

Q. No. 2 Part (i)

FUNCTION OF NEPHRON.

Nephron is the structural and functional unit of kidney. The main purpose of nephron is excretion which is done by formation of urine. It is done in three steps i.e. Pressure filtration, Selective Reabsorption and Tubular Secretion. It also functions to maintain pH of blood (7.45) by maintaining pH of urine. Nephron helps in osmoregulation by forming dilute and concentrated urine by cortical and juxtamedullary nephrons with the help of hormones i.e. ADH.

Rate of blood filtration: The rate of blood filtration is decreased if blood pressure in afferent arterioles decreases as blood particles in blood will not move into Bowman's capsule because of low pressure.

Q. No. 2 Part (ii)

EMBRYONIC DEVELOPMENT.

Embryonic development includes the series of changes from which an embryo develops into an adult. Major processes in embryonic development are:

- **Cleavage:** The division of zygote into a blastomere, the morula and finally a blastula is the result of cleavage.
- **Gastrulation:** The formation of three embryonic germ layers, i.e. ectoderm, endoderm and mesoderm is called gastrulation. These embryonic layers are primitive tissues for all body part.
- **Organogenesis:** The process of development of organs and organ systems is called organogenesis. Neurulation is a major process in organogenesis.
- **Growth:** Increase in size of an organism is called growth.

Q. No. 2 Part (iii)

Chromosomes: During cell division, Chromatin material condenses to form structures called chromosome.

Gene: Gene is a specific sequence of nucleotides along the length of DNA that encodes for a specific amino acid.

Chromosome	Gene
<ul style="list-style-type: none">• Diploid organisms have two sets of chromosome ($2n$) while gametes have one chromosome (n) of each pair.	<ul style="list-style-type: none">• A diploid cell has two alleles of a gene (RR) while gamete has only one (R or r).
<ul style="list-style-type: none">• During metaphase, chromosome orient on plate and segregate independently.	<ul style="list-style-type: none">• During segregation, both pairs of alleles separate independently.
<ul style="list-style-type: none">• Chromosome assort independently of each other.	<ul style="list-style-type: none">• Assortment of gene pair does not depend on another gene pair.

Q. No. 2 Part (iv)

CONVERGENT EVOLUTION	DIVERGENT EVOLUTION
Convergent Evolution when organisms have different ansectors but converge to same functions. It is due to analogous structure.	Divergent evolution is when organisms from a common ancestor diverge into different species. It is due to homologous structure.
Analogy	Homology
When organisms have different structures, but same function, it is called analogy.	When organisms have same structure, but different functions, it is homology.
Example	
Bird wings and butterfly wings (made of chitin) are analogous	Pentadactyl limbs of humans (for walking), and whales (swim).

Q. No. 2 Part (v)

KLIENFELTER

TURNER

Klienfelter syndrome is a sex chromosome trisomy ($2n+1$) in which patient has $44+XXY$ chromosome i.e. an extra X chromosome. The affected is male.	Turner syndrome is caused when the female has $44+XO$ chromosome i.e. absence of X-chromosome. The affected person is female.
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Causes

It is caused by chromosomal non-disjunction of maternal chromosome giving an extra copy of X.	It is caused by absence of X-chromosome in maternal egg during fertilization.
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Testicles smalls, sparse body hair, wide hips, low pitch in voice, small bones, enlarged breasts	Symptoms: short stature, infertility, Female with less-feminine characters, edema, abnormal moles, abnormal hands
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THEORY OF NATURAL SELECTION.

Q. No. 2 Part (vi)

Darwin's theory of natural selection emphasized on the origin of new species by means of natural selection and the evolutionary changes that lead to formation of new species.

Descent with modification; Darwin proposed that each organism produces offsprings that are diff. from ancestors.

Natural Selection: Natural selection means the survival of organisms that reproduce differently through:

Over-Population: Each organism produces large no. of offsprings.

