DPP - Daily Practice Problems

Chapter-wise Sheets

Date : _____ **Start Time :** _____ **End Time :** _____

BIOLOGY CB28

SYLLABUS : Molecular Basis of Inheritance

Max. Marks : 180 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. Which form of RNA has a structure resembling clover leaf?
(a) rRNA (b) hn RNA
(c) m RNA (d) t RNA

2. Other than DNA polymerase, which is/ are the enzyme(s) involved in DNA synthesis?
(a) Topoisomerase (b) Helicase
(c) RNA primase (d) All of these

3. The enzyme used for joining two DNA fragments is called:
(a) ligase (b) restriction endonuclease
(c) DNA polymerase (d) gyrase

4. Nucleotide arrangement in DNA can be seen by
(a) X-ray crystallography
(b) electron microscope
(c) ultracentrifuge
(d) light microscope

5. The okazaki fragments in DNA chain growth
(a) polymerize in the 3' - to - 5' direction and forms replication fork
(b) prove semi-conservative nature of DNA replication
(c) polymerize in the 5' - to - 3' direction and explain 3' - to - 5' DNA replication
(d) result in transcription

6. Reverse transcriptase is
(a) RNA dependent RNA polymerase
(b) DNA dependent RNA polymerase
(c) DNA dependent DNA polymerase
(d) RNA dependent DNA polymerase

7. Telomerase is an enzyme which is a
(a) simple protein
(b) RNA
(c) ribonucleoprotein
(d) repetitive DNA

8. DNA template sequence of CTGATAGC is transcribed over mRNA as
(a) GUCTUTCG (b) GACUAUCG
(c) GAUTATUG (d) UACTATCU

RESPONSE GRID					
1. ⓐⓑⓒⓓ	**2.** ⓐⓑⓒⓓ	**3.** ⓐⓑⓒⓓ	**4.** ⓐⓑⓒⓓ	**5.** ⓐⓑⓒⓓ
6. ⓐⓑⓒⓓ	**7.** ⓐⓑⓒⓓ	**8.** ⓐⓑⓒⓓ		

Space for Rough Work

9. During replication of a bacterial chromosome DNA synthesis starts from a replication origin site and
(a) RNA primers are involved
(b) is facilitated by telomerase
(c) moves in one direction of the site
(d) moves in bi-directional way

10. The enzyme, which helps to cut one strand of DNA duplex to release tension of coiling of two strands is
(a) DNA ligase
(b) DNA polymerase I
(c) topoisomerase
(d) helicase or unwindases

11. Histones are
(a) glycoproteins (b) mucoproteins
(c) basic proteins (d) acid proteins

12. One gene-one enzyme relationship was established for the first time in
(a) *Salmonella typhimurium*
(b) *Escherichia coli*
(c) *Diplocococcus pneumoniae*
(d) *Neurospora crassa.*

13. The transforming principle of *Pneumococcus* as found out by Avery, MacLeod and McCarty was
(a) mRNA (b) DNA
(c) protein (d) polysaccharide

14. How many pair of nucleotides are present in one helix of B- DNA?
(a) 10 (b) 12
(c) 5 (d) 6

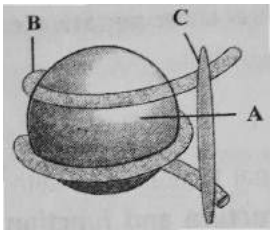
15. Read the following four statements (i - iv).
(i) In transcription, adenosine pairs with uracil.
(ii) Regulation of *lac* operon by repressor is referred to as positive regulation.
(iii) The human genome has approximately 50,000 genes.
(iv) Haemophilia is a sex-linked recessive disease.
How many of the above statements are correct?
(a) Two (b) Three
(c) Four (d) One

16. In negative operon
(a) co-repressor binds with repressor
(b) co-repressor does not bind with repressor
(c) co-repressor binds with inducer
(d) cAMP have negative effect on *lac* operon

17. Transfer of genetic material from one bacterium to another in the transduction process is through
(a) conjugation
(b) bacteriophages
(c) another bacterium
(d) physical contact between donor and recipient strain

18. Telomere and eukaryotic chromosome possesses short segments of
(a) guanine rich repeats.
(b) thymine rich repeats.
(c) cytosine rich repeats.
(d) adenine rich repeats.

