14 (BOT–2) 2016

2024

BOTANY

Paper : BOT–2016

(Cytogenetics, Plant Breeding and Evolution)

Full Marks : 80

Time : Three hours

The figures in the margin indicate full marks for the questions.

The levels of Bloom's Taxonomy are indicated in the bracket [ ] at the end of each question.

1. Choose the correct answer : 1×8=8

   (i) What is the key component of the modern theory of evolution ? [K1]

   (a) Inheritance of acquired characteristics

   (b) Natural selection

   (c) Spontaneous generation

   (d) Use and disuse of organs

(ii) What is the primary function of telomeres in a chromosome? [K2]

(a) Regulation of gene expression

(b) Protection of chromosome ends

(c) Initiation of DNA replication

(d) Synthesis of ribosomal RNA

(iii) During which phase of the cell cycle does DNA replication occur? [K1]

(a) Gl phase

(b) S phase

(c) G2 phase

(d) M phase

(iv) Which method of plant breeding involves crossing a hybrid back with one of its parents? [K3]

(a) Distant hybridization

(b) Barrier to distance hybridization

(c) Back Cross

(d) Quantitative characters breeding

(v) Which of the following statements is true regarding the C-value paradox? [K4]

(a) It refers to the mismatch between genome size and organism complexity

(b) It explains the relationship between DNA content and cell size

(c) It describes the process of DNA replication during mitosis

(d) It is related to the regulation of gene expression

(vi) What type of DNA sequences are found repetitively in the genome? [K4]

(a) Introns

(b) Exons

(c) Unique sequences

(d) Repetitive sequences

(vii) What is the main feature of synthetic theory of evolution? [K5]

(a) It emphasizes the importance of acquired characteristics

(b) It solely relies on gradualism for species change

(c) It combines natural selection and genetic drift

(d) It rejects the concept of common ancestry

(viii) Evaluate the importance of the CAP-cAMP complex in the regulation of the *lac* operon. [K5]

(a) It acts as a repressor for the *lac* operon

(b) It enhances the binding of RNA polymerase to the promoter, increasing transcription

(c) It inhibits the binding of RNA polymerase to the promoter, decreasing transcription

(d) It degrades lactose within the cell

2. Write briefly on the following : ***(any four)*** 3×4=12

(a) Describe the principle of distant hybridization in plant breeding and the challenges it poses. [K1]

(b) Explain the structural differences between prokaryotic and eukaryotic chromosomes. [K2]

(c) Discuss the significance of crossing over. [K2]

(d) Explain the concept of transposable genetic elements and their significance in genetic diversity. [K3]

(e) How does Wiseman's theory differ from Darwin's theory of natural selection ? [K3]

(f) Discuss the significance of telomeres and centromeres in chromosome structure and function. [K4]

3. Write briefly on the following : ***(any four)*** 5×4=20

(a) Explain the difference between a reverse mutation and a suppressor mutation. [K2]

(b) Discuss the challenges faced in handling quantitative data in plant breeding experiments. [K2]

(c) Discuss how an inborn error of metabolism can affect a metabolic pathway. [K2]

(d) Explain the difference between euchromatin and heterochromatin highlighting their structural and functional characteristics. [K3]

(e) Analyze the significance of crossing over in the process of genetic linkage mapping and explain how it helps in determining the relative distances between genes on a chromosome. [K4]

(f) Evaluate the importance of DNA damage and repair mechanisms in maintaining genomic stability. [K5]

4. Answer ***any four*** of the following : 10×4=40

(a) Explain the C-value paradox and its implications for our understanding of genome organization. How does this paradox challange traditional view of DNA content and organization complexity ? 7+3=10 [K2]

(b) Describe the mechanisms of transcriptional regulation in prokaryotes, focussing on the operon systems of lactose, tryptophan, and arabinose metabolism. How do these systems respond to environmental changes ? 7+3=10 [K2]

(c) Compare and contrast Lamarckism, Darwinism, and synthetic theory of evaluation. How have these theories contribute to our current understanding of evolutionary processes ? 8+2=10 [K4]

(d) Analyze the barriers to distant hybridization in plant breeding. How can these barriers be overcome using modern techniques ? Provide examples to support your analysis. 6+2+2=10 [K4]

(e) Evaluate the roles of euchromatin and heterochromatin in gene expression. How do these forms of chromatin contribute to the regulation of the cell cycle ? 6+4=10 [K5]

(f) Evaluate the impact of spontaneous, reverse, and suppressor mutations on genetic stability and variation. What role do transposable genetic elements play in these processes ? 6+4=10 [K5]
