

**St. Paul's School**  
**Class XII - Half Yearly Examination (2024-25)**  
**Biology (044)**

**Max. Marks: 70**

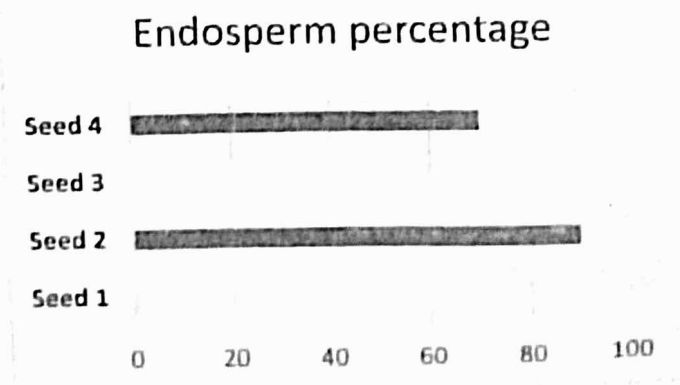
**Time: 3 hrs**

**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/passage-based questions of 4 marks each; and Section – E has 3 questions of 5 marks each.
- (iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
- (v) Wherever necessary, neat and properly labeled diagrams should be drawn.

**SECTION A**

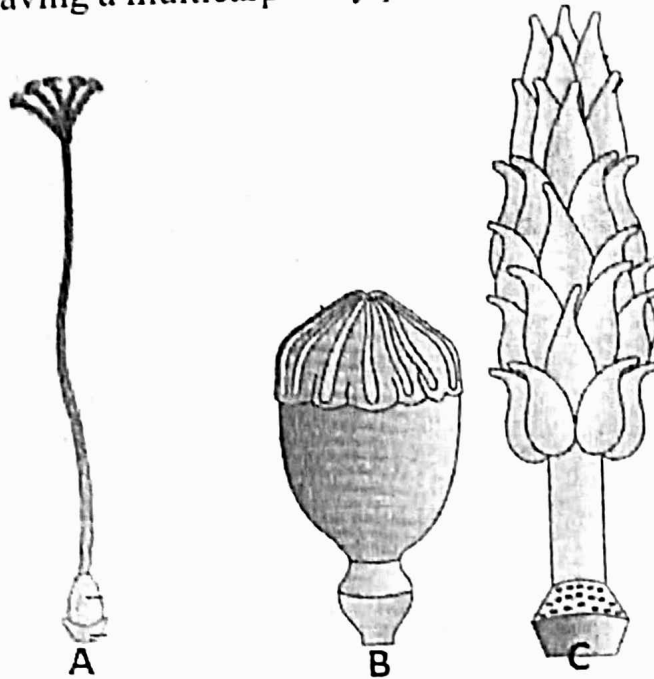
1. A mixture containing DNA fragments, a, b, c and d, with molecular weights of  $a+b=c$ ,  $a>b$  and  $d>c$ , were subjected to agarose gel electrophoresis. The positions of these fragments from anode to cathode sides of the gel would be 1
- (a) b, a, c, d  
(b) a, b, c, d  
(c) c, b, a, d  
(d) d, c, a, b
2. What is the primary function of the corpus luteum after ovulation? 1
- (a) Produces progesterone to prepare the uterus for implantation.  
(b) Releases estrogen to stimulate follicle growth.  
(c) Secretes FSH to stimulate ovulation.  
(d) Triggers the release of LH to stop menstruation.
3. Based on the given graph, which one could be an albuminous seed/seeds? 1



- (a) Seed 1 and 3  
(c) Seed 1

- (b) Seed 2 and 4  
(d) Seed 2 only

4. Which of the following statements are true related to (A), (B) and (C)?
- (I) Flower (A) is having a multicarpellary pistil.
  - (II) Flower (C) is having a syncarpous pistil.
  - (III) Flower (B) is having an apocarpous pistil.
  - (IV) Flower (B) is having a multicarpellary pistil.



