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## 2017

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## Section A

### Question: 1

Name the type of cross that would help to find the genotype of a pea plant bearing violet flowers. [1]

### Answer:

Test Cross.

### Question: 2

State two postulates of Oparin and Haldane with reference to origin of life. [1]

### Answer:

Oparin and Haldane proposed that life originated from pre-existing non-organic molecules and the diverse organic molecules were formed from these inorganic constituents by chemical evolution.

### Question: 3

A herd of cattle is showing reduced fertility and productivity. Provide one reason and one suggestion to overcome this problem. [1]

### Answer:

The cattle's productivity is decreased due to inbreeding depression. A single outcross i.e. breeding with animals of same breed but should not have common ancestors on either side upto 4-6 generations can restore its fertility.

### Question: 4

What are Cry genes? In which organism are they present? [1]

### Answer:

Cry genes codes for a toxin which is poisonous to some insects thus giving resistant to the plants. They are present in bacterium *Bacillus thuriangiensis*.

### Question: 5

An electrostatic precipitator in a thermal power plant is not able to generate high voltage of several thousands. Write the ecological implication because of it. [1]

### Answer:

It will not be able to remove particulate matter present in the exhaust of thermal power plants & hence cannot control pollution.



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## Section B

### Question: 6

A pollen grain in angiosperm at the time of dehiscence from an anther could be 2-celled or 3-celled. Explain. How are the cells placed within the pollen grain when shed at a 2-celled stage? [2]

### Answer:

In majority angiosperms, pollens are released in 2-celled stage whereas in other species, the generative cell divides into 2 male gametes & forms 3-celled stage.

When the pollen grain is shed at 2-celled stage - it has two unequal cells - bigger vegetative cell and smaller generative cell.

### Question: 7

Differentiate between the genetic codes given below:

[2]

- Unambiguous and Universal
- Degenerate and Initiator

### Answer:

- Unambiguous and Universal :** -  
Unambiguous: - The code is specific, i.e. one codon codes for only one amino acid.  
Universal: - The code is same in all organisms.
- Degenerate and Initiator :** -  
Degenerate: - When an amino acid is coded by more than one codon, it is said to be degenerate.  
Initiator: - AUG is an initiator codon i.e. it initiates the translation process & also codes for methionine.

### Question: 8

Mention one application for each of the following:

[2]

- Passive immunization
- Antihistamine
- Colostrum
- Cytokinin-barrier

### Answer:

- Passive Immunization** - When readymade antibodies are introduced into the body, it is called as passive immunization. It provides quick immune response in body.
- Anti-Histamines** - These are the chemicals which are given against allergic reactions.
- Colostrum** - It is the yellow fluid produced during the initial days of lactation. It is rich in antibodies and is necessary to develop resistance in a new born baby.
- Cytokinin-Barrier** - is Interferon. These are the glycoproteins which protect non-infected cells from further viral infection.

### Question: 9

Name the microbes that help production of the following products commercially:

[2]

- Statin
- Citric acid
- Penicillin
- Butyric acid

### Answer:

- Statin : - *Monascus purpureus* (fungus)
- Citric acid: - *Aspergillus niger* (fungi)
- Penicillin: - *Penicillium notatum* (fungi)



- 
- d. Butyric acid: - Clostridium butylicum (Bacteria)

**Question: 10**

List four benefits to human life by eliminating the use of CFCs

[2]

**Answer:**

- i. Ozone depletion will be prevented.
- ii. Greenhouse effect will be controlled
- iii. Global warming will be controlled.
- iv. It will prevent old climatic changes that takes place due to rise in temperature.

OR

Suggest two practices giving one example of each that help protect rare or threatened species.

**Answer:**

- i. By using cryopreservation (preservation at  $-196^{\circ}\text{C}$ ) technique, sperms, eggs, tissues, and embryo can be stored for long period in gene banks, seed banks etc.
- ii. Plants are propagated in vitro using tissue culture methods.



