SAMPLE QUESTION PAPER

BLUE PRINT

Time Allowed : 3 hours **Maximum Marks :** 70

S. No.		Chapter	VSA /Case based/ AR (1 mark)	SA-I (2 marks)	SA-II (3 marks)	LA (5 marks)	Total	
1.	Unit-VI	Sexual Reproduction in Flowering Plants	2(2)	–	–	–	**2(2)**	**14**
2.		Human Reproduction	1(1)	–	1(3)	1+1*(5)	**3(9)**	
3.		Reproductive Health	1(1)	1(2)	–	–	**2(3)**	
4.	Unit-VII	Principles of Inheritance and Variation	4+1*(7)	1(2)	1(3)	–	**6(12)**	**18**
5.		Molecular Basis of Inheritance	1(1)	–	–	1+1*(5)	**2(6)**	
6.	Unit-VIII	Human Health and Diseases	–	1(2)	–	1+1*(5)	**2(7)**	**14**
7.		Microbes in Human Welfare	–	2(4)	1(3)	–	**3(7)**	
8.	Unit-IX	Biotechnology : Principles and Processes	2(2)	2+2*(4)	–	–	**4(6)**	**12**
9.		Biotechnology and Its Applications	1(1)	1(2)	1(3)	–	**3(6)**	
10.	Unit-X	Organisms and Populations	2(5)	–	1+1*(3)	–	**3(8)**	**12**
11.		Biodiversity and Conservation	2(2)	1(2)	–	–	**3(4)**	
		Total	**16(22)**	**9(18)**	**5(15)**	**3(15)**	**33(70)**	

*It is a choice based question.

Subject Code : **044**

BIOLOGY

Time allowed : 3 hours ***Maximum marks : 70***

General Instructions :

(i) All questions are compulsory.

(ii) The question paper has four sections: Section A, Section B, Section C and Section D. There are 33 questions in the question paper.

(iii) Section-A has 14 questions of 1 mark each and 02 case-based questions. Section-B has 9 questions of 2 marks each. Section-C has 5 questions of 3 marks each and Section-D 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. How do the pollen grains of *Vallisneria* protect themselves?

2. Our government has intentionally imposed strict conditions for MTP in our country. Justify giving a reason.

3. Sperms have a tail whereas eggs do not. Why so?

4. A monoecious plant has male flowers with well exposed stamens and uniovulate female flowers in compound inflorescence. Which type of pollination is expected to occur in this plant?

5. Mendel succeeded in all his experiments on pea plant for selected traits and concluded the three laws without any exception. What main factor would you attribute behind his success?

6. State any two important differences between phenomenon of codominance and dominance.

7. Write the positively charged and negatively charged components of a nucleosome.

8. The milk produced by the transgenic cow Rosie is better than natural cow milk. Why?

9. Name the technique developed by Kary Mullis. What is the objective of this technique?

10. What are the two major causes of loss of biodiversity?

11. **Assertion :** The law of independent assortment can be studied by means of dihybrid cross.
Reason : The law of independent assortment is applicable only to linked genes.
(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

OR

Assertion : When yellow bodied, white eyed *Drosophila* females were hybridised with brown-bodied, red eyed males; and F_1 progeny was intercrossed, F_2 ratio deviated from 9 : 3 : 3 : 1.

Reason : When two genes in a dihybrid cross are on the same chromosome, the proportion of parental gene combinations are much higher than the non-parental type.

(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

12. Assertion : Bacterial cells are made competent by treating them with specific concentration of a divalent cation.

Reason : This increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

13. Assertion : An individual is the basic unit of ecological hierarchy.

Reason : Several ecotypes of the same organism show variations amongst them.

(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

14. Assertion : Over-exploitation of a species reduces the size of its population eventually leading to its extinction.

Reason : Steller's sea cow is a large, herbivorous, terrestrial mammal which is on the verge of extinction due to over-exploitation.

