

BIOLOGY – Code No. 044
SAMPLE QUESTION PAPER*
CLASS – XII (2025-26)

Maximum Marks: 70

Time: 3 hours

General Instructions:

- (i) All questions are compulsory.
- (ii) The question paper has five sections and 33 questions.
- (iii) 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.
- (iv) There is no overall choice. Answer all 33 questions. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
- (v) Wherever necessary, neat and properly labeled diagrams should be drawn.

Section – A Q. No. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.		
Q. No	Question	Marks
1	The male gametes are formed by: A. Mitotic division of nucleus of vegetative cell B. Meiotic division of nucleus of vegetative cell C. Mitotic division of nucleus of generative cell D. Meiotic division of nucleus of generative cell	1
2	The primary endosperm nucleus is formed by fusion of which of the following? A. A male gamete and a female gamete B. A male gamete and two polar nuclei C. A female gamete and two synergids D. Two male gametes and an egg cell	1
3	During the menstrual cycle of a human female, formation of graafian follicle is stimulated by secretion of which of the following gonadotropin hormones? A. Estrogen and progesterone B. FSH and Estrogen C. FSH and LH D. Progesterone and LH	1

**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*

4	The experimental proof on the thermal stability of genetic material was first provided by experiments of A. Hershey and Chase B. Meselson and Stahl C. Frederick Griffith D. Jacob and Monod	1
5	Short stretches of DNA used to identify complementary sequences in a sample are called A. Probes B. Markers C. Primers D. Minisatellites	1
6	Select the incorrect statement among the following. A. $p^2+2pq+q^2 = 1$. This is binomial expansion of $(p+q)^2$. B. When frequency measured differs from expected values, the difference (direction) indicates the extent of evolutionary change. C. Hardy-Weinberg principle says that phenotype frequencies in a population are stable and are constant from generation to generation. D. The gene pool (total genes and their alleles in a population) remains constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1.	1
7	Albinism is known to be due to an autosomal recessive mutation. The first child of a couple with normal skin pigmentation was an albino. What is the probability that their second child will also be an albino? A. 100% B. 25% C. 50% D. 75%	1
8	"In Cricket species, the sound produced by rubbing the wings or legs together play a crucial role in attracting mates, any change in the morphology of Cricket legs could potentially affect their ability to produce sound". A mutant Cricket had thicker hind legs. What would you expect for this cricket species? A. The leg mutation will not lead to speciation if they diversify into new habitats. B. The leg mutation will have little effect on other external features, and therefore have little effect on speciation. C. The leg mutation will have no effect on behavior, and thus have little effect on speciation. D. The leg mutation might lead to reproductive isolation and speciation due to an effect on the mating call.	1

9	<i>Plasmodium</i> is a pathogen that causes malaria. Identify the correct sequence of transmission of the pathogen. <table><tr><th></th><th>I Stage of pathogen as it is transferred by vector bite</th><th>II First site in the host body where the pathogens infect and proliferates</th><th>III Second site in the host body where the pathogen infects and manifests clinical symptoms</th><th>IV Stage of pathogen as it is transferred to a new vector</th></tr><tr><td>A</td><td>Sporozoites</td><td>Erythrocyte infection</td><td>Liver infection</td><td>Gametocytes</td></tr><tr><td>B</td><td>Gametocytes</td><td>Erythrocyte infection</td><td>Liver infection</td><td>Sporozoites</td></tr><tr><td>C</td><td>Gametocytes</td><td>Liver infection</td><td>Erythrocyte infection</td><td>Sporozoites</td></tr><tr><td>D</td><td>Sporozoites</td><td>Liver infection</td><td>Erythrocyte infection</td><td>Gametocytes</td></tr></table>		I Stage of pathogen as it is transferred by vector bite	II First site in the host body where the pathogens infect and proliferates	III Second site in the host body where the pathogen infects and manifests clinical symptoms	IV Stage of pathogen as it is transferred to a new vector	A	Sporozoites	Erythrocyte infection	Liver infection	Gametocytes	B	Gametocytes	Erythrocyte infection	Liver infection	Sporozoites	C	Gametocytes	Liver infection	Erythrocyte infection	Sporozoites	D	Sporozoites	Liver infection	Erythrocyte infection	Gametocytes	1
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10	Which mRNA will be translated to a polypeptide chain containing 8 amino acids? A. AUGUAAAUAGACGAGUAGCGACGAUGU B. AUGAGACGGACUGCAUUCCCAACCUGA C. AUGCCCAACCGUUAUUCAUGCUAG D. AUGUCGACAGUCUAAAACAGCGGG	1																									
11	In order to isolate genetic material of a bacterium, the cell must be treated with A. Lysozyme, ribonuclease, protease, chilled ethanol B. Cellulase, ribonuclease, protease, chilled ethanol C. Chitinase, ribonuclease, chilled ethanol, water D. Ribonuclease, protease, chilled ethanol, water	1																									
12	Integrated Pest Management involves I. Using pesticides/insecticides judiciously II. Using biocontrol agents III. Engaging in organic farming A. Only I B. Only II C. Both I and II D. Only III	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	Assertion (A): The ability of the pistil to recognise the pollen is the result of a continuous dialogue between pollen and pistil. Reason (R): This electrical dialogue allows only compatible pollen to germinate.	1																									

