

The Royal University of Bhutan
Paro College of Education
Spring Semester Examination – 2012

B.Ed (S) IV- Genetics (BIO408)

Full mark: 100

Pass mark: 50

Time: 3 hours

Instructions:

Do not write for the first ten minutes. This time is to be spent reading the questions. This paper consists of two sections A and B. Answer all questions in section A and any six from section B. You are required to give well labeled diagrams where they assist the answers.

Section A (40 marks)

Instruction: *Answer all the questions in this section.*

Question 1

(2x15)

In the following questions there are four possible choices. Choose the most appropriate answer.

- a. Mendel crossed yellow seeded true-breeding pea plant with green seeded pure line pea plant. The F1 hybrid is yellow seeded. This shows that the allele for yellow colour is;
 - A. dominant.
 - B. lethal.
 - C. heterozygous.
 - D. epistatic.

- b. A couple with no usual symptoms has a child with the condition Phenylketonuria (PKU). If their next child is unaffected with PKU, what is the probability that the child is a heterozygous carrier of the mutant PKU allele?
 - A. $1/2$
 - B. $1/4$
 - C. $2/3$
 - D. $1/3$

- c. The F1 individuals obtained in a cross are usually selfed to get the F2 progeny. They can also be crossed with one of the parents. The cross between a hybrid and the recessive parent is a;
 - A. monohybrid cross.
 - B. back cross.
 - C. dihybrid cross.
 - D. test cross.

- d. Diploid cells have;
 - A. two nuclei.
 - B. two sets of homologous chromosomes.
 - C. two mitotic spindles.
 - D. four centromeres.

- e. Consider organisms such as humans where females are XX and males are XY. Which of the following statement is correct?
 - A. Females inherit both their x chromosomes from their mother.
 - B. Females inherit one of their X chromosomes from their father.
 - C. Males inherit their X and Y chromosomes from their father.
 - D. Males inherit Y chromosomes from their mother.

- f. All DNA synthesis requires;
 - A. histones.
 - B. nucleosomes.
 - C. microtubules.
 - D. an RNA or DNA primer.

- g. The minimal number of nucleotides required to encode an aminoacid is;
 - A. one.
 - B. two.
 - C. three.
 - D. four.

- h. Transcription occurs from;
 - A. 3' to 5'.
 - B. N- terminal to C-terminal.
 - C. 5' to 3'.
 - D. C- terminal to N-terminal.

- i. Two dominant independently assorting genes react with each other. They are;
 - A. supplementary.
 - B. duplicate.
 - C. complementary.
 - D. epistatic.

- j. A restriction enzyme;
- A. covalently joins fragments of DNA.
 - B. cleaves DNA at specific sequence.
 - C. polymerizes DNA.
 - D. brings DNA into a cell.
- k. The rod-like chromosomes which have the centromere on the proximal end are;
- A. telocentric.
 - B. metacentric.
 - C. acrocentric.
 - D. sub-metacentric.
- l. A transversion mutation from AT to TA changes the codon from lysine to UAA. This causes chain termination at an incorrect place in a polypeptide. The mutation prematurely ends the polypeptide. The mutation described above is a;
- A. neutral mutation.
 - B. nonsense mutation.
 - C. silent mutation.
 - D. missense mutation.
- m. A chromosomal mutation causes gametes to have too many or too few chromosomes resulting in genetic disorders such as Down's syndrome, Turner's syndrome and Klinefelter's syndrome. These disorders arise as a result of;
- A. deletion.
 - B. translocation.
 - C. inversion.
 - D. non-disjunction.
- n. A colourblind man has a colourblind sister but a normal brother. The phenotype of their parents are;
- a) normal father and a colourblind mother.
 - b) normal mother and a colourblind father.
 - c) both parents are normal.
 - d) both parents are colourblind.
- o. The idea of semiconservative model of DNA was given by;
- A. Watson & Crick.
 - B. Fred Griffith.
 - C. Erwin Chargaff.
 - D. Rosalind Franklin.

Question 2

(1 x 5)

Fill in the blanks with appropriate word(s).

