Biology (Theory) [official]
CISCE
ISC (Science)
Academic Year: 2023-2024
Date & Time: 15th March 2024, 2:00 pm

Duration: 3h **Marks: 70**

1. Candidates are allowed an additional 15 minutes for only reading the paper.
2. They must NOT start writing during this time.
3. This paper is divided into four sections A, B, C and D.
4. Answer all questions.
5. **Section A** consists of one question having sub-parts of one mark/two marks each.
6. **Section B** consists of seven questions of two marks each.
7. **Section C** consists of seven questions of three marks each and
8. **Section D** consists of three questions of five marks each.
9. Internal choices have been provided in one question each in Section B, Section C and Section D.
10. The intended marks for questions or parts of questions are given in brackets [ ].

SECTION A - 20 MARKS

Q1. Answer the following questions briefly.

1.1. In human plasma, five different types of immunoglobulins are found.

Which type of immunoglobulin is responsible for allergic reactions?

Solution

Immunoglobulin E (IgE)

Explanation:

IgE plays an important role in the allergic-inflammatory process in disorders like allergic rhinitis. Multivalent allergens cross-link IgE attached to its receptor on cells, triggering a cascade of events that leads to allergic immunological reactions.

1.2. Some orchids live on the branches of mango trees. Name the type of interaction that exists between the mango tree and the orchid.

Solution

Commensalism.

Explanation:

Commensalism is defined as one species benefiting while the other remains unaffected. When a mango tree and an orchid connect, the orchid benefits because it receives assistance while the mango tree remains unharmed.

1.3. Four triplet codons code for the amino acid valine. Three of them are given below.

GUU GUC GUA

Write the fourth codon.

Solution

GUG

Explanation:

The amino acid valine has four codons: GUU, GUC, GUA, and GUG. GUG is sometimes used as a start codon instead of AUG, which codes for methionine.

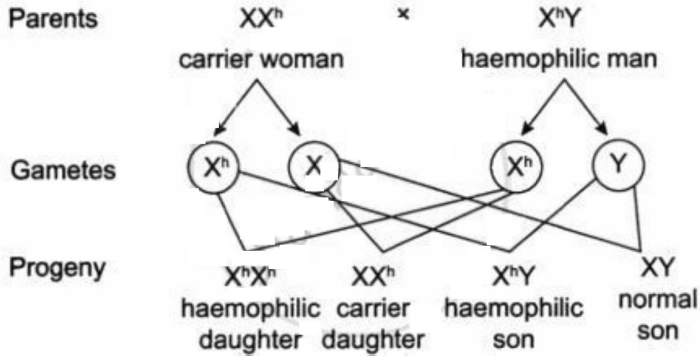
1.4. A haemophilic man marries a carrier woman and they have a daughter. What is the probability of their daughter being haemophilic?

Solution

50%

Explanation:

A haemophilic male (XhY) and a carrier lady (XXh) have a 50% of probability of conceiving a haemophiliac daughter. This is because one of the two probable daughter genes codes for haemophilia, whereas the other does not. Half of the daughters are carriers and half are hemophilic.



1.5. Home-made fruit juices are turbid, while the bottled, fruit juices purchased from the market are clear. Give a reason for this difference.

Solution

Bottled juices are transparent because they have been filtered and clarified and they frequently contain additives to maintain their stability and clarity. Because homemade juices are less processed and do not contain additions that alter their appearance, they are turbid due to the natural pulp and fibres of the fruits.

1.6. The number of lily plants in a pond was found to be 50. After one year, the number. increased to 65. Calculate the natality of lily plants.

Solution

Given that the initial number of lily plants was 50 and increased to 65 after one year, the population increase is 65 − 50 = 15 plants. The time period is 1 year. So, the calculation is:

$$\text{Natality Rate} = \frac{\text{Increase in Population}}{\text{Original Population}} \times \text{Time Period}$$

$$\text{Natality Rate} = \frac{15}{50} \times 1$$

$$\text{Natality Rate} = \frac{15}{50}$$

Natality Rate = 0.3

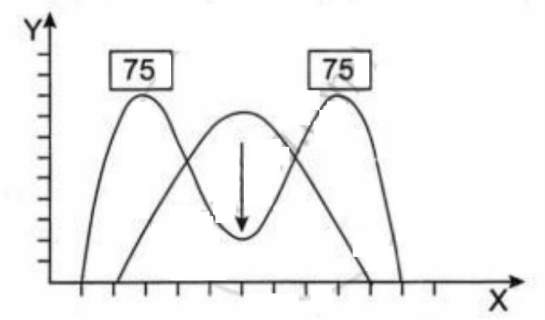
This means the pond's lily plants have a natality rate of 0.3 per plant per year.