(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

15. Read the following and answer any four questions from 15(i) to 15(v) given below:

A genetic student conducted an experiment by crossing pure red flowered plant with pure white flowered plant. He was expecting all red flowered plants in F_1 but to his surprise all F_1 hybrids were pink coloured. On selfing of F_1, flowers of all three colours (red, pink and white) were obtained in F_2.

(i) Name the type of gene interaction shown in this experiment.

(a) Multiple allelism
(b) Codominance
(c) Pleiotropism
(d) Incomplete dominance

(ii) Phenotypic ratio and genotypic ratio of this cross respectively are

(a) 3 : 1 and 1 : 2 : 1
(b) 1 : 2 : 1 and 3 : 1
(c) 1 : 2 : 1 and 1 : 2 : 1
(d) 3 : 1 and 3 : 1.

(iii) Which of the following is an example of this cross?

(a) Flower colour in snapdragon
(b) Coat colour in cattle
(c) Eye colour in fruit fly
(d) Both (a) and (b)

(iv) Different genotypes obtained in F_2 generation in this cross are

(a) RR, Rr (b) RR, Rr, rr

(c) RR, rr (d) all rr.

(v) **Assertion :** F_1 generation is similar to the dominant parent.

Reason : In F_1 hybrid, the dominant trait is completely expressed.

(a) Both assertion and reason are true, and reason is the correct explanation of assertion.

(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false.

(d) Both assertion and reason are false.

16. Read the following and answer any four questions from 16(i) to 16(v) given below:

Some bird species follow army ants which walk on the forest floor. As the army ant colony travels on the forest floor, they stir up various flying insect species. As the insects flee, the birds following the ants catch the fleeing insects.

(i) Which population interaction is seen between the army ants and birds?

(a) Commensalism (b) Amensalism (c) Mutualism (d) Predation

(ii) The type of interaction between birds and insects is

(a) commensalism (b) amensalism (c) mutualism (d) predation.

(iii) Which of the following is predator in the given passage?

(a) Bird (b) Insect (c) Ant (d) Both (a) and (b)

(iv) An advantage of interaction between birds and insects is

(a) it serves as conduit for energy transfer across trophic level

(b) it checks population of organisms of lower trophic level

(c) birds help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species

(d) all of these.

(v) **Assertion :** Interaction between army ants and birds results in negative effect on the growth and survival of both the populations.

Reason : Ants keep birds' population under control.

(a) Both assertion and reason are true, and reason is the correct explanation of assertion.

(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false.

(d) Both assertion and reason are false.

SECTION - B

17. A couple is seeking medical aid where both husband and wife are producing functional gametes, but the wife is still unable to conceive. Describe any one method that you can suggest to this couple to become happy parents.

18. Differentiate between XX-XY type and ZW-ZZ type of sex-determination mechanism.

19. Mention any four important advantages of biogas generation.

20. **(a)** How is an exonuclease functionally different from an endonuclease?
(b) Give example of any two endonucleases other than *Sal* I.

OR

(a) Illustrate the recognition sequence of *Eco*RI. Mention the term used for such sequences.
(b) How does restriction endonuclease act on a DNA molecule?

21. What are shuttle vectors?

22. **(a)** Why are transgenic animals so called?
(b) Name the scientist who introduced the term vaccine. What are edible vaccines?

OR

How is insertional inactivation of an enzyme used as a selectable marker to differentiate recombinants from non-recombinants?

23. Name the source of cyclosporin-A. How does this bioactive molecule function in our body?

24. List the symptoms of ascariasis. How does a healthy person acquire this infection?

25. David Tilman proved experimentally that stability of a community depends on its species richness. Explain.

SECTION - C

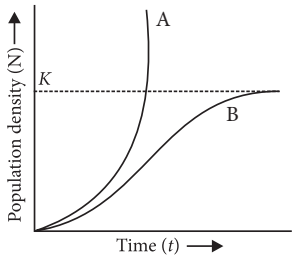
26. **(a)** Name and explain the role of the inner and middle walls of the human uterus.
(b) Write the location and function of Sertoli cells in humans.

