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**2009**

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## Section: A

### Question: 1

Why hnRNA is required to undergo splicing?

[1]

#### Answer:

The heterogeneous nuclear RNA (hnRNA) is required to undergo splicing because the primary transcript contains both exons and introns. Introns are non-functional; hence, they are removed by splicing.

### Question: 2

The microscopic pollen grains of the past are obtained as fossils. Mention the characteristic of the pollen grains that makes it happen.

[1]

#### Answer:

The pollen grains are covered by two protective layers, intine and exine. The exine is made up of sporopollenin, the most resistant material known. There is no enzyme that can degrade it. So it can remain as such for millions of years.

### Question: 3

How do colostrums provide initial protection against diseases to new born infants? Give one reason.

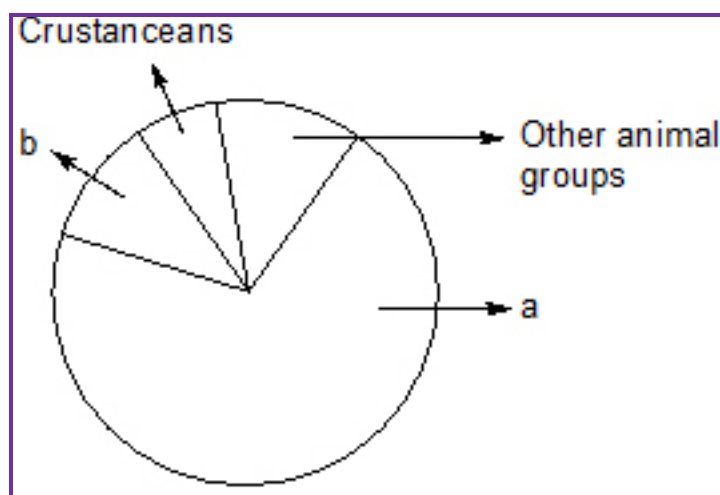
[1]

#### Answer:

After birth, the mammary glands produce protein-rich highly nutrition fluid (for few days) which is thick, yellowish in color and has antibodies. It is called colostrums.

### Question: 4 \*\*

[1]



Name the unlabelled areas 'a' and 'b' of the pie chart (given above) representing the global biodiversity of invertebrates showing their proportionate number of species of major taxonomy.



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**Question: 5**

Mention the type of evolution that has brought the similarity as seen in potato tuber and sweet potato. [1]

**Answer:**

Convergent evolution, two different species evolving similar characteristics.

**Question: 6**

[1]

Name the group of organisms and the substrate they act on to produce biogas.

**Answer:**

Biogas is produced from organic wastes by concerted action of various groups of anaerobic bacteria. An attempt has been made in this review on the work done by our scientists in understanding the microbial diversity in biogas digesters, their interactions, factors affecting biogas production, alternate feedstocks, and uses of spent slurry.

**Question: 7**

Mention the pollinating agent of an inflorescence of small dull coloured flowers with well exposed stamens and large feathery stigma. Give any one characteristic of single cell protein. [1]

**Answer:**

The pollinating agent is wind. The pollens are easily dispersed into wind currents and large, often feathery stigma easily traps air borne pollen grain. For example corn cob-its stigma and style wave in the wind to trap pollen grains.

**Question: 8**

Name the organism commercially used for the production of single cell protein. [1]

**Answer:**

Spirulina

**Section: B**

**Question: 9**

Explain the contribution of *Thermusaquaticus* in the amplification of a gene of interest. [2]