1.7. Based on the table given below, identify the type of natural selection taking place.

Size of the seeds	% of germination
Small	75%
Medium	15%
Large	75%

Solution

Disruptive selection generates a population with two extreme variants of a trait as the dominant phenotype. In disruptive selection, both extreme features are preferred.



The above chart outlines the disruptive type selection.

1.8. Give the name of the target pest of gene cry 1 Ac.

Solution

Tobacco budworm and pink bollworm.

Cry1Ac is effective against several important Lepidoptera insects, including tobacco budworm, cotton bollworm and Com earworm.

1.9. If a person shows the production of interferons in his body, then he is suffering from _____.

1. Malaria
2. Ring worm
3. Dengue
4. Typhoid

Solution

If a person shows the production of interferons in his body, then he is suffering from Dengue.

Explanation:

The body only creates interferons when it is infected with a virus. Dengue fever is caused by a viral infection and others include: Malaria: a protozoan, Ringworms are fungal and typhoid is a bacterial infection.

1.10. Match the columns I and II with reference to weeks of pregnancy and the development of a human embryo. Select the correct option from the choices given below:

	Column I		**Column II**
I.	8 weeks	(P)	Limbs and external genital organs
II.	12 weeks	(Q)	Limbs and digits develop.
III.	20 weeks	(R)	Body hair develops.
IV.	24 weeks	(S)	Eyelids separate.

1. **I - (P), II - (Q), III - (R), IV - (S)**
2. **I - (Q), II - (P), III - (R), IV - (S)**
3. **I - (R), II - (S), III - (P), IV - (Q)**
4. **I - (S), II - (R), III - (Q), IV - (P)**

Solution

I - (Q), II - (P), III - (R), IV - (S)

1.11. Assertion: In a bioreactor, it is not necessary to maintain sterile ambience.

Reason: Sterile conditions promote the growth of unwanted microbes in the culture medium.

1. Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
2. Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.
3. Assertion is true and Reason is false.
4. **Both Assertion and Reason are false.**

Solution

Both Assertion and Reason are false.

Explanation:

Maintaining sterile conditions in a bioreactor is crucial to prevent unwanted bacteria from growing in the culture medium during product production.

1.12. Assertion: Lymphocytes originate and proliferate in primary lymphoid organs.

Reason: Spleen is a secondary lymphoid organ.

1. Both Assertion and Reason are true and Reason is the correct explanation for Assertion.
2. **Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.**
3. Assertion is true and Reason is false.
4. Both Assertion and Reason are false.

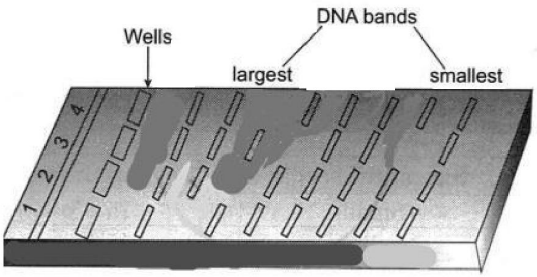
Solution

Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.

Explanation:

Lymphocytes form in the thymus and bone marrow, the principal lymphoid organs. The spleen is a secondary lymphoid organ that is the largest in the body.

1.13. The equipment shown below is used for the separation of DNA fragments.



Name the chemical used to visualise the movement of DNA fragments in the gel.

Solution

The most commonly used chemical for visualising DNA in agarose gel electrophoresis is ethidium bromide (EtBr).

EtBr is a dark red, odourless powder that binds to DNA and glows brilliant orange when exposed to UV light.

1.14. In humans, somatic gene therapy was carried out to correct an immunodeficiency disease. Name this disease.

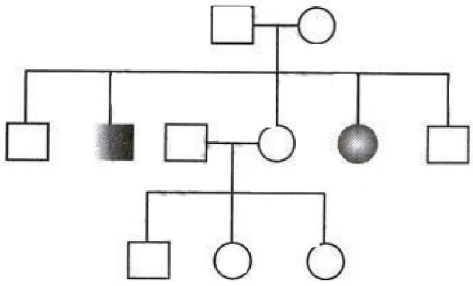
Solution

SCIO (Severe Combined Immunodeficiency)

Explanation:

Somatic gene therapy typically involves either replacing a dysfunctional gene with a functional or therapeutic gene or reducing the negative effects that the defective gene causes, depending on the type of illness.

1.15. The pedigree chart given below represents the pattern of inheritance of thalassemia in a family.



What could be the genotype of the affected male?

Solution

22 + Xa Ya

Explanation:

Thalassemia is a recessive autosomal illness. When a guy inherits one (a) allele from his father and one (a) allele from his mother, he will be affected.

1.16. Answer the following questions:

1.16. (a) In a karyotype analysis, X and Y chromosomes represent sex chromosomes.