19. Refer the given figure of nucleosome and select the option that correctly identifies the parts A, B and C.



	A	B	C
(a)	DNA	Histone octamer	H_1 histone
(b)	Histone octamer	H_1 histone	DNA
(c)	Histone	DNA	H_1 histone
(d)	DNA	H_1 histone	Histone octamer

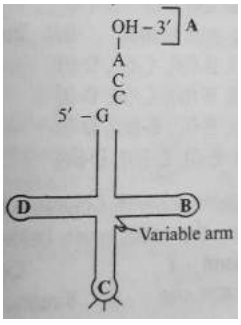
20. The process of transformation is not affected by which of the following enzymes?
A. DNase B. RNase
C. Peptidase D. Lipase
(a) A, B (b) A, B, C, D
(c) B, C, D (d) A, B, C

21. Select the incorrect statement regarding DNA replication
(a) Leading strand is formed is 5' $\rightarrow$ 3' direction
(b) Okazaki fragments are formed in 5' $\rightarrow$ 3' direction
(c) DNA polymerase catalyses polymerisation in 5' $\rightarrow$ 3' direction
(d) DNA polymerase catalyses polymerisation in 3' $\rightarrow$ 5' direction

RESPONSE GRID					
	9. (a)(b)(c)(d)	**10.** (a)(b)(c)(d)	**11.** (a)(b)(c)(d)	**12.** (a)(b)(c)(d)	**13.** (a)(b)(c)(d)
	14. (a)(b)(c)(d)	**15.** (a)(b)(c)(d)	**16.** (a)(b)(c)(d)	**17.** (a)(b)(c)(d)	**18.** (a)(b)(c)(d)
	19. (a)(b)(c)(d)	**20.** (a)(b)(c)(d)	**21.** (a)(b)(c)(d)		

Space for Rough Work

22. Identify the labels A, B, C and D in the given structure of tRNA and select the correct option.

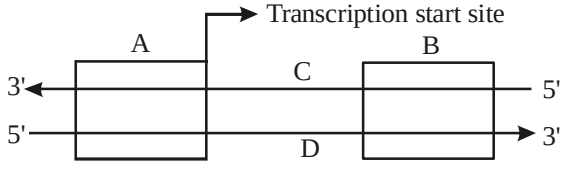


	A	B	C	D
(a)	Anticodon loop	TΨC loop	AA binding stie	DHU loop
(b)	AA binding site	TΨC loop	Anticodon loop	DHU loop
(c)	AA binding site	DHU loop	Anticodon loop	TΨC loop
(d)	AA binding site	DHU loop	TΨC loop	Anticodon loop

23. In one polynucleotide strand of a DNA molecule the ratio of A + T/G + C is 0.3. What is the A + G/T + C ratio of the entire DNA molecule?
(a) 0.3 (b) 0.6
(c) 1.2 (d) 1

24. Chemically, RNA is (i) reactive and (ii) stable as compared to DNA.
(a) (i) equally, (ii) equally
(b) (i) less, (ii) more
(c) (i) more, (ii) less
(d) (i) more, (ii) equally

25. Given diagram represents the components of a transcription unit. Select the correct answer regarding it.



	A	B	C	D
(a)	Teminator	Promoter	Template strand	Coding strand
(b)	Promoter	Terminator	Coding strand	Template strand
(c)	Promoter	Terminator	Template strand	Coding strand
(d)	Terminator	Promoter	Coding strand	Template strand

