

DSCC5 Model Questions

Unit 1: Structures of DNA and RNA / Genetic Material

Credits:4

Very short answer type/one word questions (1 mark each)

SL. No.

1. What is meant by the pitch of a double helix?
2. State Chargaff's rules.
3. What is nuclein?
4. What is puckering?
5. How is T_m dependent on GC content of genomes?
6. State the relation between linking number, twist and writhe.
7. What is a chromatosome?
8. What do you mean by maternal inheritance?
9. State any one uniqueness of a mitochondrial gene.
10. On what factors does cot value depend?

Short answer type questions (2 marks each)

Sl. No.

1. What conformation does the double stranded region of RNA adopt and why?
2. Why is B DNA the functionally active form of the double helix?
3. Explain the biological significance of A DNA.
4. Chargaff's analysis of certain prokaryotic genomes helped him to predict their habitat - Justify this statement.
5. Why can't DNA binding proteins sit and bind to A DNA conformers?
6. Explain with diagrams what is meant by syn and anti conformations of nucleotides.
7. There are 3×10^6 bp in a DNA molecule. Assuming that it is in B DNA form, calculate the linear length.
8. Why did Hershey and Chase specifically choose phosphorus and sulphur radioisotopes for their experiment and not any other element?
9. Why is cot curve generally plotted in a semi-logarithmic form?

10. Differentiate between a chromosome and a chromatin.
11. State the unique features of histone proteins.

Broad answer type questions (greater than 2 marks)

Sl. No

1. How did Chargaff's findings help Watson and Crick reconcile the uniform helix diameter of B-DNA?
2. How did Watson and Crick find out from their densitometric data that the helix is actually made up of two strands?
3. You have been given the whole genome of an unknown organism. How can you find out whether it belongs to a eukaryote or a prokaryote?
4. Why was DNA selected as a better suited genetic material than RNA in evolution?
5. Describe the experiment that conclusively showed that RNA can be the genetic material of some viruses?
6. Describe the experiment carried out by Hershey and Chase to show that DNA and not protein is the genetic material of viruses.
7. Higher molarity of sodium chloride causes elevation of T_m in B DNA but not in A DNA. Explain.
8. Draw the Cot curve of a typical eukaryotic genome and explain its different regions.
9. Describe with an experiment the importance of RNA molecules in the stabilisation of a nucleoid?
10. What are non-histone proteins. State the role of non-histone proteins in maintenance of chromosome architecture.
11. What is endosymbiotic hypothesis? Cite evidences in favour of endosymbiotic hypothesis.

Unit 2: Replication of DNA (Prokaryotes and Eukaryotes)

Very short answer type/one word questions (1 mark each)

SL. No.

1. What do you mean by a primosome complex?
2. Why is the $oriC$ region AT rich in nature?
3. Give an example of a DNA bending protein.
4. What is the function of SSB protein?

5. Theta mode of replication is also known as _____ mode of replication.
6. Replication of which strand will be affected more by rifampicin, leading or lagging strand? Explain.
7. Name any one mechanism by which multiple initiation of replication is regulated in *E. coli*.
8. What do you mean by a replisome?
9. What is ARS?
10. If an ARS sequence and *oriC* sequence are deleted respectively from a eukaryotic and a prokaryotic genome respectively, can those genomes still replicate? Explain

Short answer type questions (2 marks each)

SL No.

1. What is a concatemeric DNA? How is it generated?
2. State the characteristic features of an *oriC* region.
3. Differentiate between RNA polymerase and primase
4. Why are bypass polymerases inducible in nature?
5. State the significance of Tus protein in replication.
6. What is nick translation?
7. State the role of DNA gyrase in replication.
8. What will be the effect of mutation of the following genes on *E. coli*?
a) *dnaB* b) *dnaC* c) *dna pol V* d) *mutH*
9. Primers used in lagging strand synthesis are mostly made by primase. Is there any other source of these primers inside the cell?
10. How do plasmids replicate?
11. Does plasmid replication depend on primers? Explain

Broad answer type question (more than 2 marks)

SL. No.

