Class XII Session 2023-24
Subject - Biology
Sample Question Paper - 8

Maximum Marks: 70 **Time: 3 Hours**

General Instructions:

(i) All questions are compulsory.
(ii) The question paper has five sections and 33 questions. All questions are compulsory.
(iii) 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.
(iv) 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.
(v) Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION - - A

1. To prove that DNA is the genetic material, which radioactive isotopes were used by Hershey and Chase (1952) in their experiments?
(a) 35S and 15N
(b) 32P and 35S
(c) 32P and 15N
(d) 14N and 15N

2. Complete the given table showing different possibilities of genotypes and their corresponding blood groups, by selecting the correct option.

Genotypes	Blood groups
I^AI^A, (i)	A
I^BI^B, (ii)	B
(iii)	AB
(iv)	O

	(i)	(ii)	(iii)	(iv)
(a)	*ii*	I^Bi	I^Ai	I^AI^B
(b)	I^Ai	I^Bi	*ii*	I^AI^B
(c)	I^Ai	I^Bi	I^AI^B	*ii*
(d)	I^Ai	I^Bi	I^AI^B	I^Bi

3. The theory of natural selection was given by
(a) Lamarck
(b) Alfred Wallace
(c) Charles Darwin
(d) Oparin and Haldane.

4. The biomass available for consumption by the herbivores is called
(a) net primary productivity
(b) secondary productivity
(c) standing crop
(d) gross primary productivity.

5. Which of the following is correctly matched for the product produced by them?
(a) Methanobacterium: Lactic acid
(b) Penicillium notatum : Penicillin
(c) Saccharomyces cerevisiae : Acetic acid
(d) Acetobacter aceti: Antibiotics

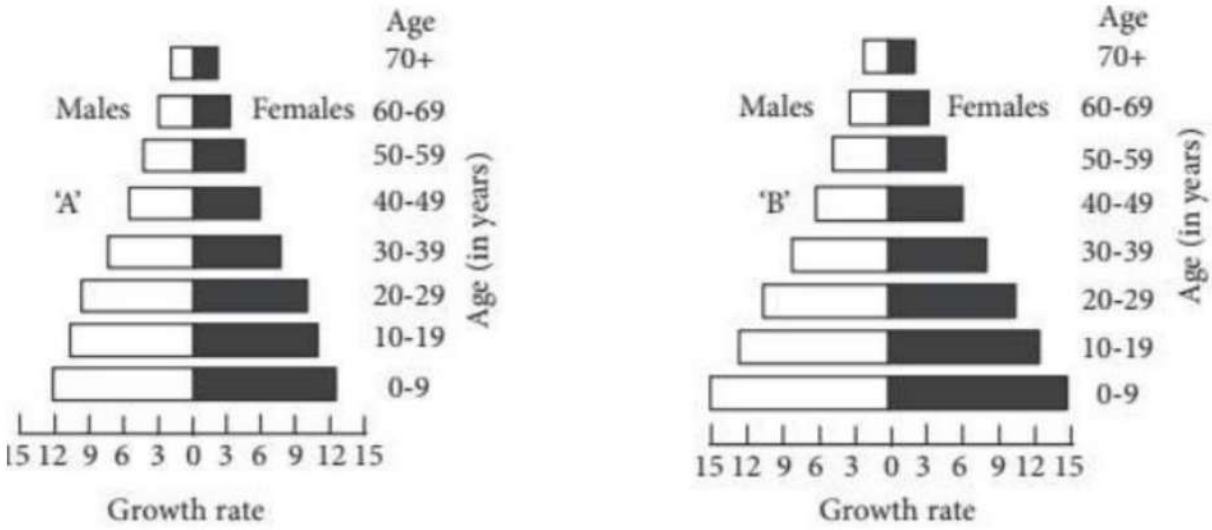
6. Which of the following is not a cloning vector?
(a) Cosmid
(b) pBR322
(c) SalI
(d) Phagemid

7. Match column I with column II and select the correct answer from the given codes.

	Column I		Column II
A.	amp^R gene	(i)	Artificial plasmid
B.	Separation of DNA fragments	(ii)	Selectable marker
C.	*Hind* II	(iii)	Electrophoresis
D.	pBR322	(iv)	*Haemophilus influenzae* Rd

(a) A-(iii), B-(ii), C-(i), D-(iv)
(b) A-(iv), B-(i), C-(iii), D-(ii)
(c) A-(ii), B-(iii), C-(iv), D-(i)
(d) A-(ii), B-(iv), C-(i), D-(iii)

8. A country with a high rate of population growth took measures to reduce it. The figure below shows age-sex pyramids of populations A and B twenty years apart. Select the correct interpretation about them.



