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Your JEE Guide

# CBSE Class XII · Biology (044)

Sample Question Paper 4 · Session 2026-27

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

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This is an original practice paper written to the official CBSE 2026-27 design; it is not issued by CBSE.

**General instructions:**

1. All questions are compulsory.
2. The question paper has five sections and 33 questions.
3. Section A has 16 questions of 1 mark each; Section B has 5 questions of 2 marks each; Section C has 7 questions of 3 marks each; Section D has 2 case-based questions of 4 marks each; and Section E has 3 questions of 5 marks each.
4. There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
5. Wherever necessary, neat and properly labelled diagrams should be drawn.

## Section A

| | | |
|---|---|---|
| **1.** | In an anther, meiosis takes place in the:<br>(A) epidermis (B) endothecium<br>(C) pollen mother cells of the sporogenous tissue (D) tapetum | 1 |
| **2.** | Cleistogamous flowers are:<br>(A) invariably autogamous (B) pollinated only by insects<br>(C) always unisexual (D) always cross-pollinated | 1 |
| **3.** | In many Citrus varieties, polyembryony is due to:<br>(A) fusion of synergids (B) embryos formed from nucellar cells<br>(C) fertilisation of several eggs (D) cleavage of the endosperm | 1 |
| **4.** | In the later phase of pregnancy, the ovary secretes the hormone:<br>(A) oxytocin (B) FSH<br>(C) hCG (D) relaxin | 1 |
| **5.** | In vasectomy, a small part of the following is removed or tied up:<br>(A) fallopian tube (B) ureter<br>(C) urethra (D) vas deferens | 1 |
| **6.** | Which of the following is an X-linked recessive disorder?<br>(A) phenylketonuria (B) thalassemia<br>(C) colour blindness (D) sickle-cell anaemia | 1 |

| | | |
|---|---|---|
| **7.** | In the $F_2$ generation of Mendel's dihybrid cross between round yellow and wrinkled green peas, the fraction of wrinkled yellow plants is:<br>(A) 1/16 (B) 3/16<br>(C) 1/4 (D) 9/16 | 1 |
| **8.** | In bacteria, termination of transcription is facilitated by the:<br>(A) rho (ρ) factor (B) sigma (σ) factor<br>(C) DNA ligase (D) release factor | 1 |
| **9.** | The mutation theory was proposed by Hugo de Vries on the basis of his work on:<br>(A) peppered moth (B) Drosophila<br>(C) evening primrose (Oenothera) (D) garden pea | 1 |
| **10.** | Ringworm in humans is caused by:<br>(A) fungi (B) helminths<br>(C) protozoans (D) bacteria | 1 |
| **11.** | The proteins encoded by the genes cryIAc and cryIIAb control:<br>(A) nematodes (B) mosquitoes<br>(C) corn borers (D) cotton bollworms | 1 |
| **12.** | Which of the following is NOT one of the biodiversity hotspots that cover parts of India?<br>(A) Himalaya (B) Thar Desert<br>(C) Western Ghats and Sri Lanka (D) Indo-Burma | 1 |
| **13.** | **Assertion (A):** Plants raised from apomictic seeds are genetically identical to the parent plant.<br>**Reason (R):** In apomixis, embryos form without meiosis and fertilisation, for example from a diploid egg cell or from nucellar cells.<br>(A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A.<br>(C) A is true but R is false. (D) A is false but R is true. | 1 |
| **14.** | **Assertion (A):** A woman carrying the colour-blindness allele, married to a man with normal vision, can have a colour-blind son.<br>**Reason (R):** Colour blindness is caused by a defect in the red or green cones of the eye.<br>(A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A.<br>(C) A is true but R is false. (D) A is false but R is true. | 1 |

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| | | |
|---|---|---|
| **15.** | **Assertion (A):** Introns are present in the mature mRNA of eukaryotes.<br>**Reason (R):** Introns are removed from hnRNA by splicing.<br>(A) Both A and R are true, and R is the correct explanation of A.<br>(B) Both A and R are true, and R is not the correct explanation of A.<br>(C) A is true but R is false.<br>(D) A is false but R is true. | 1 |
| **16.** | **Assertion (A):** In the sea, the pyramid of biomass is generally inverted.<br>**Reason (R):** The biomass of the phytoplankton is greater than that of the fishes.<br>(A) Both A and R are true, and R is the correct explanation of A.<br>(B) Both A and R are true, and R is not the correct explanation of A.<br>(C) A is true but R is false.<br>(D) A is false but R is true. | 1 |