Name the scientist who discovered the X chromosome.

Solution

The German biologist Hermann Henking discovered the X chromosome.

1.16. (b) The following is well-known abbreviation, which have been used in this chapter. Expand to its full form:

NACO

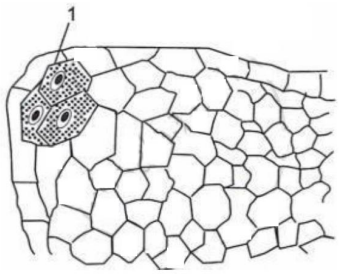
Expand the following abbreviation:

NACO

Solution

NACO - National AIDS Control Organisation

1.17. The figure given below shows the early stage of the development of microsporangium.



Name the hypodermal cell labelled '1' which divides periclinally.

Solution

Archesporium

Explanation:

An archesporium is a cell or group of cells that eventually grow into spore mother cells. A structure present in sporophytes is responsible for producing spores.

1.18. Give a reason for each of the following:

1.18. (a) The second half of the menstrual cycle is called the luteal phase as well as the secretory phase.

Solution

The luteal phase refers to the second half of the menstrual cycle, which is when the corpus luteum produces progesterone. It is sometimes referred to as the secretory phase because the endometrial glands become more active in secreting chemicals to assist a possible pregnancy.

1.18. (b) Streptokinase is administered to the patients having myocardial infarction.

Solution

Streptokinase is given to individuals with myocardial infarctions to break blood clots in the arteries and restore blood flow to heart muscle. This reduces damage to heart tissue and improves the patient's prognosis.

SECTION B - 14 MARKS

Q2.

2. (a) Name any two Cu-ions releasing IUDs.

Solution

Two Cu based IUDs which release Cu^{-} ions are Cu-7 and Cu-T.

2. (b) Explain any two ways by which IUDs devices act as contraceptives.

Solution

1. Copper-releasing IUDs produce copper ions, which reduce sperm motility and fertility.
2. Copper-releasing IUDs make it tougher for a fertilised egg to implant in the uterus.

Q3.

3.1. A population of 200 fruit flies is in Hardy Weinberg equilibrium. The frequency of the allele (a) 0.4. Calculate the following:

Frequency of the allele (A).

Solution

In Hardy Weinberg, $p^2 + 2pq + q^2 = 1$, where 'p^2' is the frequency of the homozygous dominant genotype (AA), '2pq' is the frequency of the heterozygous genotype (Aa), and 'q^2' is the frequency of the homozygous recessive genotype (aa).

Given:

$q = 0.4$

We know $p + q = 1$

$p = 1 - q$

$= 1 - 0.4$

$= 0.6$

Frequency of allele, $p(A) = 1 - 0.4$

$= 0.6$

3.2. A population of 200 fruit flies is in Hardy Weinberg equilibrium. The frequency of the allele (a) 0.4. Calculate the following:

The number of homozygous dominant fruit flies.

Solution

In Hardy Weinberg, $p^2 + 2pq + q^2 = 1$, where 'p^2' is the frequency of the homozygous dominant genotype (AA), '2pq' is the frequency of the heterozygous genotype (Aa), and 'q^2' is the frequency of the homozygous recessive genotype (aa).

Given:

$q = 0.4$

We know $p + q = 1$

$p = 1 - q$

$= 1 - 0.4$

$= 0.6$

number of homozygous dominant fruit flies is As,

$p^2(AA) = (0.6)^2$

= 0.36

= 0.36 × 200

= 72

3.3. A population of 200 fruit flies is in Hardy Weinberg equilibrium. The frequency of the allele (a) 0.4. Calculate the following:

The number of homozygous recessive fruit flies.

Solution

In Hardy Weinberg, $p^2 + 2pq + q^2 = 1$, where 'p^2' is the frequency of the homozygous dominant genotype (AA), '2pq' is the frequency of the heterozygous genotype (Aa), and 'q^2' is the frequency of the homozygous recessive genotype (aa).

Given:

q = 0.4

We know p + q = 1

p = 1 − q

p = 1 − 0.4

p = 0.6

number of homozygous recessive fruit flies is

As, $q^2(aa) = (0.4)^2$

= 0.16

= 0.16 × 200

= 32

3.4. A population of 200 fruit flies is in Hardy Weinberg equilibrium. The frequency of the allele (a) 0.4. Calculate the following:

The number of carrier fruit flies.

Solution

In Hardy Weinberg, $p^2 + 2pq + q^2 = 1$, where 'p^2' is the frequency of the homozygous

dominant genotype (AA), '2pq' is the frequency of the heterozygous genotype (Aa), and 'q^2' is the frequency of the homozygous recessive genotype (aa).

