

UP Board Class 12 Biology 2026 (Set 348 EJ) Question Paper with Solutions



General Instructions

- (i) This booklet contains 9 questions, each provided with a complete, step-by-step solution.
- (ii) It comprises 4 single-correct multiple-choice questions.
- (iii) Attempt each question on your own before reviewing the given solution.

1(a). Which of the following is a cyanobacteria?

- (A) Spirogyra
- (B) Glomus
- (C) Oscillatoria
- (D) Chlorella

Correct Answer: (C) Oscillatoria

Solution:

Understanding the Concept:

Cyanobacteria (blue-green algae) are photosynthetic prokaryotes, so they have no nucleus or membrane-bound organelles, unlike true algae or fungi.

Check each option:

Spirogyra is a filamentous green alga, a eukaryote with a nucleus, so it is not a cyanobacterium.

Glomus is a fungus that forms mycorrhizal associations with plant roots.

Oscillatoria is a filamentous, gliding, prokaryotic blue-green alga that fixes nitrogen and carries out oxygenic photosynthesis, making it a true cyanobacterium.

Chlorella is a unicellular green alga, again a eukaryote.

Final Answer:

Only Oscillatoria is a prokaryotic photosynthetic organism, so it is the cyanobacterium among the four.

Oscillatoria

Quick Tip: Recall that cyanobacteria are prokaryotic, unlike algae or fungi.



1(b). The ovule is attached to the placenta by means of a stalk called

- (A) Hilum
- (B) Funicle
- (C) Embryo sac
- (D) Nucellus

Correct Answer: (B) Funicle

Solution:

Understanding the Concept:

An ovule is the structure inside the ovary that develops into a seed after fertilisation. It is not free floating, it is joined to the placenta by a stalk.

Check each option:

The stalk that joins the body of the ovule to the placenta is called the funicle.

The point where the funicle joins the ovule body is the hilum, not the stalk itself.

The embryo sac is the female gametophyte lying inside the ovule, not the stalk.

The nucellus is the mass of tissue inside the ovule that surrounds the embryo sac, again not the stalk.

Final Answer:

The stalk attaching the ovule to the placenta is the funicle.

Funicle

Quick Tip: The stalk of the ovule is distinct from the hilum, which is just the junction point.

1(c). Who coined the term 'linkage'?

- (A) Henking
- (B) W. Sutton and T. Boveri
- (C) T.H. Morgan
- (D) Tschermak

Correct Answer: (C) T.H. Morgan

Solution:

Understanding the Concept:

Linkage is the tendency of genes located close together on the same

chromosome to be inherited together instead of independently.

Check each option:

Henking is known for discovering the X body (later named the X chromosome) in insects, not for the term linkage.

Sutton and Boveri proposed the chromosomal theory of inheritance, linking Mendel's factors to chromosome behaviour, but they did not coin the word linkage.

Tschermak was one of the three botanists who rediscovered Mendel's work in 1900.

T.H. Morgan, working on *Drosophila*, showed that genes on the same chromosome do not assort independently and introduced the term linkage for this behaviour.

Final Answer:

The term linkage was coined by T.H. Morgan.

T.H. Morgan

Quick Tip: Think of the scientist whose *Drosophila* experiments first showed genes travelling together.

1(d). Which of the following hormones is secreted by the placenta?

- (A) Progesterone
- (B) Relaxin
- (C) Prolactin
- (D) Growth hormone

Correct Answer: (A) Progesterone

Solution:

Understanding the Concept:

During pregnancy the placenta itself works as a temporary endocrine gland, alongside its role in nutrient and gas exchange.

Check each option:

The placenta secretes hCG, human placental lactogen, estrogen, and progesterone to maintain the pregnancy, so progesterone is a placental hormone.

Relaxin is mainly secreted by the ovary (corpus luteum) near the end of pregnancy to relax the pelvic ligaments, not primarily by the placenta.

Prolactin is secreted by the mother's pituitary gland to start milk production, not by the placenta.

Growth hormone is a pituitary hormone unrelated to placental function.

