



## Board Paper of Class 12 Science Term-I 2021 Biology Delhi(Set 4) - Solutions

**Total Time: 90**

**Total Marks: 35.0**

### Section A

#### Solution 1

In a young anther, a group of compactly arranged homogenous cells called the sporogenous tissue occupies the centre of each microsporangium. Each cell of the sporogenous tissue undergoes meiosis to form microspore tetrad.

Hence, the correct answer is option (A).

#### Solution 2

The cytoplasm of the pollen grain is surrounded by a plasma membrane. After maturation, pollen grain contains two types of cells, the vegetative cell, and the generative cell. The vegetative cell is bigger in size with a large irregularly shaped nucleus and has abundant food reserve. The generative cell is smaller and floats in the cytoplasm of the vegetative cell.

In the given figure, (i) is generative cell, (ii) is vegetative cell, (iii) is nucleus and (iv) is vacuole

Hence, the correct answer is option (C).

#### Solution 3

In plants, usually, the ovary develops into a fruit after fertilisation. However, in a few species thalamus also contributes to fruit formation and these are called false fruits. In plants like strawberry, apples and cashew the thalamus also contributes to fruit formation.

Hence, the correct answer is option (C).

#### Solution 4

In many citrus fruits (orange, lemon), varieties of mango, nucellar cells that surround the embryo sac start dividing, protrude into the embryo sac, and develop into many embryos. Such fruits contain more than one embryos in a seed and this is referred to as polyembryony.

Hence, the correct answer is option (C).

### **Solution 5**

Fig (i) represents megaspore mother cell and Fig (ii) represents megaspore dyad. Label X represents nucellus and label Y and Z are dyad of megaspore. The nucellus is diploid in nature as no cell division has taken place in those cells while the megaspore dyad are haploid in nature as they are formed after meiosis in the megaspore mother cell.

Hence, the correct answer is option (B).

### **Solution 6**

After triple fusion, the central cell becomes the primary endosperm cell (PEC) and develops into the endosperm, whereas the zygote develops into an embryo. Endosperm development precedes embryo development. PEC divides repeatedly and forms triploid endosperm tissue which is filled with abundant food material. The PEN undergoes successive nuclear divisions to give rise to free nuclei and forms free nuclear endosperm.

Hence, the correct answer is option (D).

### **Solution 7**

The given figure represents the female reproductive system. The parts labelled as W is myometrium layer of the uterus, X is ampulla part of the fallopian tube, Y is the cervix which is the opening of the uterus, and Z is perimetrium layer of the uterus.

Hence, the correct answer is option (B).

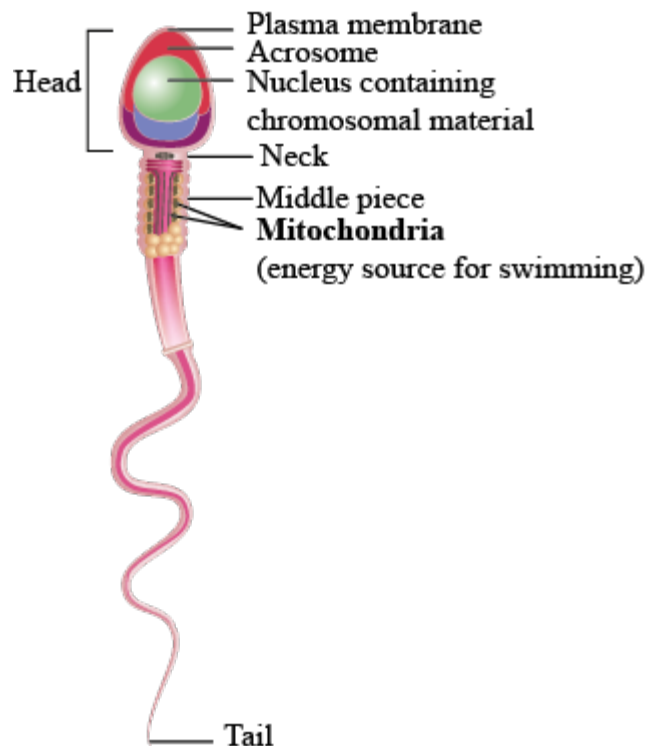
### **Solution 8**

By the end of second month of pregnancy that is 60 days, the foetus develops limbs and digits.

Hence, the correct answer is option (D).