## Section C

### Question: 11

- a. Can a plant flowering in Mumbai be pollinated by pollen grains of the same species growing in New Delhi? Provide explanations to your answer. [1]

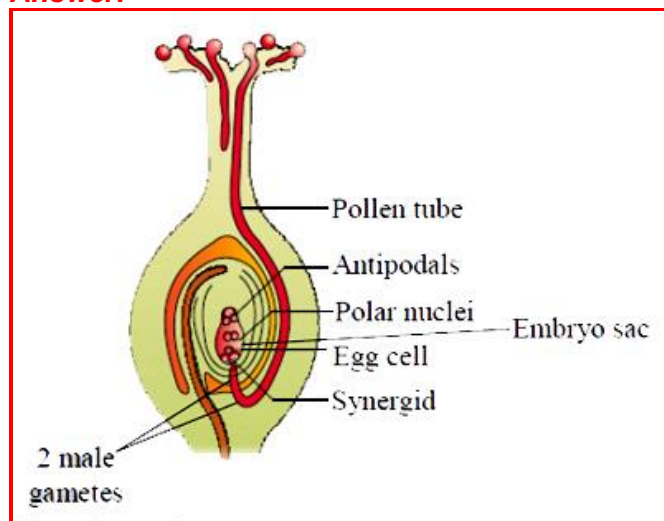
#### Answer:

It is possible by Artificial Hybridization where pollen grain of one flower is introduced artificially on the stigma of another flower. But there should not be self-incompatibility.

- ✓ For this in one flower *emasculation* is removal of anthers & by choice by then flower is *bagged*.
- ✓ After some time, the bag is removed and then desired pollen grains are introduced on its stigma.

- b. Draw the diagram of a pistil where pollination has successfully occurred. Label the parts involved in reaching the male gametes to its desired destination. [1]

#### Answer:



The pollen tube reaching the ovule.

### Question: 12

Both Haemophilia and Thalassemia are blood related disorders in humans. Write their causes and the difference between the two. Name the category of genetic disorder they both come under. [3]

#### Answer:

Both are Mendelian disorders.

- Haemophilia is a sex linked recessive disorder. The gene for haemophilia is located on X chromosome. The gene passes from a carrier female to her son.
- Thalassemia is an autosomal linked recessive disease.
- It occurs due to either mutation or deletion resulting in reduced rate of synthesis of one of globin chains of haemoglobin.
- The difference between Haemophilia and Thalassemia is: - In haemophilia, clotting is affected, i.e. there can be a non-stop bleeding even after a minor cut.
- In Thalassemia, anaemia is the characteristic of this disease.

### Question: 13

- a. List the two methodologies which were involved in human genome project. Mention how they were used. [3]



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**Answer:**

**2 Methodologies of HGP: -**

- i. **Expressed Sequence Tags (EST's):** - This method focusses on identifying all the genes that are expressed as RNA.
- ii. **Sequence Annotation:** - It is an approach of simply sequencing the whole set of genome that contains all the coding and non-coding sequences, and later assigning different regions in the sequence with functions.

b. Expand 'YAC' and mention what it was used for.

**Answer:**

'YAC' → Yeast Artificial Chromosome:

It is used as a cloning vector for cloning DNA fragments in suitable host so that DNA sequencing can be done.

**Question: 14**

Write the characteristics of *Ramapithecus*, *Dryopithecus* and Neanderthal man.

[3]

**Answer:**

Characteristics of *Ramapithecus*: -

- It evolved around 15 mya.
- More man-like, walked more erect, teeth like modern man.

Characteristics of *Dryopithecus* : -

- It evolved around 25 mya.
- Ape like, hairy arms and legs of same length, large brain, ate soft fruits and leaves, walked like gorillas and chimpanzees.

Characteristics of Neanderthal Man : -

- It evolved around 1,00,000-40,000 year ago.
- Fossil found in east and central Asia, brain size 1400 cc used hides to protect body, buried their dead.

**Question: 15**

Name a human disease, its causal organism, symptoms (any three) and vector, spread by intake of water and food contaminated by human faecal matter.

[1]

**Answer:**

Amoebic dysentery [Amoebiasis]

Causal Organism: - *Entamoeba histolytica*, a protozoa.

Symptoms: -

- a. Abdominal pain
- b. Constipation
- c. Cramps.

Vector: - Housefly.

OR

- a. Why is there a fear amongst the guardians that their adolescent wards may get trapped in drug/alcohol abuse?

[1]

**Answer:**

Reasons for alcohol abuse in adolescents: -

- a. Social pressure
- b. Curiosity and need for adventure, excitement and experiment.
- c. To escape from stress, depression and frustration.



- 
- d. To overcome hardships of life.
  - e. Unstable or unsupportive family structure

b. Explain 'addiction' and dependence' in respect of drug/alcohol abuse in youth. [1]

**Answer:**

The psychological attachment to certain effects such as euphoria and a temporary feeling of well-being, associated with drugs and alcohol is called ADDICTION.

