

MASTER TESTING AGENCY
CBSE Class 12 — Biology (Code 044)

Theory Paper | Set D | Session 2026-27

Time Allowed: 3 Hours

Maximum Marks: 70 (Theory)

General Instructions

- This question paper contains 33 questions in 5 sections. All questions are compulsory.
- Section A (16 marks): 12 multiple-choice questions and 4 Assertion-Reason questions of 1 mark each.
- Section B (10 marks): 5 questions of 2 marks each.
- Section C (21 marks): 7 questions of 3 marks each.
- Section D (8 marks): 2 case-based questions of 4 marks each, with sub-parts.
- Section E (15 marks): 3 questions of 5 marks each.
- There is no negative marking.
- Wherever necessary, neat and properly labelled diagrams should be drawn.
- The 30-mark Practical component is evaluated separately and is not part of this written paper.
- The internal choices given in some board-paper questions are not reproduced; every question in this paper is to be attempted.
- This is an original practice paper written to the CBSE question paper design (unchanged for 2025-26 and 2026-27); it is not a reproduction of any official paper.

SECTION A (QUESTIONS 1-16, 16 MARKS)

1. If the corpus luteum degenerates in the first few weeks of a pregnancy, the most likely consequence is 1 mark
 - (a) a fall in progesterone, causing the endometrium to break down and the embryo to be lost
 - (b) a rise in oestrogen that thickens the endometrium further
 - (c) no effect, because the placenta secretes all the hormones from the first day
 - (d) a rise in hCG that maintains the endometrium without progesterone
2. After double fertilisation in an angiosperm, the ploidy of the zygote, the primary endosperm nucleus and a remaining synergid is respectively 1 mark
 - (a) $2n$, $2n$ and n
 - (b) $2n$, $3n$ and n
 - (c) n , $3n$ and $2n$
 - (d) $2n$, $3n$ and $2n$
3. A woman with both fallopian tubes blocked, but with normal ovulation and a normal uterus, wants to conceive. The most suitable ART is 1 mark
 - (a) GIFT, in which her ovum and the sperm are placed in the fallopian tube
 - (b) ZIFT, in which the zygote is placed in the fallopian tube
 - (c) IVF, followed by transfer of an embryo with more than 8 blastomeres into the uterus (IUT)
 - (d) intra-uterine insemination with her partner's semen
4. In the F_2 generation of a dihybrid cross between $RRYY$ and $rryy$ pea plants, the fraction of plants that are homozygous for both genes is 1 mark
 - (a) $1/16$
 - (b) $9/16$
 - (c) $1/4$
 - (d) $1/2$
5. A colour-blind man marries a woman with normal vision whose father was colour-blind. The probability that their first child is a colour-blind son is 1 mark
 - (a) $1/2$
 - (b) $1/8$
 - (c) $1/4$
 - (d) 0