### **Solution 9**

The given diagram shows the structure of sperm:



As seen in the figure above, mitochondria are present in the middle piece region that provides energy to the sperms so that they can travel through the vagina and reach the site of fertilization in the fallopian tube.

Hence, the correct answer is option (C).

### Solution 10

The given diagram represents the structure of the mature embryo sac in which X is egg, Y shows two polar nuclei and Z are synergids. The egg fuses with the one male gametes and forms the zygote. The polar nuclei fuse with the second male gamete and form the endosperm. Synergids contain the filiform apparatus that play an important role in guiding the pollen tube into the synergids.

Hence, the correct answer is option (B).

### Solution 11

Albuminous seeds retain a part of endosperm as it is not completely used up during embryo development (e.g., wheat, maize, barley, castor).

Hence, the correct answer is option (C).

### Solution 12

Klinefelter's Syndrome is a genetic disorder that is caused due to the presence of an additional copy of the X chromosome. This results in a karyotype of 47, XXY. In this disorder, the affected individual shows an overall masculine development. However, feminine development such as the development of breasts is also seen. They are sterile individuals.

Hence, the correct answer is option (B).

### **Solution 13**

A type of sex determination, where male produces two different types of gametes- either with or without X-chromosome or some gametes with X-chromosome and some with Y-chromosome is designated to be the example of male heterogamety. The male fruit fly has an XY sex chromosome and grasshoppers exhibit XO type of sex determination in which the males have only one X-chromosome besides the autosomes.

Hence, the correct answer is option (C).

### **Solution 14**

When a single gene exhibits multiple phenotypic expressions such gene is called a pleiotropic gene. One such example is the disease phenylketonuria, which occurs in humans. Sickle cell anaemia is also a pleiotropic disease because a single mutated HBB gene contributes to the numerous consequences throughout the body like kidney failure, heart failure, paralysis etc. Morgan carried out several dihybrid crosses in *Drosophila* to study genes that were sex-linked and from there the concept of linkage arises. Incomplete dominance is observed in Snapdragon or *Antirrhinum sp.* However, in the ABO blood group only blood group AB shows co-dominance because the  $I^A$  and  $I^B$  genes express together and both the sugars are present on the surface of RBC.

Hence, the correct answer is option (A).

### **Solution 15**

There are many traits that are not so distinct in their occurrence and are spread across a gradient. Such traits are generally controlled by three or more genes and are thus called polygenic traits. Different range of human skin colour is a classic example of this.

Hence, the correct answer is option (C).

### **Solution 16**

Walter Sutton and Theodore Boveri argued that the pairing and separation of a pair of chromosomes would lead to the segregation of a pair of factors they carried. Sutton united the knowledge of chromosomal segregation with Mendelian principles and called it the chromosomal theory of inheritance. So, the chromosomal theory of inheritance was put forth by both Sutton and Boveri together.

Hence, the correct answer is option (B).

### **Solution 17**

Failure of segregation of sister chromatids during cell cycle results in the gain or loss of a chromosome(s), called aneuploidy. For example, Down's syndrome results in the gain of an extra copy of chromosome 21. Turner's syndrome results due to the loss of an X chromosome.

Hence, the correct answer is option (D).

### **Solution 18**

DNA fingerprinting involves identifying differences in some specific regions in a DNA sequence called repetitive DNA. For detection of the DNA, the sample is first isolated, then digested using specific restriction endonucleases and then separated by gel electrophoresis. Then the separated DNA is transferred onto a nitrocellulose membrane. VNTR probes are used to isolate the segment desired and then observed by autoradiography. This is the basic mechanism of southern blotting.

Hence, the correct answer is option (C).

### **Solution 19**

When an amino acid is coded by more than one codon, the genetic code is said to be degenerate. For example, valine is coded by four codons, GUU, GUC, GUA and GUG respectively.

Hence, the correct answer is option (D).

### **Solution 20**

In eukaryotes, there are three types of RNA polymerase enzymes found in the nucleus. They are RNA polymerase I, RNA polymerase II and RNA polymerase III. The different types of RNAs transcribed by RNA polymerase III are tRNA, 5srRNA, and snRNAs (small nuclear RNAs).

Hence, the correct answer is option (C).

***Disclaimer: The question has a typo error in which srRNA is written as SrRNA and snRNA as SnRNA.***

### **Solution 21**

DNA is a negatively charged molecule and is wrapped around the positively charged histone octamer to form a structure called a nucleosome. Histones are the set of positively charged basic proteins. It is rich in the basic amino acid residues lysine and arginine and both carry positive charges in their side chains. On neutralisation of the positive charge of histone proteins, there will be no attractive interaction between the histones and the DNA.

