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# CBSE Class 12 Biology Board Paper 2026 (57/5/1) with Solutions

PREVIOUS YEAR PAPER · CLASS XII · BIOLOGY (044) · BOARD EXAM 2026 · Q.P. CODE 57/5/1

| 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 – Sections 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, an internal choice has been provided in Sections B, D and E of the question paper. 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 57/5/1). 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.

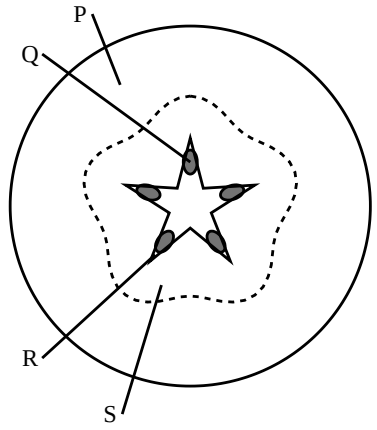
Questions: CBSE board examination 2026, Q.P. Code 57/5/1, as published by CBSE at cbse.gov.in; diagrams redrawn. Answers, step marks and worked solutions © Master Testing Agency. Free for personal practice; not for resale. Master Testing Agency is an independent test-prep publisher, not affiliated with, 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 parts P, Q, R, S in the figure given below and select the option in the correct order. 1




(A) P – Seed, Q – Thalamus, R – Mesocarp, S – Endocarp

(B) P – Thalamus, Q – Seed, R – Endocarp, S – Mesocarp

(C) P – Seed, Q – Thalamus, R – Endocarp, S – Mesocarp

(D) P – Thalamus, Q – Seed, R – Mesocarp, S – Endocarp

**2.** The foetal ejection reflex in human triggers the release of …… hormone from ……. Fill in the blanks by choosing right option. 1

(A) oxytocin, foetal pituitary

(B) oxytocin, maternal pituitary

(C) human chorionic gonadotropin, placenta

(D) progesterone, corpus luteum

**3.** A DNA molecule is 160 base pairs long. It has 30% Guanine. How many Adenine bases are present in this DNA molecule ? 1

(A) 48

(B) 64

(C) 96

(D) 192

**4.** In *Pisum sativum*, the flower colour may be violet (V) or white (v). What proportion of the offspring in a cross of 'VV' × 'vv' would be expected to be violet ? 1

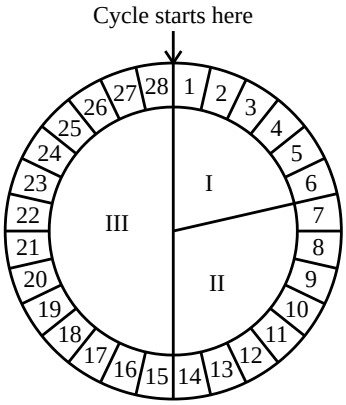
(A) 25%

(B) 50%

(C) 75%

(D) 100%

**5.** In a human female, menstrual cycle of 28 days is represented by the diagram given below. 1




Select the correct statement related with this diagram.

(A) Primary follicle of ovary matures into Graafian follicle in phase II.

(B) The hormone secreted in large amounts in phase III is also responsible for maintaining pregnancy in human females.

(C) Corpus luteum secretes progesterone in phase I, however it degenerates completely in phase III.

(D) Both (A) and (B).

**6.** Arrange the following in the correct sequence of their evolution and select the correct option : 1
(i) Seaweed (ii) Invertebrates (iii) Jawless fish

(A) (i), (ii), (iii)

(B) (i), (iii), (ii)

(C) (ii), (iii), (i)

(D) (ii), (i), (iii)

**7.** *Monascus purpureus* is a yeast used commercially in the production of which one of the following ? 1

(A) Ethanol

(B) Streptokinase

(C) Citric acid

(D) Statins

**8.** Given below is the restriction site of a restriction endonuclease Pst I and the cleavage sites on a DNA molecule. 1

5′ C — T — G — C — A ↓ G 3′

3′ G ↑ A — C — G — T — C 5′

Choose the option that gives the correct resultant fragments.