Interpretations:
(a) "B" is earlier pyramid and shows stabilised growth rate.
(b) "B" is more recent showing that population is very young.
(c) "A" is the earlier pyramid and no change has occurred in the growth rate.
(d) "A" is more recent and shows slight reduction in the growth rate.

9. A plant has 24 chromosomes in "microspore mother cell". The number of chromosomes in its endosperm will be
(a) 36
(b) 24
(c) 12
(d) 48.

10. Which of the following microbes is used for the commercial production of ethanol?
(a) Clostridium butylicum
(b) Trichoderma polysporum
(c) Monascus purpureus
(d) Saccharomyces cerevisiae

11. Match column I with column II and select the correct option.

	Column I		Column II
A.	Apomixis	(i)	Mango
B.	Polyembryony	(ii)	Seedless fruit
C.	Parthenocarpy	(iii)	Asteraceae

(a) A-(iii), B-(i), C-(ii)
(b) A-(ii), B-(iii), C-(i)
(c) A-(i), B-(ii), C-(iii)
(d) A-(iii), B-(ii), C-(i)

12. Which of the following is used as 'clot buster' for removing clots from blood vessels of patient who have undergone myocardial infarction?
(a) Ethanol
(b) Statins
(c) Cyclosporin-A
(d) Streptokinase

Question No. 13 to 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: Relationship between Balanus and Chthamalus is said to be an example of competition.
Reason: In amensalism, one species is harmed whereas the other is unaffected.

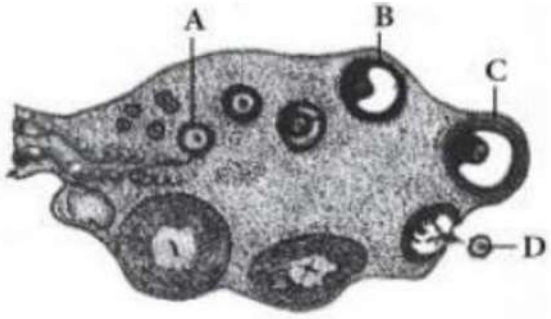
14. Assertion: Dodo, Passenger pigeon, Steller's sea cow have become extinct due to over exploitation.
Reason: Excessive exploitation of a species, whether animal or plants reduces size of its population so that it becomes vulnerable to extinction.

15. Assertion: Threatened species are those living species which have been greatly reduced in their number and are liable to become extinct if the causative factors continue.
Reason: IUCN is an international organisation which maintains the IUCN Red List of threatened species, to assess the conservation status of different species.

16. Assertion: In a microsporangium, the tapetal cells possess little cytoplasm and generally have a single prominent nucleus.
Reason: During microsporogenesis, the microspore mother cells (MMCs) undergo meiotic divisions to produce haploid microspore tetrads.

SECTION – B

17. Refer to the given figure and answer the following questions.



(i) Which of the labelled structures is a pre-birth structure and is not formed thereafter?
(ii) Which of the labelled structures responds to LH surge by rupturing?

18. Tallness of pea plant is a dominant trait, while dwarfness is the alternate recessive trait. When a pure-line tall is crossed with pure-line dwarf, what fraction of tall plant in F_2 shall be heterozygous? Give reasons.

19. A young boy when brought a pet dog home started to complaint of watery eyes and running nose. The symptoms disappeared when the boy was kept away from the pet.
(a) Name the type of antibody and the chemicals responsible for such a response in the boy.
(b) Mention the name of any one drug that could be given to the boy for immediate relief from such a response.

20. State the functions of the following in the cloning vector pBR322:
(a) ori
(b) rop

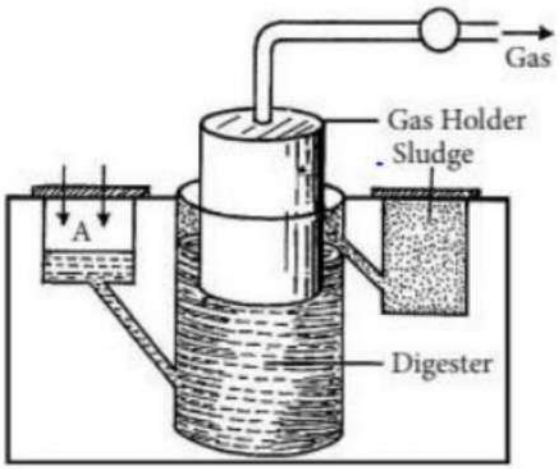
21. Write the relationship between productivity, gross primary productivity, net primary productivity and secondary productivity.

OR

State the difference between the first trophic levels of detritus food chain and grazing food chain.