Hence, the correct answer is option (B).

### **Solution 22**

The promoter is located towards 5'-end (upstream) of the structural gene. It is a DNA sequence that provides a binding site for RNA polymerase and initiates the process of transcription.

Hence, the correct answer is option (B).

### **Solution 23**

During the process of translation, the peptide bonds are formed from the amino (N) to the carboxyl (C) terminus by the removal of water and catalyzed by RNA that forms part of the ribosome. As the ribosome acts as a catalyst (23S rRNA in bacteria is the enzyme- ribozyme) and catalyses the formation of the peptide bond.

Hence, the correct answer is option (A).

### **Solution 24**

Polyploidy is caused due to the failure of cytokinesis after the telophase stage of cell division that results in the increase in a whole set of chromosomes in an organism. This condition is seen in plants. Aneuploidy refers to the condition where one or two chromosome is missing or has an extra copy.

Hence, the correct answer is option (D).

## **Section B**

### **Solution 25**

The 'family planning' programmes were initiated in 1951 and after decades this programme was further named 'Reproductive and Child Health Care (RCH)'. This program is started to create awareness among people about various reproduction related aspects and provide facilities as well as support for building up a reproductively healthy society. With the help of audio-visual and print-media governmental and non-governmental agencies have taken various steps to create awareness among the people about reproduction-related aspects.

Hence, the correct answer is option (B).

### **Solution 26**

Sterilisation process in females is called Tubectomy which is considered to be a terminal method of birth control because, in tubectomy, a small part of the fallopian tube is removed or tied up blocking gamete transport. This is a permanent or irreversible method of contraception as the cut portion of the fallopian tube cannot be joined back.

Hence, the correct answer is an option (B).

### **Solution 27**

The middle lining of the uterus, i.e. myometrium plays an important role during childbirth when it exhibits rhythmic contractions to force the baby outside the mother's body. Oxytocin from the maternal pituitary acts on the uterine muscle and causes stronger uterine contractions, which in turn stimulates the further secretion of oxytocin during childbirth.

Hence the correct answer is option (D).

### **Solution 28**

Sickle cell anaemia is caused by the point mutation or substitution mutation where glutamine is substituted by valine at the sixth position of the Beta globin chain of haemoglobin. Deletions and insertions of base pairs in DNA cause frame-shift mutations. Frameshift mutations do not include substitutions where a nucleotide replaces another.

Hence the correct answer is option (B).

### **Solution 29**

After implantation, chorionic villi appear on the trophoblast. Chorionic villi are surrounded by uterine tissue and maternal blood. It interdigitates with the uterine tissues and jointly forms the placenta which is a structural and functional unit between the developing embryo and maternal body. Chorionic villi make up a significant portion of the placenta and serve primarily to increase the surface area by which products from the maternal blood are made available to the fetus.

Hence, the correct answer is option (D).

### **Solution 30**

Emasculation refers to the process of removal of anthers from the bisexual flowers. The removal of anthers is done without injuring the pistil. It is not required in the female flowers that are unisexual. Papaya is dioecious (unisexual) and hence it does not need to be emasculated in the artificial hybridisation experiment.

Hence the correct answer is option (C).

### **Solution 31**

In *Vallisneria*, the female flower reaches the surface of the water by the long stalk and the male flowers or pollen grains are released onto the surface of the water. They are carried passively by water currents and eventually reach the female flower.

Hence, the correct answer is option (D).

### **Solution 32**

FSH or Follicle Stimulating Hormone is secreted by the anterior pituitary or adenohypophysis. In women, FSH controls the menstrual cycle and growth of the follicle inside the ovary so that the follicle can mature and release an egg.

Hence, the correct answer is option (C).

### **Solution 33**

IUD or Intrauterine devices are inserted by doctors or expert nurses in the uterus through the vagina. Examples of copper-releasing IUDs are CuT, Cu7, Multiload 375, etc. IUDs increase phagocytosis of sperms within the uterus and

the Cu ions released suppress sperm motility and the fertilising capacity of sperms.

Hence, the correct answer is option (D).

### **Solution 34**

Infections or diseases which are transmitted through sexual intercourse are collectively called sexually transmitted infections (STI) or venereal diseases (VD) or reproductive tract infections (RTI). Gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis-B and AIDS are examples of venereal diseases. Ascariasis is not an STI and is caused by a roundworm *Ascaris lumbricoides*.

