Class-XII Session 2022-23
Subject - Biology (044)
Sample Question Paper - 18
With Solution

BLUE PRINT

Ch. No.	Title	Marks Per Unit	Section-A (1 marks)	Section-B (2 marks)	Section-C (3 marks)	Section-D (4 marks)	Section-E (5 marks)	Total Marks
			MC(Q & A/R (Ques. No.	VSA (Ques. No.	SA (Ques. No.	Case based (Ques. No.	LA (Ques. No.	
1	Reproduction in organisms	16	1(Q4)					1
2	Sexual Reproduction in Flowering Plants		1(Q6)	1(Q17)			1(Q31)	8
3	Human Reproduction		1(Q16)		1(Q22)			4
4	Reproductive Health		1(Q7)	1(Q18)				3
5	Principles of Inheritance and Variation	20	1(Q1)	1(Q19)	1(Q23)			6
6	Molecular Basis of Inheritance		2(Q2, 5)		1(Q24)		1(Q32)	10
7	Evolution		1(Q3)		1(Q27)			4
8	Human Health and Disease	12		1(Q20)	1(Q25)	1(Q29)		9
9	Strategies for enhancement in food production							0
10	Microbes in Human Welfare				1(Q28)			3
11	Biotechnology-Principles and Processes	12	2(Q14, 8)			1(Q30)		6
12	Biotechnology and its Application		3(Q15, 9, 10)		1(Q26)			6
13	Organisms and Populations	10		1(Q21)				2
14	Ecosystem		2(Q11, 12)					2
15	Biodiversity and conservation						1(Q33)	5
16	Environmental issues		1(Q13)					1
	Total Marks (Total Questions)		16(16)	10(5)	21(7)	8(2)	15(3)	70(33)

NOTE: The number given inside the bracket denotes question number, ask in the sample paper, while the number given outside the bracket are the number of questions from that particular chapter.

Time Allowed : 3 Hours **Max. Marks : 70**

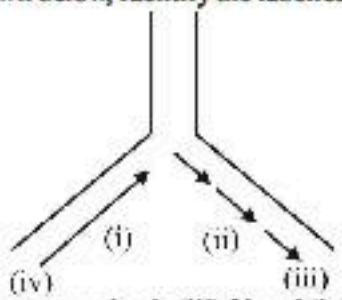
General Instructions

1. All questions are compulsory.
2. The question paper has five sections and 33 questions. All questions are compulsory.
3. Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section–C has 7 questions of 3 marks each: Section–D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.
4. There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
5. Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION-A

1. The Antirrhinum sp. when two F1 pink flowered plants were crossed with each other, the F2 generation produced 40 red, 80 pink and 40 white flowering plants. This is a case of
(a) duplicate genes (b) lethal genes (c) incomplete dominance (d) epistasis

2. Origin of replication of DNA in E. coli is shown below, Identify the labelled parts (i), (ii), (iii) and (iv)



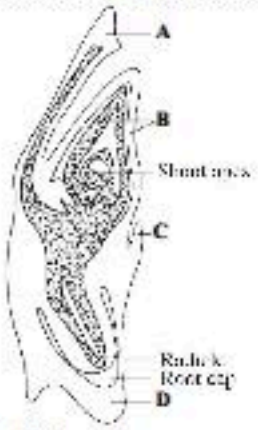
(a) (i)- discontinuous synthesis, (ii)-continuous synthesis (iii) 3' end (iv) 5'end
(b) (i)-continuous synthesis, (ii)- discontinuous synthesis (iii) 5' end (iv) 3'end
(c) (i)- discontinuous synthesis, (ii)- continuous synthesis (iii) 5' end (iv) 3'end
(d) (i)- continuous synthesis , (ii)- discontinuous synthesis (iii) 3' end (iv) 5'end

3. Adaptive radiation refers to:
(a) power of adaptation in an individual to a variety of environments.
(b) adaptations due to Geographical isolation.
(c) evolution of different species from a common ancestor.
(d) migration of members of a species to different geographical areas.

4. The term 'Terror of Bengal' is used for
(a) Bengal tiger (b) water hyacinth (c) algal bloom (d) aquatic fauna

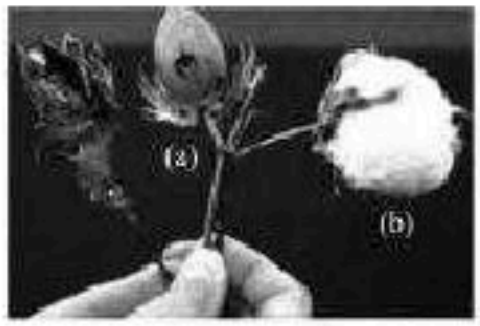
5. A DNA strand with the sequence AACGTAACG is transcribed. What is the sequence of the mRNA molecule synthesized ?
(a) AACGTAACG (b) UUGCAUUGC (c) AACGUAACG (d) TTGCATTGC

6. The given figure shows the L.S. of a monocot embryo. Choose the correct labelling for A, B, C and D marked in the figure from the options given below.