1. Why does replication always take place from 5 prime to 3 prime direction?
2. What is dispersive mode of replication? How did Messelson and Stahl disprove dispersive mode? Can the semi conservative mode be proved by growing the *E. coli* cells in N14 for a single generation only?

3. What are quick stop and slow stop mutants of replication? Cite two examples of each
4. What is a bypass polymerase? Why is it named so?
5. Why are eukaryotic okazaki fragments shorter in length than their eukaryotic counterparts?
6. In *E. coli*, generation time changes depending upon the medium of growth. Explain how this is made possible given the constant replication rate of 1000 nt/sec.
7. Design an experiment to prove that mismatch repair is methyl directed.
8. State how D loop replication in mitochondria resembles prokaryotic replication.
9. State the significance of telomerase in eukaryotic replication. Why should telomerase activity be tightly regulated?
10. The *E. coli* chromosome often gets dimerised due to formation of aberrant homology mediated cross-overs. Explain how these are resolved?
11. Differentiate between base excision repair and nucleotide excision repair.

Unit 3: Transcription in Prokaryotes and Eukaryotes

Very short answer type/one word answer type questions (1 mark each)

SL. No.

1. What is a Pribnow box?
2. Name the protein which causes transcription termination.
3. What is a transcription bubble and what is its length?
4. What should be the minimum distance between two promoter elements for successful binding and transcription by RNA polymerase?
5. Name an antibiotic which inhibits transcription.
6. What are transcription factors?
7. What is the significance of 'rut' site in transcription?
8. How many subunits are there prokaryotic RNA polymerase? Name them.
9. Name the catalytic subunit of prokaryotic RNA polymerase. Which is the first nucleotide generally inserted by RNA polymerase opposite to the DNA template?

Short answer type question (2 marks each)

SL. No.

1. Differentiate between an open promoter complex and a closed promoter complex.
2. What is an UP element? State its significance.
3. What is the general difference in promoter structures of constitutive and inducible genes?
4. What is backtracking of RNA polymerase?
5. What are abortive transcripts?
6. The sigma factor generally remains attached to the core RNA polymerase till about first 12 nucleotides and then dissociates. Explain why this happens?
7. What are enhancers and silencers?
8. Is it sufficient to have only intrinsic/sequence dependent termination? Explain.
9. Why is the mechanism of RNA polymerase primer independent?

Broad answer type question (more than 2 marks)

SL. No.

1. For genes which have an in frame stop codon generated due to mutation, it is often found that the distal ends of the corresponding transcripts are missing. Explain this observation.
2. Rho can dislodge RNA polymerase before it finishes the transcript. Explain how the cell avoids this?
3. Explain how sequence dependent transcription termination happens in prokaryotes?
4. Without the sigma factor, core RNA polymerase can bind anywhere to the genome. Explain then why sigma factor is needed.
5. Cite one evidence to show that transcription and translation are coupled in prokaryotes.
6. State categorically the roles of -10 sequence and -35 sequence in transcription. Which one is indispensable and why?
7. Transcription factors used by eukaryotes generally possess a conserved DNA binding motif. State the structure of any one of such motifs giving a relevant example.
8. Describe the events which mark the transition from a closed promoter complex to an open promoter complex?
9. What is a leucine zipper motif? Why is it called so?

Unit 4 Post Transcriptional Processing

Very short answer type/one word answer type questions (1 mark each)

SL. No.

1. Define split genes or interrupted genes.
2. What is alternative splicing?
3. What is spliceosome?
4. Define the term “siRNA” and “miRNA”
5. What is DICER?
6. What is RISK?

Short answer type question (2 marks each)

SL. No.

1. Write the significance of split genes.
2. Write the basic structure of an intron.
3. Distinguish between Group I and Group II introns.
4. Write down the significance of alternative splicing.
5. What is the function of miRNA?

Broad answer type question (Above 2 marks)

SL. No.

