CBSE Class 12 Biology
Important Questions
Chapter 6
Molecular Basis of Inheritance

1 Marks Questions

1. Name the factors for RNA polymerase enzyme which recognises the start and termination signals on DNA for transcription process in Bacteria.

Ans. Sigma (s) factor and Rho(p) factor)

---

2. Mention the function of non-histone protein.

Ans. Packaging of chromatin

---

3. During translation what role is performed by tRNA

Ans. (i) Structural role

(ii) Transfer of amino acid.

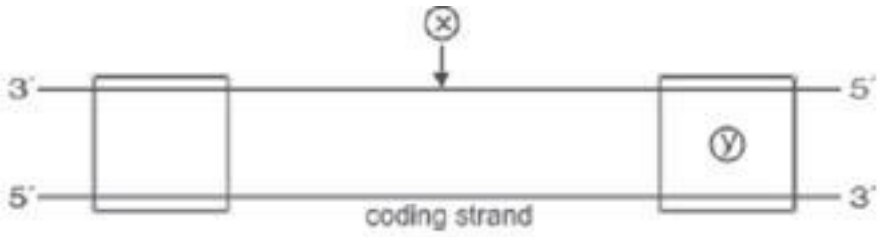
---

4. RNA viruses mutate and evolve faster than other viruses. Why?

Ans. -OH group is present on RNA, which is a reactive group so it is unstable and mutate faster.

---

5. Name the parts 'X' and 'Y' of the transcription unit given below.



Ans. X - Template strand, Y - Terminator.

6. Mention the dual functions of AUG.

Ans. (i) Acts as initiation codon for protein synthesis

(ii) It codes for methionine.

---

7. Write the segment of RNA transcribed from the given DNA

3´ -A T G C A G T A C G T C G T A '5´- Template Strand

5´ - T A C G T C A T G C A G C A T '3´ - Coding Strand.

Ans. 5'- U A C G U C A U G C A G C A U – 3' (In RNA 'T' is replaced by'U')

8.Name the process in which unwanted mRNA regions are removed & wanted regions are joined.

Ans.RNA splicing.

9.Give the initiation codon for protein synthesis. Name the amino acid it codes for?

Ans. Initiation codon – AUG & it code for methionine.

10.In which direction, the new strand of DNA synthesised during DNA replication.

Ans.5'$\rightarrow$ 3

11.What is the function of amino acyl tRNAsynthetase.

Ans. Amino acyl tRNAsynthetasecatalyses activation of amino and attachment of activated amino acids to the 3-end of specific tRNA molecule.

12.What is point mutation?

Ans. Mutation due to change in a single base pair in a DNA sequence is called point mutation.

13.Name the enzyme that joins the short pieces in the lagging strand during synthesis of DNA?

Ans. Ligase.

14.Name the enzyme which helps in formation of peptide bond?

Ans. Peptidyltransferase

15.Who experimentally prove that DNA replication is semi conservative.

Ans. Messelson&stahl.

16.What is a codon?

Ans. Triplet sequence of bases which codes for a single amino is called a codon.

17.Name the three non-sense codons?

Ans.UAA, UAG, UGA

18.What is the base pairing pattern of DNA?

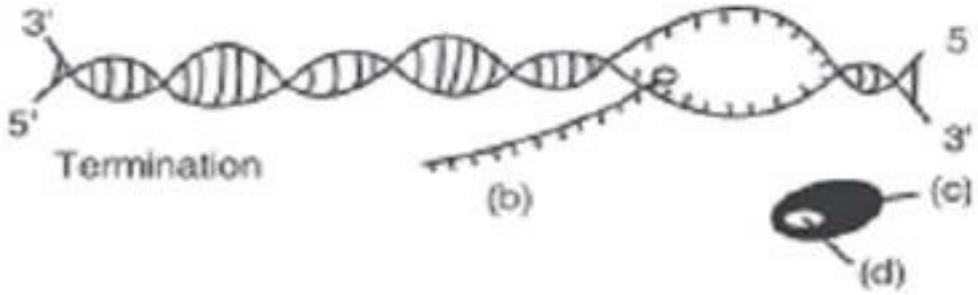
Ans. In DNA, adenine always binds with thymine & cytosine always binds with Guanine.

19.Mention the dual functions of AUG?

Ans.AUG codes for amino acid methionine & also acts as an initiator codon.

2 Marks Questions

1. The process of termination during transcription in a prokaryotic cell is being represented here. Name the label a, b, c and d.