SECTION-C

24. Study the given picture of biogas plant and answer the following questions:
(a) Name the components gaining entry from A into the chamber.
(b) Mention the group of bacteria and the condition in which they act on the component that entered from A in the digester.
(c) Name the components that get collected in gas holder.



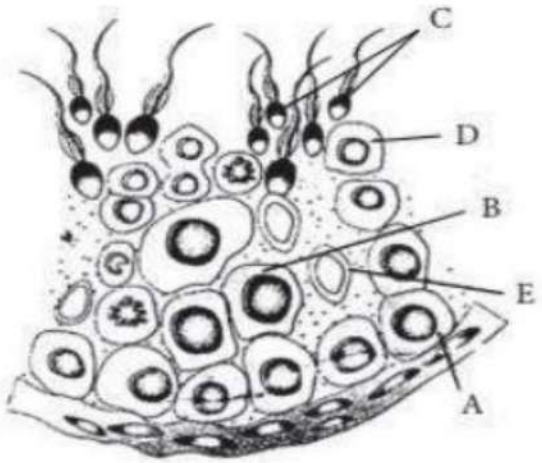
25. (a) Why are transgenic animals so called?
(b) Explain the role of transgenic animals in (i) vaccine safety and (ii) biological products with the help of an example each.

26. "In a food chain, a trophic level represents a functional level, not a species". Explain.

OR

(a) What is primary productivity? Why does it vary in different types of ecosystems?
(b) State the relationship between gross and net primary productiviy.

27. (a) Name the labels A, B, C, D and E in the given diagram of seminiferous tubule.



(b) Give one function of 'E.

28. Medically it is advised to all young mothers that breast feeding is the best for their newborn babies. Do you agree? Give reasons in support of your answer.

SECTION-D

Q. No. 29 and 30 are case based questions. Each question has 3 subparts with internal choice in one subpart.

29. The immunity that an individual acquires after the birth is called acquired immunity. It is characterised by memory. Immune response are carried out with the help of two types of cells X and Y present in our Blood.
X produces an army of proteins and Y themselves do not secrete those proteins but help X to produce them.
(a) What could be 'X' and 'Y' here?

OR

Differentiate between the roles of 'X' and 'Y' in generating immune responses.

(b) State two important functions of 'Y'
(c) Where do 'Y' cells mature.

30. In a plant species that follows Mendelian inheritance yellow flower colour is dominant over white and round fruit shape is dominant over elongated. Crossing was performed between two purelines-one having yellow-flower and round fruit and another with white flower and elongated fruits. About 20 plants survived in F, progeny. Plants of F, were allowed to self fertilise and about 960 plants survived in F2.
(a) How many plants would have yellow flower and round fruit in F_1 generation?

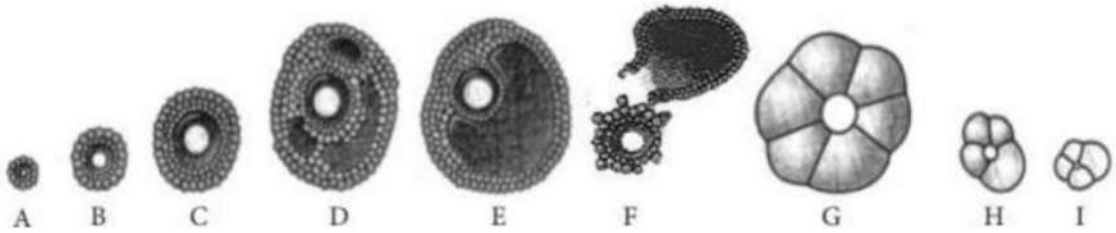
(b) How many plants would have yellow flower and round fruit in F_2 generation?
(c) Mention the phenotypic and genotypic ratio when plant heterozygous for yellow flower and round fruit is crossed with the double recessive parent.

OR

If the plant heterozygous for yellow flower and round fruit are self crossed, then what will be the genotype of plant with yellow flower and elongated fruit?

SECTION – E

31. The following is the illustration of the sequence of ovarian events "A" to "I" in a human female.



(a) Identify the figure that illustrates ovulation and mention the stage of oogenesis it represents.
(b) Name the ovarian hormone and the pituitary hormone that have caused the above mentioned event.
(c) Explain the changes that occur in the uterus simultaneously in anticipation.
(d) Write the difference between 'C' and 'H.
(e) Draw a labelled sketch of the structure of a human ovum prior to fertilisation.

OR

(a) Explain the menstrual phase in a human female. State the levels of ovarian and pituitary hormones during this phase.
(b) Why is follicular phase in the menstrual cycle also referred as proliferative phase? Explain.
(c) Explain the events that occur in a Graafian follicle at the time of ovulation and thereafter.
(d) Draw a Graafian follicle and label follicular antrum and secondary oocyte.

