(Section B)

Q. No. 2 Part (i)

Adaptation of Human Body to Extreme Temperature:

When the temperature of human body is high (hyperthermia), the **hypothalamus** detects it through **blood** and sets following **behavioral and physiological effects:**

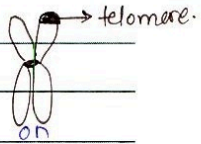
(i) **Sweating:** The sweat glands produce sweat that evaporates and has a **cooling effect.**

(ii) **Vasodialation:** The blood vessels in the human dilate so that they come **near to skin** and **release heat** efficiently into environment.

(iii) **Taking off clothes and moving to a cold place:** This is a behavioral effect.

.....

Q. No. 2 Part (ii)



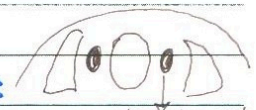
Role of Telomeres in Aging:

- The effect of **telomere shortening** aging is studied under **genetic causes** of aging.
- As the human cell **divides**, the telomere, that is the **end of a chromosome**, starts **shortening** and is reduced with every cell division.
- After successive divisions, the telomere area has **finished** and **cell cannot divide further**.
- Due to this, the **damaged, worn out and dead cells cannot be replaced** and thus **lead to aging**.

(Section B)

Q. No. 2 Part (iii)

Role of Neural Crest in Embryonic Development:



- Neural crest cells arise from the **border of neural plate** after formation of neural tube.
- It is also known as the **fourth germ layer** due to the number of structures it give rise to.
- Following structures are formed by neural crest in embryonic development.

(i) Sensory nevrons.
(ii) medulla (adrenal).
(iii) teeth.
(iv) Skull.
(v). Spinal and cranial ganglia.
(vi) Sympathetic ganglia

Q. No. 2 Part (iv)

Allometric Growth:

- **Definition:** The different rate of growth and development of different parts of the body leading to a difference in size and shape is called allometric growth.
- **Example:**

(i) The **arms and legs** grow rapidly as compared to the head after birth.
(ii) The **head** reaches 90% of the size of an adult by six years of age.
(iii) **Lymphatic system** develops rapidly.
(iv) The **reproductive organs** develop slowly with developing rapidly at puberty.

(Section B)

Q. No. 2 Part (ix)

Primary Function of the Respiratory System:

The primary function of the respiratory system is to **remove CO_2** from the body **along with H_2O produced in cellular respiration** and **inhale O_2**. Thus, **external respiration** and **gaseous exchange** is the primary function of the respiratory system.

Helpful for the body:

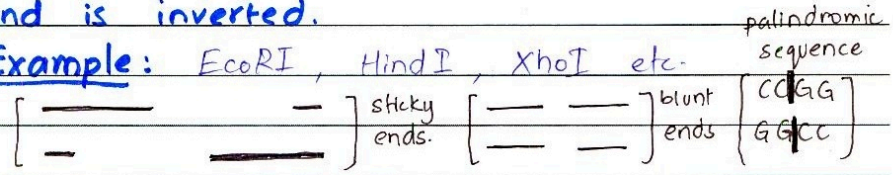
It is helpful for the body as:

(i) **its prevents hypoxia.**
(ii) **removes CO_2 that would otherwise bind to Hb and cause death.**
(iii) **helps in homeostasis.**

(Section B)

Q. No. 2 Part (v) **Role of Restriction Enzymes in Genetic Engineering:**

- Restriction enzymes are involved in making blunt ends or sticky ends of gene of interest and vector at specific sequences.
- Restriction enzymes cut at the specific sequence - they are designed for on both sides of a palandromic sequence.
- A palandromic sequence that is repeated symmetrically on the other DNA strand and is inverted.
- **Example:** EcoRI, HindI, XhoI etc.



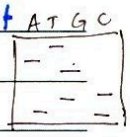
Q. No. 2 Part (vi)

Steps involved in DNA sequencing:

Following are the three steps involved in DNA sequencing:

(i) generating DNA strands starting from the same sequence and ending at different nucleotides, thus getting fragments of different length

(ii) separation of fragments of different lengths on gel-electrophoresis.

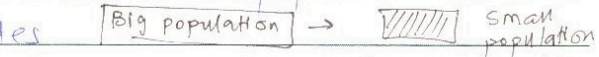


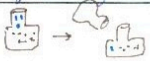
(iii) reading the DNA sequence from farthest to closest to gell well and the template strand is complementary to it.