6. A double-stranded DNA molecule of 1000 base pairs contains 300 adenine bases. The total number of hydrogen bonds between its two strands is 1 mark
(a) 2600 (b) 2700
(c) 2300 (d) 3000
7. A person tests positive for HIV antibodies but has no symptoms; some years later the helper T-cell count falls sharply. The fall occurs because HIV 1 mark
(a) is destroyed by killer T cells, which also kill the B cells
(b) infects red blood cells and lowers the oxygen supply to T cells
(c) triggers so many antibodies that they attack the T cells
(d) replicates inside helper T cells, and the new viruses released destroy them
8. In secondary (biological) treatment of sewage, the BOD of the effluent falls mainly because 1 mark
(a) anaerobic bacteria in the aeration tank convert it into biogas
(b) chlorination kills the microbes in the primary sludge
(c) filtration removes all the dissolved organic matter
(d) aerobic microbes in the flocs consume the organic matter
9. A gene is inserted at the BamHI site, which lies within the tetracycline-resistance gene of pBR322. E. coli cells carrying this recombinant plasmid will grow on a medium containing 1 mark
(a) tetracycline, but not on one containing ampicillin
(b) either ampicillin or tetracycline
(c) neither ampicillin nor tetracycline
(d) ampicillin, but not on one containing tetracycline
10. Transgenic tobacco plants made by RNA interference are protected from the nematode *Meloidogyne incognita* because 1 mark
(a) the dsRNA formed from the introduced sense and antisense RNA silences a specific mRNA of the nematode
(b) the plant makes Bt toxin, which dissolves the gut of the nematode
(c) the introduced gene makes the roots too hard for the nematode to enter
(d) the plant secretes antibodies that bind to the nematode
11. In a deer population of 800, 120 fawns are born and 40 deer die in a year, with no migration. The net increase per individual per year (birth rate minus death rate) is 1 mark
(a) 0.1 (b) 0.15
(c) 0.05 (d) 0.2
12. If 10 J of energy is available at the level of tertiary consumers, the energy fixed by the producers in that food chain (10 per cent law) is 1 mark
(a) 1000 J (b) 10,000 J
(c) 100 J (d) 1,00,000 J
13. Assertion (A): Apomixis is a form of asexual reproduction that mimics sexual reproduction. 1 mark
Reason (R): In apomixis, seeds are formed without fertilisation.
(a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A
(b) Both Assertion (A) and Reason (R) are true, but R is NOT the correct explanation of 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 ABO blood groups are an example of multiple allelism. 1 mark
Reason (R): Persons with blood group AB have both A and B sugars on the surface of their RBCs.
(a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A
(b) Both Assertion (A) and Reason (R) are true, but R is NOT the correct explanation of A
(c) Assertion (A) is true, but Reason (R) is false
(d) Assertion (A) is false, but Reason (R) is true
- 15.** Assertion (A): The eye of the octopus and that of mammals are analogous organs. 1 mark
Reason (R): They perform a similar function but have evolved independently (convergent evolution).
(a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A
(b) Both Assertion (A) and Reason (R) are true, but R is NOT the correct explanation of A
(c) Assertion (A) is true, but Reason (R) is false
(d) Assertion (A) is false, but Reason (R) is true
- 16.** Assertion (A): Restriction endonucleases are called molecular scissors. 1 mark
Reason (R): Hind II was the first restriction endonuclease to be isolated.
(a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A
(b) Both Assertion (A) and Reason (R) are true, but R is NOT the correct explanation of A
(c) Assertion (A) is true, but Reason (R) is false
(d) Assertion (A) is false, but Reason (R) is true

SECTION B (QUESTIONS 17-21, 10 MARKS)

- 17.** A person infected with a pathogen shows no symptoms yet, and the pathogen is present in very low numbers. Explain why PCR can detect the infection at this stage when conventional methods cannot. Name the technique used to detect a mutated gene in a clone. 2 marks
- 18.** The pyramid of biomass in the sea is generally inverted, but the pyramid of energy of the same ecosystem is always upright. Explain both observations. 2 marks
- 19.** The leaf cells of a flowering plant have 24 chromosomes. How many chromosomes will be present in (a) an endosperm cell, (b) a cell of the nucellus, (c) a pollen grain and (d) a synergid? Give reasons. 2 marks
- 20.** Distinguish between homologous and analogous organs, with one example of each. 2 marks
- 21.** A farmer wants to control aphids and caterpillars on his crop without using chemical pesticides. Suggest a biological method for each pest, naming the organism used and how it acts. 2 marks

SECTION C (QUESTIONS 22-28, 21 MARKS)

- 22.** State what each of the following becomes after double fertilisation in a flowering plant: (a) the zygote, (b) the primary endosperm nucleus, (c) the integuments, (d) the ovary wall, (e) the nucellus in black pepper and (f) the synergids and antipodals. 3 marks
- 23.** Compare spermatogenesis and oogenesis in humans with respect to (a) the number of functional gametes formed from one primary spermatocyte or primary oocyte, (b) the time at which meiosis I is completed, and (c) the time of life at which the process begins. 3 marks
- 24.** Predict, with reasons, whether the structural genes of the lac operon of *E. coli* will be transcribed when (a) lactose is absent from the medium, (b) lactose is present, and (c) lactose is absent but a mutation in the *i* gene has produced a repressor that cannot bind to the operator. 3 marks

