BIOLOGY

Section - A

A1. Swelling in filariasis is caused due to the prolonged existance of the filarial worm, Wuchereria (W. bancrofti or W. malayi) in the lymphatic vessels of the lower limbs.

A2. Water hyacinth or 'Terror of Bengal' or Eicchornia crassipes. The weeds grow abundantly in stagnant water and eutrophied water bodies.

A2. Basmati (Indian farmers' Basmati) has been patented by an American company.

A4. Two adaptive features are:

1. Loss of unnecessary sense organs and of digestive system.
2. Presence of adhesive organs or suckers to cling on to the host. They also have high reproductive potential.

A5. Offsprings produced by asexual reproduction are clones i.e. they are genetically and morphologically identical to their parents. Progeny produced by sexual reproduction vary by a certain degree (in few or many characteristics) from each other as well as from the parents i.e. they show variations and are not genetically and morphologically identical to the parents.

Also, in asexual reproduction, progeny is derived from a single parent, whereas in sexual reproduction, offspring is derived from two parents.

A6. a- Continuous synthesis (leading strand)
b- Discontinuous synthesis (lagging strand formed by Okazaki fragments)

A7. According to Hugo de Vries, speciation is caused by single step large mutation or saltation. These are random and directionless and refer to the sudden but large changes in the chemical sequence of the genetic material.

A8. Beeswax and honey are the two products.

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Section B

Ans. Tobacco contains nicotine, an alkaloid

1. Nicotine stimulates the adrenal gland to secrete more adrenalin and nor-adrenalin and thereby increases heart rate and blood pressure.
2. Smoking tobacco can lead to cancers of throat, urinary bladder and respiratory system (lungs), gastric ulcers, bronchitis, emphysema and coronary heart disease.
3. Chewing tobacco can cause cancers of oral cavity.
4. Smoking tobacco also increases the amount of CO in the blood. This decreases the haemoglobin and causes disorders related to deficiency of oxygen (eg. anoxia or hypoxia)

A10. a) Parasitism
b) Parasitism Commensalism
c) Competition.
d) Mutualism

A11. Cu T has the following actions:

1. Increases phagocytosis of sperms.
2. Release of copper ions reduces the motility of sperms.
3. Release of copper ions reduces the fertilising capacity of sperms.

2008

A12. The evolution of the same organ or structure along different directions to meet the different needs of the organisms and to adapt to different habitats / environments is called divergent evolution or homology. eg. Thorns of bougainvillea and tendrils of Cucurbita are both modifications of the same structure, the leaf. While the thorns provide protection tendrils provide mechanical support for climbing.

A13. The harms of thermal power plants can be divided into:

1. Air Pollution: Smokestacks release particulate and gaseous pollutants into the air.
   Effects: Acid rain, respiratory problems (irritation, inflammation and damage to lungs) in humans and

reduction in yield and growth of crops

Precaution: Using scrubbers and electrostatic precipitators in exhausts of chimneys.

2. Water pollution: Thermal waste waters are discharged into water bodies

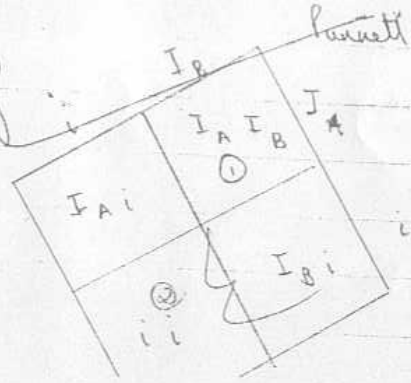
Effects: Elimination of aquatic organisms sensitive to high temperature, enhancing growth of organisms in very cold areas but at the cost of the indigenous flora & fauna.

Precaution: Proper treatment of thermal waste waters before discharging.

2008

Ans. Since O blood group is seen in daughter, both parents must have the recessive 'i' allele.
Also, since AB blood group is seen in son, the other allele in man should be I_A & in woman should be I_B. This could also ensure that man has blood group 'A' and woman has blood group 'B'.

