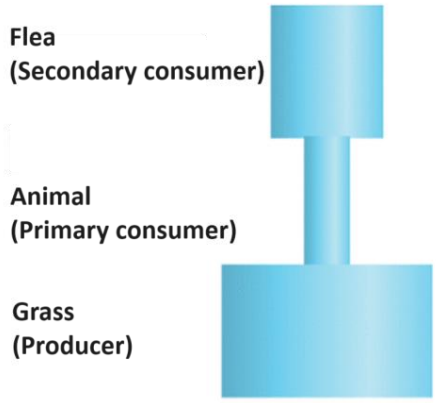
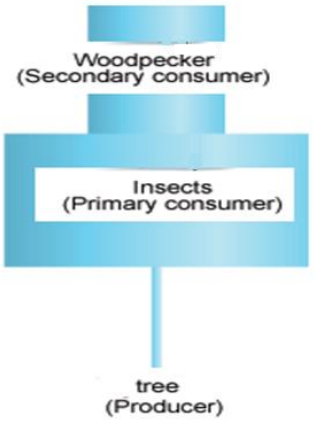
Marking Scheme
Biology (044)
Class XII (2024 – 25)

<table>
<tr><th>Q. No.</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">Section - A</td></tr>
<tr><td>1</td><td>B. Both placenta as well as fully developed foetus.</td><td>1</td></tr>
<tr><td>2</td><td>B. 2000
Formation of one seed requires fertilsation between one pollen grain and one egg. To produce 1600 seeds, 1600 pollen grains and 1600 eggs will be required. Each microspore mother cell results in the formation of 4 pollen grains after one cycle of meiotic division. So, 400 meiotic divisions will result in the production of 1600 pollen grains. One megaspore mother cell after one cycle of meiotic division results in the formation of 1 egg; so, 1600 meiotic divisions will take place to form 1600 eggs. Thus, total number of meiotic divisions required for the formation of 1600 seeds will be 400 + 1600 =2000.</td><td>1</td></tr>
<tr><td>3</td><td>A. 23%
According to Chargaff’s rules, in DNA, A =T and G=C;
Thus, A +T+G+C =100
Given T = 27% so A=T =27%
Thus A+T = 27 +27 =54%
Thus, G+C =100 – 54 = 46%
Since G = C so G = 46/2 =23%</td><td>1</td></tr>
<tr><td>4</td><td>B. CGTA
- - - - - - - - - - - - - - - - - - -
<u>For Visual Impaired Students</u>
B. 4000 bp/s
It completes replication process in 18 minutes i.e. 18x 60 seconds.
Rate of polymerization = 4.6 x 10^6 bp/ 18x 60 s
= 460000/108
= 4259.1bp/s or approximately 4000 bp/sec Thus, the correct option is B.</td><td>1</td></tr>
<tr><td>5</td><td>C.
Suresh | Rajesh
Sickle Cell Anaemia – Autosomal linked Recessive trait | Thalassemia – Autosomal Recessive blood disorder</td><td>1</td></tr>
<tr><td>6</td><td>A. present in the medium and it binds to the repressor.</td><td>1</td></tr>
<tr><td>7</td><td>A. (i) and (ii)</td><td>1</td></tr>
</table>

8	C. 5´ UAACGG 3´	1
9	B. CO_2	1
10	D. Rapid divergence of traits among populations inhabiting a given geographical area.	1
11	A. 1& 5; 5 &1	1
12	A. Reduction in BOD	1
Question No. 13 to 16 consist of two statements – **Assertion** (A) and **Reason** (R). Answer these questions selecting the appropriate option given below: 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. C. A is true but R is false. D. A is False but R is true.		
13	C. A is true but R is false.	1
14	C. A is true but R is false.	1
15	A. Both A and R are true and R is correct explanation of A.	1
16	C. A is true but R is false.	1
Section - B		
17	*Student to attempt either option A or B.* A. (i) Negative hCG implies no pregnancy (0.5); Placenta. (0.5) (ii) Human placental lactogen (hPL), estrogen, progestogens, relaxin (any two) (0.5 x 2 = 1) **OR** B. (i) A sperm induces changes in the zona pellucida membrane on contact, blocking entry of other sperms. (1) (ii) Ovum and sperms should be transported simultaneously to the ampullary region for fertilization. (1)	2
18	*Student to attempt either option A or B.* A. (i) I is point mutation; II is Frame shift (1) (ii) II as more codons are affected; (0.5) It is extremely likely to lead to large-scale changes to polypeptide length and chemical composition/ resulting in a non-functional protein that often disrupts the biochemical processes of a cell/Incorrect amino acids are inserted/ often premature termination occurs when a nonsense codon is read/ Frameshifts have very severe phenotypic effects. (any one) (0.5) **OR**	2

