केन्द्रीय माध्यमिक शिक्षा बोर्ड, दिल्ली
सीनियर स्कूल सर्टिफिकेट परीक्षा (कक्षा
परीक्षार्थी प्रवेश–पत्र के अनुसार भरे

विषय Subject : BIOLOGY

विषय कोड Subject Code : 044

परीक्षा का दिन एवं तिथि
Day & Date of the Examination : WEDNESDA

उत्तर देने का माध्यम
Medium of answering the paper : ENGLISH

प्रश्न पत्र के ऊपर लिखे कोड को दर्शाए : Write code No. as written on the top of the question paper :	Code Number	Set Number
	57/2	① ● ③ ④

अतिरिक्त उत्तर–पुस्तिका (ओं) की संख्या
No . of supplementary answer -book(s) used : 1

विकलांग व्यक्ति : हाँ / नहीं
Person with Disabilities : Yes / No : NO

किसी शारीरिक अक्षमता से प्रभावित हो तो संबंधित वर्ग में ✓ का निशान लगाऐं।
If physically challenged, tick the category

B	D	H	S	C	A

B = दृष्टिहीन, D = मूक व बधिर, H = शारीरिक रूप से विकलांग, S = स्पास्टिक
C = डिस्लेक्सिक, A = ऑटिस्टिक
B = Visually Impaired, D = Hearing Impaired, H = Physically Challenged
S = Spastic, C = Dyslexic, A = Autistic

क्या लेखन – लिपिक उपलब्ध करवाया गया : हाँ / नहीं
Whether writer provided : Yes / No : NO

यदि दृष्टिहीन हैं तो उपयोग में लाए गये सोफ्टवेयर का नाम :
If Visually challenged, name of software used : NA

*एक खाने में एक अक्षर लिखें। नाम के प्रत्येक भाग के बीच एक खाना रिक्त छोड़ दें। यदि परीक्षार्थी का नाम 24 अक्षरों से अधिक है, तो केवल नाम के प्रथम 24 अक्षर ही लिखें।
Each letter be written in one box and one box be left blank between each part of the name. In case Candidate's Name exceeds 24 letters, write first 24 letters.

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कार्यालय उपयोग के लिए
Space for office use

Write within this box

SECTION - A

1. The reduced fertility and productivity may occur due to continuous close inbreeding (mating between closely related individuals of same breed with common ancestor for past 4-6 generations). This is known as inbreeding depression.
A single outcross helps to overcome inbreeding depression which involves mating between individuals belonging to same breed but not having common ancestor for past 4-6 generations.

2. The high voltage wires in electrostatic precipitator produces a corona of electrons, which attach to dust particles, make them negatively charged and attracted by grounded by collection plates. In this way the exhaust is purified. The inability to generate thousands of volt fails to remove the particulate matter present in the exhaust and causes air pollution. This may affect both plant and animal life deleteriously by causing respiratory problems.

3. The cry genes that code for toxic protein - cry protein, specifically cry II Ab and cry I Ac are incorporated in cotton plants to protect it against cotton boll woom infestation.

4. The postulates of Oparin and Haldane's Theory about origin of life are:-

i) first form of life originated from pre existing non-living organic molecules like RNA, protein etc

ii) origin of life was succeeded by chemical evolution (ie, formation of diverse ~~inorganic~~ organic molecules from inorganic molecules.

5. A test ~~cross~~ [monohybrid test cross] which is a back cross would enable us to find the genotype of a pea plant bearing violet flowers. The plant can be crossed with its recessive parent i.e., white flowered pea plant and the progeny can be evaluated to determine its genotype as homozygous or heterozygous

Section B

6. Colostrum provides passive immunity (natural) to the new born baby.

Passive immunity should be provided ie, passive immunisation should be done for a person who requires urgent immune response so as to prevent fatality. For example, in case of tetanus infection, preformed antibodies should be introduced in the body. In case of snake bite also, similar strategy is adopted

~~7 A yeast, Trichoderm~~

8. A yeast, Monascus purpureus, helps in the production of the bioactive molecule statin, used to reduce blood cholesterol level

Another fungi, Trichoderma polysporum aids in the production of cyclosporin A, an immunosuppressant.