32. In pea plantlet, symbol Y represent dominant yellow; symbol y, the recessive green; symbol R, the round seed shape and symbol r, the wrinkle seed shape. A typical Mendelian dihybrid cross was carried out in pea plants.
(a) Write the genotypes of
(i) homozygous dominant and recessive parents
(ii) gametes produced by both the parents

(iii) F, offspring
(iv) gametes produced by F_1 offspring
(b) Write the Mendelian F_2 phenotypic ratio in a dihybrid cross. State the law that he proposed on the basis of this ratio. How is this law different from the law of segregation?

OR

How are the following formed and involved in DNA packaging in a nucleus of a cell?
(i) Histone octamer
(ii) Nucleosome
(iii) Chromatin
33. (a) List the key tools used in recombinant DNA technology. (b) Explain the role of Ti plasmids in biotechnology.

OR

(a) Describe the different steps in one complete cycle of PCR.
(b) State the purpose of such an amplified DNA sequence.

SOLUTIONS

1. (b): Hershey and Chase experiment is based on the fact that DNA contains phosphorus and similarly sulphur is present in proteins but not in DNA. They incorporated radioactive isotope of phosphorus (32p) into phage DNA and that of sulphur (355) into proteins of a separate phage culture. Viruses grown in the presence of radioactive phosphorus contained radioactive DNA because DNA contains phosphorus but proteins do not. Similarly, viruses grown on radioactive sulphur contain radioactive protein because DNA does not contain sulphur.

2. (c) In human beings, ABO blood groups are controlled by gene I which has three alleles 1A, 1B and i. The six possible genotypes are FAA, IA, IA, 1B1B, Bi and ii. The phenotypes which occur by these genotypes are A (AA, I^1), B (1, 1), AB (ATB) and O (ii).

3. (c)

4. (a) The total organic matter synthesised by the producers in the process of photosynthesis per unit time and area is known as gross primary productivity. Net primary productivity is equal to the rate of organic matter created by photosynthesis minus the rate of respiration and other losses. It is actually the biomass available for consumption by the herbivores.

5. (b) Methanobacterium is useful in the
5. (b) Methanobacterium is useful in the
production of biogas. Penicillium notatum is used to produce penicillin, an antibiotic. Saccharomyces cerevisiae is used for commercial production of ethanol. Acetobacter aceti is used to obtain acetic acid.

6. (c): Sal I is a restriction enzyme isolated from Streptomyces albus.

7. (c)

8. (d)

9. (a)

10. (d): Yeast (Saccharomyces cerevisiae) is used for commercial production of alcohol (ethanol).

11. (a)

12. (d) Streptokinase is used as 'clot buster' for removing clots from blood vessels of patients who have undergone myocardial infarction.

13. (c) In competition, both species are harmed. Interaction between Balanus and Chthamalus is an example of competition.

14. (a)

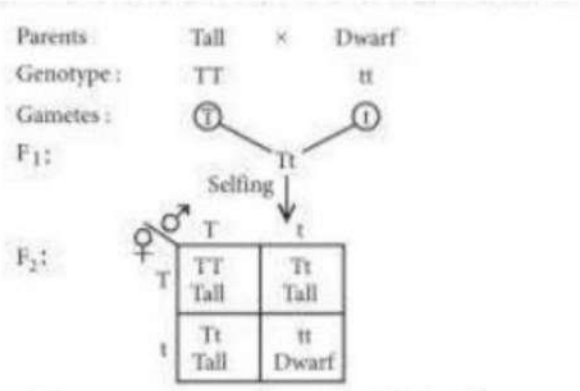
15. (b)

16. (d): Tapetum is the innermost wall layer of a microsporangium. It nourishes the developing pollen grains. The tapetal cells enlarge radially and become filled with dense protoplasmic contents as well as nutrients. Tapetal cells are generally multinucleate or their nucleus becomes polyploid due to endoploidy. Microsporogenesis refers to the process of formation of haploid microspores or pollen grains from a microspore mother cell (MMC) or pollen mother cell (PMC) through meiosis.

17. (i) The structure labelled as A, i.e., primary follicle is a pre-birth structure of a female individual. Oogenesis starts during embryo development where millions of oogonia are formed whose development arrests at primary follicle stage. No more oogonia, thus no more primary follicles, are formed after birth.

(ii) The structure labelled as C is called Graafian
follicle. It responds to LH surge by rupturing and releasing the secondary oocyte, resulting in ovulation.

18.



Fraction of heterozygous tall plants in $F_2 = \frac{1}{2}$.

This can be explained by law of segregation which states that the members of the allelic pair that remained together in the parent, segregate during gamete formation and only one factor enters a gamete.