Man - $I_A i$
Woman - $I_B i$



Gametes (Male)

① Possibility / Probability of AB blood group in progeny = 1/4

② Probability of O blood

Ans. Chasmogamous flowers are open and expose the stamens and stigma. They increase the chances for geitonogamy and xenogamy. eg. brinjal.
Cleistogamous flowers do not open at all.
The stigma and anthers lie close to each other.
They mostly pollinate through autogamy. eg. beans

Cleistogamous flowers produce assured seed-set whereas it is not so in the case of chasmogamous flowers.

A16. i) 'b' DNA - DNA from source (alien piece of DNA)
'a' DNA - Vector (or Cloning Vector) Plasmid / Bacteriophage DNA

These two are the palindromic sequences at which the restriction endonuclease makes cuts, leaving sticky ends.

ii) EcoRI is the enzyme.

iii) DNA ligase links the two fragments. The sticky ends facilitate its action by forming hydrogen bonds with complementary cut counterparts.

2008

A17. a) Streptococcus

b) Fungus

c) Cyclosporin A

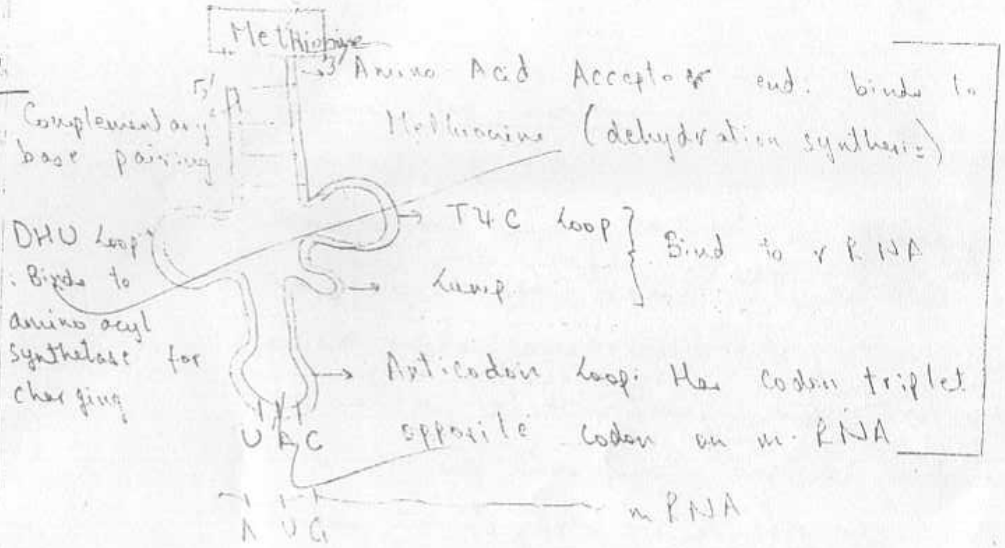
d) Clostridium butylicum

A18.

Detritivore eg. earthworm	Decomposer eg. bacteria
1. Acts on (feeds on it) detritus	Acts on simple organic substances.
2. Breaks complex organic matter into smaller substances/fragments.	Breaks simple organic molecules into inorganic constituents.
3. Facilitates fragmentation.	facilitates catabolism
4. Fragments are further broken down.	Inorganic constituents are not

Section C

Ans.



tRNA adapter (single stranded but folded)

Uniqueness:

i) Codes for methionine in polypeptide chain

ii) : : Initiator / Thrust codon is present on this. It is called the initiator t-RNA because it initiates translation (methionine is the first amino acid in a polypeptide).

A20. Charging / Aminoacylation of tRNA

Reasons for importance

1. Translation requires a lot of energy. During charging, energy is derived from ATP, so that when the amino acids come close to each other, peptide bond formation between them is energetically favoured.
2. It is during charging that an amino acid binds to its specific tRNA at the amino-acid acceptor end of the tRNA.

Process

ATP, tRNA and its specific amino acid bind to the enzyme amino acyl synthetase. An enzymatic reaction takes place leading to high energy tRNA-amino acid complex formation (Charging with energy for translation).