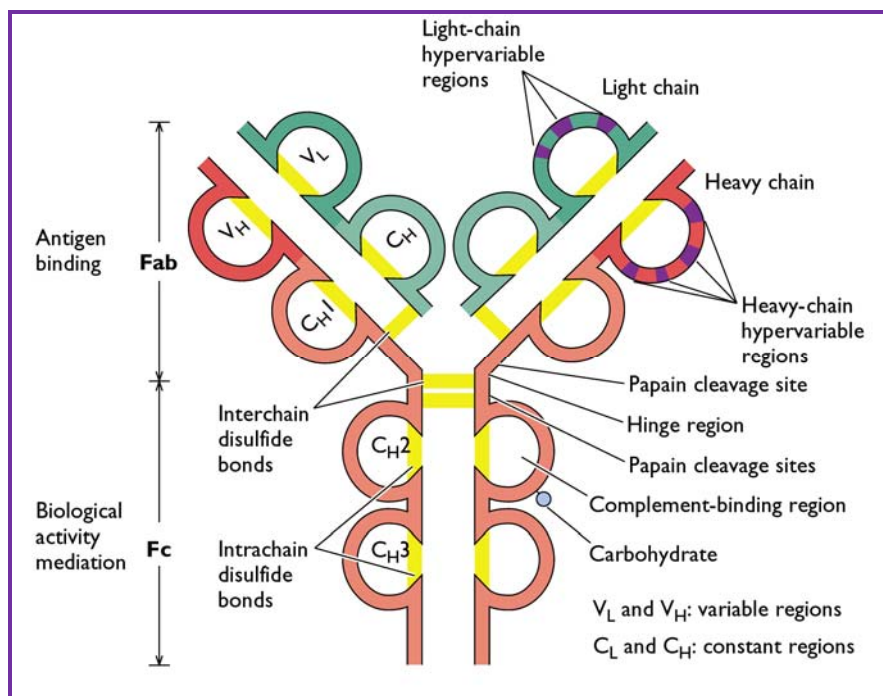
**Answer:**

*Thermos aquaticus* bacterium produces Taq polymerase, a thermostable polymerase used in polymerase chain reaction. It replaced *E.coli* DNA polymerase in PCR because of the temperature conditions of PCR. Taq polymerase is able to withstand the denaturing conditions required during PCR.



**Question: 10**

[2]



i. What does the above diagram illustrate?

**Answer:**

The diagram illustrates the structure of an antibody molecule.

ii. Name the parts labeled 'a' and 'b'.

**Answer:**

'a' – antigen binding site.

'b' – Heavy chain.

iii. Name the type of cells that produce this molecule

[2]

**Answer:**

B-lymphocytes or B-cells produce antibodies.

**Question: 11**

[2]

Banana is a parthenocarpic fruit whereas oranges show poly embryonic. How are they different from each other with respect to seeds?

**Answer:**

The banana is a parthenocarpic fruit as it develops without fertilization, whereas in oranges, an embryo develops directly from a diploid cell other than egg like nucellus and integument. In banana, the ovary may develop into the fruit without fertilization. Also the parthenocarpic fruits never contain seeds whereas oranges have seeds, so in this way they differ with each other with respect to seeds

OR



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Where are fimbriae present in a human female reproductive system? Give their function.

**Answer:**

Fimbrias are present at the edge of infundibulum of the fallopian tube. It helps in collection of the ovum after ovulation.

**Question: 12**

How is the translation of mRNA terminated? Explain.

[2]

**Answer:**

The sequence of elongation continues till the whole of mRNA is translated and a signal in the form of termination codon (UAG, UAA or UGA) is reached. These do not code for any amino acid and therefore the translation stops. These three codons, because they code for no amino acid, are frequently referred to as nonsense codons. They also signal a GTP- dependent release factor, which cleaves the polypeptide from the terminal tRNA, releasing the product from the ribosome.

**Question: 13**

Explain accelerated eutrophication. Mention any two consequences of this phenomenon.[2]

**Answer:**

Accelerated eutrophication is addition of effluents from industries and homes that accelerates the ageing of a lake. The prime contaminants are nitrates and phosphates which act as plant nutrients. They over stimulate the growth of algae causing unsightly scum and unpleasant odours and robbing the water of dissolved oxygen vital to other aquatic life.

**Question: 14**

List the specific symptoms of amoebiasis. Name the causative organism.

[2]

**Answer:**

**Symptoms**

Loose stools or diarrhea and 6-10 blood stained mucous motions per day. Loose stools alternate with constipation for a few days or weeks. In severe infection, abscesses and ulcers of the gut wall and damage to the liver may result.

**Caused by**

Amoebiasis is an infection by a protozoan, typically *Entamoeba histolytica* that inhabits that large intestine.

**Question: 15**

A crane had DDT level as 5 ppm in its body. What would happen to the population of such birds? Explain giving reasons.

[2]

**Answer:**

Population of birds will decrease. High concentrations of DDT disturbs calcium metabolism in birds, which causes thinning of eggshell and their premature breaking, eventually causing decline in bird populations.



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**Question: 16**

Describe the responsibility of GEAC, set up by the Indian Government.

[2]

**Answer:**

The Indian government has set up GEAC (Genetic Engineering Approval Committee), which takes decisions regarding the validity of GM research and safety of introducing GM organisms of public services.

