SEXUAL REPRODUCTION IN FLOWERING PLANTS

1 mark questions

1. Which of the following part in a flower is diploid?
   (a) Pollen grain (b) Egg
   (c) PEN (d) Secondary nucleus
2. In some seeds the nucellus may be persistent. Such nucellus is called……
3. Observe the relationship between the first two terms and fill in the blank.
   a. Ovary wall : Pericarp
      Integuments :
   b. 2 celled pollengrain :- vegetative cell +generative cell
      3 celled pollengrain :- vegetative cell +……..
4. Development of fruit without fertilization and are seedless known as
   a) Polyembryony b) Apomixis
   c) Parthenocarpy d) Parthenogenesis
5. ----------is the proteinaceous layer which separate endosperm & embryo in a monocot seed
6. Observe the relationship between the first pair and fill in the blanks.
   a. Perisperm :- Remnants of nucellus
      ---------- Fruit wall
   b. Parthenocarpy : Formation of fruit without fertilization
      Apomixis : ----------
7. In maize, the chromosome number present in the meiocyte is 20. Give the number of chromosomes present in the following.
   a. Maize pollen
   b. Maize endosperm
8. After syngamy & triple fusion in embryo sac, embryo will be diploid and endosperm will be……..
9. Innermost wall layer of microsporangium which nourishes the pollengrain is called----------
10. Fruit which develop from any part of the flower other than ovary is called……..
11. A date palm seed discovered during archeological investigation retained viability even after 10000years. The retention of viability is due to the state of inactivity of embryo is called……..
12. Which among the following is a parthenocarpic fruit?
    (Banana , Apple , Strawberry , Guava)
13. From the following, select the two having haploid chromosome number
    (Egg, Endosperm, Zygote, Pollen)
14. In albuminous seed, food is stored in ----------
15. In the Coconut fruit, the coconut water is ……
16. Observe the relationship between the first pair and fill in the blanks.

… …… . :- Cylindrical portion below the level of cotyledon

17. Formation of more than one embryo in the seed is called……
18. Animal visitors which consume pollengrains or nector without bringing about pollination are called……
19. Observe the relationship between the first pair and fill in the blanks
    Pollen viability :- The period for which pollen grains remain fuctional
    … …… :- Storage of pollengrains for years in liquid nitrogen (-196°C)
20. Most resistant organic material on exine of pollengrains
    (a) Sporopollenin (b) Cellulose (c) Chitin (d) Pectin
21. Name two plants where remnants of nucellus can be found in the seed

2 mark questions

22. Most of the plants produce single type of flowers but Viola, Commelina and Oxalis produce two types of flowers. Explain
23. A microsporangium is surrounded by four layers. Name the first three layers and write their function
24. Flowering plants have developed many devices to discourage self pollination and to encourage cross pollination. List out such features found in plants (any 2 point)
25. Differentiate true fruits from false fruits. Give one example for each.
26. A typical angiosperm embryo sac is 7 celled and 8 nucleate.
    a. Explain monosporic type of embryo sac development
    b. Name haploid cells present in embryosac other than egg cell
27. Observe the events given below
    (Embryogenesis , Gametogenesis , Syngamy)
    Choose a post fertilization event from the above and define it
28. Zygote is dormant for some time in fertilized ovule. Why?
29. Apomictic seeds are used in hybrid industry. Why?
30. Give reason
    a. Hybrid seeds have to be produced year after year
    b. Ground nut seeds and Castor seeds are dicot seeds. But ground nut seeds are ex-albuminous and castor seeds are albuminous.
31. Fusion of polar nuclei with male gamete in double fertilisaton result in the formation of endosperm.
    a. Write down the function of endosperm
    b. Write briefly about the endosperm development in coconut.
32. The early stages of embryo development are similar in both dicots and monocots. However, mature embryos have differences. Write the difference between dicot embryo and monocot embryo.
33. (a) What is meant by Seed dormancy?
    (b)Write any two significance of seed dormancy
34. Analyse the table given below and fill in the blanks.

Stalk of the ovule	……(a)……

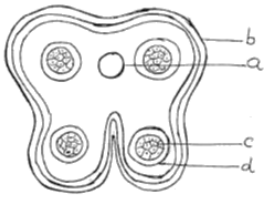
……(b)……	Nucellus
Protective envelopes of the ovule	……(c)……
Junction between ovule and its stalk	……(d)……

35. (a) Pollengrains are preserved as fossil. Why?
    (b)How do pollengrains of many species affect human health ?
36. Explain pollen pistil interaction
37. If the female parent produces bisexual flowers, emasculation is necessary in artificial hybridization.
    a. What is emasculation
    b. Write down the importance of emasculation
38. Give reasons.
    (a) Pollen tablets are in use by people these days
    (b) Self incompatibility discourage self pollination.
39. A typical angiosperm embryosac is 7 celled 8 nucleate stage.
    (a) Name the cells that constitute egg apparatus?
    (b) Name the diploid cell present in embryosac
40. Different stages of development in a dicot embryo are given below. Arrange them in the correct sequential order
    (Heart shaped embryo , Globular embryo , Mature embryo, Proembryo)
41. Name the special cellular thickening present in the synergids at micropylar end. Write its function
42. Polyembryony is the formation of more than one embryo in the seed.
    a. What are the reasons for polyembryony
    b. Give one example
43. How is it possible in Oxalis and Viola plants to produce assured seed set even in the absence of pollinators?
44. What are the features of tapetum?

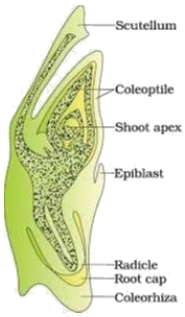
3 mark questions

45. You are supplied with vallisneria & Zostera
    a. Write down the type of pollination among these flowers.
    b. Write down any four floral characters to suit the pollination
46. Wind is a common abiotic agent of pollination.
    a. Write any four features of wind pollinated flowers
    b. Give two examples for wind pollinated flowers
47. In large number of plants, pollination is carried out by insects.
    a. List out four characters of flowers that helps insect pollination
    b. Give two examples for such flowers
48. Depending on the source of pollen, pollination can be divided into three types.
    a. What are they?
    b. Explain each
49. Artificial hybridization is one of the major approaches for crop improvement programme.
    a. How can we protect stigma from unwanted pollen

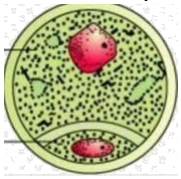
50. How artificial hybridization can be performed?The diagram given below shows the transverse section of a young anther.
    a. Identify the parts a,b,c and d.
    b. How many microsporangia are present in a typical bilobed anther of angiosperm?
    c. Expand PMC



51. Identify the given figure & explain the following terms
    (Scutellum , Coleoptile, Coleorhiza)



52. (a) Differentiate between microsporogenesis and megasporogenesis.
    (b)Name male and female gametophyte in angiosperm
53. Observe the figure of mature pollengrain and answer the questions
    a. Identify the two cells
    b. Write the peculiarities of each of them



54. Arrange the following terms in their correct developmental sequence
    (Pollengrain , Sporogenous tissue , Anther , Microspore tetrad, Pollen mother cell , Male gamete)
55. Describe in sequence the process of megasporogenesis and female gametophyte in angiosperms.
56. Double fertilization is a characteristic feature of angiosperms.
    a. Which are the events in double fertilization?
    b. Identify A, B, C & D

