
2011

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Section A

[1x8=8]

Question 1

List the changes the primary oocyte undergoes in the tertiary follicular stage in the human ovary.

Answer:

Oogenesis leads to the formation of oogonium or egg. Cell division start and enters to prophase I of mitotic division and gets arrested, called as primary oocyte. Primary oocyte are surrounded by granulosa cells called as primary follicle, these primary follicles gets surrounded by granulosa cells and theca so called secondary follicles.

Question 2

Why are the cattle and goats not seen browsing on Calotropis growing in the field?

Answer:

Browsing of cattle and goat on Calotropis is an unusual phenomenon as the grass is highly toxic and produces chemicals like cardiac glycosides, nicotine, caffeine, quinine, strychnine, opium, etc. which provides them protection against grazers.

Question 3

Mention how is mutation theory of Hugo de Vries different from Darwin's theory of natural selection.

Answer:

According to Hugo de Vries, new species arise due to single step large mutation whereas according to Darwin, evolution occurs gradually by the method of natural selection.

Question 4

Why are some organisms called as eurythermals and some others as stenohaline?

Answer:

The temperature affects the kinetics of enzymes and through it the basal metabolism, activity and other physiological functions of the organism. A few organisms can tolerate and thrive in a wide range of temperatures (eurythermals) but a vast majority of them are restricted to a narrow range of temperatures (stenothermal or stenohaline) The levels of thermal tolerance of different species determine to a large extent their geographical distribution

Question 5

Mention the type of allele that expresses itself only in homozygous state in an organism.

Answer:

Homozygous organism with sickle cell anemia display similar allele i.e. HbS (HbSHbS)

Question 6

Malaria, typhoid, pneumonia and amoebiasis are some of the human infectious diseases. Which ones of these are transmitted through mechanical carriers?

Answer:

Amoebiasis is caused by protozoan parasite, transmitted by Houseflies, mechanical carriers.

Question 7

Name any two techniques that serve the purpose of early diagnosis of some bacterial/viral human diseases.



Answer:

Early detection of bacterial or viral disease results in the cure or limitation of diseases. Two technique serves the purpose is:

1. PCR (Polymerase Chain Reaction)
2. ELIS (Enzyme Linked Immuno-sorbent Assay)

Question 8

Name the phenomenon and the cell responsible for the development of a new individual without fertilization as seen in honey bees.

Answer:

Parthenogenesis.

Section B**Question 9**

[2x10=20]

In a dihybrid cross white eyed, yellow bodies female *Drosophila* crossed with red eyed, brown bodies male *Drosophila* produces in F₂ generation 1.3 % recombinants and 98.7 % progeny with parental type combinations. This observation of Morgan deviated from Morgan's observations.

Answer:

Morgan performed various dihybrid crosses in *Drosophila* to study sex-linked gene. In his conclusion to the experiment "the two genes did not segregate independently of each other" and so deviate from 9:3:3:1.

Morgan suggested that linked genes are located in X chromosomes. If two genes involved in dihybrid cross were situated on the same chromosome, the ratio of parental gene combinations is much higher than the non-parental type. He defined it as linkage and the rearrangement of genes as recombination.

Question 10

How are recombinant vectors created? Why is only one type of restriction endonuclease required for creating one recombinant vector?

Answer:

Recombinant vector is created using recombinant DNA technology. Where segments of DNA is isolated and fragmented to obtain desired sequence. Obtained sequence is then inserted into a host microbe where it gets incorporated with the host genome, called as vector.

Only single type of restriction endonuclease (RE) is used for creation of recombinant vector because the cut made by one RE will give one type of sticky ends that can be easily ligated using DNA ligase.

Question 11

Bear hibernates whereas some species of zooplanktons enter diapause to avoid stressful external conditions. How are these two ways different from each other?

Answer:

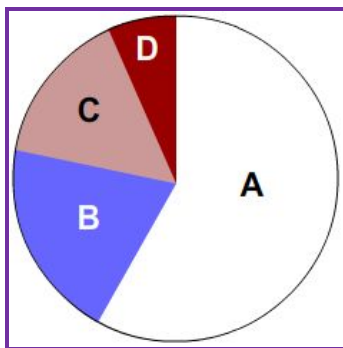
Hibernation – It is a process by which animal undergo hibernation for escaping time during winter.

