Roll No. ☐☐☐☐☐☐☐☐

Q.P. Code 57/1/1

BIOLOGY (THEORY)

CBSE Class XII Board Examination 2026 — with answers

Time allowed: 3 hours **Maximum Marks: 70**

General Instructions:

1. The paper has 33 questions in five sections (A to E); all questions are compulsory.
2. Section A: Q1–16 are multiple-choice / assertion-reason questions of 1 mark each.
3. Section B: Q17–21 are very short answer questions of 2 marks each.
4. Section C: Q22–28 are short answer questions of 3 marks each.
5. Section D: Q29–30 are case-based questions of 4 marks each, with an internal choice in one sub-part.
6. Section E: Q31–33 are long answer questions of 5 marks each.
7. There is no overall choice, but some questions have internal choices — answer only one alternative. Draw neat, labelled diagrams wherever needed.

SECTION A

Q1–16 carry 1 mark each (MCQ; Q13–16 Assertion-Reason).

1. For artificial hybridisation, in which of these plants is emasculation NOT needed? **1**

(A) Rice **(B)** Wheat

(C) Pea **(D) Papaya**

ANSWER
(D) Papaya

Emasculation means removing the anthers from a bisexual flower before they shed pollen, so that self-pollination cannot happen.
Papaya is dioecious – male and female flowers are on separate plants – so its female flowers have no anthers to remove. Only bagging of the female flower is needed.
Rice, wheat and pea have bisexual flowers, so emasculation is required in them.

2. Which one of these is NOT a part of the human immune system? **1**

(A) Lymphocytes **(B)** Plasma proteins

(C) Red blood cells **(D)** Bone marrow

ANSWER
(C) Red blood cells

The immune system consists of lymphoid organs (bone marrow, thymus, spleen, lymph nodes etc.), lymphocytes and other leucocytes, and soluble molecules such as antibodies and complement (plasma proteins).
Red blood cells carry oxygen; they have no role in recognising or fighting pathogens, so they are not a component of the immune system.

3. Pick the option that gives the correct statements about the menstrual cycle: **1**

(i) The corpus luteum secretes progesterone.
(ii) Only FSH reaches a peak in the middle of the cycle.
(iii) The LH surge causes the Graafian follicle to rupture.
(iv) The luteal phase is also known as the proliferative phase.

(A) Only (ii) is correct **(B) (i) and (iii) are correct**

(C) Only (iv) is correct **(D)** (ii) and (iv) are correct

ANSWER
(B) (i) and (iii) are correct

(i) True – after ovulation the ruptured follicle becomes the corpus luteum, which secretes large amounts of progesterone.
(ii) False – both LH and FSH peak around mid-cycle (LH much more sharply).
(iii) True – the mid-cycle LH surge induces rupture of the Graafian follicle, i.e. ovulation.
(iv) False – the follicular phase is the proliferative phase; the luteal phase is the secretory phase.

4. Which pair is wrongly matched? **1**

(A) Number of mega-diversity countries in the world – 12

(B) Genetically different strains of rice in India – fewer than 1000

(C) Robert May's estimate of global species diversity – about 7 million species

(D) Zoological parks – ex situ conservation

ANSWER

(B) Rice strains in India – fewer than 1000 (actually more than 50,000)

India has more than 50,000 genetically different strains of rice (and about 1000 varieties of mango), so 'fewer than 1000' is wrong.
The other pairs are correct: there are 12 mega-diversity countries; Robert May estimated about 7 million species globally; zoos protect animals outside their natural habitat, i.e. ex situ.

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5. The hybrid plant 'Pomato' was obtained by the fusion of protoplasts of: **1**

(A) Tomato and potato

(B) Pomegranate and tomato

(C) Pomegranate and potato

(D) Pomegranate, potato and tomato

ANSWER

(A) Tomato and potato

Pomato is a somatic hybrid: protoplasts (cells with the cell wall removed) of tomato and potato were fused and the hybrid cell was grown into a plant. It did not combine the useful features of both parents for commercial use.

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6. In an ecosystem, different species occupy different vertical levels. This vertical distribution of species is termed: **1**

(A) Stratification

(B) Layering

(C) Fragmentation

(D) Population

ANSWER

(A) Stratification

Vertical distribution of different species occupying different levels (e.g. trees on top, shrubs, then herbs and grasses at the bottom of a forest) is called stratification. It is a structural feature of an ecosystem.