1. How does spliceosome work explain with a simple diagram. 4
2. Write the major categories of pathologies resulting from aberrant splicing with examples. 3
3. How do siRNA and miRNA affect gene expression? 3
4. How is rRNA processed? 3

Unit 5 Translation

Very short answer type/one word answer type questions (1 mark each)

SL. No.

1. What are the 3 stages of protein translation?

2. Write the raw materials of protein translation
3. What do you mean by polysome?
4. What codon is replaced in sickle cell anemia?
5. What is selenoprotein?
6. What are the 21st and 22nd amino acids in protein translation?

Short answer type question (2 marks each)

SL. No.

1. What is the function of fmet tRNA?
2. Compare the subunit composition of prokaryotic and eukaryotic ribosomes.
3. Name the inhibitors of protein synthesis one each for prokaryote and eukaryote.
4. Why is the genetic code degenerate?
5. State the importance of Shine Dalgarno sequence in translation.
6. Mention the different initiation factors that are involved in prokaryotic translation.
7. Justify the statement, "tRNA with one anticodon can read more than one codon"
8. Explain why codons are triplet in nature.
9. Why are transcription and translation coupled in bacteria?

Board answer type questions (3 marks each)

SL. No.

1. How do the release factors recognize stop codons?
2. How does activation of tRNA with suitable amino acid take place?
3. Calculate the overall free energy change of aminoacylation of tRNA.
4. How are tRNA synthetases involved in fidelity of translation?

Unit 6 : Regulation of gene expression in Prokaryotes and Eukaryotes

Very short answer type/one word answer type questions (1 mark each)

SL. No.

1. What endonuclease catalysed the mating type switching of yeast?
2. Which type of mating is usually found in haploid yeasts?
3. In which chromosome number the mating type locus MAT is located?
4. What is epigenetics?
5. What happens by methylation imbalance?
6. Write an exception of CpG island with unmethylation.
7. What type of modification is histone acetylation?
8. Which amino acid residue is acetylated in histone tail?
9. Which enzyme catalyses the acetylation of histone?
10. What is a gratuitous inducer?
11. Name one cis- acting element in lac operon.
12. Which type of regulation involves removal of an inhibitor?
13. When glucose is present, is the concentration of cAMP low or high?
14. What are the daughter cells that are formed when the septum forms near the poles of the cell, called ?
15. In which growth phase does sporulation take place in bacteria?
16. Give an example of a microorganism in which endogenous spores are produced.
17. What is a repressible operon?
18. What do you mean by merodiploid ?
19. Give an example of a spore forming bacteria.
20. What is an exospore?
21. What molecule is used to signal low glucose levels to the Lac operon regulatory system?
22. What is the function of IPTG?
23. What is the role of tryptophan in trp operon?

Short answer type question (2 marks each)

SL. No.

1. Write the names of two best epigenetic mechanisms.
2. What are the three types of methylated bases found in DNA?
3. What is SAM and DNMT?
4. What is CpG island?
5. What is the difference between histone methylation & histone acetylation?
6. What does histone acetylation do to transcription?
7. Is it necessary for the operator to be adjacent to the promoter?
8. Is the attenuator a protein binding site? explain.
9. How do lactose enter an uninduced cell to initiate lac gene expression?
10. What is a constitutive mutation? explain.
11. What is an endospore?
12. What is the difference between conidiospores and cysts?
13. What do you mean by polycistronic gene?

Broad answer type question (more than 2 marks)

SL. No.

1. Write a short note on Yeast mating type switching.
2. Write short note on DNA methylation
3. Write short note on DNA Acetylation
4. Describe the sporulation cycle.
5. With a suitable diagram describe the structure of a spore.
6. Draw the structure of lac operon.
7. Describe the leader sequence in trp operon.
8. What is the function of attenuator in trp operon? Explain with a diagram.
9. Discuss about the clinical significance of bacterial spores.
10. How does lactose (allolactose) promote transcription of LacZ?