9. a) Each codon codes for only one amino acid. This implies genetic code is unambiguous and specific.
Each codon codes for the same amino acid in all organisms
eg:- the codon UUU codes for phenyl alanine in all organisms.
Hence genetic code is universal.

b) One amino acid is coded by more than codons
eg:- Phenyl alanine is coded by UUU, UUC, UUA, UUG.
Hence genetic code is degenerate

Initiator codon is AUG. It plays dual functions by coding for amino acid methionine and acting as initiator codon.

10. In 60% of the flowering plants including peas, pollen grains are shed at celled stage. The 2 cells are generative cell and vegetative cell
While in 40% of the flowering plants including wheat, this

occurs at 3-celled stage, where the generative cells divides mitotically to form 2 male gametes. The 2 male gametes along with vegetative cell constitute 3-celled stage of pollen grain.

Germ pores are prominent apertures present on the exine - outer hard wall of the pollen grain, where sporopollenin is absent.

Section - C

11. a) The two methodologies involved in human genome project were i) Expressed Sequence Tags
ii) Sequence Annotation

Expressed Sequence Tags was an approach which involved identifying all the sequences which were expressed i.e, (in the form of products)

the coding sequences.

Sequence Annotation was a blind approach of sequencing the whole set of genome ie, both coding and non-coding sequences, and different regions were assigned with their functions later.

b). YAC stands for Yeast Artificial Chromosome.

It was used as a major cloning vector, Human Genome Project for cloning the genes in yeast (as host), along with BAC.

12. Productivity can be defined as the rate of biomass production. This can be found at different trophic levels. In other words, the amount of biomass or organic produced per unit area per unit time is known as productivity.

Productivity considered at the producer level is referred to as primary productivity

(GPP) Gross Primary productivity is the rate of formation of biomass or organic matter per unit area by plants through photosynthesis

Whereas Net primary productivity (NPP) is the biomass that is available for consumption by the consumers of next trophic level ie, herbivores

$$NPP = GPP - R$$

where R = respiratory losses.

This is because, plants utilise some of GPP to carry out their respiratory activities. What remains after this constitute Net primary productivity.

13. Vallisneria shows hydrophilic pollination ie, pollination is done with the help of water as agent.
Vallisneria is an aquatic plant, found in freshwater.
It shows epihydrophily ie, pollination occurs on the surface of water. The female flowers reach the surface of water by their long stalks. Male flowers or pollen grains are also released on to the surface of water, which are carried passively by water currents. Some pollen grains reach the stigma of female flower and effects pollination (The pollen grains are covered with mucilagenous covering to avoid wetting.)

Water-lily, although being an aquatic plant, is pollinated by wind or some insects as in the case of terrestrial plants. This is because the flowers of water-lily are present much above the surface of water / water level. Hence hydrophily do not occur.

14. Haemophilia is a sex linked ~~recessive~~ disorder i.e., it is caused by a recessive gene in the X-chromosome. In this disease, a single protein which is a part of the cascade of proteins involved in blood clotting is affected. Hence a single cut or wound would result in non-stop bleeding in such individuals.

Thalassemia is an autosomal recessive disorder, ~~which~~ is caused due to mutation or deletion of a gene which affects the synthesis of any one of the globin chains of haemoglobin molecule. As a result, insufficient no: of (α or β) globin chains are produced, resulting in non-functional haemoglobin.

Thalassemia is a quantitative problem in which the required number or quantity of globin chains that make up haemoglobin is not produced.
Thalassemia results in non-functional haemoglobin, while Haemophilia results in non-clotting of blood.

Thalassemia causes anaemia due to the non-functional haemoglobin while haemophilia does so by causing massive bleeding

Thalassemia and Haemophilia belong to the category of Mendelian disorders (of genetic disoorders.)

15. According to Hardy - Weinberg genetic equilibrium, gene pool remains constant and stable. ~~Sum of~~ The allelic frequencies remain stable and constant generation and generations for sexually reproducing organisms.
Any disturbance in Hardy - Weinbergy genetic equilibrium is indicative of the action of ~~evolutionary~~ forces i.e, evolution in play.
Disturbance to Hardy - Weinberg genetic equilib.rium is caused due to mutation, genetic recombination, natural selection. gene flow or gene migration, genetic drift.

i) Mutation causes heritable change in phenotype and genotype of organisms, thereby changing allelic frequencies.

ii) Recombination occurs due to crossing over in Pachytene stage of Meiosis I. It results in variations

iii) Natural selection operates in 3 ways:

i) Stabilising :- The average phenotype is favoured and selected

ii) Directional :- Any one of the extreme characters is favoured

iii) Disruptive :- Two extreme characters are favoured.