(A) 5′ C–T–G / 3′ G–A–C–G–T and C–A–G 3′ / C 5′

(B) 5′ C–T / 3′ G–A–C–G and G–C–A–G 3′ / T–C 5′

(C) 5′ C–T–G–C / 3′ G–A–C–G and A–G 3′ / T–C 5′

(D) 5′ C–T–G–C–A / 3′ G and G 3′ / A–C–G–T–C 5′

**9.** Choose a correct option that shows an interaction in which one species benefits while the other is neither harmed nor benefitted. 1

(A) Mycorrhizal associations between fungi and roots of higher plants

(B) Sea anemone and clownfish

(C) Abingdon tortoises and goats in the Galapagos Island

(D) Cuscuta on hedge plants

**10.** Transgenic animals have their genetic material manipulated. Select the correct option in reference to transgenic animals. 1

(A) Foreign DNA and RNA are present in their cells.

(B) Foreign RNA is present in all of their cells.

(C) Foreign DNA is present in all of its cells.

(D) Foreign RNA is present in some of its cells.

**11.** Select the odd option in the context of convergent evolution. 1

(A) Eyes of Octopus and Mammals

(B) Flippers of Penguins and Dolphins

(C) Flying Squirrel and Flying Phalanger

(D) Thorns of Bougainvillea and Tendrils of Cucurbita

**12.** Which of the following fish led to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in Lake Victoria of East Africa ? 1

(A) Catla Catla

(B) Dogfish

(C) Nile Perch

(D) African Catfish

**13.** **Assertion (A) :** The embryo with 8 to 16 blastomeres is called a morula. 1
**Reason (R) :** The morula continues to divide and transform into trophoblast.

(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) :** Repetitive sequences make up a very large portion of human genome. 1
**Reason (R) :** Repetitive sequences do not have direct coding functions in the genome.

(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) :** Trichoderma species are free living fungi that are very common in the root ecosystems. 1
**Reason (R) :** They are effective bio-control agents of several plant pathogens.

(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) :** The use of chitinase enzyme is necessary for the separation of DNA from yeast cells but not in the case of Spirogyra. 1

**Reason (R) :** Fungal cell wall is made up of fungal chitin.

(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) Mention the functions of each of the following : 2

(i) Tassels of Corn Cob

(ii) Scutellum

**OR**

(b) Farmers prefer apomictic seeds over hybrid seeds. Give any two reasons.

**18.** Define the term ‘amniocentesis’. Why has the government imposed a statutory ban in spite of its importance in the medical field ? 2

**19.** Name the lymphoid organ that acts as a large reservoir of erythrocytes. Explain its role as a lymphoid organ. 2

**20.** (a) Suggest how a virus-free healthy plant can be obtained from a diseased sugarcane plant. 2

**OR**

(b) In order to force bacteria to take up the recombinant DNA, they must be made competent. Explain how it can be achieved.

**21.** (a) Differentiate between grazing food chain and detritus food chain. 2

**OR**

(b) Ecological pyramids are widely accepted but they still have some limitations. Write any two limitations.

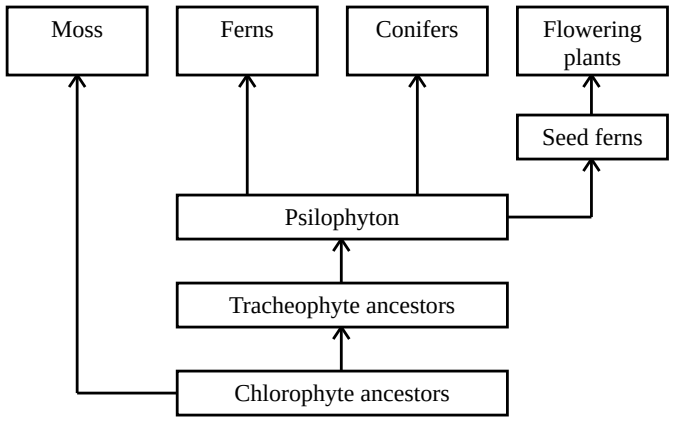
## SECTION C

*Short answer questions of 3 marks each.*

**22.** List any three outbreeding devices that flowering plants have developed for cross-pollination and explain how they help to encourage cross-pollination. 3

**23.** Draw a labelled diagram of a ‘replicating fork’ showing the polarity. Why does DNA replication occur within such ‘fork’ ? 3

**24.** Study the given chart showing evolution of plants. Answer the following questions : 3




(a) Identify the plant which acts as an immediate ancestor of both ferns and conifers.
(b) Name the nearest ancestors of flowering plants.
(c) Name the most primitive group of plants.
(d) Psilophyton provides common ancestry to which classes ?
(e) Name the common ancestor of psilophyton and seed ferns.
(f) Name the common ancestor of mosses and tracheophytes.

