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CBSE Class 12 Biology Board Paper 2026 (57/1/1) with Solutions

PREVIOUS YEAR PAPER · CLASS XII · BIOLOGY (044) · BOARD EXAM 2026 · Q.P. CODE 57/1/1

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
3 hours	70	33 (A 16 · B 5 · C 7 · D 2 · E 3)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 33 questions. All questions are compulsory.
2. Question paper is divided into FIVE sections – Section A, B, C, D and E.
3. Section A – questions number 1 to 16 are multiple choice type questions. Each question carries 1 mark.
4. Section B – questions number 17 to 21 are very short answer type questions. Each question carries 2 marks.
5. Section C – questions number 22 to 28 are short answer type questions. Each question carries 3 marks.
6. Section D – questions number 29 and 30 are case-based questions. Each question carries 4 marks. Each question has subparts with internal choice in one of the subparts.
7. Section E – questions number 31 to 33 are long answer type questions. Each question carries 5 marks.
8. There is no overall choice. However, internal choices have been provided in some questions. A candidate has to write answer for only one of the alternatives in such questions.
9. Wherever necessary, neat and properly labelled diagrams should be drawn.
10. This is the official 2026 board paper (Q.P. Code 57/1/1). The step marks shown in the solutions are our marking scheme in the CBSE style; CBSE's own marking scheme may award steps differently.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 3 hours before you look at them.

Questions: CBSE board examination 2026, Q.P. Code 57/1/1, as published by CBSE at cbse.gov.in; diagrams redrawn. Answers, step marks and worked solutions © Master Testing Agency. Free for personal practice; not for resale. Master Testing Agency is an independent test-prep publisher, not affiliated with, endorsed by or connected to the Central Board of Secondary Education (CBSE) or any other exam-conducting body.

Chapters: Full syllabus · **Topics:** Sexual Reproduction in Flowering Plants · Human Reproduction · Reproductive Health · Principles of Inheritance and Variation · Molecular Basis of Inheritance · Evolution · Human Health and Disease · Microbes in Human Welfare · Biotechnology: Principles and Processes · Biotechnology and its Applications · Organisms and Populations · Ecosystem · Biodiversity and Conservation

SECTION A

Multiple choice questions of 1 mark each (Q13–16 assertion-reason).

1. Identify the plant in which emasculation is not required for artificial hybridization. 1

(A) Rice
(B) Wheat
(C) Pea
(D) Papaya

2. Which of the following is not a component of immune system ? 1

(A) Lymphocytes
(B) Plasma Proteins
(C) Red Blood Cells
(D) Bone Marrow

3. Select the option that shows correct statements : 1

(i) Corpus luteum secretes progesterone.
(ii) Only FSH attains a peak level in middle of cycle.
(iii) LH surge induces rupture of graafian follicle.
(iv) Luteal phase of menstrual cycle is also called proliferative phase.

(A) Only (ii) is correct.
(B) (i) and (iii) are correct.
(C) Only (iv) is correct.
(D) (ii) and (iv) are correct.

4. Select the mismatched pair : 1

(A) Mega diversity countries in the world – 12
(B) Genetically different strains of rice in India – Less than 1000
(C) Robert Mays estimation on global species diversity – 7 million species worldwide
(D) Zoological parks – Ex-situ conservation

5. Pomato was produced by fusing protoplasts of 1

(A) Tomato and Potato
(B) Pomegranate and Tomato
(C) Pomegranate and Potato
(D) Pomegranate, Potato and Tomato

6. In an ecosystem, different species occupy different levels and vertical distribution of species is found. This is called _____. 1

(A) Stratification
(B) Layering
(C) Fragmentation
(D) Population

7. Which of the following sacred groves is found in Meghalaya ? 1

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

8. In the following figure, two ways of pairing of two homologous pairs of chromosomes are shown. Which of the following phenomena is expressed ? (Figure redrawn as a table: two equally probable arrangements at Metaphase I give rise to different chromosome combinations.) 1

	Possibility 1	**Possibility 2**
Metaphase I	A and B chromosomes on the same side of the plate	A and b chromosomes on the same side of the plate
Gametes	Combination 1: AB; Combination 2: ab	Combination 3: Ab; Combination 4: aB

