BIOLOGY

PAPER 1

(THEORY)

Maximum Marks: 70
Time Allotted: Three Hours
Reading Time: Additional Fifteen Minutes

Instructions to Candidates

- You are allowed **additional fifteen minutes** for **only** reading the question paper.
- You must **NOT** start writing during reading time.
- This question paper has **11 printed pages**. It has **18 questions** in all.
- Answer ***all*** questions.
- There are **four** sections in the paper: **A, B, C** and **D**. **Internal choices** have been provided in **one question** each in **Sections B, C** and **D**.
- **Section A** consists of ***one question*** each carrying ***one / two mark(s).***
- **Section B** consists of ***seven questions*** each carrying ***two marks***.
- **Section C** consists of ***seven questions*** each carrying ***three marks***.
- **Section D** consists of ***three questions*** each carrying ***five marks***.
- **Diagrams should be drawn** wherever necessary using a **pencil** only.
- The intended marks for questions are given in brackets [ ].

Instruction to Supervising Examiner

- Kindly read **aloud** the Instructions given above to all the candidates present in the examination hall.

SECTION A – 20 MARKS

Question 1

Answer the following questions briefly.

(i) Sapna has been diagnosed with an infection of the reproductive tract caused by bacteria. She experiences burning sensation during urination, pain around her genitalia and observes pus containing discharge. Her doctor tells her that this infection has an incubation period of two to five days but can be cured. **[1]**

What is the biological name of the causative agent of the disease Sapna is suffering from? **(Recall)**

(ii) The number of chromosomes in the leaf cells of a male plant is 40 and in the stem cells of a female plant is 60. If they are artificially hybridised, what will be the number of chromosomes in the endosperm? **[1]** **(Application)**

(iii) How many cycles of PCR are required to produce 250 molecules of DNA, starting with a single parental strand? **[1]** **(Application)**

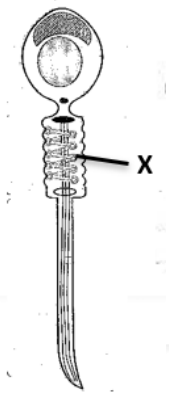
(iv) Which is the most commonly prescribed non-steroidal oral contraceptive pill in India? **[1]** **(Recall)**

(v) Tall pea plants having green pods were crossed with dwarf pea plants having yellow pods. Out of 80 plants, how many are likely to be tall plants in the F_2 generation? **[1]** **(Application)**

(vi) Write a 6-nucleotide long palindromic sequence on a double stranded DNA, which was reverse transcribed by the following nucleotide sequence on a retroviral RNA. **[1]** **(Create)**

3'-GUA- - - 5'

(vii) In the given figure of mammalian spermatozoon, "X" is an organelle. Identify the organelle. **[1]** **(Recall)**



(viii) Observe the relation between the first two words and then fill in the fourth word. **[1]**

Histamine: Mast cells :: Antibody: _____ **(Analysis)**

(ix) Which of the following sequences of mRNA will **NOT** translate completely? **[1]**
(Recall)

(a) 5' - AUG UUC AGC UCG UGA - 3'

(b) 5'- AUG AAC UAA CCA CUC - 3'

(c) 5' - AUG UUA CUC GCG UAA - 3'

(d) 5' - AUG CCA UAC GAC UAG - 3'

(x) Which one of the following choices reflects the correct number of chromosomes in the zygote and in the second polar body of *Drosophila melanogaster?* **[1]**

	Zygote	**Meiocytes**
I	08	08
II	04	08
III	08	04
IV	04	04

(a) I

(b) II

(c) III

(d) IV

(xi) Given below are two statements marked Assertion and Reason. Read both the statements carefully and choose the correct option. **[1]**
(Analysis)

Assertion: Earthworm is called a detritivore.

Reason: It breaks down the water-soluble inorganic nutrients, which percolate down into the soil.

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Assertion is true and Reason is false.

(d) Both Assertion and Reason are false.

(xii) Given below are two statements marked Assertion and Reason. Read both the statements carefully and choose the correct option. **(Analysis)** **[1]**

Assertion: *E. coli* was transformed by inserting the foreign DNA by using PvuI in pBR322.