**25.** Mention a product of human welfare obtained with the help of each one of the following : 3
(a) *Saccharomyces cerevisiae*
(b) *Propionibacterium shermanni*
(c) *Aspergillus niger*
(d) *Trichoderma polysporum*
(e) *Acetobacter aceti*
(f) *Streptococcus*

**26.** Transgenic animals are produced by man. Explain any three ways in which such animals can be beneficial to humans. 3

**27.** Explain Gause's 'Competitive Exclusion Principle' with the help of a suitable example. 3

**28.** Explain the level of biodiversity at genetic, species and ecological levels with the help of one example each. 3

## SECTION D

*Case-based questions of 4 marks each.*

**29.** The process of copying genetic information from template strand of DNA into RNA is called transcription. It is mediated by RNA polymerase. Transcription takes place in the nucleus of eukaryotic cells. In transcription, only a segment of DNA and only one of the strands is copied into RNA.

**(a)** Why is the strand of DNA with 3′ $\longrightarrow$ 5′ polarity transcribed and not the other strand of 5′ $\longrightarrow$ 3′ polarity ? [1]

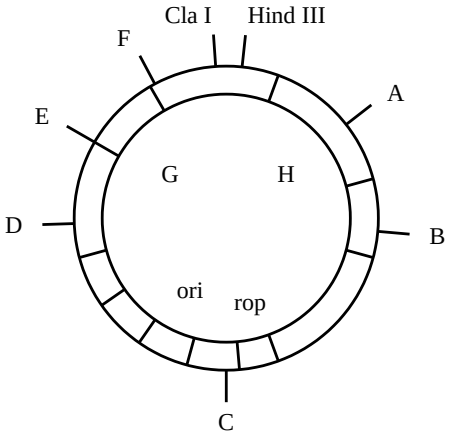
**(b)** Why is hnRNA required to undergo splicing ? [1]

**OR**

**(b)** Mention the two additional processes which hnRNA needs to undergo after splicing to become functional. [1]

**(c)** Why is only one strand of the DNA transcribed ? Give two reasons. [2]

**30.** We know that plasmids and bacteriophages are the most commonly used vectors in biotechnology experiments. If we can link an alien piece of DNA to the plasmid DNA, the alien DNA can be multiplied equal to the copy number of the plasmid. Engineered vectors are used these days. Study the diagram of the *E. coli* cloning vector pBR322 and answer the questions that follow :




**(a)** Why are plasmids and bacteriophages used as cloning vectors ? [1]

**(b)** Identify :

(I) The gene in the cloning vector that controls the copy number of the vector.

(II) The restriction site – C in the ‘rop’ gene. [1]

**OR**

**(b)** Identify and name two selectable markers shown in the diagram. [1]

**(c)** Name the two restriction sites each in the two genes you have identified as selectable markers. [2]

## SECTION E

*Long answer questions of 5 marks each.*

**31.** (a) Briefly explain the events of fertilisation and implantation in an adult human female. 5

**OR**

(b) (i) Arrange the following hormones in sequence of their secretion in a pregnant woman : hCG; LH; FSH; Relaxin.

(ii) Mention the source and the functions of the above mentioned hormones.

**32.** (a) Work out separate monohybrid crosses up to $F_2$ generation between two pea plants and two *Antirrhinum* plants, both having contrasting traits with respect to the colour of the flower. Comment on the patterns of inheritance in the crosses carried out in such two cases. 5

**OR**

(b) Answer the following questions :

(i) How does a chromosomal disorder differ from a Mendelian disorder ? Write one example for each.

(ii) Name the phenomenon that leads to situations like 'XO' abnormality in humans. Also name this genetic disorder. How are individuals with an XO chromosomal abnormality affected ? Write its symptoms as well as karyotype.

**33.** (a) (i) Draw the structure of an antibody molecule and label any four of its parts. 5

(ii) Differentiate between active and passive immunity. Write any three differences.

**OR**

(b) (i) (I) Write the scientific names of the two species of filarial worms causing filariasis.

(II) How do they affect the body of infected persons ?

(III) How does the disease spread ?