Given:

$q = 0.4$

We know $p + q = 1$

$p = 1 - q$

$= 1 - 0.4$

$= 0.6$

Number of carrier fruit flies is

As, 2pq (Aa)

$= 2 \times 0.6 \times 0.4$

$= 0.48$

$= 0.48 \times 200$

$= 96$

Q4. Jacob is genetically a carrier of the disorder that affects the shape of the RBCs, as shown in the diagram below. His son James suffers from the same disorder.

i. Give the biochemical reason for the disorder that changes the shape of the RBCs, as shown above.

ii. Draw a Punnett square to show the genotype of the mother of James.

iii. Name and define the type of 'point mutation' responsible for this disorder.

Solution

i. Red blood cells take on a sickle-like structure when oxygen tension is lowered since the deoxygenated sickle cell haemoglobin (HbS) molecules polymerize to form long fibres.

ii. Given Jacob is a carrier, his genotype has to be Hb^A Hb^S.

James, Jacob's child, suffers with the condition; so, his genotype is Hb^S Hb^S.

According to the provided data, James must inherit one Hb^S allele from each parent if he is to have sickle cell anaemia (Hb^S Hb^S). Given Jacob's known carrier status (Hb^AHb^S), he most certainly passed on the Hb^S gene to James. James's need for two Hb^S alleles requires the mother to have likewise supplied a Hb^S allele. The condition (Hb^S Hb^S) or a carrier (Hb^A Hb^S) can have an impact on the mother.

Case 1. When mother is a carrier (Hb^A Hb^S)

Mother

	Hb^A	Hb^S
Hb^A Jacob	Hb^A Hb^A (Normal)	Hb^A Hb^S (Carrier)
Hb^S	Hb^A Hb^S [Carrier]	Hb^S Hb^S [Sickle cell]

James will suffer from a disorder.

Case 2. When mother is affected (Hb^S Hb^S)

Mother

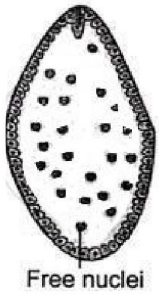
	Hb^S	Hb^S
Hb^A Jacob	Hb^A Hb^S (Carrier)	Hb^A Hb^S (Carrier)
Hb^S	Hb^S Hb^S [Sickle cell]	Hb^S Hb^S [Sickle cell]

James will suffer from a disorder.

iii. A monogenetic condition, sickle cell anaemia is caused by a single base-pair point mutation in the β globin gene, substituting glutamic acid for valine in the β-globin chain.

Q5.

5.1. The diagram given below shows the three types of endosperms in angiosperms.

		
Type 1	Type 2	Type 3

1. Identify the three types of endosperms shown above.

2. Name the type of endosperm which commonly occurs in polypetalous dicots.

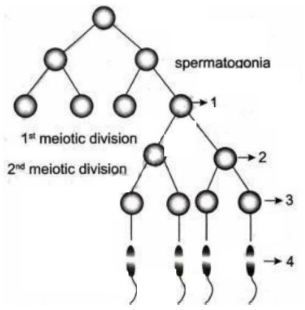
Solution

1. Type I: Nuclear endosperm.
   Type II: Cellular endosperm.
   Type III: Helobial endosperm.

2. Nuclear endosperm is the most prevalent kind of endosperm among polypetalous dicots, accounting for around 56% of plant families.

OR

5.2. The diagram given below shows the various steps in spermatogenesis.



a. Name the parts labelled '1', '2' and '3'.

b. Name the process by which part '3' changes to part '4'.

Solution

a. 1: Primary spermatocytes.
   2: Secondary spermatocytes.
   3: Spermatids.

b. The process of forming spermatozoa (4) from spermatids (3) is called spermiation.

Q6.

6.1. (a) Write the scientific name of the filarial worm that causes filariasis.

Write the scientific name of the causative agent of the following diseases.

Filariasis

Solution

The scientific name of the filarial worm is Wuchereria bancrofti.

6.1. (b) Write the mode of transmission for the following diseases:

Filariasis

Solution

Transfer from one person to another by mosquito bite (Culex quinquefasciatus).

6.2. (a) Write the scientific name of the causative agent of the following diseases:

Typhoid

Solution

The causative agent is the Salmonella typhi bacteria.

6.2. (b) Write the mode of transmission for the following diseases:

Typhoid

Solution

Contaminated food and water transmit typhoid disease.

Q7.

7.1. A male plant bearing red flowers was crossed with a female plant bearing yellow flowers. In the F_1 generation, all the flowers were orange in colour.

Give a reason to explain the change of colours in F_1 generation.

Solution

Incomplete dominance explains the colour variation in F_1 generation. In incomplete dominance, a type of gene interaction, both alleles of a gene at a locus are only partially expressed. Here in F_1 all the progeny obtained heterozygous Ry when pure red flower RR was crossed with yellow blossom yy. They start to turn orange.

