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	2(2)	–	1(3)	1+1*(5)	**4(10)**	
3.		Reproductive Health	–	1+1*(2)	–	–	**1(2)**	
4.	Unit-VII	Principles of Inheritance and Variation	3(6)	–	1+1*(3)	–	**4(9)**	**18**
5.		Molecular Basis of Inheritance	2(2)	1(2)	–	1+1*(5)	**4(9)**	
6.	Unit-VIII	Human Health and Diseases	–	3+1*(6)	1(3)	–	**4(9)**	**14**
7.		Microbes in Human Welfare	–	–	–	1+1*(5)	**1(5)**	
8.	Unit-IX	Biotechnology : Principles and Processes	3(3)	1(2)	–	–	**4(5)**	**12**
9.		Biotechnology and Its Applications	1*	2(4)	1(3)	–	**3(7)**	
10.	Unit-X	Organisms and Populations	1(1)	1(2)	1(3)	–	**3(6)**	**12**
11.		Biodiversity and Conservation	3(6)	–	–	–	**3(6)**	
		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. An anther with malfunctioning tapetum often fails to produce viable male gametophytes. Give any one reason.

2. Why is banana referred to as a parthenocarpic fruit?

3. State from where do the signals for parturition originate in human females.

4. Mention the function of zona pellucida.

5. State the chromosomal defect in individuals with Turner's syndrome.

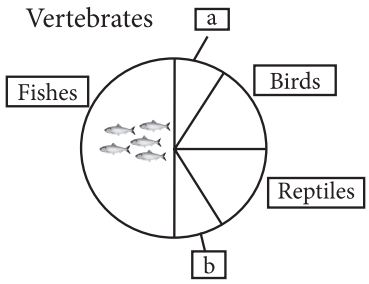
6. Mention any two contrasting traits with respect to seeds in pea plant that were studied by Mendel.

7. If the base adenine constitutes 31 percent of an isolated DNA fragment, then what is the expected percentage of the base cytosine in it?

8. What is the role of ethidium bromide during agarose gel electrophoresis?

9. Why do DNA fragments move towards the anode during gel electrophoresis?

10. Identify 'a' and 'b' in the figure given below representing proportionate number of major vertebrate taxa.



11. **Assertion :** A change in nitrogen base at the third position of a codon causes change in the expression of the codon.

Reason : A codon is mostly read by all the three nitrogen bases.

(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 :** Restriction endonuclease recognises palindromic sequence in DNA and cuts them.

Reason : Plasmid pBR322 has two unique recognition sites *Pst* I and *Pvu* I located within the tet^R gene.

(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 : Genetically modified microbes help in crop protection.

Reason : Transgenic bacteria control insects by producing endotoxins.

(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 :** *Eichhornia crassipes* (Water hyacinth) drains off oxygen from water and can be seen growing in standing water.

Reason : *Eichhornia crassipes* is an indigenous species of India.

(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 :** Unlike mammals, desert lizards lack the physiological ability required to deal with the high temperature.

Reason : Desert lizards change their body temperature in accordance to ambient conditions by behavioural means.

(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:**

Biodiversity is of great importance in order to maintain stable ecosystems, therefore it needs to be conserve. In India, ecologically unique and biodiversity-rich regions are legally protected as biosphere reserves, national parks and sanctuaries. India is biodiversity rich country that hosts biodiversity hotspots such as the Himalayas, the Western Ghats, the Indo-Burma region and the Sundaland (Includes Nicobar group of Islands). India now has 14 biosphere reserves, 90 national parks and 448 wildlife sanctuaries. India has also a history of religious and cultural traditions that emphasised protection of nature. In many cultures, tracts of forest were set aside, and all the trees and wildlife within were venerated and given total protection. Such sacred groves are found in Khasi and Jaintia Hills in Meghalaya, Western ghats of Karnataka and Aravalli Hills of Rajasthan.

(i) Sacred groves in Rajasthan are an example of
(a) *ex-situ* conservation (b) *in-situ* conservation
(c) national park (d) None of these.

(ii) Biodiversity hotspots are declared on the basis of
(a) high endemism (b) interspecific competition
(c) degree of threat (d) both (a) and (c).

