

SECTION A

Note : Choose the correct option from the choices given in each of the following questions :

1 Introduction of an alien DNA into a plant host cell is achieved by making them

- (A) Competent with bivalent ions**
- (B) Using microinjections**
- (C) Using gene gun**
- (D) Using lysozymes and chitinase**

Ans. C / Using gene gun =1

[1 Mark]

2. One of the ex situ conservation methods for endangered species is

- (A) Biosphere reserves**
- (B) National parks**
- (C) Cryopreservation**
- (D) Wildlife sanctuaries**

Ans. C / Cryopreservation = 1

[1 Mark]

OR

Ozone gas is continuously formed in the stratosphere by

- (A) Action of UV rays on nascent oxygen**
- (B) Reaction of oxygen with water vapour**
- (C) Action of UV rays on molecular oxygen**
- (D) Action of UV rays on water vapour**

Ans. C / Action of UV rays on molecular oxygen = 1

[1 Mark]

3. Intense lactation in mothers acts as a natural contraceptive due to the

- (A) Suppression of gonadotropins**
- (B) Hypersecretion of gonadotropins**
- (C) Suppression of gametic transport**
- (D) Suppression of fertilization**

Ans. A / Suppression of gonadotropins = 1

[1 Mark]

4. The principle of vaccination is based on the property of

- (A) Specificity
- (B) Diversity
- (C) Memory
- (D) Discrimination between 'self' and 'non-self'

Ans. C / Memory = 1

[1 Mark]

OR

Opioids act as

- (A) Depressants
- (B) Pain killers
- (C) Euphoria providers
- (D) Stimulants

Ans. A / Depressants = 1

[1 Mark]

5. Nematode specific genes were introduced into the tobacco host plant by using the vector

- (A) Plasmid
- (B) Bacteriophage
- (C) pBR 322
- (D) *Agrobacterium*

Ans. D / *Agrobacterium* = 1

[1 Mark]

SECTION B

6. *Spirulina* is a rich source of proteins. Mention the two ways by which large scale culturing of these microbes is possible.

Ans. Grown in waste water from potato processing plants (starch rich) / straw / molasses / animal manure / sewage (any two) // bioreactor, using any two above mentioned materials = 1+1

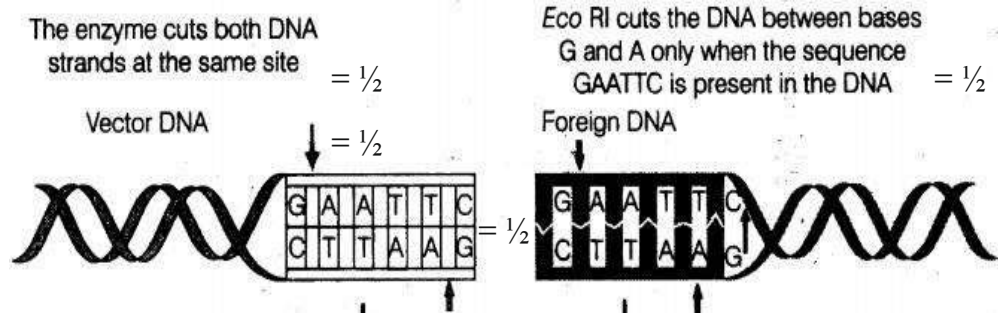
[2 Marks]

7. How does EcoRI specifically act on DNA molecule ? Explain.

Ans. Inspects the length of a DNA sequence, finds its specific recognition sequence as

$\frac{5'GAATTC 3'}{3'CTTAAG 5'}$, binds to the DNA, and cut each of the two strands of the double helix at specific points in their sugar-phosphate backbones = $\frac{1}{2} \times 4$

//



[2Marks]

8. (a) Explain the cause responsible in a human to have sex chromosomes as 'XXY' instead of 'XX' or 'XY'.
 (b) List any two ways such individuals are different from the normal being.

Ans. a) Failure of segregation of chromatids during cell division cycle/ nondisjunction/ aneuploidy, resulting in gain of an extra X chromosome in a male after fertilization

$= \frac{1}{2} \times 2$

b) Development of breasts/ gynaecomastia, sterile individuals $= \frac{1}{2} \times 2$

[2Marks]

9. Name and explain the technique that can be used in developing improved crop varieties in plants bearing female flowers only.