26. In transcription in eukaryotes, heterogenous nuclear RNA (hnRNA) is transcribed by
(a) RNA polymerase I
(b) RNA polymerase II
(c) RNA polymerase III
(d) all of these

27. What would happen if in a gene encoding a polypeptide of 50 amino acids, 25th codon (UAU) is mutated to UAA?
(a) A polypeptide of 24 amino acids will be formed.
(b) Two polypeptides of 24 and 25 amino acids will be formed
(c) A polypeptide of 49 amino acids will be formed
(d) A polypeptide of 25 amino acids will be formed

28. Regulation of gene expression occurs at the level of
(a) transcription (b) processing/splicing
(c) translation (d) all of these

29. Find out the wrong sentence about heterochromatin.
(a) It is densely packed
(b) It stains dark
(c) It is transcriptionally active
(d) It is late replicating

30. Other than DNA polymerase, which are the enzymes involved in DNA synthesis?
(a) topoisomerase (b) helicase
(c) RNA primase (d) all of these

31. What does "*lac*" refer to in what we call the *lac* operon?
(a) The number 1,00,000 (b) Lactose
(c) Lactase (d) *Lac* insect

32. The error rate of changing an incorrect base with another incorrect base during proofreading is
(a) 1 in 10 bases (b) 1 in 100 bases
(c) 1 in 1,000 bases (d) 1 in 10,000 bases

RESPONSE GRID					
	22. ⓐⓑⓒⓓ	**23.** ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ	**25.** ⓐⓑⓒⓓ	**26.** ⓐⓑⓒⓓ
	27. ⓐⓑⓒⓓ	**28.** ⓐⓑⓒⓓ	**29.** ⓐⓑⓒⓓ	**30.** ⓐⓑⓒⓓ	**31.** ⓐⓑⓒⓓ
	32. ⓐⓑⓒⓓ				

Space for Rough Work

33. DNA fingerprinting refers to
(a) molecular analysis of profiles of DNA samples
(b) analysis of DNA samples using imprinting devices
(c) techniques used for molecular analysis of different specimens of DNA
(d) techniques used for identification of fingerprints of individuals

34. In negative operon
(a) co-repressor binds with repressor
(b) co-repressor does not bind with repressor
(c) co-repressor binds with inducer
(d) cAMP have negative effect on *lac* operon

35. Genes that are involved in turning on or off the transcription of a set of structural genes are called
(a) Operator genes (b) Redundant genes
(c) Regulator genes (d) Polymorphic genes

36. If the gene encoding the *lac* repressor is mutated so that it can no longer bind the operator, will transcription of that operon occur?
(a) Yes, but only when lactose is present.
(b) No, because RNA polymerase is need to transcribe the genes.
(c) Yes, because the operator will not be bound by repressor and RNA polymerase can transcribe the *lac* operon.
(d) No, because cAMP levels are low when the repressor is nonfunctional.

37. Transcriptional regulation in prokaryotes can occur by
(a) a repressor binding an operator and preventing transcription.
(b) an activator binding upstream from a promoter and positively affecting transcription.
(c) different promoter sequences binding RNA polymerase more tightly, resulting in more effective transcriptional initiation.
(d) All of the above

38. Process used for amplication or multiplication of DNA for finger printing is
(a) polymerse chain reaction
(b) nesslerisation
(c) southern blotting
(d) northern blotting

39. Lactose operon produces enzymes
(a) β-galactosidase, permease and glycogen synthetase.
(b) β-galactosidase, permease and transacetylase.
(c) Permease, glycogen synthetase and transacetylase.
(d) β-galactosidase, permease and phosphoglucose isomerase.

40. Satellite DNA
(a) is classified in many categories such as micro-satellites, minisatellites, etc. on the basis of base composition length of segments and number of repetitive units.
(b) normally does not code for any protein.
(c) shows polymorphism.
(d) forms the basis of DNA finger printing.