    Male gamete + ……(A)…….. →Zygote (2n) → ……(B)……
    Male gamete + ……(C)…… → PEN (3n) → ……(D)……
57. Flowers are classified into Chasmogamous and Cleistogamous flowers.
    a. Cleistogamous flowers are autogamous. Justify
    b. What are the advantages and disadvantages of Cleistogamous flowers

Answer Key

Category	Question No:	Answer key / Value points	Split score	Total score
Part I		Each carries 1 mark		
	1.	Secondary nucleus	1	1
	2	Perisperm	1	1
	3	a. Protective envelope of ovule b. 2 male gametes	½ x 2	1
	4	Parthenocarpy	1	1
	5	Aleurone layer	1	1
	6	a. Pericarp b. Formation of seeds without fertilization	½ x2	1
	7	a. 10 b. 30	½ x 2	1
	8	Triploid / 3n	1	1
	9	Tapetum	1	1
	10	False fruit	1	1
	11	Dormancy	1	1
	12	Banana	1	1
	13	Egg & Pollen	½ x 2	1
	14	Endosperm	1	1
	15	Liquid endosperm	1	1
	16	Hypocotyl	1	1
	17	Polyembryony	1	1
	18	Pollen robbers	1	1

	19	Sporopollenin	1	1
	20	Black pepper and Beet	½ x 2	1
Part II		Each carries 2 mark		
	21	Chasmogamous flowers :-– Flowers with exposed anther and stigma Cleistogamous flowers :- Closed flowers	1+1	2
	22	Epidermis, Endothecium & Middle layers	½ x 4	2
	23	Function :- Protection & dehiscence Self incompatibility (genetic mechanism to prevent pollen germination / pollen tube formation) / Pollen release & stigma receptivity not synchronized (Anther & stigma mature at different time) / Anther & stigma are placed at different positions / Unisexual flowers. (any 2 points)	1+1	2
	24	True fruit – develop from the ovary . e.g., mango ,coconut etc (any 1 example) False fruit – develop from the part of the flower other than ovary. e .g., Apple , Strawberry , Cashew etc (any 1 example)	½*4	2
	26	a. Embryosac developed from single haploid megaspore. b. Synergids and Antipodals	1+1	2
	27	Embryogenesis Development of embryo from zygote	1+1	2
	28	Endosperm provide food to developing embryo. So zygote divide only after certain amount of endosperm is formed.	2	2
	29	Apomixis helps in the production of hybrid seeds with a combination of desirable characters. In apomictic hybrid seeds, there is no segregation of characters . Farmers do not have to buy hybrid seeds every year because apomixis preserve good characters over generations for crop plants.	2	2
	30	a. The plants grown from the hybrid seeds show segregation of traits and do not maintain the hybrid characters. b. In ground nut, endosperm is not present in the seed. In castor, some amount of endosperm left in the seeds	1+1	2

		Endosperm provide nourishment (food) to developing embryo b. PEN undergoes free nuclear divisions to form many triploid nuclei . This is liquid endosperm / nuclear endosperm (Coconut water from tender coconut). Then cell wall formed from periphery towards centre to form solid endosperm /multicellular endosperm. (White kernel)	1+1	2
	32	Dicot embryo – Two cotyledon, Monocot embryo – 1 cotyledon (scutellum)	2	2
	33	a. Temporary inactive state of a viable seed. b. helps the storage of seeds / help to use as food throughout the year / helps to raise crops in next season / hard seed coat provide protection to young embryo (any 2)	1 ½ x 2	2
	34	(a)Funicle , (b) Multicellular mass of tissue with resrerve food materials (c) Integument (d) Hilum	½ x 4	2
	35	a. Due to the presence of Sporopollenin (Organic material resistant to high temperature, strong acids & alkali & cannot be degraded by enzymes) b. Cause allergies & lung disorders (asthma, bronchitis).	1+1	2
	36	All events from pollen deposition of stigma until the entry of pollen tube into ovule / Through chemical conversation between pollen & stigma Pistil recognize right pollen and wrong pollen, then pistil accept (Promote pollen germination) or reject (prevent pollen germination) pollengrain	2	2
	37	a. Removal of anther from the flower buds of female flower before maturity b. prevent self pollination.	1+1	2
	38	a. Pollen grains are rich in nutrients . Pollen consumption increase the performance of athletes & race horses b. Self incompatibility is the genetic mechanism to prevent pollen germination / pollen tube formation.	1+1	2
	39	a. Eggcell & 2 synergids b. Polar nuclei / Secondary nucleus	1+1	2
	40	Proembryo – Globular embryo – Heart shaped embryo – Mature embryo	½ x 4	2
	41	Filiform apparatus It guide pollentube into synergid	1+1	2
	42	a. Presence of more than one egg cells & all get fertilized / Presence of more than one embryosac / Many embryos develop from parts like synergids, antipodals, nucellus, integuments etc	½ x 3	2

	43	Cleistogamous flowers are closed flowers, anthers & stigma lie	2	2
	44	close to each other. When anther dehisce in the flower buds, pollen grains fall on the stigma and fertilization is effected . Innermost wall layer of microsporangium / Nutritive tissue which	½ x 4	2
Part III		nourishes the pollen grain / Tapetal cells possess dense cytoplasm / more than one nuclei (multinucleate) present Answer any 3 questions from 17- 20. Each carries 3 marks		
	45	a. Water pollination / Hydrophily	1	3
	46	b. Colourless / Nector less / Odourless / Unisexual flowers / Pollen grains are protected by mucilagenous covering / Sticky and unwettable stigma / Female flowers have long coiled stalk / Female flowers remain submerged / Male flowers are released on to the surface of water and carried by water currents to the surface of stigma / Long, ribbon like pollen grain (any 4) a. Light pollengrain / non sticky pollengrain / dry	½ x 4 ½ x 4	3
	47	pollengrains / Well exposed stamens / Feathery stigma / Colourless / nectorless / Odourless (Do not have smell) / Pollen grains are produced in large quantities / Single ovule in each ovary / Numerous small flowers are packed into an inflorescence / Unisexual flowers. b. Coconut, rice, wheat, grasses, maize, date palm etc (any 2) a. Large flowers / colourful flowers / Produce nector /	½ x 2 ½ x 4	3
	48	Produce fragrance. (pleasant or foul) / Sticky and spiny pollen grains / Sticky stigma. b. Rose, Sunflower, Jasmine, Orchids , Rafflessia, Aristolochia etc (any 2) a. Autogamy / Self pollination , Geitonogamy and	½ x 2 ½ x 3	3
		Xenogamy / Cross pollination b. Autogamy:- Transfer of pollen grains from anther to stigma of same flower Geitonogamy – Transfer of pollen grains from anther to stigma of another flower of the same plant Xenogamy – Transfer of pollen grains from anther of a flower to stigma of the flower of another plant of same species.	½ x3	

