. A compound that contains hydrogen and dissociates in water to produce positive hydrogen ions. (4)
15. A B-complex vitamin, that is constituent of lecithin and essential in the metabolism of fat. (7)
18. The signal that travels along the length of a nerve fibre. (7)
21. Dark coloured hard-walled hyphal mass produced by the fungus *Claviceps purpurea*. (5)
22. A material rich in proteins fibroin and sericin which is produced by spiders, some insects and centipedes etc. (4)
23. A haploid cell that results from the meiotic division of an oocyte and becomes a female gamete or an ovum. (5)
25. A group of prokaryotic microorganisms of Phylum Cyanophyta, containing chlorophyll and a blue pigment. (3)
26. A fold of mucous membrane that covers the opening of the vagina at birth. (5)
28. Cross-fertilization between two different plants. (8)
29. A polysaccharide consisting of linear chains of between 100 and 1000 linked glucose molecules. (7)
30. A carbohydrate digesting enzyme that hydrolyses cellulose to sugars. (9)
31. Organic waste matter from industrial and domestic sources that is dissolved or suspended in water. (6)
32. The study of the theory, practice and rules of classification of living and extinct organisms. (8)
33. A malignant tumor formed by the cells of the bone marrow. (7)
34. An animal that maintains its body temperature by absorbing heat from the surrounding environment. (9)
35. An area of the retina of the vertebrate eye with increased visual acuity. (6)
36. A childhood condition caused by decalcification of the bone resulting in deformed bones. (7)
37. The phase of the heart beat during which the ventricles of the heart contract to force blood into the arteries. (7)

DOWN

2. The area around the mouth in many invertebrates and some protoctists, which assists in food collecting. (9)
4. The study of the interior of hollow organs, such as the intestines and the reproductive organs, using a flexible probe which contains optical fibres for transmitting images onto a screen. (9)
5. The plants in which shoots spread horizontally along the ground without rooting at intervals. (8)
8. A membranous sac at or near the front of a sperm that assits in penetration of the egg. (8)
9. A type of asexual reproduction occurring in some unicellular organisms in which the parent cell divides to form two or more similar daughter cells. (7)
11. The condition of the nucleus, cell or organism which has gained an additional chromosome. (7)
13. An order of insects comprising the true or two-winged flies. (7)
14. A genus of rod-shaped, Gram-negative and chemoautotrophic bacteria, which plays an important role in nitrogen cycle. (11)
16. Term used for a pelagic organism that actively swims through the water. (6)
17. A floral arrangement in which the ovary is inferior and completely enclosed by the receptacle so that the stamens and perianth arise above it. (7)
19. The gelatinous noncellular layer between the endoderm and ectoderm in the body wall of coelenterates. (8)
20. The scientist who explained *Omnis Cellula*-e-*Cellula*. (7)
24. A groove on the valve of certain diatoms. (5)
27. A sugary liquid produced in plants by nectaries, regions of secretory cells on the receptacle or other parts of a flower. (6)

BIOLOGY TODAY 2014 AT A GLANCE

MONTHS	HIGH YIELD FACTS		PMT ESSENTIAL	PMT SPECIAL/ PMT FOUNDATION	CONCEPT MAP
	BOTANY	ZOOLOGY			
JAN	Morphology of Flowering Plants-III	Neural System	Ecological Pyramids	Genetics and Evolution	Animal Husbandry
FEB	Environmental Issues-I	Theories of Evolution	Biological Classification	Biology in Human Welfare	Plant Breeding
MARCH	Environmental Issues-II	Digestion and Absorption	Cell Cycle and Cell Division	Biotechnology	Physiology of Excretion
APRIL	Mineral Nutrition in Plants	Animal Tissues-I	Transcription and Translation	Ecology	Photosynthesis
MAY	GERL System	Animal Tissues - II	Growth and Development in Flowering Plants	.....	Chromosomal Mutations
JUNE	Mendelian Genetics	Cardiovascular System	Biotechnology and Its Applications	.....	Tools and Techniques
JULY	Post Mendelian Genetics-I	The Evolution of Vertebrate Brain	Biomolecules	.....	DNA Replication
AUG	Post Mendelian Genetics-II	Species and Speciation	Phytohormones	.....	Transcription
SEPT	Anatomy of Flowering Plants-I	Evidences of Evolution	.....	*Diversity in the Living World	Translation
OCT	Anatomy of Flowering Plants-II	Common Human Diseases-I	Movements Across the Cell Membrane	Structural Organisation in Plants and Animals	Skeletal Muscles and their Contraction
NOV	Biotechnology - Principles and Processes	Common Human Diseases-II	Human Endocrine System	Cell : Structure and Functions	Reproductive Health
DEC	Cellular Respiration	Common Human Diseases-III	Enzymes	Plant Physiology	Mineral Nutrition