(a) A – Coleoptile; B – Scutellum; C – Epiblast; D – Coleorhiza
(b) A – Scutellum; B – Coleoptile; C – Coleorhiza; D – Epiblast
(c) A – Scutellum; B – Epiblast; C – Coleoptile; D – Coleorhiza
(d) A – Scutellum; B – Coleoptile; C – Epiblast; D – Coleorhiza

7. The diaphragm, cervical cap and vaults are
   (a) disposable contraceptive devices
   (b) Reusable contraceptives
   (c) Non-medicated IUDs
   (d) Cu-releasing IUDs
8. For a plasmid to be a cloning vector, the minium numbers of elements required are
   (a) origin of replication, multiple cloning site, selection marker.
   (b) origin of replication, multiple cloning site, selection marker, promoter.
   (c) origin of replication, multiple cloning site, selection marker, translational start site.
   (d) origin of replication, multiple cloning site, promoter.
9. Which of the following genes were introduced in cotton to protect it from cotton bollworms?



   (a) CryII Ac and cryl Ab
   (b) btAc and BtAc and BtAb
   (c) cryl Ac and cryII Ab
   (d) nif genes
10. Biotechnology deals with industrial scale production of biopharmaceuticals and biological products using genetically modified
   (a) microbes only
   (b) fungi only
   (c) plants and animals only
   (d) all of the above
11. Identification and enumeration of plant and animal species of an ecosystem gives its
   (a) productivity
   (b) stratification
   (c) species composition
   (d) all of these
12. Which of the following most often limits the primary productivity of the ecosystem ?
   (a) Solar radiation/light
   (b) Oxygen
   (c) Consumers
   (d) Nitrogen

Directions: Q.No. 13–16: Consist of two statements–Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is False but R is true.

13. **Assertion :** BOD (Biological oxygen demand) is a device that is used to measure quality of water.
    Reason : High BOD is observed in highly polluted water.
14. **Assertion :** Insertion of recombinant DNA within the coding sequence of b-galactosidase results in colourless colonies.
    Reason : Presence of insert results in inactivation of enzyme b-galactosidase known as insertional inactivation.
15. **Assertion :** Bt cotton is resistant to insects.
    Reason : Butterfly feeding on Bt cotton will die.
16. **Assertion :** Corpus luteum degenerates in the absence of fertilisation.
    Reason : Progesterone level decreases.