ATP + Amino Acid + tRNA $\xrightarrow{\text{Amino acyl synthetase}}$ AMP + tRNA - Amino Acid + 2 Phosphate groups.

The energy is derived from the breaking of 2 pyrophosphate bonds in ATP.

The tRNA - Amino Acid complex is now ready for translation.

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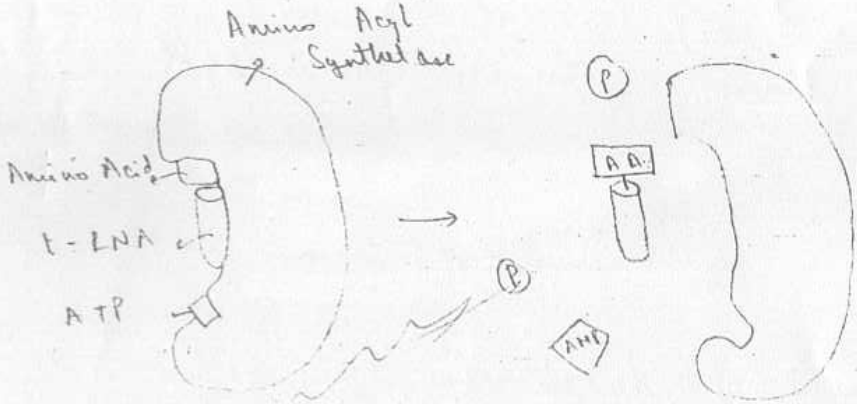
Diagrammatically:



Enzyme catalysed
Charging of t RNA

A21. i) Plasmodium enters into human body at sporozite (infectious) stage through the bite of the female Anopheles mosquito.

ii) Asexual reproduction in infected human

Sporozites (infectious stage) enter through bite of female Anopheles

↓

Sporozites travel to liver cells through blood

↓

Asexual reproduction in liver cells to produce many more copies of the protozoan

↓

Bursting of the liver cells to release protozoa

↓

in the RBCs

↓

Bursting of RBCs at periodic intervals of 3-4 days to release protozoa and a toxic substance named haemozoin. This accounts for high fever and chills that occur periodically

↓

New protozoa infect other RBCs and cause them to burst.

iii) Victim shows symptoms of high fever because of periodic bursting of red blood cells and release of a toxic substance, haemozoin at intervals of 3-4 days.

Ans. MOET stands for Multiple Ovulation Embryo Transfer Technology and is a method for herd improvement and increasing herd size.

Procedure:

Hormone with FSH like activity is given to superior female

↓

Follicular development and super ovulation in female.

↓

Instead of one egg per cycle that is normally produced, 6-8 eggs are produced

↓

Mating of superior female with elite bull or artificial insemination

↓

Fertilized eggs with 8-32 cells are retrieved non-surgically

and transferred to surrogate mother for development

↓

Genetic mother undergoes another round of Super-ovulation.

In this way, Superior females (high milk yield), cow or buffalo is bred with a high quality (lean ~~bird with~~ meat with less lipid) meat yielding ball to generate a large number of progeny and increase herd size within a short time.

A23 i) Thermus aquaticus is the source of Taq polymerase or heat resistant DNA polymerase which is required for the polymerisation of deoxyribonucleotides in Polymerase Chain Reaction (PCR), a technique employed in recombinant DNA technology for the amplification of a piece of DNA.

In PCR, the two strands of the piece of DNA are first separated using high temperature (94°C) to induce denaturation. At 60°C, two primers (chemically synthesized small oligonucleotides (10-18 nucleotides long) complementary to regions of DNA) are introduced (annealing). The Taq polymerase then catalyses the elongation of the primers using deoxyribonucleotides at high temperature (72°C). This results into amplification of the DNA piece.

Because of the high temperature requirement for PCR, taq,

high temperature and are not heat resistant.

A24. Organisms manage with stressful conditions that exist transiently in their habitat in the following two ways:

1. Migration - Organisms migrate to more hospitable areas. eg. the birds from Siberia during winter in Keoladeo National Park (Rajasthan - Bharatpur). These undertake long migratory journeys to escape the stressful harsh winter of Siberia and reside in more hospitable areas (Bharatpur). One the stressful conditions are over, the organisms return to their natural habitat.