**Question: 17**

During the secondary treatment of the primary effluent how does the significant decrease in BOD occur?

[2]

**Answer:**

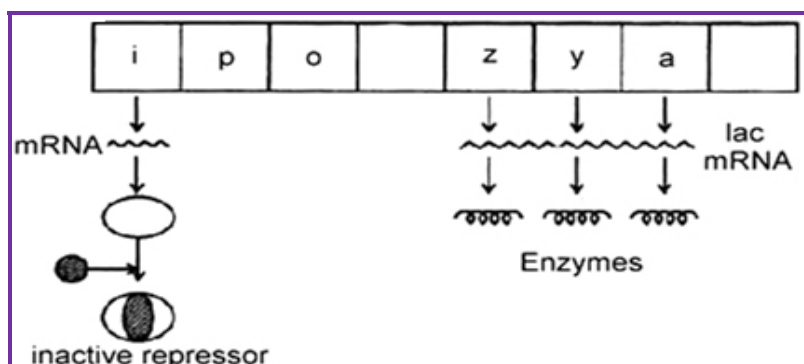
During the secondary treatment, the primary effluent is passed into large aeration tanks where it is continuously agitated mechanically. The air is allowed to pass through agitating mixture to make it aerobic. This allows vigorous growth of useful aerobic microbes into flock.

These microbes use the major part of the organic matter in the effluent. This considerably reduces the BOD (biochemical oxygen demand) of the effluent. The sewage water is treated till the BOD is reduced.

**Question: 18**

[2]

Study the figure given below and answer the questions:



i. How does the repressor molecule get inactivated?

**Answer:**

In the presence of an inducer, such as lactose, the repressor is inactivated by interaction with the inducer. This allows RNA polymerase access to the promoter and transcription proceeds.

ii. When does the transcription of lac Mrna stop?

**Answer:**

When Escherichia coli cells are grown in absence of lactose, the repressor molecule produced by I gene binds with the operator region of the operon and prevents RNA polymerase from transcribing the operon.

iii. Name the enzyme transcribed by the gene 'Z'.



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**Answer:**  
B-galactosidase.

**Section: C**

**Question: 19**

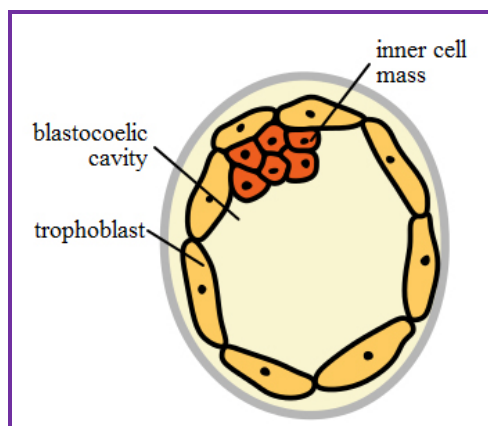
Name the pioneer species on a bare rock. How do they help in establishing the next type of vegetation? Mention the type of climax community that will ultimately get established. [3]

**Answer:**  
The pioneer species on a bare rock are usually lichens. They secrete acids to dissolve rock, helping in weathering and soil formation. These later pave way to some very small plants like bryophytes, which are able to take hold in the small amount of soil. The climax community that will ultimately get established is forest.

**Question: 20**

[3]

Study the figure given below and answer the questions that follow:



a. Name the stage of human embryo the figure represents.

**Answer:**  
Blastocytes.

b. Identify 'a' in the figure and mention its function.

**Answer:**  
Trophoblast. It helps in attachment of the blastocyst to the endometrium of uterine wall.

c. Mention the fate of the inner cell mass after implantation in the uterus.

**Answer:**  
The inner cell mass gets differentiated as the embryo

d. Where are the stem cells located in this embryo?

**Answer:**  
The inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs.



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**Question: 21**

- a. Give the scientific name of the parasite that causes malignant malaria in humans.

**Answer:**

Plasmodium falciparum.

- b. At what stage does this parasite enter the human body?

**Answer:**

Sporozoite.

- c. Trace its life cycle in human body.

[3]

**Answer:**

When an infected mosquito bites, the sporozoite is injected along with saliva into the human bloodstream. Plasmodium first enters liver cells, where it multiplies asexually, and then red blood cells, where it continues to proliferate.

Inside the red blood cell, it changes shape and divides into smaller form called merozoites. The red blood cell, containing these merozoites rupture, releasing them into the blood. The merozoites infect other red blood cells, and the life cycle is repeated.