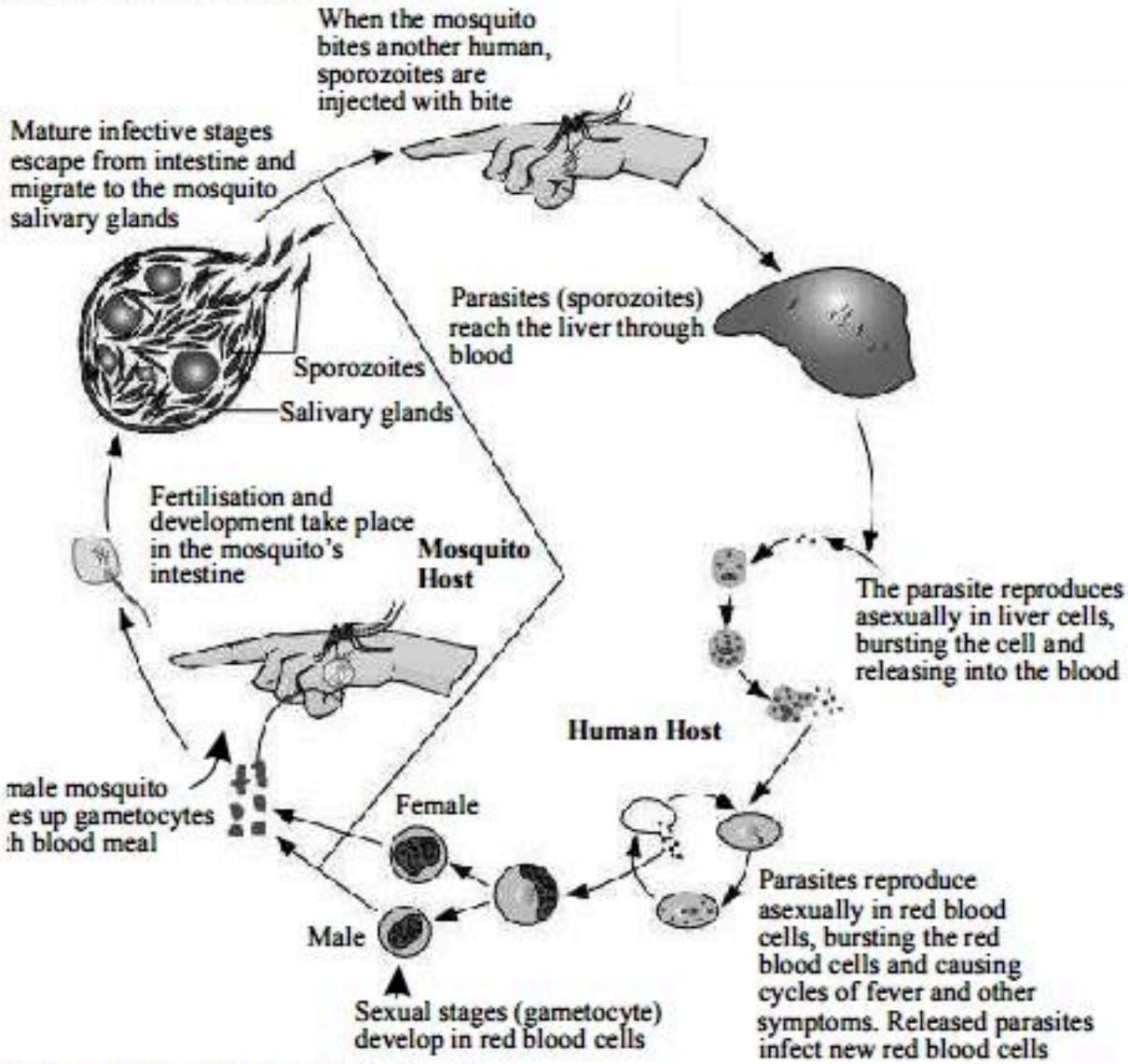
SECTION-B

17. Describe any two devices in a flowering plant which prevent both autogamy and geitonogamy.
18. Reproductive and Child Healthcare (RCH) programmes are currently in operation. One of the major tasks of these programmes is to create awareness amongst people about the wide range of reproduction related aspects. As this is important and essential for building a reproductively healthy society.
    (a) "Providing sex education in schools is one of the ways to meet this goal." Give four points in support of your opinion regarding this statement.
    (b) List any two 'indicators' that indicate a reproductively healthy society.

19. Why are F_2-phenotypic and genotypic ratios same in a cross between red flowered Snapdragon and white flowered Snapdragon plants? Explain with the help of cross.
20. Name the host and the site where the following occur in the cycle of a malarial parasite.
    (a) Formation of gametocytes
    (b) Fusion of gametocytes
21. (a) Name the two growth models that represent population growth and draw the respective growth curves they represent.
    (b) Which one of the curves represents the human population growth at present? Do you think such a curve is sustainable? Give reasons in support of your answer.

SECTION-C

22. (a) What is seminal plasma? What are its components?
    (b) Where do sperms mature and become motile?
23. (a) Sickle-cell anaemia in humans is a result of point mutation. Explain.
    (b) Write the genotypes of both the parents, who have produced a sickle-celled anaemic offsprings.
24. The base sequence in one of the strands of DNA is TAGCATGAT.
    (a) Give the base sequence of the complementary strand.
    (b) How are these base pairs held together in a DNA molecule?
    (c) Explain the base complementarity rule. Give the name of the scientist who framed this rule.
25. Refer the given life cycle and answer the questions.



    (a) Identify the parasite whose life cycle is given above.
    (b) Identify the infective stage of malaria which is found in the salivary gland of female mosquito.
    (c) What is haemozoin?
26. What is gene therapy? Can it be used for treatment of sickle-cell anaemia, haemophilia and thalassemia?

27. With the help of an algebraic equation, how did Hardy-Weinberg explain that in a given population the frequency of occurrence of alleles of a gene is supposed to remain the same through generations?

