

ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2010
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION PAPER FOR: BIOTECHNOLOGY

Date : 24th November 2010
Total Marks : 100
Examination Time : 2.5 hours
Reading Time : 15 Minutes (Prior to Exam. Time)

GENERAL INSTRUCTIONS:

1. Write your Roll Number Clearly on the answer booklet in the space provided.
2. The question paper contains **9 PAGES**. You will be given 15 minutes to read the question paper and to clarify doubts. You are **NOT PERMITTED TO WRITE**.
3. Use **BLUE or BLACK** ink pen or ball point pen for writing and **HB** pencil for drawing.
4. Section A, Part 1 consists of 30 multiple choice questions and it should be answered on the question paper itself. It is **COMPULSORY** and carries 1 mark each.
5. Section A, Part 2 consists of four (4) short answer question and this part is also compulsory and it carries 5 marks each.
6. Section B consists of two case studies. Choose only one case study, answer it carefully and support it with **JUSTIFICATIONS** and **EXAMPLES**, this carries 50 marks

Roll Number:.....

SECTION A

PART A: MULTIPLE CHOICE QUESTIONS

(30 MARKS)

Direction:

*In this part there are thirty multiple choice question, all questions are compulsory and each carries 1 mark. Each question contains four (4) suggested answers a,b c and d, Choose, then **TICK/ CIRCLE** the one alternative that best completes the statement or answers.*

1. Evolutionary relation between different organism can be determined by using
 - a. Family tree
 - b. Phylogenetic tree
 - c. Maternity tree
 - d. Paternity tree

2. Main determinant of basic structural and physiological properties of an organism
 - a. Deoxyribonucleic acid (DNA)
 - b. Ribonucleic acid (RNA)
 - c. Protein
 - d. Genome

3. Truly different version of the same basic genes which differ from each other generally in small ways. This specific forms of genes are called
 - a. Race
 - b. Forma Specialis
 - c. Isolates
 - d. Alleles

4. RNA is composed of nucleotide which contains
 - a. Deoxyribose
 - b. Sugar ribose
 - c. Gene
 - d. Amino acid

5. The polymerization of Ribonucleotides are catalyzed by enzyme known as
 - a. DNA polymerase
 - b. RNA polymerase
 - c. Reverse transcriptase
 - d. Ribosome

6. Mendel's experiment describes two pure- breeding parental lines that differed in one character, such lines produce progeny that are heterozygous for one gene, such heterozygote are also called
 - a. Dihybrid
 - b. Meiosis
 - c. Monohybrids
 - d. None of the above

7. Gene pairs on separate chromosome pairs assort independently at
 - a. Mitosis
 - b. Meiosis
 - c. Random fertilization
 - d. Gene pairing

8. During cell division (Mitosis) sister chromatids which lie side by side do not become visible during
 - a. Telophase
 - b. Prophase
 - c. Metaphase
 - d. Interphase

9. Region of chromosome to which spindle fiber attaches are called
 - a. Heterochromatin
 - b. Euchromatin
 - c. Chromomeres
 - d. Centromeres

10. How many chromosome pairs are present in *Triticum aestivum*
 - a. 30
 - b. 31
 - c. 16
 - d. 21

11. Phenotype of two heterozygote are intermediate purple colour flower cross with white produces pink flower progeny, this describes
 - a. Codominance
 - b. Complete dominance
 - c. Incomplete dominance
 - d. Autosomal dominance

12. Independent assortment or crossing over results into
- Recombination
 - Interlocus
 - Coupling
 - Linkage
13. A situation in which the differential phenotypic expression of genotypes at one locus depends on the genotypes at another locus is
- Replicons
 - Epistasis
 - Alleles
 - Archea
14. Plasmids are important in biotechnology because they are
- A vehicle for the insertion of recombinant DNA into bacteria.
 - Recognition sites on recombinant DNA strands.
 - Surfaces for protein synthesis in eukaryotic recombinants.
 - Provirus incorporated into the host DNA.
15. A virus for which the natural host is a bacterial cell
- Plasmid
 - Clone genes
 - DNA probe
 - Phage
16. Primary structure of proteins are composed of an arrangement of
- Nucleic Acid
 - Amino Acid
 - Monosaccharides
 - Lipoproteins
17. Transfer of DNA from one bacterial cell to other can be done by
- Plasmid
 - Bacteriophages
 - Virus
 - Viriod
18. Time between onset of infection process and reproduction of pathogen is called as
- Latency period
 - compounding period
 - period of illness
 - none of the above

19. One important approach to gene cloning uses
- Noncoding nucleotide sequences.
 - Plasmids.
 - Whole chromosomes.
 - DNA strand
20. Specific amino acid changes can be detected in protein by
- Amino acid sequencing
 - chromosomal walking
 - fingerprinting
 - both a and c
21. Single Nucleotide Polymorphisms (SNPs) detection methods are based on the extending a primer by a single base pair. these methods are often referred to as
- Restriction fragment length polymorphisms (RFLPs)
 - Micro sequencing
 - AFLP
 - Dot-matrix analysis
22. The association of complementary DNA (or RNA) strands to form a double helix is known as
- Amplimers
 - Anticodon
 - QTL
 - Annealing
23. A family of programs that search sequence databases for matches to a query sequence is known as
- PALMS
 - BLAST
 - SPSS
 - None of the above
24. A unit of measure of recombination frequency
- LOD score
 - CentiRay (cR)
 - CentiMorgan (cM)
 - Karyogram