## Section B

| | | |
|---|---|---|
| **17.** | What is meant by pollen viability? How does it differ in rice and in some members of the family Rosaceae?<br>**OR**<br>What are emasculation and bagging? Why are they needed in artificial hybridisation? | 2 |
| **18.** | Name the cells of the testis that (a) secrete androgens and (b) provide nutrition to the germ cells. Where is each type located? | 2 |
| **19.** | Two tall pea plants are crossed and give tall and dwarf offspring in the ratio 3 : 1. Work out the genotypes of the parents using a Punnett square.<br>**OR**<br>What is a true-breeding line? How many true-breeding pea varieties did Mendel select, and how many pairs of contrasting traits did he study? | 2 |
| **20.** | Why should a cloning vector have only one recognition site for a particular restriction enzyme? | 2 |
| **21.** | What is brood parasitism? Give an example and state the adaptation that makes it successful.<br>**OR**<br>State Gause's competitive exclusion principle. Can species facing competition still coexist? How? | 2 |

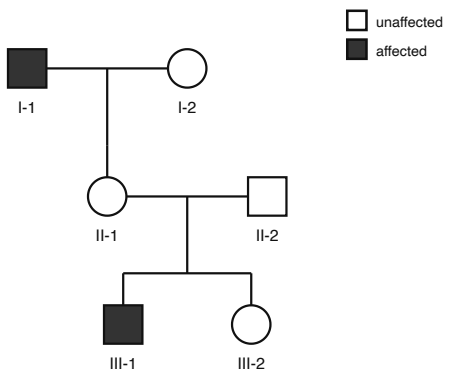
## Section C

| | | |
|---|---|---|
| **22.** | What is polyembryony? How can apomictic embryos arise? Give one example of a plant showing polyembryony. | 3 |
| **23.** | Trace the path of milk from the alveoli to the nipple in a human mammary gland. | 3 |

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| | | |
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| **24.** | (a) Name two sexually transmitted infections that are not completely curable. (b) List two complications of untreated STIs. (c) Suggest two ways of preventing STIs. | 3 |
| **25.** | Distinguish between thalassemia and sickle-cell anaemia with respect to the nature of the defect and the genes involved. | 3 |
| **26.** | Describe Griffith's experiment with Streptococcus pneumoniae. What did Avery, MacLeod and McCarty later find about the "transforming principle"? | 3 |
| **27.** | Compare pneumonia and the common cold with respect to the pathogen, the part of the body infected and one symptom. | 3 |
| **28.** | What are biofertilisers? Give one example each of a symbiotic nitrogen-fixing bacterium, a free-living nitrogen-fixing bacterium and a cyanobacterium used as a biofertiliser. How do mycorrhizae help plants? | 3 |

## Section D

| | | |
|---|---|---|
| **29.** | **Case study.** The pedigree shows the inheritance of red–green colour blindness in a family.<br><br><br>(i) Is the trait dominant or recessive? *[1]*<br>(ii) Write the genotype of II-1. *[1]*<br>(iii) What is the probability that a son of II-1 and II-2 will be colour blind? Show your working. *[2]*<br>**OR**<br>(iii) Why is colour blindness much less common in women than in men? *[2]* | 4 |

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**30.** **Case study.** Students measured the BOD of three water samples: — 4

| Sample | P: river upstream of a town | Q: untreated sewage | R: sewage after secondary treatment |
|---|---|---|---|
| BOD (mg $L^{-1}$) | 3 | 250 | 20 |

(i) Which sample has the most organic matter? *[1]*
(ii) Define BOD. *[1]*
(iii) Explain how secondary treatment lowered the BOD from Q to R. *[2]*

**OR**

(iii) What happens to the activated sludge? Name the gases produced in the sludge digesters. *[2]*

## Section E

**31.** (a) Trace the path of sperms from the seminiferous tubules to the outside. (b) Name the male accessory glands and state the role of their secretions. (c) How many compartments (lobules) does each testis have, and what do they contain? — 5

**OR**

(a) Describe the structure of a typical dicotyledonous embryo. (b) How does a grass embryo differ? (c) Distinguish between perisperm and pericarp.