• **Variation:** These offsprings have variation that can be positive or negative.

• **Survival of fittest:** These large number of organisms compete on natural resources and only those survive which are best for environment i.e. Natural Selection.

Origin of species: These genetically diff. organisms isolated by geographical barriers give rise to new species.

Q. No. 2 Part (vii)

DIFFERENTIATE

AMMONIFICATION	DENITRIFICATION
The process of formation of ammonia or ammonium ions by saprophytic bacteria and fungi in aerobic environment from nitrogen is called ammonification. It is through decomposition of organic matter. It increases fertility of soil.	The conversion of ammonia and nitrates into molecular nitrogen is called denitrification. It is done in anaerobic environment by Pseudomonas. It decreases the fertility of soil. $\text{NO}_3 \rightarrow \text{NO}_2 \rightarrow \text{NO} + \text{N}_2\text{O} \rightarrow \text{N}_2 + \text{O}_2$
XERARCH	HYDRARCH
The process of changing of species in rocks, dungs, soil i.e. dry land is xerarch. The seral stages are called xeres.	The process of change of species in fresh water or any waterbodies is called hydrach. The seral stages are called hydrases.

(ix)
Q. No. 2 Part (viii)

A. Genetic Markers: Like specific tables in physical mapping, genetic markers are used to locate the loci (position) in DNA fragments. They include RFLPs (Restriction fragment length Polymorphism), single nucleotide polymorphism, short tandem fragments, VNTRs.

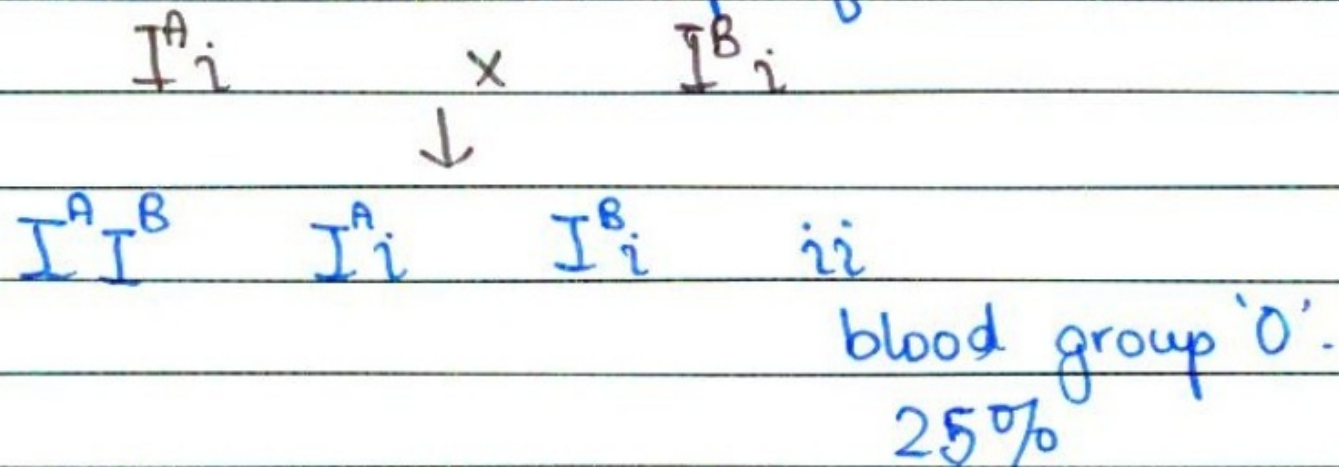
B. Genomics: Genomics is the branch which deals with the exploration and analysis of genome and genetic makeup.

C. Genome Map: Genome Map is used to locate the loci (position) of gene along the length of chromosome.

Q. No. 2 Part (ix)

BLOOD GROUP 'O'.