Hence, the correct answer is option (B).

### **Solution 35**

Mature seeds can be ex-albuminous or non- albuminous. In non-albuminous seeds, there is no residual endosperm as it is completely consumed during embryo development. Examples are pea and groundnut.

Hence, the correct answer is option (C).

### **Solution 36**

The number of different types of gametes from a single genotype (AABBCCDd) is

$$= 2^n \quad (n = \text{number of heterogeneous alleles that are found in the genotype})$$

$$= 2^1 \quad (n = 1, \text{ only } Dd \text{ is the heterogenous allele})$$

$$= 2$$

Hence, the correct answer is option (B).

### **Solution 37**

The given below cross shows the inheritance of the cross:



Parents



Gametes

♂ \ ♀	G	g
G	GG	Gg
g	Gg	gg

Phenotype : Green : Yellow  
3 : 1

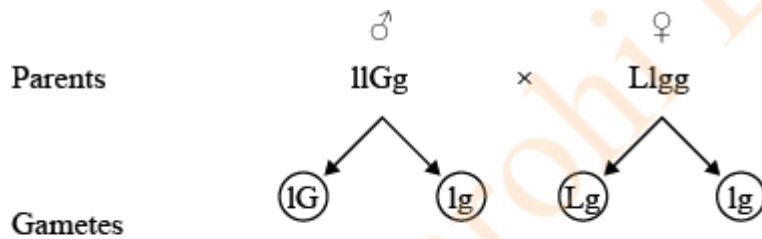
Genotype : GG : Gg : gg  
1 : 2 : 1

The percentage of green pod colour offsprings will be 75% ( $\frac{3}{4} \times 100 = 75\%$ )

Hence, the correct answer is option (C).

### Solution 38

Here large seed (L) is dominant over small seed (l) and green colour seed (G) is dominant over yellow colour seed (g).



Parents

Gametes

F<sub>1</sub> Generation

♀ \ ♂	lG	lg
Lg	LlGg Large, green seeds	Llgg Large, yellow seeds
lg	llGg small, green seeds	llgg Small, yellow seeds

Therefore, in the F<sub>1</sub> generation progenies are obtained that are having small seeds and green colour (llGg) and large seeds with yellow colour (Llgg) besides other phenotypic progenies like large seeds with green colour (LlGg) and small seeds with yellow colour (llgg). So the genotypes of the parents are llGg and Llgg.

The first cross will produce all large and green seeds (LlGg). The second cross will produce all large and yellow seeds (Llgg) and the third cross will produce small, green (llGG and llGg) seeds.

Hence, the correct answer is option (D).

### **Solution 39**

The given pedigree chart shows an autosomal recessive trait. The trait is autosomal because both daughter and son in each generation are getting affected by the disease. The trait is recessive because it is hidden (parents are carriers) in the first generation but getting expressed in the second and third. An example of this disease could be Sickle cell anaemia.

Hence, the correct answer is option (A).

### **Solution 40**

Possible Genotypes:

Child → O group → ii

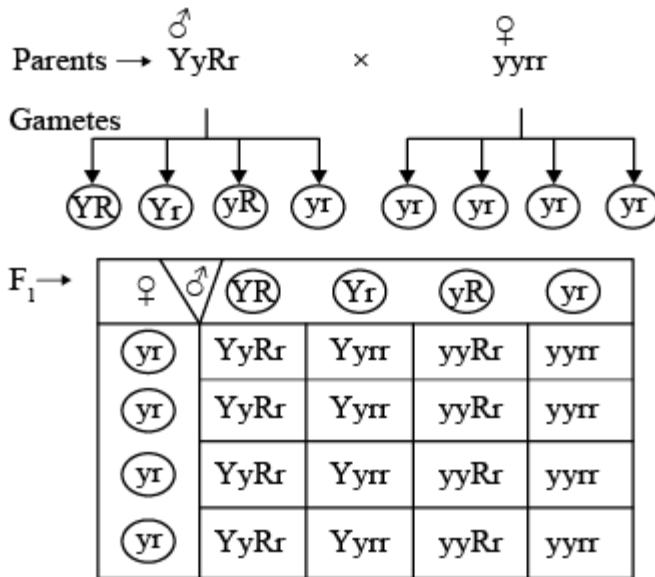
Father → A group →  $I^A i$  or  $I^A I^A$

Mother → B group →  $I^B i$  or  $I^B I^B$

Now, if the child is having O blood group, then the father must be  $I^A i$ , and the mother should be  $I^B i$ , so that i allele can be inherited from both mother and father and the child can show ii genotypes for O blood group.