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7. Which of these sacred grove regions lies in Meghalaya? **1**

(A) Jaintia hills
(B) Bastar
(C) Chanda
(D) Sarguja

ANSWER
(A) Jaintia hills

Sacred groves in India: Khasi and Jaintia hills – Meghalaya; Aravalli hills – Rajasthan; Western Ghats – Karnataka and Maharashtra; Sarguja, Chanda and Bastar – Madhya Pradesh / Chhattisgarh region. So the Meghalaya grove is in the Jaintia hills.

8. A figure shows a cell with two homologous chromosome pairs (one carrying A/a, the other B/b). Two equally likely arrangements at Metaphase I are drawn: in Possibility 1 the A and B chromosomes line up on the same side, in Possibility 2 the A and b chromosomes line up on the same side. After meiosis these give four gamete combinations: AB, ab, Ab and aB. Which phenomenon does this show? **1**

(A) Linkage of genes
(B) Independent assortment of genes
(C) Multiple alleles
(D) Incomplete dominance

ANSWER
(B) Independent assortment of genes

The orientation of one homologous pair at the metaphase I plate does not depend on the orientation of the other pair. So alleles of genes on different chromosomes separate independently, giving four kinds of gametes (AB, ab, Ab, aB) in equal proportion. This is Mendel's law of independent assortment explained at chromosome level.
Linkage would keep A with B together, which is not shown here.

9. Match Column I with Column II: **1**
Column I: a. Biolistic gun b. Chitinase c. Ti d. Ca^{++}
Column II: i. Bacterial cell ii. Tumour inducing iii. Animal cell iv. Fungal cell v. Plant cell

(A) a-i, b-ii, c-iii, d-iv
(B) a-ii, b-v, c-i, d-iii
(C) a-v, b-iv, c-ii, d-i
(D) a-v, b-i, c-iv, d-ii

ANSWER
(C) a-v, b-iv, c-ii, d-i

a. Biolistic (gene) gun – shoots DNA-coated gold/tungsten particles into plant cells → v.
b. Chitinase – enzyme used to break the chitin cell wall of fungal cells → iv.
c. Ti plasmid – the tumour-inducing plasmid of Agrobacterium tumefaciens → ii.
d. Ca^{2+} ions – used to make bacterial cells competent to take up DNA → i.

10. Who proposed that the use and disuse of organs drives the evolution of organisms? **1**

(A) Charles Darwin

(B) Thomas Malthus

(C) Hugo de Vries

(D) Lamarck

ANSWER

(D) Lamarck

Lamarck said that organs which are used more get stronger and those not used degenerate, and that such acquired characters are passed on (e.g. the long neck of giraffes). Darwin proposed natural selection, Malthus wrote on population, and de Vries proposed mutation theory.

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11. Which statement about plasmids is NOT correct? **1**

(A) Plasmids can replicate inside the bacterial cell.

(B) Their replication is controlled by the chromosomal DNA.

(C) They are circular extra-chromosomal DNA that replicates autonomously.

(D) They often carry genes for antibiotic resistance.

ANSWER

(B) Their replication is controlled by chromosomal DNA – incorrect

Plasmids are autonomously replicating, circular, extra-chromosomal DNA. They have their own origin of replication (ori), so their replication is independent of the chromosomal DNA. Hence (B) is the wrong statement. They often carry antibiotic-resistance genes, which is why they are useful as cloning vectors.

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12. Which type of connective tissue attaches the ovary to the pelvic wall and the uterus? **1**

(A) Tendons

(B) Ligaments

(C) Cartilage

(D) Bone

ANSWER

(B) Ligaments

Each ovary is held in place by ligaments that connect it to the pelvic wall and to the uterus. Tendons join muscle to bone, so they are not the answer.

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13. Assertion (A): After the Industrial Revolution, the number of melanised (dark) moths went up in industrial areas. **1**

Reason (R): In industrial areas, lichen-covered tree trunks were replaced by soot-covered trunks, which camouflaged dark moths better.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

ANSWER

(A) Both true; R explains A

Industrial melanism: pollution killed lichens and darkened tree trunks with soot. Dark moths resting on dark trunks were hidden from predatory birds, while white moths were easily seen and eaten. So natural selection increased the dark moth population. R directly explains A.