- _____, so called the Father of Genetics, was the first man to conduct decisive experiments in heredity and to formulate basic genetic laws.
- _____ is the chromosomal constitution of a cell or organism having three or more sets of chromosomes.
- DNA replication begins at the initiation site called_____.
- Synapsis occurs during the _____stage of the first prophase of meiosis.
- Any agent that can bring about sudden heritable changes in the gene is called a _____.

Question 3

(1 x 5)

Define the following terms.

- Gene.
 - Epistasis.
 - Okazaki fragments.
 - Phenotype.
 - Variation.
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Section B (60 marks)

Instruction: *There are seven sets of questions in this section. You are asked to write **any six**. All questions carry equal marks.*

Question 4

(1+6+3)

- State the Mendel's Law of Segregation.
- Give examples to show how the law of segregation plays an important role in inheritance. Calculate the genotypic and phenotypic ratios of the F₂ individuals.
- Give an example of codominance in animals **OR** Give an example of Lethal genes in man.

Question 5

(2+6+2)

A pea plant with white flowers when crossed with another pea plant with red flowers produced 60 plants with pink flowers. When these pink flowers are self-pollinated produced 60 red flowers, 120 pink flowers and 60 white flowers.

- Give the scientific name and the family to which the pea plant belongs.
- Explain the genetics behind these results.
- Define the phenomenon explaining the above genetic interaction.

Question 6

(1+2+7)

- What is a dihybrid cross?
- State the Law of Independent Assortment.
- With the help of suitable examples, work out the genotypic and phenotypic ratios of the F₂ offspring in the dihybrid inheritance.

Question 7

(2x5)

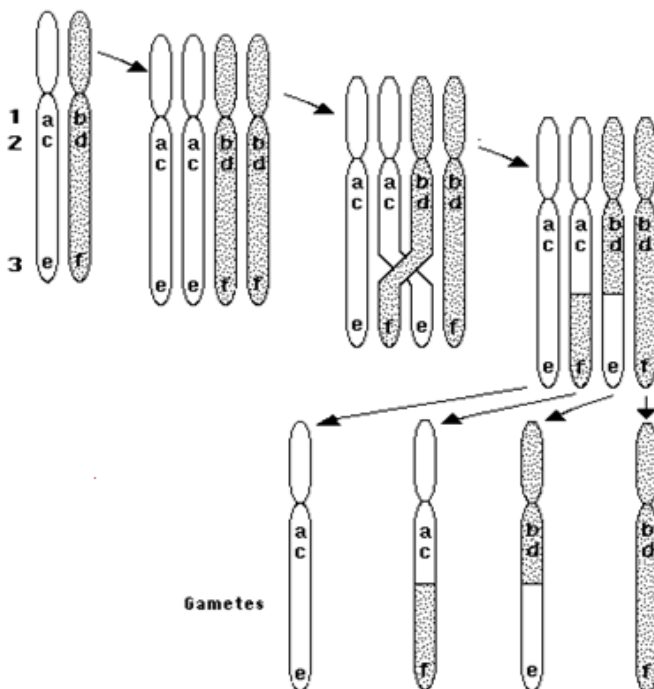
Differentiate between (**any five**) the following pairs.

- Mitosis and Meiosis.
- Homozygous gene and Heterozygous gene.
- Duplication and Inversion.
- Nullisomy and Tetrasomy.
- Linkage and Crossing over.
- Female heterogamy and Male heterogamy.

Question 8

(2+4+2+2)

The following illustration shows genetic recombination in the sex cells during meiosis.



- Name the process and define it.
- Discuss the mechanism shown in the above figure.
- Explain the different types with suitable diagrams.
- Give the genetic significance shown as a result of the above mechanism.

Question 9

(5+5)

- a. Explain the mechanism of DNA replication using proper diagrams.
- b. Describe the important characteristic features of the common genetic code.

Question 10

(2x5)

Write short notes on **any two** of the following.

- a. Nucleosome model of chromosomes.
- b. Recombinant DNA technology.
- c. Sex-linkage in man
- d. Multiple allelism