Diapause – It is process in which organism stays in suspended state.

Question 12

The figure bellows shows the relative contribution of four greenhouse gases to global warming:





- Identify the gases A and C.
- Why these four gases are called the greenhouse gases?

Answer:

Given figure is a pi-chart describing various concentration of gases contributing to green house.

1. Labeling

- Carbon dioxide (60%)
- CFCs (14%)

2. The chart represents various concentration of carbon dioxide (A), Methane (B) CFCs (C) and N₂O (D). These gases cause absorption and radiation of heat back to earth surface. Repetition of the process leads to formation of greenhouse effect.

Question 13

At the time of Independence, the population of India was 350 million, which exploded to over 1 billion by May 2000. List any two reasons for this rise population and any two steps taken by the Government to check this population explosion.

Answer:

Rise in population –

- Rapid increase in population is attributed to improve quality and facility of human being.
- Other important factor contributing is sharp decline in death rate, maternal mortality rate and infant mortality rate, with sharp elevation of people in reproducible age.

Steps taken by government to check pollution explosion

- Family planning, it was first initiated in the year 1951 and is evaluated every decay.
- Reproductive and Child Health Care (RCH) programs.

Question 14

Explain the function of 'reservoir' in a nutrient cycle. List the two types of nutrient cycles in nature.

Answer:

Nutrient is never lost from the ecosystem which is being recycled again and again so that they remain in the environment as a reservoir. Nutrient cycles are also called as biogeochemical cycle. There are two types of nutrient cycle.

- Gaseous
- sedimentary

OR

Explain with the help of two examples, how the pyramid of numbers and the pyramid of biomass can look inverted.



Answer:

Pyramid of numbers –

It allows us to compare or study number of individual present in a particular trophic level at given time. During some special cases the pyramid may be inverted if –

- a. Smaller animal feeds on large plant e.g. butterfly larva fed by parasitic wasp.
- b. Animals with huge numbers of parasites. E.g. Human body inhabits large number of parasites.

Pyramid of biomass –

Biomass is used to measure total number of living material present in a given place, comparing biomass at each trophic level. Pyramid may get inverted when –

- a. Number of producer or presence of producer at a given time is lesser than biomass of consumers. E.g. biomass of fishes is more than phytoplankton biomass.

Question 15

A list of three flowering plants is given below. Which ones out of them are monoecious and bearing pistillate flowers? List – Date palm, Cucurbits and Pea.

Answer:

Monoecious plant – Cucurbits and Pea

Bearing pistillate flowers – Date palm

Question 16

Name the organism from where the thermostable DNA polymerase is isolated. State its role in genetic engineering.

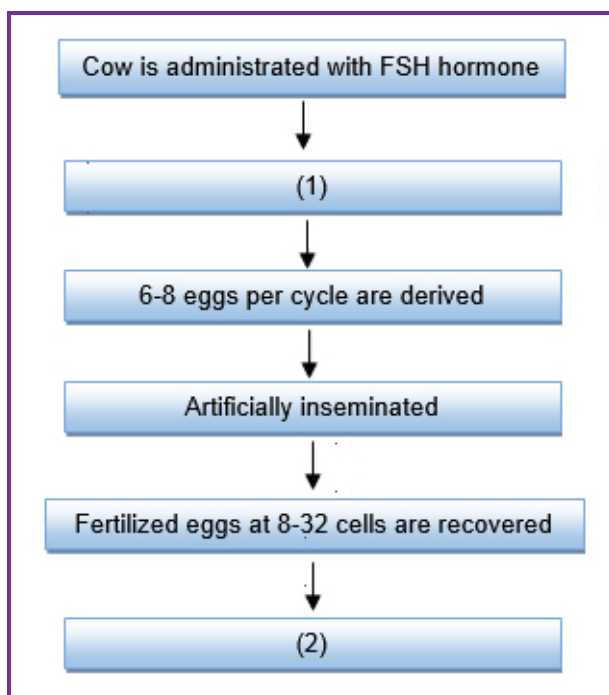
Answer:

DNA polymerase used in PCR technique is isolated from bacterium, *Thermusaquaticus*. Use of DNA polymerase is attributed to its stability to resist and sustain at a very high temperature during renaturation of double stranded DNA.