The rupturing of red blood cell causes the symptoms of fever and chills plasmodium enters the sexual phase when some merozoites in the erythrocytes develop into gametocyte, cells capable of producing both male and female gametes. Erythrocyte containing gametocytes do not rupture.

**Question: 22**

Draw a labeled schematic sketch of replication fork of DNA. Explain the role of the enzymes involved in DNA replication.

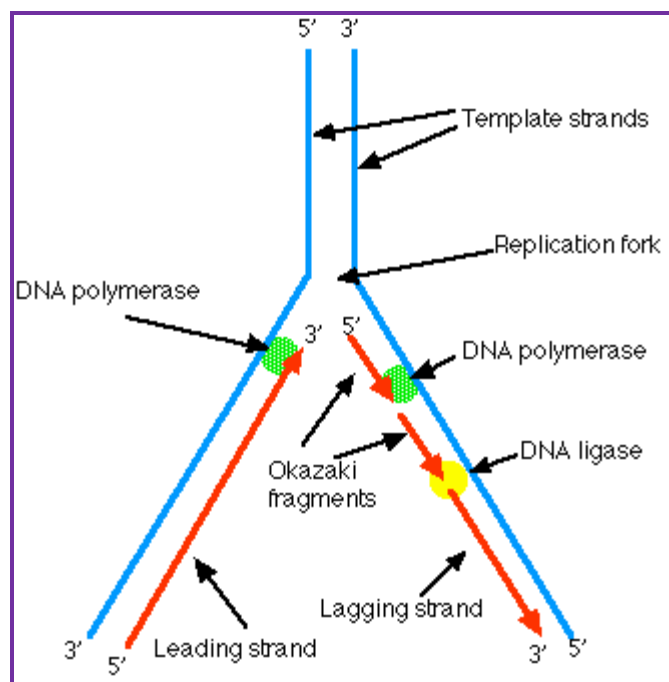
[3]

**Answer:**

DNA polymerase uses a DNA template to catalyze the polymerization of deoxynucleotides. Ligase joins the discontinuously synthesized fragments of DNA.







**Question: 23 \*\***

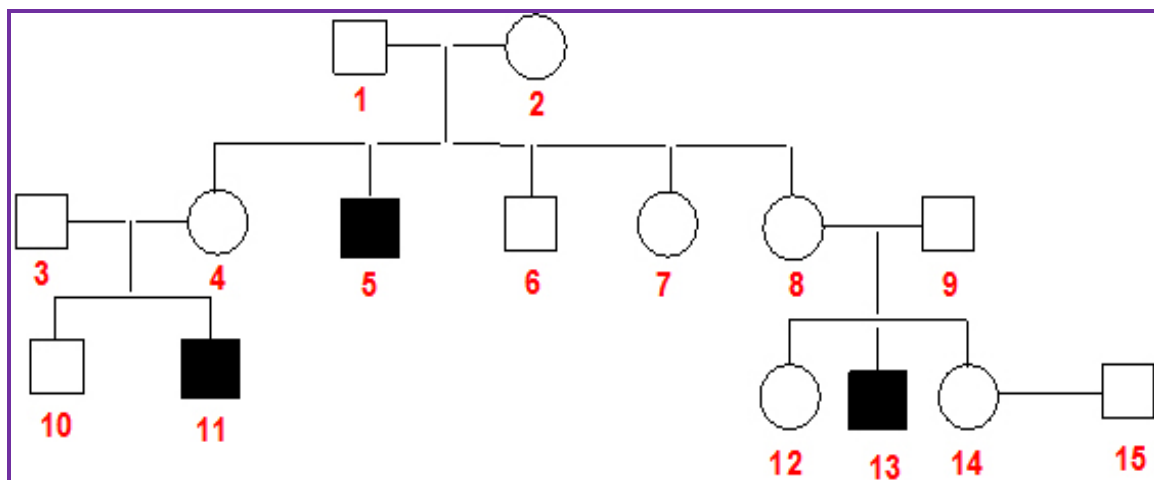
Explain the causes of global warming. Why is it a warning to mankind?

[3]

**Question: 24**

[3]

Hemophilia is a sex linked recessive disorder of humans. The pedigree chart given below shows the inheritance of hemophilia in one family. Study the pattern of inheritance and answer the questions given.



a. Give all the possible genotypes of the members 4, 5 and 6 in the pedigree chart.