19. (a) Such a response in the boy is called allergy which occurs due to production of IgE antibodies and chemicals like histamine and serotonin from the mast cells.
(b) Anti-histamine could be given to the boy for immediate relief from such a response.

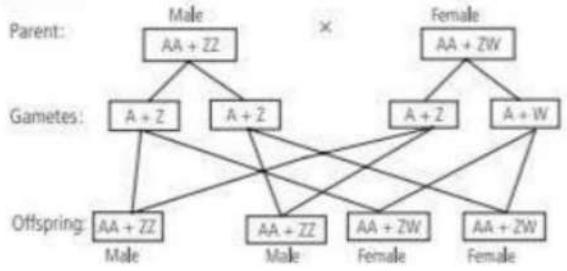
20. (a) Origin of replication (Ori) is a specific sequence of DNA bases which is responsible for initiating replication. It is also responsible for controlling the copy number of the linked DNA.
(b) rop in pBR322 encodes for a protein involved in replication of plasmid.

21. Productivity is the rate of biomass production per unit area in unit time at any trophic level. It can be divided into gross primary productivity and net
primary productivity. Gross primary productivity (GPP) is the total organic matter synthesised by producers, in the process of photosynthesis per unit time and area while net primary productivity (NPP) is the weight of the organic matter stored by the producers in a unit area/ volume per unit time. It is equal to the rate of organic matter synthesised during photosynthesis, i.e., gross primary productivity minus the rate of respiration and other losses.
NPP = GPP-R Secondary productivity is the rate of formation of new organic matter by consumers. It depends upon the loss while transferring energy containing organic matter from the previous trophic level plus the consumption due to respiration and predation.

OR

In a grazing food chain, producers constitute the first trophic level. Producers are autotrophic living green plants which can manufacture their own food through photosynthesis utilising inorganic raw materials and sunlight. In a detritus food chain, detritivores and decomposers constitute the first trophic level. Decomposers are the saprophytes, chiefly bacteria and fungi that breakdown the complex compounds of dead organisms into simple substances. During the fetal

22. Birds have ZW - ZZ type of sex determination mechanism. In this type the male has two homomorphic sex chromosomes (ZZ) and is homogametic, and the female has two heteromorphic sex chromosomes (ZW) and is heterogametic. There are, thus, two types of eggs: with Z and with W, and only one type of sperms, i.e., each with Z. Fertilisation of an egg with Z chromosome by a sperm with Z chromosome gives a zygote with ZZ chromosomes (male). Fertilisation of an egg with W chromosome by a sperm with Z chromosome yields a zygote with ZW chromosomes (female). ZW-ZZ type of sex determination is as follows:



23. (a) Differences between unambiguous and universal genetic codes are:

	Unambiguous code	Universal code
(i)	A codon specifies only one amino acid.	The codons specifies the same amino acids from a virus to a tree or human being.
(ii)	*E.g.*, AUG codes for methionine.	*E.g.*, from bacteria to human UUU would code for phenylalanine.

(b) Difference between the degenerate and initiator code is:

Degenerate code	Initiator code
More than one codon code for a single amino acid.	Signal polypeptide synthesis. It has dual functions.

24. (a) Dung and water enter the digester chamber from part A.

(b) Methanogens are the group of bacteria and these grow anaerobically. In anaerobic sludge digester, methanogens digest the flocs of bacteria and fungi in activated sludge and produce biogas.

(c) Biogas is a methane rich fuel gas produced by anaerobic breakdown of biomass with the help of methanogenic bacteria. It is made up of methane (50-70%), carbon dioxide (30-40%) with traces of nitrogen, hydrogen sulphide and hydrogen.

25. (a) Transgenic animals are those animals which contain in their genome, a foreign gene introduced by recombinant DNA technology. Such gene is called transgene. Examples of transgenic animals are transgenic mice, transgenic rabbit, etc.

(b) Role of genetically modified organisms are as follows:

(i) Genetically modified organisms such as mice are being formed for use in testing the safety of vaccines before they are used on human beings. Transgenic mice are being used to test the safety of the polio vaccine.

(ii) Medicines required to treat certain human diseases can contain biological products, but such products are often expensive to make. Transgenic animals that produce useful biological

products can be created by the introduction of the portion of DNA (or genes) which codes for a particular product such as human protein (α-1-antitrypsin) used to treat emphysema. Similar attempts are being made for treatment of phenylketonuria (PKU) and cystic fibrosis. In 1997, the first transgenic cow, Rosie, produced human protein-enriched milk (2.4 grams per litre). The milk contained the human alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow-milk.