Ans. Artificial hybridization $= \frac{1}{2}$

The female flower buds are bagged before the flower open, when stigma becomes receptive pollination is carried out using the desired pollen, and flower is rebagged (and fruits are allowed to develop) $= \frac{1}{2} \times 3$

[2Marks]

OR

When are the non-flowering plants said to be homothallic and monoecious; and heterothallic and dioecious? Give an example of each.

Ans. Homothallic and monoecious: bisexual condition/ having both male and female reproductive structures on the same plant, eg. *Chara* and several fungi or any other suitable example $= \frac{1}{2} \times 2$

Heterothallic and dioecious: unisexual condition/ having either male or female reproductive structures present in different plants, example *Marchantia* or any other suitable example $= \frac{1}{2} \times 2$

[2Marks]

10. Mention the kind of interaction mycorrhizae exhibit. How is Glomus in mycorrhizal association beneficial to the plants ?

Ans. Symbiotic relationship / mutualism = ½

absorbs phosphorus from the soil, provides resistance to the root borne pathogens, tolerance to salinity and drought, overall increase in the plant growth (any three) = ½ × 3

[2Marks]

11. Given below is the segment of a DNA strand. Write its complementary strand and the RNA strand that can be transcribed from the DNA molecule formed.

5' TAC CGT GAC GTC 3'

Ans. Complementary strand 3' ATG GCA CTG CAG 5' (correct polarity) = ½ (correct sequence) = ½

RNA strand 5' UAC CGU GAC GUC 3' (correct polarity) = ½ (correct sequence) = ½

[1 + 1 = 2Marks]

12. Name the type of Ecological Pyramid that can exist as upright as well as inverted. Explain how does it happen.

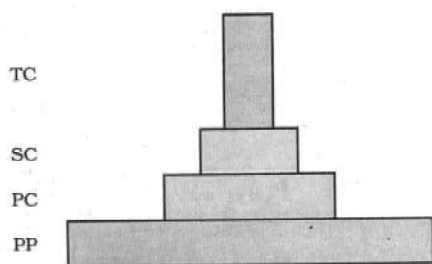
Ans. Pyramid of number = ½

Pyramid of number

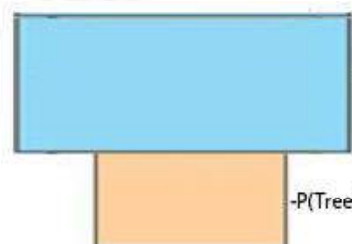
A. Upright Pyramid

B. Inverted Pyramid

Trophic level



Grassland Ecosystem



-Primary Consumer (Insects)

= ½ × 2

-P (Tree)

Tree Ecosystem (both example) = ½

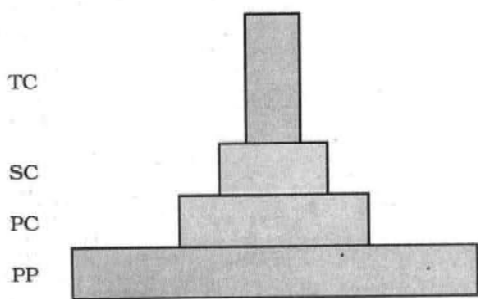
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Pyramid of Biomass = ½

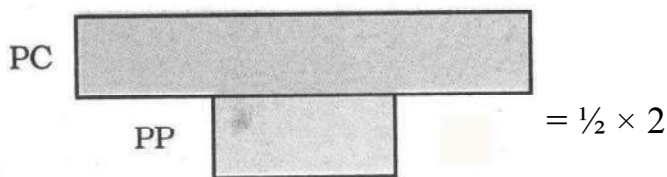
A. Upright Pyramid

B. Inverted Pyramid

Trophic level



Tree Ecosystem



Sea Ecosystem (both example) = $\frac{1}{2}$

//

In the upright pyramid of number the producers / grass are more than the number of primary consumer / secondary consumer = $\frac{1}{2}$

Eg. grassland ecosystem = $\frac{1}{2}$

In inverted pyramid of number the producer is less in number than the number of primary consumer = $\frac{1}{2}$

Eg. Tree and insects feeding on it = $\frac{1}{2}$

//

In the upright pyramid of biomass the producers / tree are more in biomass than the primary consumer / secondary consumer = $\frac{1}{2}$

Eg. forest ecosystem = $\frac{1}{2}$

In inverted pyramid of biomass the biomass of the producer/phytoplanktons are less than the biomass of the zooplanktons / small standing crop of phytoplanktons supports large standing crop of zooplanktons = $\frac{1}{2}$

Eg. Pyramid of biomass in sea = $\frac{1}{2}$

[2Marks]

SECTION C

13. “Cotton bollworms enjoy feeding on cotton plants, but get killed when feed on Bt cotton plant.” Justify the statement.