Ans. (a) DNA molecule
(b) mRNA transcript
(c) RNA polymers
(d) Rho factor

---

2. Complete the blanks a, b, c and d on the basis of Frederick Griffith Experiment.
S Strain → inject into mice → (a)
R strain → inject into mice → (b)
S strain (heat killed) → inject into mice → (c)
S strain (heat killed) + R strain (live) → inject into mice → (d)
Ans.(a) Mice die
(b) mice live
(c) mice live
(d) mice die

---

3. Give two reasons why both the strands of DNA are not copied during transcription.
Ans. (a) If both the strands of DNA are copied, two different RNAs(complementary to each other) and hence two different polypeptideswill produce; If a segment of DNA produces two polypeptides, thegenetic information machinery becomes complicated.

(b) The two complementary RNA molecules (produced simultaneously)would form a doublestranded RNA rather than getting translated intopolypeptides.
(c) RNA polymerase carries out polymerisation in 53direction andhence the DNA strand with 35 polarity acts as the template strand.(Any two)

---

4. Mention any two applications of DNA fingerprinting.

Ans.(i) To identify criminals in the forensic laboratory.

(ii) To determine the real or biological parents in case of disputes.

(iii) To identify racial groups to rewrite the biological evolution. (Any two)

---

5. State the 4 criteria which a molecule must fulfill to act as a genetic material.

Ans.(i) It should be able to generate its replica.

(ii) Should be chemically and structurally stable.

(iii) Should be able to express itself in the form of Mendelian characters.

(iv) Should provide the scope for slow changes (mutations) that are necessary for evolution.

6.“DNA polymerase plays a dual function during DNA replication” comment on statement?

Ans.DNA polymerase plays a dual function –it helps in synthesis of new strand & also helps in proof reading i.e replacement of RNA strands lay DNA fragments.

7.Three codons on mRNA are not recognised by tRNA what are they? What is the general term used for them what is their significance in protein synthesis?

Ans.UAG UAA & UGA are the three codons that are not recognised by tRNA these are known as stop codon or non-sense codon. Since these three codons are not recognised by any tRNA

they help in termination of protein chain during translation.

8.Give two reasons why both the strands of DNA are not copied during DNA transcription?

Ans.I)If both the strands code for RNA two different RNA molecules & two different proteins wouldbe formed hence genetic machinery would become complicated

II) Since the two RNA molecules would be complementary to each other, they would wind togetherto form dsRNA without carrying out translation which means process of transcription would befutile

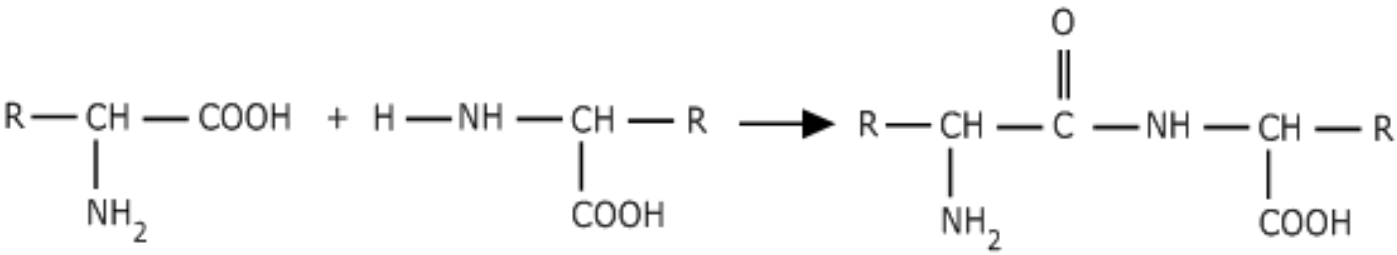
---

9.Why is it essential that tRNA binds to both amino acids & mRNA codon during protein synthesis?

Ans. It is essential that tRNA binds to both amino acids & mRNA codon because tRNA acts as an adapter molecule with picks up a specific activated aminoacid from the cytoplasm & transferred it to the ribosomal in the cytoplasm where proteins are synthesized. It attracts itself to ribosome with the sequence specified by mRNA & finally it transmits its amino acid to new polypeptide chain.

10.What is peptide bond? How is it formed?

Ans. Peptide bond is formed between carboxylic group (COOH) of first amino acid & amino group (-NH2) of second amino acid. This reaction is catalysed by peptidyltransferase



11.Explain what happens in frameshift mutation? Name one disease caused by the disorder?

Ans. Frameshift mutation is a type of mutation where addition or deletion of one or two bases changes the reading from the site of mutation, resulting in protein with different set of amino acid.

12.What do you mean by "Central Dogma of Molecular genetics?"

Ans. The central dogma of molecular genetics is the flow of genetic information from DNA to DNA through replication, DNA to mRNA through transcription & mRNA to proteins through translation.