Reason: It was done to make the transformed cells survive in the culture medium containing ampicillin.

(a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.

(c) Assertion is true and Reason is false.

(d) Both Assertion and Reason are false.

(xiii) What is the advantage of growing apomictic seeds in crop improvement? **(Understanding)** **[1]**

(xiv) A farmer has two fields in which he wants to grow a cereal crop and a legume. He cannot afford to spend a lot of money on chemical fertilisers to increase the fertility of the soil. **[1]**

Suggest a way to help him resolve the issue. **(Application)**

(xv) Answer the following questions. **[2]**

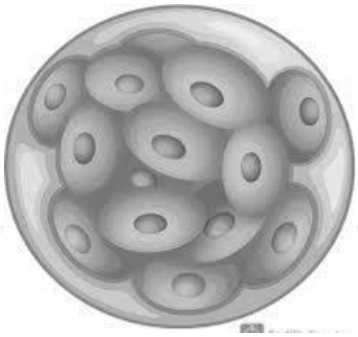
(a) Expand the abbreviation MALT. **(Recall)**

(b) David is a molecular biologist. He uses a technique to know the amino acids occupy the first and the last positions in the Chain – A and Chain – B of insulin. Name the scientist whose contribution made it possible for David to use this technique. **(Recall)**

(xvi) In a flower, the megaspore mother cell formed four megaspores without undergoing meiosis. One of the four megaspores developed into the embryo sac. What would be the ploidy level of the antipodal cells in this embryo sac? **[1]**

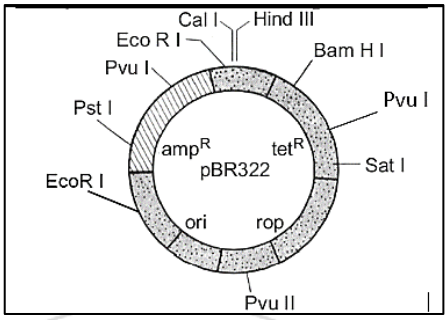
(Understanding)

(xvii) The diagram given below represents a specific stage of human embryonic development. Identify the stage. **(Recall)** **[1]**



(xviii) Give a reason for each of the following. **(Analysis)** **[2]**

(a) The diagram given below represents vector pBr322 which was modified by a research scholar Dr. Rayon, but the vector was rejected by his guide.

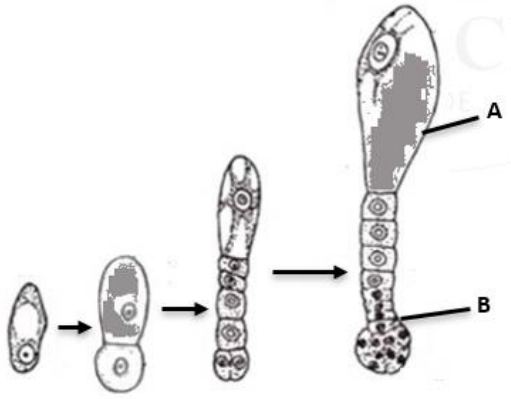


(b) The continuous inbreeding of crops may lead to reduced fertility and productivity. However, the self-pollinated crops do not show the ill-effects of inbreeding.

SECTION B – 14 MARKS

Question 2 **[2]**

(i) During embryogenesis in dicots, the zygote divides into a basal cell and a terminal cell. The basal cell divides repeatedly to produce a structure called suspensor. Carefully observe the image given below and describe the function of cell – A and cell – B of the suspensor. **(Understanding)**



OR

(ii) Given below are the features of Seed A and Seed B. Study them carefully and answer the question that follows.

SEED A	Papery endosperm, swollen cotyledon, perisperm develops from nucellus, suspensor / haustoria substitute endosperm
SEED B	Swollen endosperm, papery cotyledons or absent, perisperm does not develop from nucellus, suspensor /haustoria do not substitute endosperm.

Identify the type of Seed A and Seed B. Cite *one* example of each of Seed A and Seed B. **(Understanding)**

Question 3 **[2]**

Name the pollinating agent of a flowering plant with large and coloured flowers with sticky stigma. State *one* characteristic feature of the pollen grains produced in such flowers. **(Understanding)**

Question 4 **[2]**

Read the passage given below carefully and answer the questions that follow.