25. The Australian marsupials, such as the koala, the wombat and the marsupial mole, evolved from a common ancestor, yet the Tasmanian wolf (a marsupial) closely resembles the placental wolf. (a) Name the process by which the marsupials diversified. (b) Explain why the two wolves resemble each other. (c) State which of the two is an example of divergent evolution. 3 marks
26. A biopsy shows that the cells of a tumour have lost contact inhibition, and cells of the same type are found in a distant lymph node. (a) Is the tumour benign or malignant? Give a reason. (b) Name and explain the process by which it has spread. (c) How does α -interferon help in its treatment? 3 marks
27. Explain the logistic growth model with the help of its equation and state what K represents. 3 marks
28. In a population of 1000 individuals in Hardy-Weinberg equilibrium, 160 show the recessive phenotype (aa). Calculate the frequencies of the alleles A and a, and the expected number of heterozygous individuals. 3 marks

SECTION D (QUESTIONS 29-30, 8 MARKS)

T. H. Morgan crossed yellow-bodied, white-eyed female *Drosophila* with brown-bodied, red-eyed males and intercrossed their F_1 progeny. In the F_2 , 98.7 per cent of the flies were of the parental types and only 1.3 per cent were recombinants. In a similar cross involving white eye and miniature wing, 37.2 per cent of the F_2 were recombinants. Both pairs of genes are carried on the X chromosome.

29. (i) Why did the F_2 ratios in these crosses deviate so much from 9 : 3 : 3 : 1? 1 mark
- (ii) Which pair of genes lies closer together on the X chromosome? Give a reason. 1 mark
- (iii) Define linkage and recombination. How did Sturtevant use such recombination frequencies? 2 marks

Alexander von Humboldt found that, within a region, species richness rises with the area explored, but only up to a limit. When the number of species (S) is plotted against area (A) on a log-log scale, the relationship is a straight line, $\log S = \log C + Z \log A$, where C is the Y-intercept and Z is the slope.

30. (i) Write the equation of this relationship in its non-logarithmic form, and state what it is called. 1 mark
- (ii) Compare the usual value of Z within a region with its value when very large areas, such as whole continents, are compared. 1 mark
- (iii) Taking $Z = 0.2$, about what fraction of its species would an island lose if 90 per cent of its habitat were destroyed? Which cause of biodiversity loss does this illustrate? 2 marks

SECTION E (QUESTIONS 31-33, 15 MARKS)

31. A couple has been unable to conceive for over two years. (a) Give one possible cause of infertility in each partner. (b) Suggest a suitable assisted reproductive technology, with a reason, when (i) the woman cannot produce ova but can provide a suitable environment for fertilisation and development, (ii) the man has a very low sperm count, and (iii) the man is unable to inseminate the woman. (c) At what stage, and into which part of the female tract, is the embryo transferred in ZIFT and in IUT? 5 marks

- 32.** (a) State any four features of the double-helix model of DNA proposed by Watson and Crick. (b) In a DNA molecule, 20 per cent of the bases are adenine. Calculate the percentage of guanine, naming the rule used. (c) Describe how Meselson and Stahl showed that DNA replicates semiconservatively, stating the kind of DNA found after one and after two generations. 5 marks
- 33.** (a) Why is the pyramid of energy always upright? (b) Why can the pyramid of numbers be inverted in a tree ecosystem? (c) If the producers of a food chain fix 20,000 J of energy, how much energy reaches the third trophic level? (d) Why do food chains rarely have more than four or five trophic levels? 5 marks

MASTER TESTING AGENCY

Answer Key

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SECTION A

1.	(a) a fall in progesterone, causing the endometrium to break down and the embryo to be lost
2.	(b) $2n$, $3n$ and n
3.	(c) IVF, followed by transfer of an embryo with more than 8 blastomeres into the uterus (IUT)
4.	(c) $1/4$
5.	(c) $1/4$
6.	(b) 2700
7.	(d) replicates inside helper T cells, and the new viruses released destroy them
8.	(d) aerobic microbes in the flocs consume the organic matter
9.	(d) ampicillin, but not on one containing tetracycline
10.	(a) the dsRNA formed from the introduced sense and antisense RNA silences a specific mRNA of the nematode
11.	(a) 0.1
12.	(b) 10,000 J
13.	(a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A
14.	(b) Both Assertion (A) and Reason (R) are true, but R is NOT the correct explanation of A
15.	(a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A
16.	(b) Both Assertion (A) and Reason (R) are true, but R is NOT the correct explanation of A