		49 a. Emasculation to prevent self pollination and Bagging to prevent cross pollination b. Select male and female parents , Remove anthers from female parent before maturation (emasculation) Emasculated flowers are covered with a bag to prevent cross pollination (Bagging). pollen grains from male parent are dusted on stigma of female parent , when stigma attain receptivity (artificial pollination). Rebagging to prevent cross pollination. Tagging and labeling	½ x 2 2	3
	50	a. (a)- Connective, (b) Epidermis (c) Sporogenous tissue (d) Tapetum b. 4 c. Pollen mother cell	½ x 4 ½ ½	3
	51	Scutellum – Single cotyledon of monocot embryo, situated towards the lateral side of the embryonal axis. Coleoptyle – Covering of plumule Coleorhiza – Covering of radicle.	1+1+1	3
	52	a. Microsporogenesis :- formation of microspore from Microspore mother cells or pollen mother cells through meiosis Megasporogenesis :– Formation of megaspore from megasporemother cell through meiosis b. Male gametophyte – Pollengrain. Female gametophyte – Embryosac	1+1 ½ x 2	3
	53	a. Vegetative cell and generative cell b. Vegetative cell :– Bigger cell. Contain reserve food materials. Large irregularly shaped nucleus. Generative cell :– Small cell. Float in the cytoplasm of vegetative cell. Spindle shaped with dense cytoplasm and nucleus.	½ x 2 1+1	3
	54	Anther – Sporogenous tissue – Pollen mother cell – Microspore tetrad – Pollengrain – Male gamete	½ x 6	3
	55	Megaspore mother cell (single cell at mycropylar end of nucellus) develops within the Ovule (megasporangium). MMC undergo meiosis to form 4 megaspores (Linear tetrad). Three megaspores degenerate .. Functional megaspore undergo 3repeated mitotic divisions (8 nucleus formed). Out of 8 nucleus, 3 located at chalazal region, 3 located at micropylar region , 2 remain in the	3	3

		centre. Cytokinesis leads to the formation of 7 celled 8 nucleate stage called Embryosac / Female gametophyte		
	56	a. Syngamy & Triple fusion b. (A) – female gamete / egg cell. (B) – Embryo (C) – Polar nuclei / Secondary nucleus. (D) - Endosperm	½ x 2 ½ x 4	3
	57	a. Cleistogamous flowers are Closed flowers . Anther and stigma lie close to each other .So there is no chance of cross pollination b. Advantage- Assured seed set in the absence of pollinators Disadvantage - No chance for variation & causes inbreeding depression	1 1 ½+ ½	3

x————————————x

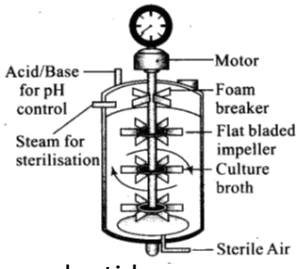
BIOTECHNOLOGY – PRINCIPLES AND PROCESSES

1 mark questions

1. In rDNA technology, Precipitated DNA threads can be removed by ……
2. Which of the enzymes removes nucleotides from the ends of a DNA?
   (a) Exonuclease (b) Endonuclease (c) DNA ligase (d) DNA polymerase
3. What is the principle of PCR?
4. Who constructed the first rDNA?
5. In Gel electrophoresis, separated DNA fragments can be visualized after staining. Name the stain used for it.
6. DNA fragments with same kind of sticky ends can be joined by
   (a) Ligase (b) Endonuclease (c) Exonuclease (d) polymerase
7. The first restriction endonuclease isolated is……
8. The restriction enzyme EcoRI is isolated from the bacterium……..
9. Ti plasmid used in genetic engineering is obtained from……
10. Name the process through which a piece of DNA is introduced into host bacterium
11. Identify the substance used as a matrix in Gel electrophoresis
12. Name the specific base sequence in the DNA , which is recognised by particular restriction endonuclease
13. Small chemically synthesized oligonucleotides that are complementary to the template DNA are called ……..
14. Name two commonly used vectors for genetic engineering
15. Self replicating extra chromosomal circular DNA present in prokaryoytic cells are called……
16. Name the enyme used for the digestion of bacterial cell wall
17. Name the enzyme used for the digestion of fungal cell wall
18. Which gene is used as an alternative selectable marker?
19. protein formed in a heterologous host is called……

2mark questions

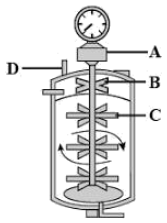
20. (a) Which enzymes are known as ‘ molecular scissors’?
    (b) What is the use of these enzymes in Genetic engineering?
21. How can we visualize DNA fragments in Gel electrophoresis?
22. Distinguish Spooling from Elution
23. Write notes on (a) Microinjection (b) Biolistics
24. Observe the figure and answer the questions
    a. Identify the instrument in the figure
    b. Write the role of this instrument in biotechnology.



25. Observe the nucleotide sequence given below
    a. Name this kind of nucleotide sequence
    b. Define this sequence

26. Multiple copies of gene of interest can be synthesized through PCR. Expand PCR and write its steps
27. EcoRI is a restriction endonuclease. What do E, co, R, I represent?
28. Briefly describe Down stream processing and Bioreactor
29. Bioreactor is an apparatus used for large scale production of proteins.
    a. Name two types of bioreactors.
    b. Write any two feature of bioreactors
30. Isolation of DNA from plant cell involves many steps. Explain the different steps.
31. (a) Agrobacterium tumifaciens is a natural genetic engineer of plants. Justify
    (b) What is the role of retrovirus in rDNA technology?
32. What is meant by sticky ends? Why are they called sticky ends?
33. Explain (a) ‘Ori’ (b) Selectable marker
34. Name two disarmed pathogen vectors used in rDNA technology.
35. (a) What is meant by Insertional inactivation?
    (b) How insertional inactivation is used to identify recombinants?
36. Mention the key tools (any 4) in biotechnology?
37. Cloning vectors are used to transfer gene from one cell to another.
    a. Name an artificially reconstructed plasmid vector.
    b. What are the features of cloning vector?
38. DNA fragments of size 500 bp , 1600 bp & 2000 bp are separated by Gel electrophoresis. Which fragment will migrate fast? Why?

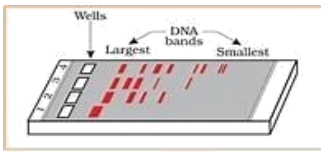
39. What is the basic principle of Gel electrophoresis?
40. (a) Mention the technique of genetic engineering
    (b)What is recombinant DNA / rDNA ?
41. Observe the sketch of stirred - tank bioreactor and label the parts A, B, C & D



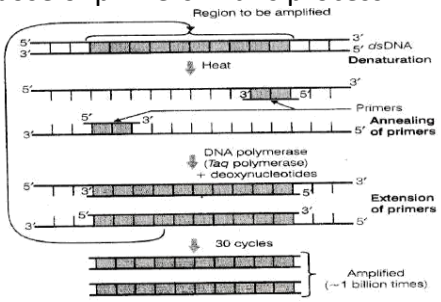
42. (a) What are the two kinds of nuclease enzyme?
    (b)Write their role in rDNA technology

3 mark questions

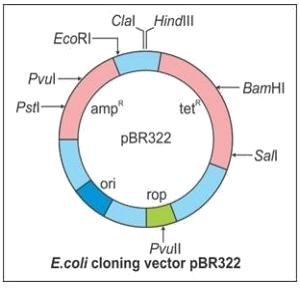
43. The cell which is capable of taking up alien DNA is called Competent host
    a. How can we make a host cell competent to receive a foreign gene or DNA?
    b. Why should the host cell be made competent ?
44. Observe the figure given below



    (a) Name the technique?
    (b) How can we separate DNA fragment using this technique?
    (c) Write the name of technique used to remove the DNA from the gel?
45. Observe the figure and answer the questions.
    a. Write the name of the process given in the figure
    b. What is the purpose of this technique in rDNA technology?
    c. What is the name of thermostable DNA polymerase enzyme used in this technique?
    d. Name the bacterium from which DNA polymerase is extracted in this process
    e. What is the peculiarity of this DNA polymerase enzyme?
    f. What is the purpose of primers in this process



46. Obseve the figure and answer the questions
    a. Name two selectable markers in this cloning vector
    b. Write any two cloning sites / restriction sites present in pBR322
    c. Write the function of 'rop' in this cloning vector