The bacterium *Bacillus thuringiensis serovar israelensis* (*Bti*) is commercially prepared in various formulations such as liquid, water dispersible granules, powders, and pellets. It is used as a larvicide all over the world due to its ability to produce a toxic protein that primarily targets the larvae of mosquitoes.

In Sweden, *Bti* has been applied on a large scale in the form of commercially available granular formulation Vecto Bac G (Valent BioScience, USA). The applications have taken place in the lower Dalalven River Area to control mass outbreaks of the floodplain mosquito *Aedes sticticus*.

(Source: Environmental Evidence Journal, page 26, November 2023)

(i) Why does the toxic protein kill the insects but not the bacterium? **(Understanding)**

(ii) Can the formulation Vecto Bac G be used to eliminate the species of mosquito referred to above? Why? **(Evaluate)**

Question 5 **[2]**

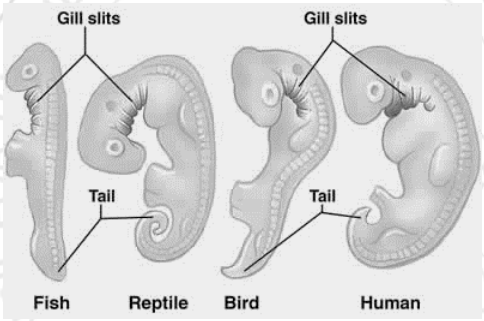
What happens to an inferior competitor if:

(i) a superior competitor is present in the same environment? **(Understanding)**

(ii) the superior competitor is removed from the environment? **(Understanding)**

Question 6 **[2]**

The diagram given below shows the early embryonic stages of fish, reptiles, birds and humans. Though adult reptiles, birds and mammals breathe air, their embryos possess gills. How does this fact support evolution? **(Understanding)**



Question 7 **[2]**

Name the technique used to detect the presence of HIV in the body of an individual, Justify the principle associated with this technique. **(Evaluate)**

Question 8 **[2]**

Name *any two* factors responsible for the loss of biodiversity in a geographical region. **(Recall)**

SECTION C – 21 MARKS

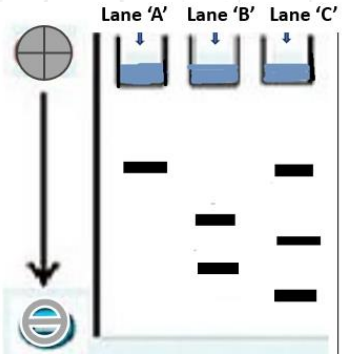
Question 9 **[3]**

(i) What are ZIFT and GIFT? **(Recall)**

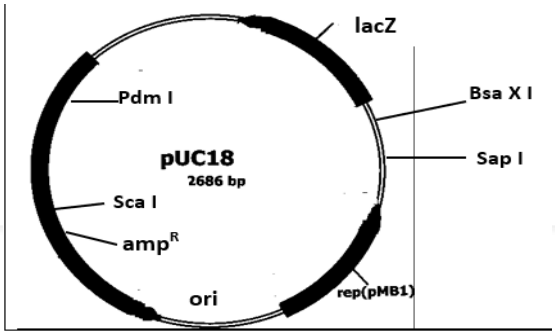
(ii) All STDs do not affect the genital organs. Justify the statement. **(Evaluate)**

Question 10 **[3]**

(i) The DNA molecules of the same size were extracted from *E. coli* and *Plasmodium vivax*. It was discovered that both the DNA molecules had one target site each for the restriction enzyme Hind II. After being digested with Hind II, the DNA fragments were subjected to gel electrophoresis.
With reference to the diagram given below, identify the lanes that represent the DNA fragments of *E. coli* and *Plasmodium vivax* respectively. Justify your answer with a reason for each. **(Evaluate)**



(ii) The diagram given below represents the image of the cloning vector pUC 18. The gene of interest is inserted and ligated within the gene *lacZ*. The recombinant DNA is introduced in the host bacterial cell. Explain the method that would help in selection of recombinant colonies from non-recombinant colonies.
(Understanding)



[3]