Final Answer:

Progesterone is the hormone secreted by the placenta among the choices.

Progesterone

Quick Tip: Recall which of these four hormones the placenta itself produces to sustain pregnancy.

2(a). Write the name of any one cloning vector.

Correct Answer: pBR322 plasmid

Solution:

Answer:

A cloning vector is a DNA molecule used to carry a foreign gene into a host cell and replicate it.

pBR322, a plasmid isolated from *E. coli*, is a widely used cloning vector because it carries an origin of replication, antibiotic resistance genes for selection, and unique restriction sites.

pBR322

Quick Tip: Think of the *E. coli* plasmid used most often to carry foreign DNA.

2(b). Write the name of any one water pollinated plant.

Correct Answer: Vallisneria

Solution:

Answer:

Water pollination (hydrophily) happens when pollen is carried to the stigma by water instead of wind or insects.

Vallisneria is a common example: its male flowers detach and float on the water surface to reach the female flowers.

Vallisneria

Quick Tip: Recall a submerged aquatic plant whose male flowers float to reach the stigma.



2(c). Write the name of any one ecto-parasite.

Correct Answer: Louse (Pediculus)

Solution:

Answer:

An ecto-parasite lives on the outer body surface of its host and feeds on it, unlike an endo-parasite that lives inside.

The head louse, Pediculus, attaches to human hair and skin and feeds on blood, making it a classic ecto-parasite.

Louse (Pediculus)

Quick Tip: Think of a blood-feeding insect that stays on the outside of the human body.



2(d). Give the names of two decomposers.

Correct Answer: Bacteria and fungi

Solution:

Answer:

Decomposers break down dead organic matter into simple inorganic substances, returning nutrients to the ecosystem.

Bacteria (such as species that rot dead leaves) and fungi (such as saprophytic mushrooms) are the two main groups of decomposers.

Bacteria and fungi

Quick Tip: Think of the microorganisms that rot dead leaves and animal remains.

2(e). Which gas is used for the storage of pollen grains?

Correct Answer: Liquid nitrogen

Solution:

Answer:

Pollen grains lose viability quickly at ordinary room conditions, so they are stored in a pollen bank for later use in breeding programmes. They are preserved by storing them in liquid nitrogen at minus 196 degrees Celsius, which keeps them viable for years.

Liquid nitrogen

Quick Tip: Recall the extremely cold liquefied gas used in pollen banks.

3(a). Define micro-propagation.

Correct Answer: —

Solution:

Understanding the Question:

Micropropagation is a plant tissue culture technique used to produce many identical plants from one parent plant.

Detailed Explanation:

A small piece of tissue, called an explant, is taken from a healthy parent plant and grown on a sterile nutrient medium containing hormones like auxins and cytokinins.

Under these controlled conditions, the explant multiplies into a mass of undifferentiated cells called a callus, which is then induced to form shoots and roots, giving complete plantlets.

Because every plantlet comes from the same parent cell, all the plants raised this way are genetically identical, or clones.

Final Answer:

Micropropagation is the rapid production of thousands of genetically identical plants from a single explant using tissue culture, which is why commercial banana and orchid growers rely on it.

Quick Tip: Recall the tissue culture method that multiplies a single explant into many identical plantlets.



3(b). Draw a ray diagram (flow chart) of energy flow in an ecosystem.

Correct Answer: —

Solution:**Understanding the Question:**

Energy flow in an ecosystem is one directional, moving from the sun

through successive trophic levels and being lost as heat at each step.

Detailed Explanation:

The chain can be shown as a flow diagram: Sun leads with an arrow to Producers (green plants, which trap about 2 to 10 percent of incoming solar energy).

Producers lead with an arrow to Primary Consumers (herbivores).

Primary Consumers lead with an arrow to Secondary Consumers (carnivores).

Secondary Consumers lead with an arrow to Tertiary Consumers (top carnivores).

At every arrow, only about 10 percent of the energy of one level passes on to the next (the ten percent law), while the rest is lost as heat through respiration and other life processes.