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14. Assertion (A): Milk from the transgenic cow 'Rosie' was a nutritionally more balanced product for human babies than ordinary cow milk. **1**

Reason (R): The milk was enriched with the human protein alpha-lactaglobulin.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

ANSWER

(C) A true, R false

Rosie (1997) produced milk containing human alpha-lactalbumin (2.4 g per litre), which made it more balanced for human babies – so A is true.

R names the wrong protein ('alpha-lactaglobulin'); the protein is alpha-lactalbumin, so R is false.

15. Assertion (A): In secondary sewage treatment, flocs are masses of bacteria held together with fungal filaments. **1**

Reason (R): Flocs digest the solid waste by anaerobic respiration.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

ANSWER

(C) A true, R false

In the aeration tank of secondary (biological) treatment, aerobic bacteria associated with fungal filaments form mesh-like flocs – A is true.

These microbes consume organic matter aerobically (that is why air is pumped in and BOD falls).

Anaerobic digestion happens later in the sludge digester by other bacteria. So R is false.

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16. Assertion (A): In a terrestrial ecosystem, a much larger fraction of energy flows through the grazing food chain. **1**

Reason (R): The grazing food chain may be linked to the detritus food chain at some levels.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

ANSWER

(D) A false, R true

In terrestrial ecosystems most energy flows through the detritus food chain, not the grazing food chain (the grazing chain carries the major share only in aquatic ecosystems). So A is false.

R is true: some organisms of the detritus chain are eaten by animals of the grazing chain, so the two chains are connected at some levels.

SECTION B

Q17–21 are very short answer questions of 2 marks each.

17. (a) What is meant by the humoral immune response? **2**

(b) Name any two kinds of antibodies that take part in the humoral immune response in humans.

ANSWER

(a) Antibody-mediated immunity by B-lymphocytes; (b) any two of IgA, IgM, IgE, IgG

(a) Humoral immune response is the antibody-mediated response: B-lymphocytes produce large numbers of antibodies (proteins) that are released into the blood (humor) to fight pathogens.
(b) Any two: IgG, IgA, IgM, IgE (also IgD).

18. (i) How can a farmer benefit from the dormancy of seeds? **2**

(ii) Give one difference between a pea seed and a castor seed.

ANSWER

(i) Dormant seeds can be stored and sown next season; (ii) pea – non-endospermic, castor – endospermic

(i) Because mature seeds are dehydrated and dormant, the farmer can store them safely for a long time and use them to raise the crop in the next season (or sell them / use them as food).
(ii) Pea is a non-endospermic (non-albuminous) seed – the endosperm is used up completely during embryo development and food is stored in the cotyledons. Castor is an endospermic (albuminous) seed – part of the endosperm remains in the mature seed.

OR

In which follicle stage does the primary oocyte complete its first meiotic division? What are the products formed by this division?

ANSWER

Tertiary follicle; products – secondary oocyte and first polar body

The primary oocyte inside the tertiary follicle (in the ovary) grows and completes meiosis I.
The division is unequal and gives a large haploid secondary oocyte and a tiny first polar body.
Tip: do not say 'ovum' – meiosis II is completed only after the sperm enters.

19. A DNA segment has the base sequence **2**

5' – GAATTC – 3'

3' – CTTAAG – 5'

(a) What is such a sequence called, and which enzyme recognises it?

(b) How do such enzymes act on DNA?

ANSWER

(a) Palindromic sequence; restriction endonuclease EcoRI; (b) cut both strands at specific sites to give sticky ends

(a) The sequence reads the same on both strands when read in the same direction (5'→3'), so it is a palindromic sequence. It is recognised by a restriction endonuclease – here EcoRI.

(b) The enzyme binds to the recognition site and cuts each strand of the sugar-phosphate backbone a little away from the centre of the palindrome, between the same two bases on both strands (for EcoRI, between G and A). This leaves single-stranded overhangs called sticky ends, which can join with complementary ends cut by the same enzyme.

20. Two sex-determination systems are described: **2**

Case I: males are XO and females are XX.

Case II: females are ZW and males are ZZ.

Name the type of heterogamety in each case and give one example of each.

ANSWER

Case I – male heterogamety (e.g. grasshopper); Case II – female heterogamety (e.g. birds)

The sex that makes two kinds of gametes is the heterogametic sex.

