Solved Paper 2022

BIOLOGY (TERM-I, SET-4)

Time : 90 Minutes **Class-XII** **Max. Marks : 35**

General Instructions :

*(i) The question paper contains **three** sections: Section **A, B** and **C**.*

*(ii) Section **A** has **24** questions. Attempt any **20** questions.*

*(iii) Section **B** has **24** questions. Attempt any **20** questions.*

*(iv) Section **C** has **12** questions. Attempt any **10** questions.*

(v) All questions carry equal marks.

*(vi) There is **no** negative marking.*

Set 4, Series: SSJ/2 **057/1/4**

SECTION - A

Section A consists of 24 questions. Attempt any 20 questions from this section. The first 20 questions attempted would be evaluated.

1. Enclosed within the integuments of a typical anatropous ovule is a diploid mass of cellular tissue known as:

(A) Megaspore mother cell

(B) Nucellus

(C) Synergids

(D) Embryo sac

Ans. Option (B) is correct.

Explanation: Enclosed within the integuments of a typical anatropous ovule is a mass of cells called the nucellus. Nucellus have abundance reserve food material and its ploidy is 2n.

2. Researchers over the world are trying to transfer apomictic genes to hybrid varieties as hybrid characters in the progeny:

(A) do not segregate.

(B) segregate.

(C) develop genetic variations.

(D) will remain unexpressed.

Ans. Option (B) is correct.

Explanation: Apomixis refers to the development of seed without fertilization. The method of producing hybrid seeds by cultivation is very expensive for farmers. Also, by sowing hybrid seeds, it is difficult to maintain hybrid characters as characters segregate during meiosis. Apomixis thus prevents the loss of specific characters into hybrid. If hybrids with desirable characteristics can be made into apomicts, there is no segregation of characters in the hybrid progeny.

3. The aquatic plant having long and ribbon like pollen grains is:

(A) *Vallisneria* **(B)** *Hydrilla*

(C) *Eichhornia* **(D)** *Zostera*

Ans. Option (D) is correct.

Explanation: In *Zostera* (sea grasses), the female flowers remain submerged in water and the long, ribbon-like pollen grains are carried inside the water to reach the stigma.

4. In a typical dicotyledonous embryo, the portion of embryonal axis above the level of cotyledon is:

(A) Plumule **(B)** Coleoptile

(C) Epicotyl **(D)** Hypocotyl

Ans. Option (C) is correct.

Explanation: The portion of embryonal axis above the level of cotyledons is the epicotyl, which terminates into plumule (stem tip). The part below the level of cotyledons is hypocotyl.

5. To overcome incompatible pollination so as to get desired hybrids, a plant breeder must have the knowledge of ..... .

(A) pollen - nucellar interaction

(B) pollen - egg cell interaction

(C) pollen-pistil interaction

(D) pollen - embryo sac interaction

Ans. Option (C) is correct.

Explanation: A plant breeder can manipulate pollen-pistil interaction, even in incompatible pollinations, to get desired hybrids.

Pollen-pistil interaction is a dynamic process involving pollen recognition followed by promotion or inhibition of the pollen. This interaction takes place through the chemical components produced by them. If the pollen is compatible, then the pistil

accepts it and promotes post-pollination events. The pollen grain germinates on the stigma to produce a pollen tube through one of the germ pores. The contents of the pollen grain move into the pollen tube. The pollen tube grows through the tissues of the stigma and style and reaches the ovary. But, if the pollen is incompatible, then the pistil rejects the pollen by preventing pollen germination on the stigma or the pollen tube growth in the style. However, a plant breeder can manipulate pollen-pistil interaction, even in incompatible pollination, to get desired hybrids.

6. Pollen grains retain viability for months in plants belonging to different families given below:

(i) Solanaceae **(ii)** Leguminosae
(iii) Gramineae **(iv)** Rosaceae
(v) Liliaceae

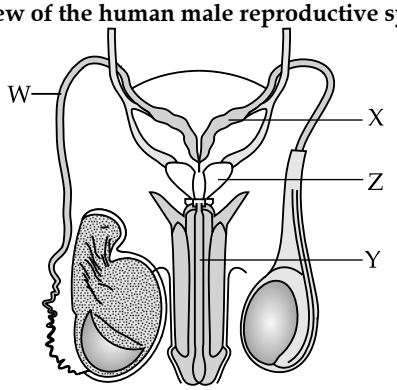
The correct option is:

(A) (i), (ii) and (v) **(B)** (i) (ii) and (iv)
(C) (ii), (iv) and (v) **(D)** (i), (iii) and (v)

Ans. Option (B) is correct.

Explanation: Some members of Solanaceae, Leguminoseae and Rosaceae, maintain viability for months.

7. Given below is a diagrammatic view of the human male reproductive system:

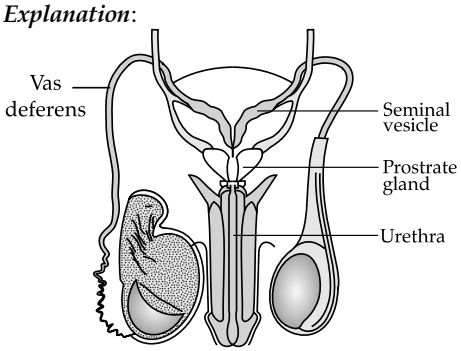


Identify the correct labelling for W, X, Y and Z and choose the correct option from the table below:

	W	X	Y	Z
(A)	Epididymis	Prostrate gland	Glans penis	Bulbourethral Gland
(B)	Bulbourethral gland	Glans penis	Prostrate gland	Epididymis
(C)	Vas deferens	Seminal vesicle	Urethra	Prostrate gland
(D)	Rete testis	Bulbourethral gland	Epididymis	Glans penis

Ans. Option (C) is correct.