27. Linkage and crossing over of genes are alternative to each other. Justify the statement.

28. **(a)** Mention important functions of activated sludge in a sewage treatment plant.
(b) What is the role of flocs in sewage treatment?

29. Explain the process of RNA interference.

30. Study the population growth curves shown below and answer the following questions:



(i) Identify curves A and B.
(ii) Mention the conditions responsible for the curves A and B respectively.
(iii) Give the necessary equation for the curve B.

OR

Define the following:
(i) Allen's rule
(ii) Diapause
(iii) Mimicry

SECTION - D

31. Write short notes on the following:

(i) Vaccine

(ii) Lymphoid organs

(iii) AIDS

(iv) Organ transplantation

OR

Give the scientific name of the organism that causes whooping cough. Give two main symptoms of this disease. What vaccine gives protection from this disease?

32. **(a)** How is placenta formed in the human female?

(b) How is the placenta connected to the embryo?

(c) Comment on the role of placenta as an endocrine gland.

OR

(a) Describe the events of oogenesis with the help of schematic representation.

(b) Write two differences between oogenesis and spermatogenesis.

33. Illustrate the steps of DNA packaging in eukaryotes.

OR

Discuss the Hershey and Chase experiment. State the conclusion they drew after the experiment.

SOLUTIONS

1. *Vallisneria* is a water pollinated plant. Pollen grains of *Vallisneria* have a protective mucilaginous coat that prevents the water from damaging the pollen grains.

2. Government of India has imposed strict conditions for MTP because it is being misused for sex determination and illegal abortions of female fetuses. Due to female feticides, male and female sex ratio may get disturbed, raising many ethical, religious and social issues.

3. Sperms are tailed whereas eggs do not, as sperms have to move (tail helps in locomotion) through the cervix, uterus and Fallopian tube to reach to the egg already present there.

4. Wind pollination is expected to occur in this plant.

5. The main reason behind Mendel's success is that he unknowingly selected those traits that were present either on different chromosomes or were distantly located on same chromosome. Hence, he did not encounter linkage.

6. Differences between phenomenon of codominance and dominance are as follows :

	Codominance	**Dominance**
(i)	Both the alleles are equally dominant.	Only one allele is dominant.
(ii)	The alleles show their independent effects even in heterozygous condition.	The dominant allele shows its independent effect in heterozygous condition, whereas other (recessive) allele shows its effect only in homozygous condition.

7. The positively charged component of a nucleosome is histone and negatively charged component is DNA.

8. The milk produced by transgenic cow Rosie, is enriched with the human protein alpha lactalbumin and is nutritionally more balanced product for human babies than natural cow milk.

9. Kary Mullis developed the technique Polymerase Chain Reaction (PCR). The objective of this technique is selective amplification of specific region of DNA molecule.

10. (i) Habitat destruction
(ii) Alien species invasion

11. (c) : The law of independent assortment states that two factors of each character assort or separate independent of the factors of other characters at the time of gamete formation and get randomly rearranged in the offspring producing both parental and new combinations of traits. The principle of law of independent assortment is applicable to only those factors or genes which are either located distantly on the same chromosome or occur on different chromosomes.

OR

(a) : In *Drosophila*, the genes for body and eye colour are located on X chromosome. When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combination are higher than non-parental type. This occurs due to physical association or linkage of the two genes while non-parental gene combinations due to recombination between two genes. Thus, linkage and recombination deviates the ratio from Mendelian ratio of a dihybrid cross, (9 : 3 : 3 : 1).

12. (a)

13. (b)

14. (c) : Steller's sea cow was a large, herbivorous, marine mammal which had been discovered in 1741 and became extinct by 1768 due to over-exploitation.