Case I: XO males produce sperms with X and without X, so it is male heterogamety – e.g. grasshopper (many insects).

Case II: ZW females produce eggs with Z or W, so it is female heterogamety – e.g. birds (hen).

OR

(i) Give one difference between a DNA nucleotide and an RNA nucleotide.

(ii) Name the two kinds of bonds found within a single nucleotide.

ANSWER

(i) DNA – deoxyribose (bases A, G, C, T); RNA – ribose (A, G, C, U); (ii) N-glycosidic bond and phosphoester bond

(i) A DNA nucleotide has deoxyribose sugar (and one of A, G, C, T), while an RNA nucleotide has ribose sugar (and one of A, G, C, U).

(ii) The nitrogenous base is joined to the 1' C of the pentose by an N-glycosidic linkage; the phosphate is joined to the 5' C of the sugar by a phosphoester linkage.

21. A pyramid of standing crop is drawn with two bars: the lower bar (PP, primary producers) is narrow and the upper bar (PC, primary consumers) is wider. **2**

(i) Name this type of pyramid and, with an example, explain where such a pyramid occurs in nature.

(ii) State any two limitations of ecological pyramids.

ANSWER

(i) Inverted pyramid of biomass – e.g. sea: small standing crop of phytoplankton supports larger zooplankton/fish; (ii) e.g. ignores a species at two trophic levels; no place for food webs or saprophytes

(i) Standing crop = biomass, and the consumer bar is larger than the producer bar, so it is an inverted pyramid of biomass. It occurs in the sea: phytoplankton have a small standing crop at any time but reproduce very fast, so they support a larger standing crop of zooplankton or fish.

(ii) Any two:

• It does not account for one species belonging to two or more trophic levels.

• It assumes a simple food chain and cannot show a food web.

• Saprophytes/decomposers are given no place though they are vital.

OR

A development project caused loss of biodiversity in an area.

(i) Give two ways in which the ecosystem will be affected.

(ii) Name two major causes of biodiversity loss.

ANSWER

(i) e.g. fall in plant production, lower resistance to drought etc.; (ii) e.g. habitat loss/fragmentation, over-exploitation (also alien species, co-extinction)

(i) Any two effects of biodiversity loss in a region:

• Decline in plant production.

• Lowered resistance to environmental disturbances such as drought.

• Increased variability in ecosystem processes like water use and pest/disease cycles.

(ii) Any two of the 'Evil Quartet': habitat loss and fragmentation; over-exploitation; invasion of alien species; co-extinctions.

SECTION C

Q22–28 are short answer questions of 3 marks each.

22. (a) Do pollen grains of all plants stay viable for the same time? Justify with two examples. **3**
(b) How are pollen grains preserved in pollen banks?

ANSWER

(a) No – rice/wheat pollen lose viability in ~30 min; some Rosaceae, Leguminosae, Solanaceae pollen stay viable for months; (b) cryopreservation in liquid nitrogen at −196 °C

(a) No. Viability depends on the species and on temperature and humidity.
• In rice and wheat, pollen grains lose viability within about 30 minutes of release.
• In some members of Rosaceae, Leguminosae and Solanaceae, pollen remain viable for months.
(b) Pollen grains can be stored for years in liquid nitrogen at −196 °C (cryopreservation) in pollen banks, for later use in crop-breeding programmes.

23. (a) What is pedigree analysis? Give its importance in human genetics (two points). **3**
(b) A pedigree shows: an unaffected father and unaffected mother have six children – a normal son, an affected son, a normal son, a normal daughter, an affected daughter and a normal son. The normal daughter marries a normal man and they have an affected son and two normal daughters. Write (i) the mode of inheritance shown, and (ii) one disease inherited in this way.

ANSWER

(a) Study of a trait over several generations of a family – traces inheritance of traits/disorders; (b) (i) autosomal recessive; (ii) e.g. sickle-cell anaemia (or thalassemia, phenylketonuria)

(a) Pedigree analysis is the study of how a trait is inherited over several generations of a family, using a family tree.
Importance: it helps trace the inheritance of a trait, abnormality or disease; it helps predict the chance of a disorder in future children (genetic counselling).
(b)(i) Two unaffected parents have affected children, so the trait is recessive and the parents are carriers. An affected daughter has an unaffected father – this is impossible for an X-linked recessive trait – so the trait is autosomal recessive.
(ii) Sickle-cell anaemia (also thalassemia or phenylketonuria).