Question 11

Samson and Dorothy surveyed two islands, 'A' and 'B'. They recorded the relevant data in the following format in their research folder:

	Parameter	Island A	Island B
(a)	Area (A)	45×10^3 Km^2	12×10^5 Km^2
(b)	Regression co-efficient (Z)	1	1
(c)	Y-intercept	20	10

(i) Derive the species-richness for each island. **(Application)**

(ii) Which island exhibits greater biodiversity? Support your answer with a reason. **(Application)**

Question 12 **[3]**

The black colour on the beak of finches dominates over the yellow colour. There are 210 individuals with the genotype DD, 245 individuals with the genotype Dd and 45 individuals with the genotype dd. Deduce the frequency of individuals with dominant, heterozygous, and recessive traits. **(Application)**

Question 13 **[3]**

Robert was suffering from chronic renal failure. At the doctors' recommendation of transplantation of kidney received from a healthy donor, Robert underwent kidney transplant. However, after two weeks, the transplanted kidney was rejected by the immune system of Robert.

(i) Identify and define the type of immune response that is responsible for the rejection of the grafted organ. **(Understanding)**

(ii) Suggest a clinical method by which the rejection of the transplanted organ can be prevented. **(Understanding)**

Question 14 **[3]**

The red panda has been listed as an endangered species on the IUCN Red List since 2015. Regional captive breeding programmes have been established in the zoos around the world to protect the red panda from extinction.

(i) Classify the biodiversity conservation programme referred to above. **(Understanding)**

(ii) Mention any other *two* methods of conservation which belong to the same category. **(Understanding)**

Question 15 **[3]**

(i) Draw a well-labelled diagram of tRNA. **(Recall)**

OR

(ii) Draw a well-labelled diagram of nucleosome. **(Recall)**

SECTION D – 15 MARKS

Question 16 **[5]**

(i) Answer the following questions.

(a) Why are the biocontrol agents preferred over the chemical pesticides? **(Understanding)**

(b) Explain the role of *any two* biocontrol agents by mentioning their target pests. **(Understanding)**

OR

(ii) Answer the following questions.

(a) Why are some molecules called bioactive molecules? **(Understanding)**

(b) Mention the respective source and state the specific use of *any two* bioactive molecules. **(Understanding)**

Question 17 **[5]**

In a forest ecosystem, a large population of insect feeds upon a banyan tree. Several small birds feed upon these insects. The small birds are fed upon by big-sized birds.

(i) With respect to this ecosystem, draw a pyramid each of biomass and a pyramid of number. **(Application)**

(ii) If 20,000 Kcal energy is available at the level of insects, calculate the amount of energy available at the level of big-sized birds. **(Application)**

Question 18 **[5]**

(i) Consider the following information and answer the question that follows

- Reshma's mother is normal, but her father is suffering from PKU.
- Reshma is suffering from PKU. She has two younger brothers who are identical twins; both are suffering from PKU. Reshma's two elder sisters are normal.
- Reshma marries Robert, who is normal. Reshma gives birth to a son named Jason who is normal. After some time, Resham and Robert have two more children: a daughter with symptoms of PKU and a son without any symptoms of PKU.

Make a single pedigree chart, using the above information, to show the pattern of inheritance of phenylketonuria (PKU) in the family of Reshma. **(Application)**

(ii) Enumerate the cause and the characteristic symptom of PKU. **(Recall)**

BIOLOGY

PAPER 1

(THEORY)

ANSWER KEY

SECTION A – 20 MARKS

Question 1

In answering Multiple Choice Questions, candidates have to write either the correct option number or the explanation against it. Please note that only ONE correct answer should be written.