7.2. A male plant bearing red flowers was crossed with a female plant bearing yellow flowers. In the F_1 generation, all the flowers were orange in colour.

Mention the ratio of red flowers, yellow flowers and orange flowers in the F_2 generation.

Solution

When heterozygous orange flowers from the F_1 generation interbreed, the F_2 generation displayed pure parental features. Instead of the conventional 3:1, the Mendelian ratio becomes

	R	y
R	RR Red	Ry Orenge
y	Ry Orenge	yy yellow

1 (Red flower) : 2 (Orange flower) : 1 (Yellow flower)

Q8.

8.1. Microbes are useful to human beings in diverse ways. Give the biological name of the following microbe:

Lactic acid producing bacterium.

Solution

Lactobacillus

8.2. Microbes are useful to human beings in diverse ways. Give the biological name of the following microbe:

Microbe known as Baker's yeast.

Solution

Saccharomyces cerevisiae

8.3. Microbes are useful to human beings in diverse ways. Give the biological name of the following microbe:

Fungus which helps in the production cyclosporin-A.

Solution

Trichoderma polysporum

8.4. Microbes are useful to human beings in diverse ways. Give the biological name of the following microbe:

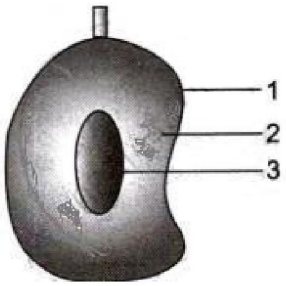
Microbe used in the production of statins.

Solution

Monascus purpureus

SECTION C - 21 MARKS

Q9. The diagram given below is the L.S. of a typical fruit.



i. Identify the parts labelled '1', '2' and '3'.

ii. State the difference between a true fruit and a false fruit.

iii. What is the significance of the formation of fruit in angiosperms?

Solution

i. 1 - Apicarp, 2 - Mesocarp, 3 - Endocarp

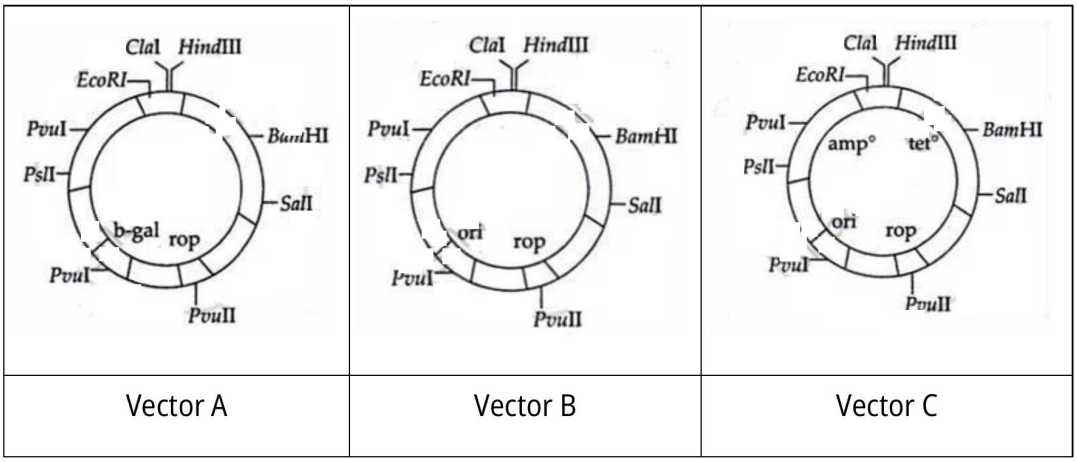
ii.

True fruits	False fruits
True fruits develop from ovary, which is mature and ripe.	False fruits arise from alternative floral elements except the ovary.
True fruits have seeds inside them	False fruits do not have seeds.

iii. To protect the seeds from harsh weather conditions and help in their dispersal to other locations.

Q10. Suneeta is planning an experiment to clone a gene in a vector. So, she has to choose a good cloning vector.

Which one of the vectors shown below should she choose? Justify your answer by giving two reasons.



Vector A	Vector B	Vector C

Solution

A cloning vector should have a replication origin that allows it to reproduce itself within the host cell. It should include a restriction site for the insertion of the target DNA. It should include a selectable marker with an antibiotic resistance gene to aid in the screening of the recombinant organism. By taking into account all of the above, She should select Vector-C.

Q11. Study the two figures shown below that represent two growth models.