MONTHS	NCERT XTRACT	SOLVED PAPER	CBSE BOARD PRACTICE PAPER	SPECIAL FEATURES
JAN	Microbes in Human Welfare	.....	Unit - V Practice Paper	AIPMT Practice Paper, A & R (Botany and Zoology), Xplore & Win contest, You Ask We Answer
FEB	Body fluids and Circulation	.....	Sample Paper	AIPMT Practice Paper, A & R (Botany and Zoology), Xplore & Win contest, Target PMTs, You Ask We Answer
MARCH	Organisms and Populations	.....	.....	AIPMT Practice Paper, Xplore & Win contest, You Ask We Answer
APRIL	Digestion and Absorption	.....	.....	AIPMT Special, AIIMS Practice Paper, Xplore & Win contest, You Ask We Answer
MAY	Ecosystem	CBSE Board	.....	AIIMS Special (A & R), AIIMS Model Test Paper, Xplore and Win Contest, Target PMTs, You Ask We Answer, *Concept Booster
JUNE	Cell Cycle and Cell Division	AIPMT, Kerala PMT	.....	Xplore and Win Contest, Concept Booster, *Crossword, Target PMTs, You Ask We Answer
JULY	Human Reproduction	Karnataka CET, J & K CET, WB-JEE, Maharashtra CET	.....	AIPMT Topper Interview, My Success Story, Biology Olympiad Problems, Xplore and Win Contest, Concept Booster, Crossword
AUG	Environmental Issues	AMU Medical	.....	Biology Olympiad Problems, Xplore and Win Contest, Concept Booster, Crossword, Target PMTs, You Ask We Answer
SEPT	Cell : The Unit of Life	COMEDK	Unit - I Practice Paper	Biology Olympiad Problems, Concept Booster, Crossword, Five point something, You Ask We Answer
OCT	Excretory Products and their Elimination	.....	Unit - II Practice Paper	Biology Olympiad Problems, Concept Booster, Crossword, You Ask We Answer
NOV	Molecular Basis of Inheritance	.....	Unit - III Practice Paper	Biology Olympiad Problems, Crossword, You Ask We Answer
DEC	Locomotion and Movement	.....	Unit - IV Practice Paper	Biology Olympiad Problems, Crossword, You Ask We Answer

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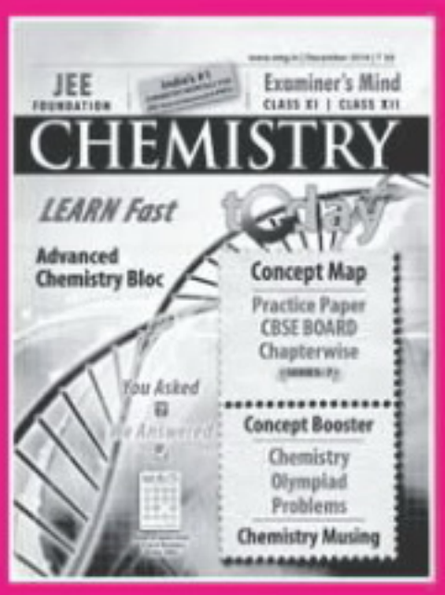
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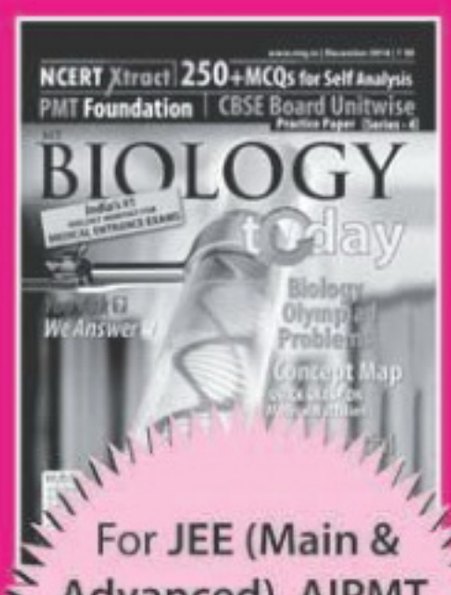
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