(Section B)

Q. No. 2 Part (vii) **Neutral Selection:**

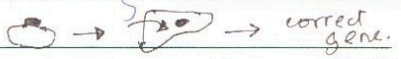
- Neutral selection or genetic drift is the phenomenon in which the **individuals having** a specific alleles for a gene are removed from the population completely by chance or luck.
- This occurs despite the advantage of a gene or trait.
- Whether the trait is harmful or not has no effect on it.
- This is of **two types:**

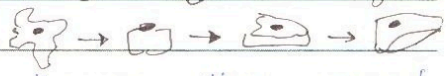
(i) **Founder effect:** a small population out of a large one separates 

(ii) **Bottleneck effect:** change in gene frequency due to a **disaster.** 

Q. No. 2 Part (viii) **Use of Gene Therapy to Treat Genetic Disorder:**

A genetic disorder can be treated by gene therapy by the following **two methods:**

(i) **In-vivo therapy.** 

(ii) **Ex-vivo therapy.** 

- **In-vivo:** In in-vivo gene therapy, the correct gene is **taken into the body** by an **agent** that is **usually a virus like adenovirus, retrovirus etc.** and implanted on organ
- **Ex vivo:** In ex-vivo gene therapy, the organ cell are taken out through **biopsy** and a **grown with therapevtic gene in cell culture.** Then, they are implanted on the organ.

Q. No. 2 Part (x) **Role of Fallopian tubes:**

Fallopian Tubes are involved in the following functions:

(i) Capturing secondary oocyte from the suspended ovary through fimbrae. The fimbrae take the oocyte towards themselves.

(ii) Fertilization occurs in the proximal part of fallopian tube. The sperm fuses with oocyte and forms zygote.

(iii) Cilia in the fallopian tube take or push the oocyte or 8-cell stage embryo after fertilization towards uterus.

(Section B)

Q. No. 2 Part (xi) **Conditions for Hardy-Weinberg Equilibrium:**

Following conditions are required to meet the Hardy-Weinberg equilibrium.

(i) free mating among the individuals of the breeding population.

(ii) No mutation.

(iii) No natural selection.

(iv) No gene flow.

(v) The population should be large.

In these condition, the Hardy-Weinberg equilibrium is maintained ie. the gene frequency remains constant. in the population. $(p+q=1)$ $(p^2+2pq+q^2=1)$

Q. No. 2 Part (xii) **Hypothalamus' significance in endocrine system:**

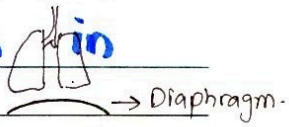
- The hypothalamus acts as the connection between nervous system and endocrine system.
- It regulates the activities and secretions of pituitary gland which control the functioning of other endocrine glands.
- Thus, hypothalamus is the main control of endocrine glands.
- It releases releasing and inhibiting factors along with ADH and oxytocin through its neurosecretory cells and controls functioning of pituitary gland.

(Section B)

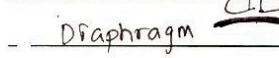
Q. No. 2 Part (xiii) **Integrated Disease Management:**

- Integrated disease management is the process in which all the measures are employed which are thought necessary to stop the spread of disease.
- It includes creating public awareness through print or electronic media, seminars in schools and colleges etc.
- It also includes the following steps.
  (i) introducing preventive measures.
  (ii) medicinal drugs and treatment.
  (iii) vaccines
  (iv) awareness of cause.

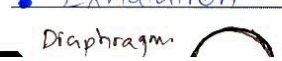
Q. No. 2 Part (xiv) **Role of Diaphragm in Respiration:**



- Diaphragm is a **skeletal muscle** present at the **floor of thoracic cavity.**
- Diaphragm plays a significant role in respiration by **contracting and relaxing** and thus leads to a **decrease or increase in pressure to increase or decrease area during respiration.**
- This helps in **inhalation and exhalation process**
- Inhalation → **contracts and moves downward increase area, reduces pressure**



- Exhalation → **relaxes and moves upward and decrease area, increase pressure**



(Section C)

Q. No. 3 (Page 1)

XX - XY Mechanism of sex-determination in man:

- **Determination System:**

XX- XY mechanism is used for sex determination in man.

- **Female Genotype.**

XX is the female

- **Male Genotype:**

XY is the male

- **Homogametic Female:**

Female (XX) is homogametic. as it produces the same type of gamete that contains X - chromosome only.

- **Heterogametic Male:**

Male (XY) is heterogametic as it produces different type of gametes that contain either X-chromosome or Y- chromosome.

- **Determination of sex of offspring:**

The sex of the organism formed after fertilization is determined by the male.

Reason:

- The reason is that male contributes to the chromosome ie. Y-chromosome which is involved in determining the sex.
- If X-chromosome from male fertilizes with the egg, it

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will be a **female.**

- If Y-chromosome from the male fertilizes with the egg, the offspring will be a **male.**

- **Sex Ratio:**

The sex ratio is **1 : 1** ie. there is an equal chance of a female and a male offspring after fertilization.

50% chance of daughter
50% chance of son.