26. In a food chain, each trophic level represents a functional level not a species because:
(i) At a particular time, a trophic level is never occupied by a single species.
(ii) At a particular time, all organisms of a trophic level are considered together for calculating biomass, number and energy not a single species.
(iii) A particular species may occupy more than one trophic level, e.g., omnivorous species may occupy more than one trophic level in the same ecosystem at the same time.
(iv) If we consider few species then no generalisation can be made for studying ecosystem.

OR

(a) Primary productivity is the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. It is expressed in terms of gm-2 yr^1 or (kcal m^2)yr". It varies in different types of ecosystems, because it depends upon plant species of the area, their photosynthetic capacity, availability of nutrients, solar
radiations, precipitation, soil type and a number of other environmental factors.
(b) Productivity is the rate of biomass production per unit area in unit time at any trophic level. Gross productivity is the total organic matter synthesised by producers, in the process of photosynthesis per unit time and area. It is also called gross primary productivity (GPP). Net primary productivity is the weight of the organic matter stored by the producers in a unit area/volume per unit time. It is equal to the rate of organic matter synthesised during photosynthesis, i.e., gross primary productivity minus the rate of respiration and other losses, i.e., NPP=GPP-R

27. (a) In the given diagram of seminiferous tubule A-Spermatogonium, B-Primary spermatocyte, C-Spermatozoa, D-Secondary spermatocyte, E-Sertoli cell
(b) Sertoli cells (E) provide nourishment to the developing sperms.

28. Yes, I agree that all young mothers must breast-feed their newborn babies to provide best nourishment to them. Human milk consists of fat, casein (milk protein), lactose (milk sugar), mineral salts (sodium, calcium, potassium, phosphorus, etc). and vitamins that are necessary for development of the child. Mammary glands start producing milk at the end of pregnancy. The milk produced by the mammary glands of mother during initial days after child birth, for 2 to 3

days is called colostrum. It is rich in proteins (lactalbumin and lactoprotein) and various other nutrients. It also contains certain antibodies (IgA), which provide passive immunity to the baby. This milk helps in developing resistance to disease for newborn babies. It helps the baby to fight from viruses and bacteria. It is also easily digested by the baby with no constipation or diarrhoea.

29. (a) X is B-lymphocyte, while Y is T-lymphocyte.

OR

Differences between the role of B-lymphocytes (B-cells) and T-lymphocytes (T-cells) in generating immune responses are:

	B-lymphocytes (B-cells)	T-lymphocytes (T-cells)
(i)	B-cells form humoral or antibody mediated immune system(AMIS).	T-cells form cell-mediated immune system (CMIS).
(ii)	They defend against viruses and bacteria that enter the blood and lymph.	They defend against pathogens including protists and fungi that enter the cells.
(iii)	Plasma cells formed by division of B-cells produce antibodies and provide immunity against foreign substances.	T-lymphocytes produce different types of T-cells, e.g., killer T-cells react against cancer cells, suppressor cells inhibit immune system.

(b) The two important functions of T-lymphocytes are effector and regulatory. The effector function includes cytolysis (destruction of cells by immune processes) of cells infected with microbes and tumour cells and lymphokine production. The regulatory functions are either to increase or to suppress other lymphocytes and accessory cells.
(c) T cells (Y) migrate from the bone marrow to the thymus, a small gland located in the neck. Here, they mature and differentiate into different types of T-cells.

30. (a) In F, generation, all the 20 plants would be heterozygous for the trait and thus, they would possess yellow flower and round fruit.
(b) When heterozygous plants in F, generation undergo selfing, F2 progeny gives 9:3:3: 1

phenotypic ratio. Thus, in the given case, yellow flower with round

$$\text{fruit are } 960 \times \frac{9}{16} = 540.$$

(c) When heterozygous for yellow flower and round fruit is crossed with double recessive parent then phenotypic and genotypic ratio will be

1 : 1 : 1 : 1.

Parents : YrRr X yyrr

Progenies : ♀ / ♂	yr
YR	YyRr Yellow round
Yr	Yyrr Yellow elongated
yR	yyRr White round
yr	yyrr White elongated

Phenotypic ratio = 1 yellow round : 1 yellow elongated : 1 white round : 1 white elongated