41. In prokaryotes, gene regulation occurs at the level of
(a) transcription (b) translation
(c) post-transcription (d) post-translation

42. The regulation of tryptophan synthesis in *E. coli* is an example of affecting gene expression through
(a) translational control.
(b) transcriptional control.
(c) homeotic gene control.
(d) breaking down mRNA molecules.

43. Transcription in prokaryotic cell is :
(a) initiated at a promoter using one of three RNA polymerases (RNA polymerase II).
(b) initiated at a start codon with the help of initiation factors and the small subunit of the ribosome.
(c) initiated at a promoter and uses only one strand of DNA, the template strand, to synthesize a complementary RNA strand.
(d) is terminated at stop codons.

44. DNA replication is an _____ process and _____ energy.
(a) exergonic; does not require
(b) endothermic; does require
(c) endergonic; does require
(d) endothermic; does not require

45. Which one of the following triplet codes, is correctly matched with its specificity for an amino acid in protein synthesis or as 'start' or 'stop'codon ?
(a) UAC – Tyrosine (b) UCG – Start
(c) UUU – Stop (d) UGU – Leucine

RESPONSE GRID					
	33. ⓐⓑⓒⓓ	**34.** ⓐⓑⓒⓓ	**35.** ⓐⓑⓒⓓ	**36.** ⓐⓑⓒⓓ	**37.** ⓐⓑⓒⓓ
	38. ⓐⓑⓒⓓ	**39.** ⓐⓑⓒⓓ	**40.** ⓐⓑⓒⓓ	**41.** ⓐⓑⓒⓓ	**42.** ⓐⓑⓒⓓ
	43. ⓐⓑⓒⓓ	**44.** ⓐⓑⓒⓓ	**45.** ⓐⓑⓒⓓ		

Space for Rough Work

DAILY PRACTICE PROBLEM DPP CHAPTERWISE 28 - BIOLOGY			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	55	Qualifying Score	65
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

HINTS & SOLUTIONS

DPP /CB28

1. (d) rRNA occurs inside ribosomes. m RNA brings information from DNA to polypeptides. hnRNA are heterogenous nuclear RNA.

2. (d) (a) **Helicase** also known as unwindase, these enzymes separate the two strands of DNA.
(b) **Topoisomerases :** Tension produced by unwinding of DNA strands is reduced by these enzymes.
(c) **RNA Primase :** This is an RNA polymerase, which helps in the synthesis of a small fragment of RNA called primer.

3. (a) DNA ligase is the enzyme which helps in joining two fragments of DNA. The enzyme is used in DNA replication as it joints the Okazaki segments (also in proof reading). It also finds its use in genetic engineering as it can join two or more desired nucleotide sequences of DNA.

4. (a) In 1953 Wilkins obtained very fine X-ray crystallographic pictures of DNA from which Watson and Crick developed the double helix model of DNA.

5. (c) Okazaki fragments in DNA are linked up by the enzyme DNA *ligase*. Replication always occurs in 5' - 3' direction. Okazaki fragments synthesized on 3' - 5' DNA template, join to form lagging strand which grows in 3' - 5' direction.

6. (d) The phenomenon of making DNA over RNA genome through enzyme reverse transcriptase is called reverse transcription or teminism.

7. (c) Telomerase is a ribonucleoprotein which synthesize the rich strand of telomers in DNA. **Telomerase** is an enzyme that adds specific DNA sequence repeats ("TTAGGG" in all vertebrates) to the 3' ("three prime") end of DNA strands in the telomere regions, which are found at the ends of eukaryotic chromosomes. The telomeres contain condensed DNA material, giving stability to the chromosomes. The enzyme is a reverse transcriptase that carries its own RNA molecule, which is used as a template when it elongates telomeres, which are shortened after each replication cycle. Telomerase was discovered by Carol W. Greider in 1984.

8. (b) During transcription, from the DNA template, complementary mRNA is formed and thymine is replaced by uracil.