14	Assertion (A): Some organisms are better adapted to survive in an otherwise hostile environment. Reason (R): Adaptive ability is inherited and has a genetic basis.	1																																
15	Assertion (A): Excess dose of coke or crack produces a sense of euphoria, increased energy and causes hallucinations. Reason(R): It interferes with the transport of dopamine	1																																
16	Assertion (A): Rosie was the first transgenic cow to make more nutritionally balanced milk for consumption by human babies. Reason (R): The milk of Rosie cow contained human beta- lactalbumin which made the milk rich in protein.	1																																
Section - B																																		
17	During artificial hybridisation it is important to ensure that only desired pollen grains are used for pollination. How is it ensured?	2																																
18	How is the rate of initiation of RNA polymerase at a given promoter in a transcriptional unit of prokaryotes regulated ?	2																																
19	The table below shows a hypothetical blood report of a patient. <table><tr><th>Test description</th><th>Observed value</th><th>Unit</th><th>Reference range</th></tr><tr><td><i>Leucocytes</i></td><td></td><td></td><td></td></tr><tr><td>Total leucocyte count</td><td>1100</td><td>Per Microliter</td><td>4400-11000</td></tr><tr><td>Neutrophils</td><td>31</td><td>%</td><td>55-70</td></tr><tr><td>Lymphocytes</td><td>25</td><td>%</td><td>20-40</td></tr><tr><td>Basophils</td><td>0.5</td><td>%</td><td>0.5 - 1</td></tr><tr><td>Eosinophils</td><td>02</td><td>%</td><td>1-4</td></tr><tr><td>Monocytes</td><td>0</td><td>%</td><td>1-8</td></tr></table> A. Looking at the values suggest which defense mechanism/ immunity is affected and state how this defense mechanism provides immunity. B. Name the barrier with least count and enumerate its role in providing immunity.	Test description	Observed value	Unit	Reference range	<i>Leucocytes</i>				Total leucocyte count	1100	Per Microliter	4400-11000	Neutrophils	31	%	55-70	Lymphocytes	25	%	20-40	Basophils	0.5	%	0.5 - 1	Eosinophils	02	%	1-4	Monocytes	0	%	1-8	2
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20	A cheese maker claims to be a biotechnologist. How will you support the same?	2																																
21	<u>Attempt either option A or B.</u> A. (i) Compare the two ecological pyramids of biomass I and II given below and explain the situations in which this is possible.	2																																

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Trophic level

Dry weight (kg m⁻²)

TC

1.5

SC

11

PC

37

PP

809

Fig. I

PC

21

PP

4

Fig. II

- (ii) Construct an ideal pyramid of energy if 200,000 joules of sunlight are available.

For Visually impaired students:

A.

- (i) Compare the upright and inverted ecological pyramids of biomass and explain the situations in which this is possible.
(ii) Construct an ideal pyramid of energy if 200,000 joules of sunlight is available.

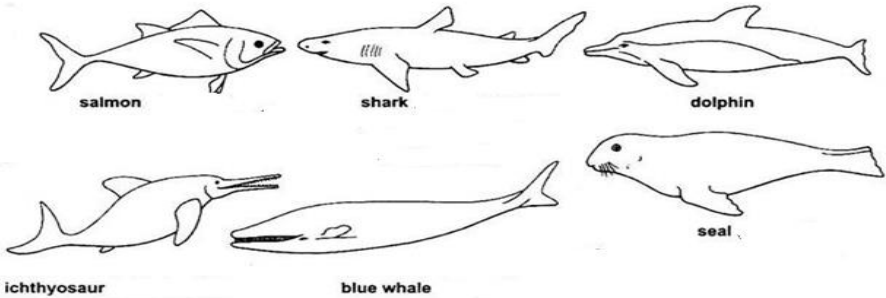
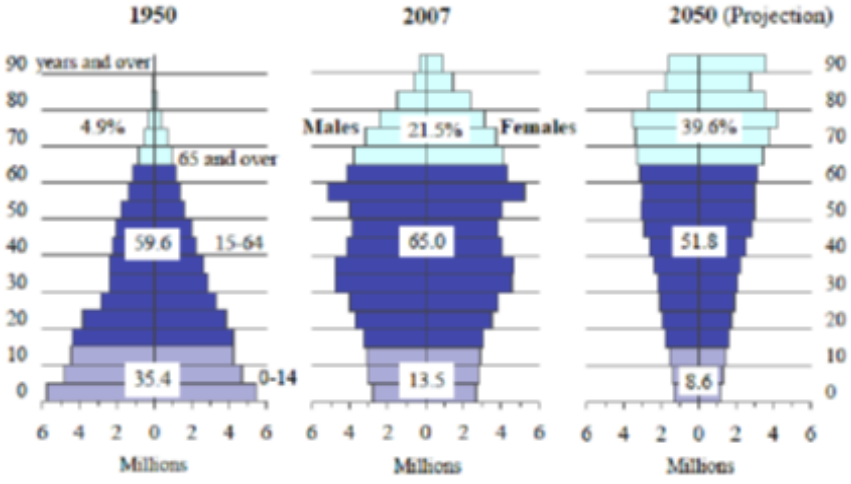
OR

B. A tropical rainforest in South America is home to more than 40,000 species of plants, 3,000 of fishes, 1,300 of birds, 427 of mammals, 427 of amphibians, 378 of reptiles and 1,25,000 insects, snails and worms.