28. Given below is a list of six micro-organisms. State their usefulness to humans.
    (a) Nucleopolyhedrovirus
    (b) Saccharomyces cerevisiae
    (c) Monascus purpureus
    (d) Trichoderma polysporum
    (e) Penicillium notatum
    (f) Propionibacterium sharmanii

SECTION-D

29. Read the following and answer any four questions from 29(i) to 29(iv) given below:

Cancer:

Cancer is one of the most dreaded diseases of human beings and is a major cause of death all over the globe. In our body, cell growth and differentiation is highly controlled and regulated. In cancer cells, there is breakdown of these regulatory mechanisms. Normal cells show a property called contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appears to have lost this property. As a result of this, cancerous cells just continue to divide giving rise to masses of cells called tumors. Tumors are of two types: benign and malignant. Benign tumors normally remain confined to their original location and do not spread to other parts of the body and cause little damage. The malignant tumors, on the other hand are a mass of proliferating cells called neoplastic or tumor cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues. As these cells actively divide and grow they also starve the normal cells by competing for vital nutrients. Cells sloughed from such tumors reach distant sites through blood, and wherever they get lodged in the body, they start a new tumor there. This property called metastasis is the most feared property of malignant tumors. Transformation of normal cells into cancerous neoplastic cells may be induced by physical, chemical or biological agents. These agents are called carcinogens. Ionising radiations like X-rays and gamma rays and non-ionizing radiations like UV cause DNA damage leading to neoplastic transformation. The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer. Cancer causing viruses called oncogenic viruses have genes called viral oncogenes. Furthermore, several genes called cellular oncogenes (c-onc) or proto oncogenes have been identified in normal cells which, when activated under certain conditions, could lead to oncogenic transformation of the cell.

    (i) What is the property of neoplastic cell?
    (ii) Write the primary contribution to the metastatic spread of cancer cells?
    (iii) What is the basic difference between cancer cell and a normal cell?
    (iv) Which genes is involved in the conversion of proto-oncogenes into oncogenes causing cancer?

30. Read the following and answer any four questions from 30(i) to 30 (iv) given below:

Gel Electrophoresis:

The cutting of DNA by restriction endonucleases results in the fragmentes of DNA. These fragments can be separated by a technique known as gel electrophoresis. Since DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix. Nowadays the most commonly used matrix is agarose which is a natural polymer extracted from sea weeds. The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves. The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. You can see bright orange coloured bands of DNA in a ethidium bromide stained gel exposed to UV light. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.

    (i) Which technique is used to separate DNA fragments generated by the restriction endonucleases in a chemical reaction?
    (ii) Agarose extracted from sea weeds is used in which technique ?
    (iii) What is the criterion for DNA fragments movement on agarose gel electrophoresis?
    (iv) Which compound is used to visualised the separated DNA fragments after its staining?

SECTION-E

31. Draw a labelled diagram of the sectional view of a mature pollen grain in angiosperms. Explain the functions of its different parts.

OR

    (a) What is the role of cervix of the human female system in reproduction?
    (b) Distinguish between spermatogenesis and oogenesis.

32. What are salient features of HGP ? What are the prospects of this project ?

OR

(a) A group of passengers were severely burnt beyond recognition during a train accident. A modern technique will help to hand over the dead to their relatives.
Name the technique and explain it briefly.

(b) What do 'Y and 'B' stand for in YAC' and 'BAC' used in Human Genome Project (HGP). Mention their role in the project.

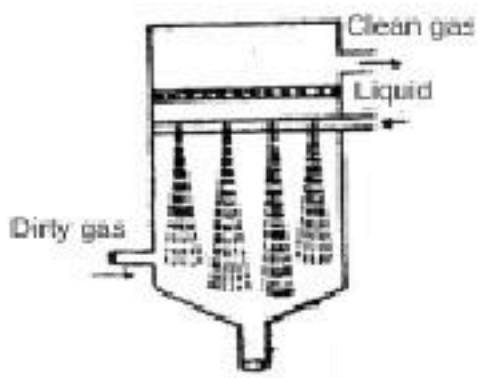
33. How can you, as an individual, prevent the loss of biodiversity?

OR

Following is a diagram of latitudinal diversity.

(i) What does it indicate?

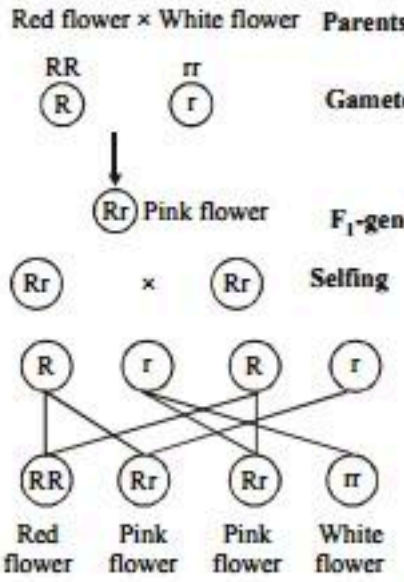
(ii) What are the reasons for such a differential distribution?