15. (i) (d) : Incomplete dominance is the phenomenon where none of the two alleles of a gene is dominant over each other and a new intermediate phenotype is formed.

(ii) (c) : Phenotypic and genotypic ratios of incomplete dominance are same .

1	:	2	:	1
Red(RR)	:	Pink(Rr)	:	White(rr)

(iii) (a) : Example of incomplete dominance is Flower colour in Snapdragon (four O'clock plant).

(iv) (b)

(v) (d) : In incomplete dominance, F_1 generation is different from either of the two parents as in F_1 hybrid, dominant trait is incompletely expressed.

16. (i) (a) : The relationship is commensalism as two organisms live together without any physiological dependence.

(ii) (d) : The interaction between birds and insects is predation, where birds capture, kill and eat up insects.

(iii) (a)

(iv) (d)

(v) (d) : The interaction between army ants and birds is commensalism in which two organisms live together without any physiological dependence between them. One is benefitted and other is neither harmed nor benefitted.

17. In the given case, both the partners are producing normal gametes but female is unable to conceive. This means there is some problem in Fallopian tube or uterus or hormonal levels of the female. Thus, one of the method that we can suggest to the couple is of surrogacy. In this method the ova from the wife and sperms from the husband are induced to form zygote in the laboratory. The zygote is then allowed to divide to form an embryo. A developing embryo is then implanted in the uterus of another female (surrogate mother). The surrogate mother then gives birth to the child.

18. Differences between XX-XY and ZW-ZZ type of sex determination mechanism are as follows:

	XX-XY type	**ZW-ZZ type**
(i)	Male produces two types of sperms.	Male produces only one type of sperm.
(ii)	Female forms only one type of ovum.	Female forms two types of ova.
(iii)	Male contains heteromorphic sex chromosomes (XY).	Female contains heteromorphic sex chromosomes (ZW).
(iv)	Example: humans.	Example : birds.

19. The important advantages of biogas generation are given below:

(i) Biogas can be stored and used more efficiently and economically.

(ii) The energy value of biogas is lower than that of organic matter but due to more efficient handling, the net energy output is roughly equal to the output in direct burning of organic wastes.

(iii) The manure produced in biogas plants is used as fertiliser.

(iv) Biogas use does not add to pollution.

20. (a) Differences between action of exonucleases and endonucleases are as follows :

	Exonucleases	**Endonucleases**
(i)	They remove nucleotides from terminal ends of DNA strand.	They make cut at specific positions within the DNA except terminal ends.
(ii)	They act on single strand of DNA or gaps in double stranded DNA.	They cleave one strand or both strands of double stranded DNA.
(iii)	They do not cut RNA.	They may cut RNA.

(b) *Eco*RI and *Hin*d III.

OR

(a) Recognition sequence of *Eco*RI is :

↓

5′ - GAATTC-3′

3′ - CTTAAG-5′

↑

Such sequences are called palindromic sequences, that are same base pair sequences when read forward or backward direction from central axis of symmetry.

(b) Restriction endonuclease recognises the base sequence at palindrome site in DNA duplex and cuts its strands.

21. Vectors that can exist in both eukaryotic cell and *Escherichia coli* are known as shuttle vectors ,*e.g.*, yeast episomal plasmid (YEp). Such vectors contain two types of origin of replication and selectable marker genes, one that functions in *E. coli* and other that functions in eukaryotic cell.

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

(b) Edward Jenner introduced the term vaccine. The genes encoding antigenic proteins can be isolated from pathogens and expressed in plants. Such transgenic plants or their tissues producing antigens can be eaten for vaccination/immunisation and are called as edible vaccines.

OR

Insertional inactivation refers to the process where insertion of recombinant DNA (rDNA) within the coding sequence of an enzyme causes its inactivation.

The non-recombinants having intact functional gene, *e.g.,* β-galactosidase produce blue colour with chromogenic substrate but when rDNA is inserted within the coding sequence of enzyme β-galactosidase, recombinants do not produce any colour. Hence, recombinants can be easily differentiated from non-recombinants due to insertional inactivation.