ReplicationDNA $\rightarrow$ mRNA $\rightarrow$ proteins. transcription translation

---

13.Give two reasons why both the strands are not copied during transcription?

Ans.i) If both the strands codes for RNA, two different RNA molecules & two different proteins areformed hence genetic machinery would be complicated.

ii)Since two RNA molecules produced would be complementary to each other, they would wind together to form ds-RNA.

14.Why is human Genome project considered as mega project?

Ans. Human Genome project was called mega project for the following facts.

1. The human genome has approximately 3.3 x 109bp, if the cost of sequencing is US $3 per bp, the approximate cost is about US$ g billion.
2. If the sequence obtained were to be stored in a typed form in books & if each page contained1000 letters & each book contained 1000 page than 3300 such books would be needed to store complete in formation
3. The enormous quantity of data expected to be generated also necessitates the use of high speedcomputational devices for data storage, retrieval & analysis.

15.Why is DNA & not RNA is the genetic material in majority of organisms?

Ans. The -OH group in the nucleotides of RNA is much more reactive & makes RNA labile & easily degradable thus, DNA and not RNA acts as genetic material in majority of organisms.

16.Mention any four important characteristics of genetic code.

Ans. Genetic codon has following imp-features :-

1. Each codon is a triplet consisting of three bases.
2. Each codon codes for only one amino acid i.e. – unambiguous.
3. Some amino acids are coded lay more than one codon ∴ said to be degenerative.
4. Codons are read in a continuous manner in direction & have no punctuation.

17.Why it is that transcription & translation could be coupled in prokaryotic cell but not in eukaryotic cell?

Ans. In prokaryotes the mRNA synthesised does not require any processing to become active &both transcription & translation occurs in the same cytosol but In Eukaryotes, primary transcriptcontains both exon & intron & is subjected to a process called splicing where introns are removed &exons are joined in a definite order to form mRNA.

3 Marks Questions

1. Give six points of difference between DNA and RNA in their structure/chemistry and function.

Ans.

DNA	RNA
(i) Double stranded molecules (ii) Thymine as pyrimidine base (iii) Pentose sugar is Deoxyribose (iv) Quite stable and not very reactive (v) Dictates the synthesis of Polypeptides (vi) Found in the nucleus.	(i) Single stranded molecules (ii) Uracil as pyrimidine base (iii) Sugar is Ribose (iv) 2´-OH makes it reactive (v) Perform their functions in protein synthesis. (vi) They are transported into the cytoplasm.

2. Explain how does the hnRNA becomes the mRNA. OR Explain the process of splicing, capping and tailing which occur during transcription in Eukaryotes.

Ans.hnRNA is precursor of mRNA. It undergoes

(i) Splicing : Introns are removed and exons are joined together.

(ii) Capping : an unusual nucleotide (methyl guanosine triphosphate isadded to the 5´ end of hnRNA.

(iii) Adenylate residues (200-300) are added at 3´ end of hnRNA.

3. Name the three major types of RNAs, specifying the function of each inthe synthesis of polypeptide.

Ans. (i) mRNA-(Messenger RNA) : decides the sequence of amino acids.

(ii) tRNA-(Transfer RNA) : (a) Recognises the codon on mRNA (b) transport the aminoacid to the site of protein synthesis.

(iii) rRNA (Ribosomal RNA) : Plays the structural and catalytic role during translation.

---

4. Enlist the goals of Human genome project.

Ans. The Human Genome Project (HGP) is an international scientific research project with the goal of determining the sequence of chemical base pairs which make up human DNA, and of identifying and mapping all of the genes of the human genome from both a physical and functional standpoint

---

5. A tRNA is charged with the amino acid methionine.

(i) Give the anti-codon of this tRNA.

(ii) Write the Codon for methionine.

(iii) Name the enzyme responsible for binding of amino acid to tRNA.

Ans. (a) UAC **(b)** AUG **(c)** Amino-acyltRNAsynthetase.

---

6. Illustrate schematically the process of initiation, elongation and termination during transcription of a gene in a bacterium.

Ans. In bacteria, the mRNA provides the template, tRNA brings aminoacids and reads the genetic code, and rRNAs play structural and catalytic role during translation.
There is single DNA-dependent RNA polymerase that catalyses transcription of all types of RNA in bacteria.
RNA polymerase binds to promoter and initiates transcription (Initiation)
It somehow also facilitates opening of the helix and continues elongation
Once the polymerases reaches the terminator region, the nascent RNA falls off, so also the RNA polymerase. This results in termination

7.What is transformation? Describe Grifith's experiment to show transformation? What did he prove from his experiment?