(iii) Which of the following is not a kind of *in-situ* conservation?
(a) Biosphere reserve (b) Seed bank (c) Sanctuaries (d) National Park

(iv) The number of Biodiversity hotspots in India are
(a) 1 (b) 2 (c) 3 (d) 4

(v) **Assertion :** Biodiversity conservation of an ecosystem has a great significance.
Reason : Biodiversity is responsible for ecosystem equilibrium maintenance.
(a) Both assertion and reason are true, and the reason is the correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not the correct explanation of the 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:
Radhika got married at the age of 40 and at the age of 43, she gave birth to a baby boy. With the time, the kid show abnormal symptoms with slow growth, short statured with small round head, furrowed tongue and partially open mouth, upward slanting eyes and a flattened face. The major problem is overall developmental and intellectual disability. The baby has a problem in learning basic skills like sitting, walking and talking at a delayed pace as compared with other children. The baby's palm is broad with characteristic palm crease and his physical, psychomotor and mental development is retarded. The disease is diagnosed as Down's syndrome which arises due to trisomy of chromosome number 21. In nature, the risk of having a baby with Down's syndrome increases with the mother's age.

(i) Down's syndrome is
(a) chromosomal disorder (b) mendelian disorder
(c) autosomal recessive (d) autosomal dominant.

(ii) The reason behind the appearance of down's syndrome in baby is due to _____ of chromosome.
(a) disjunction of chromosome (b) nondisjunction of chromosome
(c) doubling of chromosomes (d) none of these

(iii) The characteristic feature of down's syndrome is _____
(a) slow growth (b) mental retardation
(c) palm crease (d) all of these

(iv) The down's syndrome is generally seen in _____
(a) baby boys born from aged mother (b) baby boys born from young mother
(c) baby girl born from aged mother (d) both (a) and (c)

(v) Read the given cases.
Case 1 : A cross between a female who had gametes with nondisjunction of chromosomes 21 and a male having normal gametes.
Case 2 : A cross between a male who had gametes with nondisjunction of chromosomes 21 and a female having normal gametes.

The following statements are drawn as conclusions from the given data.

I. There is a chance of baby boy having down's syndrome in case 1.
II. There is a chance of baby boy having down's syndrome in case 2.
III. There is a chance of baby girl having down's syndrome in case 1.
IV. There is a chance of baby girl having down's syndrome in case 2.

Choose the correct option.

(a) Only I and II are true.
(b) Only II and III are true.
(c) Only III and IV are true.
(d) I, II, III and IV are true.

SECTION - B

17. "Intra-Cytoplasmic Sperm Injection" and 'Gamete Intra Fallopian Transfer' are two assisted reproductive technologies. How is one different from other?

OR

How do 'implants' act as an effective method of contraception in human females? Mention its one advantage over contraceptive pills.

18. How do histones acquire positive charge?

19. Differentiate between benign and malignant tumors.

20. Explain the insertional inactivation in biotechnology.

21. How does the gene therapy help patients with ADA-deficiency?

22. How transgenic tomatoes prevent softening?

23. **(a)** Name the group of viruses responsible for causing AIDS in humans. Why are these viruses so named?
(b) List any two ways of transmission of HIV infection in humans, other than sexual contact.

OR

A student on a school trip started sneezing and wheezing soon after reaching the hill station for no explained reasons. But, on return to the plains, the symptoms disappeared. What is such a response called? How does the body produce it?

24. How does the HIV breakdown the immune system of the AIDS patient?

25. Differentiate between commensalism and mutualism by taking one example each from plants only.

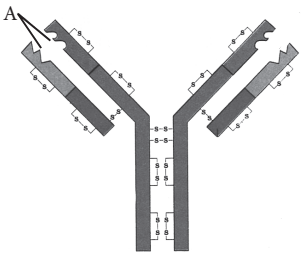
SECTION - C

26. **(a)** Draw a sectional view of human ovary. Label the following parts:
(i) Primary follicle
(ii) Secondary oocyte
(iii) Graafian follicle
(iv) Corpus luteum
(b) Name the hormones influencing follicular development of corpus luteum.

27. Explain polygenic inheritance with the help of a suitable example.

OR

How did Morgan explain linkage of genes?

28. 

(i) Identify the molecule shown and the site labelled 'A'.