Dependence: - The tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome on abrupt discontinuation of regular dose of drug/alcohol is called Dependence.

**Question: 16**

a. Write the desirable characters a farmer looks for in his sugarcane crop. [3]

**Answer:**

The desirable characters that should be present in sugarcane crop are: -

- a. High yield
  - b. Thick stem
  - c. High sugar content
  - d. Ability to grow in North India.
- b. How did plant breeding techniques help north Indian farmers to develop cane with desired characters?

**Answer:**

With the help of plant breeding, the two varieties of sugarcane i.e. *Saccharum barberi* [sugarcane of North India] and *Saccharum officinarum* [sugarcane of South India] were crossed to obtain sugarcane varieties having desirable qualities. So that a good quality sugarcane variety could be grown in North India.

**Question: 17**

Secondary treatment of the sewage is also called Biological treatment. Justify this statement and explain the process. [3]

**Answer:**

Secondary treatment or Biological treatment:

- ✓ Primary effluent is passed into large aeration tanks with constant mechanical agitation and air supply.
- ✓ Useful aerobic microbes grow rapidly and form flocs.
- ✓ Flocs are masses of bacteria and consumes organic matter and thus reduce the biochemical oxygen demand (BOD).
- ✓ When BOD of sewage has reduced, the effluent is passed into settling tank.
- ✓ Here, the bacterial flocs settle and sediment is called activated sludge.
- ✓ A small part of the sludge is used as an inoculum in the aeration tank and the remaining part is passed into large tanks called anaerobic sludge digesters.
- ✓ In the digesters, heterotrophic microbes anaerobically digest bacteria and fungi in sludge producing mixture of gases such as methane,  $H_2S$ ,  $CO_2$  which forms the biogas.

**Question: 18**

a. Explain the significance of palindromic nucleotide sequence in the formation of recombinant DNA. [3]

**Answer:**

The palindromic sequences i.e. the sequence of base pairs read the same on both the DNA strands, when orientation of reading is kept the same.



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Example: -

5' ——— GAATTC ——— 3'  
3' ——— CTTAAG ——— 5'

b. Write the use of restriction endonuclease in the above process.

**Answer:**

On finding the palindrome, the endonuclease binds to the DNA.

It cuts the opposite strands of DNA, but between the same bases on both the strands & forms STICKY ENDS. This sticky ends facilitate the action of enzyme DNA ligase and helps in the formation of recombination DNA.

**Question: 19**

[3]

Describe the roles of heat, primers and the bacterium *Thermus aquaticus* in the process of PCR.

**Answer:**

**Role of Heat:** - It helps in **denaturation** process in PCR. The ds DNA is heated in this process at very high temperature (95°C) so that both the strands separates.

**Role of primers:** - Primers are chemically synthesised small oligonucleotides of about 10-18 nucleotides that are complementary to a region of template DNA and helps in the extension of new chain.

**Role of Bacterium *Thermus aquaticus*:** - From this bacterium, a thermostable Taq DNA polymerase is isolated which can tolerate high temperatures and forms new strand.

**Question: 20**

Explain the various steps involved in the production of artificial insulin.

[3]

**Answer:**

Genetically Engineered Insulin: -

- ✓ Insulin contains two short polypeptide chains: chain A and chain B linked together by disulphide bridges.
- ✓ In mammals insulin is synthesized as a pro-hormone. It contains an extra stretch called C-peptide.
- ✓ C-peptide is absent in the mature insulin and is removed during maturation into insulin.
- ✓ Production of insulin by rDNA techniques was achieved by an American company, Eli Lilly in 1983. It prepared two DNA sequences corresponding to A and B, chains of human insulin and introduced them in plasmids of *E. coli* for production.  
The A and B chains produced were separated, extracted and combined, by creating disulfide bonds to form human insulin.

**Question: 21**

a. "Organisms may be conformers or regulators." Explain this statement and give one example of each.

[3]

**Answer:**

"Regulators": - The organism is able to maintain homeostasis by physiological and behavioural means.

All birds and mammals and few lower vertebrates and invertebrates' species maintain homeostasis by thermoregulation and osmoregulation.

For eg: - Birds & Mammals.

"Conformers": - Majority (99%) of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature is not constant. They are simply conformers. Eg: - Fishes, Frogs etc.

b. Why are there more conformers than regulators in the animal world?