All these cause change in allelic frequencies.

iv) Gene flow :- the migration of a group of individuals (emmigration and immigration) leads to changes in the allelic frequencies in the old and new population

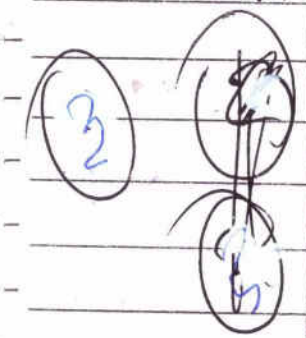
v) Genetic drift :- When gene flow occurs due to chance events like natural calamities, it is known as genetic drift.

When a group of individuals move into a new population, the allelic frequencies are so different in the new one such that they become a new species. This is Founders Effect and the original drifted population is known as Founders.

16. Amoebiasis or Amoebic dysentery caused by Entamoeba histolytica is transmitted through food and water contaminated with faecal matter of infected person. The symptoms include abdominal cramps, constipation, passage of stools with excess mucus and blood clots.

Houseflies act as mechanical carriers for the spread of disease by transferring the pathogen from faecal matter to food and water.

17. Polymerase Chain Reaction is a technique of synthesising multiple copies of a desired gene in vitro.



For this process, DNA Polymerase enzyme is required for the synthesis of new DNA strands. A thermostable DNA Polymerase enzyme - Taq Polymerase is used. This enzyme is extracted from the bacterium Thermus aquaticus.

PCR ~~requir~~ involves the steps of denaturation, annealing and primer extension.

In the first step - ie, denaturation the 2 DNA strands are separated by heating to 94°C, which breaks the H bonds in between so that each strand would act as a temple for the synthesis of new DNA strands. Such separation is essential in case of any replication. Here heat aids in separation through denaturation.

2 nucleotide primers - 10 to 18 nucleotide long (oligonucleotide which are complementary to the sequence at the 3'

end of the gene to be amplified are required in PCR technique. These primers provide 3' OH group for the activity of DNA Polymerase.

18. Aestivation is summer sleep ie, inactivity during summer seasons, undertaken by organisms of warm climates during hot seasons. This is a type of respone shown by organisms when the stressful conditions persist for a short time. Aestivation is undertaken when the stressful conditions arise due to high temperature. Organisms like snails, fishes etc aestivate to avoid summer related problems like heat, dessication etc.

While hibernation is inactivity during cold condition when the organism cannot carry out its normal functions in such an extreme condition. It is known as winter sleep. Organisms seen in polar regions such as polar bears hibernate

Encystation / Fungi respond to adverse climatic conditions by forming thick walled spores which are resistant to such conditions. Spore formation enables them to overcome unfavourable conditions. On availability of favourable conditions, they germinate.

19. Artificial insulin / Cumulin was first produced by Eli Lily Company.
The various steps involved are:-
i) production of 2 DNA sequences corresponding to chains A and B of human insulin
ii) introduction of the sequences into a host such as E. coli
iii) synthesis of the 2 chains separately in the host
iv) extraction of the 2 polypeptide chains from the host
v) joining the 2 chains by forming disulphide bonds between them to create mature insulin.

20. a) Palindrome in DNA is a sequence which reads the same on both strands when the orientation of reading is kept the same. Restriction endonucleases always recognise palindromic nucleotide sequences in DNA, and cut always between the same the 2 bases on both strands. These enzyme cut the palindromic sequences a little away from the centre. These creates single stranded portions at the end. These overhanging stretches on both strands are called sticky ends or cohesive ends, since they can form H bond with complementary cut counterpart. The stickiness of the ends facilitate the action of the enzyme DNA ligase and enables ligation of source and vector DNA to form recombinant DNA

(or)

b) Restriction endonucleases are used in the formation of r-DNA, composed of DNA from different sources or genome. Both the vector DNA and source DNA are cut by the same restriction endonuclease. This creates the

same kind of sticky ends which are complementary to each other and can be joined together (end to end) using joining enzyme DNA ligase.