SECTION B

17.	Model answer / value points Conventional methods (serum and urine analysis) detect a pathogen only after its numbers have risen and symptoms have appeared ($1/2$). PCR amplifies the specific DNA/RNA of the pathogen many times over, so even a very small number of copies can be detected early (1). A mutated gene is detected with a radioactively labelled single-stranded DNA/RNA probe that hybridises to its complementary sequence, followed by autoradiography ($1/2$).
18.	Model answer / value points In the sea, the standing biomass of the phytoplankton (producers) at any moment is smaller than that of the fish that feed on them, because the phytoplankton are tiny, short-lived and are eaten and replaced rapidly; so the pyramid of biomass is inverted (1). The pyramid of energy shows the energy that flows through each level; at every transfer only about 10 per cent passes on and the rest is lost as heat, so each level always has less energy than the level below and the pyramid can never be inverted (1).
19.	Model answer / value points (a) Endosperm: 36, since it is triploid (fusion of two polar nuclei with a male gamete) ($1/2$). (b) Nucellus: 24, as it is maternal diploid tissue ($1/2$). (c) Pollen grain: 12, as it is formed by meiosis ($1/2$). (d) Synergid: 12, as it is part of the haploid embryo sac ($1/2$).
20.	Model answer / value points Homologous organs have the same basic structure and origin but may perform different functions, e.g. forelimbs of whale, bat and human (1). Analogous organs perform similar functions but have different structures and origins, e.g. wings of a butterfly and a bird (1).

21.	Model answer / value points Aphids: release ladybird beetles, which are predators that feed on aphids (1). Caterpillars: spray spores of the bacterium <i>Bacillus thuringiensis</i> (Bt) on the plants; the caterpillars eat them, and the toxin released in their gut kills them while the other insects are not harmed (1). (Baculoviruses of the genus Nucleopolyhedrovirus, which are species-specific, may also be named for the caterpillars.)
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SECTION C

22.	Model answer / value points (a) Zygote: the embryo ($\frac{1}{2}$). (b) Primary endosperm nucleus: the endosperm ($\frac{1}{2}$). (c) Integuments: the seed coats, testa and tegmen ($\frac{1}{2}$). (d) Ovary wall: the pericarp, i.e. the wall of the fruit ($\frac{1}{2}$). (e) Nucellus: it persists as the perisperm ($\frac{1}{2}$). (f) Synergids and antipodals: they degenerate ($\frac{1}{2}$).
23.	Model answer / value points (a) One primary spermatocyte gives four spermatozoa, whereas one primary oocyte gives only one ovum, because its divisions are unequal and the polar bodies degenerate (1). (b) A primary spermatocyte completes meiosis I soon after it is formed; a primary oocyte enters meiosis I in the foetal ovary, stays arrested in prophase I until puberty and completes it only just before ovulation (its meiosis II is completed only when a sperm enters) (1). (c) Spermatogenesis begins at puberty and continues throughout life; oogenesis begins before birth, and no new oogonia are formed after birth (1).
24.	Model answer / value points (a) Not transcribed: the repressor made by the <i>i</i> gene binds to the operator and stops RNA polymerase from transcribing the operon (1). (b) Transcribed: lactose (the inducer) binds to the repressor and inactivates it, so it cannot bind to the operator; RNA polymerase then transcribes the <i>z</i> , <i>y</i> and <i>a</i> genes (1). (c) Transcribed all the time: the faulty repressor cannot bind to the operator, so the operon is expressed whether or not lactose is present (1).
25.	Model answer / value points (a) Adaptive radiation: the evolution of different forms from one ancestral stock, each adapted to a different habitat (1). (b) Convergent evolution: when more than one adaptive radiation occurs in an isolated area, animals that are not closely related come to look alike because they are adapted to similar ways of life (1). (c) The radiation of the marsupials from one ancestor is divergent evolution; the resemblance of the two wolves is convergent evolution (1).
26.	Model answer / value points (a) Malignant: its cells divide uncontrollably and invade the surrounding tissue, whereas a benign tumour stays confined to its place of origin (1). (b) Metastasis: cells sloughed off from the tumour travel in the blood or lymph to distant sites and start new tumours there (1). (c) α -interferon is a biological response modifier; it activates the patient's immune system and helps it destroy the tumour cells (1).
27.	Model answer / value points In nature resources are limited, so growth has a lag phase, then acceleration and deceleration, and finally an asymptote (1). $\frac{dN}{dt} = rN[(K - N)/K]$ (1). <i>K</i> is the carrying capacity, the maximum population size the environment can support; the curve is sigmoid (Verhulst-Pearl) (1).
28.	Model answer / value points $q^2 = 160/1000 = 0.16$, so q (frequency of <i>a</i>) = 0.4 (1). $p = 1 - q = 0.6$ (1). Heterozygotes: $2pq = 2 \times 0.6 \times 0.4 = 0.48$, i.e. $0.48 \times 1000 = 480$ individuals (1).