Final Answer:

The energy flow chain is Sun to Producers to Herbivores to Carnivores to Top carnivores, with roughly 90 percent of energy lost as heat at each transfer.

Quick Tip: Think of the one-way arrow chain from sun to producers to herbivores to carnivores.

3(c). Write a short note on biopiracy.

Correct Answer: —

Solution:

Understanding the Question:

Biopiracy is the unauthorised use of a country's biological resources and the traditional knowledge tied to them, usually by companies from another country.

Detailed Explanation:

Many developing countries, including India, are rich in biodiversity and hold generations of traditional knowledge about using local plants for medicine and agriculture.

When foreign organisations extract these bio-resources or patent products based on this traditional knowledge without paying royalties or getting consent from the local community, it is called biopiracy.

The neem and turmeric patent disputes are well known Indian examples, where patents were granted abroad for uses that Indian farmers and healers had practised for centuries, and India had to legally challenge these patents to get them revoked.

Final Answer:

Biopiracy is the exploitation of a nation's biodiversity and traditional knowledge without proper authorisation or benefit sharing, and India has fought several such patent cases to protect its bio-resources.

Quick Tip: Think of the neem and turmeric patent disputes, where traditional Indian knowledge was patented abroad.



3(d). Comment upon biological evolution.

Correct Answer: —

Solution:

Understanding the Question:

Biological evolution is the gradual, heritable change in the characteristics of populations of organisms over successive generations.

Detailed Explanation:

It happens because individuals in a population show variation, and some variations help an organism survive and reproduce better in its environment than others.

Natural selection favours individuals carrying these useful variations, so their genes become more common in the next generation, which slowly shifts the traits of the whole population.

Over long spans of time, this accumulation of small changes can produce new species, explaining the diversity of life we see today, from bacteria to complex animals and plants sharing a common ancestry.

Final Answer:

Biological evolution is the slow, natural-selection driven change in populations across generations that has produced the entire diversity of life from shared common ancestors.

Quick Tip: Recall that evolution works through variation plus natural selection acting over generations.

3(e). Write the importance of species diversity in an ecosystem.

Correct Answer: —

Solution:

Understanding the Question:

Species diversity is the number and variety of different species living in an ecosystem.

Detailed Explanation:

A higher species diversity generally makes an ecosystem more stable, because the loss or decline of one species is less likely to disturb the whole food web when many other species can fill similar roles.

Diverse ecosystems are also more productive, since different species use resources like light, water and nutrients in slightly different ways, so the community as a whole captures more energy.

Species diversity is also a genetic reserve for the future: many wild species carry genes that could be useful for breeding better crops, producing new medicines, or coping with a changing climate.

Final Answer:

Species diversity gives an ecosystem stability, higher productivity, and a genetic resource base, so losing species weakens the ecosystem's ability to function and adapt.

Quick Tip: Think about stability, productivity, and genetic resources as the three benefits of high species diversity.



4(a). Write a short note on self-incompatibility.

Correct Answer: —

Solution:

Understanding the Question:

Self-incompatibility is a genetic mechanism in flowering plants that prevents self-pollen from fertilising the same flower or plant.

Detailed Explanation:

Even when self-pollen lands on the stigma of the same flower, a biochemical recognition system stops the pollen tube from growing properly or stops fertilisation from completing, so self-fertilisation is blocked.

Species belonging to the Brassicaceae and Solanaceae families are common examples that show this trait.

This mechanism forces cross-pollination between different plants, which increases genetic variation in the offspring and avoids the harmful effects of inbreeding.

Final Answer:

Self-incompatibility is a genetic barrier that stops self-pollen from fertilising the same plant, promoting cross-pollination and healthier genetic variation.

Quick Tip: Think of a flower's own biochemical defence against fertilising itself with its own pollen.

4(b). What is colostrum? Write its importance.

Correct Answer: —

Solution:

Understanding the Question:

Colostrum is the special milk that a mother's mammary glands produce during the first few days right after childbirth.