Ans. Transformation means change in genetic makeup of an individual. Fredrick Grifith conducted aseries of experiments on streptococcus pneumoniae. He observed two strains of this bacterium –one forming smooth colonies with capsule (s-type) & other forming rough colonies without capsule

(R-type)

(i) when live s-type cells are infected into mice, they produced pneumonia & mice dies.

(ii) When live R-type cells are infected into mice, disease was not produced did not appear.

(iii) When heat – killed S-type cells were infected into mice, the disease did not appear.

(iv) When heat killed S-type cells were mixed with live R-cells & infected into mice, the mice died.

He concluded that R-strain bacteria had somehow been transformed by heat –killed S-strain bacteria which must be due to transfer of genetic material

---

8.The base sequence on one strand of DNA is ATGTCTATA

(i) Give the base sequence of its complementary strand.

(ii) If an RNA strand is transcribed from this strand what would be the base sequence of RNA?

(iii) What holds these base pairs together?

Ans. (i) TACAGATAT.

(ii) UACAGAUAU

(iii) Hydrogen bonds hold these base pairs together. Adenine & thymine are bounded by twohydrogen bonds & cytosine & Guanine are bonded by three hydrogen bonds.

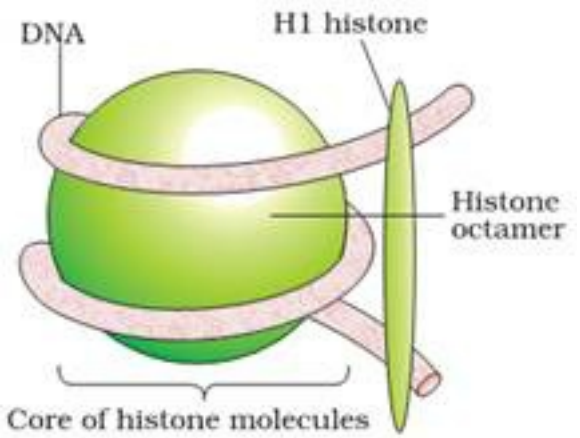
9.Two claimant fathers filed a case against a lady claiming to be the father of her only daughter. How could this case be settled identifying the real biological father?

Ans. This case to identify the real biological father could lee settled lay DNA – finger printingtechnique. In this technique :-

1. first of all, DNA of the two claimants who has to be tested is isolated.
2. Isolated DNA is then digested with suitable restriction enzyme & digest is subjected to gelelectrophoresis.
3. The fragments of ds DNA are denatured to produce ss DNA by alkali treatment.
4. The electrophoresed DNA is then transferred from get into a nitrocellulose filter paper where itis fixed.
5. A known sequence of DNA is prepared called probe – DNA & is labelled with radioactive esotope32p & then probe is added to nitrocellulose paper.
6. The nitrocellulose paper is photographed on X –ray film through auto radiography. The film isanalysed to determine the presence of hybrid nucleic acid.

Then, the DNA fingerprints of the two claimants is compared with the DNA fingerprint of the lady &her daughter, whosoever matches with each other would be declared as biological father of herdaughter.

10.The length of DNA in an eukaryotic cell is N 2.2 m How can such a huge DNA be packaged in a nucleus of micrometer in diameter.



Ans. In eukaryotes, the DNA is wrapped around positivelycharged histone octamer into a structure called nucleosome. Atypical nucleosome consists of 200bp of DNA helix. Thenucleosomes are the repeating units that form chromatin fibres.

These chromatin fibres condense at metaphase stage of celldivision to form chromosomes. The packaging of chromatin at higher level requires additional set ofproteins called non-histone chromosomal proteins thus in nucleus, certain regions of the chromatinare loosely packed & they Stain lighter than the other region, these are called euchromatin. Theother region are lightly packed & they stain darker & are called heterochromatin

---

11.A tRNA is charged with amino acid methionine.

i) At what site in the ribosome will the tRNA bind?

ii) Give the anticodon of this tRNA?

iii) What is the mRNA codon for methionine?

iv) Name the enzyme responsible for this binding?