Blood group A has two genotypes $I^A i$ and $I^A I^A$. Similarly, blood group B has two genotypes $I^B i$ and $I^B I^B$. It is possible for a child to have blood group O (ii) homozygous recessive if both of its parents are heterozygous. This can be shown with the help of a test cross.



The chances of blood group 'O' for heterozygous parents is 25% i.e. the both gametes of parents contains i gene.

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Q. No. 2 Part (x)

DNA ANALYSIS.

DNA Analysis is a technique that is used by forensic scientists for identification.

SYMPATHETIC N.S	PARASYMPATHETIC N.S
Sympathetic System prepares the body for flight and fight responses.	Parasympathetic Nervous System is active during rest conditions.
• It includes spinal nerves of cervical, lumbar and thoracic.	• It includes cranial nerves, Vagus Nerve and sacral spinal nerves.
• It dilates pupil.	• It constricts pupil.
• Dilation of bronchi.	• Constriction of bronchi.
• Inhibits constriction of bladder.	• Constricts bladder.
• Vasodilation of skeletal muscles.	• Vasoconstriction of skeletal muscles.
• Increased heart rate.	• Decreased heart rate.
• Inhibits digestive activities.	• Promotes digestive activities.

Q. No. 2 Part (xi)

DNA Analysis.

DNA Analysis is a technique that is used by forensic scientists for identification of individuals by their specific nucleotide segments.

Applications:

- 1- Identification of crime and catastrophe victims.
- 2- Establishing paternity and other relations.
- 3- Matching DNA for organ donation.
- 4- Finding the culprit out of possible suspects of a crime scene.

Q. No. 2 Part (xii)

DNA Sequencing.

The three major steps of DNA Sequencing are:

STEP 1:

Formation of different sized fragments of DNA through Sanger-Coulson method or Chemical Cleavage through PCR.

STEP 2:

Separation of these segments by gel electrophoresis based on their length to form a sequence of nucleotides.

STEP 3:

Reading of the deduced sequence of DNA nucleotides.

Q. No. 2 Part (xiii)

EPISTASIS.

Epistasis is a phenomena in which a gene on a locus masks or hides the effect of a gene on another locus. It is shown by coat colour in Labrador, Bombay phenotype, etc.

Dominance

Dominance is the effect of an allele of a gene to hide the effect of allele of same gene on same locus.

Only one gene is involved.

Epistasis.

Epistasis is the effect of a gene on another gene on different loci of different chromosomes.

Two genes are involved.

Example.

Dominance of Round seed over wrinkled

Coat colour in L. Retriever.

Q. No. 2 Part (xiv)

ROLE OF VACCINATION

Vaccination is the process of administering a vaccine for the purpose of stimulation of artificially induced active immunity.

Vaccine is an attenuated or killed pathogen that is injected into an individual. The immune system of the organism recognizes it and starts synthesizing antibodies against it. It is given in such small amount that the body is actually not affected by pathogen. Now, if the body is exposed to the original virus, it can easily start its defence mechanism.

Example :

Administration of Polio Vaccine.

Identification of Parts

E: Level of LH (Luteinizing hormone)

F: Level of FSH (Follicle Stimulating Hormone)

G: Level of Estrogen

H: Level of Progesterone

Menstrual Cycle

The human female reproductive system undergoes changes throughout the month forming the menstrual cycle. Both the uterus and the ovaries undergo change. It is a 28 day cycle.

UTERINE CYCLE: The changes in the uterus form the uterine cycle.

OVARIAN CYCLE: The changes of ovary form ovarian cycle.

The major events of menstrual cycle are:

Menstruation

(Day 1-5)

On the 1st day of menstrual cycle, the endometrium lining of uterus sheds its deepest walls. This occurs in the form of blood flow (menstruation) that occurs for 3-5 days. At this time, the level of female hormones FSH is starting to rise.

Proliferative Phase

(Day 6-14)

Role of FSH:

FSH acts on the follicles present in the ovary. Almost 10-15 follicles are stimulated by FSH each month and these follicles compete. One of this follicle is transformed into a tertiary follicle the Graffian follicle while the others undergo degeneration (Follicular Atresia).