23. Cyclosporin A is an eleven membered cyclic oligopeptide obtained through fermentive activity of fungus *Trichoderma polysporum*. It has antifungal, anti-inflammatory and immunosuppressive properties. It inhibits activation of T cells and therefore prevents rejection reactions in organ transplantation.

24. Ascariasis is caused by the common round worm *Ascaris lumbricoides*, a giant intestinal worm. Symptoms of this disease include internal bleeding, muscular pain, fever, anemia and blockage of the intestinal passage. A healthy person acquires infection through contaminated water, vegetables, fruits, etc.

25. Communities with more species tend to be more stable than those with less species as it is able to resist occasional disturbance. This has been confirmed experimentally by David Tilman. He raised plots with different diversities in Minnesota grassland and subjected them to various stresses so as to carry out long term ecosystem experiments. He found that plots with more species showed less year to year variation in total biomass. He also showed in his experiments, that increased diversity contributed to higher productivity.

26. (a) The inner glandular wall of the uterus is known as endometrium.
Role - During the menstrual cycle, the endometrium wall grows into a thick, vascular (blood vessel-rich) glandular layer. These modifications favour the implantation of the embryo. If fertilisation does not occur, the endometrium is shed during the hemorrhagic phase of the menstrual cycle.
The middle wall of the uterus is known as myometrium.
Role - It consists of smooth muscles. It exhibits contraction during delivery of the baby.
(b) Sertoli cells are located in the germinal epithelium of the seminiferous tubules. These cells nourish the germ cells in the testes.

27. Linkage is the tendency of two different genes on the same chromosome to remain together during the separation of homologous chromosomes at meiosis. Linked genes do not exhibit the dihybrid ratio of 9:3:3:1. It produces offspring with parental characters. Crossing over is the exchange of genes occurring during meiotic prophase I to break old linkage and establish new ones. It produces recombination resulting in new varieties. Thus, they are alternatives of one another, *i.e.*, if linkage is present in between genes, no crossing over occurs between them and if crossing over occurs between the two genes, then they are not linked. For example, in *Drosophila* a yellow bodied white eyed female was crossed with brown bodied red eyed male, F_1 progeny produced was intercrossed. The resulting F_2 phenotypic ratio of *Drosophila* deviate significantly from Mendel's dihybrid ratio of 9:3:3:1.
This signifies that the genes for eye colour and body colour are closely located on the 'X' chromosome and are linked. Therefore, they are inherited together. Recombinants were formed due to crossing over but with low recombination frequency.

28. (a) A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the activated sludge is pumped into large tanks called anaerobic sludge digesters. The anaerobic bacteria present in this tank, digest the organic mass and aerobic bacteria and fungi in sludge and produce mixture of gases like methane, hydrogen sulphide and CO_2 which constitute biogas.

(b) Flocs are masses of aerobic bacteria held together by slime and fungal filaments to form mesh like structures. These microbes digest a lot of organic matter converting it into microbial biomass and releasing a lot of minerals to reduce the biochemical oxygen demand or BOD.

29. Different steps involved in RNA interference are as follows:
(i) Double stranded RNAs are processed into approximately 21-23 nucleotide RNAs with two nucleotides. An RNase enzyme called dicer cuts the dsRNA molecules (from a virus, transposon, or through transformation) into small interfering RNAs (siRNAs).
(ii) Each siRNA complexes with ribonucleases (distinct from dicer) to form an RNA-induced silencing complex (RISC).
(iii) The siRNA unwinds and RISC is activated.
(iv) The activated RISC targets complementary *m*RNA molecules. The siRNA strands act as guides where the RISCs cut the transcripts in an area where the siRNA binds to the *m*RNA. This destroys the *m*RNA.
(v) When *m*RNA of the parasite is destroyed no protein is synthesised. It results in the death of the parasite in the transgenic host.