(ii) Mention the source and the role of the following in providing defence against infection in the human body :

(I) Histamine

(II) Interferons

**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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (B) | (B) | (B) | (D) | (D) | (C) | (D) | (D) | (B) | (C) | (D) | (C) | (C) | (B) | (B) | (A) |

## 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 (B).** This is the T.S. of an apple, a false fruit (NCERT Fig. 2.13): the outer fleshy part P is the thalamus; Q is a seed; R, the papery lining of the star-shaped core, is the endocarp; S, the region outside it up to the dotted line, is the mesocarp.

**Q2. Answer (B).** The foetal ejection reflex triggers release of oxytocin from the mother's pituitary, which causes strong uterine contractions.

**Q3. Answer (B).** 160 bp = 320 bases. G = C = 30% each, so A + T = 40% and A = 20%: 0.20 × 320 = 64.

**Q4. Answer (D).** VV × vv gives only Vv; violet is dominant, so all (100%) are violet.

**Q5. Answer (D).** Phase I (days 1–6) is the menstrual phase, II (to day 14) the follicular phase, in which follicles grow into a Graafian follicle, and III (days 15–28) the luteal phase, in which the corpus luteum secretes large amounts of progesterone, the hormone that also maintains pregnancy. (C) is wrong: the corpus luteum forms after ovulation, in phase III. So both (A) and (B).

**Q6. Answer (C).** NCERT's account of evolution: invertebrates were formed and active about 500 mya, jawless fish probably around 350 mya, and sea weeds and a few plants probably around 320 mya.

**Q7. Answer (D).** Statins (blood-cholesterol lowering agents) are produced by the yeast *Monascus purpureus*.

**Q8. Answer (D).** The top strand is cut between A and G, the bottom strand between G and A: left piece 5′ CTGCA (top) with 3′ G (bottom), right piece G 3′ (top) with ACGTC 5′ (bottom). The cut leaves 3′ overhangs of TGCA.

**Q9. Answer (B).** Commensalism: the clownfish gets protection among the stinging tentacles of the sea anemone, which gets no apparent benefit. Mycorrhiza is mutualism, the tortoise and goats compete, and *Cuscuta* is a parasite.

**Q10. Answer (C).** A transgenic animal has had its DNA manipulated to possess and express an extra (foreign) gene, which is present in all its cells.

**Q11. Answer (D).** Thorns of *Bougainvillea* and tendrils of *Cucurbita* are homologous organs (divergent evolution); the others are analogous structures or forms (convergent evolution).

**Q12. Answer (C).** The Nile perch, introduced into Lake Victoria, led to the extinction of more than 200 species of cichlid fish (alien species invasion).

**Q13. Answer (C).** An embryo of 8 to 16 blastomeres is a morula (A true). It divides further and becomes a blastocyst, whose outer layer is the trophoblast; the morula does not turn into trophoblast (R false). Answer (C).

**Q14. Answer (B).** Both are findings of the Human Genome Project: repeated sequences make up a very large portion of the genome, and they are thought to have no direct coding function. Having no coding function does not explain why they are so plentiful. Answer (B).

**Q15. Answer (B).** Both statements are from NCERT and both are true, but being a biocontrol agent does not explain why *Trichoderma* is common in root ecosystems. Answer (B).

**Q16. Answer (A).** Yeast is a fungus whose wall contains chitin, so chitinase is used to break it; *Spirogyra* (an alga) has a cellulose wall, broken with cellulase. R explains A. Answer (A).

**Q17. (2 marks)** Answer: (a) trap pollen; food for the embryo; (b) no segregation, no yearly purchase.
**(a)** (i) The tassels are the stigmas and styles; they wave in the wind and trap wind-borne pollen. [1]
(ii) The scutellum is the single cotyledon of the grass family; it absorbs food from the endosperm and passes it to the growing embryo. [1]
**OR (b)** Apomictic hybrid seed does not segregate, so the hybrid characters are kept generation after generation and farmers can use their own seed every year; and they need not buy costly hybrid seed every season. [2]

**Q18. (2 marks)** Answer: testing amniotic fluid; misused for sex determination.
Amniocentesis is a test in which some amniotic fluid around the developing foetus is drawn and its cells studied (chromosomal pattern) to detect genetic disorders. [1]
It was being misused to find the sex of the foetus, and normal female foetuses were aborted (female foeticide); so the use for sex determination is banned by law. [1]