	B. (i) Translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and the stop codon (UAA) and codes for a polypeptide/ AUG AUC UCG UAA. (1) (ii) Untranslated regions (UTR). The UTRs are present at both 5' -end (before start codon) and at 3' -end (after stop codon). They are required for an efficient translation process. (1)	
19	A. As the adaptive immune response gears up, there is a reciprocal relationship between virus levels in the blood and helper T lymphocytes levels. As the level of helper T levels rises, the virus levels decline. (1) B. Several years later, if untreated, HIV patient will lose the adaptive immune response, including the ability to make antibodies, as gradually the HIV enters the helper T lymphocytes leading to a progressive decrease in the number of helper T lymphocytes. (1) - - - - - - - - - - - - - - - - - - - *For visually impaired students.* After getting into the body of the person, the virus enters into macrophages where the RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase. The viral DNA gets incorporated into the host cell's DNA and directs the infected cells to produce virus particles. Macrophages continue to produce virus particles; in this way they act like HIV factory. (1) Simultaneously, HIV enters into helper T-lymphocytes (T_H), replicates and produces progeny viruses. The progeny virus released in blood attack other T lymphocytes leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person. Due to decrease in the number of helper T lymphocytes, the person becomes immuno-deficient. (1)	2
20	• The variation in colour of colonies is due to the principle of insertional inactivation. (0.5) • In this, a recombinant DNA is inserted within the coding sequence of an enzyme, β-galactosidase. This results into inactivation of the enzyme, which is referred to as insertional inactivation. (0.5) • The presence of a chromogenic substrate gives blue-coloured colonies if the plasmid in the bacteria does not have an insert. (0.5) • Presence of insert results into insertional inactivation of the β -galactosidase and the colonies do not produce any colour, these are identified as recombinant colonies. (0.5)	2

21	*Student to attempt either option A or B.* A. (i) NPP = GPP – R; Given GPP = 400 J/m^2/day R = 150 J/m^2/day NPP = 400 J/m^2/day – 150 J/m^2/day = 250 J/m^2/day (1) (ii) Pyramid of energy is always upright. As energy flows from one trophic level to the next trophic level some amount of energy is lost in each trophic level in the form of heat. Therefore, the pyramid of energy is always upright and can never be inverted. (1) **OR** B. (i) If GPP is equal, then we can manipulate the NPP equation and solve. • NPP = GPP – Respiration of plants; • Respiration of Plants = GPP – NPP. • This means that the smallest NPP corresponds to the largest respiration. That is forest C. (1) (ii) (a) (b)   (0.5) (0.5)	2
	Section – C	
22	A. Seed X- 3 embryos; 1embryo sac; 1ovule; (0.5 x 3=1.5) B. The nucellar cells grow mitotically and develop into the embryos by asexual reproduction. (0.5) C. The plants growing from seed X will have to share the resources/endosperm so there is a possibility of some plant being undernourished/; only one plant in seed Y will use the entire endosperm for its growth **or** as the plants of seed X are clones they will not show variation and may succumb to environmental stress;/ plants from seed Y will have genetic variation and so can show greater adaptability. (1)	3