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

9. Match Column-I with Column-II and choose the correct option : 1

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

Options (a, b, c, d) :

(A) i, ii, iii, iv
(B) ii, v, i, iii
(C) v, iv, ii, i
(D) v, i, iv, ii

10. The idea of use and disuse of organs for evolution of organism was proposed by 1

(A) Charles Darwin
(B) Thomas Malthus
(C) Hugo De Vries
(D) Lamarck

11. Which of the following statements about plasmids is incorrect ? 1

(A) Plasmids have the ability to replicate within the bacterial cell.
(B) Their replication is controlled by chromosomal DNA.
(C) They are autonomously replicating circular extra-chromosomal DNA.
(D) They often carry antibiotic resistant genes.

12. Which connective tissue connects ovary to pelvic wall and uterus ? 1

(A) Tendons
(B) Ligaments
(C) Cartilage
(D) Bone

13. **Assertion (A) :** The population of melanized moths increased in industrial areas after Industrial Revolution. 1

Reason (R) : In Industrial environment lichen covered trees were replaced by soot-covered trees offering better camouflage to dark coloured moths.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation for Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation for Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

14. **Assertion (A) :** The milk produced by transgenic cow 'Rosie' was nutritionally more balanced product for human babies than natural cow milk. 1

Reason (R) : It was human protein enriched milk containing human alpha lactaglobulin.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation for Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation for Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

15. **Assertion (A) :** Flocs are masses of bacteria associated with fungal filaments in secondary treatment of sewage. 1

Reason (R) : Flocs help in digestion of solid waste by anaerobic respiration.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation for Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation for Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

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

Reason (R) : Grazing food chain may be connected to Detritus food chain at some levels.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation for Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation for Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

SECTION B

Very short answer questions of 2 marks each.

17. (a) Define Humoral immune response. [1] 2

(b) Name any two types of antibodies found to give humoral immune response in humans. [1]

18. (a) (i) How does a farmer use dormancy of seed to his advantage ? [1] 2

(ii) Differentiate between pea seed and castor seed. [1]

OR

(b) Identify the stage of follicle where primary oocyte undergoes first meiotic division. Also mention the products of this division.

19. Study the sequence of bases in a DNA molecule that is shown below and answer the questions. 2

5′ – GAATTC – 3′

3′ – CTTAAG – 5′

(a) What are such sequences called ? Name the enzyme used that recognises such nucleotide sequences. [1]

(b) How do these enzymes function ? [1]

20. (a) Analyse the following two cases of sex determination in different organisms : Case I : Males have (XO) sex chromosomes and females have two copies of same sex chromosome (XX). Case II : Females have two different sex chromosomes (ZW) and males have two copies of same sex chromosome (ZZ). Identify the type of heterogamety in each case, giving one example of each. 2

OR

(b) (i) Differentiate between a DNA and RNA nucleotide. [1] (ii) Name the two types of bonds present within a single nucleotide. [1]

21. (a) Given below is a pyramid found in an ecosystem, where each bar represents the standing crop available in the trophic level. 2



(i) Identify the kind of pyramid and with the help of an example explain the conditions where this kind of pyramid is possible in nature. [1]

(ii) Write any two limitations of ecological pyramids. [1]

OR

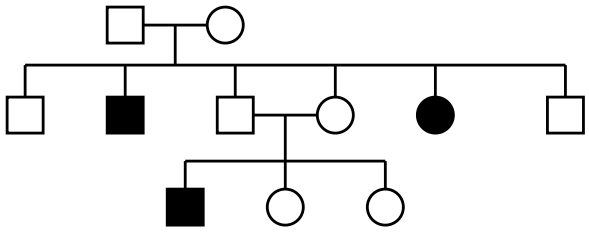
(b) In an ecosystem there was loss of biodiversity due to some project in that area. (i) How will biodiversity be affected ? (2 points) [1] (ii) List two major causes of loss of biodiversity. [1]

SECTION C

Short answer questions of 3 marks each.