(ii) Why is this molecule referred to as H_2L_2? Explain.

29. Explain the structure of human insulin with the help of a diagram.

30. Explain with the help of suitable examples the three different ways by which organisms overcome their stressful conditions lasting for short duration.

SECTION - D

31. **(a)** Explain the process of fertilisation in human.

(b) Name the embryonic stage that gets implanted in human females. Explain the process of implantation.

OR

(a) Explain with the help of schematic representation the process of formation of mature gamete in a human female.

(b) How is spermatogenesis different from the process mentioned above? Explain.

32. **(a)** How are the following formed and involved in DNA packaging in a nucleus of a cell?

(i) Histone octamer

(ii) Nucleosome

(iii) Chromatin

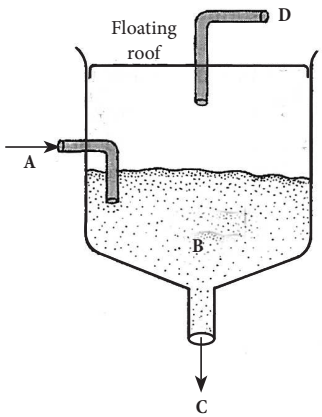
(b) Differentiate between euchromatin and heterochromatin.

OR

(a) State the 'central dogma' as proposed by Francis Crick. Are there any exceptions to it? Support your answer with a reason and an example.

(b) Explain how the biochemical characterisation (nature) of 'Transforming Principle' was determined, which was not defined from Griffith's experiments.

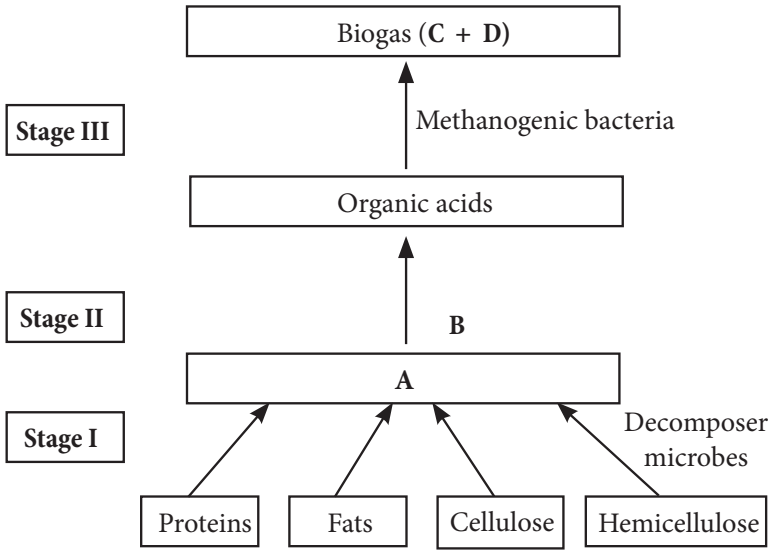
33. Refer to the given figure and answer the following questions.



(i) Identify the given figure.
(ii) Identify A, B, C and D in the given figure.
(iii) What is the use of C?
(iv) What is the function of methanogenic bacteria in this process?

OR

Study the given flow chart of biogas formation and answer the following questions.



(i) Identify A, B, C and D in the given flow chart.
(ii) What is the percentage of C and D in biogas?
(iii) What is the another name of biogas? State few of its uses.

SOLUTIONS

1. Tapetum is the microsporangial layer that provides nourishment to the developing microspores. In an anther with malfunctioning tapetum, microspores do not get sufficient nutrition and hence viable male gametophytes are often not produced.

2. Banana is a fruit obtained from an unfertilised ovary. It is seedless and produced without pollination and fertilisation, therefore, it is referred to as parthenocarpic fruit.

3. The signals for parturition originate from the fully developed fetus and the placenta induce mild uterine contractions called fetal ejection reflex.

4. During fertilisation, a sperm comes in contact with the zona pellucida layer of ovum which induces changes in the egg membrane that block the entry of additional sperms. So, zona pellucida ensures that only one sperm can fertilise an ovum.

5. Turner's syndrome is due to monosomy. It occurs due to union of an allosome free egg (22 + 0) and a normal X sperm or a normal egg and an allosome free sperm (22 + 0). The individual has 2n = 45 chromosomes (44 + X0) instead of 46.