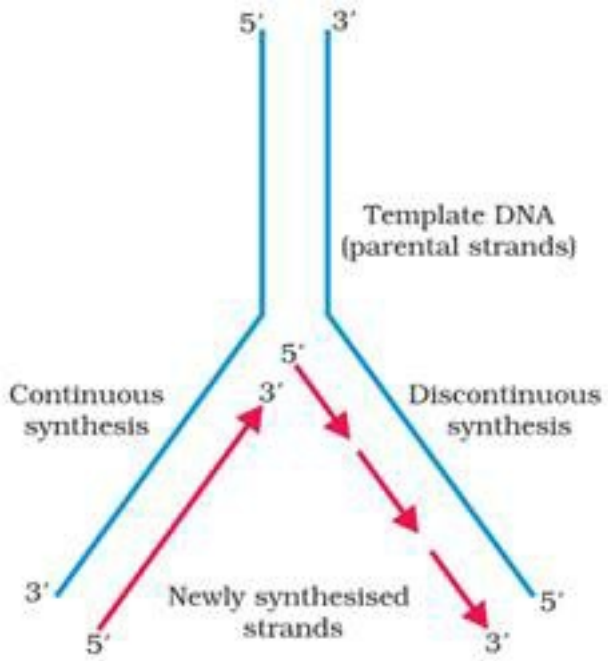
Ans. (i) P- site

(ii) UAC

(iii) AUG

(iv) Amino acyl tRNASynthetase

12.Describe the continuous & discontinuous Synthesis of DNA?



Ans. Synthesis of new strand of DNA takes place lay additionof fresh nucleotides to the 3 – OH group of the last nucleotideof the primer. This synthesis takes place in 5 direction&enzyme that catalyses this is DNA – polymerase

∴ synthesis of strand called leading strand iscontinuous.

The replication of second strand of the DNA molecule is

DISCONTINOUS on strand called lagging strand.

Primase initiates primer synthesis on strand near the fork. The RNA – primer thus formedprovides free for replication of single stranded region on lagging strand the newcomplementary strand is formed in small fragments of DNA called Okazaki fragments. It is calleddiscontinuous because it has to be initiated several times & every time an Okazaki fragment isproduced.

13.What are the three types of RNA & Mention their role in protein Synthesis?

Ans. There are three types of RNA :

1. Messenger RNA (mRNA) :- It is a single – stranded RNA which brings the genetic information ofDNA transcribed on it for protein synthesis.
2. Transfer RNA (tRNA) :- It has a clover leaf like structure which acts as an adapter

moleculewhich contains an “anticodon loop” on one end that reads the code on one hand &” an amino acid acceptor end which binds to the specific amino acid on other hand.

3. Ribosomal RNA (rRNA) :- Ribosomes provides the site for synthesis of protein &catalyse theformation of peptide bond.

---

14. Define bacterial transformation? Who proved it experimentally & how?

Ans. The transformation is a mode of exchange or transfer of genetic information betweenorganism or from one organism to another.

Fredrick Griffith tested the virulence of two strains of Diplococci to show transformation in thefollowing steps :-

1. When S-III strains of bacteria are injected into mice. It developed pneumonia & died.
2. When R-II strains are infected into mice, they did not develop pneumonia & survive.
3. When heat – killed S-III strains of bacteria are injected into mice, No symptoms of pneumoniadevelops& mice remain healthy.
4. When a mixture of heat – killed S-III strain & lives R-II strain is injected into mice, theydeveloped pneumonia & died.

From these results, Griffith concluded that the presence of heat – killed S-III bacteria must convertliving R-II type bacteria to type S-III so as to restore them the capacity for capsule formation. Thiswas called “BACTERIAL TRANSFORM ATION”

S strain $\rightarrow$ Inject into mice $\rightarrow$ Mice die

R strain $\rightarrow$Injct into mice $\rightarrow$ Mice live

S strain (heat-killed)$\rightarrow$ Inject into mice $\rightarrow$ Mice live

S strain (heat-killed) + R strain (live) $\rightarrow$ Inject into mice $\rightarrow$Mice die

5 Marks Questions

1. What is meant by semi conservative replication? How did Meselson and Stahl prove it experimentally?

Ans. Meselson and Stahl, performed an experiment using E.coli to prove that DNA replication is semi conservative.

- They grew E.coli in a medium containing $^{15}NH_4Cl$.
- Then separated heavy DNA from normal (14N) by centrifugation in CsCl density gradient.
- The DNA extracted, after one generation of transfer from 15N medium to 14N medium, had an intermediate density.

-The DNA extracted after two generations consisted of equal amounts of light and hybrid DNA.

-They proved that DNA replicates in a semiconservative manner.

---

2. What does the lac operon consist of? How is the operator switch turned on and off in the expression of genes in this operon? Explain.

Ans. Lac Operon consists of the following :

- Structural genes : z, y, a which transcribe a polycistronic mRNA.
- gene ‘z’ codes for b-galactosidase
- gene‘y’ codes for permease.
- gene‘a’ codes for transacetylase.
- Promotor : The site where RNA polymerase binds for transcription.
- Operator : acts as a switch for the operon
- Repressor : It binds to the operator and prevents the RNAPolymerase from transcribing.
- Inducer : Lactose is the inducer that inactivates the repressor by binding to it.
- Allows an access for the RNA polymerase to the structural gene andtranscription.