**Q19. (2 marks)** Answer: spleen; filters blood, lymphocytes meet antigens.
The spleen. [1]
It is a secondary lymphoid organ, mainly made of lymphocytes and phagocytes; it filters the blood by trapping blood-borne micro-organisms, and lymphocytes there meet antigens and multiply into effector cells. [1]

**Q20. (2 marks)** Answer: (a) meristem culture; (b) $CaCl_2$, ice, heat shock at 42 °C.
**(a)** Although the plant is infected, its meristems (apical and axillary) are free of virus. [1] The meristem is removed and grown *in vitro* (meristem culture), giving virus-free plants. [1]
**OR (b)** The bacterial cells are treated with a specific concentration of a divalent cation such as calcium, which increases the chance of DNA entering through pores in the cell wall. [1] The cells are then incubated with the recombinant DNA on ice, given a brief heat shock at 42 °C, and put back on ice, so that they take up the DNA. [1]

**Q21. (2 marks)** Answer: (a) producers vs dead organic matter; (b) one species at two levels, no food web, no saprophytes.
**(a)** Grazing food chain starts with producers (green plants) and passes to herbivores and carnivores; its energy comes from the sun, and in aquatic ecosystems it is the major conduit of energy flow. [1] Detritus food chain starts with dead organic matter and passes to decomposers (fungi, bacteria) and detritivores; in terrestrial ecosystems a much larger fraction of energy flows through it. [1]
**OR (b)** Any two: a species that belongs to two or more trophic levels at the same time is not taken into account; they assume a simple food chain and do not show a food web; saprophytes (decomposers) are given no place, although they play a vital role. [2]

**Q22. (3 marks)** Answer: dichogamy, positions of anther and stigma, self-incompatibility, unisexual flowers.
Any three, 1 mark each:
Pollen release and stigma receptivity are not synchronised: the pollen is shed before the stigma is ready, or the stigma is ready long before the pollen is released.
The anther and stigma are placed at different positions, so the pollen cannot reach the stigma of the same flower.
Self-incompatibility: a genetic mechanism that stops pollen from the same flower (or plant) germinating or growing a tube in the pistil.
Unisexual flowers: in monoecious plants (castor, maize) autogamy is prevented; in dioecious plants (papaya) both autogamy and geitonogamy are prevented.

**Q23. (3 marks)** Answer: leading strand continuous, lagging strand in Okazaki fragments; unwinding all at once needs too much energy.

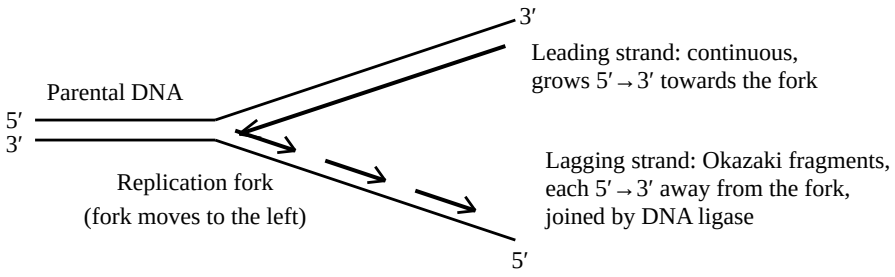



Diagram with polarity, leading and lagging strands and Okazaki fragments. [2]
The two strands of a long DNA molecule cannot be separated all at once, because that needs a very high amount of energy; so replication takes place in a small opening of the helix, the replication fork, which moves along the molecule. [1]

**Q24. (3 marks)** Answer: Psilophyton; seed ferns; chlorophyte ancestors; ferns, conifers, seed ferns; tracheophyte ancestors; chlorophyte ancestors.
(a) *Psilophyton*. [½]
(b) Seed ferns. [½]
(c) Chlorophyte ancestors (green algae). [½]
(d) Ferns, conifers and seed ferns. [½]
(e) Tracheophyte ancestors. [½]
(f) Chlorophyte ancestors. [½]

**Q25. (3 marks)** Answer: bread; Swiss cheese; citric acid; cyclosporin A; acetic acid; streptokinase.
(a) Bread (or ethanol / alcoholic beverages). (b) Swiss cheese (the large holes come from its $CO_2$). (c) Citric acid. (d) Cyclosporin A, an immunosuppressant used in organ transplant patients. (e) Acetic acid. (f) Streptokinase, a 'clot buster' for clots in blood vessels. [½ each]

**Q26. (3 marks)** Answer: disease models, biological products, vaccine and chemical safety testing.
Any three, 1 mark each:
Normal physiology and development: they show how genes are regulated and how they affect body functions (e.g. study of insulin-like growth factor).
Study of disease: they serve as models for human diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's, helping new treatments.
Biological products: e.g. α-1-antitrypsin used to treat emphysema; the transgenic cow Rosie gave milk with human α-lactalbumin (2.4 g per litre).
Vaccine safety: transgenic mice are used to test the safety of vaccines (e.g. polio vaccine) before use on humans.
Chemical safety testing: animals made more sensitive to toxic substances give results faster.