22. (a) Do all pollen grains remain viable for the same length of time ? Support your answer with two suitable examples. [2½] 3
(b) How are pollen grains stored in pollen banks ? [½]

23. (a) What is pedigree analysis ? Mention its importance in human genetics. (2 pts.) [1 + 1] 3
(b) Analyse the following pedigree and write the (i) Pattern of inheritance. [½] (ii) Give one example of disease showing such an inheritance pattern. [½]



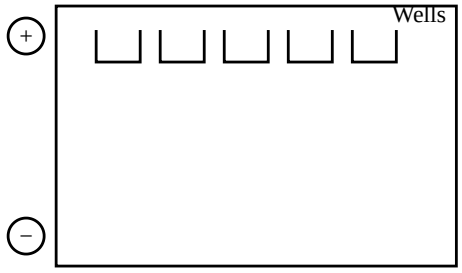
24. (a) How is Hardy-Weinberg expression $(p^2 + 2pq + q^2) = 1$ derived ? [2] 3
(b) List any two factors that disturb the genetic equilibrium. [1]

25. Draw a neat diagram of megasporangium of an angiosperm and label any six parts. [½ × 6 = 3] 3

26. (a) Mention the scientific name of the source plant and the part from which opioids are extracted. [1] 3
(b) How are morphine and heroin related ? Mention the effect each one of them has on human body. [2]

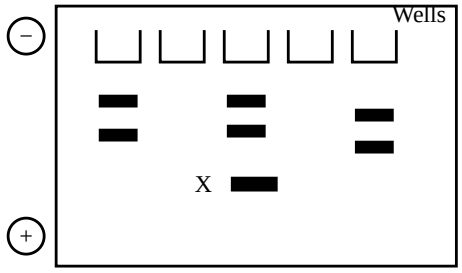
27. A farmer grew two varieties of corn crop in field A and B. He grew normal corn crops in field A and GM corn crops in field B. He observed that corn borers attacked only in field A. To control it, spores of Bt were sprayed on field A. 3
(a) Name the gene in the spores responsible for control of pest. [½]
(b) What effect will the spores of Bt have on insect pest ? [1½]
(c) How has corn plants of field B developed resistance against this pest ? Explain. [1]

28. Observe the given picture carefully. A mixture of DNA with fragments ranging from 100 base pairs to 1800 base pairs were separated by electrophoresis on agarose gel with the following arrangement : 3



(a) What result will be obtained in staining with ethidium bromide ? Explain with reasons. [1]

(b) The above setup was modified as shown below and a band with 100 base pairs was obtained at X.



What changes were made to the previous design to get a band at 'X'. Why did the band appear at 'X' ? [2]

SECTION D

Case-based questions of 4 marks each.

29. The diagram below shows the distribution of two barnacle species, Chthamalus and Balanus on a rocky sea shore. When Balanus is experimentally removed, Chthamalus expands its range in lower intertidal zone. (Figure redrawn as a table: *Balanus balanoides* and *Chthamalus stellatus*, from the highest to the lowest tides.)

Zone	**What happens**
Upper intertidal zone	*Balanus* dessicates in this zone, allowing *Chthamalus* to thrive
Middle intertidal zone	Where it can survive, *Balanus* outcompetes *Chthamalus* for space
Lower intertidal zone	*Balanus* is subject to predation in the lower tidal zone

(a) Identify and define the ecological phenomenon demonstrated by this observation. [1]

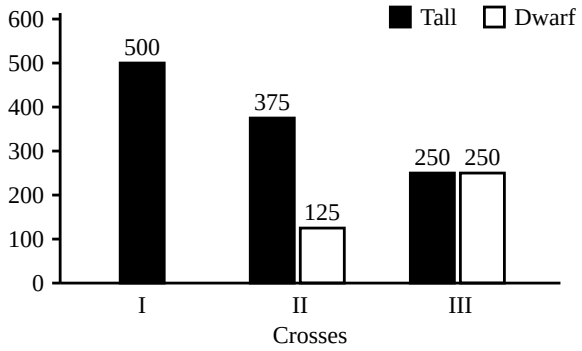
OR

(a) State the principle that explains the elimination of one species. [1]

(b) Two different species can compete for the same resource. Give another example of it. [1]

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

30. A student performed some crosses in plants and represented the result in the form of bar graphs as shown below. Each graph displays the phenotypic proportion of the progeny. Study the graphs and answer the questions :



(a) What can you infer about the genotype of parents in crosses I and II ? [1]

OR

(a) Which genetic cross is represented by these crosses ? [1]

(b) Looking at bar graph of cross III, identify the type of cross performed and its importance in genetics. [2]

(c) What conclusion can you draw from the results of bar graphs of crosses I and II ? Name the genetic principle illustrated. [1]

SECTION E

Long answer questions of 5 marks each.