Graffian follicle: The Graffian follicles has the developing egg. Besides, it also secretes estrogen.

Role of Estrogen:

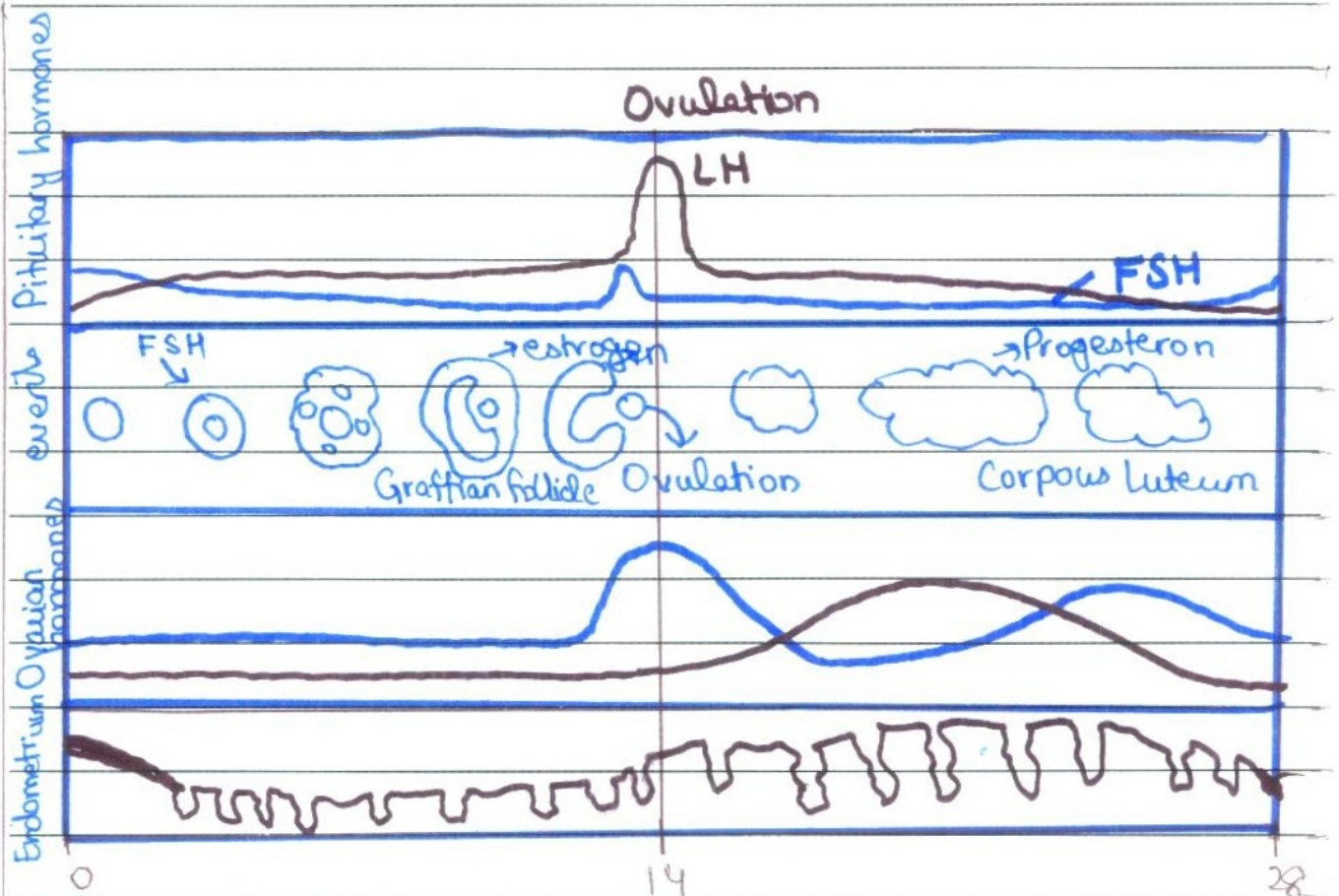
- Estrogen acts on the Endometrium of uterus and helps it in its thickening. It also helps in vasculization of endometrium to prepare it for implantation
- Estrogen has negative feedback on FSH and decreases its production.
- Estrogen also helps in thinning of mucus of cervix. Normally, the mucus is thick. But estrogen thins it to clear passage of sperm.