9. (d) Replication begins at the *Ori* - origin of replication and proceeds on both sides from the Ori. Unidirectional replication is rare. RNA primers are involved in both prokaryotes and eukaryotes.

10. (c) During the process of replication the enzyme that helps to cut one strand of DNA duplex to release the tension of coiling of two strands is topoisomerase.

11. (c)

12. (d) It was given by Geneticists George W. Beadle and E. L. Tatum which states that each gene in an organism controls the production of a specific enzyme. It is these enzymes that catalyze the reactions that lead to the phenotype of the organism.

13. (b) The transforming chemical discovered by Griffith in his experiments with *Pneumococcus*, was confirmed as DNA by Avery, McLeod and McCarty.

14. (a)

15. (a) Statement (i) and (iv) are / is correct
Regulation of *lac* operon by repressor is referred to as negative regulation. In negative regulation, a repressor molecule binds to the operator of an operon and terminates transcription. In positive regulation, an activator interacts with the RNA polymerase in the promoter region to initiate transcription. Human genome contains some 20,000-25,000 billion genes bases.

16. (a) In negative (repressible) operon, the repressor co-repressor complex binds with the operator. The free repressor cannot bind to the operator.

17. (b)

18. (a)

19. (c) In eukaryotes, DNA organization is complex. There is a set of positively charged, basic proteins called histones. Histones are rich in the basic amino acid residues lysine and arginine. There are five types of histone proteins – H_1, H_2A, H_2B, H_3 and H_4. Four of them (H_2A, H_2B, H_3 and H_4) produce histone octamer called nu body or core of nucleosome. The negatively charged DNA is wrapped around the positively charged histone octamer to form nucleosome. DNA connecting two adjacent nucleosomes is called linker DNA which bears H_1 histone proteins.

20. (c) Transformation is a phenomenon by which DNA isolated from one type of cell when introduced into another type is able to give some of its properties to the latter. In 1944, Avery, McCarty and MacLeod discovered that protein-digesting enzymes (proteases) and RNA-digesting enzymes (RNase) did not affect transformation, so the transforming substance was not a protien or RNA. Digestion with DNase did inhibit transformation, suggestion that the DNA caused did inhibit transformation, suggesting that the DNA caused the transformation. They concluded that DNA is the hereditary material.

21. (d) Synthesis in DNA by DNA polymerases occurs only in 5' $\rightarrow$ 3' direction. One strand called leading strand, is copied in the same direction as the unwinding helix. The other strand is known as the lagging strand. Replication of lagging strand is in a discontinuous way, synthesizing short segments of DNA which are always in the 5' $\rightarrow$ 3' direction. These short segments are called Okazaki fragments joined together by the action of DNA ligase.

22. (b) In tRNA, there is a TΨC loop which contains pseudouridine and ribothymidine. The loop is the site for attaching to ribosomes. Another loop, DHU loop contains dihydrouridine. It is binding site for aminoacyl synthetase enzyme. tRNA molecules have unpaired (single stranded) CCA–OH sequence at the 3' end. This is called amino acid attachment site, because the amino acid becomes covalently attached to adenylic acid or A of CCA sequence during polypeptide synthesis. Anticodon loop is made up of three nitrogen bases for recongnising and attaching to the codon of mRNA.

23. (d) According to Chargaff's rules (1950), purine and pyrimidine base pairs are present in equal amounts in a DNA molecule.
i.e., [A + G] = [T + C]

$$\text{or } \frac{[A+G]}{[T+C]} = 1 .$$

24. (c) 2'–OH group present in ribose sugar of every nucleotide of RNA is a reactive group. Uracil present in RNA is less stable as compared to thymine (= methyl uracil) of DNA. Being unstable, RNA mutates at a much faster rate and there is no repairing system. That is why RNA viruses have shorter life span. They mutate and evolve very fast.