Solutions

SAMPLE PAPER-4

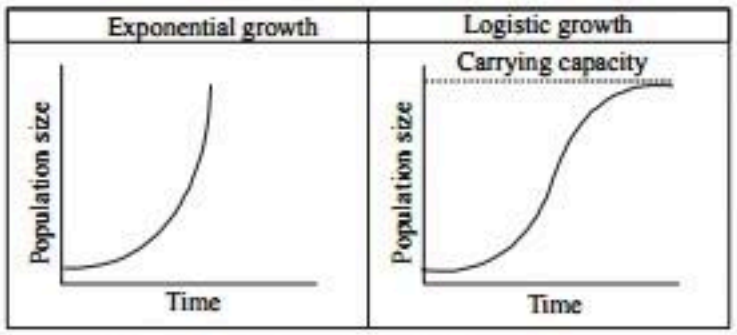
1. **(c)** In incomple dominace, F1 hybrids are not related to either of the parents but exhibited a blending of characters of two parents. E.g. 40' clock plant (Mirabilis jalapa), and dog flower (Antirrhinum majus). (1 mark)
2. **(d)** (i) Continuous synthesis
   (ii) Discontinuous synthesis
   (iii) 3' end
   (iv) 5' end (1 mark)
3. **(c)** Adaptive radiation refers to evolution of different species from a common ancestor. The mammals are adapted for different mode of life i.e. they show adaptive radiation. They can be aerial (bat), aquatic (whale and dolphins), burrowing or fossorial (rat), cursorial (horse), scantorial (squarrel) or arboreal (monkey). The adaptive radiation, the term by Osborn, is also known as divergent evolution. (1 mark)
4. **(b)** The excessive growth of a floating aquatic plant, water hyacinth (Eichhornia crasipes) caused havoc in India by blocking our water ways. In India, it is also known as 'Terror of Bengal'. (1 mark)
5. **(b)** When a DNA strand with the sequence AACGTAACG is transcribed, the resultant sequence of the mRNA molecule synthesized is UUGCAUUGC. (1 mark)
6. **(d)** In the given figure of monocot embryo, the structure marked as A, B, C and D are respectively scutellum, coleoptile, epiblast and coleorhiza. (1 mark)
7. **(b)** Diaphragms, cervical caps and vaults are reusable barrier contraceptives made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus. They prevent conception by blocking the entry of sperms through the cervix. (1 mark)
8. **(a)** Restriction endonuclease-Hind II, always cuts DNA molecules at a particular point by recognizing a specific sequence of six base pairs. This specific base sequence is known as the recognition sequence for Hind II. (1 mark)
9. **(c)** (1 mark)
10. **(d)** Biotechnology is the exploitation of biological processes for industrial and other purposes, especially the genetic manipulation of microorganisms (like microbes, fungi, plants and animals) for the production of antibiotics, hormones, etc. (1 mark)
11. **(c)** Identification and enumeration of plants and animal species of an ecosystem gives its species composition. (1 mark)
12. **(a)** Primary productivity is the rate at which energy is converted by photosynthetic and chemosynthetic autotrophs to organic substances. It is expressed in terms of weight or energy. The total amount of productivity in a region or system is gross primary productivity. (1 mark)
13. **(a)** BOD indicates the amount of decaying organic matter present in water. Therefore, a low BOD is an indicator of good quality of water, while a high BOD indicates polluted water. Dissolved oxygen (DO) is consumed by bacteria when large amounts of organic matter from sewage or other discharges are present in the water. (1 mark)
14. **(a)** Alternative markers have been developed that can differentiate recombinants from non-recombinants based upon their ability to produce colour in the presence of a chromogenic substrate. The plasmid in the bacteria, lacking an insert produces blue-coloured colonies, while those plasmids with an insert do not produce any colour due to insertional inactivation of the enzyme, β-galactosidase. (1 mark)
15. **(c)** *Bt* cotton is an insect-resistant transgenic crop designed to combat the bollworm. (1 mark)
16. **(b)** In female, Graafian follicle forms corpus luteum after ovulation. The cells of corpus luteum are called luteal cells. The cytoplasm of luteal cells have yellow granules called lutein which secrete the hormone progesterone to maintain pregnancy if fertilisation takes place. In the absence of fertilisation, corpus luteum degenerates and forms corpus albicans and there is decrease in progesterone level as well.
17. • Dioecy and dichogamy are two devices which are used in flowering plant to prevent both autogamy and geitonogamy.
    • In several species (for e.g. papaya) male and female flowers are present on different plants that are each plant is either male or female. This condition is called dioecy. Whereas in case of dichogamy, maturity of the stamens and carpels in a bisexual flower is not synchronised *i.e.*, male or female flowers mature at different time e.g., cotton, *Ficus* etc. (1 + 1 marks)
18. (a) The main aim of the RCH programmes is create awareness amongst people about the wide range of reproduction related aspects. Providing sex education in schools really meets the goal of RCH. The following are the reasons to support the statement: (any four)
    (i) Provide right information to the young so as to discourage children from believing in myths and misconception about sex related aspects.
    (ii) Correct information about reproductive organs, adolescence and related changes, safe sexual practices and sexual hygiene help the adolescents lead a healthy reproductive life.
    (iii) Awareness of problem due to uncontrolled population growth.
    (iv) Giving proper information on social evils like sex abuse and sex related crimes etc. help to make a healthy society.
    (v) Proper information about sexually transmitted diseases and HIV-AIDS is important for turning adolescents into responsible adults.
    (vi) Creating awareness on available birth control options and care of pregnant mothers, post-natal care and importance of breast feeding.
    (b) Two indicators that indicate a reproductively healthy society are:
    (i) Increased medical facilities for all sex related problems and better post-natal care.
    (ii) Better detection and cure of Sexually Transmitted Diseases. (4 × ¼ + 2 × ½ marks)
19. (i) In Snapdragon, the inheritance of flower colour shows incomplete dominance.
    (ii) Neither of the alleles of gene for flower colour is completely dominant over the other and hybrid shows an intermediate phenotype.