Ovulation: Low level of FSH and high level of estrogen triggers the anterior pituitary to release LH. The LH acts on graffian follicle and causes its ovulation of Day 14.

• **Role of LH:** After ovulation, the LH converts the Graffian follicle into a yellow mass Corpus Luteum. The Corpus Luteum secretes progesterone.

Secretory Phase (Day 15-28)

High level of progesterone secreted by Corpus Luteum acts on the endometrium and further helps in its vasculization. It also develops secretory cells in endometrium which secrete glycoprotein and glycogen for nourishment if embryo is implanted. At 28th day, if fertilization doesn't occur, it results in decrease in progesterone leading to menstruation. Progesterone also inhibits the secretion of FSH and LH.



Habituation

Habituation is the process of ignoring a repeated, unharmed stimulus. If an organism like buffaloes are exposed to a stimulus e.g human near them, from repeated exposure they have come to know that humans are unharmed. So, they ignore the traffic. Habituation is reversible.

Example:

Humans after wearing many times, get habitual and now are not bothered by clothes on skin.

Classical Conditioning

Classical Conditioning is the response to a particular stimulus by exposure of another stimulus.

Pavlov:

Pavlov through the series of experiments explained classical conditioning. A dog was given a piece of meat and ring of bell at the same time. But after successful repetition, if only a bell was rung the dog gave response by salivating (CR).

Example:

Humans get saliva secreted by listening to words like tamarind, grapes, etc. or by seeing food.

Latent Learning

Latent learning is the learning about a certain thing without reward or punishment.

Example:

A person can get to a place fast if he knows the route than a person who doesn't know the route.

Lashley's experiment:

Lashley put a rat in a maze with a piece of food at a corner. The rat went to the exit. As he was not hungry, it does not pay attention to food. Now, if the rat is hungry and put into maze it will go quickly to the food.

Insight Learning

Insight Learning is a complex type of learning in which an individual goes through mental trial and error before forming a procedure to get rid of the problem.

Example :

Solving a mathematical problem is an example of insight learning.

Kohler's experiment :

This type of learning is only shown by humans, apes and chimpanzees.

Kohler put few chimpanzees in a cage with boxes and hung bananas that were out of reach. Chimpanzees had not gone through such experience before but through mental conditioning, it put the boxes one above another to reach the bananas.

Anterior Pituitary

MASTER GLAND:

The anterior lobe of the pituitary gland is called Master gland because it secretes a large number of tropic hormones that act on other glands to stimulate its function.

HORMONES OF ANTERIOR PITUITARY.

Anterior pituitary secretes six hormones i.e.

Growth hormone (STH)

Thyroid Stimulating hormone (TSH)

ACTH Adrenocorticic ———— Trophic hormone.

Prolactin

Gonadotrophic hormones → FSH
→ LH

Growth Hormone

Growth hormone (STH) is a protein nature hormone. Its secretion is regulated by GRF from hypothalamus. And it is inhibited by somatostatin.

FUNCTION:

Growth hormones act on the bones and skeletal muscles and help in its growth. It also helps in formation of proteins.

UNDER-SECRETION: Undersecretion of growth hormone results in Dwarfism.

OVER-SECRETION: If it is oversecreted in adolescence it cause gigantism. Over-secretion in adulthood is characterized by large hands, feet, jaws called Acromegaly.