25. A measure of the likelihood of genetic linkage between loci.
- Prior probability
 - LOD score
 - Quantitative trait locus
 - Recombination fraction
26. Enzymes that can make a DNA strand using an RNA template. Used to make cDNA libraries and for RT-PCR
- Reverse transcriptase
 - DNA polymerase
 - RNA polymerase
 - PCR polymerase
27. A microarray of oligonucleotides or cDNA clones fixed on a glass surface.
- DNA fingerprinting
 - DNA footprinting
 - DNA profiling
 - DNA chip
28. A chromosomal region that remains highly condensed throughout the cell cycle and shows little or no evidence of active gene expression.
- Heterochromatin
 - Imprinting
 - Intron
 - Isochromosome
29. A mathematical equation describing the relation between recombination fraction and *genetic distance*.
- Mapping function
 - Probability
 - Centi Morgan
 - Recombination fraction
30. the position of a gene whose variant alleles contribute to quantitative variation of some character is known as
- R plasmid
 - QTL
 - Proteome
 - SARs

SECTION A

PART B: WRITE SHORT ANSWERS

(20 MARKS)

Direction:

*In this part there are FOUR questions and each carries 5 marks. All questions are compulsory. Write **SHORT ANSWERS** on the answer sheets provided. Marks will be award based on knowledge of the subject, clarity and preciseness of your response.*

1. Define Paralogs, Orthologs, Homology and Analogy.
Let's consider a gene A in species 1 which at a certain moment is duplicated to form genes A1 and A2. Many million years' later species 1 has evolved into different species 2 and 3. Give example of Paralogs and Orthologs by examining the genes A1 and A2 in species 1, 2, and 3 - support with examples.
2. Explain the procedure of Polymerase Chain Reaction (PCR) and explain the steps involved? How many different DNA molecules 10 nucleotide pair long are possible write one.
3. Define the terms
 - a. Inoculum,
 - b. Necrotroph,
 - c. Race specific resistant
 - d. Saprophytes
 - e. Virulence
4. Explain a Mendel's law? Two black guinea pigs were mated and over several years produced 29 black and 9 white offsprings. Explain these results, giving the genotypes of parents and progeny.

SECTION B

PART B: ANSWERS ONE CASE STUDY

(50 MARKS)

Direction:

*In this part there are **TWO** questions based on the case studies. **CHOOSE ANY ONE** question then write your answer carefully, support it with justification & examples. It carries 50 marks.*

1. There are two ways of enhancing desired traits in varieties of crops, one is through Conventional Plant Breeding and other is Genetic Engineering. The best known example of Genetic Engineering is the use of Bt. genes in corn and other crops for corn borer.
 - a. Should Bhutan go for GMOs or Conventional Breeding in order to produce resistant cultivars for fighting against diseases and insects and ultimately acquire 55% food self sufficiency. Explain your answer and support it with justification for the statement you have chosen?
 - b. What is Genetically Modified Organism or GMOs give one example and explain how to make GMOs?
 - c. You are given rice cultivar A with resistant gene for blast disease of rice and rice cultivar B which is susceptible to the same disease but with other desirable trait liked by Bhutanese farmers. Explain conventional breeding and selection methods to obtain a resistant cultivar against rice blast disease with other desirable traits from cultivar B.
 - d. Some of the Seed Company uses biotechnology to sterilize second generation seed. Should Bhutan Government support this research and promote the genetically modified seed which has three fold more production than the present production, and it is easy for the Ministry of Agriculture to attain 100% food self sufficiency in the first year of 10th FYP. Explain what are the consequences of this kind of technology in Bhutan?
 - e. Should seed industries be allowed to engineer this kind of seeds for the purpose of protecting their intellectual property, Explain?

2. Sorghum is one of the problematic weed for rice production fields in Bhutan and is extremely difficult to control. There were advances in biotechnology and Rice has been genetically engineered to have an herbicide resistant gene. An international donor agency funded the research that engineered rice herbicide resistance, but after examining the potential consequences to Japanese rice production, they refused to allow the rice to be released for Japanese rice production.

A scientist from RNR-RDC Bajo learned of the herbicide resistant rice and requested and received seeds for commercial production. The scientist wanted the seed because using the seed would eliminate the chemical load on the environment, and reduce production costs.

- a. What are the potential harms that could occur from using herbicide resistant rice? Who would be harmed Explain?
- b. What are the potential benefits that could occur from using herbicide resistant rice? who would be benefited by using the herbicide resistant rice
- c. If you were the international research agency executive who decided to ban its use in the Japan, how would you defend your position on moral grounds?
- d. Suppose you are a member of the Sierra Club, which opposes using herbicide resistant crops. What arguments would you use to oppose its use?
- e. Assume that the herbicide resistant rice can be effectively grown for a long time, but the herbicide resistance is transferred to another native plant in the community. What are the moral implications of allowing this change in the native species to occur, Explain?