(½ + 1 ½ marks)

20. (a) Red Blood Cells (RBCs) of human.
(b) Intestine of female *Anopheles* mosquito. (1 + 1 marks)

21. (a) The two growth models that represent population growth are exponential growth curve and logistic growth curve.



(b)
- At present exponential growth curve represent the human population growth curve.
- No, this growth curve is not sustainable due to limited resources and carrying capacity.

(1 + 1 marks)

22. (a) The accessory glands of a male reproductive system secrete a fluid mixture called seminal plasma. It serves as a medium to carry, protect and nourish spermatozoa after ejaculation up to fertilistion, and as a functional modulator of spermatozoa function. It is rich in fructose, calcium and certain enzymes.

(b) The sperms mature and gain motility in epididymis. Capacitation is the process by which spermatozoa become motile and are fully mature; this does not occur until they are in the female reproductive tract. The mature spermatozoa from epididymis pass into the vas deferens. Here, they partly swim and are mainly moved by muscular action of the vas deferens.

(1 ½ + 1 ½ marks)

23. (a) Point mutation is the result of change in single base pair of DNA. It occurs due to defect caused by the single base substitution at the sixth codon of the beta chain of haemoglobin from GAG to GUG. This causes substitution of glutamic acid by valine. The defective haemoglobin molecule undergoes polymerisation under low oxygen tension causing sickle-cell-shaped red blood cell.

(b) The genotypes of parents must be Hb^AHb^S and Hb^AHb^S. (2 + 1 marks)

24. (a) ATCGTACTA

(b) Base pairs are held together by weak hydrogen bonds, adenine pairs with thymine by two H–bonds and guanine pairs with cytosine by three H–bonds.

(c) Base complementarity rule for a double-stranded DNA states that the ratios between adenine and Thymine and Guanine and Cytosine are constant and equal to one. Erwin Chargaff framed this rule.(1 + 1 + 1 marks)

25. (a) Malaria Parasite - *Plasmodium*

(b) The infective stage of malaria is sporozoites which are found in the salivary gland of female mosquito.

(c) Haemozoin is a toxin released by *Plasmodium* species, which is responsible for the chill and high fever recurring every three to four days. To continue their life-cycle, *Plasmodium* enters the human body as sporozoites and multiplies within the liver cells, resulting in the rupture of the RBCs. The ruptured RBCs are associated with release of a toxic substance, haemozoin. (1 + 1 + 1 marks)

26. Gene therapy is alteration of specific genes to modify the patient's genotype for the treatment of hereditary diseases like haemophilia and phenylketonuria.
Yes, It can be used for treatment of sickle cell anaemia, haemophilia and thalassemia by transplanting defective genes by correct ones. (2 + 1 marks)