**32.** (a) Distinguish between homologous and analogous organs, giving two examples of each. (b) How do the use of herbicides and antibiotics show evolution happening before our eyes? (c) Who proposed the mutation theory, and how did it differ from Darwin's idea of variation? — 5

**OR**

(a) Describe the two approaches used in the Human Genome Project. (b) Outline the method used to sequence the genome. (c) How were the genetic and physical maps prepared?

**33.** (a) How is DNA isolated in a pure form from a plant, bacterial or fungal cell for genetic engineering? (b) How is a bacterial cell made competent to take up recombinant DNA? (c) Why are stirred-tank bioreactors used to produce products on a large scale? — 5

**OR**

(a) Give three hypotheses that explain why the tropics have greater biological diversity than temperate regions. (b) Why is the Amazon rainforest called the "lungs of the planet"? (c) State one narrowly utilitarian and one broadly utilitarian reason for conserving biodiversity.

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# Answers and Marking Scheme

Marks for each step are shown in brackets. Any correct alternative method gets full credit.

## Section A

**1.** **(C)** pollen mother cells of the sporogenous tissue. *Working:* Each pollen mother cell forms a microspore tetrad by meiosis.

**2.** **(A)** invariably autogamous. *Working:* They never open, so only self-pollination is possible.

**3.** **(B)** embryos formed from nucellar cells. *Working:* Nucellar cells protrude into the embryo sac and develop into embryos.

**4.** **(D)** relaxin. *Working:* Relaxin is secreted by the ovary in the later phase of pregnancy.

**5.** **(D)** vas deferens. *Working:* This blocks the passage of sperms.

**6.** **(C)** colour blindness. *Working:* The other three are autosomal recessive.

**7.** **(B)** 3/16. *Working:* The $F_2$ ratio is 9 : 3 : 3 : 1, and wrinkled yellow is one of the 3/16 classes.

**8.** **(A)** rho (ρ) factor. *Working:* The σ factor helps initiation and the ρ factor termination.

**9.** **(C)** evening primrose (Oenothera). *Working:* He held that large, sudden mutations cause evolution.

**10.** **(A)** fungi. *Working:* Microsporum, Trichophyton and Epidermophyton.

**11.** **(D)** cotton bollworms. *Working:* cryIAb controls corn borers.

**12.** **(B)** Thar Desert. *Working:* India has parts of three hotspots: Western Ghats and Sri Lanka, Indo-Burma and Himalaya.

**13.** **(A)** Both A and R are true, and R is the correct explanation of A. *Working:* No meiosis or fusion of gametes means no genetic variation.

**14.** **(B)** Both A and R are true, and R is not the correct explanation of A. *Working:* Both are true, but the son is colour blind because he gets his only X chromosome from his carrier mother.

**15.** **(D)** A is false but R is true. *Working:* A is false: introns are removed, so mature mRNA has only exons. R is true.

**16.** **(C)** A is true but R is false. *Working:* A is true. R is false: the biomass of fishes far exceeds that of the phytoplankton.

## Section B

**17.** The period for which pollen grains remain able to germinate after release (1). Rice pollen loses viability within about 30 minutes of release, while in some members of Rosaceae it stays viable for months (1).

**OR** Emasculation: removal of the anthers from a bisexual flower bud before they dehisce. Bagging: covering the emasculated flower with a bag, generally of butter paper (1). They ensure that only the desired pollen reaches the stigma and prevent contamination with unwanted pollen (1).

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**18.** (a) Leydig (interstitial) cells, in the interstitial spaces outside the seminiferous tubules (1). (b) Sertoli cells, in the lining of the seminiferous tubules (1).

**19.** Both parents are heterozygous, Tt (½). Punnett square (1):

| | T | t |
|---|---|---|
| T | TT | Tt |
| t | Tt | tt |

TT and Tt are tall, tt is dwarf: 3 tall : 1 dwarf (½).

**OR** A line that, through continuous self-pollination, shows stable inheritance and expression of a trait for several generations (1). 14 true-breeding varieties, i.e. 7 pairs of contrasting traits (1).