22. a) A farmer looks for the characters like high yield, thicker stems, high sugar content and ability to grow in different sugarcane growing belts in his sugar cane crop.

b) North Indian sugarcane variety - Saccharum barberi had low yield and sugar content. While the south Indian variety of tropical can. Saccharum officinarum had high yield, high sugar content, thicker stem but was unable to grow in the sugar cane growing regions of North India. Plant breeding techniques enabled the development of new variety which combined the desirable characters of both North Indian and South Indian variety.

The new variety had high yield, thicker stems, high sugar content and ability to grow in North Indian regions.

:-

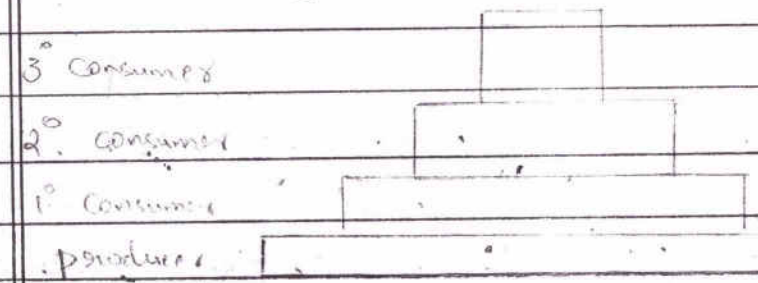
Section E

24) a) An ecological pyramid is a graphical representation of different trophic levels of a food chain in an ecosystem, reflecting any one of the parameters like number, biomass, energy etc.

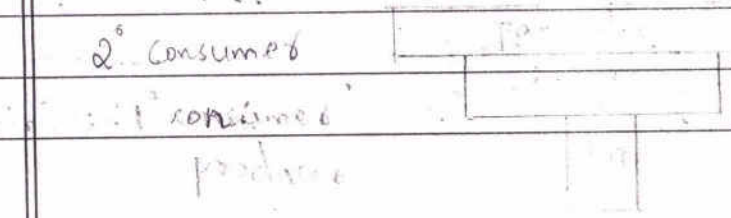
A pyramid of number indicates the number of organisms involved in each trophic level.
These pyramids may be upright, inverted or spindle-shaped.

For a grassland ecosystem, the number pyramid is upright. The number of ~~producers~~ producers ie, plants and trees are far greater than the primary consumers - herbivore which feed up on these plants and trees. The herbivores are

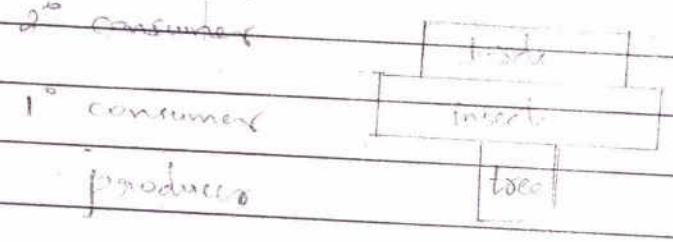
greater in number than the 2° consumers - i.e, carnivores who in turn have greater number when compared to 3° consumers - top carnivores. Hence the pyramid can be depicted as:



When a single tree is considered and the birds feeding on the tree will be greater in number. The parasites which reside in the body of birds will be still higher in number. Thus such a food chain gives an inverted number pyramid

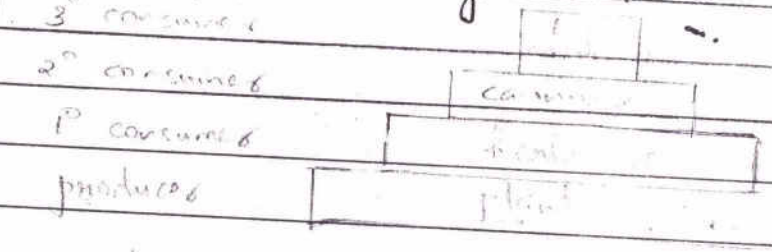


Again, consider a single tree and the no: of insects feeding on it will be higher. The number of birds in turn feeding on insects will be lower. Hence it gives a spindle shaped pyramid