- (i) From the given data, calculate the total number of known vertebrate species in the rainforest.
(ii) Give a reason to justify the huge difference in the number of plant and animal species.

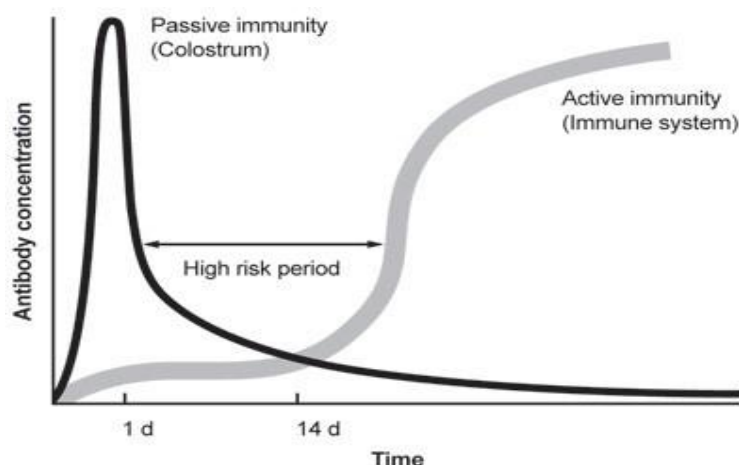
Section - C		
22	Suggest a suitable contraceptive device for the following cases with justification. (i) Mohini does not want to take the risk of conception and sexually transmitted infections (STIs). (ii) Lalita has two children and does not want any more children. (iii) Geeta wants a contraceptive that she can take till she wants to avoid conception and can resume back to her fertile life without the intervention of the doctor. Also, it should have a lower failure rate.	3
23	Given below is a figure showing transport of ovum, fertilisation and passage of growing embryo through fallopian tube in a human female. Answer the questions that follow: (i) What will be the ploidy of cells shown in (a) and (c) stage in the figure given below? (ii) What will happen if component L as shown in the figure (g) given below does not attach properly to the endometrium? (iii) In a pregnant mother (case X), during early pregnancy, the fertilised egg splits into two embryos at stage C shown in the figure given below, resulting in the formation of twins. Will the genome of cells of these two embryos exhibit variation? Justify your answer. ----- <u>For Visually impaired students</u> Explain the events and journey of an ovum in the fallopian tube of a mother from fertilisation stage to implantation.	3
24	In guinea pigs, black coat colour (G) dominates over white (g) and brown eyes (B) dominate over blue (b). The alleles for coat colour and eye colour are not linked. What will be the probability of the offspring having blue eyes and a white coat if both parents are heterozygous for eye and coat colour? Find the probability using a Punnett square	3

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25	Shown below are certain aquatic vertebrates, where natural selection has favoured them to develop certain characteristics which enable them to live in water.  salmon shark dolphin ichthyosaur blue whale seal A. Name and explain the phenomenon exhibited by the above animals. B. Which one of the above is the most primitive one? What is its significance? ----- <u>For Visually impaired students</u> A. What are the basic conceptual similarities and differences between Lamarckian and Darwinian theory of evolution? B. Give an example that supports any one of the above two theories.	3
26	The Biological Oxygen Demand (BOD) of a primary effluent during sewage treatment is reduced. Enlist the process of how this is achieved.	3
27	<u>Attempt either option A or B.</u> A. Expand ELISA. On what principle is the ELISA test based? List two ways by which an infection can be detected by this test. OR B. Gene expression can be controlled with the help of complementary RNA molecules. Justify it with the help of an example.	3
28	The population pyramids of Japan for 1950, 2007 and 2050 (projections) are shown below to answer the questions that follow:  1950 2007 2050 (Projection) 90 years and over 90 80 80 70 70 60 60 50 50 40 40 30 30 20 20 10 10 0 0 6 4 2 0 2 4 6 6 4 2 0 2 4 6 6 4 2 0 2 4 6 Millions Millions Millions 4.9% 21.5% 39.6% 65 and over Males Females 59.6 65.0 51.8 15-64 13.5 8.6 0-14	3