27. In a given population one can find out the frequency of occurrence of alleles of a gene or a locus. This frequency is supposed to remain fixed and even remain the same through generations. Hardy-Weinberg principle stated it using algebraic equations.
This principle says that allele frequencies in a population are stable and is constant from generation to generation. The gene pool (total genes and their alleles in a population) remains a constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1. Individual frequencies, for example, can be named p, q, etc. In a diploid, p and q represent the frequency of allele A and allele a. The frequency of AA individuals in a population is simply p^2. This is simply stated in another ways, i.e., the probability that an allele A with a frequency of p appear on both the chromosomes of a diploid individual is simply the product of the probabilities, i.e., p^2. Similarly of aa is q^2, of Aa 2pq.
Hence, $p^2 + 2pq + q^2 = 1$. This is a binomial expansion of $(p + q)^2$. When frequency measured, differs from expected values, the difference (direction) indicates the extent of evolutionary change. Disturbance in genetic equilibrium, or Hardy-Weinberg equilibrium, i.e., change of frequency of alleles in a population would then be interpreted as resulting in evolution. (3 marks)

28.

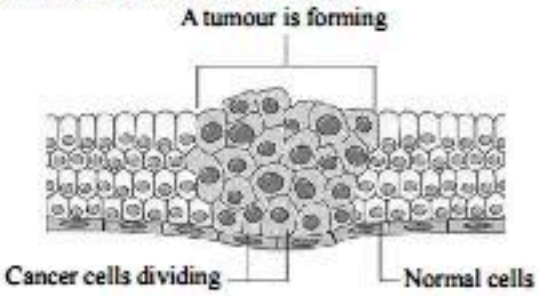
Micro-Organism	Usefulness to Humans
Nucleopolyhedrovirus	It is a biological control agent. It is a species-specific insecticide.
Saccharomyces cerevisiae	It is used to ferment bread dough. It is used in the preparation of ethanol by fermenting fruit juices and cereals.
Monascus purpureus	Statins produced by it work as blood cholestrol lowering agents.
Trichoderma polysporum	It produces cyclosporin A, which works as an immunosuppressant.
Penicillium notatum	It is a source of penicillin, an antibiotic.
Propionibacterium sharmanii	It helps in the ripening of swiss cheese. It is also responsible for the appearance of large holes in the cheese, as it produces high amount of carbon dioxide.

(6 × ½ marks)

29. (i) Neoplastic or tumor cells grow very rapidly, invading and damaging the surrounding normal tissues.

(ii) The metastatic spread of cancer cells are caused due to the following :
- (a) cytoskeletal changes and cell motility
- (b) increased enzyme production.
- (c) loss of contact inhibition

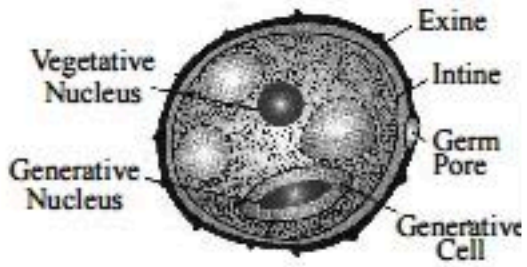
(iii) Cancerous cells just continue to divide but do not differentiate like normal cells.



(iv) Tumor suppressor genes. (1+1+1+1 marks)

30. (i) Electrophoresis
(ii) Gel electrophoresis
(iii) The smaller the fragment size, the farther it moves.
(iv) Ethridium Bromide (1+1+1+1 marks)

31. • Sectional view of mature pollen grain



• A mature pollen grain has two layered wall-the outer exine and the inner intine. The wall encloses a large vegetative cell containing vegetative nucleus and a lenticular generative cell. Their functions are as follows:

(i) Exine: The outer thick exine layer is made up of sporopollenin which is resistant to physical and biological decomposition. It provides protection during the hazardous journey of pollen from anther to the stigma. There are one or many germpores on the pollen surface which are directly or indirectly associated with its germination.

(ii) Intine: The intine is pecto-cellulosic in nature. It is associated with the formation of pollen tube.

(iii) Vegetative cell: The vegetative cell is large and contains abundant food reserve. It has a large vegetative nucleus. The function of vegetative cell is to provide the medium for the movement of male gametes in pollen tube.

(iv) Generative cell: The generative cell cytoplasm is highly reduced but it contains the usual cell organelles. It divides mitotically to produce two functional male gametes. (2+3 marks)

OR

(a) Cervix helps in regulating the passage of sperms into the uterus and forms the birth canal to facilitate parturition.