**Q27. (3 marks)** Answer: closely related competitors cannot coexist; Balanus and Chthamalus.
Two closely related species competing for the same limited resources cannot co-exist indefinitely; the competitively inferior one is eliminated in time. [1½]
Example: on the rocky sea coasts of Scotland the larger barnacle *Balanus* dominates the intertidal area and excludes the smaller *Chthamalus* from it (Connell); similarly, when goats were introduced in the Galapagos, the Abingdon tortoise became extinct. [1½]

**Q28. (3 marks)** Answer: Rauwolfia/rice; Western Ghats amphibians; India vs Norway.
Genetic diversity: variation of genes within a species, e.g. *Rauwolfia vomitoria* in different Himalayan ranges varies in the potency and amount of reserpine it makes; India has more than 50,000 strains of rice and 1,000 varieties of mango. [1]
Species diversity: variety in the number and kinds of species in a region, e.g. the Western Ghats have a greater amphibian species diversity than the Eastern Ghats. [1]
Ecological diversity: variety of ecosystems, e.g. India, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries and alpine meadows, has greater ecosystem diversity than a Scandinavian country such as Norway. [1]

**Q29. (4 marks)** Answer: polymerase works 5′ → 3′; introns; capping and tailing; two different proteins, dsRNA.
(a) RNA polymerase can polymerise nucleotides only in the 5′ → 3′ direction, so it can use only the strand with 3′ → 5′ polarity as the template. [1]
(b) hnRNA contains introns (non-coding sequences) as well as exons; the introns must be removed and the exons joined (splicing) before the RNA can be translated. [1]
**OR** (b) Capping: methyl guanosine triphosphate is added to the 5′ end. Tailing: 200–300 adenylate residues are added to the 3′ end. [1]
(c) If both strands were transcribed, the same segment of DNA would code for two different RNAs (and proteins), complicating the transfer of genetic information. [1] And the two RNAs, being complementary, would pair to form double-stranded RNA, which cannot be translated, making transcription futile. [1]

**Q30. (4 marks)** Answer: independent replication, high copy number; ori; Pvu II; amp^R and tet^R; Pst I, Pvu I; Bam HI, Sal I.
(a) They can replicate within bacterial cells independently of the chromosomal DNA, and they have a high copy number, so any DNA linked to them is multiplied. [1]
(b) (I) ori, the origin of replication, which controls the copy number of the linked DNA (rop codes for the proteins involved in replication of the plasmid). [½] (II) *Pvu* II. [½]
**OR** (b) G: $amp^R$ (ampicillin resistance gene) and H: $tet^R$ (tetracycline resistance gene). [1]
(c) $amp^R$: *Pst* I and *Pvu* I (D and E). $tet^R$: *Bam* HI and *Sal* I (A and B). [2]

**Q31. (5 marks)** Answer: (a) ampullary-isthmic junction, zygote, morula, blastocyst, implantation; (b) FSH, LH, hCG, relaxin.
**(a)** Fertilisation: semen released into the vagina (insemination); the sperms swim through the cervix and uterus to the ampullary–isthmic junction of the fallopian tube, where the ovum released at ovulation also arrives; fertilisation happens only if both reach there at the same time. [1] A sperm contacts the zona pellucida, which then changes and blocks the entry of other sperms; acrosome secretions help the sperm enter the ovum. This makes the secondary oocyte complete meiosis II (forming the second polar body and the haploid ovum); the sperm and ovum nuclei fuse to form the diploid zygote. [2]
Implantation: the zygote divides by mitosis (cleavage) as it moves towards the uterus, forming a morula (8–16 blastomeres) and then a blastocyst, with an outer trophoblast and an inner cell mass. [1] The trophoblast attaches to the endometrium; the uterine cells divide rapidly and cover the blastocyst, which becomes embedded in the endometrium: implantation, which leads to pregnancy. The inner cell mass forms the embryo. [1]
**OR (b)** (i) FSH → LH → hCG → Relaxin. [1]
(ii) FSH (anterior pituitary): stimulates the growth of ovarian follicles and oestrogen secretion. [1] LH (anterior pituitary): its mid-cycle surge causes ovulation and the formation of the corpus luteum. [1] hCG (placenta): maintains the corpus luteum and the pregnancy. [1] Relaxin (ovary, in the later phase of pregnancy): relaxes the pelvic ligaments, helping parturition. [1]