31. (a) Trace the events from fertilization till implantation of blastocyst in human female. Also mention the site where fertilization takes place. 5

OR

(b) (i) Case studies of some couples are given below. They were not able to have kids even though the parents were not taking any precautions. They also do not wish to adopt a child or take the help of donors. Study these cases and suggest an appropriate Assisted Reproductive Technology that could help them.

Case I – Female – Normal Reports; Male – Normal sperms but no connection between epididymis and vas deferens. [1]

Case II – Female – Normal eggs but Fallopian tube blocked; Male – Normal sperms. Male reports are normal. [1]

Case III – Female – Normal Reports; Male – Low sperm count with less motility. [1]

(ii) Copper releasing intrauterine devices are very effective and popular contraceptive devices. Name any two copper releasing IUDs. Write two reasons that make them effective contraceptives. [2]

32. (a) (i) Watson and Crick's discovery of double helical structure was based on which two findings. Also mention the name of the scientists associated with these findings. [2] 5

(ii) Write down the salient features of double helix structure of DNA (any three points). [3]

OR

(b) Given below is a stretch of DNA showing the coding strand of structural gene of transcription unit.

5′ - ATG ACC GTA TTT TCT GTA GTG CCC GTA CTT CAG GCA TTA 3′

(i) Write the corresponding template strand and m-RNA strand that will be transcribed along with its polarity. [2]

(ii) If GUA of transcribed mRNA is an intron, then depict the sequence involved in formation of mRNA / mature / processed hnRNA strand : (1) In a bacterium [1] (2) In humans [1]

(iii) How many amino acids the resulting polypeptide will have after the process of translation in humans ? [1]

33. (a) (i) Name the protozoan species that is responsible for causing the most serious and even fatal malarial disease. [½] 5

(ii) Name the host in which the parasite completes its sexual stages and explain the changes taking place. [2]

(iii) How does the parasite damage the human body after entering the blood stream ? [1½]

(iv) Suggest two effective preventive measures to control the spread of this disease in endemic regions. [1]

OR

(b) (i) What are bio-fertilizers ? [1] (ii) Name the different types of microorganisms used as bio-fertilizers in organic farming and explain how each contributes to soil fertility. [3] (iii) Write two advantages of using bio-fertilizers over chemical fertilizers. [1]

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
(D)	(C)	(B)	(B)	(A)	(A)	(A)	(B)	(C)	(D)	(B)	(B)	(A)	(A)	(C)	(D)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (D). Papaya is dioecious (unisexual flowers on separate plants), so there are no anthers to remove from the female flower; emasculation is needed only in bisexual flowers such as rice, wheat and pea.

Q2. Answer (C). Red blood cells carry gases and play no part in immunity. Lymphocytes, the bone marrow (a primary lymphoid organ) and plasma proteins (antibodies) are parts of the immune system.

Q3. Answer (B). (i) True. (ii) False: both LH and FSH peak in the middle of the cycle. (iii) True: the LH surge causes ovulation. (iv) False: the luteal phase is the secretory phase; the follicular phase is the proliferative phase.

Q4. Answer (B). India has more than 50,000 genetically different strains of rice (NCERT), not fewer than 1000. The other pairs are correct.

Q5. Answer (A). Pomato is the somatic hybrid of tomato and potato, made by fusing their protoplasts.

Q6. Answer (A). The vertical distribution of different species occupying different levels is called stratification (e.g. trees, shrubs and herbs in a forest).

Q7. Answer (A). Sacred groves are found in the Khasi and Jaintia Hills of Meghalaya; Bastar, Chanda and Sarguja are in Madhya Pradesh/Chhattisgarh.

Q8. Answer (B). The two pairs line up independently at metaphase I, giving four equally likely combinations of gametes (AB, ab, Ab, aB): the chromosomal basis of independent assortment.

Q9. Answer (C). Biolistic (gene) gun – plant cell (v); chitinase – breaks fungal cell walls (iv); Ti plasmid – tumour inducing (ii); Ca^{2+} – makes bacterial cells competent (i). So a-v, b-iv, c-ii, d-i.