6. Seed traits studied by Mendel in pea plant were:

(i) Seed shape	–	Smooth/Round (R) Wrinkled (r)
(ii) Seed (cotyledon) colour	–	Yellow (Y) Green (y)

7. According to Chargaff's rule,
[A] + [G] = [C] + [T] = 50%
Therefore, if [A] = 31%, then [T] = 31%
[C] + [T] = 50%
Therefore, [C] = 50% – 31% = 19%

8. In gel electrophoresis, ethidium bromide (EtBr) is used to stain separated DNA fragments so that it can be seen as bright orange coloured bands after exposure to UV radiation.

9. DNA is a negatively charged molecule and during gel electrophoresis, DNA fragments move towards anode (positive electrode) under the influence of electrical field.

10. (a) Mammals (b) Amphibians

11. (d) : According to the Wobble hypothesis, only the first two position of a triplet codon on *m*RNA have a precise pairing with the bases of the *t*RNA anticodon. The pairing of the third position bases of the codon may be ambiguous and varies according to the nucleotide present in this position. Thus, a single *t*RNA type is able to recognise two or more codons differing only in the third base. The same is called wobble position.

12. (c) : Plasmid pBR322 has two unique recognition sites, PstI and Pvu I located within the amp^R gene.

OR

(a)

13. (c) : *Eichhornia* crassipes is an aquatic plant, native to Amazon basin. This plant was introduced into India for its beautiful flowers and shape of leaves.

14. (c) : Desert lizards lack the physiological ability that mammals have to deal with high temperatures of their habitat, but manage to keep their body temperature fairly constant by behavioural means. they bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing.

15. (i) (b) : *In-situ* conservation is the methods of conserving all the living species, especially the wild and endangered species in their natural habitats and environment. *In-situ* conservation of biodiversity includes biosphere reserves, national parks, wildlife sanctuaries, sacred groves, etc.

(ii) (d) : The hotspots are determined on the basis of number of endemic species and degree of threat in terms of habitat loss.

(iii) (b) : A seed bank is a place where seeds are stored in order to preserve genetic diversity. It is a type of *ex-situ* conservation.

(iv) (d)

(v) (a) : Biodiversity provide stability to the ecosystem and maintains the ecological balance. Plants and animals in ecosystem are linked to each other through food chain and food web. The loss of one species in the ecosystem affects the survival of other species. Thus the ecosystem becomes fragile.

16. (i) (a) : Down's syndrome is a condition in which a child is born with an extra copy of their 21st chromosome — hence its other name, trisomy 21. It is a chromosomal disorder.

(ii) (b) : Nondisjunction of chromosomes is the failure of synapsed homologs to completely separate and migrate to separate poles during the first cell division of meiosis, as a result there is deficiency of one chromosome in one egg/sperm and there is an extra chromosome in the other. Down's syndrome is due to trisomy of chromosome 21.

(iii) (d) : The major symptoms of down's syndrome is the overall developmental and mental retardation and broad palm with characteristic palm crease.

(iv) (d)

(v) (d)

17. The differences between ICSI and GIFT are :

S.No.	Intra Cytoplasmic Sperm Injection (ICSI)	Gamete Intra Fallopian Transfer (GIFT)
(i)	Spermatozoon/ Spermatid is directly injected into the cytoplasm of the oocyte by puncturing zona pellucida.	Sperms and unfertilised ova both are transferred into the Fallopian tubes of the female where fertilisation takes place.
(ii)	Overall success rate is 20-40%.	Overall success rate is 27-30%.

OR

Subcutaneous 'implants' are under the skin implantation of synthetic progesterone. They are an effective contraceptive method as they check ovulation and thicken cervical mucus to prevent sperm transport. 'Subcutaneous implants' are more advantageous than contraceptive pills as they are long lasting, once implanted they are effective upto 5 years.

18. Histones are rich in basic amino acids lysine and arginine, hence they are positively charged.

19. Differences between benign tumor and malignant tumor are as follows :

S.No.	Benign tumor	Malignant tumor
(i)	It remains confined to the affected organ.	It spreads to other organs of the body.
(ii)	Rate of growth is usually slow.	Rate of growth is usually rapid.
(iii)	It causes limited damage to the body.	The cancer cells migrate to other sites of the body and start a new tumor there. This property is called metastasis.
(iv)	It is non-cancerous.	It is cancerous.