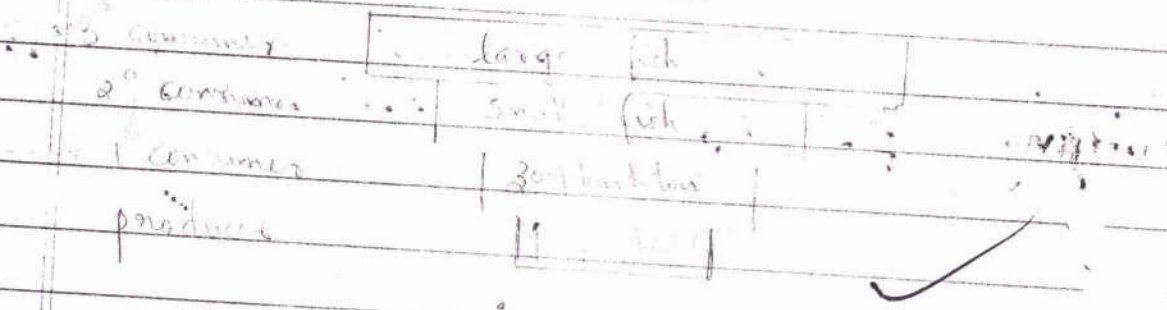


A pyramid of biomass indicates the biomass of ~~diffent~~ organisms occupying ~~at~~ different trophic levels.

In a forest ecosystem, the pyramid of biomass is ~~inverted~~ upright

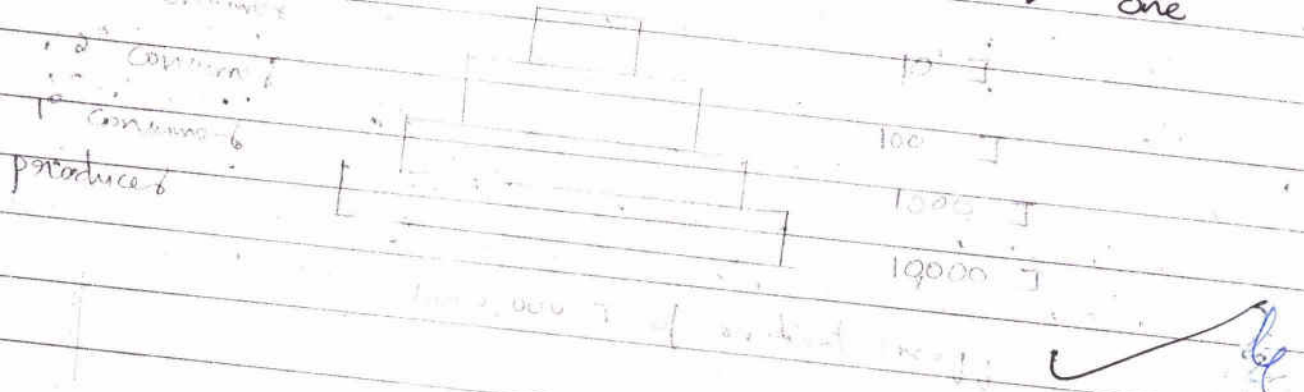


In a sea ecosystem, the pyramid of biomass is inverted
Considering the food chain phytoplanktons → zooplanktons →
small fishes → large fishes
the biomass of phytoplanktons which are microscopic,
is far less than that of zooplanktons though being abundant
The biomass of fishes feeding on zooplanktons is inturn
higher while the largest fishes feeding on small fishes
have still higher biomass
∴ The pyramid is depicted as:



A pyramid of energy - depicts the energy at the each trophic level. Such a pyramid is always upright
Because, according to 10% law, only 10% energy is

transferred to a trophic level from lower trophic level. Hence some ~~energy~~ energy is always lost in the form of heat etc during transfer. This makes energy at highes trophic level less than the lower one



d) The limitations of ecological pyramids are:-

i) it does not take into account the same species belonging to different trophic levels

ii) it assumes a simple food chain, which never exists in nature, it does not accomodate a food web

iii) saprotrophs are not given any place.