Ans. Once a bollworm feeds on Bt cotton plant the inactive protoxin produced by *Bacillus thuringiensis*, is converted into an active form of toxin, due to the alkaline pH of the gut which solubilise the crystals, the activated toxin binds to the surface of its midgut epithelial cells, create pores that cause cell swelling and lysis, and eventually cause death of the insect = $\frac{1}{2} \times 6$

[3 Marks]

OR

(a) Mention the cause of ADA deficiency in humans.

- (b) How is gene therapy carried out to treat the patients suffering from this disease ?
- (c) State the possibility of a permanent cure of this disease.

- Ans. a) Caused due to the deletion of the gene for adenosine deaminase = $\frac{1}{2}$
- b) lymphocytes from the blood of the patient are grown in a culture medium outside the body, a functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes which are subsequently returned to the patient, patient requires periodic infusion of such genetically engineered lymphocytes = $\frac{1}{2} \times 3$
- c) if the gene isolated from bone marrow cells producing ADA, is introduced into cells at early embryonic stages it could be a permanent cure = $\frac{1}{2} + \frac{1}{2}$

[3 Marks]

14. (a) Differentiate between Intrauterine insemination and Intrauterine transfer.
- (b) Mention one positive and one negative application of amniocentesis.

- Ans. a) IUI - the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus of the female = 1
- IUT - embryos with more than 8 blastomeres transferred into the uterus = 1
- b) Positive application: used to test for the presence of certain genetic disorders / Down's syndrome / Klinefelter's syndrome / Haemophilia / Sickle-cell anemia = $\frac{1}{2}$

Negative application : used to detect sex of the foetus and leads to female foeticides = $\frac{1}{2}$

[3 Marks]

15. Explain the solutions found by Ahmed Khan, a Bengaluru based plastic sack manufacturer, after realising the problems created by plastic wastes.

- Ans. Polyblend a fine powder was made from recycled modified plastic, this was mixed with the bitumen to lay roads which proved to enhance the bitumen's water repellent properties, and helped to increase road life by the factor of three = 1×3

[3 Marks]

16. Mention the chemical nature of an antibody and name the type of cells they are produced by. Write the difference between active and passive immune responses on the basis of antibodies.

- Ans. Made up of proteins / peptide, B-lymphocytes / B-cells = $\frac{1}{2} + \frac{1}{2}$

Active immunity - due to exposure to antigens / pathogens / vaccination / immunisation leads to production of antibodies by the individual, slow process = $\frac{1}{2} + \frac{1}{2}$

Passive immunity - Ready-made antibodies are directly given to protect the body of an individual against foreign agents, fast process / provide immediate immunity = $\frac{1}{2} + \frac{1}{2}$

[3 Marks]

OR

- Name the cells that act as HIV factory in humans when infected by HIV. Explain the events that occur in these infected cells.

- Ans. Macrophages = $\frac{1}{2}$

Once the virus enters the human body the virus / viral genome infects macrophages where its RNA genome replicates, to form viral DNA, with the help of the enzyme reverse transcriptase, this viral DNA gets incorporated into host cell's DNA, and directs the infected cells to produce virus particles = $\frac{1}{2} \times 5$

[3 Marks]

17. (a) **Why is the collection of white winged moths and dark winged moths made in England between 1850 – 1920 considered a good example of natural selection ?**

(b) **“Evolution is based on chance events in nature and chance mutations in organisms.” Justify the statement.**

Ans. a) During Pre-industrialisation white-winged moths survived due to white coloured lichens on trees, During post-industrialisation white-winged moths did not survive due to predation / predators could spot the moth against contrasting background, then the dark-winged or melanised moths survived, this showed that in a mixed population of white and dark winged moths those who can adapt better will survive = $\frac{1}{2} \times 4$

b) excess use of herbicides / pesticides and antibiotics has resulted in selection of resistant varieties that developed due to chance mutation (in much lesser time scale) = 1

[2 + 1 = 3 Marks]

18. (a) **Compare the mechanism of sex determination in humans with that of honey bees, with respect to chromosome number.**