(b)

S. No.	Spermatogenesis	Oogenesis
1.	It is the process of formation of haploid spermatozoa from diploid male germ cells of the	It is the process of formation of haploid ova from the gamete mother cells (oogonia) in the ovary.
2.	It occurs in testes.	It occurs in ovaries.
3.	Spermatogonia changes to primary spermatocyte.	Oogonia changes to primary oocyte.
4.	A primary spermatocyte divides to form two secondary spermatocytes.	A primary oocyte divides to form one secondary oocyte and a polar body.
5.	A secondary spermatocyte divides to form two spermatids.	A secondary oocyte divides to form one ovum and a polar body.
6.	No polar body is formed.	Polar bodies are formed.
7.	Four spermatozoa are produced.	One ovum/egg is produced.

(2+3 marks)

32. Human genome project was launched in 1990 for sequencing human genome. Human genome has 3×10^9 bp and the cost of sequencing human genome was estimated approximately 9 billion US dollars. The project was 13 year old project co-ordinated by U.S. Department of Energy and National Institute of Health. Various countries like Japan, France, Germany, China contributed to this project. The project completed in 2003.

The salient features are –

(i) The human genome contains 3164.7 million nucleotide bases.

(ii) The average gene consists of 3000 bases, but sizes vary greatly, with the largest known human gene being dystrophin at 2.4 million bases.

(iii) The total number of genes is estimated at 30,000–much lower than previous estimates of 80,000 to 1,40,000 genes. Almost all (99.9 per cent) nucleotide bases are exactly the same in all people.

(iv) The functions are unknown for over 50 per cent of discovered genes.

(v) Less than 2 per cent of the genome codes for proteins.

(vi) Repeated sequences make up very large portion of the human genome.

(vii) Repetitive sequences are stretches of DNA sequences that are repeated many times, sometimes hundred to thousand times. They are thought to have no direct coding functions, but they shed light on chromosome structure, dynamics and evolution.

(viii) Chromosome 1 has most genes (2968), and the Y has the fewest (231).

(ix) Scientists have identified about 1.4 million locations where singlebase DNA differences (SNPs – single nucleotide polymorphism, pronounced as 'snips') occur in humans. This information promises to revolutionise the processes of finding chromosomal locations for disease-associated sequences and tracing human history.

The discovery of human genome is a great achievement of man. It will show new ways to diagnose, treat many human diseases. It will help in healthier living and give knowledge about designer drugs, genetically modified foods and our genetic identity also. It will also help us to sequence the genomes of some other organisms like *Drosophila*, Yeast, Bacteria, Plants etc. (4+1 marks)

OR

(a)
- DNA finger printing can help hand over the dead to their relatives by distinguishing individuals of same species using their DNA as sample. DNA finger printing exploits the highly variable repeating sequences, i.e. VNTRs for profiling. These VNTRs are highly conserved among members of the same species.
- This technique has following steps:
  (i) Isolation of DNA and digestion of DNA by restriction endonucleases.
  (ii) Separation of DNA fragments by (gel) electrophoresis and transferring (blotting) of separated DNA fragments to synthetic membrane or nitrocellulose or nylon.
  (iii) Hybridisation using VNTR probe and detection of hybridised DNA fragments by autoradiography.
  (iv) Matching the banding pattern so obtained with that of relative.

(b)
- Y and B stands for yeast and bacteria respectively in YAC (Yeast artificial chromosomes) and BAC (bacterial artificial chromosomes).
- They are used as a vector for cloning foreign DNA in human genome project. (3+2 marks)

33. The loss of biodiversity can be prevented by

(i) Practise of recycling waste paper etc.

(ii) Judicious exploitation of medicinal and commercial plants and animals.

(iii) Generating awareness among the public on the importance of biodiversity, conversation through skits, screening of films, lectures etc. Teaching people how to reduce green house gases emissions, through alternate eco friendly green technologies like use of solar energy, wind energy, biogas, vermi-compost, organic farming etc. (5 marks)

OR

(i) The above diagram indicates that at 0 (zero) latitude *i.e.* equator, there is maximum biodiversity. As we move away from the equator towards poles, the biodiversity goes on decreasing so that at poles 80°, there is very little biodiversity.

(ii) The reason for this differential distribution of biodiversity is that at the equator, there is favourable environmental conditions for speciation as well as for sustaining both variety and number of organisms. This region is represented by tropical rain forests.

As we move away from tropic $23\frac{1}{2}$ N° – $66\frac{1}{2}$ N°, the biodiversity decreases because harsh conditions exist in temperate areas during the cold winter season.

Beyond $66\frac{1}{2}$ N°– very harsh conditions prevail for most of the year in Arctic polar region and the biodiversity reaches to the maximum decline.

(2+3 marks)