Detailed Explanation:

It differs from regular breast milk in being thicker and richer in antibodies, particularly immunoglobulin A.

Because the newborn's own immune system is still immature, colostrum passes on ready-made antibodies from the mother that protect the baby against many infections in its earliest, most vulnerable days.

It is also rich in proteins and nutrients suited to a newborn's needs, so doctors always recommend that a baby be fed colostrum rather than it being discarded.

Final Answer:

Colostrum is the antibody-rich first milk that gives a newborn passive immunity and vital nutrition in its first days of life.

Quick Tip: Recall the very first milk a mother produces, packed with antibodies for the newborn.



4(c). Write a short note on birth control.

Correct Answer: —

Solution:**Understanding the Question:**

Birth control refers to methods used to prevent unwanted pregnancy

so that couples can plan the size and timing of their family.

Detailed Explanation:

Barrier methods, such as condoms and diaphragms, physically block sperm from reaching the egg.

Natural methods, such as the rhythm method, avoid intercourse during the fertile period of the menstrual cycle.

Hormonal methods, such as oral contraceptive pills, prevent ovulation by altering hormone levels.

Intra-uterine devices placed in the uterus prevent implantation, and surgical methods like vasectomy and tubectomy give permanent contraception.

Final Answer:

Birth control covers barrier, natural, hormonal, intra-uterine and surgical methods, all aimed at preventing fertilisation or implantation so couples can control family planning.

Quick Tip: List the main categories: barrier, natural, hormonal, intra-uterine, and surgical methods.

◆

4(d). What is a biodiversity hot-spot? Describe with an example.

Correct Answer: —

Solution:

Understanding the Question:

A biodiversity hotspot is a geographic region that has an exceptionally large number of species, many of which are found nowhere else, but

which also faces serious habitat loss.

Detailed Explanation:

To qualify as a hotspot, a region must have at least 1,500 species of vascular plants found only there (a high level of endemism), and it must have already lost at least 70 percent of its original habitat.

These two conditions together mean the region holds unique life that is under severe threat, making conservation there especially urgent.

The Western Ghats and Sri Lanka form one such recognised hotspot, home to many endemic amphibians and plants that exist nowhere else on Earth, but where forest cover has shrunk sharply due to human activity.

Final Answer:

A biodiversity hotspot is a highly endemic but heavily threatened region, such as the Western Ghats and Sri Lanka hotspot, that needs priority conservation.

Quick Tip: Recall the two conditions: high endemism and over 70 percent habitat loss, using the Western Ghats as an example.



5(a). Briefly explain the test cross.

Correct Answer: —

Solution:

Understanding the Question:

A test cross is used to find out whether an organism showing a dominant trait is homozygous or heterozygous for that trait.

Detailed Explanation:

The individual of unknown genotype (showing the dominant phenotype, genotype either AA or Aa) is crossed with a homozygous recessive individual (aa).

If the unknown parent is homozygous dominant (AA), all offspring of this cross show the dominant phenotype.

If the unknown parent is heterozygous (Aa), the offspring appear in a 1 to 1 ratio of dominant to recessive phenotype, because the recessive parent contributes only recessive alleles, so the ratio directly reflects the gametes made by the unknown parent.

Final Answer:

A test cross, crossing the unknown dominant individual with a homozygous recessive one, reveals the hidden genotype from the ratio of offspring phenotypes.

Quick Tip: Recall crossing the unknown dominant genotype with a full recessive (aa) partner.

5(b). Briefly describe crossing over.

Correct Answer: —

Solution:**Understanding the Question:**

Crossing over is the exchange of genetic material between non-sister chromatids of homologous chromosomes during meiosis.

Detailed Explanation:

It happens at the pachytene stage of prophase I, when homologous chromosomes pair up closely (synapsis) and form a tetrad of four chromatids.

At certain points, called chiasmata, the non-sister chromatids break and rejoin with each other, swapping segments of DNA.

Because the swapped chromatids now carry a new combination of alleles from both parental chromosomes, crossing over is the main source of genetic recombination, producing gametes with combinations of traits different from either parent.