**20.** To link the alien DNA, the vector is cut with the restriction enzyme at the cloning site (1). If there were more than one site, the vector would be cut into several fragments, which would complicate the cloning (1).

**21.** A bird lays its eggs in the nest of its host and lets the host incubate them, e.g. the cuckoo (koel) laying eggs in the crow's nest (1). The eggs of the parasite resemble the host's eggs in size and colour, which reduces the chance of the host detecting and ejecting them (1).

**OR** Two closely related species competing for the same resources cannot coexist indefinitely; the competitively inferior one is eventually eliminated (1). Yes: they may coexist by resource partitioning, e.g. by choosing different times for feeding or different foraging patterns, as in MacArthur's warblers (1).

## Section C

**22.** The occurrence of more than one embryo in a seed (1). In apomixis a diploid egg cell may form without reduction division and develop into an embryo without fertilisation; or some nucellar cells surrounding the embryo sac start dividing, protrude into the embryo sac and develop into embryos (1). Citrus or mango (1).

**23.** The glandular tissue of each breast is divided into 15–20 mammary lobes containing clusters of cells called alveoli, which secrete milk and store it in their lumens (1). The alveoli open into mammary tubules; the tubules of each lobe join to form a mammary duct (1). Several mammary ducts join to form a wider mammary ampulla, which is connected to the lactiferous duct through which milk is sucked out (1).

**24.** (a) Any two: hepatitis B, genital herpes, HIV infection (1). (b) Any two: pelvic inflammatory disease, abortions, still births, ectopic pregnancy, infertility, cancer of the reproductive tract (1). (c) Any two: avoid sex with unknown or multiple partners; always use condoms; consult a qualified doctor for early detection and complete treatment if in doubt (1).

**25.** Thalassemia is a quantitative problem: too few globin molecules are made. Sickle-cell anaemia is a qualitative problem: an incorrectly functioning globin is made (1). α-thalassemia is controlled by two closely linked genes, HBA1 and HBA2, on chromosome 16; β-thalassemia by a single gene, HBB, on chromosome 11 (1). Sickle-cell anaemia is caused by a single base substitution in the β-globin gene (GAG → GUG), replacing glutamic acid by valine at the sixth position (1).

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**26.** Mice injected with the S strain (smooth, with a capsule) died, while those injected with the R strain or with heat-killed S bacteria lived (1). A mixture of heat-killed S and live R bacteria killed the mice, and live S bacteria were recovered from them: the R strain had been transformed by some material from the dead S bacteria (1). Avery, MacLeod and McCarty found that proteases and RNases did not affect transformation but DNase did, so the transforming principle is DNA (1).

**27.** Pneumonia: caused by bacteria such as Streptococcus pneumoniae and Haemophilus influenzae; Common cold: caused by rhinoviruses (1). Pneumonia infects the alveoli of the lungs, which fill with fluid; the common cold infects the nose and respiratory passage but not the lungs (1). Pneumonia: fever, chills, cough, headache, and in severe cases grey or bluish lips and fingernails; common cold: nasal congestion and discharge, sore throat, hoarseness, cough (1).

**28.** Organisms that enrich the nutrient quality of the soil (½). Rhizobium (in the root nodules of legumes); Azotobacter or Azospirillum (free-living in soil); Anabaena, Nostoc or Oscillatoria (cyanobacteria) (1½). Fungi such as Glomus form mycorrhizae with plant roots; they absorb phosphorus from the soil and pass it to the plant, and the plants also show resistance to root pathogens, tolerance to salinity and drought, and better growth (1).

## Section D

**29.** (i) Recessive: III-1 is affected although neither of his parents is.
(ii) $X^{C}X^{c}$: she is a carrier, having received the allele from her affected father.
(iii) Mother $X^{C}X^{c}$ × father $X^{C}Y$. Sons get Y from the father and either $X^{C}$ or $X^{c}$ from the mother, so half the sons (probability ½, i.e. 50%) are colour blind. **OR** A woman is colour blind only if she is homozygous ($X^{c}X^{c}$), which needs a colour-blind father and at least a carrier mother; a man needs only one recessive allele on his single X chromosome.