Q10. Answer (D). Lamarck proposed the use and disuse of organs (e.g. the long neck of the giraffe).

Q11. Answer (B). Plasmids replicate independently of the chromosomal DNA (they have their own origin of replication), so (B) is incorrect.

Q12. Answer (B). The ovaries are connected to the pelvic wall and uterus by ligaments.

Q13. Answer (A). After industrialisation, tree trunks became dark with soot, so dark (melanised) moths were less visible to predators and increased: A is true and R explains it. Answer (A).

Q14. Answer (A). Rosie's milk contained the human protein alpha-lactalbumin (2.4 g per litre; NCERT's term), which made it nutritionally more balanced for babies: both are true and R explains A. Answer (A).

Q15. Answer (C). Flocs are masses of bacteria with fungal filaments in the aeration tanks: A is true. They consume organic matter by aerobic respiration (reducing the BOD), not anaerobically: R is false. Answer (C).

Q16. Answer (D). In terrestrial ecosystems a much larger fraction of energy flows through the detritus food chain (NCERT): A is false. The GFC and DFC are connected at some levels: R is true. Answer (D).

Q17. (2 marks) Answer: (b) e.g. IgG, IgA.
(a) The immune response mediated by antibodies, produced by B-lymphocytes and found in the blood (body fluids). [1]
(b) Any two of IgA, IgM, IgE, IgG. [½ + ½]

Q18. (2 marks) Answer: see the model answer.
(a) (i) Dormant seeds can be stored for a long time and used as food through the year, or sown in the next season. [1]
(ii) Pea seed is non-albuminous: the endosperm is used up in development, and food is stored in the cotyledons. Castor seed is albuminous: part of the endosperm remains in the mature seed. [1]
OR (b) In the tertiary follicle the primary oocyte completes its first meiotic division. [1]
Products: a large haploid secondary oocyte and a tiny first polar body. [1]

Q19. (2 marks) Answer: palindromic sequence; restriction endonuclease (EcoRI).
(a) Palindromic nucleotide sequences (they read the same on both strands in the $5' \rightarrow 3'$ direction); recognised by restriction endonuclease EcoRI. [½ + ½]
(b) The enzyme binds the DNA, recognises the specific palindromic sequence and cuts each strand between the same two bases (G and A for EcoRI), a little away from the centre, leaving single-stranded sticky ends. [1]

Q20. (2 marks) Answer: (a) male heterogamety (grasshopper); female heterogamety (birds).
(a) Case I: male heterogamety (XO type), e.g. grasshopper. [1]
Case II: female heterogamety (ZW type), e.g. birds. [1]
OR (b) (i) A DNA nucleotide has deoxyribose sugar and one of A, G, C, T; an RNA nucleotide has ribose (with 2′-OH) and uracil in place of thymine. [1]
(ii) N-glycosidic bond (between base and sugar) and phosphoester bond (between phosphate and the 5′-OH of the sugar). [1]

Q21. (2 marks) Answer: see the model answer.
(a) (i) An inverted pyramid of biomass (primary consumers PC more than primary producers PP), as in the sea: the small standing crop of phytoplankton reproduces fast enough to support a larger biomass of zooplankton and fish. [1]
(ii) Any two: it does not account for a species belonging to two or more trophic levels; it assumes a simple food chain, not a food web; saprophytes (decomposers) are not given a place. [½ + ½]
OR (b) (i) Any two: decline in plant production; lowered resistance to environmental perturbations such as drought; increased variability in some ecosystem processes such as productivity, water use and pest and disease cycles. [1]
(ii) Any two: habitat loss and fragmentation; over-exploitation; alien species invasions; co-extinctions. [1]

Q22. (3 marks) Answer: no; rice/wheat ~30 min, Rosaceae/Leguminosae/Solanaceae months; liquid nitrogen at −196 °C.
(a) No, viability varies with the species and the conditions. [½]
In rice and wheat pollen loses viability within about 30 minutes of release; in members of Rosaceae, Leguminosae and Solanaceae it stays viable for months. [2]
(b) By cryopreservation in liquid nitrogen at −196 °C. [½]