25. (c) The segment of DNA that takes part in transcription is called transcription unit. It has three components (i) a promoter, (ii) the structural gene and (iii) a terminator. Besides a promoter, eukaryotes also require an enhancer. Promoter is located upstream of structural gene. It is called 5' end of the coding strand which is 3' end of template strand. Terminator region is present downstream of structural gene at the 3' end of coding strand which if actually 5' end of the template strand. Promoter has different parts for attachment to various transcription factors. In many cases, the promoter has an AT rich region called TATA box. The area has a groove to which specific protein components can combine. TATA containing region is also called Pribnow box.

26. (b) Eukaryotes have three RNA polymerases. RNA polymerase I is located in the nucleolus and transcribes for rRNAs (28s, 18s and 5.8S), RNA polymerase II is localized in the nucleoplasm and used for hnRNA, mRNA and RNA polymerase III is localized in the nucleus, possibly the nucleolar-nucleoplasm interface and transcribes for tRNA, 5s tRNA and snRNAs.

27. (a) UAA is a nonsense codon. It signals for polypeptide chain termination. Hence, only 24 amino acids chain will be formed.

28. (d) Regulation of gene expression can be exerted at four levels:
(i) Transcriptional level during formation of primary transcript.
(ii) Processing like splicing, terminal additions or modifications
(iii) Transport of RNAs from nucleus to cytoplasm and
(iv) Translational level

29. (c) A typical nucleosome contains 200 bp of DNA helix. Nucleosomes constitute the repeating unitof a structure in nucleus called chromatin. Chromatin is held over a scaffold of non histone chromosomal (or NHC) proteins. At some places chromatin is densely packed to form darkly stainned heterochromatin. At other places chromatin is loosely packed. It is called euchromatin. It is transcriptionally active chromatin whereas heterochromatin is transcriptionally inactive and late replicating or heteropycnotic.

30. (d) Process of DNA synthesis where by a parent DNA molecule is faithfully copied, giving rise to two identical daughter molecules is called DNA replication. In DNA synthesis, DNA polymerase plays important role having the capability to elongate an existing DNA strand but cannot initiate the synthesis. So, the synthesis is initiated with the help of RNA primer formed by RNA primase. RNA primase synthesizes the short primer RNA of about 10 nucleotides that is elongated by DNA polymerase to form an okazaki fragment of DNA during DNA replication. Helicase unzips the two strands of DNA and topoisomerase reduces the coiling tension developed due to the unwinding of the two strands.

31. (b) Lactose operon in *E.coli* is a catabolic pathway in which the structural genes remain switched off unless the inducer (Lactose) is present in the medium.

32. (d)

33. (a) DNA fingerprinting is the technique of determining nucleotide sequences of certain areas of DNA which are unique to each individual. DNA contains non cistronic hypervariable repeat sequences called VNTR. DNA fingerprinting involves the identification of these VNTRs.

34. (a) In negative (repressible) operon, the repressor co-repressor complex binds with the operator. The free repressor cannot bind to the operator.

35. (a) Operator gene allows the functioning of the operon.

36. (c) If the *lac* repressor is non functional, it cannot bind the operator site and transcription of the *lac* operon will occur at all times, whether or not lactose is present.

37. (d) Option *a* refers to the *lac* and *trp* repressors, option *b* to the CRP protein, and option *c* refers to promoter that have different transcriptional efficiencies.

38. (a) 39. (b) 40. (b) 41. (a)

42. (b) The presence or absence of tryptophan determines whether the genes that code the necessary enzymes in tryptophan synthesis will even be transcribed.

43. (c) Option (a) describes transcription in eukaryotic cells; Option (b) describes translation.

44. (c) DNA replication is an energy-consuming process that must have an input of energy to proceed. Energy is provided in the breaking of the triphosphate tails of each nucleotide.

45. (a) AUG is initiating codon. UCG codes for serine, UUU codes for phenylalanine, UGU codes for cysteine.