**Answer:**  
 $4 - X X^h$ ,  $X = \text{normal}$

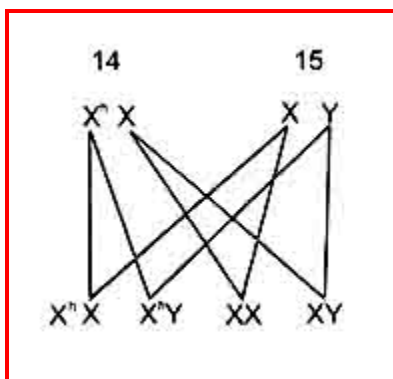


5 –  $X^hY, X^h$  = hemophilic  
6 -  $XY$

- b. A blood test shows that the individual 14 is a carrier of hemophilia. The member numbered 15 has recently married the member numbered 14. What is the probability that their first child will be a hemophilic male?

**Answer:**

The probability of their first child being a hemophilic male is 25%.



OR

Inheritance pattern of ABO blood groups in humans shows dominance, co dominance and multiple allelisms. Explain each concept with the help of blood group genotypes.

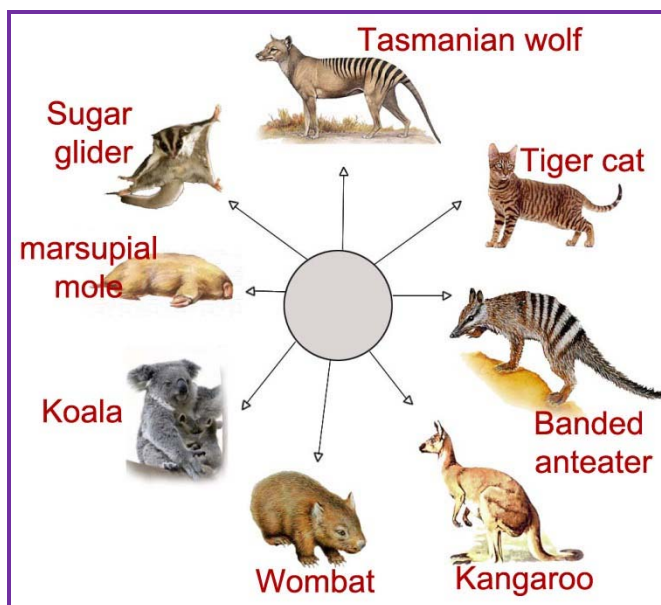
**Answer:**

Inheritance pattern of ABO blood groups in humans show dominance, co-dominance and multiple allelism. ABO blood groups are controlled by the gene I. The plasma membrane of the red blood cells has sugar polymers that protrude from its surface and the kind of sugar is controlled by the gene.

The gene (I) has three alleles  $I^A$ ,  $I^B$  and i. Therefore this is an example of multiple alleles. The alleles  $I^A$  and  $I^B$  produce a slightly different form of the sugar while allele i doesn't produce any sugar.

Because humans are diploid over I, in other words when  $I^A$  and i are present only  $I^A$  expresses (because i does not produce any sugar), and when  $I^B$  and i are present  $I^B$  expresses. This explains principle of dominance. But when  $I^A$  and  $I^B$  are present together they both express their own types of sugars: this is because of co-dominance.





- a. Mention the specific geographical region where these organisms are found.

**Answer:**

Australia.

- b. Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.

**Answer:**

Adaptive radiation

The processes of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

- c. Explain giving reasons the existence of placental wolf and Tasmanian wolf sharing the same habitat.

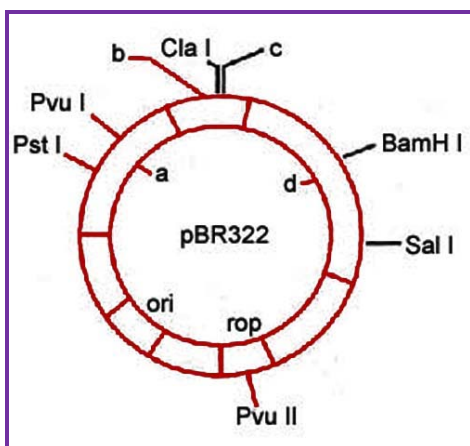
**Answer:**

Existence of placental wolf and Tasmanian wolf sharing the same habitat is because of convergent evolution. This pattern occurs when organisms coming from different stocks, evolve similar features and adapt to the same habitat.



**Question: 26**

[3]



- a. Identify the selectable markers in the diagram of Ecoli vector shown above.