(b) **How is the gamete formation comparable in the above two cases ?**

Ans. a) In honeybee union of a sperm and an egg develops as a female (queen or worker), and an unfertilised egg develops as a male (drone) by means of parthenogenesis, the females are diploid / having 32 chromosomes and males are haploid / having 16 chromosomes, in humans both male and female individuals have 23 pair of chromosomes / diploid / female 44+ XX and males 44+ XY = $\frac{1}{2} \times 4$

b) In humans gametes are formed by meiosis, in honeybee female gametes are formed by meiosis and male gametes by mitosis = $\frac{1}{2} \times 2$

[2 + 1 = 3 Marks]

19. **Differentiate between the pattern of inheritance in humans of the blood diseases, haemophilia and thalassemia.**

Ans.	Haemophilia	Thalassemia
1.	Sex linked recessive disorder	1. Autosomal recessive disorder
2.	heterozygous female carrier may transmit it both to her son and daughter	2. Transmitted from both the carrier parents
3.	males are generally affected but female are rarely affected	3. both sexes can be affected

(both corresponding points to be written for credit)

= 1 × 3

[3 Marks]

20. Identify i, ii, iii, iv, v and vi in the following table :

No.	Organism	Bioactive molecules	Use
1	<i>Monascus purpureus</i>	i	ii
2	iii	iv	Antibiotic
3	v	Cyclosporin A	v

- Ans. i) statin
 ii) cholesterol lowering agent
 iii) *Penicillium notatum*
 iv) Penicillin
 v) *Trichoderma polysporum*
 iv) Immunosuppressive agent = $\frac{1}{2} \times 6$

[3 Marks]

21. (a) Write the scientific name of methanogen bacteria. Where are these bacteria generally found ? Explain their role in biogas production.

(b) Name the components of biogas.

Ans. a) *Methanobacterium* = $\frac{1}{2}$

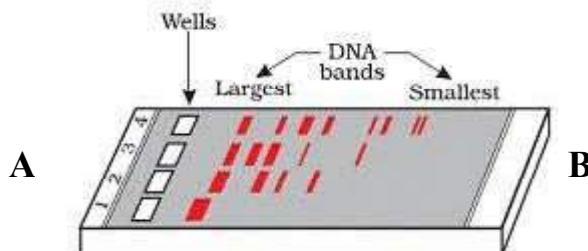
found in the anaerobic sludge / rumen of cattle, they grow anaerobically on cellulosic material and cause its breakdown (into methane CO_2 and H_2) = $\frac{1}{2} \times 2$

b) methane, CO_2 , H_2 = $\frac{1}{2} \times 3$

[$1\frac{1}{2} + 1\frac{1}{2} = 3$ Marks]

SECTION -D

22. Given below is the diagram representing the observations made for separating DNA fragments by Gel electrophoresis technique. Observe the illustration and answer the questions that follow :

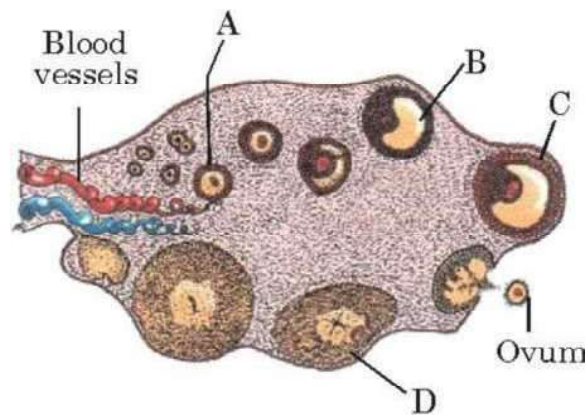


- (a) Why are the DNA fragments seen to be moving in the direction A → B ?
- (b) Write the medium used on which DNA fragments separate.
- (c) Mention how the separated DNA fragments can be visualised for further technical use.

- Ans. a) Because the DNA fragments are negatively charged =1
 b) Agarose gel =1
 c) After staining DNA with ethidium bromide, followed by exposure to UV rays = $\frac{1}{2} \times 2$

[3 Marks]

23. Study the transverse section of human ovary given below and answer the questions that follow :

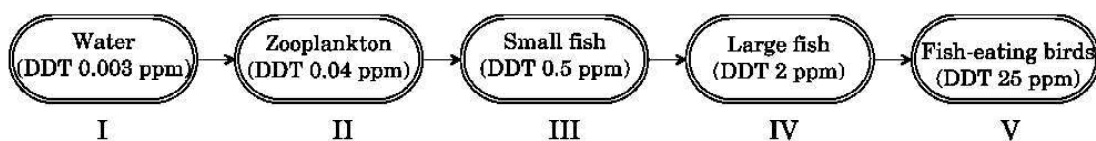


- (a) Name the hormone that helps in the growth of A → B → C.
- (b) Name the hormone secreted by A and B.
- (c) State the role of the hormone produced by D.