Question 17

Study the flow chart given below:





- Identify the events that take place at stage (1) and (2) respectively.
- State the importance of the technology explained above.

Answer:

- In the given below flow chart we are discussing the technical steps involved during multiple ovulation embryo transfer technology (MOET).

Labeling

- Induction of follicular maturation and super ovulation.
- Recovered cell is transferred to surrogate mother.

Discussed method in the above section is multiple ovulation embryo transfer technology (MOET). This technique is applicable for:

- Increase milk yielding capacity.
- Fertilizing female with high quality bull sperms.

Question 18

Give the scientific name of the microbes from which cyclosporine A and statin are obtained. Write one medical use of each one of these drugs.

Answer:

Cyclosporine A, it is used as immunosuppressive agent during organ transplantation. Cyclosporine A is extracted from a fungus named *Trichoderma polysporum*.

The strain produced from yeast is called as *Monascus purpureus*, being used to deprecate blood cholesterol level. Which act as competitively inhibiting the enzyme responsible for synthesis of cholesterol.

Section C

[3x9=27]

Question 19

Draw a labelled diagram of the microscopic structure of a human sperm.



Answer:

Question 20

Convergent evolution and divergent evolution are the two concepts explaining organic evolution. Explain each one with the help of an example.

Answer:

Convergent evolution:

Evolution of unrelated organism in common environmental and ecological condition e.g Eyes of octopus and mammal or flips of penguin and dolphin.

Question 21

- a. Name a drug used as an effective sedative and pain killer for helping patients to cope with mental illnesses like depression, but often misused.

Answer:

- i. Morphine is used as an effective sedative and painkiller.
- ii. Morphine is often used in medical for patient to get relief from surgical pains, to cure depression etc. while administration of morphine in excess leads to hallucination or impairment of physiological function.

- b. How does the moderate and high dosage of cocaine affect the human body?

Answer:

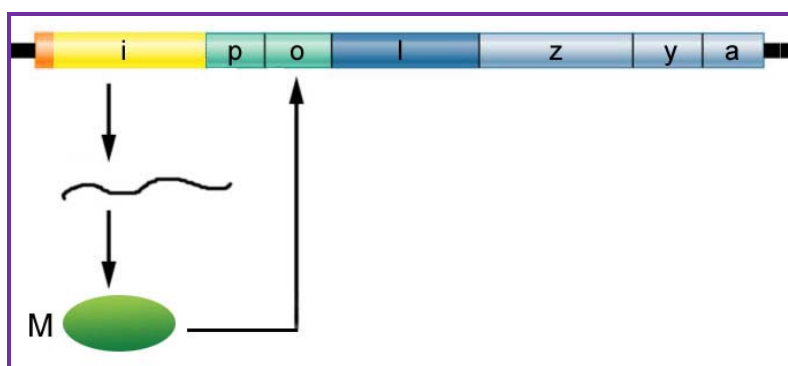
Cocaine – it is produced or isolated from plant named *Erythroxylum coca*, native of South America. It obstructs the functioning of neurotransmitter dopamine.

Mild dosage – stimulates the activity of CNS and transmit person in a state of euphoria

High dosage – leads to hallucination.

Question 22

Give below is a schematic representation of lac operon.



- a. Identify i and p.

Answer:

i denotes inducer, while *p* denote promoter.

- b. Name the 'inducer' for this operon and explain its role.

Answer:

i act as an inducer, production of repressor by the inducer results in the blocking of operator gene from initiating transcription by RNA.



Question 23

Explain the different steps involved in sewage treatment before it can be released into natural water bodies.

Answer:

Water is believed to be the place where first life form has originated and we require it for the survival and maintenance of life on earth. Polluting water may lead to severe consequences for the survival of human and water animals. To check the level of pollutant in water government of India has established Water (Prevention and Control of Pollution) Act, 1974. Most part of waste water is human excretions this municipal waste is called sewage. Sewage is added by many organic, inorganic and microbes (pathogenic). Discharge of these waters in natural system is done after treating them in STPs (sewage treatment plant).