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	C. Identify the age pyramids for 1950, 2007 and 2050. D. What insights can you gain about their population dynamics? ----- <u>For visually impaired students</u> The population pyramid of Japan for 1950, 2007 and 2050 (projections) shows the shape of a pyramid, broad-based, inverted bell and urn shape, respectively. Answer the questions that follow: A. Identify the age pyramids for 1950, 2007 and 2050. B. What insights can you gain about their population dynamics?											
Section - D												
29	Given below is a set of information about some fruits and seeds. <table border="1"><thead><tr><th>Fruit</th><th>Fruit and seed formation</th></tr></thead><tbody><tr><td>P</td><td>Nucellar cells surrounding the embryo sac develop into embryos.</td></tr><tr><td>Q</td><td>Ovary develops into the fruit by the application of growth hormones.</td></tr><tr><td>R</td><td>Thalamus contributes to fruit formation.</td></tr><tr><td>S</td><td>Ovary matures into a fruit after fertilisation.</td></tr></tbody></table> On the basis of the information provided above, answer the following questions with justification for each answer. A. How many embryo sacs will be present in each ovule of S before maturation and how many egg(s) will be present in each embryo sac when the embryo sac is developed from a single megaspore? (1) B. (i) Which of these fruits exhibits polyembryony? Will their embryos exhibit genetic variation? Justify. (ii) What will be ploidy of the embryonic cells in the above case? (2) <u>Attempt either subpart C or D.</u> C. Which of these fruits can be considered as parthenocarpic? Give a reason. (1) OR D. Which of the fruits P, Q, R or S is a true fruit with seeds? Give reason. (1)	Fruit	Fruit and seed formation	P	Nucellar cells surrounding the embryo sac develop into embryos.	Q	Ovary develops into the fruit by the application of growth hormones.	R	Thalamus contributes to fruit formation.	S	Ovary matures into a fruit after fertilisation.	4
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Q	Ovary develops into the fruit by the application of growth hormones.											
R	Thalamus contributes to fruit formation.											
S	Ovary matures into a fruit after fertilisation.											
30	The graph below shows the Antibody concentration in young calves. Study the graph and answer the questions that follow:	4										



- A. What do you think is the difference between passive and active immunity in this case? (1)
- B. What happens to passive immunity as days go by and why? (1)

Attempt either subpart C or D.

- C. What kind of trend does active immunity show and why?
OR
- D. What kind of immunity will be observed when a vaccine is administered to the calf and why? (2)

For visually impaired students

The antibody concentration in a young calf was studied. It was found that the antibodies derived from colostrum (passive immunity) decreased from day 1 to 14, while the antibodies derived from immune cells (active immunity) increased between day 1 to day 14 and remained steady thereafter.

- A. What do you think is the difference between passive and active immunity in this case?
- B. What happens to passive immunity as days go by and why?

Attempt either subpart C or D.

- C. What kind of trend does active immunity show and why?
OR
- D. What kind of immunity will be observed when a vaccine is administered to the calf and why?

Section - E

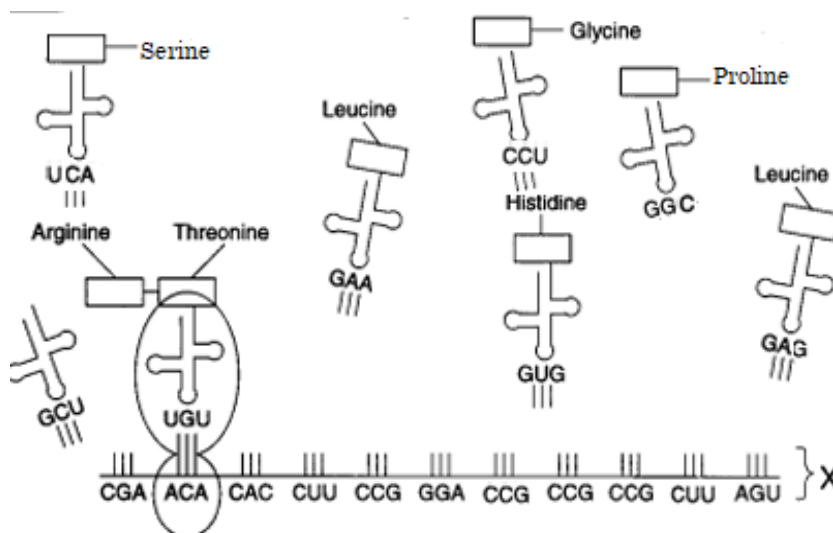
- | | | |
|----|--|---|
| 31 | <p>A. Construct a complete transcription unit with promoter and terminator on the basis of the hypothetical template strand given below.</p> <p style="text-align: center;"> A T G C A T G C A T A C
 ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑
 ←—————→ </p> <p>B. How is transcription a more complex process in eukaryotic cells? Explain the additional processes that a precursor mRNA has to undergo in these organisms.</p> | 5 |
|----|--|---|

For visually impaired students

- A. Why are both the strands not copied during transcription?
 B. How is transcription a more complex process in eukaryotic cells?
 Explain the additional processes that a precursor mRNA has to undergo in these organisms.