Final Answer:

Crossing over is the exchange of chromatid segments between homologous chromosomes at pachytene, creating new allele combinations and driving genetic variation.

Quick Tip: Recall that it happens at pachytene between non-sister chromatids of paired homologous chromosomes.

5(c). Write a short note on the prevention and control of Drug/Alcohol abuse.

Correct Answer: —

Solution:**Understanding the Question:**

Drug and alcohol abuse is the habitual, harmful use of substances, and prevention means the steps taken to stop it from starting or spreading.

Detailed Explanation:

Avoiding peer pressure and choosing friends carefully protects young people from the initial exposure that often leads to abuse.

Open conversation between children and parents builds trust, so warning signs can be caught early rather than hidden.

Education about the dangerous effects of drugs and alcohol, delivered at school and through the media, helps people make informed choices.

If abuse has already started, professional medical and psychological counselling is needed, and appropriate help should be sought from a qualified doctor rather than self-treatment.

Final Answer:

Prevention relies on avoiding peer pressure, open family communication and education, while control of existing abuse needs proper medical and psychological help.

Quick Tip: Think of the standard prevention steps: avoiding peer pressure, education, family support, and seeking medical help.

5(d). What is a terminator codon? Write two examples.

Correct Answer: UAA, UAG

Solution:**Understanding the Question:**

A terminator (stop) codon is a triplet of mRNA bases that does not code for any amino acid but instead signals the ribosome to end

translation.

Detailed Explanation:

During protein synthesis, the ribosome reads the mRNA codon by codon, adding one amino acid for each codon using the matching tRNA.

When the ribosome reaches a stop codon, no tRNA has an anticodon that matches it, so instead a release factor binds there and causes the completed polypeptide chain to be released from the ribosome.

There are three stop codons in the genetic code, UAA, UAG and UGA, and any one of them marks the end of the coding sequence for a protein.

Final Answer:

A terminator codon stops protein synthesis by having no corresponding tRNA. Examples are UAA and UAG (a third, UGA, also exists).

UAA, UAG

Quick Tip: Recall the three stop codons that carry no amino acid and end translation.

6(a). Distinguish between convergent evolution and divergent evolution.

Correct Answer: —

Solution:

Understanding the Question:

Both are patterns of evolution, but they describe opposite relationships between similarity in appearance and similarity in ancestry.

Detailed Explanation:

Convergent evolution happens when unrelated species, living in similar environments, independently evolve similar looking structures because they face similar selection pressures. The wings of a bird and the wings of a bat look and function alike, but the two lineages are not closely related, so these are analogous structures.

Divergent evolution happens when a single ancestral species gives rise to many different species that adapt to different environments and end up looking quite different from each other, even though they share a common origin. The forelimbs of a human, a whale and a bat come from the same basic ancestral bone plan but have diverged into a hand, a flipper and a wing, so these are homologous structures.

Final Answer:

Convergent evolution makes unrelated species look similar (analogous structures), while divergent evolution makes related species with a common ancestor look different (homologous structures).

Quick Tip: Convergent = unrelated species end up alike; divergent = related species end up different.

6(b). Give a diagrammatic presentation of the stages in the life cycle of Plasmodium in human.

Correct Answer: —

Solution:

Understanding the Question:

Plasmodium, the malarial parasite, completes part of its life cycle inside the human body after being introduced by a female Anopheles mosquito bite.

Detailed Explanation:

The stages, in order, can be shown as a flow chart: Sporozoites (injected by mosquito bite) leads to Liver cells (sporozoites multiply here as liver or exo-erythrocytic stage).

Liver cells lead to Merozoites (released into blood, these invade red blood cells).

Merozoites inside RBCs lead to Trophozoites, which grow and multiply, rupturing the RBC and releasing more merozoites along with the toxic pigment haemozoin.

This RBC-rupturing release of toxin causes the periodic high fever chills that are the classic symptom of malaria.

Some merozoites also develop into Gametocytes, which are taken up by another mosquito bite to continue the cycle in the insect.