- (a) I and II are true
  - (b) III and IV are true
  - (c) II and III are true
  - (d) I and IV are true
5. Alleles of different genes that are on the same chromosome can occasionally be separated by a phenomenon called
- (a) Crossing over
  - (b) Continuous variation
  - (c) Epistasis
  - (d) Pleiotropy
6. Which native plasmid did Stanley Cohen and Herbert Boyer use for the construction of the first recombinant DNA?
- (a) *Salmonella typhimurium*
  - (b) *Streptococcus pneumoniae*
  - (c) *Escherichia coli*
  - (d) *Haemophilus influenza*
7. A dsDNA fragment has 2000 nucleotides, out of which 140 are Adenine. How many bases does this DNA segment possess that have triple hydrogen bonds between them?
- (a) 280
  - (b) 860
  - (c) 1720
  - (d) 1860

8. Leydig cells are present in- 1  
(a) Seminiferous tubules and secrete androgens.  
(b) Seminiferous tubules and help in maturation of sperms.  
(c) Interstitial space and secrete androgens.  
(d) Interstitial space and help in maturation of sperms.
9. Select the correct statement regarding the mutation theory of evolution. 1  
(a) This theory was proposed by Alfred Wallace.  
(b) Variation are small directional changes.  
(c) Single step large mutation is a cause of speciation.  
(d) Large differences are due to mutations that arise gradually in a population.
10. Polymerase chain reaction is not used in 1  
(a) Confirming the presence of a pathogen during early infection.  
(b) Identifying the mutated genes in suspected cancer patients.  
(c) Isolating the gene of interest from the host DNA to be cloned by recombinant process.  
(d) Detection of the presence of HIV in suspected AIDS patients.
11. The function of copper ions in copper releasing IUD is 1  
(a) to suppress sperm motility and fertilising capacity of sperms.  
(b) to inhibit gametogenesis.  
(c) to make the uterus unsuitable for implantation.  
(d) to inhibit ovulation.
12. Natural selection, where more individuals acquire specific character value other than the mean character value, leads to 1  
(a) Random change (b) Stabilised change  
(c) Directional change (d) Disruptive change
13. Questions 13 to 16 consist of two statements – Assertion (A) and Reason (R). 1  
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 but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.

**Assertion:** Patients with STDs often go undetected for a long period in our society.

**Reason:** Social stigma, asymptomatic patients contribute to the delay of timely detection of STDs.

14. **Assertion:** In birds the sex of the offspring is determined by males. 1

**Reason:** Males are homogametic and females are heterogametic.

15. **Assertion:** Thalassemia is an autosome-linked dominant blood disease transmitted from parents to the offspring. 1

**Reason:**  $\alpha$ -Thalassemia is controlled by genes HBA1 and HBA2 on chromosome 16.

16. **Assertion:** Indian Government has set up an organisation known as GEAC to decide the validity of GM research. 1

**Reason:** Genetic modification of organisms has no effect when such organisms are introduced in the ecosystem.

### SECTION B

17. The length of DNA is 1.36 mm. Calculate the number of base pairs in this DNA. 2

18. On the basis of SL Miller's experiments, answer the following questions. 2

(a) How did SL Miller create the conditions which existed before the origin of any life on earth?

(b) Name the organic compound formed and collected at the end of his experiment.

(c) Mention the kind of evolution his experiment supports.

19. How has the use of *Agrobacterium tumefaciens* helped in controlling pest infestation in tobacco plant? 2

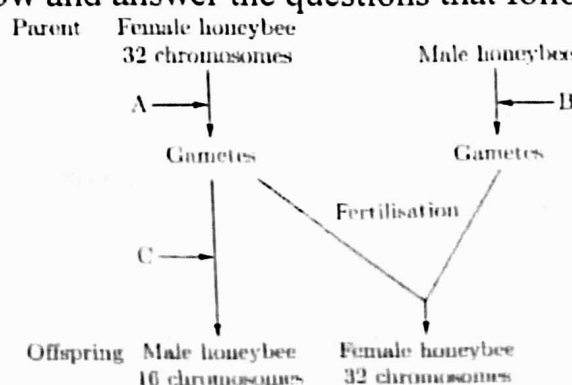
OR

Rohini took tissues from root and cultivated a whole new plant in lab condition in the nutritive medium.

(a) What all chemicals are needed in the nutritive medium for the healthy growth of new plant?

(b) Why do we prefer cells from meristem for invitro cultivation?