OR

- A. Explain the process of aminoacylation of tRNA. Mention its role in translation.
 B. How do ribosomes in the cells act as factories for protein synthesis?
 C. Given below is a strand of mRNA undergoing the process of translation, what will be the sequence of Amino acids that will be translated? Name the triplet codons that should be added to bring to the end of translation at X.



For visually impaired students

- C. Explain the phenomenon that forms the genetic basis to prove that codon is a triplet and it is read in a contiguous manner.

- | | | |
|----|--|---|
| 32 | <p>Some plant and animal pathogens serve as one of the tools of recombinant DNA (rDNA) technology.'</p> <p>A. Name one animal and one plant pathogen and discuss the pathogenic nature of both. State how they serve as a tool in rDNA technology.</p> <p>B. What are the enzymes needed for rDNA technology?</p> <p>C. A farmer owns a cotton farm land which is getting infested with coleopteran pests. He is not willing to use the microbes to protect his farm.</p> <p>i. Name an alternate method to introduce the gene of interest the pathogen would have otherwise delivered and discuss how the alternate method would deliver the gene.</p> <p>ii. State how this gene would control the pest.</p> | 5 |
|----|--|---|

	OR BamH1 is a restriction enzyme which recognizes the sequence- 5' - GGATCC - 3'. The restriction activity of this enzyme is between G and G. A. Construct the palindrome for the above sequence. B. Draw a labeled diagram to show the formation of recombinant DNA (rDNA) using BamH1. C. PBR322 is a plasmid that has a restriction site for this enzyme at the tetracycline resistant gene. If BamH1 were to be used, how will it impact the response of the transformant with rDNA to antibiotics- ampicillin and tetracycline. Justify.													
33	Justify the following statements with suitable proof/examples: - A. 'competition is not limited to closely related species' B. 'competition is not always dependent on resources being limiting' C. 'competitive exclusion occurs in nature' D. 'competing species may evolve mechanisms for co-existence' E. 'competition in nature comes from what is called 'competitive release'' OR A. How does a simple food chain exemplify the First Law of Thermodynamics? B. The table below shows the number of species in different parts of the world. <table border="1"><thead><tr><th>Name of Place</th><th>Number of Bird species</th></tr></thead><tbody><tr><td>Columbia</td><td>1400</td></tr><tr><td>India</td><td>1200</td></tr><tr><td>Northern South America</td><td>1300</td></tr><tr><td>New York</td><td>105</td></tr><tr><td>Denmark</td><td>504</td></tr></tbody></table> Identify the common factor in regions with a higher number of bird species and suggest at least two reasons for this greater diversity.	Name of Place	Number of Bird species	Columbia	1400	India	1200	Northern South America	1300	New York	105	Denmark	504	5
Name of Place	Number of Bird species													
Columbia	1400													
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BIOLOGY Code no. 044
MARKING SCHEME
CLASS – XII (2025–26)

Q. No.	Answer	Marks
Section - A		
1	C. Mitotic division of nucleus of generative cell	1
2	B. A male gamete and two polar nuclei	1
3	C. FSH and LH	1
4	C. Frederick Griffith	1
5	A. Probes	1
6	C. Hardy-Weinberg principle says that phenotype frequencies in a population are stable and are constant from generation to generation.	1
7	B. 25%	1
8	D. The leg mutation might lead to reproductive isolation and speciation due to an effect on the mating call.	1
9	D. Sporozoites, Liver infection, Erythrocyte infection, Gametocytes	1
10	B AUGAGACGGACUGCAUUCCCAACCUGA	1
11	A. Lysozyme, ribonuclease, protease, chilled ethanol	1
12	C. Both I and II	1
13	C. A is true but R is false	1
14	A. Both A and R are true and R is the correct explanation of A	1
15	A. Both A and R are true and R is the correct explanation of A	1
16	C. A is true but R is false	1
Section - B		
17	It is achieved by emasculation and bagging techniques. If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary. This step is referred to as emasculation. Emasculated flowers have to be covered with a bag of suitable size, generally made up of butter paper, to prevent contamination of its stigma with unwanted pollen. This process is called bagging. (1 x 2 = 2)	2
18	In a transcription unit, the activity of RNA polymerase at a given promoter is regulated by accessory proteins that have an ability to recognise start sites. (1) These regulatory proteins can act both positively (activators) and negatively	2