30. (i) Growth curve A represents the J-shaped or exponential growth while growth curve B represents S-shaped or logistic growth.

(ii) For curve A, population growth is not limited by the resources whereas for curve B resources limit the population growth.

(iii) Equation for curve B is $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

OR

(i) Mammals from colder climates generally have shorter ears and limbs to minimise heat loss. This is called as the Allen's rule.

(ii) Diapause is a stage of suspended development, which is exhibited by many zooplankton species in lakes and ponds, under unfavourable conditions.

(iii) Mimicry is resemblance one species with another in order to obtain advantage especially against predation. The species which is imitiated is called model while the animal which imitates is known as mimic or mimictic.

31. (i) Vaccine: It is a preparation of dead/ weakened germs of a disease which on inoculation into a person provides temporary/permanent active/ passive immunity by inducing antibody formation. The antibodies produced in the body against these antigens would neutralise the pathogenic agents during actual infection. The vaccines also generate memory B and T cells that recognise the pathogen quickly on subsequent exposure and attack the invaders with a large production of antibodies.

(ii) Lymphoid organs: These are those organs where the maturation and proliferation of lymphocytes takes place. There are two types of lymphoid organs:

(a) Primary lymphoid organs are those where T-lymphocytes and B-lymphocytes mature and acquire their antigen-specific receptors. Bone marrow and thymus are primary lymphoid organs. B-lymphocytes mature in bone marrow and T-lymphocytes mature in thymus.

(b) Secondary lymphoid organs are those where B-lymphocytes and T-lymphocytes undergo proliferation and differentiation. They acquire immune response in these organs and become effector cells. Lymph nodes and spleen are secondary lymphoid organs.

(iii) AIDS – The full form of AIDS is Acquired Immuno Deficiency Syndrome. It is caused by human immunodeficiency virus (HIV), a member of a group of viruses called retroviruses. These viruses are called retroviruses because they have RNA as their genome, enclosed within an envelope. Other than sexual contact, transmission of HIV infection in humans could also occur by:

(a) Transfusion of contaminated blood and blood products.

(b) From an infected mother to her child through placenta.

(iv) Organ transplantation: It is the implantation of an organ or tissue from one part of the body to another or from one person (donor) to another (recipient). Tissue matching, blood group matching are essential before undertaking any graft/transplant and even after this the patient has to take immunosuppressants all his/ her life. This is because the body is able to differentiate 'self' and 'nonself' and the cell-mediated immune response may cause graft rejection.

Organ transplantation is of four types:

(a) Autograft, (b) Isograft,
(c) Allograft and (d) Xenograft

OR

Whooping cough or pertussis is caused by *Bordetella pertussis* and is common childhood disease.

It causes constant cough leaving the child breathless, tired and red in face. Later the voice becomes hoarse and the cough gives a whoop or a loud crowing sound while inhaling.

The child usually vomits and there is frothy discharge from his mouth and nose.

Immunisation of the disease is done by DPT vaccination within six weeks of birth.

32. **(a)** After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (fetus) and maternal body called placenta, which facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory waste materials produced by the embryo.

(b) The placenta is connected to embryo through an umbilical cord which helps in the transport of substances to and from the embryo.

(c) Placenta acts as an endocrine tissue and produces several hormones essential for supporting the fetal growth, metabolic changes in the mother and maintenance of pregnancy. It secretes the following hormones:

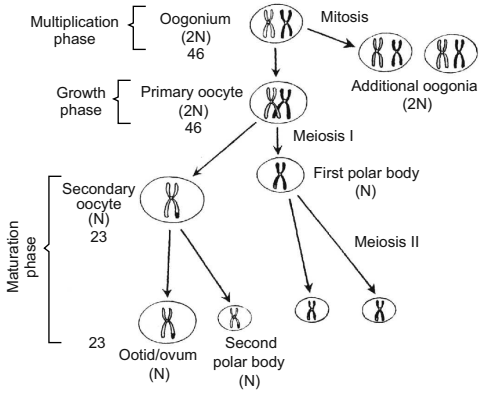
(i) Human chorionic gonadotropin (hCG)
(ii) Human chorionic somatomammotropin (hCS)
(iii) Progesterone