- **Cross:**

♀ \ ♂	X	Y
X	XX	XY
X	XX	XY

daughters sons

- **Karyotype:**

Karyotype of Female Human: 44 + XX
Karyotype of Male Human: 44 + XY

Reason of Males to be known as Heterogametic:

- The males (XY) are known as heterogametic because they produce different types of gametes:
- The gametes differ on the basis of containing **different sex chromosome.**
- The two different types of

Q. No. 3 (Page 3)

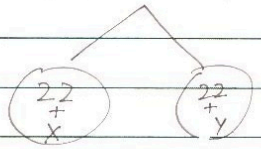
chromosome in male gametes are.

(i) X-chromosome

(ii) Y-chromosome.

- This ability lends them the choice of sex of the offspring.

Male 44 + XY



Q. No. 4 (Page 1)

Ecological Pyramids:

- **Definition:** When different trophic levels in an ecosystem are arranged in the form of graph, a pyramid like shape is formed. This is known as **ecological pyramid.**
- The pyramid like shape of the graph is due to **decrease in number, energy and biomass as we move from T_1 to T_5 ie lower to higher trophic level.**

(i) Pyramid of Energy:

- Pyramid of energy is the graphical representation of showing the energy present in a trophic level.
- It gives a pyramid like shape due to **decrease in energy in successive trophic levels.**
- The reason for a decrease in energy per trophic level is that the previous trophic level uses some energy for
  (i) growth.
  (ii) reproduction.
  (iii) movement.
  (iv) defecation
  (v) lost as heat.

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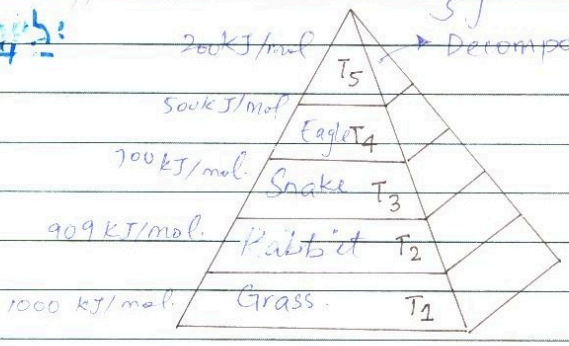
- The energy also depends upon the **quality of food**. The high quality food is efficient in energy utilization.

Graph:

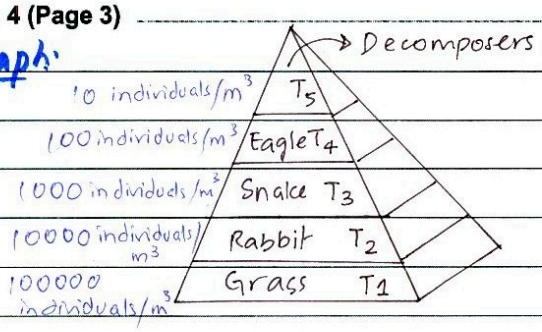


(ii) Pyramid of Biomass:

- Definition: Pyramid of biomass is defined as the **number of organism per unit area or** per unit **volume** in a population.
- The biomass also **decreases** as we move from one trophic level to the next.
- This is due to a decrease in energy as we move from one trophic level to another.
- Only **10%** of the biomass is left as we move from one trophic level to another.

Q. No. 4 (Page 3)

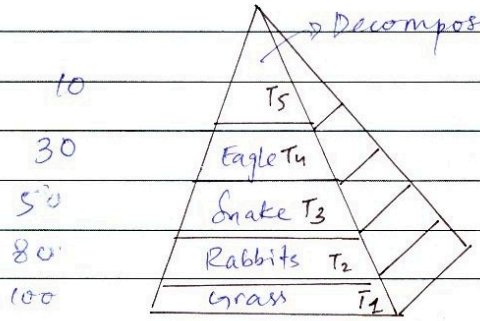
Graph:



(iii) Pyramid of Number:

- **Definition:** The pyramid of mass is the graphical representation of the **number of individuals** in a population.
- The number of organisms in successive trophic levels **decrease** due to decrease in energy available which is necessary to sustain life.

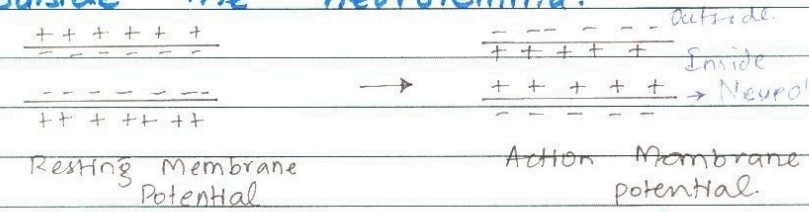
Graph:



Q. No. 5 (Page 1)

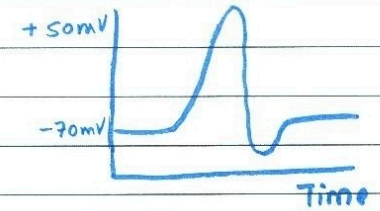
ACTION POTENTIAL:

- **Definition:** The action membrane potential is defined as the **reversal of the charge distribution on both sides of the membrane of the neuron.**
- It is characterized by **more positive inside and more negative outside the neurolemma.**



Resting Membrane Potential

Action Membrane potential.