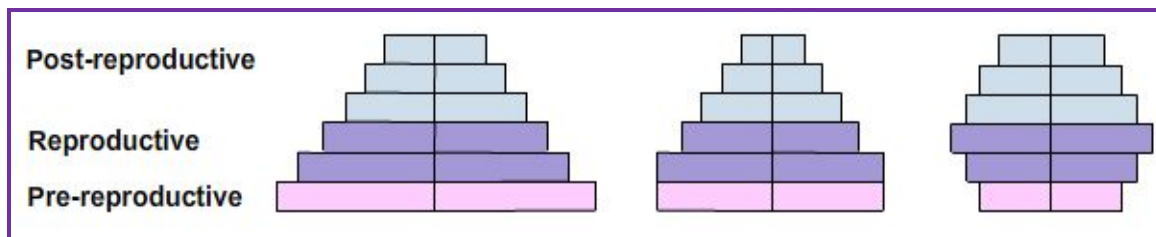
STPs is done in two steps – 1. Primary treatment 2. Biological treatment

Primary treatment- removal of large and small colloidal particle is done by physical process, followed by its filtration and sedimentation. Supernatant of the treatment is sent to biological treatment process.

Biological treatment – obtained effluent of primary treatment is kept in a large tank, agitated continuously with addition of air for the growth of aerobic microbes into flocks. Growing microbes consume organic matter with decrease in amount of BOD present. Treatment continues till BOD level reaches minimum level. Water is then allowed to sediment (active sludge) and floating water is released into water bodies for reuse.

Question 24

Study the three different age pyramids for human population given below and answer the questions that follow:



- i. Write the names given to each of these age pyramids.

Answer:

1. Names of the given age pyramids

- A. Expanding
- B. Stable
- C. Decline

- ii. Mention the one which is ideal for human population and why.

Answer:

Pyramid B i.e. Stable condition of pyramid is best suited for human population because

- a. The ratio of male to female is stable called as sex ratio.
- b. Number of reproductive population is followed by same number of pre reproductive population.

Question 25

Name a disorder, give the karyotype and write the symptoms a human suffers from as a result of monosomy of the sex chromosome.



Answer:

Klinefelter's Syndrome is characterized by the presence of an additional copy of X chromosome. With overall development of masculine character but have partial influence of feminine characters as development of breast.

Karyotype – 47, XXY

Monosomy of sex chromosome results in Down syndrome. Characteristics feature –

1. Individual will be short stature.
2. Small round head, furrowed tongue and partially open mouth.
3. Broad palm.
4. Mental retardation.

Question 26

Explain, giving one example, how co-extinction is one of the causes of loss of biodiversity. List the three other causes also (without description).

Answer:

Co-extinction – elimination of species, plant and animal showing obligatory way also become extinct e.g. elimination of fishes results in the elimination of its parasite from the environment.

Three other causes of biodiversity losses are:

1. Alien species invasions
2. Over-exploitation
3. Habitat loss and fragmentation.

OR

Eutrophication is the natural aging of a lake. Explain.

Answer:

Eutrophication is a process where lake attains biological enrichment in its water content. Prior to eutrophication water in lake remain cold and clear with less number of microbes inhabiting. Addition of stream and small water body increases the nutritive (nitrogen and phosphorous) value of the lake encouraging growth of aquatic flora and fauna.

The by-products of flora and fauna gets deposited on Lake Bottom and forms silt, lake grows shallower and warmer, with warm-water organisms supplanting those that thrive in a cold environment.

Then marsh plant spread roots and form huge floating body finally leading to a land.

The whole process require thousands of year. It may get accelerated by human activity so called as Cultural or Accelerated Eutrophication.

Question 27

IARI had released several varieties of crop plants that are bio fortified. Give three examples of such crops and their bio fortifications.

Answer:

- i. Bittergourd enriched in vitamin C.
- ii. Carrots enriched in vitamin A.
- iii. Spinach enriched in iron and calcium.