20. Insertional inactivation is a technique that involves inactivation of a gene by inserting a fragment of DNA into the middle of its coding sequence. For example, a recombinant DNA is inserted within the coding sequence of enzyme β-galactosidase that results into inactivation of the enzyme. The presence of a chromogenic substrate gives blue coloured colonies if the plasmid in the bacteria does not have an insert. Presence of insert results into insertional inactivation of the β-galactosidase and the colonies do not produce any colour, these are identified as recombinant colonies. Hence, insertional inactivation differentiates recombinants from non-recombinants on the basis of their ability to produce colour in the presence of a chromogenic substrate.

21. In gene therapy, lymphocytes from the blood of the patient are grown in a culture outside the body. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are reinjected to the patient's bone marrow. However, as these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes. However, if the gene isolate from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

22. In 'Flavr Savr' transgenic tomato, expression of a native tomato gene has been blocked. This gene produces enzyme polygalacturonase which promotes softening of fruit. The production of this enzyme was reduced in the Flavr Savr transgenic tomato. The non-availability of this enzyme prevents over-ripening because the enzyme is essential for degradation of cell walls. Thus, fruit remains fresh for a longer period than the fruit of normal tomato variety. It retains flavour, has superior taste and higher quantity of total soluble solids.

23. (a) AIDS 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.

(b) Other than sexual contact, transmission of HIV infection in humans could also occur by
(i) Transfusion of contaminated blood and blood products.
(ii) From infected mother to her child through placenta.

OR

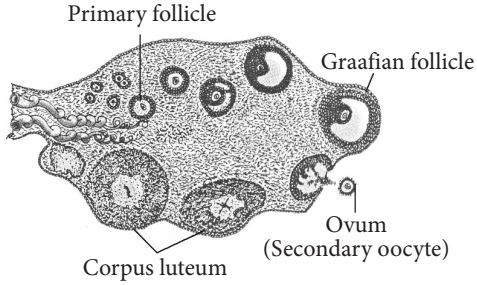
Hill station and plains do have different weather conditions and environment. Sneezing and wheezing on hill station is due to exposure to different allergens, this response is called allergy. It is a hypersensitive response of a person to foreign substance coming in contact with or entering the body. Allergy involves IgE antibodies and release of chemicals like histamine and serotonin from mast cells.

24. Macrophages act as HIV factory in humans. Events that occur in infected cells are:
(i) After the entrance of the virus into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of reverse transcriptase enzyme.
(ii) Viral DNA gets incorporated into the host cell's DNA and directs the infected cells to produce viruses.
(iii) Simultaneously, HIV virus enters into helper T at lymphocytes where it replicates and produces more viruses. This is repeated so that the number of helper T at lymphocytes decreases in the body of the infected person.
(iv) Due to decrease in the number of helper T at lymphocytes in the body, the person starts suffering from infections and gets immune deficiency and he/she is unable to protect himself/herself against these infections.

25. The differences between mutualism and commensalism are as follows :

S.No.	Mutualism	Commensalism
(i)	It is an association between two organisms in which both are benefitted.	It is an association between two organisms in which only one is benefitted. The second is neither benefitted nor harmed.
(ii)	Contact between the two organism is obligatory.	Contact between commensal and its benefactor may be periodic or continuous.
(iii)	Nitrogen fixing blue-green alga or cyanobacterium called *Anabaena* is associated with water fern *Azolla* in a mutualistic interaction.	Many epiphytes, *e.g.*, orchids, are found growing on the branches and in the forks of trees. These epiphytes use the trees only for attachment and manufacture their own food by photosynthesis.

26. (a) Diagrammatic sectional view of human ovary showing the development of follicles, corpus luteum and ovulation is as follows:



(b) After ovulation, the remaining cells of the ovarian follicles are stimulated by LH to develop corpus luteum. Now, the corpus luteum secretes large amount of progesterone that is essential for the maintenance of the endometrium.

27. The skin colour of human is controlled by three genes where the dominant alleles have cumulative effect. Each dominant allele expresses a part or unit of the trait (skin colour). Such type of genes are called polygenes and their inheritance is called as polygenic inheritance. So, the skin colour of human is a polygenic trait.