3. What is an operon? Describe the major steps involved in an operon?

Ans. Operon is a group of controller & structural genes which controls the catabolism of the cell geneticallyeg lactose operon / lac operon.

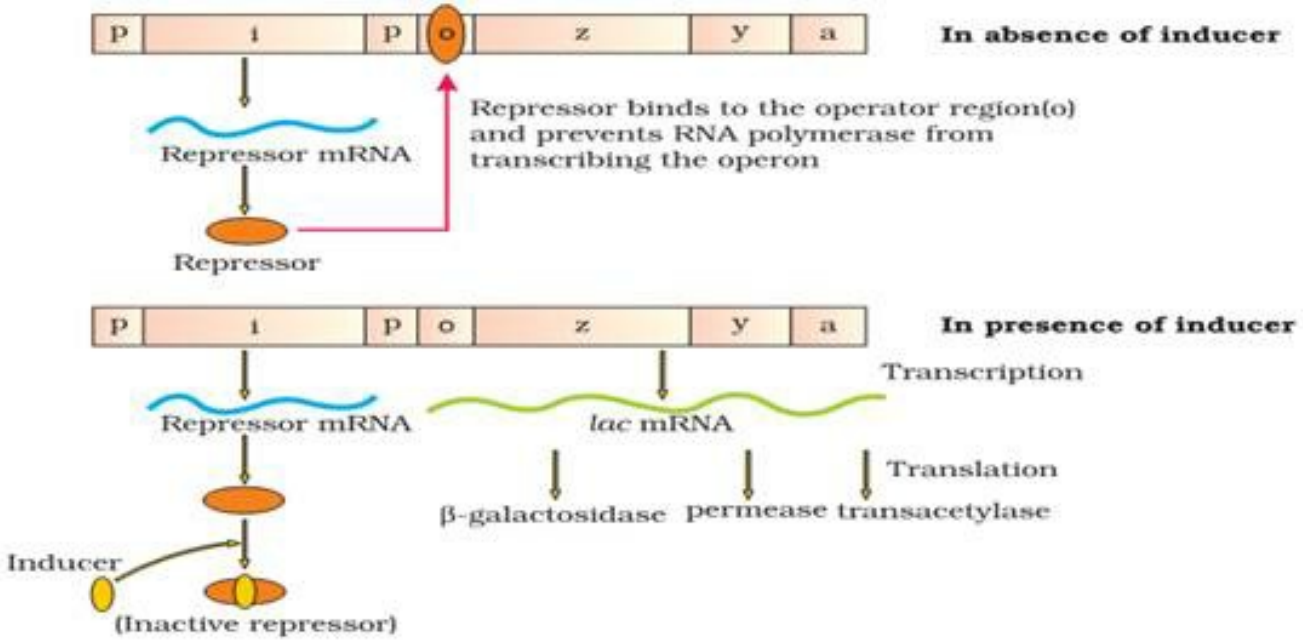
(i) When inducer or lactose is absent :-

The lac regulator gene synthesize a repressor protein by transcription & translation. This repressor protein binds with operator site of lac operon & blocks RNA polymerase. Thus, RNA polymerase unable to transcribe mRNA & structural gene unable to translate enzyme B-galactosidase.

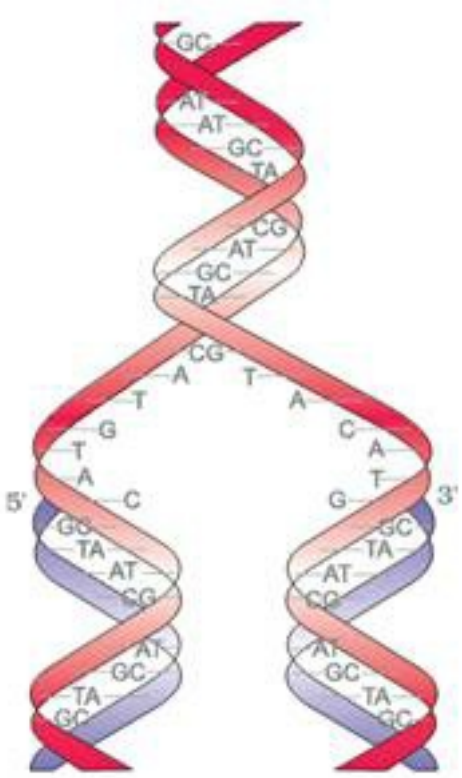
(ii) When inducer or lactose is present :_

The lac regulator gene transcribe mRNA &synthesise active lac repressor protein & at the same time lactose is converted into isomer allolactose. Allolactose binds to active lac repressor due to which it is converted to inactive repressor. This inactive repressor is released from operator site of lac operon & RNA polymerase binds to promoter & starts to transcribe mRNA & forms β-galactosidase are which converts lactose into glucose &galactose.