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**Answer:**

Because they lack the capability maintain a constant internal environment or homeostasis.

**Question: 22**

Describe the inter-relationship between productivity, gross primary productivity and net productivity.

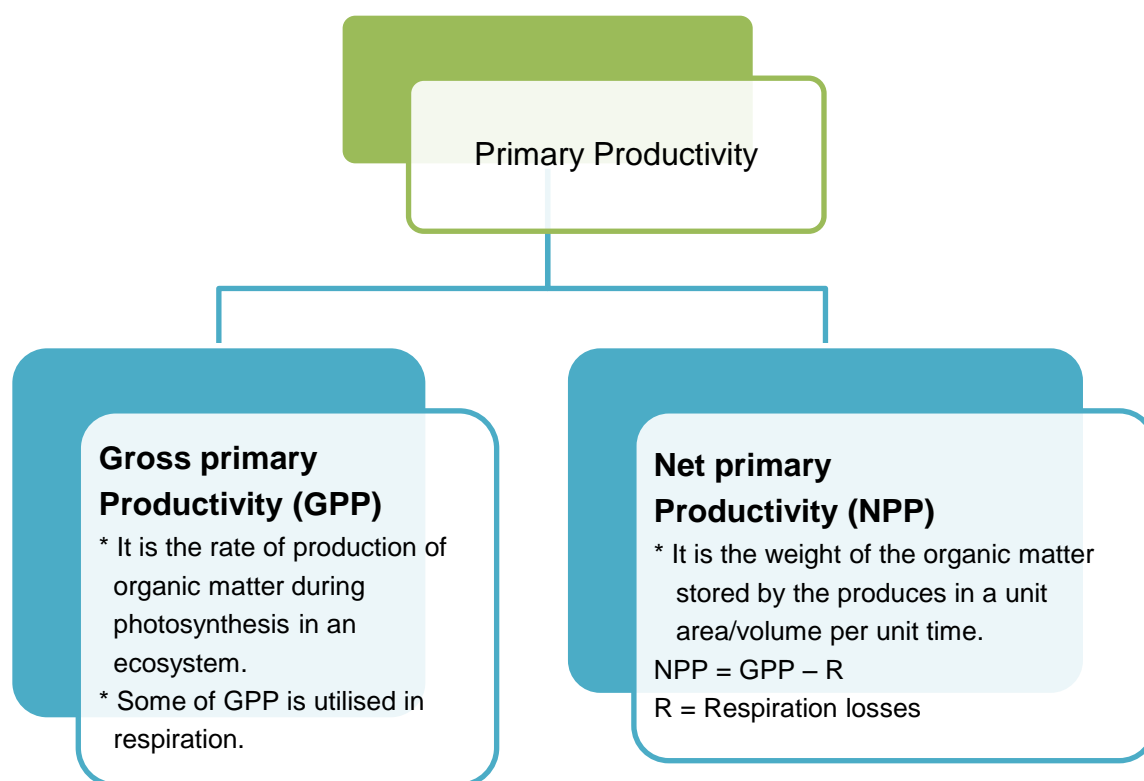
[3]

**Answer:**

The rate of biomass production per unit area, over a time period by plant during photosynthesis is called productivity.

It is expressed in  $(\text{kcal m}^{-2})\text{yr}^{-1}$  or  $\frac{\text{g}}{\text{m}^2 \text{ yr}}$  or  $\text{g m}^{-2} \text{ y}^{-1}$ .

The amount of biomass or organic matter produced per unit area over a time period in plants during photosynthesis is called primary production.



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## Section D

### Question: 23

It is commonly observed that parents feel embarrassed to discuss freely with their adolescent children about sexuality and reproduction. The result of this parental inhibition is that the children go astray sometimes. [4]

- a. Explain the reasons that you feel are behind such embarrassment amongst some parents to freely discuss such issues with their growing children.

### Answer:

Parents feel embarrassed as: -

Indian Society is not that broad minded and parents feel shy talking openly regarding these matters to their children due to which their children go astray sometimes.

But parents should consider that at adolescence parents should behave like friends to their child.

So that child could also share his problems with parents.

Parents should give right information about the reproductive aspects, sexual practices, adolescence changes to their children so that their children will never be misleader.

- b. By taking one example of a local plant and animal, how would you help these parents to overcome such inhibitions about reproduction and sexuality?

### Answer:

By an example of male honey bee and orchid ophrys flower, it is evident that sexual attraction is a natural phenomenon, the honey bee is attracted to a ophrys flower and assumes its one petal as its female partner & pseudo copulates with it.