IDENTIFICATION:

X = Depolarization
Y = Repolarization
Z = Hyperpolarization (Refractory period)

EXPLANATION:

Depolarization (X):

- Depolarization is the process in which the **reversal of the charge distribution across the neuron membrane.**
- This occurs due to **opening of the voltage-regulated Na^+ channels.**
- Due to opening of the channels, Na^+ ions move in and change the membrane potential from **-70 mV** to

Q. No. 5 (Page 2)

0 mV and then +50 mV.

- This is known as depolarization because the charge distribution is reversed than that in polarized or resting stage when it is not conducting nerve impulse.
- It lasts for about 1 millisecond.

(ii) Repolarization (Y):

- When the membrane potential reaches +50 mV, the voltage-regulated Na^+ channels close. and the voltage regulated K^+ channels open.

- As the K^+ is in higher concentration inside the neuron, the K^+ ions start to rush out from inside leading to change of charge distribution.
- The neuron membrane starts returning towards the depolarized state
- The membrane potential changes from +50 mV to 0 mV and then slowly starts moving towards −70 mV but exceeds.
- This is known as repolarization as the membrane potential is moving towards the polarized state.

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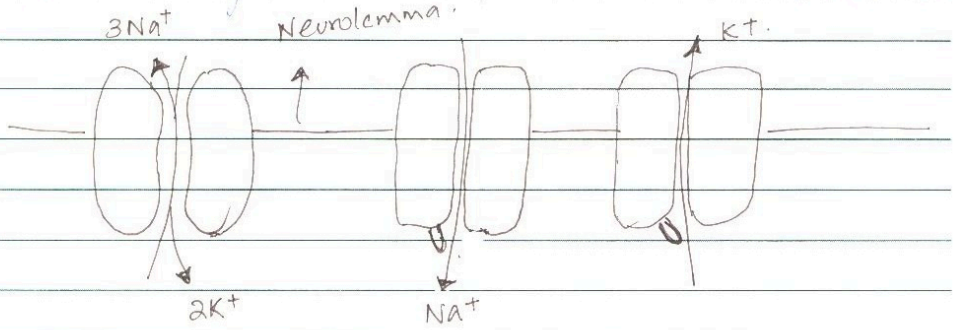
(iii) Hyperpolarization:

- The voltage regulated K^+ channels delay to close as a result of which the membrane potential inside the neuron becomes more negative than normal.
- This is known as hyperpolarization as the membrane exceeds its potential.
- The normal polarized state is gained by the Na^+/K^+ pump.

Action potential:

⇒ This cycle lasts for about 4 milliseconds.



Na^+/K^+ pump	voltage regulated Na^+ channels	voltage regulated K^+ channels.
(Maintains polarized state)	(Depolarization)	(Repolarization and hyperpolarization

(Section C)

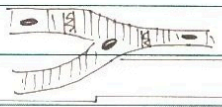
Q. No. 6 (Page 1)

IDENTIFICATION OF MUSCLES:

A: cardiac muscles
B: skeletal muscles
C: smooth muscles.

CARDIAC MUSCLE	SKELETAL MUSCLE	SMOOTH MUSCLE
Stripes.		
irregular stripes	regular stripes	no stripes.
Striation.		
striated	striated	unstriated.
Nuclei Number		
one per cell	multinucleated	one per cell
Branching		
branching	no branching	no branching
Shape of Nucleus.		
round/oval nucleus	oval nucleus	elongated nuclei.
Speed of contraction.		
intermediate	slow to rapid	slow.
Fatigue		
not possible	gets fatigued.	rarely.
Location.		
present in heart.	attached to skeleton.	in visceral organs like blood vessels, reproductive, urinary system etc.

Q. No. 6 (Page 2)

Function		
pumping of heart	movement and locomotion	movement of fluid.
Control.		
Spontaneous	autonomic nervous system	somatic nervous system.
Troponin		
has troponin	has troponin	lacks Troponin.
Diagram		
		
Sarcolemma.		
present	present	absent.

Similiraties:

(i) They contain muscle fibres.

(ii) They are surrounded by connective tissues.

(iii). All have actin, myosin and tropomyosin.

(Section C)

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Space for rough work

Space for rough work

Space for rough work