Hence, the correct answer is option (B).

### **Solution 41**



Phenotypic Ratio	:-	Yellow and Round	:	Yellow and Wrinkled	:	White and Round	:	White and Wrinkled
	:-	4	:	4	:	4	:	4
	:-	1	:	1	:	1	:	1
Genotypic Ratio	:-	YyRr	:	Yyrr	:	yyRr	:	yyrr
		4	:	4	:	4	:	4
		1	:	1	:	1	:	1

Hence, the correct answer is option (C).

### Solution 42

5' - ATGCGGC - 3' → DNA strand (coding strand)  
3' - TACGCCG - 5' → DNA strand (Template strand)

5' - AUGCGGC - 3' strand	→ mRNA
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The given strand of DNA represents the coding strand, so first we need to form a template strand out of it, then from the template strand the bases of transcribed mRNA could be predicted.

Hence, the correct answer is option (A).

### Solution 43

According to Chargaff's rule,  
A = T and G = C and  
A + G = T + C

So, according to this  
the concentration of Guanine will be 30 % of 160 = 48 and Cytosine will be

equal to guanine that is 48

now, If G and C are 60% then the remaining 40% will be divided among A and T.

Adenine and Thymine will have 64 bases.

Hence, the correct answer is option (B).

#### Solution 44

As the DNA template strand is given in the question, so this strand will decide the sequence of bases in the RNA,

Sequence of DNA is 5' - GGTTTAACGA - 3'

Sequence of RNA is 3' - CCAAUUGCU - 5'

Hence, the correct answer is option (A).

#### Solution 45

The possible genotypes according to the condition given would be :

Mother - Pp because P is dominant over p and mother is affected by polydactyly

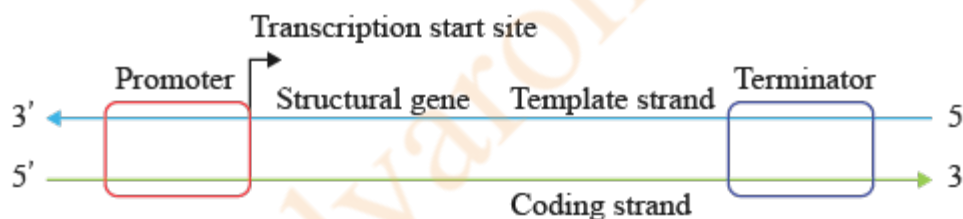
Father - pp because father shows normal condition

Child - pp because the child is normal

Hence, the correct answer is option (B).

#### Solution 46

The Terminator (I) is located towards the 3' -end of the coding strand (II) and it usually defines the end of the process of transcription.



Hence, the correct answer is option (A).

#### Solution 47

In prokaryotes, such as *E. coli*, though they do not have a defined nucleus, the DNA is not scattered throughout the cell. DNA (being negatively charged) is held with some proteins (that have positive charges) in a region termed as 'nucleoid'. The DNA in nucleoid is organised in large loops held by proteins.

Hence, the correct answer is option (C).

#### Solution 48

Mendel selected pea plant, i.e. *Pisum Sativum* for his genetic experiments and studied seven contrasting characters for his breeding experiment. These seven characters were stem height, flower colour, flower position, pod shape, pod colour, seed shape, and seed colour. Axial flower position was recessive to

terminal flower position.

Hence, the correct answer is option (D).

### Section C

#### Solution 49

Infertility in males is caused due to low sperm count and inadequate motility of the sperm as the sperm is not capable of moving into the vagina of the females and do not fuse with the ovum. In this case, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus. Blocked uterine tubes prevent the meeting of egg and ova and the process of fertilisation does not take place. In this case, ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and are induced to form a zygote under simulated conditions in the laboratory. This process is called IVF (In Vitro Fertilization). The zygote or early embryos with up to 8 blastomeres can also be transferred into the fallopian tube of the female and this process is called ZIFT (Zygote intrafallopian transfer). Embryos with more than 8 blastomeres are transferred into the uterus and this process is called IUT (Intrauterine transfer) to complete its further development.

Hence, the correct answer is option (C).