47. Describe the contribution od Stanley Cohen and Herbert Boyer in genetic engineering.
48. What are the two core techniques that enabled birth of modern biotechnology (principles of biotechnology) ? Explain them
49. How can we identify recombinants / transformants using selectable markers?
50. Different steps in rDNA technology are given below. Arrange them in correct sequential order.
    a. Ligation of DNA fragment into vector
    b. Culturing of host cells in a medium at large scale
    c. Isolation of DNA
    d. Transferring the rDNA into host
    e. Fragmentation of DNA
    f. Separation of desired DNA fragment

Answer Key

Category	Question No:	Answer key / Value points	Split score	Total score
Part I		Each carries 1 mark		
	1.	Spooling	1	1
	2	a. Exonuclease	1	1
	3	Amplification of genetic material	1	1
	4	Stanly Cohen & Herbert Boyer	½ x2	1
	5	Ethidium bromide	1	1
	6	a. Ligase	1	1
	7	Hind II	½ x 2	1
	8	*Escherichia coli RY 13*	1	1

	9	Agrobacterium tumefaciens	1	1
	10	Transformation	1	1
	11	Agarose gel	1	1
	12	Recognition sequence	1	1
	13	Primers	1	1
	14	Plasmids & bacteriophages	½ x 2	1
	15	Plasmid	1	1
	16	Lysozyme	1	1
	17	Chitinase	1	1
	18	Gene for β galactosidase enzyme	1	1
	19	Recombinant protein	1	1
Part II		Each carries 2 mark		
	20	Restriction endonuclease Used to cut DNA into fragments at specific sites within molecules	1+1	2
	21	Separated DNA fragments can be visualised after staining with Ethidium bomide followed by exposure to UV light. bright orange coloured bands obtained.	2	2
	22	Spooling :- Process by which DNA threads wind on a reel. Last step of Isolation of DNA Elution - Separated bands of DNA are cut out from the agarose gel and extracted from gel piece. Last step of separation using Gel electrophoresis	1+1	2
	23	Microinjection - Recombinant DNA is directly injected into the nucleus of an animal cell using micropipette. Biolistics / Gene gun - High velocity microparticles of gold or tungsten coated with DNA and is bombarded into the host cell (plant cell)	1+1	2

		a. Bioreactor b. Large scale production of recombinant proteins / extraction of biological products in large quantities	1+1	2
	24	a. Palindromic sequence b. sequence of base pairs that read the same on the two strands when orientation of reading is kept the same	1+1	2
	25	Polymerase Chain reaction. Steps :- Denaturation , annealing, & Extension	½ x 4	2
	26	E - First letter of genus from which it is isolated Co - first two letters of species name of the prokaryotic cell from which they were isolated R - denotes the strain I - romen number , denotes the order in which they are isolated from that strain of bacteria.	½ x 4	2
	27	Downstream Processing :- All process after biosynthetic phase is collectively called Downstream processing / Downstream processing include Separation of Products , Purification of Products, Addition of Preservative , Clinical trials for drugs, Quality control test Bioreactor : – Large vessel in which raw materials are biologically converted into products.	1+1	2
	29	a. Stirred tank bioreactors & Sparged stirred-tank bioreactor b. Possess an agitator system / Oxygen delivery system / A foam control system / A temperature control system/ pH control system / Sampling ports for periodic withdrawal of culture (any two feature)	½ x 2 ½ x 2	2
	30	The cells are treated with Cellulase to digest cellwall. Treated with protease , ribonuclease etc to remove other impurities. The purified DNA is precipitated on the addition of chilled ethanol and are seen as threads in suspension. Spooling :- Process by which DNA threads wind on a reel. Last step of Isolation of DNA	½ x 4	2
	31	a. Agrobacterium can deliver T- DNA to host b. Retrovirus is used as a disarmed pathogen vector	1+1	2
	32	sticky ends - When a fragment of DNA is cleaved by restriction enzyme, Two separate strands obtained. Both are overhanging piece of DNA.	1+1	2

		They called sticky ens because they form hydrogen bonds with their complementary cut counter parts.		
	33	a. Origin of replication (Ori) :- Specific sequence from where replication starts. b. Selectable markers :- A gene which helps to identify and eliminate recombinants/ transformants from non-recombinants/non-transformants	1+1	2
	34	Ti plasmid of Agrobacterium tumefaciens & Retrovirus	1+1	2
	35	a. Inactivation of an enzyme due to inactivation of a gene as a result of insertion of foreign DNA b. A recombinant DNA is inserted within the coding sequence of an enzyme β galactosidase. So the enzyme is inactivated. Recombinants do not produce colour, but Non - recombinants gives bluish coloured colonies	1+1	2
	36	Restriction enzymes / Polymerase enzymes / Ligase or Molecular glue / Vectors / Host (any 4)	½ x 4	2
	37	a. pBR322 b. Origin of replication Single recognition sequence / cloning site , Selectable marker	½ x 4	2
	38	500 bp. DNA fragments are separated according to their size through a sieving effect provided by agarose gel . Smaller fragments move farther	1+1	2
	39	Negatively charged DNA molecules are forced to move towards anode under an electric field through agarose medium	2	2
	40	a. Creation of recombinant DNA , Gene cloning (making identical copies) and Gene transfer b. Artificially made DNA that is composed of a combination of DNA sequences from two or more organisms.	½ x 3 ½	2
	41	A – Motor. B – Foam breaker. C- Flat bladed impeller. D – Acid / Base for p^H control.	½ x 4	2
	42	a. Exonuclease & Endonuclease b. Exonucleases - Cut the DNA at the end Endonucleases - Cut at specific site within the DNA	½ x 2 ½ x 2	2
Part III		Answer any 3 questions from 17- 20. Each carries 3 marks		

		a. DNA enters the bacterium through the pores in cell wall.The bacterial cell is treated with divalent cation such as calcium. Incubate Recombinant DNA and bacterial cell on ice. Place this bacterial cell at 42° C which provides a heat shock & then Put them back on ice. Now bacteria can take up the Recombinant DNA b. To take up hydrophylic DNA molecule from external medium.	2 1	3
	43	a. Gel electrophoresis b. Negatively charged DNA molecules move towards anode under an electric field through agarose medium . DNA fragments are separated according to their size through a sieving effect provided by agarose gel c. Elution	1+1+1	3
	44	a. PCR /Polymerase chain reaction b. Amplification of gene to make multiple copies c. Taq DNA polymerase d. Thermus aquaticus e. remains active in high temperature /Thermostable f. DNA Polymerase enzyme extend the primer by adding nucleotides.	½ x 6	3
	45	a. ampicillin resistance gene / amp^R and tetracycline resistance gene / tet^R b. Hind III , Cla I , EcoR I , BamH I, Sal I, Pvu I, Pst I, Pvu II. (any 2) c. codes for the proteins involved in the replication of plasmids	½ x 2 ½ x 2 1	3
	47	Cohen & Boyer create first rDNA. They isolate antibiotic resistance gene from plasmid of *Salmonella typhimureum* . Piece of DNA was cut at specific site by restriction endonuclease & linked it to the plasmid of *Escherichia coli.* By DNA ligase and then these rDNA was transferred to E.coli host.	3	3
	48	Genetic engineering and Bioprocess engineering Genetic engineering :- Technique to alter chemistry of genetic material (DNA or RNA) to introduce these into host organisms and thus change the phenotype of the host organisms. Bioprocess engineering :- Maintenance of sterile environment in chemical engineering process to enable the growth of only the desired microbe/ eukaryotic cell in large quantities for the manufacture of biotechnological products like antibiotics, vaccines , enzymes etc	½ x 2 1+1	3