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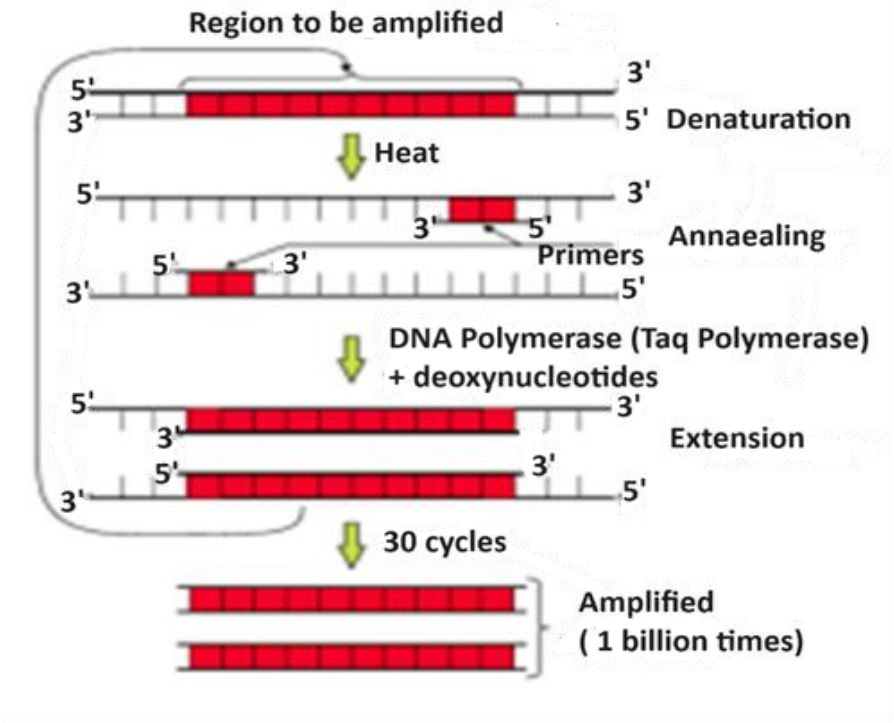
23	• The first meiotic division is completed in the primary oocyte during oogenesis. (1) • Then primary oocyte undergoes first meiotic division to form a large haploid secondary oocyte and a tiny first polar body. (1) • The primary oocyte comprises of 46 chromosomes, whereas secondary oocyte and first polar body have 23 chromosomes each. (1)	3
24	A. During replication, Adenine pairs with thymine in DNA; during transcription, adenine pairs with uracil in RNA. (0.5+0.5) B. In retrovirus the nucleic acid is RNA and it is used to synthesize DNA; the process is called reverse transcription. (0.5+0.5) C. It is a highly energy-rich process/ or as per the need only the gene coding for a specific protein is transcribed. (1) - - - - - - - - - - - - - - - - - - *For visually impaired students* A. During replication, Adenine pairs with thymine in DNA; during transcription, adenine pairs with uracil in RNA. (0.5+0.5) B. In retrovirus the nucleic acid is RNA and it is used to synthesize DNA; the process is called reverse transcription. (0.5+0.5) C. It is a highly energy-rich process/ or as per the need only the gene coding for a specific protein is transcribed. (1)	3
25	• isolation of DNA, • digestion of DNA by restriction endonucleases, • separation of DNA fragments by electrophoresis, • transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon, • hybridisation using labelled VNTR probe, and • detection of hybridised DNA fragments by autoradiography. (0.5 x 6 =3)	3

26	The main sources of biofertilizers are bacteria, fungi and cyanobacteria. - The nodules on the roots of leguminous plants are formed by the symbiotic association of Rhizobium. These bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as a nutrient. Other bacteria can fix atmospheric nitrogen while free-living in the soil (examples *Azospirillum* and *Azotobacter*), thus enriching the nitrogen content of the soil. (1) - Fungi are also known to form symbiotic associations with plants (mycorrhiza). Many members of the genus Glomus form mycorrhiza. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development. (1) - Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environments many of which can fix atmospheric nitrogen, e.g. Anabaena, Nostoc, Oscillatoria, etc. In paddy fields, cyanobacteria serve as an important biofertiliser. Blue green algae also add organic matter to the soil and increase its fertility. (1)	3
27	PCR stands for Polymerase Chain Reaction. In this reaction, multiple copies of the gene (or DNA) of interest are synthesised in vitro using two sets of primers (small chemically synthesised oligonucleotides that are complementary to the regions of DNA) and the enzyme DNA polymerase. The enzyme extends the primers using the nucleotides provided in the reaction and the genomic DNA as template. (1) If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times, i.e., 1 billion copies are made. Such repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a bacterium, *Thermus aquaticus*), which remains active during the high temperature induced denaturation of double stranded DNA. The amplified fragment if desired can now be used to ligate with a vector for further cloning. (1) Each cycle has three steps: (i) Denaturation, (ii) Annealing and (iii) Extensions. (1)	3