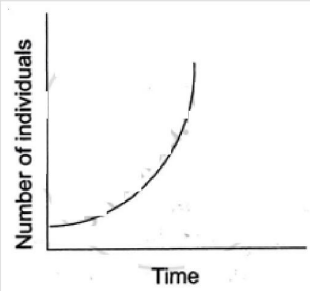


Figure A

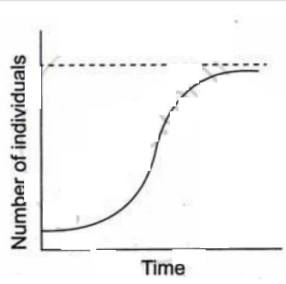


Figure B

i. Which one of the two figures represents an unlimited supply of nutrients? Give a reason.
ii. Which figure depicts a challenge to population growth?
iii. Explain the term reproductive fitness.
iv. Give the mathematical expressions for Figure A and Figure B.

Solution

i. Population expansion in the J-shape, also known as the exponential growth curve, occurs when nutrients are abundant. Figure A depicts that circumstance. The population's per capita growth rate remains constant, regardless of population size.

ii. Figure B depicts a challenge to population growth.

iii. Reproductive fitness assesses an individual's ability to pass on genes to the next generation through survival and reproduction. It plays an important role in determining which features become more widespread to a population due to natural selection.

iv. Related mathematical expressions:

1. mathematical expression for Figure A is

$$\frac{dN}{dt} = rN$$

Where N represents population size, t is time, r is the intrinsic rate of natural increase and $\frac{dN}{dt}$ is the rate of change in population size over a certain time period.

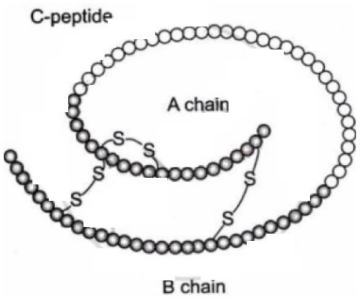
2. The mathematical expression for Figure A is

$$\frac{dN}{dt} = rN\left(\frac{K - N}{K}\right)$$

N is population size, t is time, r is the intrinsic rate of natural increase, K is carrying capacity and $\frac{dN}{dt}$ is the rate of change in population size over time.

Q12. The diagram given below represents the schematic structure of proinsulin, which undergoes certain modifications before it becomes a fully functional insulin.

Study the diagram carefully and answer the questions that follow:



i. State the change the proinsulin undergoes to become fully functional.

ii. Name the modern scientific technique used for the production of human insulin.

iii. How are the two polypeptide chains of the fully functional insulin held together?

Solution

i. Proinsulin undergoes a chemical change in which the C-peptide is cleaved and eliminated before becoming completely functional as mature insulin. The C-chain breaks to generate an active insulin molecule.

ii. Recombinant DNA (rDNA) technology is used to produce human insulin.

iii. Disulfide bonds connect the two polypeptide chains, the A chain (21 amino acids) and the B chain (30 amino acids), to form the fully functioning insulin molecule. These chains are linked by two disulfide bonds, while the A chain contains an additional internal disulfide bond. These connections are critical to insulin's structure and activity.

Q13.

13.1. (a) A patient was given an anti-retroviral drug by the doctor.

Which disease was the patient diagnosed with?

Solution

HIV patients should take an antiretroviral medicine. So, the patient is diagnosed with HIV.

13.1. (b) A patient was given an anti-retroviral drug by the doctor.

Mention any one symptom of HIV disease.

Solution

Two symptoms of this disease are:

1. Swollen lymph glands and coughing.
2. Chills, fever and weight loss.

13.2. A patient was given an anti-retroviral drug by the doctor.

Give the scientific name of the causative agent of HIV disease

Solution

Human immunodeficiency virus

13.3. A patient was given an anti-retroviral drug by the doctor.

Which method was used to diagnose HIV disease?

Solution

The Enzyme-Linked Immunosorbent Assay (ELISA) is a laboratory test that detects HIV.

13.4. A patient was given an anti-retroviral drug by the doctor.

What is the role of Reverse Transcriptase and Integrase in the life cycle of a retrovirus?

Solution

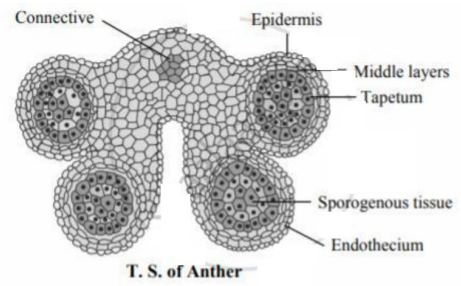
All retroviruses and associated retrotransposons use reverse transcription to complete their life cycle. Only the retroviral reverse transcriptase (RT) enzyme is capable of carrying out this intricate process, which involves turning viral single

stranded RNA into integration competent double-stranded DNA. The enzyme invertase speeds up the attack of the 3'-hydroxyl group at the ends of the processed DNA on a pair of phosphodiester bonds in the target DNA.