Thus, presence of lactose determines whether or not lac. Repressor is bound to operator & genes are expressed on not.



4.What do you mean semi conservative nature of DNA replication. Who proved it & how?



Ans. Semiconservative nature of DNA replication suggested that during replication two strandswould separate & each acts as a template for the synthesis of new complementary strand so, thatafter complete replication, each DNA molecule would have one parental & one

newly synthesizedstrand thus, half the information is conserved over generation.Mathew Messselson& Franklin stahl have performed an experimentusing Escherichia coli to prove that DNA replication isSemiconservative. They grew E.coli in a medium containing 15

{tex}N{{H}_{4}}Cl**{/tex}**

until 15N wasincorporated in the two strands of newly synthesised DNA this heavyDNA can be separated from normal DNA lay centrifugation in

{tex}CsCl**{/tex}**

density gradient. Then they transferred the cells into a medium withnormal

{tex}^{14}N{{H}_{4}}Cl**{/tex}**

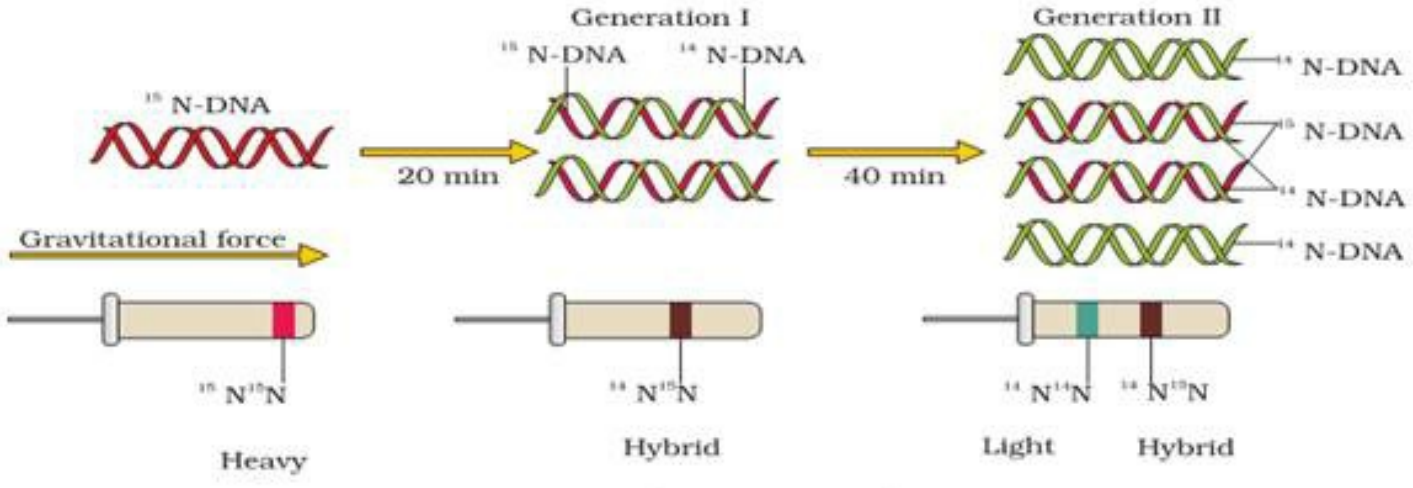
& took samples at various time intervals & extractedDNA & centrifuged then to measure their densities. The DNA extracted from the cells after onegeneration to transfer from

{tex}^{15}N**{/tex}**

medium to

{tex}^{14}N**{/tex}**

medium had an intermediate / hybrid density. TheDNA extracted after two generations (i-e after 40 min) consisted of equal amount of “light” DNA &“Hybrid”DNA.



(Separation of DNA by Centrifugation)

5.Where do transcription & translation takes place in a prokaryotic cell? Describe the three stepsinvolved in translation?

Ans. In a prokaryotic cell both transcription & translation occurs in cytoplasm. It consist offollowing steps :-

(i)ACTIVATION OF AMINO ACIDS :- amino acids are activated in the presence of ATP lay enzaminoacyltRNASynthetase.

(ii)BINDING OF ACTIVATED AMINOACID WITH tRNA :- Activated amino acids binds with specific tRNA to form charged tRNA .

(iii)INITIATION OF POLYPEPTIDE CHAIN :- Initiation codon is AUG which codes for methionine. Initiation codon of mRNA binds to p-site of ribosome with the help of initiation factors.