Final Answer:

The human-stage life cycle runs: Sporozoite injection to Liver stage to Merozoite release to RBC infection (trophozoite growth and RBC rupture causing fever) to Gametocyte formation, which restarts the cycle in the next mosquito.

Quick Tip: Trace the path: sporozoite injection, liver stage, merozoite release, RBC infection, gametocyte formation.

6(c). Write a descriptive note on BOD.

Correct Answer: —

Solution:

Understanding the Question:

BOD stands for Biochemical Oxygen Demand, a measure used to judge how polluted a water sample is with organic waste.

Detailed Explanation:

BOD is defined as the amount of oxygen, in milligrams per litre, that microorganisms use up while decomposing the organic matter present in a water sample over five days at 20 degrees Celsius.

Clean water has a low BOD because it contains little organic matter for microbes to break down, so little oxygen gets consumed.

Water polluted with sewage or industrial organic waste has a high BOD, because a large population of decomposer microbes uses up a lot of dissolved oxygen while digesting the extra organic load, leaving too little oxygen for fish and other aquatic life.

BOD is therefore routinely used as a simple, reliable indicator of the degree of organic pollution in a water body.

Final Answer:

BOD measures the oxygen consumed by microbes decomposing organic waste in water over five days, and a higher BOD value directly indicates heavier organic pollution.

Quick Tip: Recall that BOD is the oxygen used by microbes to break down organic waste over five days.

6(d). Write a note on lymphocytes.

Correct Answer: —

Solution:

Understanding the Question:

Lymphocytes are a type of white blood cell that carries out the body's specific immune response against pathogens.

Detailed Explanation:

There are two main classes of lymphocytes: B lymphocytes and T lymphocytes, both produced from stem cells in the bone marrow. B lymphocytes mature in the bone marrow itself and, once activated, turn into plasma cells that secrete antibodies, giving humoral immunity that works mainly against pathogens circulating in blood and body fluids.

T lymphocytes migrate to the thymus to mature, and they directly attack infected or foreign cells, providing cell-mediated immunity, which is important against viruses hiding inside body cells and against cancer cells.

Together, B and T lymphocytes give the body its adaptive immunity, meaning the immune system can recognise a specific pathogen and remember it for a faster response next time.

Final Answer:

Lymphocytes are B cells and T cells that provide the body's specific, adaptive immunity, with B cells making antibodies and T cells directly attacking infected cells.

Quick Tip: Recall the two lymphocyte types: B cells (antibodies) matured in bone marrow, T cells (cell attack) matured in the thymus.



7. What is oogenesis? Describe the process of oogenesis with diagram.

Correct Answer: —

Solution:

Understanding the Question:

Oogenesis is the process by which a female's primary germ cells develop into a mature, fertilisable ovum (egg) inside the ovary.

Detailed Explanation:

It begins in the foetal stage itself, when oogonia (diploid germ cells) in the ovary multiply by mitosis and then enter meiosis, but this meiosis pauses at prophase I, so the cell is now called a primary oocyte.

Millions of primary oocytes stay arrested in this state, each surrounded by a layer of granulosa cells forming a primordial follicle, until puberty begins.

From puberty onward, in each menstrual cycle a few follicles start to grow under hormonal stimulation (FSH), and usually one primary oocyte completes its first meiotic division.

This first division is unequal, giving a large secondary oocyte and a tiny first polar body, so nearly all the cytoplasm and nutrients stay with the future egg.

The secondary oocyte begins the second meiotic division but again arrests, this time at metaphase II, and it is released from the ovary in this state during ovulation.

Meiosis II is completed only if a sperm fertilises the secondary oocyte,

producing the mature ovum plus a second polar body, while an unfertilised oocyte simply degenerates.

Diagram (described): Oogonium ($2n$) leads by mitosis to more oogonia, one of which enlarges into a Primary Oocyte ($2n$, arrested at prophase I inside a primordial follicle) leads by meiosis I to Secondary Oocyte (n) plus first Polar Body (n) leads by meiosis II, completed only after fertilisation, to Ovum (n) plus second Polar Body.