(i)	*Neisseria gonorrhoeae*	**[1]**
(ii)	80	**[1]**
(iii)	8 cycles	**[1]**
(iv)	'Saheli'	**[1]**
(v)	60 plants	**[1]**
(vi)	5'- CATATG -3' 3'- GTATAC -5'	**[1]**
(vii)	Mitochondrion / Mitochondria	**[1]**
(viii)	Plasma cells / B-Lymphocytes	**[1]**
(ix)	(b) 5'- AUG AAC UAA CCA CUC - 3'	**[1]**
(x)	(c) III	**[1]**
(xi)	(c) Assertion is true and Reason is false.	**[1]**
(xii)	(c) Assertion is true and Reason is false.	**[1]**
(xiii)	Helps in retaining parental characters.	**[1]**
(xiv)	By recommending him to use cyanobacteria and / or Nitrogen-fixing bacteria	**[1]**
(xv)	(a) Mucosal Associated Lymphoid Tissues	**[1]**

(b) Sanger **[1]**

(xvi) Diploid (2n) **[1]**

(xvii) Morula **[1]**

(xviii) (a) More than one restriction site for the same RE **[1]**

(b) Because the weaker alleles become homozygous and exhibit their harmful effects. So, such plants die and get eliminated out of population. In this way, the population becomes free of such genes **[1]**

SECTION B – 14 MARKS

Question 2 **[2]**

(i) Cell – A: The haustorial cell absorbs and transfer nutrients from the endosperm to the proembryo.

Cell – B: Hypophysis forms radicle

OR

(ii) Seed A- Non-endospermic/ Exalbuminous, Seed B-Endospermic or Albuminous
Seed A – Pea, bean, Cucurbita, Seed B- Castor, maize – (Any relevant points to be accepted)

Question 3 **[2]**

Insect pollinated.
One characteristic feature of pollen grain - pollen kit / sticky pollen grains

Question 4 **[2]**

(i) Protein remains insoluble at low pH in the bacterial cell, but in stomach of insects it becomes soluble and damages the epithelial cells

(ii) No, because the toxin is species-specific.

Question 5 **[2]**

(i) The inferior competitor will be eliminated as per Gause' 'Competitive exclusion principle'.

(ii) The inferior competitor expands its territory as per 'Competitive release'.

Question 6 **[2]**

Embryos show the presence of gills to prove that the ancestors were aquatic.
The concept of "ontogeny recapitulates phylogeny".

Question 7 **[2]**

Technique: ELISA
Principle: Presence of specific anti-viral antibodies

Question 8 **[2]**

Habitat loss and fragmentation, Alien species invasion

SECTION C - 21 MARKS

Question 9 **[2]**

(i) Zygote Intra Fallopian Transfer, Gamete Intra Fallopian Transfer

(ii) STDs like AIDS and Hepatitis – B do not directly affect the genital organs because AIDS affects only the immune system and Hepatitis affects the liver.

Question 10

(i) Lane A – DNA of *E. coli*
Lane B – DNA of *Plasmodium vivax*

Because the circular DNA of *E. coli* was cut to release just one fragment, while the linear DNA of *Plasmodium* was cut to release two fragments

OR

(ii) Blue-white selection

LacZ codes for β-galactosidase
The product (β-galactosidase) becomes inactive due to insertion of foreign protein (coded by foreign gene)
Chromogenic substrate converted into blue coloured product in non-recombinant colonies, remains colourless in recombinant colonies

Question 11 **[3]**

(i) $S = CA^Z$

Island 'A'	Island 'B'	
$Sa = 20 \times (45 \times 10^3)^1$	$Sb = 10 \times (12 \times 10^5)^1$	1 mark
$Sa = 900 \times 10^3$	$Sb = 120 \times 10^5$	1 mark

(ii) Sb > Sa, therefore, species richness of Island 'B' is greater than that of Island 'A', because Island B has optimum environmental conditions / temperature / higher productivity.

Question 12 **[3]**

The frequency of individuals with the dominant genotype: $p^2 = 0.49$
The frequency of individuals with the heterozygous genotype: $2pq = 0.42$
The frequency of individuals with the recessive genotype: $q^2 = 0.09$

Question 13 **[3]**

(i) Cell mediated Immunity. It is the type of immunity provided by the T – lymphocytes

(ii) Administration of immunosuppressants

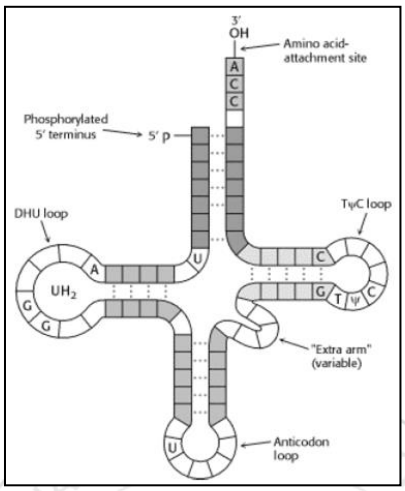
Question 14 **[3]**

(i) *ex situ* method of conservation

(ii) cryopreservation/ tissue culture/ gene banks

Question 15 **[3]**

(i)