**Q32. (5 marks)** Answer: (a) 3 : 1 complete dominance; 1 : 2 : 1 incomplete dominance; (b) aneuploidy, Turner's syndrome, 44 + XO.

**(a)** Pea: VV (violet) × vv (white) → $F_1$ all Vv, violet. $F_1 \times F_1 \rightarrow F_2$ 1 VV : 2 Vv : 1 vv; phenotypes 3 violet : 1 white. [2]

*Antirrhinum* (snapdragon): RR (red) × rr (white) → $F_1$ all Rr, pink. $F_1 \times F_1 \rightarrow F_2$ 1 RR red : 2 Rr pink : 1 rr white. [2]

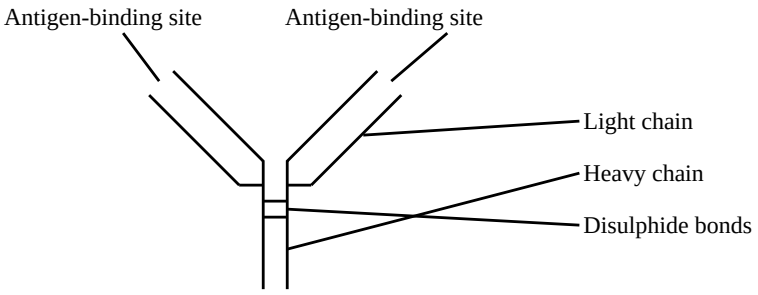
Comment: in pea, violet is completely dominant over white (complete dominance; phenotype ratio 3 : 1 differs from genotype ratio 1 : 2 : 1). In snapdragon, red is incompletely dominant, so the heterozygote is intermediate (pink) and the phenotype ratio equals the genotype ratio, 1 : 2 : 1. [1]

**OR (b)** (i) A chromosomal disorder is caused by the absence, excess or abnormal arrangement of one or more chromosomes, e.g. Down's syndrome (trisomy 21). A Mendelian disorder is caused by a mutation in a single gene and is inherited by Mendel's laws, e.g. haemophilia, sickle-cell anaemia, colour blindness. [2]

(ii) Aneuploidy, from failure of segregation of chromatids during cell division (non-disjunction). [1] The disorder is Turner's syndrome. [½] Karyotype 45 chromosomes, 44 + XO. [½] The individuals are sterile females with rudimentary ovaries, lack other secondary sexual characters and are short in stature. [1]

**Q33. (5 marks)** Answer: (a) $H_2L_2$, antigen-binding sites; (b) Wuchereria bancrofti, W. malayi; Culex; mast cells; virus-infected cells.

**(a)** (i) A Y-shaped molecule of four polypeptide chains, two heavy and two light ($H_2L_2$):




Constant region (stem); variable regions at the tips of the arms

[2]

(ii) Any three: Active immunity is produced by the body itself after exposure to the antigen (infection or vaccine); passive immunity is given as ready-made antibodies (colostrum, through the placenta, antitoxin injections). Active immunity develops slowly; passive acts at once. Active immunity lasts long and has memory; passive is short-lived. [3]

**OR (b)** (i) (I) *Wuchereria bancrofti* and *W. malayi*. [1] (II) They live in the lymphatic vessels, usually of the lower limbs, causing slowly developing chronic inflammation: the limbs swell enormously (elephantiasis or filariasis); the genital organs are often affected, causing gross deformities. [1] (III) Through the bite of the female mosquito vector (*Culex*). [1]

(ii) (I) Histamine: released by mast cells; it dilates blood vessels and makes them leaky in the inflammatory response, bringing fluid and defence cells to the site (it also causes the symptoms of allergy). [1] (II) Interferons: proteins secreted by virus-infected cells; they protect non-infected cells from further viral infection (cytokine barrier). [1]

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