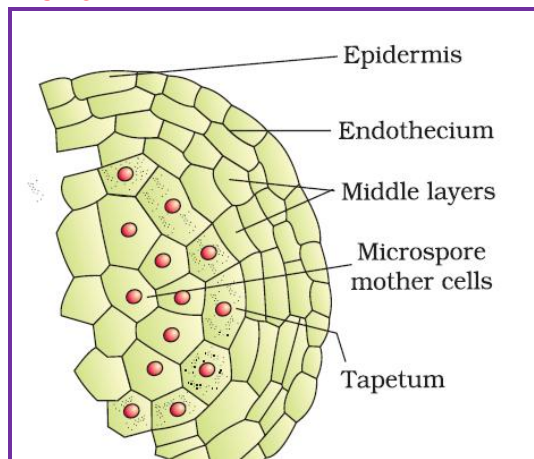
Section D

[5×3=15]

Question 28

- a. Draw a diagram of an enlarged view of T.S. of one microsporangium of an angiosperm and label the following parts:
- Tapetum
 - Middle layer
 - Endothecium
 - Microspore mother cells

Answer:



- b. Mention the characteristic features and function of tapetum.

Answer:

Tapetum is the inner nourishing layer of microsporangial wall. The cells have dense cytoplasm and more than one nucleus.

- c. Explain the following giving reasons:
- Pollen grains are well preserved as fossils.

Answer:

Outer exine layer of pollen grains is highly resistant because of sporopollenin. It is an organic material which can withstand harsh conditions, action of alkali and acids. No enzymes can degrade sporopollenin. So pollen grains are well preserved as fossils.

- Pollen tablets are in use by people these days.

Answer:

Pollen grain tablets are rich in nutrients. So, used by people as health tablets.

OR

- a. Why is the process of fertilization in angiosperms termed as double fertilization? Explain. (**)

Answer:

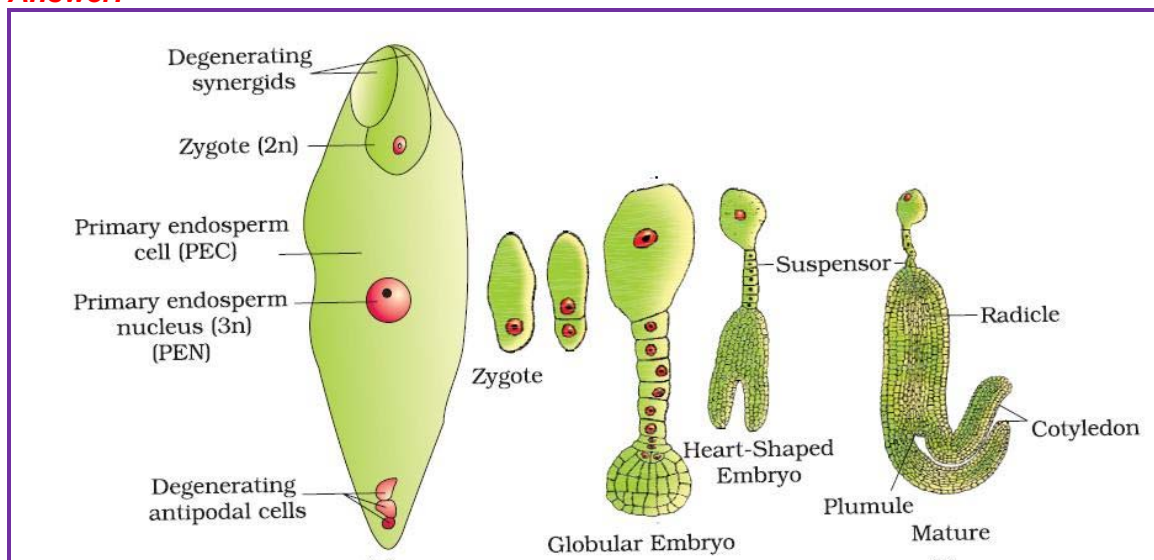
Fertilization results in the formation of zygote. Fertilization in angiosperm takes place in two stages so termed as double fertilization. Entry of synergids cell stimulate pollen tube for release of two male gametes. Of the two gamete one fuses with the nucleus of the egg cell completing syngamy, resulting in formation of diploid cell or the zygote. While other moves toward the polar



nuclei located at the center and fuse together to form triploid primary endosperm nucleus (PEN) termed as triple fusion. Since occurrence of syngamy and triple fusion happens in a single cell the whole process is called as double fertilization.