So it is a natural phenomenon & parents should talk regarding this matter to their children.



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## Section E

### Question: 24

[3]

- a. When a seed of an orange is squeezed, many embryos, instead of one are observed. Explain how it is possible.

#### Answer:

It is due to polyembryony.

Occurrence of more than one embryos in a seed is called as POLYEMBRYONY.

In orange, the nucellar cells, synergid or integument cells develop into a number of embryos of different sizes. eg : - Citrus.

\* Sometimes formation of more than one egg in an embryo sac can lead to polyembryony.

- b. Are these embryos genetically similar or different? Comment.

[2]

#### Answer:

In such embryos parental characters are maintained hence they are genetically similar.

In this process, there is no segregation of characters in the offspring (progeny).

OR

- a. Explain the following phases in the menstrual cycle of a human female:

[4]

- i. Menstrual phase
- ii. Follicular phase
- iii. Luteal phase

#### Answer:

##### i. Menstrual phase: -

- ✓ The soft tissue of endometrial lining of the uterus disintegrates causing bleeding.
- ✓ The unfertilized egg and soft tissues are discharged.
- ✓ It lasts for 3-5 days.

##### ii. Follicular phase/Proliferative Phase: -

- ✓ The primary follicles in the ovary grow and become a fully mature Graafian follicle.
- ✓ The endometrium regenerates.
- ✓ It lasts for about 10 to 14 days.

##### iii. Luteal phase (15 days to 28/29 days)

- ✓ In this phase the ruptured follicle changes into corpus luteum in the ovary and it begins to secrete hormone progesterone.
- ✓ The endometrium thickens further.
- ✓ If ovum is not fertilized, the corpus luteum undergoes degeneration and this causes disintegration of endometrium leading to menstruation.

- b. A proper understanding of menstrual cycle can help immensely in family planning. Do you agree with the statement? Provide reasons for your answer.

[1]

#### Answer:

Yes, a proper understanding of menstrual cycle can help immensely in family planning.

As day 10 to 17 of the menstrual cycle is called as FERTILE PERIOD of human female. If coitus is done during this period increases the chances of conception but coitus is abstained in this period, pregnancy can be prevented.

### Question: 25

- a. Compare, giving reasons, the J-shaped and S-shaped models of population growth of a species.

[3]



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**Answer:**

There are 2 models of population growth:

- The exponential growth
- Logistic growth

**Exponential growth:** This growth occurs where the resources (food + space) are unlimited. The equation can be represented as

$$\frac{dN}{dt} = (b - d) \times N$$

Let  $(b - d) = r$

$$\frac{dN}{dt} = rN$$

$$\text{or, } N_t = N_0 e^{rt}$$

$N$  = population size

$N_t$  = population density after time  $t$ .

$N_0$  = population density at time zero

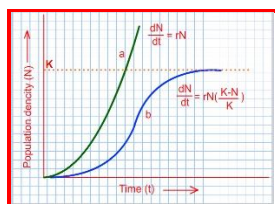
$r$  = growth rate

$b$  = birth rate

$d$  = death rate

In this growth, when  $N$  in relation to time is plotted on graph, the curve becomes J-shaped.

**Logistics growth model:** This is a realistic approach as the resources become limited at a certain point of time.



- J-shaped curve  $\Rightarrow$  exponential growth
- S-shaped curve  $\Rightarrow$  logistics growth

Every ecosystem has limited resources to support a particular maximum carrying capacity ( $K$ ). When  $N$  is plotted in relation to time  $t$ , a sigmoid-S-shaped curve is obtained & is also called as VERHULST-PEARL logistic growth. The equation is:

$$\frac{dN}{dt} = rN \frac{(K-N)}{K}$$

$N$  = population density at time  $t$ .

$r$  = growth rate

$K$  = carrying capacity.

- Explain ‘fitness of a species’ as mentioned by Darwin.

[2]

**Answer:**

“Fitness of a species” according to Darwin means reproductive fitness. All organisms after reaching reproductive age have varying degree of reproductive potential some organisms produce more offspring and some organism produce only few offspring. This phenomenon is also called as DIFFERENTIAL REPRODUCTION.

Hence the species which produces more offspring are selected by nature.