Q14.

14.1. Draw a neat and well labelled diagram of T.S. of anther.

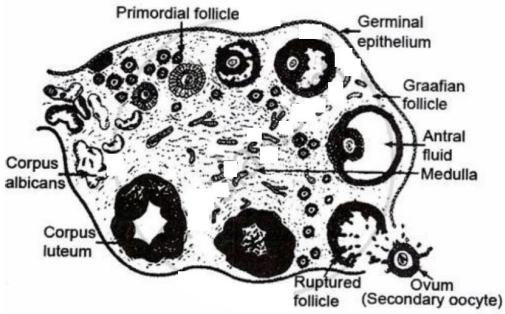
Solution



OR

14.2. Draw a neat and well labelled diagram of T.S. of the mammalian ovary.

Solution



Q15. The table given below shows the Area, Y-intercept and regression coefficient of the continents namely, Africa and Europe. Study the table carefully and answer the questions that follow:

	Africa	Europe
Area (A)	62,000 km sq.	65,000 km sq.
Y-intercept	(C) 10	20
Regression coefficient (Z)	1	1

i. **Calculate the species richness (S) of each continent.**

ii. **Which of these continents shows a higher biodiversity?**

iii. **State any two factors that cause an increase in biodiversity.**

Solution

(i) The formula for species richness with Y-intercepts is

$\log S = \log C + Z \log A$

where S is species richness.

C is the Y-intercept.

Z is a regression coefficient.

A is area.

- **Here, in Africa**

$\text{Log } S = \log 10 + 1 \cdot \log 62000$

$\log S = 1 + 4.79$

$\text{Log } S = 5.79$

$S = e^{5.79}$

$S = 327.01$

species richness is 327.01

- **Here, in Europe**

$\text{Log } S = \log 20 + 1 \cdot \log 65000$

$\log S = 1.3 + 4.81$

$\text{Log } S = 6.11$

$S = e^{6.11}$

$S = 450.33$

species richness is 450.33

(ii) In Africa biodiversity is higher.

(iii) Several factors influence species diversity.

There are two of them: habitat diversity and genetic diversity.

SECTION D - 15 MARKS

Q16.

16.1. Meena had grown Rose and China-rose plants in her garden. She collected pollen grains from China-rose plants and sprinkled them on the stigma of the Rose flowers, as she wanted to grow a hybrid variety of Rose.

a. Will this pollination give the desired results? Give a reason for your answer.

b. What is geitonogamy? Why is it considered equivalent to cross-pollination in ecological context and self-pollination in genetic context?

Solution

a. No. Rose and China rose are two separate species that do not belong in the same category. Pollen can only fertilise seeds belonging to the same species. As a result, Meena did not receive the desired fertilisation results.

b. Geitonogamy is the transfer of pollen grains from one flower's anther to the stigma of another blossom on the same plant.

Geitonogamy, such as cross-pollination, involves a pollinating agent. Geitonogamy is a kind of self-pollination in which pollen is transferred from the anther of one flower to the stigma of another on the same plant.

OR

16.2. Fertilisation is the key process in sexually reproducing organisms and it acts as a vital link between two generations. Flowering plants adopt a unique pattern of sexual reproduction as compared to other organisms.

a. Explain the process of fertilisation in angiosperms.

b. What is the precise location and function of filiform apparatus in the embryo sac of angiosperms?

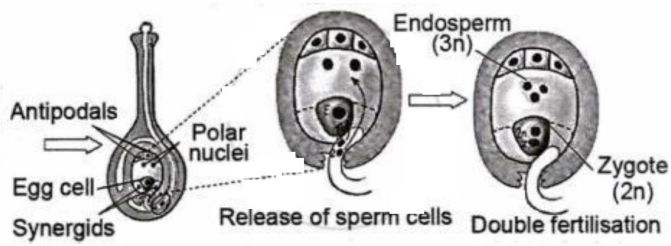
c. Fruits and seeds are generally formed due to fertilisation. Name the process involved in the production of the following without fertilisation:

    1. Fruits

    2. Seeds

Solution

a. Angiosperms, or flowering plants, have a unique fertilisation process known as double fertilisation, which begins when a pollen grain reaches the female stigma. The pollen tube discharges two sperm cells. Two polar nuclei combine to form a secondary nucleus, which then merges with one sperm nucleus from the pollen tube to generate an endosperm cell. The other sperm nucleus enters the egg cell with the help of synergids, degenerates and fuses with the nucleus.