	49	The foreign DNA is ligated at a restriction site present in one of		
		the two antibiotic resistance genes. (eg. Foreign DNA is inserted at the **BamHI** site of tetracycine resistance gene in the vector pBR322). Recombinant plasmids lose tetracycline resistance due to insertion of foreign DNA. simultaneous plating of bacteria on ampicillin containing medium and tetracycine containing medium. Recombinants grow in ampicillin medium but not on tetracycline medium.	3	3
	50	Isolation of DNA		
		Frgmentation of DNA Separation of desired DNA fragments Ligation of DNA fragments into vector Transferring the rDNA into host Culturing of host cells in a medium at large scale	½ x 6	3

x.....x

BIOTECHNOLOGY AND ITS APPLICATIONS

1 mark questions

1. Name the first transgenic cow that produce human protein enriched milk
2. Name the gene that control corn borer insect?
   a. cry I Ac
   b. cry II Ab
   c. cry I Ab
   d. cry II Ac
3. What does Bt stands for in Bt cotton?
4. Name the nematode which infects the roots of tobacco plants , resulting in the reduction of yield?
5. Clones with radioactivity can be detected by
   (a) Gel electrophoresis (b) Autoradiography (c) Chromatography (d) ELISA
6. Insulin consists of two short polypeptide chains A and B and the two chains are joined by
   (a) Peptide bond (b) Disulphide bond (c) Hydrogen bond (d) Ionic bond
7. Name two gens that control cotton bollworms
8. Which company prepared genetically engineered human insulin ?
9. In which year first clinical gene therapy was performed and to whom ?
10. Somatic hybrid developed by fusing Tomato & Potato cells are called .....
11. Expand ADA
12. Name the toxic protein produced by Bacillus thuringiensis?
13. Name a Bioinsecticide
14. Name a genetically modified pest resistant crop
15. The regeneration of whole plants from any part of the plant grown under sterile conditions is .....

2 mark questions

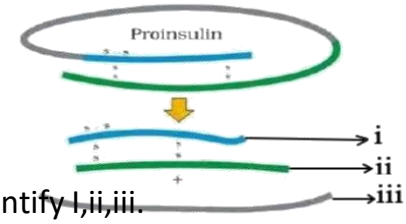
16. Bt- toxin does not kill bacillus, but it kill insects. Write the reason
17. Expand ELISA. What is the principle of this process?
18. Write four uses of transgenic animals.
19. How gene therapy is practiced for a permanent cure of disease?
20. How cancer due to mutation can be detected by molecular diagnostic method?
21. First clinical gene therapy was given in 1990 to a 4 year girl with Adenosine deaminase (ADA) deficiency.
    a. What is gene therapy?
    b. What are the two alternative methods to cure ADA deficiency?
22. Bt-cotton is an example of genetically engineered plant.
    a. Name the gene responsible for Bt-toxin production.
    b. Cry protein is harmless to bacillus. Why?
23. Explain how Bt-toxin kill the insect
24. RNA can suppress the activity of a gene. Explain it with suitable examples.
25. The first clinical gene therapy was given to a 4 year old girl child.
    a. What was her disorder?
    b. What is the cause of this disorder?
26. How does the inactive protoxin of Bacillus thuringiensis gets converted into active toxin when an

insect ingest it?

27. Early diagnosis is essential for the effective treatment of a disease. Write molecular diagnostic methods.
28. Write any two critical research areas of biotechnology
29. Differentiate between Somaclones & Somatic hybrids?
30. What is the structural difference between proinsulin and mature insulin?
31. Define (a) Biopatent (b) Biopiracy
32. a) What is meant by Somatic hybridization?
    b) Why Pomato is not used for commercial utilization?
33. The first clinical gene therapy was given to a 4 year old girl child.
    a. Briefly describe the clinical procedure adopted in this case.
    b. What is the role of Adenosine deaminase enzyme ?
34. Expand GEAC . Mention their aim
35. "Healthy plants can be recovered from diseased plants by tissue culture."
    (a) Which part of the plant should be selected as explants?
    (b) State the reason for the selection of this part as explant

3 mark questions

36.



    a. Identify I,ii,iii.
    b. How did Eli Lilly company manage to produce mature human insulin?
37. Transgenic animals are produced to obtain biological products.
    a. Define transgenic animals?
    b. Which human protein is used in the treatment of emphesema?
    c. Name the protein present in the milk of transgenic cow
38. The genes of organisms can be altered by manipulation. Such organisms are called genetically modified organisms (GMO) . List any three merits of GM plants
39. A novel strategy was adopted to prevent the infestation of a nematode in the roots of tobacco plants.
    a. Name the strategy
    b. Explain the principle behind this strategy
    c. What is the role of Agrobacterium in this strategy?
40. Biopiracy is the unauthorised use of bioresources by multinational companies & other organisations ,without compensatory payment
    a. Mention reason for biopiracy
    b. Give an example for biopiracy?
    c. How can we stop biopiracy?
41. Explain the terms. (a) Micropropagation (b) Totipotency (c) Explant

Answer Key

Category	Question No:	Answer key / Value points	Split score	Total score
Part I		Each carries 1 mark		
	1.	Rosie	1	1
	2	cryI Ab	1	1
	3	*Bacillus thuringiensis*	1	1
	4	Meloidegyne incognitia	1	1
	5	Autoradiography	1	1
	6	Disulphide bond	1	1
	7	*cryIAc* & *cryIIAb*	½ x 2	1
	8	Eli Lilly	1	1
	9	1990	1	1
	10	Pomato	1	1
	11	Adenosine Deaminase	1	1
	12	Cry protein /Bt toxin	1	1
	13	Bt Cotton	1	1
	14	Tobacco	1	1
	15	Tissue culture	1	1
Part II		Each carries 2 mark		
	16	The Bt toxin exist as inactive protoxins in bacillus. When an insect ingest the inactive toxin, it is converted into an active toxin	1+1	2

17		Enzyme Linked Immuno-Sorbent AssayAntigen – Antibody reaction	1+1	2
	18	To study how genes are regulated & how they affect normal functions of the body and its development (Study of complex factors involved in growth) / to study how genes contribute to the development of disease. (Transgenic models exist for cancer, cystic fibrosis, rheumatoid arthritis, & Alzheimers) / To Produce biological products / To test the safety of vaccines / To test safety of chemicals (toxicity / safety testing) (any 4 response)	½ x 4	2
	19	Gene therapy at embryonic stage /ADA gene from bonemarrow is introduced into cells at early embryonic stage	2	2
	20	Clone having mutated gene will not appear on photographic film because probe will not have complimentarity with the mutated gene	2	2
	21	a. collection of methods that allows correction of a gene defect that has been diagnosed in a child / embryo. b. Bone marrow transplantation . Enzyme replacement therapy(functional ADA is given by injection) .	1 ½ x 2	2
	22	a. cry gene b. The Bt toxin exist as inactive protoxins in bacillus.	1+1	2
	23	When an insect ingest the inactive toxin, it is converted into an active toxin due to the alkaline pH of the gut which solubilise the crystals. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually leads to death of the insect.	2	2
	24	RNA interference (RNAi) , a cellular defence mechanism suppress the activity of a gene / RNAi is mRNA silencing or Silencing of mRNA due to complementary double stranded RNA (dsRNA). We can prevent nematode infestation through RNAi in transgenic tobacco plant.	1+1	2
	25	a. ADA deficiency b. The gene which produce ADA enzyme is deficient .	1+1	2
	26	When an insect ingest the inactive toxin, it is converted into an active toxin due to the alkaline pH of the gut which solubilise the crystals.	2	2

