

**ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2015
EXAMINATION CATEGORY: TECHNICAL**

PAPER III: SUBJECT SPECIALIZATION PAPER for *Biotechnology*

Date	: 11 October 2015
Total Marks	: 100
Examination Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to examination time)

GENERAL INSTRUCTIONS:

1. Write your Roll Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is being provided to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A and SECTION B:
 - **SECTION A** has two parts: Part I - 30 Multiple-Choice Questions
Part II - 4 Short Answer Questions
All questions under SECTION A are COMPULSORY.
 - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions under your choice.
4. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating any or correct Section, Part and Question Number will NOT be evaluated and no marks would be awarded.
5. Begin each Section and Part in a fresh page of the Answer Booklet.
6. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
7. Use of any other paper including paper for rough work is not permitted.
8. You are required to hand over the Answer Booklet to the Invigilator before leaving the examination hall.
9. This paper has 08 printed pages in all, including this instruction page.

GOOD LUCK!

SECTION A

PART I: Multiple Choice Questions (30 Marks)

Choose the correct answer and write down the letter of the correct answer chosen in the Answer Booklet against the question number. E.g. 31 (c). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. The gene formed by combining two different segment from different source are called
 - a. Recombinant gene
 - b. Joined gene
 - c. Both “a” and “b”
 - d. Chimaeric gene

2. Highest capacity vector is
 - a. Cosmid
 - b. Yeast integrative vector
 - c. Bacteriophage vector
 - d. YAC

3. Which one of the following enzymes is used to cut DNA molecules in rDNA technology?
 - a. Ligase
 - b. Phosphatase
 - c. Ribonuclease
 - d. Restriction enzyme

4. The heterozygosity of any locus can be determined by
 - a. SNPs
 - b. RFLPs
 - c. Either RFLPs analysis or SNP
 - d. FISH

5. Embryo rescue is a technique to
 - a. Grow /generate hybrids between different plant species
 - b. Complete the growth of embryos
 - c. Break the dormancy of seeds
 - d. All of the above

6. PCR technique was developed by
 - a. Kohler
 - b. Milstein
 - c. Kary Mullis
 - d. Altman

7. PCR is
- DNA degradation technique
 - DNA amplification technique
 - DNA sequencing technique
 - All of these
8. Two bacteria mostly used in genetic engineering
- Rhizobium* and *Azotobacter*
 - Nitrosomonas* and *Klebsiella*
 - Escherichia* and *Agrobacterium*
 - Rhizobium* and *Diplococcus*
9. Single Nucleotide Polymorphisms (SNPs) is a detection method based on the extending a primer by a single base pair, often referred as
- Restriction fragment length polymorphisms (RFLPs)
 - Micro sequencing
 - AFLP
 - Dot-matrix analysis
10. Which of the following enzyme is used for synthesis of mRNA
- Alkaline Phosphatase
 - RNA primase
 - Reverse transcriptase
 - Taq Polymerase
11. Under alkaline conditions, DNA is more stable than RNA because
- RNA forms secondary structures
 - RNA is a single stranded molecule
 - RNA has uracil in place of thymidine
 - RNA is susceptible to hydrolysis
12. Gene pairs on separate chromosome pairs assort independently at
- Gene pairing
 - Mitosis
 - Meiosis
 - Random fertilization
13. Most suited method to produce virus free plants is
- Embryo culture
 - Anther culture
 - Ovule culture
 - Meristem culture

14. Phenotype of two heterozygote are intermediate purple colour flower cross with white produces pink flower progeny, this describes
- Complete dominance
 - Codominance
 - Autosomal dominance
 - Incomplete dominance
15. Haploid plants are produced in large number through
- Ovary culture
 - Anther culture
 - Ovule culture
 - Both a and b
16. Vectors designed to replicate in cells of two different species are called.
- Phasmids
 - Shuttle vectors
 - Transfer vectors
 - Phagemids
17. Plasmids are important in biotechnology because they are
- Recognition sites on recombinant DNA strands.
 - Surfaces for protein synthesis in eukaryotic recombinants.
 - A vehicle for the insertion of recombinant DNA into bacteria.
 - Provirus incorporated into the host DNA.
18. Reverse transcriptase PCR uses
- mRNA as a template to form cDNA
 - DNA as a template to form ssDNA
 - DNA templates to form m RNA
 - RNA as a template to form DNA
19. Time between onset of infection process and reproduction of pathogen is called as
- compounding period
 - period of illness
 - Latency period
 - none of the above
20. The term “Genome” was coined by H. Winkler in the year;
- 1962
 - 1996
 - 1920
 - 1990

21. Controversy regarding genetically modified organism is mainly due to
- Contamination of water
 - Contamination of soil
 - Its potential cause of allergen to humans and living organisms
 - None of the above
22. Which of the following statements is true regarding genomics?
- Genomics of animals and microorganisms are advanced than plant genomics
 - Genomic information are used by researchers even when entire genome of an organism is not known
 - Wheat genome is being researched currently
 - All of the above
23. A unit of measure of recombination frequency
- LOD score
 - CentiRay (cR)
 - Karyogram
 - CentiMorgan (cM)
24. Plants derived sexually from the same plant are_____ while those derived from somatic tissue from the same plant are_____.
- different, identical
 - identical, different
 - different, also different
 - identical and identical also
25. The first field tests were conducted with which of the following genetically altered organism?
- Bt Corn
 - Vaccinia virus containing a gene from the rabies virus
 - Strawberry seedlings sprayed with ice-minus bacteria
 - The flavrsavr tomato
26. The position of a gene whose variant alleles contribute to quantitative variation of some character is known as
- R plasmid
 - QTL
 - Proteome
 - SARs