**Answer:**

a = Ampicillin, d = Tetracycline

- b. How is the coding sequence of  $\alpha$ -galactosidase considered a better marker than the ones identified by you in the diagram? Explain.

**Answer:**

This is because when a recombinant DNA is inserted within the coding sequence of an enzyme,  $\beta$  – galactosidase results into inactivation of the enzyme, which is referred to as insertional inactivation. The presence of a chromogenic substrate gives blue colored colonies if the plasmid in the bacteria does not have an insert.

Presence of insert results into insertional inactivation of the  $\beta$  – galactosidase and the colonies do not produce any color and thus these colonies are identified as recombinant colonies.

**Question: 27 \*\***

Construct an ideal pyramid of energy when 1,000,000 joules of sunlight is available. Label all its trophic levels.

[3]

**Section: D**

**Question: 28**

Explain with the help of a diagram the development of a mature embryo sac from a megaspore mother cell in angiosperm.

[5]

**Answer:**

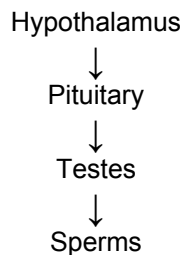
The process of megasporogenesis begins with the differentiation of primary archesporial cell in the nucellar hypodermis. The primary archesporial cell divides to form outer primary cell wall and inner primary sporogenous cell. This sporogenous cell directly behaves as the megaspore mother.

OR



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Study the following flow chart. Name the hormones involved at each stage. Explain their functions.



**Answer:**

The hypothalamus secretes gonadotropin-releasing hormone (GnRH). The increased levels of GnRH then acts at the anterior pituitary gland and stimulate secretion of two gonadotropins luteinizing hormone (LH) and follicle stimulating hormone (FSH).

LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, in turn, stimulate the process of spermatogenesis. FSH acts on the sertoli cells and stimulates secretion of some factors which help in the process of spermatogenesis.

**Question: 29**

[5]

- a. Explain the experiment performed by Griffith on streptococcus pneumonia. What did he conclude from this experiment?

Griffith's experiment was conducted in 1928 by Frederick Griffith which was one of the first experiments suggesting that bacteria are capable of transferring genetic information. In 1928, the bacteriologist Frederick Griffith, a British scientist performed an experiment with bacterium *Streptococcus pneumonia* that causes pneumonia in mammals including humans.

The disease causing or S- strain has cell surrounded by a capsule, and forms smooth glistening colonies when grown on agar medium. Some mutant strains form rough colonies or R strain. This strain does not cause pneumonia.

Also, when S strain is heat-killed and injected into mouse, no disease symptom appears. Amazingly, however, when mixture of heat-killed S reappeared. Live S type cells could be recovered from the blood of dead mice.

Griffith proposed that a 'transforming principle', a chemical substance was released by the killed S cells, which transformed the R bacteria into S type. This was a permanent genetic change as S type bacteria continued to produce similar cells. This is the first known example of bacterial transformation.

- b. Name the three scientists who followed up Griffith's experiments.

**Answer:**

Oswald T Avery, Colin MacLeod, and Maclyn McCarty.

- c. What did they conclude and how?

**Answer:**

They concluded that DNA isolated from S bacteria could by itself confer the pathogenic properties to R cells. Their evidence included the following observations:

- DNA from S strain bacteria causes R strain bacteria to be transformed.



- 
- Enzyme that degrades proteins cannot prevent transformation, nor did RNase an enzyme that digests RNA.

Enzymatic digestion of the transforming substance with Dnase, an enzyme that digest DNA, does prevent transformation. These experiments showed that not only that DNA is the genetic material but also DNA controls the biosynthetic properties.

OR

Two blood samples A and B picked up from the crime scene were handed over to the forensic department for genetic fingerprinting. Describe how the technique of genetic fingerprinting is carried out. How will be confirmed whether the samples belonged to the same individual or to two different individuals? \*\*

**Question: 30\*\***

[5]

One of the main objectives of biotechnology is to minimize the use of insecticides on cultivated crops. Explain with the help of a suitable example how insect resistant crops have been developed using techniques of biotechnology.

OR

- a. How is mature insulin different from proinsulin secreted by pancreas in humans?
- b. Explain how human functional insulin produced using rDNA technology was.
- c. Why is the functional insulin thus produced considered better than the ones used earlier by diabetic patients?

\*\*Out of syllabus. Answer will be provided up on request