25. a) Polygenic inheritance is the inheritance of characters which are controlled by 3 or more genes. Such characters do not have two alternative forms but are spread across a gradient. Such characters are called polygenic traits or quantitative traits. They also take into account the influence of environmental conditions. In such inheritance, the phenotype reflects the contribution of each allele ie, the effect of each allele is additive. Hence these genes are called additive or cumulative gene

eg:- Skin colour in humans is a polygenic trait.
Consider that 3 genes A, B and C consider the skin colours whose dominant forms are A, B, C while recessive forms are a, b, c.
A person with all dominant alleles (genotype AABBCC) will have the darkest skin colour - negro. A person with all recessive alleles ie, aabbcc will have lightest skin colours - white. A person with 3 dominant

(AaBbCc)

and 3 recessive alleles will have intermediate skin colour - mulatto.

A cross between AABBCC and aabbcc will result in a progeny generation with 7 phenotypes of phenotypic ratio 1:6:15:20:15:6:1 corresponding to black, very dark, dark, mulatto, light, very light, white phenotypes. Thus the number of dominant and recessive alleles determines the skin colour.

Multiple allelism is the phenomenon in which more than 2 alleles are present for a character in a population.
eg:- ABO Blood grouping in man.

The Blood group is determined by the type of sugar polymer protruding from the surface of plasma membrane of red blood cells. The type of sugar is controlled by 'I' gene. It has 3 alleles - I^A, I^B and i. I^A and I^B produce slightly different forms of sugar while 'i' do not produce any sugar. Being diploid, an individual can have only 2 of the 3 alleles.
I^A and I^B are completely dominant over 'i' i.e., when

I^A and i are present together, only I^A expresses. since 'i' do not produce any gene. Similarly I^B is expressed in presence of i. But when both I^A and I^B are present together, both of them expresses. Thus blood cell has both type of sugars. Thus this is an example ~~In total~~ of codominance - where both alleles expresses equally and the phenotype resembles both the parents In total, there are six genotypes and 4 phenotypes

Genotype	Phenotype (Blood group)
I^A i	A
I^A I^A	A
I^B i	B
I^B I^B	B
I^A I^B	AB
ii	O

The polygenic inheritance differs from multiple allelism in the fact that the different polygenes are located on different loci on same or different homologous chromosomes while in multiple alleles, the alleles are present on the same loci on homologous chromosomes.

b) Pleiotropy refers to the multiple phenotypic effect of a gene. It arises due to the effect of a gene on metabolic pathway controlling different phenotypes.
Phenylketonuria is caused due to the mutation of a gene causing the lack of an enzyme phenylalanine hydroxylase. This results in the accumulation of the enzyme and its derivatives in brain. This is manifested in the form of phenotypic effects such as retardation of mental development, reduced skin and hair pigmentation. Thus the gene seems to affect different phenotypes. Hence this is an example of pleiotropy.

∴ 26. a) i) Menstrual phase :- It lasts for 3-5 days during which menstrual flow occurs due to the breakdown of endometrium and its blood vessels. This occurs due to decrease in the level of luteinising hormone (LH) which results in regression of corpus luteum, thereby decreasing progestrone level. This leads to breakdown of endometrium. Menstruation is indicature of normal reproductive cycle and its absence may be indicating pregnancy or stress, poor health etc

ii) Follicular phase :- This phase follows the menstrual phase. The FSH levels are high initially which results in the selection of 1 1° follicle from one ovary. It develops into 2°, 3° and finally mature Graafian follicle. The developing follicular cells secrete estrogen, which controls this phase. Estrogen gives a negative feed back to FSH, so as to decrease its level and prevent further selection of 1° follicle. It also rebuilds the endometrium through rapid proliferation. At the middle of the

cycle, the FSH & LH level will be maximum. The rapid secretion of LH causing the maximum level of LH is known as surge which induces ovulation. The release of 2° oocyte arrested at Metaphase II occurs. The ruptured graafian follicle transforms into corpus luteum which starts secreting progestrone. Estrogen level falls down. Thus the cycle moves to next phase.

iii) Luteal phase :- is under the control of progestrone. It continues rebuilding of endometrium. It also quitens the uterus expectation fertilisation and implantation. When fertilisation does not occur, the high progestrone level gives negative feedback to LH. Decrease in LH regresses corpus luteum, progestrone level falls. It os The endometrium breakdown moving into next menstrual cycle.