27. The process of binding of primer to denatured strand is called
- Denaturation
 - Annealing
 - substitution
 - none of the above
28. Antibody diversity is generated by
- protein splicing
 - somatic mutations
 - allelic exclusion
 - interchromosomal recombination
29. Father of Plant Tissue culture
- Parkinson
 - Mandel
 - Haberlandt
 - Kohler
30. Who discovered restricted enzymes
- Watson and Crick
 - Nathan, Arber and Smith
 - Mendel
 - Boyer and Cohen

PART II – Short Answer Type Questions (20 Marks)

Answer ALL the questions. Each question carries 5 marks. Mark for each sub-question is indicated in the brackets.

- How does Biology differ from Biotechnology? Describe briefly applications of modern biotechnology in (1 X 5=5)
 - Microbes
 - Plant
 - Animal
 - Health
- What are basic steps of polymerase chain reaction (PCR), explain? Why are thermostable polymerases used in PCR? Write two application of PCR? (3+1+1=5)
- Write short notes of the following (1 X 5=5)
 - Transgenic plants/GM plant
 - GM food

- c. Genomic DNA library
 - d. Cloning
 - e. Somatic hybrid
4. What is the key function of mitosis? What are the two key functions of meiosis? Who defined law of "*Independent Assortment*" and law of "*Segregation of Characteristics*" and Explain each laws (1+1+3=5)

SECTION B

Case Study

Choose either Case 1 or Case 2 from this Section. Each Case carries 50 marks. Mark for each sub-question is indicated in the brackets.

CASE 1

You are researcher in one of the research center of Renewable Natural Resource Research and Development Center (RNR-RDC) of Ministry of Agriculture and Forests. In this context answer the following.

- a. You made a monohybrid cross of red and white flower, and got only red flower in F₁ generation. F₂ plants were selfed which produced progenies having red flower and white flower. Explain the basis of using RR and rr symbols to represent the genotype of plants of parental generation. What does it tell us about the nature of alleles involved? Justify your answer. (10 marks)
- b. Is the use of genetic engineering different from classical breeding of plants and animals? Explain in brief how plant breeding developed from the past to current advancements with a view of GMO? Is GMO answer to current agricultural problem? (2+4+4 = 10 marks)
- c. In a certain population, the frequency of three genotypes is as follows: (5 marks)
- d. In animal husbandry, if two closely related animals are mated for a few generations, it results in loss of fertility and vigor. Why is it so? Given below are the events that are observed in an artificial hybridization programme, i.e. (a) re-bagging; (b) selection of parents; (c) bagging; (d) dusting the pollen on stigma; (e) emasculation; (f) collection of pollen from male parent. Arrange them in the correct sequential order in which they are followed in the hybridization programme. (2 + 3 = 5 marks)
- e. You are given wheat cultivar A with resistant gene for stripe rust disease of wheat and cultivar B which is susceptible to the same disease but with other desirable trait liked by Bhutanese farmers. Explain conventional breeding and selection methods with biotechnology tools used to obtain a resistant cultivar against stripe rust resistance with embedded entire desirable trait like by our farmers. (10 marks)

- f. Assume that there is insect problem in rice growing areas in Bhutan. One of the international research centers working on rice have genetically engineered and created GMO of rice which is resistant to that particular insect. This GMO can solve the problem of this insect infestation on rice; however there is gene flow from this insect resistant rice which can be transferred to another native plant in the community. Would you bring that GMO for Bhutanese farmers, explain keeping in mind the Seed Act of Bhutan? (10 marks)

CASE 2

You have been given all the resources used in application of Biotechnology in Ministry of Agriculture and Forests; answer the following to be utilized in the breeding and pathological aspect

- a. What is plant tissue culture and List the various steps involved in it and factor affecting propagations? How would you use this technique to produce virus free potato plants? (3+3+4= 10 marks)
- b. What is MAS expand it? How will you use marker assisted breeding in producing cultivar resistant to diseases? Explain keeping in mind new development of biotechnology in plant breeding - why it is preferred over conventional breeding (2+4+4= 10 marks)
- c. Expand GMO? Is biotechnology fundamentally different from other breeding techniques, and does it pose unacceptable risks? How is it different from a hybrid? (10 marks)
- d. In order to obtain the F₁ generation, Mendel pollinated a true-breeding, say, tall plant with a true-breeding dwarf plant. But for getting the F₂ generation, he simply self-pollinated the tall F₁ plants. Why? (5 marks)
- e. Describe the role of *Agrobacterium tumefaciens* in transforming a plant cell? What do you understand by the term bio-pesticide? Name and explain the mode of action of Bt toxin. (2+ 1+2= 5 marks)
- f. For producing a recombinant protein (for therapeutic purpose) in large scale, which vector would you choose – a low copy number or high-copy number, why? Give any two microbes that are useful in biotechnology? How are alleles of particular gene different? Explain its significance. Based on genomic studies, why do people say that different species and organisms had a common ancestor 100 million years ago? (2+1+3+4=10 marks)