	27	PCR based on amplification of DNA , ELISA based on antigen antibody reaction , Radioactive probe and rDNA technology	½ x 4	2
	28	Applications of biotechnology in agriculture Applications of biotechnology in medicine	1+1	2
	29	Somaclones :- Plants produced through tissue culture . Somatic hybrids :- Hybrid produced by somatic hybridization		
	30	prohormone (Proinsulin) - contains an extra stretch called the C peptide. This C peptide is removed during maturation . or C peptide present in proinsulin . C peptide absent in mature insulin	1+1	2
	31	a. Biopatent – Patent granted for biological products and processes. b. Biopiracy- Unauthorised use of bioresources by multinational companies & other organisations ,without compensatory payment.	1+1	2
	32	a) Fusion of protoplasts from two different varieties of plants with desirable characters in a nutrient medium *in-vitro* to get hybrid protoplasts. b) pomato did not have all the desired combination of tomato & potato)	1+1	2
	33	a. Lymphocytes from the blood of the patient are grown in a culture outside the body. A functional ADA cDNA is then introduced into these lymphocytes using retroviral vector & are returned to the patient. Lymphocytes are not immortal, so periodic transfusion is necessary. b. Activate immune system	½ x 3	2
	34	a. Genetic Engineering Approval Committee b. Take decision regarding validity of GM research and safety of introducing GM organisms for public services	1 ½ x2	2
	35	a) Meristem b) Due to active cell division, meristem is free of virus	1+1	2
Part III		Answer any 3 questions from 17- 20. Each carries 3 marks		

	36	a. i - A peptide. ii – B peptide. iii – C peptide b. Prepare two DNA sequences corresponding to chain A & chain B of human insulin Introduced them in plasmids of *E.coli* to produce insulin chains. Chain A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin	½ x 3 ½ x 3	3
	37	a. Animal whose genome has been altered by introducing a foreign gene. b. Alpha -1 antitrypsin. c. human protein, alpha –lactalbumin	1+1+1	3
	38	It makes crops more tolerant to abiotic stresses / reduce the use of chemical pesticides / Helped to reduce post harvest loses / Increased efficiency of mineral usage by plants / Enhanced nutritional value of food, eg., Vitamin 'A' enriched rice (Golden rice) (any 3 response)	1+1+1	3
	39	a. RNA interference / RNAi b. mRNA silencing / Silencing of mRNA due to complementary double stranded RNA (dsRNA) c. Nematode specific gene is introduced into tobacco plant using Agrobacterium as a vector.	1+1+1	3
	40	a. Developed countries are rich financially but poor in biodiversity & traditional knowledge. In contrast developing & underdeveloped countries are rich in biodiversity & traditional knowledge. This inequality leads to biopiracy b. Indian Basmathi was crossed with semidwarf varieties by an American company and claimed as a new invention & got patent on Basmathi rice through US Patent and Trademark office. This allowed the company to sell a new variety of Basmathi in US &abroad. / Turmeric & Neem are some of the products have patents in other countries (any 1 example) c. Take legal actions by government / develop laws against biopiracy	1+1+1	3
	41	a) Method of producing thousands of plants in short time through tissue culture. b) Capacity to generate whole plant from any part of a plant c) Cell / Plant part from which whole plant is regenerated	1+1+1	3

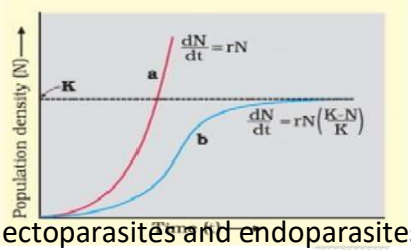
ORGANISMS AND POPULATION

1 mark questions

1. Name the interaction in which both the interacting species are benefited
2. Name the relationship between an orchid plant and a mango tree
3. Name the interaction in which one organism captures and feeds on another
4. Insects which are feeding on plant saps are called…….
5. Name the Interaction between two organism for same resource.
6. A mechanism that promote co-existance rather than exclusion is…….
7. Name the interaction in which one species is harmed and the other is neither benefited nor harmed.
8. Relative measure of reproductive success of an organism is called…….
9. Number of individuals present per unit area at a given time is called……
10. The size of a population is not static. Which of the following leads to increase in population?
    (a) Natality & Mortality (b) Mortality & Emigration
    (c)Mortality & Immigration (d) Natality & Immigration
11. Observe the relationship between the first two terms anf fill in the blanks.
    a. Mycorrhiza :- Mutualism
       Lice on humans :- …….
    b. Mortality :- No of death in the population during a given period
       … …….. .:- No of births in the population during a given period
12. The feeding efficiency of one species is reduced due to the interfering & inhibitory presence of the other species even if resources are abundant is …….

1 mark questions

13. Observe the diagram and answer the questions.
    a. Identify the growth model a & b
    b. Which type of growth model is considered to be more realistic? Why?



14. Differentiate ectoparasites and endoparasites. Give an example for ectoparasites & endoparasites
15. Write any two methods to measure population density?
16. What is meant by interspecific competition? Give example.
17. List out four adaptations of prey to protect from predation in plants.
18. Write any two physical factors that affect population density ?
19. The density of population in a given habitat during a given period fluctuates due to changes in four basic process.

a. List out them
b. How do these process affect the population density.

20. Define the following.
    (a) Natality (b) Mortality (c) Immigration (d) Emigration
21. Predation is an interaction which has great significance in nature. Write down two significance of predation.
22. What is brood parasitism? Give one example for it
23. Nt+1 = Nt + [(B + I) – (D + E)] is the equation to find the population density at a given time. What does B, I, D & E stands for?
24. What are the effects of parasites on their host?
25. (a) How does monarch butterfly protect itself from predation?
    (b) How do some species of insects and frogs avoid being easily detected by the predators?
26. Observe the equation

    dN/dt =rN [K-N/k]

a. What do 'N' , 'r' and 'K' represent?
b. Define K

27. Population growth may be exponential or logistic. Differentiate between them.
28. Fill in the blanks

Species A	Species B	Name of interaction
+	-	Parasitism
-	-	……
+	+	……
+	0	……
-	0	……

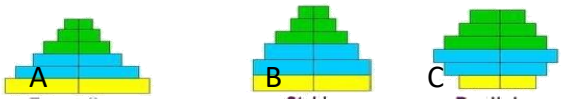
29. Population has certain attributes that an individual organism does not. What are they?
30. Parasites evolved special adaptations to live on host. What are they?
31. Explain life history variations with examples.

2 mark questions

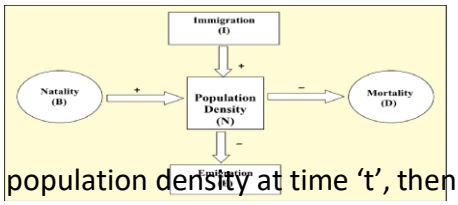
32. Competition is an interaction between two organisms for same resource.
    a. Define Gause's competitive exclusion principle?
    b. What is meant by competitive release? Give example
33. Given below are examples of some ecological interactions. Identify the interactions.
    a. Sea anemone and Clown fish
    b. Loranthus and host tree
    c. Balanus and Cathamalus barnacle
    d. Cuckoo and crow
    e. Fig tree & wasp

F. Cattle egret and grazing cattle

34. Observe the figure and answer the questions
    a. Identify A, B &C
    b. Compare the nature of population growth in A, B & C



35. Observe the figure given below and answer the questions



    a. If 'N' is the population density at time 't', then write down the population density equation at time 't+1'
    b. Which two processes contribute to an increase in population density?
    c. Which two processes contribute to a decrease in population density?