Final Answer:

Oogenesis converts a diploid oogonium into a haploid ovum through two unequal meiotic divisions, with the second division completing only after fertilisation, producing one functional egg and up to three polar bodies.

Quick Tip: Trace the path: oogonium, primary oocyte (arrested at prophase I), secondary oocyte plus polar body, ovum plus polar body (after fertilisation).

OR

Write explanatory notes on the following: (i) Water pollination (ii) Polyembryony.

Correct Answer: —

Solution:

Water pollination:

Water pollination, or hydrophily, is pollination carried out with water as the transferring agent, and it is uncommon, seen in only a small number of fully or partly submerged aquatic plants.

In genera like *Vallisneria*, the plant is unisexual: male flowers detach from the parent plant and float freely on the water surface, while female flowers stay attached but rise to the surface on a long stalk. Water currents carry the floating male flowers to the female flowers, allowing pollen to reach the stigma, after which the female flower is pulled back under water as the fruit develops.

In fully submerged plants such as *Zostera*, pollen grains are long and thread like and are released directly into the water, drifting until they reach the stigma of a female flower underwater.

Polyembryony:

Polyembryony is the occurrence of more than one embryo developing within a single seed, instead of just one.

It commonly happens because extra embryos form from nucellar or integument cells surrounding the embryo sac, a phenomenon especially common in citrus fruits, or because more than one egg cell or synergid gets fertilised in the same embryo sac.

This is agriculturally valuable, because nucellar embryos are genetically identical to the mother plant, so growers use polyembryony in citrus species to raise disease-free, true-to-type seedlings without depending on grafting.

Quick Tip: Water pollination: pollen carried by water currents, as in *Vallisneria*. Polyembryony: more than one embryo in a single seed, common in citrus.

8. Describe Mendel's law of one gene (monohybrid) inheritance.

Correct Answer: —

Solution:

Understanding the Question:

Mendel's law for the inheritance of a single gene is called the Law of Dominance and Segregation, discovered from his monohybrid crosses in garden pea plants.

Detailed Explanation:

Mendel crossed a pure tall pea plant (TT) with a pure dwarf pea plant (tt) and found that all the F₁ offspring were tall, showing that the tall trait is dominant over the dwarf trait, which is recessive.

Although the F₁ plants (Tt) looked tall, they still carried the hidden recessive allele for dwarfness, which is the first part of the law: a gene exists as a pair of alleles, and only the dominant allele expresses itself in the phenotype when both are present together.

When Mendel self-pollinated these F₁ plants, the F₂ generation showed both tall and dwarf plants in a ratio of 3 tall to 1 dwarf, instead of every plant simply resembling the F₁.

This reappearance of the dwarf trait proved the second part of the law, segregation: the two alleles of a gene separate cleanly from each other during gamete formation, so each gamete carries only one allele, and they recombine randomly at fertilisation.

This is why the F₂ genotype ratio works out to 1 TT : 2 Tt : 1 tt, which produces the observed 3:1 phenotypic ratio of tall to dwarf.

Final Answer:

Mendel's law of one gene inheritance states that a gene's two alleles segregate during gamete formation and unite randomly at fertilisation, with the dominant allele masking the recessive one, giving the classic 3:1 phenotype ratio in F₂.

Quick Tip: Recall the pea cross: $Tt \times Tt$ selfed gives 3 tall to 1 dwarf in F_2 , proving allele segregation.

OR

Describe chromosomal aberration with examples.

Correct Answer: —

Solution:

Understanding the Question:

A chromosomal aberration is a change in the normal structure or number of chromosomes, which can alter the phenotype of the affected individual.

Detailed Explanation:

Structural aberrations change the arrangement within a chromosome without necessarily changing chromosome number: deletion removes a chromosome segment, duplication repeats a segment, inversion reverses the order of a segment, and translocation moves a segment to a non-homologous chromosome.

Numerical aberrations change the total chromosome count.