24. (a) Show how the Hardy–Weinberg expression $p^2 + 2pq + q^2 = 1$ is obtained. **3**

(b) Name any two factors that upset genetic equilibrium.

ANSWER

(a) $p + q = 1$, so $(p + q)^2 = p^2 + 2pq + q^2 = 1$; (b) any two: gene flow, genetic drift, mutation, recombination, natural selection

(a) Take a gene with two alleles, A (frequency p) and a (frequency q). Since these are the only alleles, $p + q = 1$.

In a diploid, random mating combines gametes at random:

- Chance of AA = $p \times p = p^2$
- Chance of aa = $q \times q = q^2$
- Chance of Aa = $pq + qp = 2pq$

The genotype frequencies must add to 1, so $p^2 + 2pq + q^2 = (p + q)^2 = 1$.

(b) Any two: gene migration (gene flow), genetic drift, mutation, genetic recombination, natural selection.

25. Draw a well-labelled diagram of an angiosperm megasporangium (ovule) and label any six parts. **3**

ANSWER

Anatropous ovule with any six labels: funicle, hilum, micropyle, outer integument, inner integument, nucellus, embryo sac, chalaza (and egg, synergids, antipodals, polar nuclei)

Draw an inverted (anatropous) ovule attached to the placenta by a stalk.

Labels that must be shown (any six):

- Funicle – the stalk joining the ovule to the placenta
- Hilum – junction of ovule and funicle
- Micropyle – small opening at the tip of the integuments
- Outer integument and inner integument
- Nucellus – mass of cells inside the integuments
- Embryo sac (female gametophyte) inside the nucellus, with egg apparatus (egg + 2 synergids) at the micropylar end, 3 antipodals at the chalazal end and 2 polar nuclei in the centre
- Chalaza – basal part opposite the micropyle

Common mistake: drawing the micropyle and the chalaza on the same side.

26. (a) Give the scientific name of the plant that is the source of opioids and the part from which they are obtained. **3**

(b) How are morphine and heroin chemically related? State the effect of each on the body.

ANSWER

(a) Papaver somniferum (poppy), latex; (b) heroin = acetylated morphine (diacetylmorphine); morphine – sedative/painkiller; heroin – depressant

(a) Opioids come from the poppy plant Papaver somniferum; they are extracted from the latex (milky juice) of the unripe fruit/capsule.

(b) Heroin (smack) is diacetylmorphine – it is obtained by acetylation of morphine.

Morphine is a very effective sedative and painkiller, useful for patients after surgery.

Heroin is a depressant that slows down body functions.

27. A farmer grows ordinary corn in field A and genetically modified (GM) corn in field B. Corn borers attack only field A, so he sprays Bt spores on field A. **3**

(a) Which gene in the spores is responsible for killing the pest?

(b) How do the Bt spores act on the insect?

(c) Explain how the corn in field B became resistant to this pest.

ANSWER

(a) cry IAb; (b) eaten by larvae, inactive protoxin activated by alkaline gut pH → kills larva; (c) GM corn carries and expresses the Bt cry gene, making its own toxin

(a) cry IAb – the gene for the Bt toxin that controls corn borer.

(b) The spores (mixed with water) are sprayed on the plants and eaten by the insect larvae. The Bt toxin crystals are an inactive protoxin; in the alkaline pH of the insect gut they dissolve and become active. The active toxin binds to the epithelial cells of the midgut, makes pores, the cells swell and burst, and the larva dies.

(c) The corn of field B is Bt corn: the cry IAb gene from Bacillus thuringiensis was inserted into it, so the plant itself makes the Bt toxin. Any borer feeding on it is killed, so no spraying is needed.

28. A DNA mixture with fragments from 100 bp to 1800 bp was run on an agarose gel. In the first set-up the wells were at the top, next to the positive electrode, and the negative electrode was at the bottom. **3**

(a) What will be seen after staining with ethidium bromide? Explain why.

(b) The set-up was changed so that the wells were next to the negative electrode and the positive electrode was at the bottom. Now bands appeared and a 100 bp band was seen at position X, the farthest from the wells. What change was made, and why is the 100 bp band at X?