2. Suspend-

a) Bacteria, fungi and lower plants - Thick walled spores to protect from unfavourable conditions. Wall breaks when conditions are favourable.

b) Higher plants - Seeds and protecting reproductive structures tide over unfavourable conditions and germinate when there is moisture and suitable temperature. They slow down metabolism and enter into dormancy.

c) Hibernation in bears - In winters, organism escapes in time but continues to grow.

Aestivation in snails and fish - To protect from heat and dessication in summer, organisms go into summer-sleep.

e) Diapause in zooplankton - State of suspended development.

A25. Haemophilia is a sex-linked recessive disease.

Let X^{H} - normal allele

X^{h} - haemophilic allele

Non-haemophilic couple

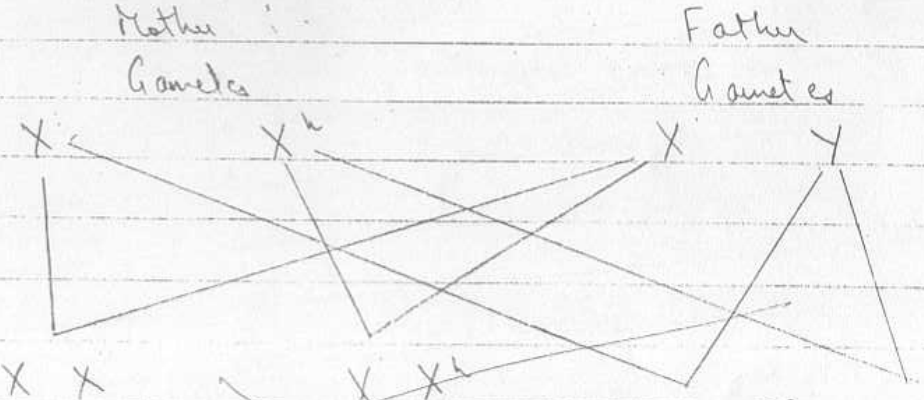
Mother : $X^{H}X^{H}$ or $X^{H}X^{h}$

Father : $X^{H}Y$

For haemophilic child, mother must be carrier ($X^{H}X^{h}$)

Basis for doctor conveying this information

1) Detection of carrier state in mother



Note: Can also be represented as Punnett Square

2) Partial haemophilia in mother due to lyonization and X-Chromosome inactivation

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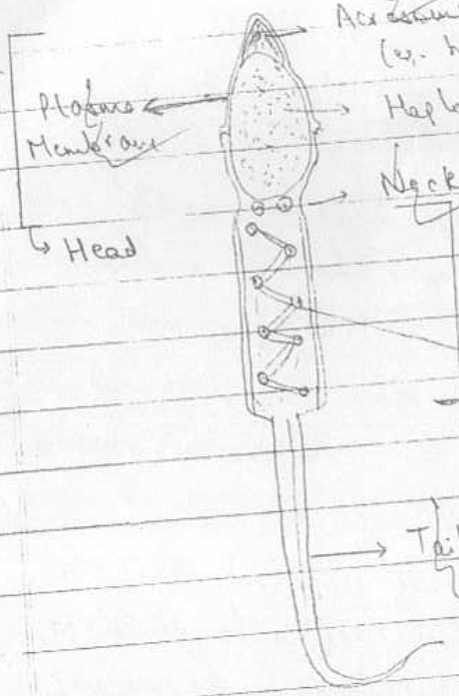
A26.



Acrosome (Cap-like) filled with lysins (e.g. hyaluronidase) for fertilization

Plasma Membrane

Haploid Nucleus containing chromosomal material

Neck

Head

Middle piece containing spiral mitochondria (generate energy for swimming)

Tail / Flagellum (Motility)

Human Sperm

A27. i) 'a' - Exponential growth curve
'b' - Verhulst-Pearl Logistic growth curve

ii) Verhulst-Pearl logistic growth curve is more realistic as it considers limited resources (food and space) in a habitat and competition between the species. Exponential growth curve is for unlimited resources, something which never occurs in nature.