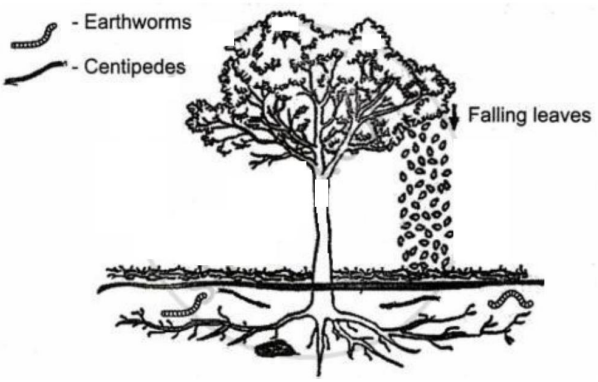
b. The filiform apparatus is a thickened structure located at the embryo sac's micropylar end, also known as the megasporangium. The filiform apparatus guides pollen tubes into the synergids and releases male gametes

c.

1. **Fruits:** Parthenocarpy is the process of generating fruit without fertilisation.
2. **Seeds:** Apomixis is the process of creating seeds without fertiliser.

Q17. The diagram given below shows the process of decomposition in the forest ecosystem.

Observe the diagram carefully and answer the questions that follow.



i. Why is the breaking down of complex organic matter an important event in the ecosystem?

ii. The forest soil has a higher humus content than the desert soil. Give a reason to justify this statement.

iii. Earthworms and centipedes play an important role in the decomposition process of forest ecosystems. At which stage of the decomposition are these organisms involved?

iv. The net annual primary productivity of a particular wetland ecosystem is found to be 8,000 kcal/m2 per year. If respiration by the aquatic producers is 11,000 kcal/m2 per year, calculate the gross primary productivity for this ecosystem.

Solution

i. Decomposition is the process of converting complex organic compounds into simpler ones. It is a crucial aspect of Earth's life cycle, supplying nutrients to plants and new species. Plants' important nutrients are mineralized, which is the process of converting organic nutrients into soluble forms that are readily available to plants. Higher rates of decomposition result in faster cycling of important plant nutrients, which influences productivity.

ii. Forests have more trees and animals, which add to the soil's organic material. Humus is a black organic material that forms in soil as plant and animal waste decays. Forest soil contains more humus than arid soil.

iii. Stage 3, often known as active decay, is when earthworms and centipedes begin to function. Earthworms eat soil and decaying plant matter, such as straw, leaf litter and dead roots. They combine dead surface litter with soil, allowing microorganisms to decompose it more easily.

iv. NPP = GPP − R

Given:

NPP = 8000 kcal/m^2/year and R = 11000 kcal/m^2/year

So, 8000 = GPP − 11000

GPP = 8000 + 11000

GPP = 19000 kcal/m^2/year

Gross primary productivity for this ecosystem is 19000 kcal/m^2/year.

Q18. Griffith conducted a series of experiments on mice with two different strains of the bacterium Diplococcus pneumoniae.

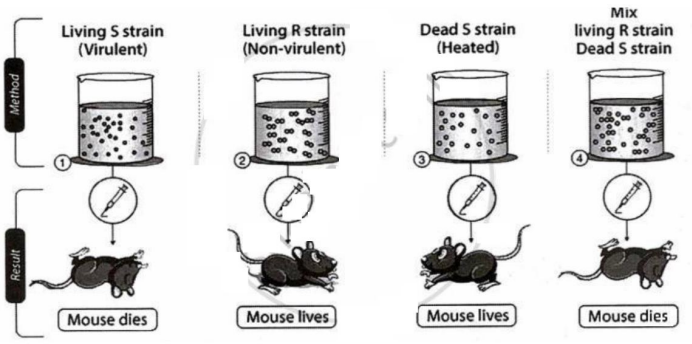
i. Describe the entire procedure for this experiment.

ii. Write the conclusion of this experiment.

iii. What would have been the result of the experiment if both strains of bacteria were first heat-killed, mixed and then injected in the mice?

Solution

i. During the experiment, Griffith cultivated Diplococcus pneumonial bacteria, which exhibited two growth patterns. One culture plate contained smooth, glossy colonies (S), whereas the other contained rough colonies (R). The difference was attributable to the presence of a mucous coat in S strain bacteria, whereas R strain bacteria lacked one. Griffith introduced both S and R strains into mice. The person infected with the S strain died from pneumonia, whereas the one infected with the R strain survived. In the second stage, Griffith heat-killed the S strain bacteria and injected them into mice, but the mice survived. Then he combined the heat-killed S and live R strains. This concoction was put into mice, which died. In addition, he discovered live S-strain bacteria in deceased mice.



ii. Griffith inferred from his observations that S strain bacteria had altered R strain bacteria. The R strain inherited a 'transforming principle' from the heat-killed S strain bacteria, which made them virulent and he adopted this transforming principle as genetic material.

iii. If both strains of the bacteria were first heat-killed, mixed, and then injected into mice, the mice would stay alive because heat-killing bacteria would destroy their ability to cause infection.