Genotypic ratio = 1 YyRr : 1 Yyrr : 1 yyRr : 1 yyrr

OR

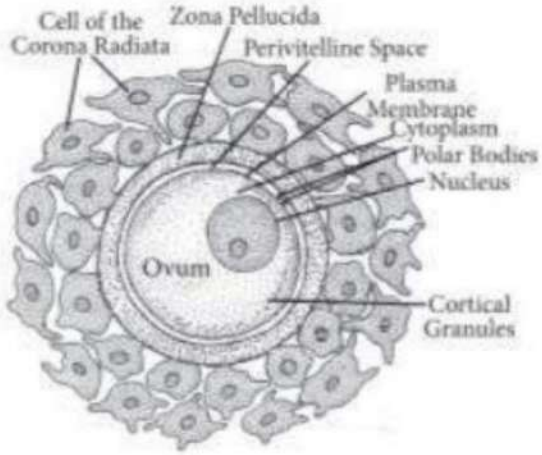
When plant YyRr is self pollinated, 9:3:3:1 ratio of phenotype will be observed. This can be explained as follows:

Parents : YyRr × YyRr

Progenies : ♀ / ♂	YR	Yr	yR	yr
YR	YYRR Yellow round	YYRr Yellow round	YyRR Yellow round	YyRr Yellow round
Yr	YYRr Yellow round	YYrr Yellow elongated	YyRr Yellow round	Yyrr Yellow elongated
yR	YyRR Yellow round	YyRr Yellow round	yyRR White round	yyRr White round
yr	YyRr Yellow round	Yyrr Yellow elongated	yyRr White round	yyrr White elongated

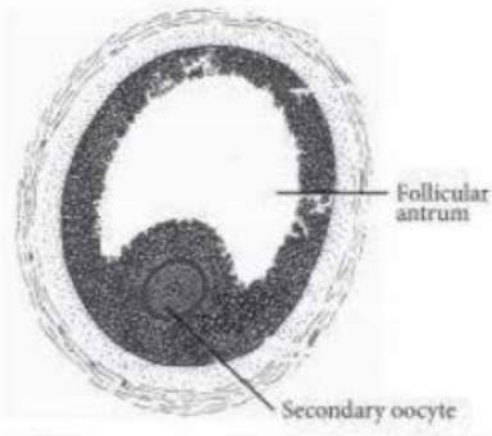
Phenotypic ratio = 9 yellow and round: 3 yellow and elongated: 3 white and round : 1 white and elongated. Genotype of plant with yellow flower and elongated fruit will be Yyrr and YYrr.

31. (a) Fillustrates ovulation. It represents secondary oocyte.
(b) Estrogen (ovarian hormone) and LH (pituitary hormone).
(c) Endometrium becomes thicker by rapid cell multiplication which is accompanied by an increase of uterine glands and blood vessels.
(d) 'C' is developing follicle under the influence of FSH. 'H' is regressing corpus luteum under the influence of reduction of LH.
(e) The labelled structure of a human ovum prior to fertilisation is as follows:



OR

(a) In a 28 day menstrual cycle, the menses takes place on days 3-5. The production of LH from the anterior lobe of the pituitary gland is considerably reduced. The withdrawal of this hormone causes degeneration of the corpus luteum and, therefore, progesterone production from the ovary is reduced. Production of estrogens from the ovary is also reduced in this phase. The endometrium of the uterus breaks down and menstruation begins. The cells of endometrium secretions, blood and the unfertilised ovum constitute the menstrual flow.
(b) During follicular phase, follicle stimulating hormone (FSH) stimulates the ovarian follicle to secrete estrogens, which in turn stimulate the proliferation of the endometrium of the uterine wall. As a result, endometrium becomes thicker by rapid cell multiplication and is accompanied by an increase of uterine gland and blood vessels. Hence, this phase is also referred as proliferative phase.
(c) At the time of ovulation, rapid secretion of LH induces rupturing of Graafian follicle, thereby releasing ovum. After ovulation has taken place, LH stimulates cells of ovarian follicle to develop corpus luteum. Corpus luteum secretes large amount of progesterone.
(d) The structure of a mature Graafian follicle is as follows:

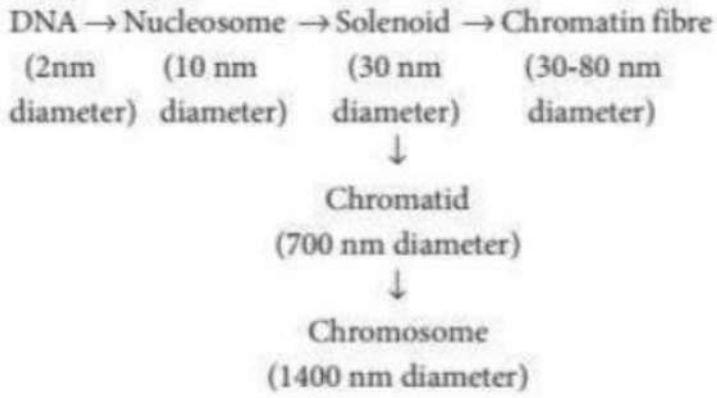


32. (a) (i) Homozygous dominant = YYRR Homozygous recessive = yyrr
(ii) Gametes produced by both the parents = YR and yr
(iii) F_1 = YyRr
(iv) Gametes produced by F, offspring
=YR, Yr, YR and yr.
(b) Mendelian F_2 phenotypic ratio in a dihybrid cross is 9:3:3:1. Law proposed by Mendel on the basis of this ratio is law of independent assortment. It states that in the inheritance of two pairs of contrasting characters, the factors of each pair of characters segregate independently of the factors of the other pair of characters. It is different from law of segregation as law of segregation states that the members of the allelic pair that remained together in the parent, segregate during gamete formation and only one factor enters a gamete.