Q23. (3 marks) Answer: (b) autosomal recessive, e.g. sickle-cell anaemia.
(a) Analysis of the inheritance of a trait over several generations of a family, using a family tree. [1] Importance: it traces how a trait or disorder is inherited and helps predict its appearance in future generations, which is used in genetic counselling. [1]
(b)(i) Autosomal recessive: unaffected parents have affected children (so it is recessive), and an affected daughter is born to an unaffected father (so it is not X-linked). [½]
(ii) Sickle-cell anaemia (or phenylketonuria, thalassaemia). [½]

Q24. (3 marks) Answer: see the model answer.
(a) For a gene with alleles A and a with frequencies p and q, $p + q = 1$. With random mating, gametes combine at random, so the genotype frequencies are $AA = p^2$, $Aa = 2pq$, $aa = q^2$; their sum is $(p + q)^2 = p^2 + 2pq + q^2 = 1$. [2]
(b) Any two: gene migration (gene flow), genetic drift, mutation, genetic recombination, natural selection. [½ + ½]

Q25. (3 marks) Answer: diagram of the ovule.
A labelled diagram of an anatropous ovule (megasporangium) with any six of: funicle, hilum, outer and inner integuments, micropyle, nucellus, embryo sac, chalaza, antipodals, polar nuclei, egg apparatus (egg cell and synergids). [½ × 6]

Q26. (3 marks) Answer: Papaver somniferum, latex; heroin = diacetylmorphine.
(a) *Papaver somniferum* (poppy plant); from the latex of its (unripe) fruit/capsule. [½ + ½]
(b) Heroin (smack) is diacetylmorphine, obtained by acetylation of morphine. [1] Morphine is a very effective sedative and painkiller; heroin is a depressant that slows down body functions. [½ + ½]

Q27. (3 marks) Answer: (a) cry gene (cryIAb).
(a) The *cry* gene (*cryIAb* for corn borer). [½]
(b) Bt makes an inactive protoxin (crystals). In the alkaline gut of the insect it is converted to the active toxin, which binds to the epithelial cells of the midgut and makes pores, so the cells swell and burst and the insect dies. [1½]
(c) The GM corn carries the Bt *cry* gene (cryIAb) introduced by genetic engineering, so the plants make the Bt toxin themselves and the corn borers that feed on them die. [1]

Q28. (3 marks) Answer: see the model answer.
(a) No bands will be seen in the gel: DNA is negatively charged and moves towards the anode, but the wells are at the anode (+) end, so the DNA does not move into the gel (it stays in or leaves the wells). [1]
(b) The electrodes were reversed: the wells are now at the cathode (−) and the anode (+) at the far end, so DNA moves through the gel. [1] The fragments separate by size through the sieving action of the agarose; the smallest fragment (100 bp) moves the farthest, so it is at X. [1]

Q29. (4 marks) Answer: competition / competitive exclusion; resource partitioning.
(a) Competition (interspecific, competitive exclusion): an interaction in which the fitness of one species is lowered by the presence of another that uses the same limited resource; here the superior competitor Balanus excludes Chthamalus from the lower zone. [1]
OR (a) Gause's competitive exclusion principle: two closely related species competing for the same resources cannot co-exist indefinitely; the competitively inferior one is eliminated. [1]
(b) Flamingoes and fishes in South American lakes compete for zooplankton (or the Abingdon tortoise and goats on the Galapagos). [1]
(c) By resource partitioning: the species use the same resource in different ways, times or places. [1] E.g. MacArthur's five closely related warblers lived on the same tree by foraging in different parts of the branches. [1]

Q30. (4 marks) Answer: (a) I: TT parent; II: Tt × Tt; (b) test cross; (c) law of dominance.
(a) Cross I: all tall, so at least one parent is homozygous tall (e.g. TT × TT or TT × tt). Cross II: 375 : 125 = 3 : 1, so both parents are heterozygous, Tt × Tt. [½ + ½]
OR (a) Monohybrid crosses (one character, height). [1]
(b) Cross III gives 250 : 250 = 1 : 1: a test cross (Tt × tt). [1] It is used to find the unknown genotype of an organism showing the dominant phenotype, by crossing it with the recessive parent. [1]
(c) Tallness is dominant over dwarfness; in the F_1 only the dominant trait appears and the recessive one reappears in the F_2 in a 3 : 1 ratio: the law (principle) of dominance (and segregation). [1]

Q31. (5 marks) Answer: see the model answer.