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OR

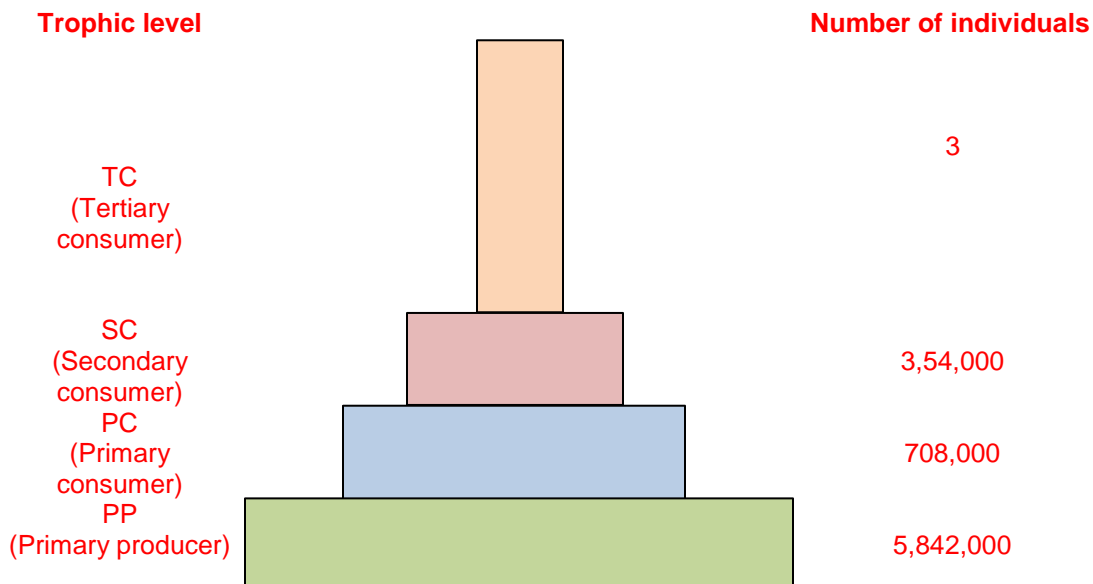
- a. What is an ecological pyramid? Compare the pyramids of energy, biomass and numbers. [4]

**Answer:**

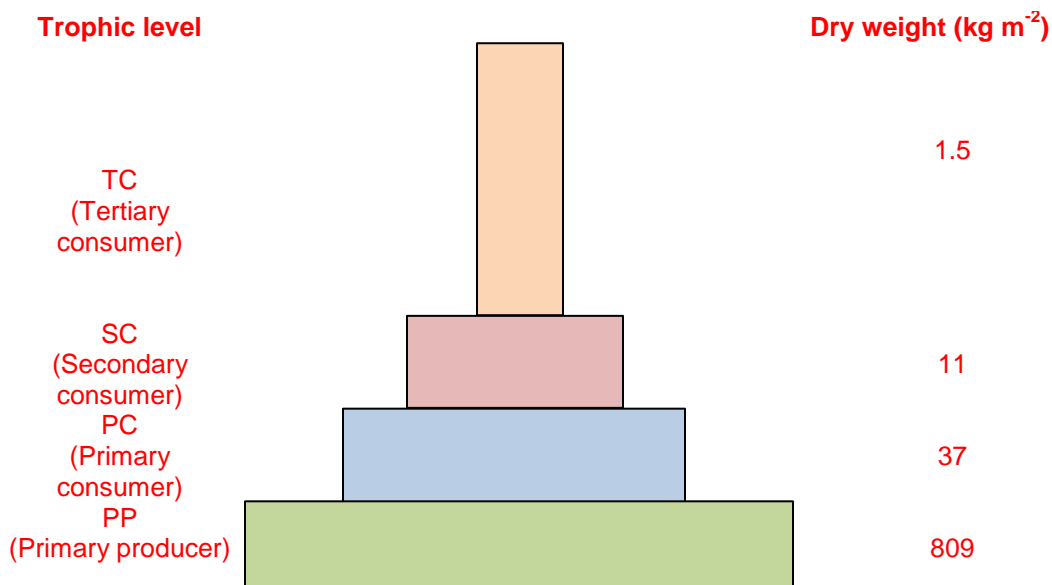
**Ecological pyramid:** The relation between producers and consumers in an ecosystem can be graphically represented in the form of a pyramid called ecological pyramid.