36. Different types of population interaction has been observed in population. Write the type of interactionobserved among the following species:-

Species A	Species B	Type of interaction
Orchid Ophrys	Bees	---------- -a----------
Ticks	Dogs	---------- -b----------
Barnacles	Whale	---------- -c----------
Fungus	Photosynthetic algae	---------- -d----------
Abingdon tortoise	Goats	---------- -e----------
Sea anemone	Clown fish	---------- -f----------

Answer Key

Category	Question No:	Answer key / Value points	Split score	Total score
Part I		Each carries 1 mark		
	1.	Mutualism	1	1
	2	Commensalism	1	1
	3	Predation	1	1
	4	Phytophagous insects	1	1
	5	Competition	1	1

	6	Resource partitioning	1	1
	7	Ammensalism	1	1
	8	Darwinian fitness	1	1
	9	Population density	1	1
	10	d. Natality & Immigration	1	1
	11	a. Parasitism b. Natality	½ x2	1
	12	Interference competition	1	1
Part II		Each carries 2 mark		
	13	a. (a)Exponential /Geometric growth model / J shaped curve (b)Logistic growth model / verhulst pearl logistic growth / S shaped growth curve. b. Logistic growth model. Resources for growth for most animal populations are finite & become limiting sooner or later	½ x 2 ½ x2	2
	14	Ectoparasites :- depend on the external surface of the host. Endoparasites :- take shelter within the body of the host organism Ectoparasite, example :- head lice on humans / ticks on dogs / Copepods on marine fish / Cuscuta / Loranthus (any 1) Endoparasite, example – Liverfluke / Plasmodium (any 1)	½ x2 ½ x2	2
	15	Counting number of individuals of a population / measure % cover / biomass (e.g., 200 parthenium plant and one huge banyan tree in an area. The role of banyan tree in that community is greater than parthenium) / measure relative population density. (e .g., The number of fish caught /trap is used to measure total population density of fish in the lake) / Counting the colonies in a bacterial culture / Indirect method – In tiger reserves tiger census is done on pug marks (foot prints)and fecal matter (any 2 method)	1+1	2
	16	Competition between unrelated species for the same resource. eg., in some shallow south American lakes visiting flamingoes & native fishes compete for common food, zooplankton	1+1	2

	17	Thorns in cactus, opuntia, Acacia etc / Poisonous chemical content kill insects / Poisonous cardiac glycosides seen in calotropis / Presence of alkaloids (nicotine, caffeine, quinine, strychnine , opium etc) against grazers & browsers	½ x4	
	18	Food availability /Predation pressure / Weather (any 2)	1+1	2
	19	a. Natality, Mortality, Immigration & Emigration b. Natality & Immigration leads to increase in population. Mortality & Emigration leads to decrease in population	2	2
	20	a. Natality – Number of births in a population during a given period, that are added to the initial density b. Mortality – Number of deaths in the population in a given period. c. Immigration – Number of individuals of the same species that have come into the habitat from elsewhere during a given period. population Increase d. Emigration – Number of individuals of the population who left the habitat during a given period.	2	2
	21	Predation act as a channel for energy transfer across trophic levels / Predators keep prey population under control / Predators help in maintaining species diversity (by reducing competition among competing prey species) / If predator overexploits the prey, then the prey become extinct. When there is a shortage of prey the predator will also become extinct (any 2)	1+1	2
	22	Brood parasitism – seen in parasitic bird e.g., between cuckoo & crow . Cuckoo lays its eggs in the nest of its host, Crow for incubation, hatching &rearing of youngones. The eggs of cuckoo resembles the eggs of crow in size, shape & colour. Crow cannot detect the foreign egg.	1+1	2
	23	B – Natality. I – Immigration D – Mortality E – Emigration	½ x4	2
	24	Reduce the survival of host / Growth and reproductive rate of host reduced / Render the host vulnerable to its predators by making them weak / Reduce the population density of host	½ x 4	2
	25	a. Monarch butterfly is distasteful to its predator (bird) due to poisonous chemical content in the body. b. Camouflaged (cryptically coloured)	1+1	2

	26	a. N – population density , r- intrinsic rate of natural increase , K - Carrying capacity b. Maximum number of individuals of a particular species that can live in a particular area.	½ x3 ½	2
	27	Exponential /Geometric growth model :- Growth curve is J shaped. Initial slow growth or lag phase, followed by rapid growth . Growth stops suddenly due to death of individuals. There is an unlimited supply of resources .There is no environmental resistance/ check Logistic growth model / verhulst pearl logistic growth :- S shaped growth curve. Initial slow growth (lag phase) followed by rapid growth (exponential /log phase) . When environmental resistance come into play / when carrying capacity reaches, growth slows down (Stationary phase)	1+1	2
	28	Competition (- -) Mutualism (+ +) Commensalism (+ 0) Ammensalism (- 0)	½ x 4	2
	28	Birth rate, death rate, sex ratio and age group	½ x2	2
	29	Loss of unnecessary sense organs / Hooks and sucker / Loss of digestive system / High Reproductive capacity	½ x 4	2
	31	Certain organism breed only once in their life time(eg., bamboo, pacific salmon fish). Others breed many times during their life time. eg., Most birds & mammals Some produce large number of small- sized offspring (eg., Oysters, pelagic fishes). Others produce small number of large-sized offspring (eg., birds, mammals)	1+1	2
Part III		Answer any 3 questions from 17- 20. Each carries 3 marks		
	32	a. Two closely related species competing for the same resources cannot co-exist indefinitely & the competitively inferior one will be eliminated eventually. b. Competitive release :- A species is restricted to a small geographical area due to competitively superior species. When the superior species is experimentally removed, the small species flourish. eg., Connell's field experiment. Competitively superior barnacle called Balanus dominates the intertidal area & excludes the smaller barnacle Chathamalus from that zone	1 1+1	3

	33	a. Commensalism b. Parasitism c. Competition d. Brood parasitism e. Mutualism f. Commensalism	½ x 6 3	
	34	a. A- Expanding population. B- Stable population. C- Declining population b. Expanding age pyramid – More number of pre-reproductive individuals. Population is growing. Stable age pyramid – Pre-reproductive &reproductive individuals are almost equal. No increase or decrease in population. Declining age pyramid – Pre-reproductive individuals are lesser in number. Large number of reproductive individuals	½ x 3 ½ x3	3
	35	a. Nt+1 = Nt + [(B + I) – (D + E)] b. Natality & Immigration c. Mortality & Emigration	1+1+1	3
	36	a. Mutualism b. Parasitism c. Commensalism d. Mutualism e. Competition f. Commensalism	½ x6	3

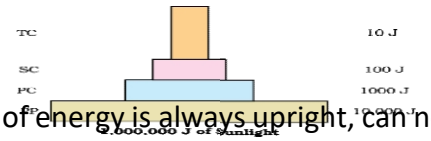
1 mark questions

1. Natural interlinked food chains are called……
2. Which of the following is a detritivore?
   (a) Earthworm (b) Virus (c) Lion (d) Deer
3. Detritus food chain begins with……
4. What is the percentage of photosynthetically active radiation (PAR) in the incident solar radiation?
   (a) 100% (b) 20 % (c) 39% (d) 50%
5. Vertical distribution of different species occupying different levels in an ecosystem is called……
6. Total biomass of living organisms at a particular time in a given ecosystem is called……
7. Organism which breakdown detritus is called……
8. Dead remains of plants and animals are called……
9. Annual NPP of biosphere is ……
10. Linear sequence of energy transfer in an ecosystem by eating and being eaten is called……