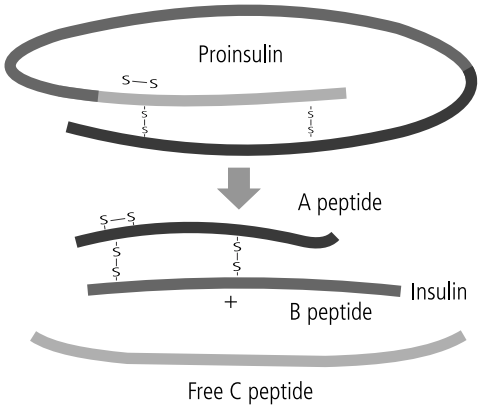
OR

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 alternative 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, they are not linked. Example : In *Drosophila* a yellow bodied white eyed female was crossed with brown bodied red

eyed male, F_1 progeny produced and intercrossed. The F_2 phenotypic ratio of *Drosophila* deviate significantly from Mendel's 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, inherited together. Recombinants were formed due to crossing over but at low percentage.

28. (i) Given figure shows an antibody molecule, and A is antigen binding site.
(ii) An antibody molecule consists of four peptide chains, two small light chains and two longer heavy chains. Hence, an antibody is represented as H_2L_2.

29. Insulin consists of two short polypeptide chains: chain A and chain B, that are linked together by disulphide bridges. In mammals, including humans, insulin is synthesised as a prohormone which contains an extra stretch called the C peptide. This C peptide is not present in the mature insulin and is removed during maturation into insulin. The given diagram explains the maturation of proinsulin into insulin:

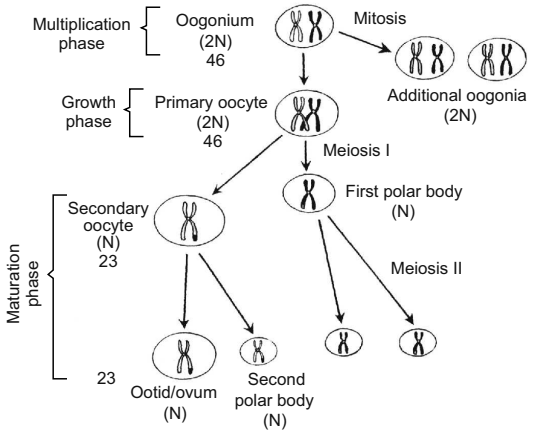


30. Physiological and behavioural adaptations help organisms to manage stressful conditions. These include migration, hibernation, aestivation, camouflage, mimicry, etc. Caribou migrate during winter to warmer places for search of food. Some animals like Northern ground squirrels undergo hibernation during winter to avoid low temperature whereas others undergo aestivation to avoid extreme heat. Viceroy butterfly mimics unpalatable toxic monarch butterfly in order to get protection against predator.

31. **(a)** The motile sperms swim rapidly, pass through the cervix, enter into the uterus and finally reach the junction of the isthmus and ampulla (ampullary-isthmic junction) of the Fallopian tube. The ovum released by the ovary is also transported to the ampullary-isthmic junction where fertilisation takes place. During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that block the entry of additional sperms. The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces the completion of the meiotic division of the secondary oocyte. The second meiotic division is also unequal and results in the formation of a second polar body and haploid ovum (ootid). Soon the haploid nucleus of the sperms and that of the ovum fuse together to form a diploid zygote.
(b) Blastocyst gets implanted in human female. In a blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells called the inner cell mass. The trophoblast then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This whole phenomenon is called implantation and it leads to pregnancy.

OR

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



(b) The process of formation of mature gamete in a human female is called oogenesis. The differences between spermatogenesis and oogenesis are as follows:

S.No.	Spermatogenesis	Oogenesis
(i)	It occurs in the testes.	It occurs in the ovaries.
(ii)	Spermatogonia change to primary spermatocytes.	Oogonia change to primary oocytes.