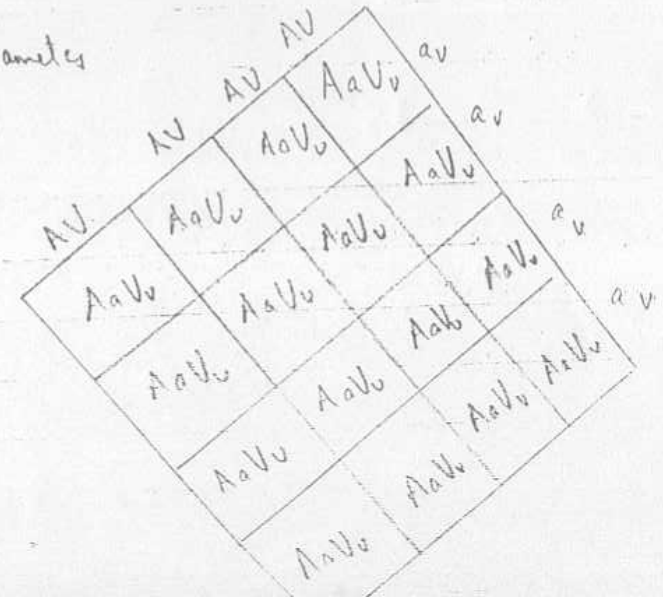
iii) K → Carrying capacity of habitat or maximum number / population of a particular species that can be supported in a habitat.

N is for population density, a measure of the size of the population at time 't'

A28 True breeding pea plant homozygous for axial violet flowers has genotype AAVV.
Other plant has genotype aa vv.

a) F_1 generation

Gametes



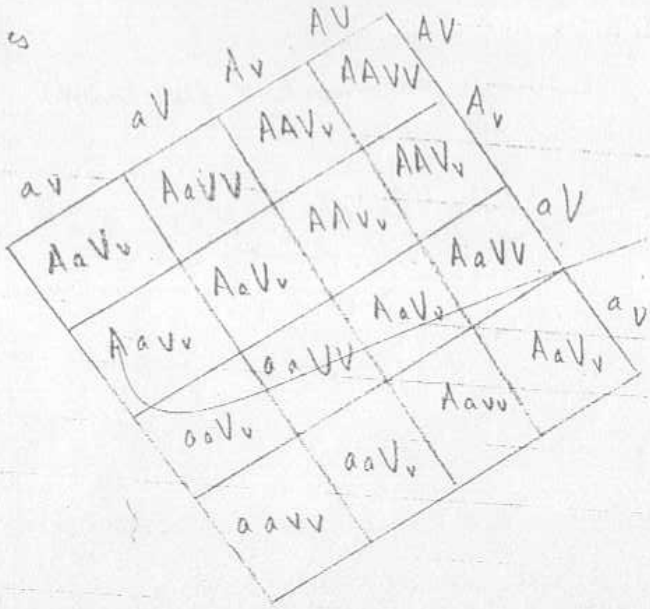
Gametes

Genotype: A_aV_v

Phenotype: Axial violet flowers

F_2 generation.

Gametes



Gametes

Genotypes predicted from Punnett Square

Diff phenotypes shown:

1) Axial violet
2) Axial white
3) Terminal white
4) Terminal violet

b) Phenotypic ration of

Axial violet : Axial white : Terminal violet : Terminal white = 9 : 3 : 3 : 1

C) Generalisations of Mendel :