OR

(i) Histone octamer: Histones are positively charged proteins, rich in basic amino acid residues lysines and arginines. These amino acids carry positive charges on their side chains. There are five types of histone proteins: H_1, H_2A, H_2B, H, and H. Four of them (HA, H,B, H, and H,) are organised in pairs to from a unit of eight molecules called histone octamer, nu body or core of nucleosome. Negatively charged DNA wraps around this octamer to form nucleosome.
(ii) Nucleosome: It is the compaction unit. The positively charged ends of histone octamer attract the negatively charged strands of DNA. The DNA is thus wrapped around the positively charged histone octamer to form a structure called nucleosome. Around 200 bp of DNA is wrapped around the nu body or histone octamer for 12 turns. DNA connecting two adjacent nucleosomes is called linker DNA which bears H histone protein. Nucleosome and linker DNA together constitute chromatosome. Nucleosome chain gives a bead on string appearance under electron microscope.
(iii) Chromatin : The nucleosomal organisation has approximately 10 nm thickness, which

further gets condensed and coiled to produce a solenoid (having 6 nucleosomes per turn) of 30 nm diameter. This solenoid structure further undergoes coiling to produce a chromatin fibre of 30-80 nm thickness. These chromatin fibres are further coiled and condensed to form chromatid which further forms chromosome at metaphase stage of cell division. The packaging can be summarised as follows:



33. (a) Biological or key tools used in recombinant DNA technology are:
(i) Enzymes: Different kinds of specific enzymes used in recombinant DNA technology are lysing enzymes (used to open up the cells to get DNA), it includes lysozyme, cellulase and chitinase and cleaving enzymes (enzymes used to break DNA molecules) which includes exonuclease, endonuclease and restriction endouclease.
(ii) Cloning vectors: These are DNA molecules that can carry foreign DNA segment and replicate inside a host cell. It may be plasmids, a bacteriophage, cosmids, yeast artifical chromosomes (YACs), Bacterial artifical chromosomes (BACs) and viruses.
(iii) Competent host: A competent host is essential for transformation with recombinant DNA. It includes DNA mediated or vector mediated gene transfer and direct or vectorless gene transfer (microinjection, electroporation, chemical mediated gene transfer, biolistic method or gene gun method).
(b) Agrobacterium tumefaciens is a soil-inhabiting bacterium that may invade growing plants at the junction of root and stem, where it can cause a cancerous growth known as a crown gall. A. tumefaciens contains Ti plasmid which carries gene for tumour formation. For using Agrobacterium tumefaciens as a cloning vector researchers deleted the genes which governs auxin and cytokinin production (the oncogene) from T-DNA of Ti plasmid by the process is known as disarming. After disarming, this T-DNA is inserted into chromosomes of the host plant where it produces copies of itself.

OR

(a) Polymerase chain reaction (PCR) is a technique of synthesising multiple copies of the desired gene (DNA segment) in vitro. The basic requirements of PCR are DNA template, two oligonucleotide primers usually 20 nucleotides long, dNTPs and DNA polymerase which is stable at high temperature (usually Taq polymerase). Working mechanism of PCR is as follows:
(i) Denaturation: The target DNA (DNA segment to be amplified) is heated to high temperature (94°C). Heating results in the separation of two strands of DNA. Each of the two strands of the target DNA now act as template for synthesis of new DNA strand.
(ii) Annealing: During this step, two oligonucleotide primers hybridise to each of single stranded template DNA in presence of excess of synthetic oligonucleotides.
(iii) Extension: During this step, the enzyme DNA polymerase synthesises the DNA segment between the primers. Taq DNA polymerase, isolated from a thermophilic bacterium Thermus aquaticus, is used in most of the cases. This step requires presence of deoxynucleotide triphosphates (dNTPs) and Mg2+ and occurs at 72°C.
(b) Applications of PCR:
(i) Diagnosis of pathogens
(ii) Diagnosis of specific mutations
(iii) DNA fingerprinting
(iv) In prenatal diagnosis
(v) In gene therapy.OR
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