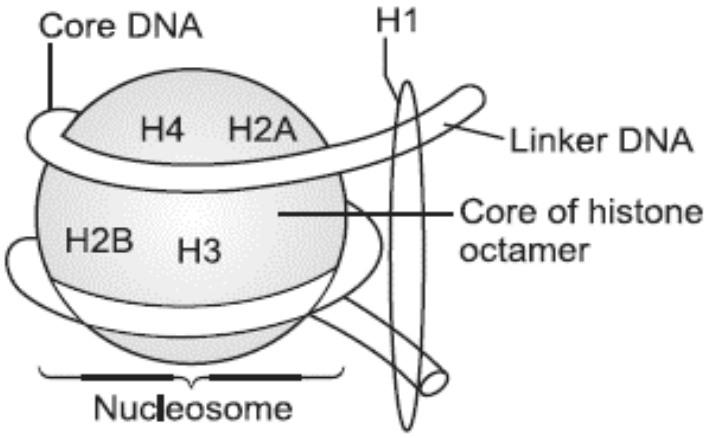


- Proper shape (5'- arm at a lower level than 3'-arm)

Three loops with proper orientation (with reference to 3' and 5'-ends)

OR

(ii)



SECTION D – 15 MARKS

Question 16 **[5]**

(i) a Biocontrol agents do not pollute the environment and are highly specific in nature

(b) Baculovirus – Specifically attack insect pests.

Bacillus thuringiensis – Specifically destroys cotton bollworm/ corn borer

OR

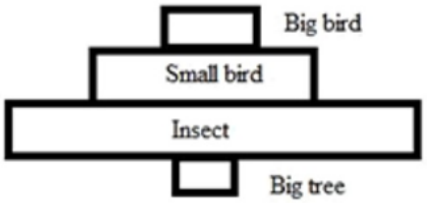
(ii) Bioactive molecules modulate the metabolic pathways of the living organism.
(a)

(b) Streptokinase: Source – *Streptococcus*: Use – Intravascular clot buster

Cyclosporin: Source – *Trichoderma polysporum:* Use– Immunosuppressant

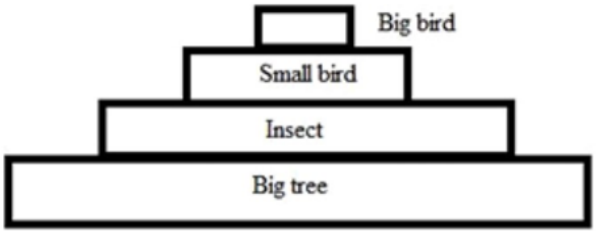
Question 17 **[5]**

(i)



Pyramid of number

(ii)

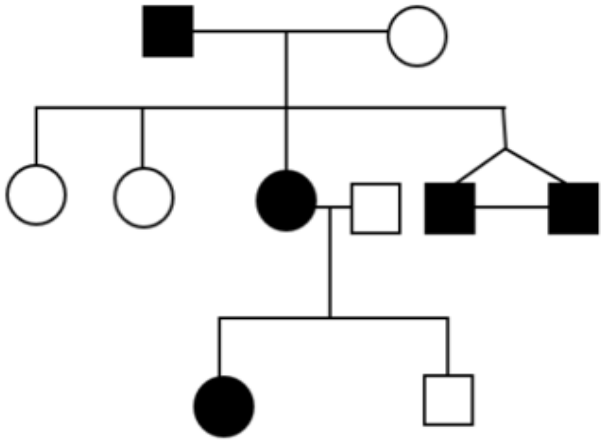


Pyramid of biomass

[5]

Question 18

(i)



(ii) Cause: Deficiency of the enzyme phenylalanine hydroxylase

Symptom: Retarded mental growth/ light skin pigmentation