- Ans. a) Gonadotropins // FSH and LH = 1
 b) Estrogen =1
 c) Maintenance of uterine endometrium =1

[3 Marks]

24. Indiscriminate use of chemicals, pesticides and weedicides by humans are polluting our water bodies, which in turn are harming the living organisms. Study the flow chart and answer the questions based on it.



- (a) Why does the concentration of DDT seem to be considerably high in the top consumer ?
- (b) How would the organisms at the highest level be affected ?
- (c) Name the phenomenon observed.

Ans. a) DDT cannot be metabolised or excreted so gets accumulated by an organism, increase in concentration at successive trophic levels = $\frac{1}{2} \times 2$

b) Disturb calcium metabolism in fish eating birds / causes thinning of egg shell, premature breaking of eggs leading to population decline = $\frac{1}{2} \times 2$

c) Biomagnification = 1

[3 Marks]

SECTION - E

25. (a) According to ecologists, tropical regions in the world account for greater biological diversity. Justify.
- (b) Why are habitat loss and alien species invasion considered as the causes of biodiversity loss ? Explain with the help of an example of each.

Ans. a) (i) have remained relatively undisturbed for millions of years / had a long evolutionary time for species diversification = 1

(ii) environment less seasonal / more constant and predictable / such constant environment promotes niche specialization = 1

(iii) more solar energy available in the tropics contributes to higher productivity and greater diversity = 1

b) Habitat loss

Amazon rain forest is being cut for cultivating soyabeans / degradation of habitat by pollution / human activities leading to clearing of forests for commercial or tourism purpose = 1 (any other relevant example)

Alien species invasion -

The Nile perch introduced into Lake Victoria in East Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake / Recent illegal introduction of the African catfish *Clarias gariepinus* for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers / carrot grass / lantana / water hyacinth causes threat to our indigenous species = 1

(any other relevant example)

[5 Marks]

OR

- (a) What is an ecological succession ?
- (b) Differentiate between primary and secondary succession. Why is secondary succession faster than primary succession ? Explain with suitable examples.

(c) **What are pioneer species ? Give examples of pioneer species in Xerarch and Hydrarch successions respectively.**

Ans. a) The gradual and fairly predictable change in the species composition of a given area is called ecological succession =1

b) <u>Primary succession</u>	<u>Secondary succession</u>
Starts in an area where no living organisms ever existed / bare rock / newly created pond / reservoir / bare area	Areas that somehow lost all the living organisms that existed there / abandoned farmlands / flooded field area / burnt forest . =1

Secondary succession is faster since some soil or sediment is already present =1

eg. abandoned lands/ burnt or cut forests/ lands that have been flooded = $\frac{1}{2}$

c) The species that invade a bare area are called pioneer species = $\frac{1}{2}$

Xerarch- lichens , Hydrarch- phytoplanktons = $\frac{1}{2} \times 2$

[5 Marks]

26. (a) **Name the type of DNA that forms the basis of DNA fingerprinting and mention two features of this DNA.**

(b) **Write the steps carried out in the process of DNA fingerprinting technique, and mention its application.**

Ans. a) Satellite DNA / repetitive DNA = $\frac{1}{2}$

These sequences normally do not code for any proteins, these sequence show high degree of polymorphism = $\frac{1}{2} \times 2$

b) (i) isolation of DNA,
(ii) digestion of DNA by restriction endonucleases,
(iii) separation of DNA fragments by electrophoresis,
(iv) transferring (blotting) of separated DNA fragments to synthetic membranes such as nitrocellulose or nylon,
(v) hybridisation using labelled VNTR probe,
(vi) detection of hybridised DNA fragments by autoradiography = $\frac{1}{2} \times 6$

Application - Forensic science / determining population and genetic diversities / paternity test = $\frac{1}{2}$

[5 Marks]

OR

Explain the role of different genes in a lac operon, when in a 'Switched On' state.