Ecological pyramids are of 3 types:

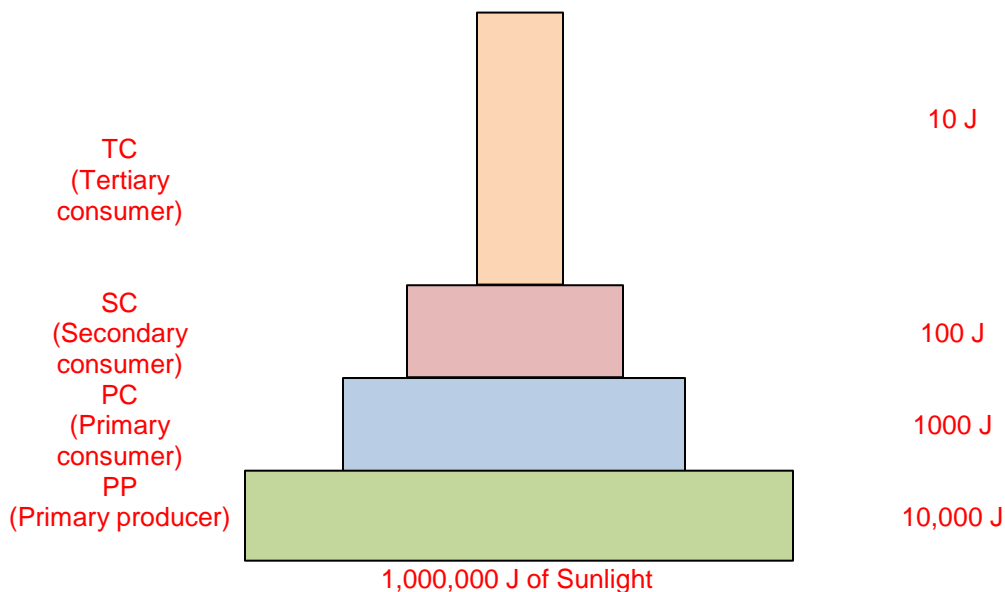
- Pyramid of number
  - Pyramid of biomass
  - Pyramid of energy
- a. **Pyramid of number:** - The relationship between producers and consumers in an ecosystem can be represented in the form of a pyramid in terms of number is called pyramid of number.



- b. **Pyramid of Biomass:** - The relationship between producers and consumers in an ecosystem can be represented in the form of a pyramid in terms of biomass is called pyramid of biomass. It can be upright or inverted.



- c. **Pyramid of energy:** - The relationship between producers and consumers in an ecosystem can be represented in the form of pyramid in terms of flow of energy called pyramid of energy. Always upright as energy is lost as heat at each step.



- b. Write any two limitations of ecological pyramids.

[1]

**Answer:**

Limitations of ecological pyramids: -

- It never takes into account the same species belonging to two or more trophic levels.
- It assumes a simple food chain, which never exists in nature.

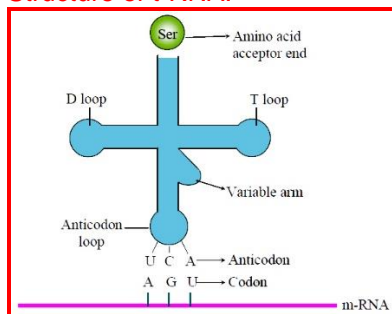
**Question: 26**

- a. Describe the structure and function of a t-RNA molecule. Why is it referred to as an adapter molecule? [3]

**Answer:**

t-RNA (transfer RNA) reads the genetic code on one hand & transfers amino acids on the other hand, so it is called as adapter molecule by Francis Crick. It is also called as soluble RNA (SRNA).

Structure of t-RNA:



The secondary structure of t-RNA is clover leaf like but the 3-D structure is inverted L-shaped. t-RNA has five arms or loops

- Anticodon loop: - Which has bases complementary to the code.



- ii. Amino acid acceptor end: - To which amino acid binds.
- iii. T-loop: - Which help in binding to ribosome.
- iv. D-loop: - Which help in binding amino acyl synthetize.
- v. Variable loop: - No function known.

b. Explain the process of splicing of hn-RNA in a eukaryotic cell.

[2]

**Answer:**

The primary transcript formed in eukaryotes are non-functional, containing both the coding region, exon and non-coding region, intron in RNA and are called heterogeneous RNA or hn-RNA.

hn-RNA undergoes a process where the introns are removed and exons are joined to form m-RNA (Functional) by the process called SPLICING.

OR

Write the different components of a *lac*-operon in *E. coli*. Explain its expression while in an 'open' state.