	(repressors) with the operator which is adjacent to the promoter in an operon unit. (1)	
19	A. Innate immunity/ non-specific type of defense/immunity present at the time of birth is effected. It provides different types of barriers to the entry of the foreign agents into our body/destroys microbes/ prevents microbial growth. (1) B. Cellular barrier-monocytes is with least count and it can phagocytose and destroy microbes. (1)	2
20	Anyone who can use/modify any living organism or their products using technology is considered to be a biotechnologist. (1) Thus, cheese maker can be a biotechnologist as he uses microbes like bacteria, fungi to make cheese for commercial purpose. (1)	2
21	A. (i) The first (upright) pyramid of biomass corresponds to a terrestrial ecosystem. Producers have maximum biomass, decreasing with herbivores (primary consumer), secondary consumer and tertiary consumer. Second (inverted) pyramid refers to a small standing crop of phytoplankton supporting a large standing crop of zooplankton/aquatic ecosystem. (1) (ii) Tertiary Consumer (2J) Secondary Consumer (20J) Primary Consumer (200J) Producer (2000J) 200,000J of sunlight (1) ----- <u>For Visually impaired students</u> (Answer same as (i) and (ii) above) OR B. (i) $3000+1300+427+427+378= 5532$ (1) (ii) (a) Animals are mobile and can migrate to escape harsh conditions or explore new areas. (b) Animals have adapted to changing environments, developing complex nervous systems and receptors. Their responses are adaptive and ensure survival. Iii. Plants, being fixed, have fewer evolutionary adaptations for water, minerals, and sunlight. (Anyone, 1)	2
Section – C		
22	(i) Condoms; these act by blocking the entry of microbes and sperms in the cervix.	3

	(ii) Surgical methods such as Tubectomy by her or vasectomy by her husband as these are highly effective but irreversible methods. (iii) Oral pills containing progestogens or progestogen – estrogen combination are very effective and can be repeated as long as the female derives to prevent conception. (1 x 3 =3)	
23	(i) (a) ovum is haploid (n) and (c) – blastomeres are diploid(2n). (ii) If the trophoblast (L) does not attach to the endometrium properly, it can lead to implantation failure, pregnancy loss, and other pregnancy complications. (iii) In case X, the cells of these embryos will have identical genome as they have developed from the same zygote. (1 x 3 =3) ----- <u>For Visually impaired students</u> - The mitotic division called cleavage starts as the zygote moves through the isthmus of the oviduct towards the uterus and forms 2,4,8,16 daughter cells called blastomeres. The embryo with 8 to 16 cell blastomeres is called a morula. (1) - The morula transforms into blastocyst and the blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called the inner cell mass. (1) - The trophoblast layer then gets attached to the endometrium of the uterus and the inner cell mass gets differentiated as the embryo. After attachment, the uterine cells divide rapidly and cover the blastocyst which gets embedded in the endometrium leading to implantation. (1)	3
24	BbGg Male is crossed with BbGg female which are both heterozygous of both the characters for eye and coat colour. (1) Punnett square (1) 1/16 or 6.25 % - blue eyes and white coat (1)	3
25	A. These animals exhibit convergent evolution, structures that are not anatomically similar are evolved to perform similar functions adapted to the same habitat, the fins of Salmon and Shark, flippers of Dolphins, Seals and whales. One can say that it is the similar habitat that has resulted in selection of similar adaptive features in different groups of organisms but toward the same function: hence, analogous structures are a result of convergent evolution. (2)	3

	B. Ichthyosaurs. Some of the land reptiles went back into water to evolve into fish like reptiles probably 200 mya. (1) ----- <u>For Visually impaired students</u> A. Both Lamarck and Darwin believed that living things had hereditary traits, traits they could pass on to their offspring. They believed that some traits were more useful than others, and that over time the more useful trait would become more common. (1) The difference is that Lamarck believed that the changes in an organism experienced during its life could be passed on to succeeding generations/Inheritance of acquired characters. So, for instance Giraffe stretched its neck its entire life to eat leaves on tall plants, it would have longer-necked offspring (or any other example of Lamarckian theory). (1) Darwin believed that small, random and gradual genetic variations followed by natural selection lead to evolution- that some giraffes just naturally had longer necks, and these were the ones who had more children. So over time natural selection led to evolution of Giraffes with long neck were fitter than short-necked. (1)	
26	'Flocs' and 'activated sludge' in sewage treatment help to reduce the BOD. (i) Flocs: These are masses of bacteria held together by slime and fungal filaments to form mesh-like structures. These are used during the secondary sewage treatment in the aeration tank to increase the rate of decomposition. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As a result, the BOD of sewage is reduced. As the BOD of waste is reduced to 1% of raw sewage. it is passed into the settling tank. In these tanks, flocs are allowed to undergo sedimentation. (ii) Activated sludge: The sediment of the settling tank is called activated sludge. A part of it is used as an inoculum in aeration tanks. The remaining part is passed into a large tank called an anaerobic sludge digester. In these tanks, anaerobic microbes are present that digest the organic mass as well as aerobic microbes of activated sludge. The remaining sludge is used as manure or compost.	3
27	ELISA-Enzyme Linked Immunosorbent Assay. (1) ELISA is based on antigen-antibody interaction. (1) The ways to detect the presence of infection or disease by ELISA are as follows: The presence of antigens (proteins, glycoproteins, etc.) is detected. / Antibodies produced against the pathogens are detected. (1) OR The technology is called RNA Interference(RNAi) The principle is to block certain genes through a process called gene silencing (1) It involves silencing of a specific mRNA due to its complementary Double-stranded RNA /dsRNA molecule that binds to and prevents translation of the	3