ANSWER

(a) No bands in the gel – negatively charged DNA stays at the wells near the anode; (b) electrodes were reversed (anode moved to far end); smallest fragment moves fastest and farthest

(a) DNA is negatively charged (phosphate groups) and moves towards the anode (+). In the first set-up the wells are already at the anode, so the DNA does not move into the gel. After staining, no separated bands are seen in the gel (DNA remains at the wells).

(b) The positions of the anode and the cathode were interchanged, so the wells are now at the cathode and DNA moves through the gel towards the anode.

Agarose acts as a sieve: smaller fragments move faster and farther. The 100 bp fragment is the smallest, so it travels the farthest – to position X.

SECTION D

Q29–30 are case-based questions of 4 marks each, with an internal choice in one sub-part.

29. On a rocky sea shore, two barnacles are found in zones: Chthamalus stellatus in the upper intertidal zone (where Balanus dries out) and Balanus balanoides in the middle intertidal zone, where it out-competes Chthamalus for space; in the lower zone Balanus is eaten by predators. When Balanus is removed experimentally, Chthamalus spreads into the lower zones. **4**

(a) Name and define the ecological phenomenon shown by this observation. (1)

(b) Two different species can compete for the same resource. Give one more example. (1)

(c) How do species avoid competition in nature? Explain with an example. (2)

ANSWER

(a) Competitive release; (b) e.g. flamingos and fishes in South American lakes compete for zooplankton; (c) resource partitioning – e.g. MacArthur's warblers feed in different parts of the tree

(a) Competitive release: a species whose distribution is restricted by a competitively superior species expands its range when the superior competitor is removed. Here Chthamalus spreads once Balanus is removed.

(b) In some shallow South American lakes, visiting flamingos and resident fishes compete for the same food – zooplankton. (Any correct example.)

(c) By resource partitioning – species use the resource differently, e.g. by feeding at different times or using different foraging patterns. Example: MacArthur showed that five closely related warbler species living on the same tree avoid competition and coexist because they forage in different parts of the tree.

OR

(a) (a) State the principle that explains the elimination of one of the competing species.

ANSWER

Gause's competitive exclusion principle

Gause's competitive exclusion principle: two closely related species competing for the same limited resources cannot coexist indefinitely; the competitively inferior one will eventually be eliminated.

30. A student made three crosses in a plant for height (Tall/Dwarf) and drew a bar graph of the progeny: Cross I – 500 tall, 0 dwarf; Cross II – 375 tall, 125 dwarf; Cross III – 250 tall, 250 dwarf. **4**

(a) What can you conclude about the genotypes of the parents in crosses I and II? (1)

(b) From the graph of cross III, name the type of cross and state its importance in genetics. (2)

(c) What conclusion follows from crosses I and II? Name the genetic principle shown. (1)

ANSWER

(a) I – TT × TT/Tt/tt (one parent TT); II – Tt × Tt; (b) test cross (Tt × tt) – reveals genotype of a dominant-looking plant; (c) tall is dominant over dwarf – Law of Dominance

(a) Cross I: all 500 progeny are tall, so at least one parent is homozygous tall – TT × tt, TT × Tt or TT × TT.

Cross II: 375 : 125 = 3 : 1 tall : dwarf, which is obtained only from Tt × Tt.

(b) Cross III gives 250 : 250 = 1 : 1. This is a test cross (Tt × tt) – crossing a dominant-phenotype plant with the recessive parent. It is used to find whether a plant showing the dominant trait is homozygous (TT) or heterozygous (Tt).

(c) In both crosses only the tall character appears in heterozygotes and dwarf appears only when homozygous, so tall is dominant over dwarf. This illustrates Mendel's Law of Dominance.

OR

(a) (a) Which kind of genetic cross do these crosses represent?

ANSWER

Monohybrid cross

Only one character (plant height, with tall and dwarf forms) is studied in each cross, so they are monohybrid crosses.

SECTION E

Q31–33 are long answer questions of 5 marks each.