		
28	A. • They are able to co-exist by mechanism of 'resource partitioning'. • If two species compete for the same resource, they could avoid competition by choosing different foraging patterns. • MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities. B. • Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely • and the competitively inferior one will be eliminated eventually. • No (0.5 x 6=3) - - - - - - - - - - - - - - - - - - - *For visually impaired students* A. • They are able to co-exist by mechanism of 'resource partitioning'. • If two species compete for the same resource, they could avoid competition by choosing different foraging patterns. • MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities. B. • Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist	3

	indefinitely • and the competitively inferior one will be eliminated eventually. • No (0.5 x 6=3)	
Section – D		
29	A. Given is bb = q^2 = 0.4. To determine q, which is the frequency of the recessive allele in the population, simply take the square root of q^2 which works out to be 0.632 (i.e. 0.632 x 0.632 = 0.4). So, q = 0.63 (1) B. As we know that p + q = 1, then p must be 1 - 0.63 = 0.37. (1) The percentage of beetles in the population that are heterozygous would be 2pq. 2 (0.37) (0.63) = 0.47 (1) *Student to attempt either subpart C or D.* C. Given is BB= p^2 = $(0.37)^2$= 0.14 (1) **OR** D. As, 1500 is the total population 40% is red population, hence the number of beetles with red colour will be 1500x0.4= 600 (0.5) If total population is 1500 and red is 600 then black would be 1500-600=900 (0.5)	4
30	A. The rupture of RBCs associated with the release of toxic substance haemozoin is responsible for the chills and fever/recurring every 3 - 4 days. (1) B. - The parasite reproduces asexually in liver cells, bursting the cell and releasing into the blood. (1) - Parasite further reproduces asexually in red blood cells. Released parasite infects new red blood cells. Sexual stages (gametocytes) develop in red blood cells. (1) *Student to attempt either subpart C or D.* C. The infection is caused by the bite of the female *Anopheles* mosquito which introduces the sporozoites in the human body. (1) **OR** D. Fertilisation and development take place in the mosquito's gut. (1) - - - - - - - - - - - - - - - - - - -	4

	For visually impaired students A. The rupture of RBCs associated with the release of toxic substance haemozoin is responsible for the chills and fever/recurring every 3-4 days. (1) B. - The parasite reproduces asexually in liver cells, bursting the cell and releasing into the blood. (1) - Parasite further reproduces asexually in red blood cells. Released parasite infects new red blood cells. Sexual stages (gametocytes) develop in red blood cells. (1) *Student to attempt either subpart C or D.* C. The infection is caused by the bite of the female *Anopheles* mosquito which introduces the sporozoites in the human body. (1) **OR** D. Fertilisation and development take place in the mosquito's gut. (1)	
Section – E		
31	*Student to attempt either option A or B.* A. (i) • Sperm count decreases, spermatogenesis is impaired; • Spermatids do not get nourishment to develop into spermatozoa thus spermiogenesis will be affected; • Leydig cells synthesize and secrete androgen hormones (like testosterone) so secretion of androgens will be affected. (0.5 x 3 = 1.5) (ii) Spremiation (0.5) (iii) Artificial insemination (AI) technique. In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI – intra – uterine insemination) of the female. **OR** Intra cytoplasmic sperm injection (ICSI) is another specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum. (1) (iv) The zygote or early embryos (with upto 8 blastomeres) could be transferred into the fallopian tube (ZIFT–zygote intra fallopian transfer); embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development. (1+1) - - - - - - - - - - - - - - - - - - -	5

	For visually impaired students (iv) The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the fallopian tube (ZIFT–zygote intra fallopian transfer); embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development. (1+1+0.5 mark for ZIFT with full form) **OR** B. (I) (i) In rose – bay plant, the time of maturation of stamen and pistil is not same, the pollen will not be able to germinate on the stigma. This prevents autogamy in rose-bay. (1) (ii) Different position and incompatible placement of the reproductive structure prevent successful pollination and thus autogamy in primrose. (1) (iii) Pollen pistil interaction for same species is not possible; this is a genetic mechanism which prevent the pollen grain from forming pollen tube on the pistil of the same flower. (1) (II) The male and female flowers are present in the same plant but are not in proximity preventing self-fertilization in castor. In papaya, the male flower and female flowers are in different plants, it prevents autogamy. (2)	
32	*Student to attempt either option A or B.* A. - Several nematodes parasitize a wide variety of plants and animals including human beings. - A nematode *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield. - A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi). - RNAi takes place in all eukaryotic organisms as a method of cellular defense. - This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing). - The source of this complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate. - Using Agrobacterium vectors, nematode-specific genes were introduced into the host plant. - The introduction of DNA was such that it produced both sense and anti-sense RNA in the host cells. - These two RNA's being complementary to each other formed a	5