	mRNA(silencing). (1) Example: Resistance to nematode (<i>Meloidogyne incognita</i>) in tobacco is achieved by this (or ANY OTHER RELEVANT EXAMPLE.) (1)	
28	1950 – Expanding - The population structure in 1950 exhibits a broad-based pyramid with a wider base, indicating a higher percentage of young individuals. This suggests a population with a higher birth rate. (1) 2007 – Stable - The narrowing of the pyramid towards the top signifies a lower proportion of elderly individuals. By 2007, the population was more stable with the number of pre reproductive and reproductive age nearly being the same. Bell shape indicates static population. (1) 2050– Declining - By 2050 urn shaped pyramid shows a declining population where birth rates are very less and the populations of elderly people will increase. (1) ----- <u>For Visually impaired students</u> Answer same as above	3
Section – D		
29	A. One embryo sac is present in each ovule and one egg is present in each embryo sac when the embryo sac is developed from a single megaspore. (1) B. (i) P exhibits polyembryony due to occurrence of more than one embryo in a seed. Embryos developed from nucellar cells by apomixis, a form of asexual reproduction, don't show genetic variation. (1) (ii) Cells of embryos developed from diploid nucellar cells are diploid (2n) as these are formed by apomixis, a form of asexual reproduction. (1) <u>Student to attempt either subpart C or D.</u> C. Q, because this fruit is developed without fertilisation and will thus be seedless. (1) OR D. Fruit S is a true fruit with seeds. True fruits develop from the ripened ovary after fertilisation and fertilised ovules mature into seeds. (1)	4
30	A. Passive immunity – Ready made antibodies from colostrum / less effective / transient / no memory cells involved Active Immunity – Made by host's immune system/ Lag phase/ memory based/ largely effective. (1) B. In the first weeks of life, the calf's immunity is strong because it absorbs antibodies from the cow's colostrum and milk. This passive immunity peaks at day 1 and declines as the calf ages as the antibodies are used up to develop immunity against diseases. (1) <u>Attempt either subpart C or D.</u> C. As the calf grows, its immune system starts to produce antibodies in response to bacteria or viruses in the environment and by the time it is nearly 14 days old after which active immunity takes charge. OR	4

D. Active immunity. As the vaccine contains a weakened or inactivated form of the pathogen (microbe), which is harmless but still recognized by the immune system as foreign. The immune system responds by activating lymphocytes, which produce specific antibodies to fight the pathogen. This process also leads to the creation of memory cells, which provide long-term protection by "remembering" to fight this pathogen if the person is exposed again. (2)

For Visually impaired students

Same answers as given in parts a-d.

Section – E

31

A.



B.

(2)

- Transcription in eukaryotes involves one of three types of polymerases, depending on the gene being transcribed. RNA polymerase II transcribes all of the protein-coding genes, whereas RNA polymerase I transcribes rRNA genes, and RNA polymerase III transcribes rRNA, tRNA, and small nuclear RNA genes. (1)
- The primary transcripts contains the coding region, exon, and non-coding region, intron, hnRNA undergoes a process where the introns are removed and exons are joined to form mRNA by the process called splicing. (1)
- The hnRNA undergoes two additional processes called capping and tailing. In capping, an unusual nucleotide, methyl guanosine triphosphate, is added to the 5'-end of hnRNA. In tailing, adenylate residues (about 200–300) are added at 3'-end in a template independent manner. (1)

For visually impaired students

A. If both strands act as a template, they will code for RNA molecules with different sequences as complementarity does not mean the strands are identical and hence, the sequence of amino acids in the proteins would be different. Hence, one segment of the DNA would be coding for two different proteins, and this would complicate the genetic information transfer machinery. (1)

The two RNA molecules if produced simultaneously would be complementary to each other, hence would form a double stranded RNA. This would prevent RNA from being translated into protein and the exercise of transcription would become a futile one. (1)

B. Transcription in eukaryotes involves one of three types of polymerases, depending on the gene being transcribed. RNA polymerase II transcribes

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all of the protein-coding genes, whereas RNA polymerase I transcribes rRNA genes, and RNA polymerase III transcribes rRNA, tRNA, and small nuclear RNA genes. (1)

The primary transcripts contain the coding region, exon, and non-coding region, intron, hnRNA undergoes a process where the introns are removed and exons are joined to form mRNA by the process called splicing. (1)

The hnRNA undergoes two additional processes called capping and tailing. In capping, an unusual nucleotide, methyl guanosine triphosphate, is added to the 5'-end of hnRNA. In tailing, adenylate residues (about 200–300) are added at 3'-end in a template independent manner. (1)

OR

A. Aminoacylation is the process by which amino acids become activated by binding with its aminoacyl tRNA synthetase in the presence of ATP. If two charged tRNAs come close during translation process the formation of peptide bond between them is energetically favourable. (1)

B. The cellular factory responsible for synthesising proteins is the ribosome. In its inactive state it exists as two subunits: a large subunit and a small subunit. When the small subunit encounters an mRNA the process of translation of the mRNA to protein begins. There are two sites in the large subunit for subsequent amino acids to bind to and thus be close enough to each other for the formation of a peptide bond. The ribosome also acts as a catalyst 23S rRNA in bacteria is the enzyme-ribozyme for the formation of peptide bonds. (2)