#### Solution 50

The gonadotropins such as LH and FSH the Assisted Reproductive Technologies (ARTs) are administered to the women to stimulate the growth of ovarian follicles in the ovaries as well as the secretion of estrogens by the growing follicles. It induces the release of the ovum by the rupture of the Graafian follicle.

Hence, the correct answer is option (B).

#### Solution 51

The ovum or secondary oocyte is present inside the Graafian follicle and it ruptures to release the secondary oocyte (ovum) from the ovary by the process called ovulation. The ovum or secondary oocytes are aspirated by using laparoscopy from the Graafian follicle.

Hence, the correct answer is option (C).

#### Solution 52

Case I: Husband (X)

Husband (X) has a low sperm count (less than 20 million/mL), Intracytoplasmic sperm injection (ICSI) is a specialised procedure that involved the formation of an embryo in the laboratory in which a sperm is

directly injected into the ovum.

Case II: Husband (Y)

Husband (Y) has normal sperm count (300 million/mL), in this case, an ova from the wife/donor and sperms from the husband are collected and are induced to form a zygote under simulated conditions in the laboratory. The zygote or early embryos with up to 8 blastomeres could then be transferred into the fallopian tube ZIFT -(Zygote intra fallopian transfer).

Hence, the correct answer is option (A).

### **Solution 53**

Before the implantation of the embryo, the women are administered progesterone in the procedure to make the endometrium lining of the uterus receptive. This hormone prepares the lining of the uterus (endometrium) to allow an embryo to implant.

Hence, the correct answer is option (A).

### **Solution 54**

When the oviduct of the female is blocked, then the ova from the female and sperms from the male are collected and are induced to form a zygote under simulated conditions in the laboratory. Then the embryos with more than 8 blastomeres are transferred into the uterus and this technique is called IUT – (Intrauterine transfer) to complete its further development.

Hence, the correct answer is option (B).

### **Solution 55**

The types of gametes produced by this diploid organism will be  $2^n$  where n is the number of heterozygous loci. The given organism is heterozygous for 3 loci, so the types of gametes produced will be  $= 2^3 = 2 \times 2 \times 2 = 8$ .

Hence, the correct answer is option (B).

### **Solution 56**

The given karyotype depicts the presence of an additional copy of chromosome number 21 which is also known as trisomy of 21. This causes a genetic disorder known as Down's syndrome. The affected individual is short-statured with a small round head, furrowed tongue and partially open mouth.

Hence, the correct answer is option (B).

### **Solution 57**

Morgan performed an experiment on *Drosophila melanogaster*, where he hybridised yellow-bodied, white-eyed females to brown-bodied, red-eyed males and intercrossed their  $F_1$  progeny. He observed that the two genes did not

segregate independently of each other and the  $F_2$  ratio deviated significantly from the 9:3:3:1 ratio. This deviation occurred due to the linkage and recombination of genes.

Hence, the correct answer is option (A).

### **Solution 58**

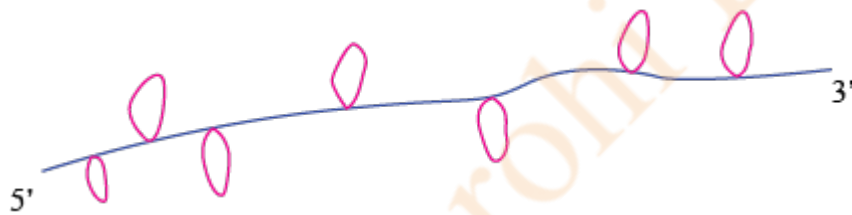
In the experiment performed by Avery, MacLeod and McCarty to determine the biochemical nature of transforming principle, they discovered that protein-digesting enzymes (proteases) and RNA-digesting enzymes (RNases) did not affect transformation, so the transforming substance was not a protein or RNA. Digestion with DNase did inhibit transformation, suggesting that the DNA caused the transformation. In the given figure, the action of RNase is inhibiting the transformation of R bacteria which is wrong.

Hence, the correct answer is option (A).

### **Solution 59**

Introns are the non-coding sequences while exons are coding sequences found on the hnRNA. Introns are removed during the processing of hnRNA into mRNA by the process known as splicing.

In the given hnRNA, there are total 7 introns (coloured in pink) and 8 exons (coloured in blue).



Hence, the correct answer is option (D).

### **Solution 60**

In the given figure of lac Operon, Q is Regulatory gene, R is Promoter, S is Transacetylase and T is Repressor protein

Hence, the correct answer is option (B).