	double stranded (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of the nematode. - The consequence was that the parasite could not survive in a transgenic host expressing specific interfering RNA. The transgenic plant therefore got itself protected from the parasite. (0.5 x 10 =5) **OR** B. - Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. Here genes are inserted into a person's cells and tissues to treat a disease. - Correction of a genetic defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for the non-functional gene. - The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase (ADA) deficiency. This enzyme is crucial for the immune system to function. - The disorder is caused due to the deletion of the gene for adenosine deaminase. - In some children ADA deficiency can be cured by bone marrow transplantation; in others it can be treated by enzyme replacement therapy, in which functional ADA is given to the patient by injection. - But the problem with both of these approaches is that they are not completely curative. - As a first step towards gene therapy, lymphocytes from the blood of the patient are grown in a culture outside the body. - A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient. - However, as these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes. - However, if the gene isolate from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure. (0.5 x 10 =5)	
33	*Student to attempt either option A or B.* A. (i) There are three main reasons for conserving the biodiversity which have been classified into the following categories: (Any two reasons) - Narrowly utilitarian arguments. Human beings derive direct economic benefits from nature, like food, firewood, fibre, construction material, industrial products (resins, gums, dyes, tannins, etc.) and medicinally important products. - Broadly utilitarian arguments. Biodiversity plays a major role in maintaining and sustaining supply of goods and services from	5

various species as well as ecological systems. The different ecological services provided are:

- Amazon forest is estimated to contribute 20 per cent of the total oxygen in the atmosphere on earth.
- Pollinators like bee, bumble bees, birds and bats pollinate plants to form fruits and seeds.
- Aesthetic pleasures like bird watching, spring flowers in full bloom, walking through the thick forest, waking up to a bulbul's song, etc. are some other benefits of the ecosystem.

- Ethical reasons there are thousands of plants, animals and microbes on this earth which are not useless. Everyone has some intrinsic value even if it is not of any economic value to us. It is, therefore, our moral duty to ensure well-being of all the living creatures for the utilisation of future generations. (1+1)

(ii) There are four major causes of biodiversity loss. These are also known as 'The Evil Quartet'. (Any two Ways) (1.5 +1.5)

- Habitat loss and fragmentation Destruction of habitat is the primary cause of extinction of species. When large-sized habitats are broken or fragmented due to human settlements, building of roads, digging of canals, etc., the population of animals requiring large territories and some animals with migratory habitats declines.
- Over-exploitation When biological system is over-exploited by man for the natural resources, it results in degradation and extinction of the resources. For example, Stellar's sea cow, passenger pigeon and many marine fishes.
- Alien (exotic) species invasions Some alien (exotic) species when introduced unintentionally or deliberately, become invasive and cause harmful impact, resulting in extinction of the indigenous species. Nile perch, a large predator fish when introduced in Lake Victoria (East Africa) caused the extinction of an ecologically unique species of Cichlid fish in the lake.
- Co-extinctions When a species becomes extinct, the plant and animal species associated with it in an obligatory manner, also become extinct. For example, if the host fish species becomes

extinct, all those parasites exclusively dependent on it, will also become extinct

OR

B.

(i)

S. No.	*In situ* conservation	*Ex situ* conservation
(*i*)	It is conservation and protection of biodiversity in its natural habitat.	It is conservation of selected threatened plant and animal species in places outside their natural habitat.
(*ii*)	Population is conserved in the surroundings where they have developed their distinctive features.	Population is conserved under simulated conditions that closely resemble their natural habitats.
(*iii*)	*e.g.*, national parks, biosphere reserves, wildlife sanctuaries, etc.	*e.g.*, botanical gardens, zoological parks, wildlife safari, gene banks, etc.

(2)

(ii) A stable community should not show too much variation in productivity from year to year; it must be either resistant or resilient to occasional disturbances (natural or man-made), and it must also be resistant to invasions by alien species. (3)

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