Thyroid Stimulating Hormone

TSH acts on the thyroid gland and helps in its enlargement and production of T_3 and T_4 i.e. Thyroxin. Its production is stimulated by releasing factor from hypothalamus.

Over-Secretion: Its over-secretion causes hyperthyroidism.

Under-Secretion:

Its under-secretion leads to hypothyroidism.

Prolactin

The Prolactin or Lactogen acts on the mammary glands of female and helps in its development. It functions in production of Milk. In males, it has no function. Its production is inhibited by PIF.

ACTH

ACTH acts on the adrenal cortex and stimulates it to secrete its hormones. The

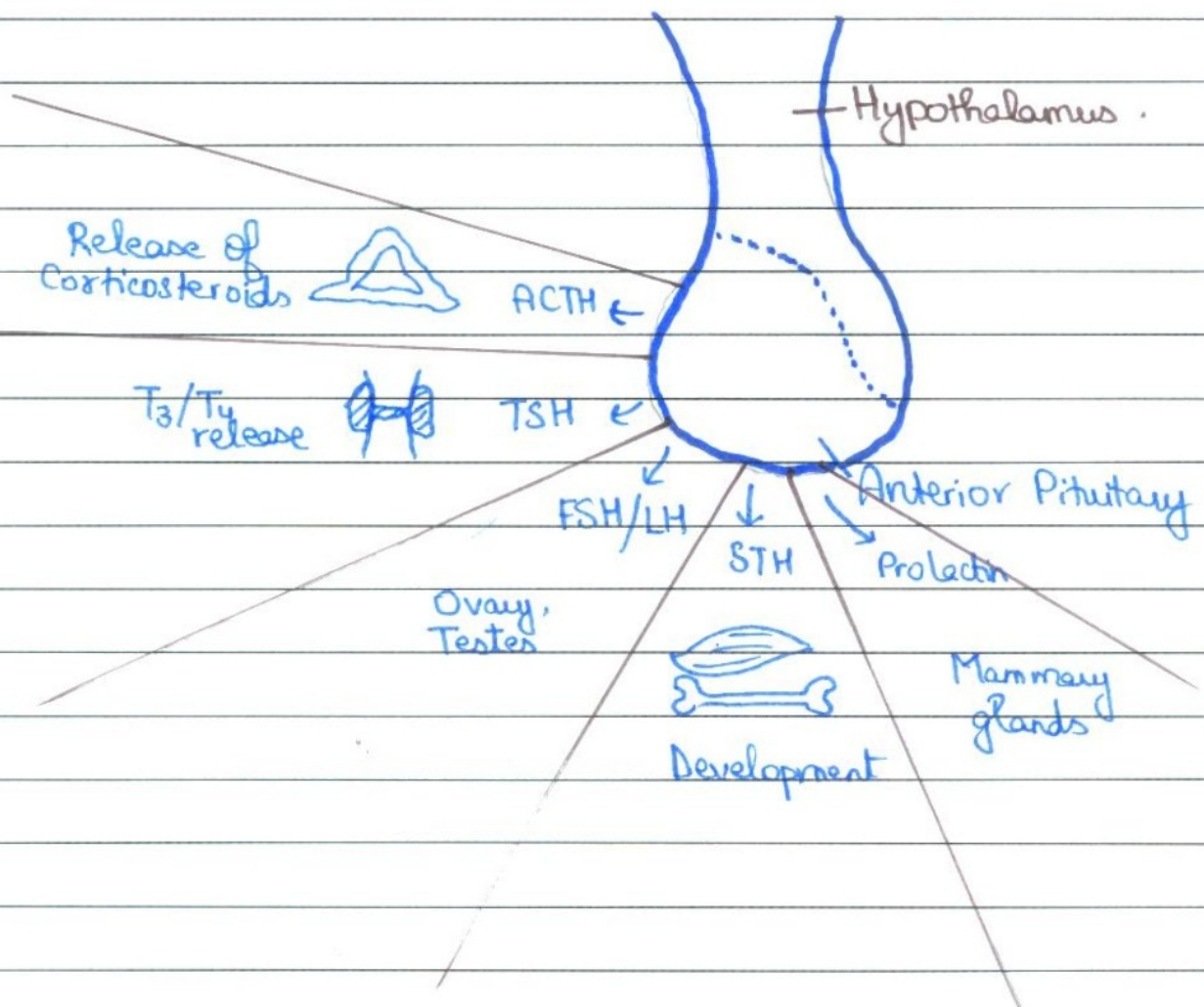
ACTH is stimulated by CRF from hypothalamus