20. The cytological observations made in a number of insects led to the development of the concept of genetic/ chromosomal basis of sex-determination mechanism. Honeybee is an interesting example to study the mechanism of sex-determination. Study the schematic cross between the male and the female honeybees given below and answer the questions that follow: 2



- (a) Identify the cell divisions 'A' and 'B' that lead to gamete formation in male and female honeybees respectively.
- (b) Name the process 'C' that leads to the development of male honeybee (drone).
- (c) Mention the type of sex determination in the above case.
21. (a) If during spermatogenesis, the chromatids of sex chromosome fail to segregate during meiosis, write the different types of gametes with altered chromosome number that could possibly be produced. 2
- (b) A normal human sperm (22+Y) fertilises with an ovum with karyotype 22 + XX. Name the disorder the offspring thus produced would suffer from and write any one symptom of the disorder.

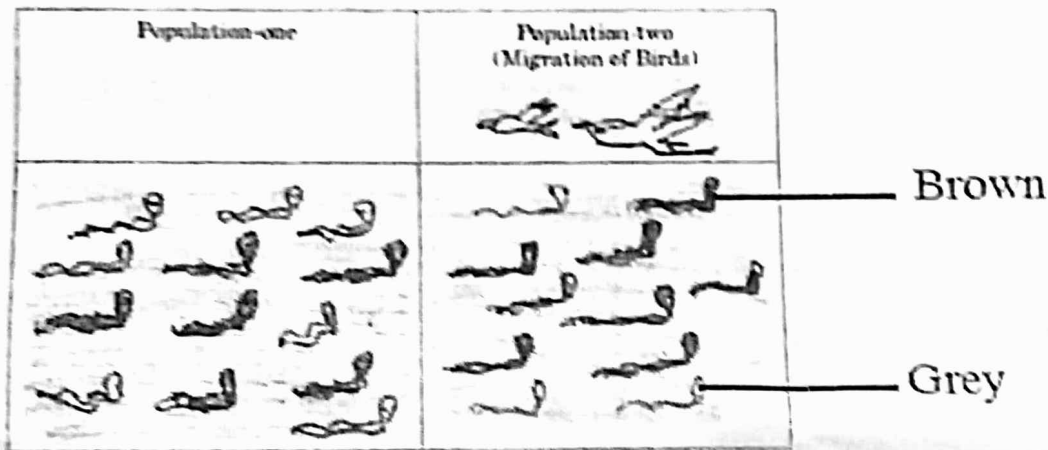
### SECTION C

22. (a) The development of endosperm precedes that of embryo in plants. Justify. 3
- (b) Draw and label the structure of a fertilised embryo sac.
23. (a) Explain the role of accessory glands in human male reproductive system. 3
- (b) How is the entry of only one sperm and not many into an ovum during fertilisation in humans ensured?
24. A flower of the brinjal plant, following the process of sexual reproduction, produces 360 viable seeds. Answer the following questions giving reasons: 3
- (a) What is the minimum number of pollen grains that must have been involved in the pollination of its pistil?
- (b) How many megaspore mother cells were involved?
- (c) What is the minimum number of microspore mother cells involved in the above case?
- (d) How many male gametes were involved in this case?
- (e) How many cell divisions are required for the formation of male gametes from one pollen mother cell?
- (f) Name the structure in which the male gametes are formed.
25. Placed below are case studies of some couples who were not able to have kids. These couples are not ready for adoption or taking gametes from donors. After thoroughly examining the cases, which Assisted Reproductive Technology will you suggest to these couples as a medical expert? Explain briefly with justification of each case. 3

Couple	Test reports of Female partner	Test reports of male partner
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Couple 1	Normal reports	Normal sperms in testes, Missing connection in epididymis and Vas deferens.
Couple 2	Blockage in the fallopian tube.	Normal reports
Couple 3	Normal reports	Poor semen parameters in terms of count, motility and morphology.

26. A population of snakes lived in a desert with brown sand. Study the drawings given below showing the change in population from one to two over time and answer the question that follows. Brown snakes and Grey snakes are represented by alleles A/a (Dominant/recessive).



- (a) If the frequency of the recessive trait is 9% in population-one, work out the frequency of homozygous dominant and heterozygous dominant snakes assuming they are in Hardy Weinberg's equilibrium.  
 (b) Name the mechanism of evolution that must have operated so that population-two evolved from population-one.