(iv)ELONGATION OF POLYPEPTIDE CHAIN :-

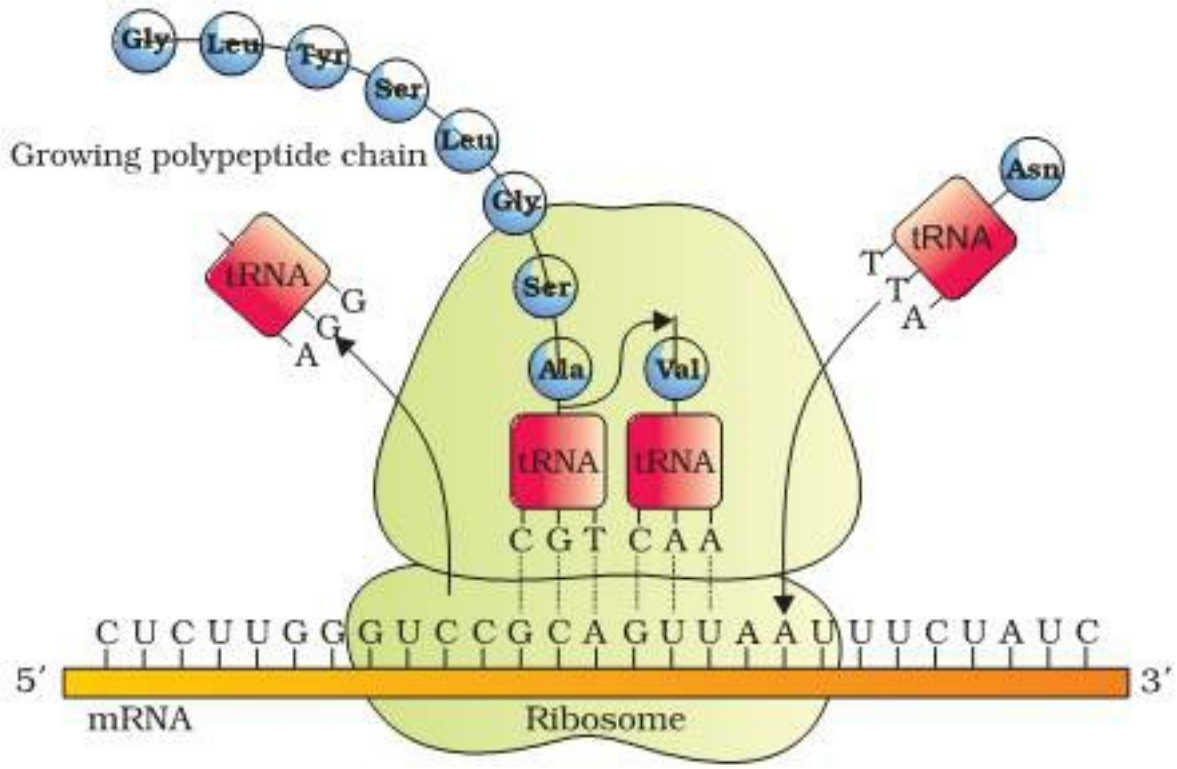
(a)Second activated amino acid along itstRNA reaches the 'A' site & binds to mRNA codon next to AUG.

(b)A peptide bond is formed betweentwo amino acid by peptidyl transferase.

(c) Ribosomes translocation mRNA in -direction due to which free tRNA slips away &peptidyltRNA reaches at P – site. Now third amino acid reaches at A – site & process continues.

(d)TERMINATION OF POLYPEPTIDE CHAIN :- When a termination codon (UAA, UAG, UGA) reaches at A- site translation terminates Since there is no specific tRNA for these codons.

(i)



6.Who performed the blender experiment? What does this experiment prove? Describe the stepsfollowed in this experiment?

Ans. The proof for DNA as the genetic material came from the experiments of Harshey& chase whoworked with bacteriophage.

The bacteriophage on infection injects only the DNA into the bacterial cell & not the protein coat.

Bacterial cell treats the viral DNA as its own & subsequently manufactures more virus particles.

They grew some viruses on a medium that ‘contained radioactive Phosphorus & some other on medium that contained radioactive sulphur. Virus grown in the presence of radioactive phosphorus contained radioactive DNA but not proteins because DNA contains phosphorus. Similarly virus grown on radioactive sulfur contained radioactive protein because DNA does not contain sulfur.

Radioactive phages are allowed to infect E. coli bacteria & soon after infection the cultures weregently agitated in a blender to separate the adhering protein coat of virus from bacterial

cell.It was found that when phage containing radioactive DNA was used to infect the bacteria itsradioactivity was found in bacterial cells indicating that DNA has been injected into bacterial cell so,the DNA is the genetic material & not proteins