- b. Draw a diagram of an angiospermic embryo-sac where fertilization is just completed. Label the following parts:
- Micropylar end of the embryo-sac
 - The parts that develops into an embryo
 - The parts that develops into an endosperm
 - The degenerating cells at the chalazal end

Answer:



- c. Draw a labelled diagram of globular embryonic stage of an angiosperm.

Answer:

Question 29

Name the process involved in the production of nematode-resistant tobacco plants, using genetic engineering. Explain the strategy adopted to develop such plants.

Answer:

Nematode resistance tobacco plants were produced with the help of RNAi called as RNA interference.

Nematodes are found to inhabit various plant and animal species. One such nematode inhabiting tobacco plant is *Meloidogyne incognita*, responsible for infecting roots of tobacco plant resulting in depleted production of tobacco.

Discovery of RNAi was a big solution to the issue. Where the process includes silencing of mRNA because of the presence of complementary dsRNA, prevent proceeding of mRNA translation called as silencing.

Use of transposons is also recommended for the process to obtain complementary sequence. Most widely used vector is *Agrobacterium*. Introduction of nematode specific gene results in production of both sense and anti-sense RNA in the host. Complementary nature of synthesised



RNA forms dsRNA silencing specific mRNA of the nematodes. As a result of silencing the host couldn't sustain and results in death, protecting plant.

OR

Describe the various stages involved in gene transfer for the commercial production of human insulin by Eli Lilly.

Answer:

Diabetes is taking tall elevation as the number of patient suffering from the disease increases day by day. So the demand of insulin for the treatment of diabetes is increasing. It was found that animals also produce insulin but injection of animal derived insulin results in allergy to the patients. In intense research it was found that insulin can be produced from bacterium also.

The advantage of bacterium source is that it can be cultured in large number in a short duration of time. Native insulin is called proinsuline or inactive insulin with 2 polypeptide chain joined by disulphide bond.

The proinsulin then undergoes enzyme activity and is converted into active insulin, which involves elimination of C peptide from proinsulin. Eli Lilly in 1983 was the first American to prepare chain A and chain B of human insulin artificially.

Which was then inserted in E. coli plasmid for production of chain A & B. The synthesised chain A and B was then separately isolated and was joined by disulphide bonds to create human insulin artificially.

Question 30 ()**

- a. Explain the process of aminoacylation of tRNA. Mention its role in translation.

Answer:

- b. How do ribosomes in the cells act as factories for protein synthesis?

Answer:

- c. Describe 'initiation' and 'termination' phases of protein synthesis.

Answer:

OR

- a. Explain the role of DNA dependent RNA polymerase in initiation, elongation and termination during transcription in bacterial cell.

Answer:

Role of DNA dependent RNA polymerase.

- RNA polymerase becomes associated transiently with initiation factor and binds to the promoter site on DNA and initiates transcription.
- It uses the nucleoside triphosphate as substrates and polymerises them in a template-dependent fashion following the base complementarity rule in the 5' → 3' direction.
- It also facilitates the opening of the DNA helix and continues the elongation process.
- When the polymerase falls off a terminator region on the DNA, the nascent RNA separates. This results in termination.



e. How is transcription a more complex process in eukaryotic cells? Explain.

Answer:

Reasons that transcriptions in more complex in eukaryotes are:

- a. The three types of RNA polymerases in the nucleus show division of labour
RNA polymerase I transcribes rRNAs (28S, 18S and 5.8S).
RNA polymerase II transcribes the precursor of mRNA called hnRNA.
RNA polymerase III transcribes tRNA, 5 srRNA and snRNAse.
- b. hnRNA contains both coding sequences called exons and non-coding sequences called introns. So, it undergoes a process called splicing, in which the non-coding sequences (introns) are removed and the coding sequences (exons) are joined together in a defined order.
- c. In capping, unusual nucleotide, methyl guanosine triphosphate residues are added at the 5-end of the hnRNA.
- d. In tailing, 200-300 adenylate residues are added at the 3-end of the hnRNA.