**30.** (i) Sample Q, untreated sewage, as it has the highest BOD.
(ii) The amount of oxygen that would be consumed if all the organic matter in one litre of water were oxidised by bacteria.
(iii) In aeration tanks, the effluent is agitated mechanically and air is pumped in, so useful aerobic microbes grow as flocs. These consume the major part of the organic matter in the effluent, so the BOD falls significantly. **OR** A small part is pumped back into the aeration tank as inoculum; the rest goes to anaerobic sludge digesters, where anaerobic bacteria digest the bacteria and fungi in it, producing methane, hydrogen sulphide and carbon dioxide (biogas).

## Section E

**31.** (a) Seminiferous tubules → rete testis → vasa efferentia → epididymis → vas deferens → ejaculatory duct → urethra → urethral meatus (2). (b) Seminal vesicles, prostate and bulbourethral glands (1). Their secretions form the seminal plasma, which is rich in fructose, calcium and certain enzymes; the secretion of the bulbourethral glands also helps in lubrication of the penis (1). (c) About 250 testicular lobules, each with one to three highly coiled seminiferous tubules (1).

**OR** (a) An embryonal axis with two cotyledons (1). The part above the cotyledons, the epicotyl, ends in the plumule (stem tip); the part below, the hypocotyl, ends in the radicle (root tip), covered by a root cap (1). (b) Grass embryos have one large shield-shaped cotyledon, the scutellum, on one side of the axis (1); the shoot apex is enclosed in a hollow sheath, the coleoptile, and the

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radicle and root cap in the coleorrhiza (1). (c) Perisperm is residual, persistent nucellus in some seeds such as black pepper and beet; pericarp is the wall of the fruit, formed from the ovary wall (1).

**32.** (a) Homologous organs have the same structure and origin but different functions (divergent evolution), e.g. forelimbs of whale, bat, cheetah and human; thorn of Bougainvillea and tendril of Cucurbita (1). Analogous organs have different structures but similar functions (convergent evolution), e.g. wings of butterflies and of birds; eyes of octopus and of mammals; sweet potato (root) and potato (stem) (1). (b) Excessive use of herbicides and pesticides has selected resistant varieties of weeds and pests in a short time; similarly, microbes resistant to antibiotics have evolved. Organisms with the resistance survive and multiply, which is natural selection caused by human action (2). (c) Hugo de Vries: evolution is caused by large, sudden mutations (saltation), while Darwin had described small, directional variations (1).

**OR** (a) Expressed Sequence Tags: identifying all the genes that are expressed as RNA (1). Sequence annotation: sequencing the whole genome, coding and non-coding, and later assigning functions to the different regions (1). (b) The total DNA was broken into random small fragments, which were cloned in suitable hosts using vectors such as BAC and YAC (1); the fragments were sequenced by automated sequencers based on the method developed by Frederick Sanger, and arranged using their overlapping regions with specialised computer programs (1). (c) Using information on polymorphism of restriction-endonuclease recognition sites and on repetitive DNA sequences called microsatellites (1).

**33.** (a) The cell is broken open with enzymes: lysozyme (bacteria), cellulase (plant cells) or chitinase (fungi) (1). RNA is removed with ribonuclease and proteins with protease (1); purified DNA is precipitated by adding chilled ethanol and is seen as fine threads (½). (b) The cells are treated with a specific concentration of a divalent cation such as calcium; the recombinant DNA is then forced in by incubating the cells with it on ice, heat shock at 42 °C, and placing them back on ice (1½). (c) Bioreactors provide optimal conditions (temperature, pH, substrate, salts, vitamins, oxygen) for the cells to grow on a large scale, and the stirrer mixes the contents evenly and keeps oxygen available throughout (1).

**OR** (a) The tropics have remained relatively undisturbed for millions of years, giving a long time for species diversification, unlike temperate regions affected by glaciations (1). Tropical environments are less seasonal, more constant and predictable, which promotes niche specialisation (1). More solar energy is available in the tropics, contributing to higher productivity (1). (b) It produces about 20 per cent of the total oxygen in the Earth’s atmosphere by photosynthesis (1). (c) Narrowly utilitarian: direct economic benefits such as food, firewood, fibre and medicines. Broadly utilitarian: ecosystem services such as oxygen production, pollination and flood control (1).

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