31. Describe the events in the human female from fertilisation up to implantation of the blastocyst. Also state where fertilisation occurs. **5**

ANSWER

Sperm entry → meiosis II of secondary oocyte → fusion of nuclei → zygote → cleavage → morula (8–16 cells) → blastocyst (trophoblast + inner cell mass) → trophoblast attaches to endometrium → implantation; site: ampullary region of the fallopian tube

1. Fertilisation: a sperm contacts the zona pellucida of the secondary oocyte; changes in the membrane block entry of other sperms.
2. Entry of the sperm induces completion of meiosis II in the secondary oocyte, giving a haploid ovum (ootid) and a second polar body.
3. The haploid nuclei of the sperm and the ovum fuse to form a diploid zygote.
4. Cleavage: the zygote divides by mitosis as it moves through the isthmus of the oviduct towards the uterus, forming blastomeres.
5. The embryo with 8–16 blastomeres is called a morula.
6. The morula continues to divide and becomes a blastocyst – an outer layer of trophoblast and an inner cell mass (which later forms the embryo).
7. Implantation: in the uterus, the trophoblast attaches to the endometrium; uterine cells divide rapidly and cover the blastocyst, which becomes embedded in the endometrium. This leads to pregnancy.

Site of fertilisation: the ampullary region (ampullary–isthmic junction) of the fallopian tube.

OR

(i) Some couples cannot have children though they use no contraception. They do not want to adopt or use donor gametes. Suggest a suitable assisted reproductive technology for each:
Case I – Woman: normal reports. Man: normal sperms but the epididymis is not connected to the vas deferens.
Case II – Woman: normal eggs but blocked fallopian tubes. Man: normal sperms.
Case III – Woman: normal reports. Man: low sperm count and poor motility.
(ii) Copper-releasing IUDs are very effective, popular contraceptives. Name two of them and give two reasons why they work well.

ANSWER

(i) Case I – IVF + ZIFT/IUT (sperm retrieved from epididymis/testis); Case II – IVF followed by IUT; Case III – ICSI or artificial insemination (IUI); (ii) CuT, Cu7, Multiload 375 – Cu ions increase phagocytosis of sperms and suppress sperm motility/fertilising capacity

(i) Case I: sperms are normal but cannot reach the ejaculate. Sperms can be collected and used for in vitro fertilisation followed by embryo transfer (ZIFT or IUT); IUI/artificial insemination with the collected sperms is also accepted.
Case II: eggs cannot travel through the blocked tubes, so in vitro fertilisation is done in the lab and the embryo (more than 8 blastomeres) is placed directly in the uterus – IVF followed by IUT (intra-uterine transfer).
Case III: low count and poor motility – ICSI (intra-cytoplasmic sperm injection, a sperm injected directly into the ovum) or artificial insemination/IUI with the husband's concentrated semen.
(ii) Copper-releasing IUDs: CuT, Cu7, Multiload 375 (any two).

> Why effective: they increase phagocytosis of sperms inside the uterus; the Cu ions released suppress sperm motility and the fertilising capacity of sperms.

32. (i) Watson and Crick's double-helix model was based on two earlier findings. Name them and the scientists linked with each. **5**

(ii) Write any three main features of the double-helix structure of DNA.

ANSWER

(i) X-ray diffraction data of Wilkins and Franklin; Chargaff's rules (A = T, G ≡ C, A/T = G/C = 1); (ii) e.g. two antiparallel polynucleotide chains, complementary base pairing by H-bonds, right-handed coil with pitch 3.4 nm and 10 bp per turn

(i) • X-ray diffraction studies of DNA by Maurice Wilkins and Rosalind Franklin.
• Base-pairing rules of Erwin Chargaff: in double-stranded DNA, A/T = 1 and G/C = 1.
(ii) Any three:
• DNA has two polynucleotide chains; the sugar–phosphate backbone is outside and the bases project inside.
• The two chains have antiparallel polarity (5'→3' and 3'→5').
• Bases of the two strands pair by hydrogen bonds: A=T with two H-bonds and G≡C with three H-bonds (purine opposite pyrimidine, so the distance between strands is uniform).
• The two chains are coiled in a right-handed manner; pitch 3.4 nm, about 10 bp per turn, 0.34 nm between adjacent base pairs.
• The plane of one base pair stacks over the next, which adds stability.

OR

The coding strand of the structural gene of a transcription unit is:

5' – ATG ACC GTA TTT TCT GTA GTG CCC GTA CTT CAG GCA TTA – 3'

(i) Write the template strand and the mRNA transcribed from it, showing polarity.

(ii) If GUA in the transcribed RNA is an intron, write the sequence of the mature (processed) mRNA formed (1) in a bacterium (2) in humans.