11. Sun is the only source of energy on earth. But one exception. What is that?

2 mark questions

12. What are the limitations of ecological pyramids ?(4 points)
13. What are the different trophic levels?
14. Decomposition takes place through different steps. Mineralisation is the last step. Write the other four steps.
15. Observe the equation given below
    NPP = GPP – Respiration
    a. What does NPP and GPP stand for?
    b. GPP depends on various factors. Write any two factors.
16. What are the factors which affect decomposition?
17. The figure depicts pyramid of energy.



    a. Pyramid of energy is always upright, can never be inverted. Justify.
    b. Which are the other two ecological pyramids?
18. (a) Define productivity
    (b) Distinguish primary productivity from secondary productivity
19. Ecological pyranids are usually upright. Meanwhile some pyramid of biomas is inverted. Give reason with example
20. What is an ecological pyramid? Name the different types of ecological pyranids.
21. Ecological pyranids are usually upright. Meanwhile some pyramid of number is inverted. Give reason with example
22. What is 10% law?
23. Flow of energy in plant is based on the law of thermodynamics. Explain
24. A list of different organisms in an ecosystem are given below. Arrange them in 1st, 2nd, 3rd, and 4th trphic levels.
    (Phytoplanktom, Man, Fish, Zooplankton)
25. Given number of individuals in a grassland ecosystem.
    Grasshopper – 1500, Grass – 5842000 , Wolf – 28 , Birds – 215
    a. Draw a pyramid of number showing various trophic levels
    b. Explain trophic level
26. In a marine ecosystem, a population of phytoplankton (150000) supports a standing crop of fishes (4000)
    a. Draw a pyramid of biomass
    b. Draw a pyramid of number
27. Humification leads to accumulation of a dark coloured amorphous substance.
    a. Identify the substance
    b. Write its peculiarities
28. Match the following

A	B

Fragmentation Water soluble inorganic nutrients go down into the soilLeaching Breakdown of detritus into smaller particles

Catabolism Formation of inorganic nutrients from humus

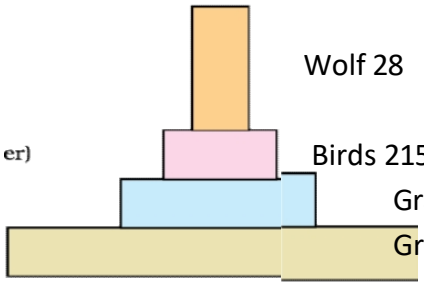
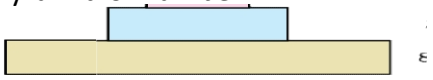
Mineralisation Bacterial and fungal enzymes degrade detritus into simpler inorganic substances

29. Distinguish Grazing food chain from Detritus food chain.
30. (a) Construct a grazing food chain using the following organisms.
(Frog, Grass, Grasshopper, Snake)
(b)Write the trophic level of Grass hopper and Snake.

Answer Key

Category	Question No:	Answer key / Value points	Split score	Total score
Part I		Each carries 1 score		
	1.	Food web	1	1
	2	Earthworm	1	1
	3	Detritus / Dead remains	1	1
	4	50 %	1	1
	5	Stratification	1	1
	6	Standing crop	1	1
	7	Decomposer / Detritivore	1	1
	8	Detritus	1	1
	9	170 billion tons	1	1
	10	Food chain	1	1
	11	Deep sea hydrothermal ecosystem	1	1
Part II		Each carries 2 score		

		Ecological pyramid does not accommodate food web / Do not take into account same species belonging to two or more trophic levels. / Assumes simple food chain, which never exist in nature, / **S**aprophytes are not included.	½ x 4	2
	12	Producers – first trophic level Primary consumers – second trophic level Secondary consumer – third trophic level Teritiary consumer – fourth trophic level	½ x4	2
	13	Fragmentation , Leaching , Catabolism, Humification	½ x4	2
	15	a. NPP – Net primary productivity. GPP – Gross primary productivity b. Sunlight, temperature, moisture, plants in that area, photosynthetic capacity, availability of nutrients etc (any 2)	½ x 2 ½ x2	2
	16	Warm and moist environment favour decomposition Decomposition rate becomes high if detritus, rich in nitrogen and water soluble substances . Decomposition rate is slow in detritus, rich in lignin & chitin. Low temperature and lack of Oxygen inhibit decomposition	½ x 4	2
	17	a. Flow of energy is always unidirectional. Only 10% of energy is transferred to next trophic level, rest is lost as heat b. Pyramid of number and Pyramid of biomass	1 ½ x 2	2
	18	a. Productivity :- Rate of biomass /Organic matter produced per unit area during a given period of time. b. Primary productivity :- Rate of biomass produced per unit area during a given period of time by plants through photosynthesis /Rate of biomass production at producer level Secondary productivity :- Rate of biomass production at consumer level	1 1	2
	19	In aquatic ecosystem, pyramid of biomass is inverted because biomass of phytoplankton is less as compared with that of small herbivorous fish, that feed on these producers.	1+1	2
	20	Ecological pyramids :- Representation of food chain in the form of pyramid Pyramid of number , Pyramid of biomass and Pyramid of energy	½ ½ x2	2
	21	In tree ecosystem, pyramid of number is inverted because tree is single in number, primary consumers are more in	1+1	2

		number.10% law of energy transfer :- 10% of the energy in the food is		
		fixed into their flesh & is available to next trophic level. 90% of energy is utilized for life activities & released as heat energy	2	2
	22	• Solar energy captured by plants and flows through	1+1	2
	23	different organisms in an ecosystem as food energy. (first law of thermodynamics- - Energy can neither be created nor destroyed it can only be transformed from one form to another • Only 10% of energy is transferred to next trophic level, rest is lost as heat (Second law of thermodynamics states that Whenever energy is transferred fron one form to another, there is a decrease in the amount of useful energy). Phytoplankton – first trophic level	½ x 4	2
		Zooplankton – second trophic level Fish – third trophic level Man – fourth trophic level	1+1	
	25	a.  b. Trophic levels :- Based on the source of food, organisms occupy a specific place in the food chain	1+1	2
	26	a. Pyramid of biomass.  b. Pyramid of number 		

		a. Humus b. partially decomposed dark coloured amorphous substance . Humus is resistant to microbial action . colloidal in nature so it undergoes slow decomposition . Humus is Reservoir of nutrients. (any 2)	1 ½ x2	2
	28	Fragmentation – Breakdown of detritus into smaller particles Leaching – Water soluble inorganic nutrients go down into the soil Catabolism – Bacterial and fungal enzymes degrade detritus into simpler inorganic substances Mineralisation – Formation of inorganic nutrients from humus	½ x 2	2
	29	• Grazing food chain (GFC)– Begins from plants. Major food chain in aquatic ecosystems. Less fraction of energy flow. eg., Grass →Goat→Lion→Hawk • Detritus food chain (DFC) – Energy transfer begins from detritus. It include Saprophytes which take food from detritus. Major food chain in terrestrial ecosystem. Large fraction of energy flow takes place.	1+1	2
	30	a. Grass →Grass hopper→Frog→Snake b. Grass hopper – second trophic level Snake – Fourth trophic level	1 ½ x 2	2