C. ARGININE, THREONINE, HISTIDINE, LEUCINE, PROLINE, GLYCINE, PROLINE PROLINE, PROLINE, LEUCINE SERINE (1)
Stop codon UGA/UAG/UAA (1)

For visually impaired students

A and B as above

C. Insertion or deletion of one or two bases changes the reading frame from the point of insertion or deletion. Such mutations are referred to as frame-shift mutations. Insertion or deletion of three or multiple of three bases does not alter the frame. However, the mutation takes place. This proves that codon is a triplet and it is read in a contiguous manner. (2)

32

A. Retrovirus in animals and *Agrobacterium tumefaciens* can transform normal cells into cancerous cells/*Agrobacterium tumefaciens* is responsible for causing crown gall disease/ it can transfer its T-DNA to transform normal plant cell into tumorous cells (1). They are used as cloning vectors to deliver desirable genes into animal/plant cells. (1)

B. restriction enzyme and ligase. (1).

C.
(i) Biolistic/ gene guns can be used. The plant cells are bombarded with high velocity micro particles of gold or tungsten coated with DNA. (1)
(ii) the cry gene will create Bt toxin inside the pest which will get activated in the alkaline gut of the pest and cause the gut epithelial lining to disintegrate. (1)

5

OR

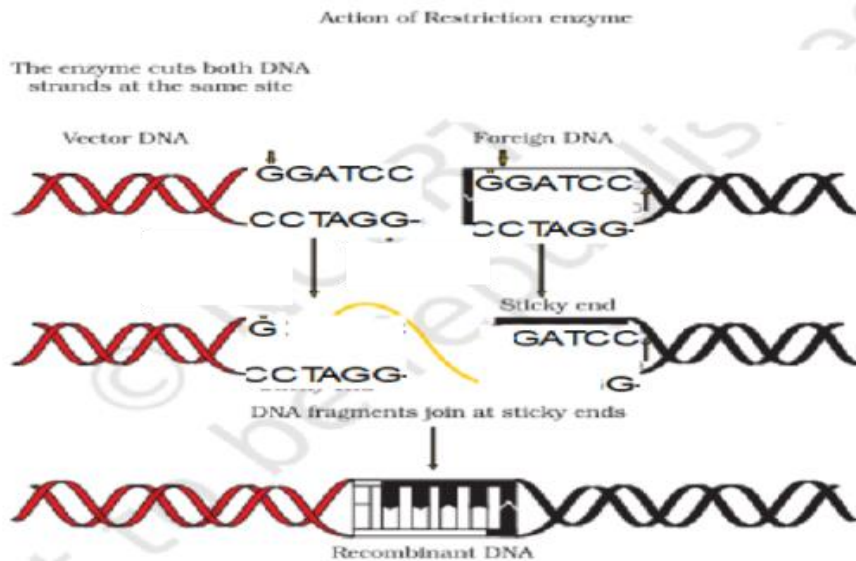
A. 5' - GGATCC - 3'.

3' - CCTAGG-5'

(1)

B. drawing and labelling

(2)



C. If ampicillin is added, the bacteria will show resistance as the gene is intact and will survive;
if tetracycline is added, the bacteria will die as it will show insertional inactivation/ gene is not functional owing to insertion of the gene of interest in the tetracycline region of selectable marker. (2)

33

- A. Totally unrelated species could also compete for the same resource. For instance, in some shallow South American lakes, visiting flamingoes and resident fishes compete for their common food, the zooplankton in the lake. (1)
- B. Resources need not be limiting for competition to occur; in interference competition, the feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species, even if resources (food and space) are abundant. (1)
- C. Gause and other experimental ecologists believed when resources are limited the competitively superior species will eventually eliminate the other species. The Abingdon tortoise in Galapagos Islands became extinct within a decade after goats were introduced on the island, apparently due to the greater browsing efficiency of the goats. (1)
- D. One such mechanism is 'resource partitioning'. If two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or 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. (1)
- E. A species whose distribution is limited to a smaller area because of the presence of a competitively superior organism, is found to increase its range when the competing species is experimentally removed. For example, in the coasts of Scotland the superior barnacle (*Balanus*)

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dominates the intertidal region and excludes the smaller barnacle from that zone. (1)

OR

A. Food chain and the first law of thermodynamics. The solar energy trapped by the plants is transformed to chemical energy through the process of photosynthesis. When the plants are consumed by the animals, the organic matter (chemical energy) is transferred to the animal, some amount of this organic matter is lost as heat through the process of respiration. Death of the producers or consumers will result in the organic matter getting transferred to detritivores. As demonstrated, energy is not created nor destroyed but transformed from one form to another. (2)

B. Greater diversity is seen in regions closer to equator/ tropics (latitudinal range of 23.5° N to 23.5° S) harbour more species. (1)

Reasons for this greater diversity are: (Any two reason)

- Speciation is generally a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification
- Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity
- There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity. (2, any two)