Aneuploidy is the gain or loss of one or a few chromosomes due to faulty separation (non-disjunction) during meiosis, and Down syndrome, caused by an extra copy of chromosome 21 (trisomy 21), is a well known human example.

Polyploidy is the gain of one or more complete extra sets of chromosomes, which is common in plants and often produces larger, more vigorous individuals, as seen in many cultivated wheat and cotton varieties.

Another human example of aneuploidy is Klinefelter's syndrome,

where an individual has an extra X chromosome (genotype XXY), leading to male sterility.

Final Answer:

Chromosomal aberrations are structural changes (deletion, duplication, inversion, translocation) or numerical changes (aneuploidy such as Down syndrome, polyploidy in plants), both of which alter gene dosage or arrangement and can change the phenotype.

Quick Tip: Split into structural (deletion, duplication, inversion, translocation) and numerical (aneuploidy, polyploidy) aberrations, with Down syndrome as the classic example.



9. Write an essay on population interactions.

Correct Answer: —

Solution:

Understanding the Question:

Population interactions describe how the populations of different species living together in a community affect each other, whether positively, negatively, or with no effect.

Detailed Explanation:

In mutualism, both species benefit, as in the relationship between flowering plants and their pollinators, where the plant gets pollinated and the pollinator gets food.

In competition, both species are harmed because they use the same

limited resource, such as two bird species competing for the same nesting sites or food.

In predation, the predator benefits by killing and eating the prey, which is harmed, and predation helps keep prey populations in check while also transferring energy up the food chain.

In parasitism, the parasite benefits by living on or in a host and drawing nutrients from it, while the host is harmed, as seen with tapeworms living in the human intestine.

In commensalism, one species benefits while the other is neither helped nor harmed, such as an orchid growing on a tree branch simply for physical support.

In amensalism, one species is harmed while the other is unaffected, as when a large tree shades out smaller plants growing beneath it without gaining anything itself.

These interactions together shape which species can coexist in a community and how energy and resources move through it.

Final Answer:

Population interactions such as mutualism, competition, predation, parasitism, commensalism and amensalism define the pattern of benefit and harm between coexisting species and shape the structure of the whole community.

Quick Tip: List the six interaction types with the net effect on each species: mutualism, competition, predation, parasitism, commensalism, amensalism.

OR

What is an ecological pyramid? Describe different types of ecological pyramid with diagram.

Correct Answer: —

Solution:

Understanding the Question:

An ecological pyramid is a graphical way of showing the relationship between different trophic levels of an ecosystem, in terms of number, biomass, or energy, with producers forming the base.

Detailed Explanation:

The pyramid of numbers shows the count of individual organisms at each trophic level; it is usually upright, with many producers supporting fewer herbivores and even fewer carnivores, though in a forest ecosystem a few large trees (producers) can support far more herbivores, giving an inverted shape at the base.

The pyramid of biomass shows the total dry weight of organisms at each level; in most land ecosystems it is upright since biomass decreases going up the food chain, but in a pond ecosystem it can be inverted, since the standing crop of phytoplankton at any instant is small even though it reproduces very fast to support a larger fish biomass.

The pyramid of energy shows the amount of energy present at each trophic level, and this pyramid is always upright and never inverted, because energy is always lost as heat at each transfer (the ten percent law), so the level below always has more usable energy than the level above it.

Diagram (described): draw the widest bar at the bottom labelled Producers, a narrower bar above it labelled Primary Consumers, a still narrower bar above that labelled Secondary Consumers, and the narrowest bar at top labelled Tertiary Consumers, stacked to form a triangular pyramid shape (this shape may invert for the number or biomass pyramid in specific ecosystems, but never for the energy pyramid).

Final Answer:

An ecological pyramid plots trophic levels as number, biomass, or energy; the pyramids of number and biomass can sometimes be inverted, but the pyramid of energy is always upright because energy is lost as heat at every transfer.

Quick Tip: Three types: pyramid of numbers, biomass, and energy. Only the energy pyramid is always upright.