LH/ICSH

In males, it acts on interstitial cells to produce testosterone. Whereas, in female it acts on Graffian follicle for ovulation.

FSH

In males, it acts on the sertoli cells to produce their nourishment. In females, it helps in development and maturation of Graffian follicle.

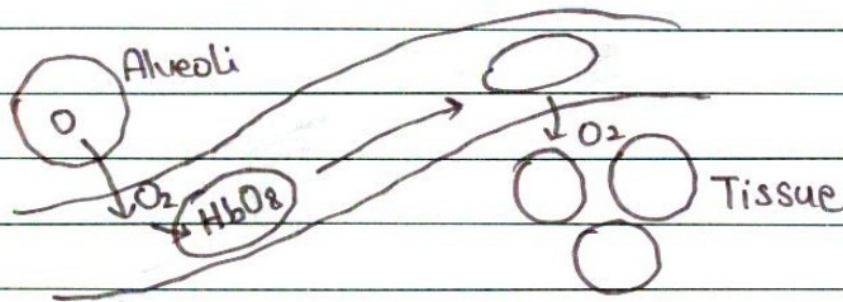


Transport of O_2 .

Oxygen is transported from alveoli (where they are in higher concentration) to tissues (where they are in lower concentration) by plasma (3%) and Haemoglobin (97%). Oxygen binds to Hb when it is at high partial pressure i.e. >100 mmHg and detaches at tissue level where it is at lower concentration <60 mmHg.



This reaction occurs by carbonic Anhydrase.



Transport of CO_2 .

Transport of Carbon dioxide can occur by:

- forming bicarbonates (70%)
- Carboxyhaemoglobin (23%)
- Dissolved in blood plasma (7%)

BLOOD PLASMA

Almost 7% CO_2 is transported from tissues to alveoli by dissolving in blood plasma. More CO_2 is dissolved in blood plasma than O_2 .

as it has more affinity to dissolve in plasma due to its polar bonds.

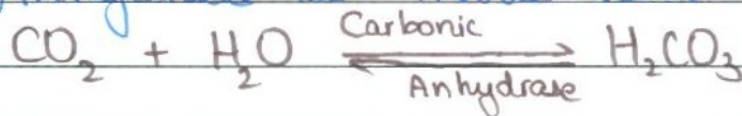
HAEMOGLOBIN

Almost 23% of CO_2 is transported by binding with Hb. CO_2 binds with the globin part of haemoglobin forming Carboxyhaemoglobin.

BICARBONATES

Almost 70% of CO_2 is transported in blood by bicarbonates.

CO_2 dissolves in the blood and enters RBCs. where it reacts with H_2O to form H_2CO_3 Carbonic acid. This reaction is carried out by Carbonic Anhydrase at tissue level.



Ionization:

The H_2CO_3 is a highly unstable compound. It quickly ionizes to form H^+ and bicarbonate ion.



Movement of bicarbonates:

The bicarbonates move out of the RBC into the blood plasma.

Chloride Shift:

To balance the charge distribution, the

Cl^- ions from plasma enter RBCs through special Chloride-bicarbonate channels. This phenomena is called Hamburger Phenomena or Chloride Shift.