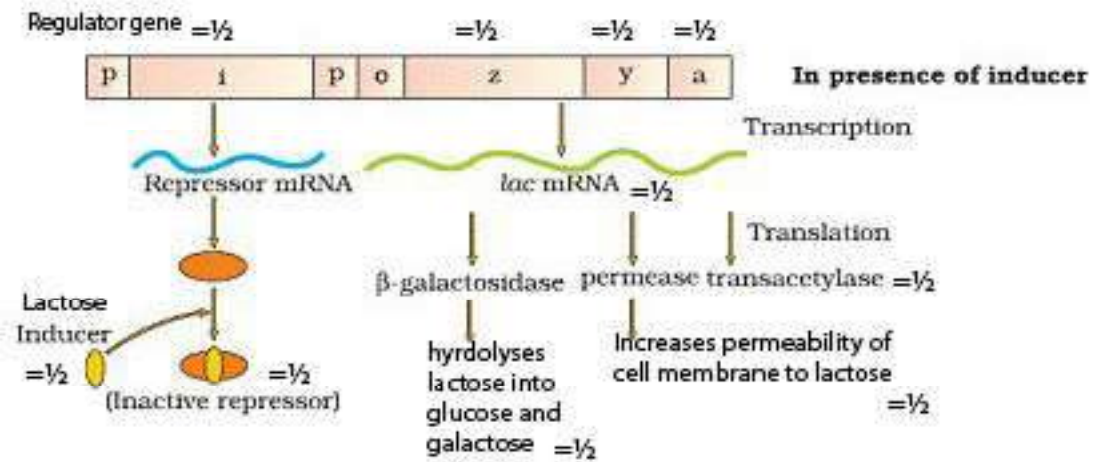
Ans. The regulator gene produces repressor, inactivated in the presence of inducer, that is lactose, RNA polymerase then gets access to the promoter gene and transcription proceeds = $\frac{1}{2} \times 4$

z gene codes for beta-galactosidase (β -gal), responsible for the hydrolysis of the disaccharide lactose into galactose and glucose = $\frac{1}{2} \times 2$

y gene codes for permease, which increases permeability of the cell to β -galactosides / lactose = $\frac{1}{2} \times 2$

a gene encodes enzyme transacetylase = 1

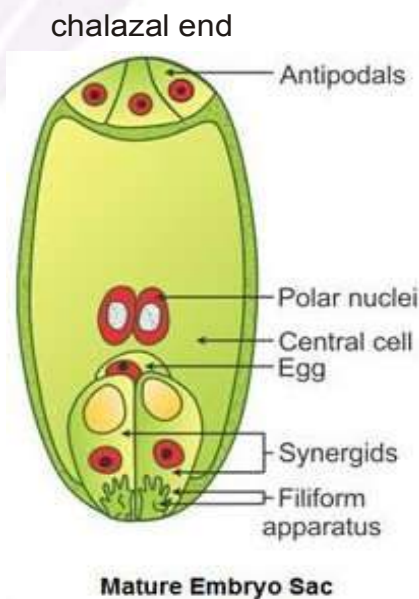
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[5 Marks]

27. (a) Draw a diagram of a fully developed embryo sac of an angiosperm. Label its chalazal end and any other five parts within the embryo sac.
- (b) Why does the development of an endosperm precede that of the embryo in angiosperm?
- (c) Number of chromosomes in an onion plant cell is 16. Name the cells of the embryo sac having 16 and 24 chromosomes formed after fertilisation.

Ans. a)



Chalazal end = $\frac{1}{2}$, and any other five parts = $\frac{1}{2} \times 5$

- b) the cells get filled with reserve food materials, used for providing the nutrition of developing embryo / for assured nutrition of developing embryo = $\frac{1}{2} \times 2$
- c) cells with 16 chromosome- zygote,
cells with 24 chromosome- endosperm = $\frac{1}{2} \times 2$ [5 Marks]

OR

Describe the events that occur after fertilisation of an ovum till implantation in a human female.

Ans. The mitotic division called cleavage, starts as the zygote moves towards the uterus and forms 2-4 - 8 -16 daughter cells called blastomeres, and forms the first embryonic stage morula, the morula continues to divide and transforms into blastocyst as it moves further into the uterus, the blastomeres in the blastocyst are arranged into an outer layer called trophoblast, and an inner group of cells attached to trophoblast called the inner cell mass, the trophoblast layer then gets attached to the endometrium, and the inner cell mass gets differentiated as the embryo, after attachment the uterine cells divide rapidly and covers the blastocyst, that gets embedded in the endometrium of the uterus (this is called implantation) = $\frac{1}{2} \times 10$

[5 Marks]