b) The understanding of menstrual cycle can be applied in family planning through the use of natural methods of contraception. One of the methods known as periodic abstinence is based on the fact ovulation occurs at the

middle of menstrual cycle. By abstaining from coitus during day 10 to 17 of menstrual cycle, conception can be avoided since this is period during which ovulation is expected. This is called fertile period since chances of fertilisation is very high during this period. Another method, lactational amenorrhea is based on the fact that ovulation and menstrual cycle do not occur during the period of intense lactation following pasturition. Thus upto 6 months after pasturition, chances of pregnancy is low. Thus knowledge and understanding of menstrual cycle can help immensely in family planning.

Section - D

23) a) The parents think that such discussions and information are unnecessary for the adolescent children, and that they need not know about these facts. They have the notion that only after they become adults or after

they mature, they should come to know about such matter. They believe that the children at the adolescent age if comes to know about such matters, would be misleadi to them ~~case~~.

b) Parents should be made aware about the fact that lack of knowledge about sexuality and reproduction would have dire consequences in their future life. It is in the adolescent period that the children are more vulnerable to many abuses like sex abuse and also to sexually transmitted diseases. They should also known about safe sexual practices, adolesant related changes, use of contracep Children should be made aware of such matters. Taking example of local plant and animal, we can make the parents realise the fact that reproduction is a natural phenomenon. There is nothing to be shy of or be embarassed of discussing about reproduction with their children. Instead they would be highly benefitted from such knowledge on leading a healthy reproductive life. For ~~plants~~, we see the contact of right and wrong pollen on the stigma. The ability of

pistil enables the plant to accept the right pollen. Similarly the children should have proper knowledge about sexuality so that they may not be ignorant and not be sexually abused. In animals also, we see reproduction to be taking place in the way that it is a natural process. Though they have no reasoning power, they accept reproduction as nature's way to perpetuate species. Children should have this notion and behave accordingly. For all these, the parents should provide great support and provide them sufficient knowledge. Parents can be made to accept the fact that reproduction is a method to perpetuate the species and that all have equal rights to be aware of it

2017

21) Secondary treatment is applied to the sewage which has undergone physical treatment. There are 2 steps in secondary treatment - aerobic digestion and anaerobic digestion. Both involves the action of microbes. Due to the involvement of living organisms, it is referred to as biological treatment. In the first step, the sewage is taken in an aerobic digestion tank and agitated strongly. This enables the growth of aerobic microbes present in it - resulting in the formation of floc - which are mucilagenous threads

of microbial association with fungi. The flocs greatly reduces the Biochemical Oxygen Demand by digesting the ~~sewage~~ organic matter present in it. BOD indicates the amount of pollutants in the sewage. Sufficient lowering of BOD indicates lowered organic content of the sewage. The sludge that separates out now is called activated sludge since microbes are present in it. The supernatant fluid can be released into any water bodies or taken for chemical treatment. Activated sludge is taken for anaerobic digestion by heterotrophic microbes like methanogens - Methylophilus methylotrophus which can live anaerobically. This results in the production of biogas. The slurry that remains can be used as landfill or other purposes. Thus the active participation of microbes make secondary treatment of sewage a biological treatment.

OR question is attended

7) Chlorofluorocarbons when eliminated will impart the following benefits to human life :-

i) ozone depletion can be prevented thereby the exposure of living organisms to harmful ultraviolet radiations can be reduced

ii) CFCs are also ~~a~~ a cause of global warming. Its elimination will enable the reduction of the rate of increase of global temperature

iii) ~~The leakage~~ The elimination of CFCs will in a way result in decreased rates of skin cancer due to decrease in ozone depletion. Also it is beneficial for the improvement of our immune system

iv) CFCs are hazards to our natural environment Their elimination will result in decreased harm to nature due to human activities

v) Elimination of CFCs will control pollution of our environment

Or question for (7)

Rare or threatened species can be conserved by following measures

i) establishment of national parks, zoological parks, wildlife sanctuaries etc
→ ex situ mode of conservation

ii) • Conservation of sacred groves which ~~can~~ provide habitat to innumerous varieties of wildlife. → ~~ex~~ in situ mode of conservation
• Giving more importance to endemic species