SECTION D

29(i).	Model answer / value points The genes of each pair lie on the same (X) chromosome, so they did not segregate independently; the parental combinations appeared far more often than they would for unlinked genes (1).
29(ii).	Model answer / value points The genes for yellow body and white eye: their recombination frequency (1.3%) is much lower than that of white eye and miniature wing (37.2%), and the closer two genes are, the stronger the linkage (1).
29(iii).	Model answer / value points

	Linkage is the physical association of genes on a chromosome; recombination is the generation of non-parental gene combinations (1). Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between them, and mapped their positions on the chromosome (1).
30(i).	Model answer / value points S = CA ² ; it is the species-area relationship (1).
30(ii).	Model answer / value points Within a region Z is about 0.1 to 0.2, whatever the taxonomic group or region; for very large areas such as whole continents the slope is much steeper, Z being about 0.6 to 1.2 (e.g. 1.15 for frugivorous birds and mammals of tropical forests on different continents) ($\frac{1}{2} + \frac{1}{2}$).
30(iii).	Model answer / value points $S(\text{new})/S = 0.1$ raised to the power $0.2 \approx 0.63$, so about 37 per cent (roughly one-third) of the species would be lost (1). This is habitat loss and fragmentation, the most important cause in the "Evil Quartet" (1).

SECTION E

31.	Model answer / value points (a) Man: very low sperm count or immotile sperms; woman: blocked fallopian tubes or failure of ovulation (also infections, congenital defects, drugs, immunological or psychological causes) ($\frac{1}{2} + \frac{1}{2}$). (b) (i) GIFT: an ovum collected from a donor is transferred into her fallopian tube, where fertilisation takes place (1). (ii) ICSI: a sperm is injected directly into the ovum in the laboratory and the embryo is then transferred (1). (iii) Artificial insemination (AI/IUI): semen collected from the husband or a donor is introduced into the vagina or the uterus (1). (c) ZIFT: the zygote or early embryo with up to 8 blastomeres, into the fallopian tube ($\frac{1}{2}$); IUT: an embryo with more than 8 blastomeres, into the uterus ($\frac{1}{2}$).
32.	Model answer / value points (a) Any four ($\frac{1}{2}$ each): two polynucleotide chains with a sugar-phosphate backbone and the bases projecting inside; the chains are antiparallel (5'→3' and 3'→5'); A pairs with T by two hydrogen bonds and G with C by three, a purine always facing a pyrimidine, so the distance between the strands is uniform; the chains are coiled right-handed, with a pitch of 3.4 nm, about 10 bp per turn and 0.34 nm between adjacent base pairs (2). (b) By Chargaff's rule, A = T and G = C; A + T = 40 per cent, so G + C = 60 per cent and guanine = 30 per cent (1). (c) E. coli grown for many generations in ¹⁵ NH ₄ Cl (so that its DNA was heavy) was transferred to a medium with ¹⁴ NH ₄ Cl, and the DNA extracted at intervals was separated by caesium chloride density-gradient centrifugation (1). After one generation (20 minutes) all the DNA was hybrid (of intermediate density); after two generations (40 minutes) there were equal amounts of hybrid and light DNA, as expected only for semiconservative replication (1).
33.	Model answer / value points (a) Energy flow is unidirectional and only about 10 per cent is passed on at each step; the rest is lost as heat in respiration, so each level has less energy than the one below ($1\frac{1}{2}$). (b) A single large tree (producer) supports many herbivorous insects, which in turn support fewer birds, so the base is narrow (1). (c) Producers 20,000 J, primary consumers 2000 J, secondary consumers (third trophic level) 200 J ($1\frac{1}{2}$). (d) Too little energy remains at higher levels to support another level of consumers (1).