(iv) Estrogen
(v) Relaxin
(vi) Chorionic thyrotropin and
(vii) Chorionic corticotropin

The hCG stimulates and maintains the corpus luteum to secrete progesterone until the end of pregnancy. The hCS stimulates the growth of the mammary glands during pregnancy. Relaxin facilitates parturition (act of birth) by softening the connective tissues of the pubic symphysis. The level of hormones like estrogen, progesterone, etc. are increased in maternal blood during pregnancy. Increased production of these hormones is necessary for supporting the fetal growth, metabolic changes in mother and maintenance of pregnancy.

OR

(a) The schematic representation of events of oogenesis is as follows:



(b) Differences between spermatogenesis and oogenesis are as follows :

	Spermatogenesis	Oogenesis
(i)	A spermatogonium forms four spermatozoa.	An oogonium forms only one ovum.
(ii)	No polar body is formed.	Polar bodies are formed.

33. DNA packaging in eukaryotes is carried out with help of lysine and arginine rich basic proteins called histones. The unit of compaction is nucleosome. There are five types of histone proteins - H_1, H_2A, H_2B, H_3 and H_4. Four of them (H_2A, H_2B, H_3 and H_4) occur in pairs to produce histone octamer, called nu body or core of nucleosome. Their positively charged ends (due to basic amino acids) towards the outside attract negatively charged strands of DNA. DNA connecting two adjacent nucleosomes is called linker DNA. It bears H_1 histone protein. Nucleosome chain gives 'a beads on string' appearance under electron microscope. A typical nucleosome contains 200 bp of DNA helix with a diameter of 10 nm. It represents the functional euchromatin, which further coils to form cylindrical solenoid having 6 nucleosomes per turn. The solenoid have a thickness of 30 nm. Further, coiling of solenoid gives rise to thick chromatin fibre forming loops upto 300 nm in length. These fibres are compressed to form 250 nm wide fibre which further coils to form a chromatids each of 700 nm in diameter, which are held over a scaffold of non-histone chromosomal proteins to form a chromosome.

The various stages in DNA packaging in an eukaryotic nucleus can be summarised as :

DNA (2 nm) → Nucleosome (10 nm) → Solenoid (30 nm) → Chromatin fibre (300 nm) → Chromatid (700 nm) → Chromosome (1400 nm)

OR

Alfred D. Hershey and Martha Chase, chose T_2 bacteriophage as their experimental material. They decided to see which of the bacteriophage components-protein or DNA-entered bacterial cells and directed reproduction of the virus.

Hershey and Chase experiment was based on the fact that DNA but not the protein contains phosphorus, and similarly sulphur is present in proteins (cysteine and methionine) but not in DNA. They incorporated radioactive isotopes of phosphorus (^{32}P) into phage DNA and that of sulphur (^{35}S) into proteins of separate phage cultures. These phage types were used independently to infect the bacterium *Escherichia coli*. After sometime, the cultures were agitated in a blender to separate the empty phage capsids from the surface of bacterial cells and the two were separated by centrifugation. Hershey and Chase showed that in bacterial cells, infected with virus containing radioactive phosphorus (^{32}P), radioactivity was associated with bacterial cells and also, appeared in the progeny phage. However, in bacterial culture where radioactive sulphur (^{35}S) was used, all radioactive material was limited to phage 'ghosts' (empty viral protein coats). These results indicated that the DNA of the bacteriophage and not the protein enters the host, where viral replication takes place. Therefore, they concluded that DNA is the genetic material of T_2 bacteriophage. It directs protein coat synthesis and allows replication to occur.

☺ ☺ ☺