(iii) How many amino acids will the polypeptide made in humans contain?

ANSWER

(i) Template 3'–TAC TGG CAT AAA AGA CAT CAC GGG CAT GAA GTC CGT AAT–5'; mRNA 5'–AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UUA–3'; (ii)(1) unchanged; (2) cap–AUG ACC UUU UCU GUG CCC CUU CAG GCA UUA–poly A; (iii) 10

(i) Template strand is complementary and antiparallel to the coding strand:
3' – TAC TGG CAT AAA AGA CAT CAC GGG CAT GAA GTC CGT AAT – 5'
mRNA has the same sequence as the coding strand with U in place of T:
5' – AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UUA – 3'
(ii)(1) Bacteria have no split genes and no splicing, so the mRNA stays the same:
5' – AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UUA – 3'
(2) In humans the hnRNA is spliced (all three GUA introns removed), capped at the 5' end and tailed at the 3' end:
5' – m^7Gppp – AUG ACC UUU UCU GUG CCC CUU CAG GCA UUA – poly(A) tail – 3'
(iii) The mature mRNA has 10 codons (no stop codon in the given stretch), so the polypeptide has 10 amino acids.

33. (i) Which species of protozoan causes the most serious, even fatal, form of malaria? **5**

(ii) In which host does the parasite complete its sexual stages? Describe the changes that take place there.

(iii) How does the parasite harm the human body after it enters the blood?

(iv) Suggest two effective measures to prevent the spread of the disease in endemic areas.

ANSWER

(i) Plasmodium falciparum; (ii) female Anopheles mosquito – gametocytes taken up, fertilisation in gut, sporozoites move to salivary glands; (iii) multiply in liver then RBCs, RBCs burst releasing haemozoin → chill and high fever; (iv) e.g. no stagnant water, mosquito nets, Gambusia fish

(i) Plasmodium falciparum (causes malignant malaria).

(ii) The sexual stages are completed in the female Anopheles mosquito:

• the mosquito sucks blood of an infected person and takes up gametocytes;

• gametes form, fertilisation occurs and development takes place in the mosquito's gut (stomach wall);

• sporozoites formed move to the salivary glands, ready to be injected at the next bite.

(iii) Sporozoites reach the liver and multiply asexually there; then they attack red blood cells, multiply inside them and cause the RBCs to rupture. This releases a toxic substance, haemozoin, which causes chills and high fever recurring every 3–4 days.

(iv) Any two: avoid stagnant water around houses; clean coolers regularly; use mosquito nets and wire mesh on doors/windows; introduce larva-eating fish such as Gambusia into ponds; spray insecticides in ditches and drains.

OR

(i) What are biofertilisers?

(ii) Name the different groups of microbes used as biofertilisers in organic farming and explain how each improves soil fertility.

(iii) Give two advantages of biofertilisers over chemical fertilisers.

ANSWER

(i) Organisms that enrich soil nutrient quality; (ii) bacteria (Rhizobium, Azotobacter, Azospirillum – N_2 fixation), fungi (Glomus mycorrhiza – phosphorus uptake), cyanobacteria (Anabaena, Nostoc, Oscillatoria – N_2 fixation in paddy); (iii) non-polluting, keep beneficial soil microbes/safe for health

(i) Biofertilisers are living organisms that enrich the nutrient quality of the soil. Main sources: bacteria, fungi and cyanobacteria.

(ii) • Bacteria: Rhizobium lives symbiotically in root nodules of legumes and fixes atmospheric nitrogen into organic forms used by the plant; Azotobacter and Azospirillum fix nitrogen while free-living in the soil.

• Fungi: Glomus forms mycorrhiza with plant roots; the fungus absorbs phosphorus from the soil and passes it to the plant. Such plants also resist root-borne pathogens, tolerate salinity and drought and grow better.

• Cyanobacteria: autotrophic microbes such as Anabaena, Nostoc and Oscillatoria fix atmospheric nitrogen; they are important in paddy fields and also add organic matter.

> (iii) Any two: they do not pollute soil or ground water; they conserve beneficial soil microbes and soil health; they do not harm human health; they reduce dependence on costly chemical fertilisers.

— END —

Questions restated from the CBSE Class XII Board Examination 2026 (set 57/1/1) for practice. Reading passages and map items are described, not reproduced.