27. Read the passage given below and answer the questions that follow. In recombinant DNA technology, restriction enzymes are used as they recognize and cut DNA within a specific recognition sequence. BamH I is one such restriction enzyme which binds at the recognition sequence 5' G-G-A-T-C-C 3' and cleaves this sequence between G and G on each strand, whereas Alu I binds at the recognition sequence 5' A-G-C-T 3' and cleaves these sequences between G and C on each strand.

- (a) If Alu I is used to cut the given DNA strand, how many DNA fragments would be formed? Write the sequence of each fragment formed with its polarity.

5' C C G T A G C T A T C A G C T G G 3'  
 3' G G C A T C G A T A G T C G A C C 5'

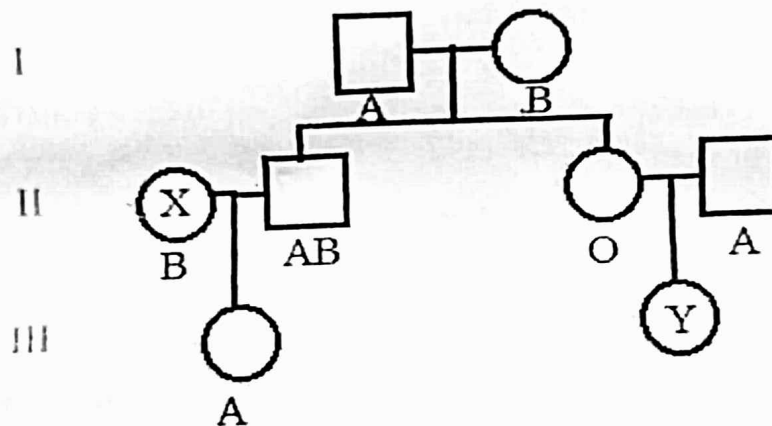


(b) Which one of the two restriction enzymes BamH I or Alu I will preferably be used on the same given DNA strand to make a recombinant DNA molecule and why?

28. Based on the understanding of the lac operon answer the following questions. 3
- (a) The active site of enzyme permease present in the cell membrane of a bacterium has been blocked by an inhibitor, how will it affect the lac operon?
- (b) The protein produced by the *i* gene has become abnormal due to unknown reasons. Explain its impact on lactose metabolism stating the reason.
- (c) If the nutrient medium for the bacteria contains only galactose; will operon be expressed? Justify your answer.

### SECTION D

29. Study the pedigree chart showing the pattern of inheritance of blood group character in a family. 4



- (a) Give the genotypes of the parents in generation I.
- (b) State the possible genotypes of the individuals mentioned below.
- (i) X in generation II.
- (ii) Y in generation III.
- (c) How does the inheritance of this blood group explain codominance?

OR

- (c) How is ABO blood group an example of multiple allelism?

30. A child suffers from a disease caused due to the non-functioning of an enzyme required by the immune system. It is a metabolic disorder that primarily affects lymphocyte development, viability, and function. Lymphocytes are white blood cells that help the body fight infections. 4

- (a) Name the conventional methods used for its treatment and their disadvantage.
- (b) With the use of rDNA technology, how can this be treated? Explain the process.
- (c) What could be a permanent cure for this disease?

## SECTION E

31. Describe the post-zygotic events leading to implantation and placenta formation in humans. Mention any two functions of placenta. 5

OR

Explain the ovarian and uterine events taking place along with the role of pituitary and ovarian hormones, during menstrual cycle in a normal human female under the following phases:

- (i) Follicular phase/proliferative phase
- (ii) Luteal phase/secretory phase
- (iii) Menstrual phase

32. Meselson and Stahl carried out an experiment to prove the nature of DNA replication. Recall the experiment and answer the following questions. 5
- (i) Which two types of nitrogen were used by them in their experiment and why?
  - (ii) Why did they take samples of *E. coli* at definite time intervals for their observation?
  - (iii) State the role of caesium chloride density gradient in their experiment.
  - (iv) Write the conclusions they arrived at.

33. Answer the following questions with respect to recombinant DNA Technology. 5
- (a) Why is plasmid considered to be an important tool in rDNA technology? Where can plasmids be isolated from?
  - (b) How is insertional inactivation of an enzyme used as a selectable marker to differentiate recombinants from non-recombinants?
  - (c) Why does the host cell have to be made competent in recombinant DNA technology?