(iii)	A primary spermatocyte divide to form two secondary spermatocytes.	A primary oocyte divides to form one secondary oocyte and one polar body.
(iv)	A secondary spermatocyte divides to form two spermatids.	A secondary oocyte divides to form one ootid and one polar body.
(v)	No polar body is formed.	Polar bodies are formed.
(vi)	A spermatogonium forms four spermatozoa.	An oogonium forms one ovum.
(vii)	Sperms are minute, yolkless and motile.	Ova are much larger often with yolk and non-motile.
(viii)	It is generally completed in the testes and thus mature sperms are released from the testes.	It is often completed in the female reproductive tract or in many animals in water because oocytes are released from the ovaries.

32. (a) (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_3 and H_4. Four of them (H_2A, H_2B, H_3 and H_4) 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 $1\frac{3}{4}$ turns. DNA connecting two adjacent nucleosomes is called linker DNA which bears H_1 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 :

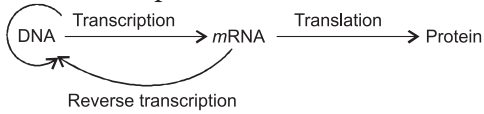
DNA fibre (2nm diameter) → Nucleosome (10 nm diameter) → Solenoid (30 nm diameter) → Chromatin (30-80 nm diameter) → Chromatid (700 nm diameter) → Chromosome (1400 nm diameter)

(b) The differences between euchromatin and heterochromatin are as follows :

S.No.	Euchromatin	Heterochromatin
(i)	These are the regions where chromatin is loosely packed.	These are the regions where chromatin is densely packed.
(ii)	It stains lighter.	It stains darker.
(iii)	This is transcriptionally active.	It is transcriptionally inactive or late replicating.

OR

(a) Francis Crick (1958) proposed 'Central dogma 'in molecular biology which states that the flow of information first occurs from DNA to *m*RNA by the process of transcription and then the information present in *m*RNA is decoded for the formation of polypeptide chain by the process of translation. The central dogma suggests that DNA contains the information needed to make all of our proteins, and that RNA is a messenger that carries this information to ribosomes. The ribosomes serve as factories in the cell where the information is translated from a code into the functional product.



Yes, central dogma differs in retroviruses, *e.g.*, HIV, etc. where it is called central dogma reverse (inverse

flow of information) *i.e.*, from RNA to DNA. RNA of these viruses first synthesises DNA through reverse transcription and DNA then transfers information to RNA which takes part in translation of coded information to form a polypeptide.

(b) In 1928, Frederick Griffith performed the transformation experiment using *Streptococcus pneumoniae*. When he injected heat killed, virulent S strain along with non-virulent, live R strain in mice, then the mice died. It showed that something from dead S strain transformed the non-virulent R strain into virulent one. During the course of his experiment, a living organism (bacteria) had changed in physical form. This phenomenon was called transformation by him. He concluded that the R strain bacteria had somehow been transformed by the heat-killed S strain bacteria. Some 'transforming principle', transferred from the heat-killed S strain, had enabled the R strain to synthesise a smooth polysaccharide coat and become virulent. This must be due to the transfer of the genetic material. However, the biochemical nature of genetic material was not defined from his experiments. Now, Avery, MacLeod and McCarty worked to determine the biochemical nature of transforming principle in Griffith's experiment. They later purified biochemicals (proteins, DNA, RNA, etc.) from the heat-killed S cells to see which ones could transform live R cells into S cells. They discovered that DNA alone from S bacteria caused R bacteria to become transformed. They also discovered that protein-digesting enzymes (proteases) and RNA-digesting enzymes (RNases) did not affect transformation. Digestion with DNase did inhibit transformation, suggesting that the DNA caused the transformation and they concluded that DNA is the hereditary material.

33. (i) The given figure is of anaerobic sludge digester.

(ii) A-Sludge inlet, B-Sludge, C-Spent sludge, D-Methane vent

(iii) Spent sludge from the anaerobic sludge digester can be used as manure or part of compost.

(iv) Methanogenic bacteria digest the activated sludge and produce marsh gas which is a mixture of methane, H_2S and CO_2.

OR

(i) A-Soluble compounds or monomers, B-Fermentative microbes, C-Methane, D-CO_2

(ii) C - 50-70%, D - 30-40%

(iii) Another name of biogas is gobar gas. Biogas provides both storable form of energy and manure. It does not add to pollution. It minimises the chances of spread of faecal pathogens.

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