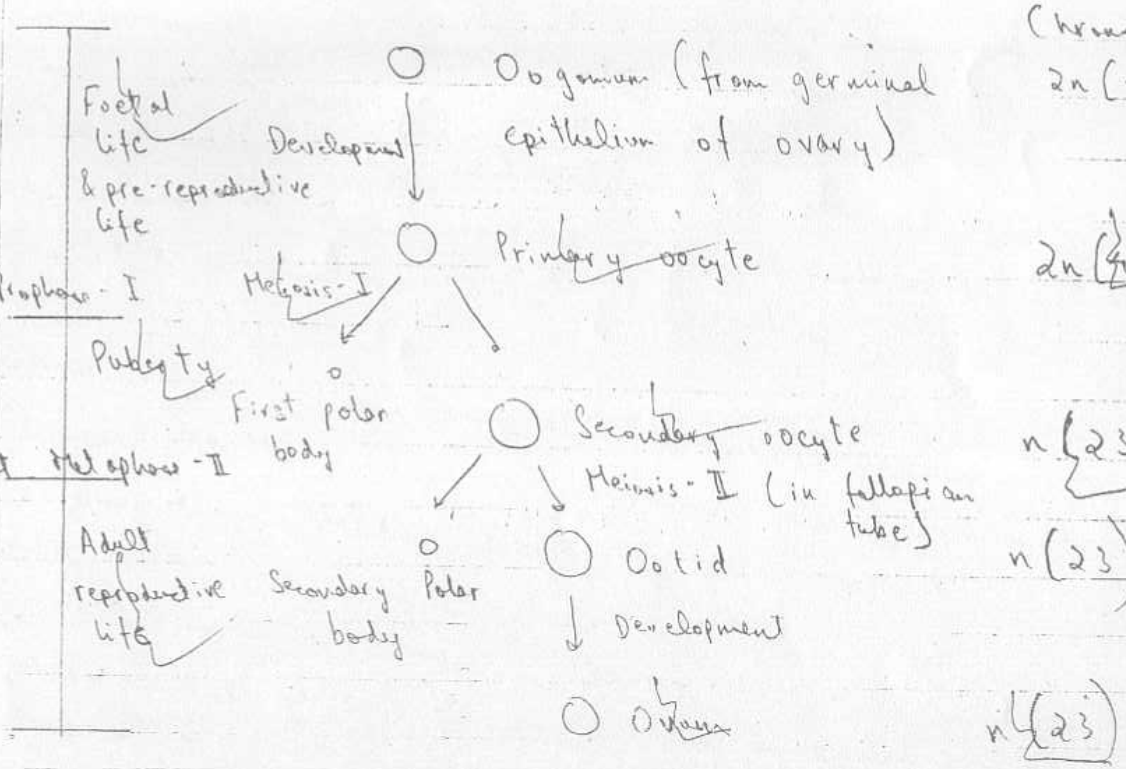
i) Law of Dominance - In a pair of dissimilar factors (stable & discrete), one factor dominates over the other (recessive).

ii) Law of Independent Assortment - When two pairs of characters are combined in a hybrid, segregation of one pair of characters takes place independently of the segregation of the other pair of characters.

iii) Law of Segregation - Though a parent contains two alleles, only one of these is transmitted to a gamete during gamete formation and that too, with random probability (& equal proportion). This accounts for no blending of the two alleles.

A29. 11)

Oogenesis



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A30. ii) a). Plasmid is an autonomously replicating circular extra-chromosomal DNA found in certain bacteria. It has small number of base pairs and can act as a cloning vector. Number (or copy number) in a cell may vary from one to many thousand. It has an origin of replication (a special DNA sequence) for initiating replication.

b) ADA deficiency refers to deficiency of Adenosine Deaminase, an enzyme crucial to the function of the body's immune system. Deficiency is caused due to ~~defect~~ deletion of gene responsible for synthesis of ADA.
Gene therapy - Collection of methods to correct a gene defect diagnosed in a child / embryo by inserting a normal gene to compensate for non-functional gene.

In case of ADA deficiency,

Lymphocytes ~~taken out~~ from blood, cultured

↓

Functional ADA cDNA (using retroviral vector) coding for ADA introduced into lymphocytes

↓

Lymphocytes returned to patient who starts having ADA in his blood (or her blood), so cured

Not permanent cure as lymphocytes are not immortal & periodic infusions of these cells have to be given.

If gene isolated from marrow cells coding for ADA is introduced in lymphocytes at early embryonic stage → maybe permanent cure.