[5]

**Answer:**

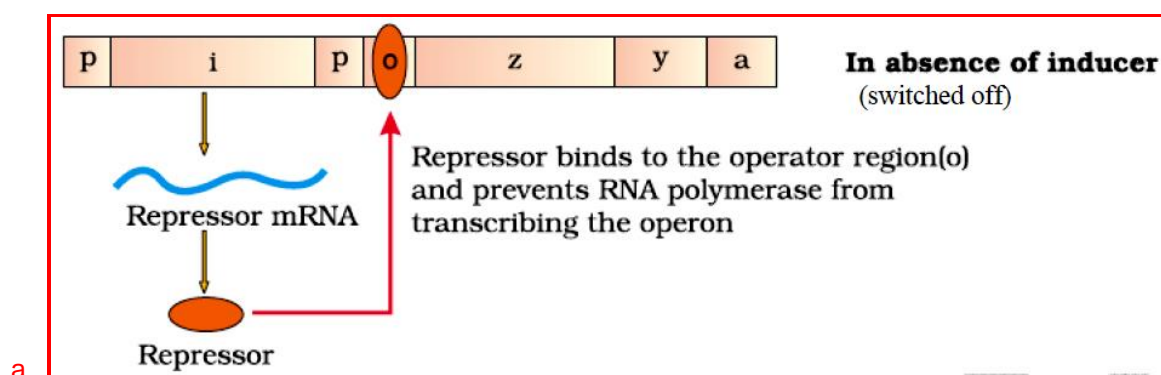
The lac operon (Inducible operon)

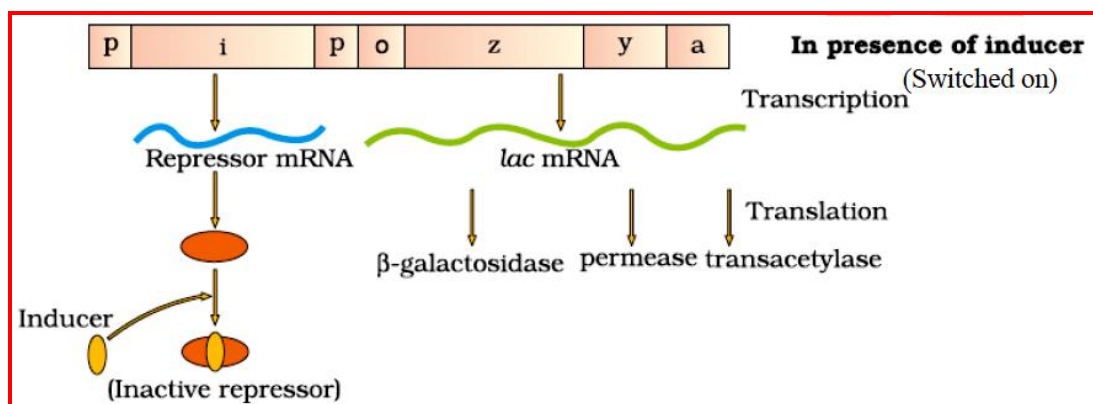
Operon: - The concept of operon was first proposed in 1961, by Jacob and Monod

Components of an operon: -

- i. Structural genes: - The fragment of DNA which transcribe mRNA for polypeptide synthesis.
- ii. Promoter: - The sequence of DNA where RNA polymerase binds and initiates transcription.
- iii. Operator: - The sequence of DNA adjacent to promoter is called OPERATER.
- iv. Regulator gene: - It is the gene that codes for repressor protein which binds to operator due to which operon is switched "off"
- v. Inducer: - Lactose is inducer which helps in switching "on" of operon.

Lac operon consists of their structural genes (z, y, a), operator (o), promoter (p), regulatory gene (i)





b.

- Gene z codes for  $\beta$ -galactosidase
- Gene y codes for permease.
- Gene a codes for enzymes transacetylase.

#### When lactose is absent:-

When lactose is absent, i.e. gene produces repressor protein.

This repressor protein binds to operator and as a result prevents RNA polymerase to bind to operon.

The operon is switched off.

#### When lactose is present: -

- Lactose act as inducer which binds to the repressor and forms inactive repressor.
- The repressor cannot bind to operator.
- Now the RNA polymerase binds to operator and transcribes lac mRNA.
- Lac mRNA is polycistronic i.e. produces all three enzymes  $\beta$ -galactosidase, permease and trans-acetylase.
- The lac operon is switched on.