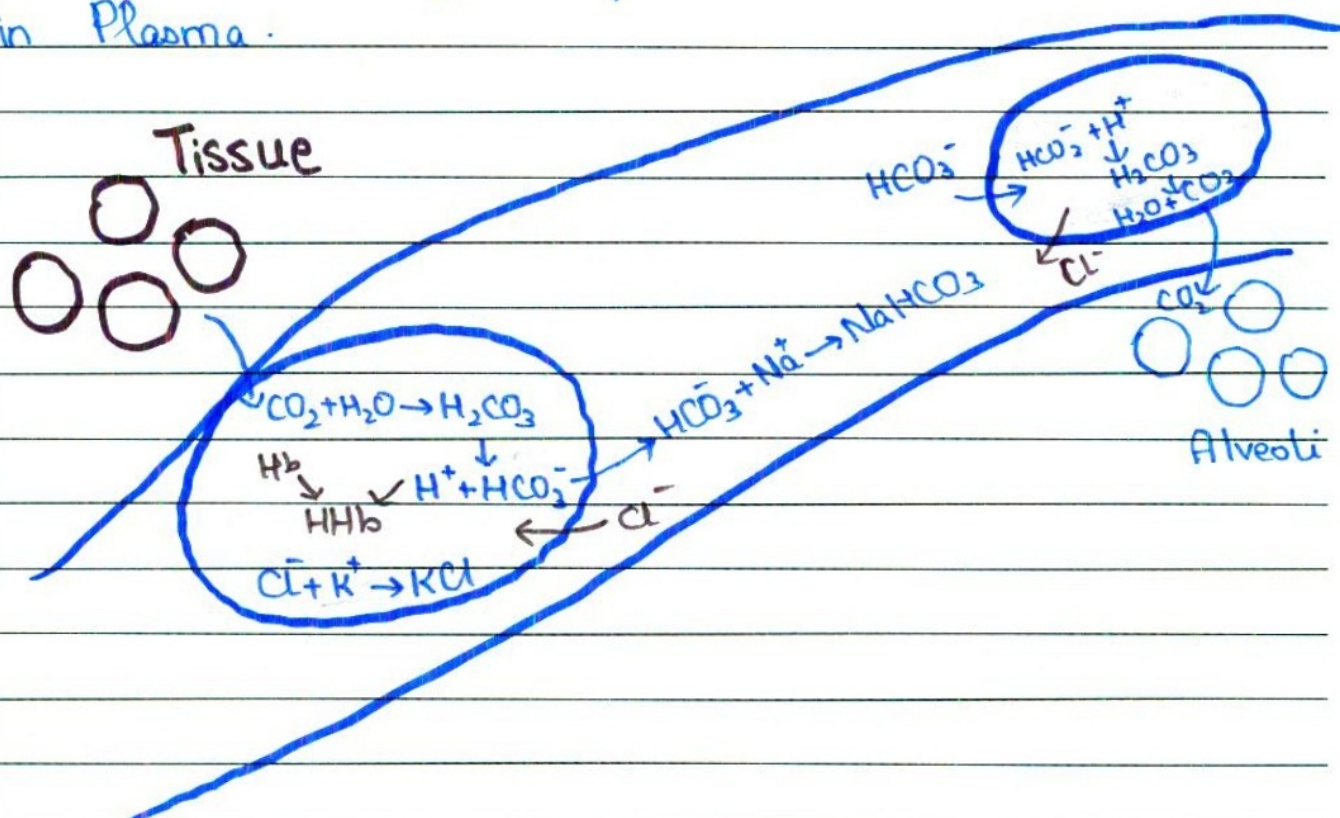
BUFFER:

The H^+ ions binds with Hb molecules so the pH of blood is maintained at 7.45.



K^+ and Na^+ :

The Cl^- ions inside the RBCs bind with K^+ to form KCl whereas the Na^+ ions bind with HCO_3^- to form Sodium bicarbonate in Plasma.



Alveolar level:

At alveolar level, this reaction is reversed to released CO_2 .