(a) Fertilisation takes place in the ampullary region of the fallopian tube (oviduct): a sperm fuses with the secondary oocyte, which completes meiosis II, forming a diploid zygote. [1½]

The zygote moves towards the uterus, dividing by mitosis (cleavage) into 2, 4, 8, 16 blastomeres; the 8–16 cell embryo is the morula. [1]

The morula divides further into a blastocyst: an outer layer, the trophoblast, and an inner cell mass. [1]

The trophoblast attaches to the endometrium of the uterus; the uterine cells divide rapidly and cover the blastocyst, which becomes embedded: implantation. The inner cell mass gives rise to the embryo. [1½]

OR (b) (i) Case I: the sperms cannot reach the semen, so sperms are taken directly from the epididymis or testis and injected into the ovum (ICSI), followed by embryo transfer. [1] Case II: IVF (test tube baby) with transfer of the embryo into the uterus (IUT), since the tubes are blocked. [1] Case III: artificial insemination (IUI), placing the husband's collected semen directly into the uterus. [1]

(ii) CuT, Cu7, Multiload 375 (any two). [1] The Cu ions released suppress sperm motility and their fertilising capacity; IUDs also increase phagocytosis of sperms in the uterus. [1]

Q32. (5 marks) Answer: (b)(iii) 10 amino acids.

(a) (i) X-ray diffraction data of DNA, by Maurice Wilkins and Rosalind Franklin; and Chargaff's rule (A = T and G ≡ C, purines = pyrimidines), by Erwin Chargaff. [1 + 1]

(ii) Any three: two polynucleotide chains coiled in a right-handed helix with a sugar-phosphate backbone and the bases inside; the chains are antiparallel (5′ → 3′ and 3′ → 5′); the bases pair by hydrogen bonds, A with T (two bonds) and G with C (three bonds); the pitch is 3.4 nm with about 10 bp per turn, 0.34 nm apart; the helix diameter is constant because a purine always pairs with a pyrimidine. [1 × 3]

OR (b) (i) Template: 3′ - TAC TGG CAT AAA AGA CAT CAC GGG CAT GAA GTC CGT AAT - 5′. [1]

mRNA: 5′ - AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UUA - 3′. [1]

(ii)(1) In a bacterium there is no splicing: the mRNA is the same as above. [1]

(2) In humans the GUA introns are removed: 5′ - AUG ACC UUU UCU GUG CCC CUU CAG GCA UUA - 3′. [1]

(iii) 10 codons remain and none is a stop codon (UAA, UAG, UGA), so 10 amino acids (starting with methionine). [1]

Q33. (5 marks) Answer: (a)(i) Plasmodium falciparum; (ii) female Anopheles mosquito.

(a) (i) *Plasmodium falciparum*. [½]

(ii) The female *Anopheles* mosquito. [½] The gametocytes taken in with blood develop into gametes and fertilise in the mosquito's gut; the zygote develops (oocyst) on the stomach wall, forms sporozoites, which move to the salivary glands and are injected when the mosquito bites. [1½]

(iii) Sporozoites multiply in the liver cells, then attack the red blood cells, multiply and rupture them, releasing haemozoin, a toxin that causes chills and high fever recurring every 3–4 days; loss of RBCs causes anaemia. [1½]

(iv) Any two: using mosquito nets and repellents; draining stagnant water; spraying insecticides; introducing larvivorous fish such as Gambusia in ponds. [½ + ½]

OR (b) (i) Organisms that enrich the nutrient quality of the soil. [1]

(ii) Bacteria: *Rhizobium* in root nodules of legumes and free-living *Azotobacter* and *Azospirillum* fix atmospheric nitrogen. [1] Fungi: mycorrhiza (e.g. *Glomus*) absorbs phosphorus from the soil and passes it to the plant, and gives resistance to root pathogens and drought. [1] Cyanobacteria: *Anabaena*, *Nostoc*, *Oscillatoria* fix nitrogen in paddy fields and add organic matter. [1]

(iii) Any two: they are eco-friendly and do not pollute soil and water; they are cheap and renewable; they improve soil texture and long-term fertility. [½ + ½]

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