Explanation:



8. During human embryonic development, the heart in the embryo is formed after:

(A) 15 days of pregnancy
(B) 30 days of pregnancy
(C) 45 days of pregnancy
(D) 60 days of pregnancy

Ans. Option (B) is correct.

Explanation: At around 18 to 19 days after fertilisation, the heart begins to form. After one month of pregnancy (around 22-30 days), the heart starts to beat and to pump circulating blood.

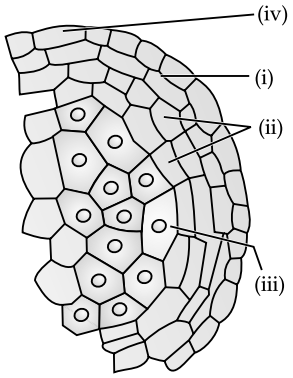
9. The uterus opens into the vagina through a narrow:

(A) Ampulla **(B)** Isthmus
(C) Cervix **(D)** Infundibulum

Ans. Option (C) is correct.

Explanation: The uterus opens into vagina through a narrow cervix.The cavity of the cervix is called cervical canal which along with vagina forms the birth canal.

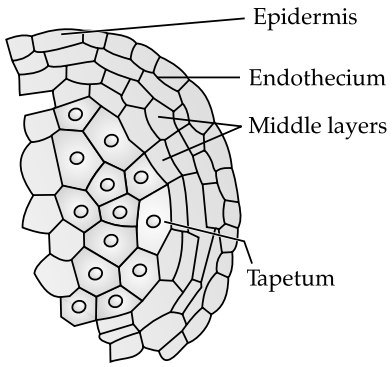
10. In the transverse section of a young anther shown below, identify the correct sequence of wall layers from outside to inside:



	(i)	(ii)	(iii)	(iv)
(A)	Middle layers	Endothecium	Epidermis	Tapetum
(B)	Tapetum	Middle layers	Endothecium	Epidermis
(C)	Epidermis	Endothecium	Middle layers	Tapetum
(D)	Endothecium	Middle layers	Tapetum	Epidermis

Ans. Option (D) is correct.

Explanation:



11. Floral reward's provided by insect pollinated flowers to sustain animal visit is/are:

(A) nectar and fragrance
(B) nectar and pollen grains
(C) pollen grains and fragrance
(D) fragrance and bright colour

Ans. Option (B) is correct.

Explanation: Insect pollinated flowers reward their pollinators such as butterflies, bees, birds, wasps, etc. with nutrient rich nectar and pollen grains. The absence of either of the two rewards in an entomophilous flower may reduce flower attractiveness for nectar and pollen-collecting pollinators.

12. The cause of Klinefelter's syndrome in humans is:

(A) Absence of Y-chromosome
(B) Absence of X-chromosome
(C) Extra copy of an autosome
(D) Extra copy of an X-chromosome

Ans. Option (D) is correct.

Explanation: Klinefelter's syndrome is a genetic disorder caused due to the presence of an additional copy of X-chromosome resulting into a karyotype of 47, XXY. Such an individual has overall masculine development, however, the feminine development (development of breast, i.e., Gynaecomastia) is also expressed. Such individuals are sterile.

13. Select the incorrect pair:

(A) Polygenic inheritance : Haemophilia
(B) Linkage : *Drosophila*
(C) Incomplete dominance : *Antirrhinum*
(D) Pleiotropy : Phenylketonuria

Ans. Option (A) is correct.

Explanation: Polygenic inheritance is the inheritance of traits that are produced by the combined effect of many genes. Polygenic trait is controlled by more than one pair of non-allelic genes and shows different types of phenotypes. For example, human skin colour.

Haemophilia is sex linked recessive disease. In this, a protein involved in the blood clotting is affected. The heterozygous female (carrier) for haemophilia may transmit the disease to sons.

14. According to Mendel, the nature of the unit factors that control the expression of traits were:

(A) Stable **(B)** Blending
(C) Stable and discrete **(D)** Discrete

Ans. Option (C) is correct.

Explanation: According to Mendel, factors were stable and discrete units that controlled the expression of traits and of the pair of alleles which did not 'blend' with each other.

15. Which of the following animals exhibit male heterogamety?

(i) Fruit fly **(ii)** Fowl
(iii) Human **(iv)** Honey bee
(a) (i) and (iii) **(b)** (ii) and (iv)
(c) (ii) and (iii) **(d)** (i) and (iv)

Ans. Option (A) is correct.

Explanation: Heterogamety is occurrence of two types of gametes in one of the two sexes. In human and fruit fly (*Drosophila*), male is heterogametic (X & Y-chromosomes) and female is homogametic (two X-chromosomes).

Male is homogametic (ZZ) and female is heterogametic (Z & W) in fowl. Honey bee exhibits haplodiploid sex-determination system. Male honey bees are born from the unfertilized eggs by the process known as parthenogenesis whereas female honeybees are born from fertilized egg. Since, unfertilized egg carries only half the number of chromosomes as compared to fertilized egg, male honey bees have half the number of chromosomes (n) as compared to female honey bee (2n).

16. The probability of all possible genotypes of offsprings in a genetic cross can be obtained with the help of:

(A) Test cross **(B)** Back cross
(C) Punnett square **(D)** Linkage cross

Ans. Option (C) is correct.

Explanation: Punnett square is a graphic representation of the probabilities of all the possible genotypes and phenotypes of offsprings in a cross.

17. The number of different type of gametes that would be produced from a parent with genotype AABBCc is:

(A) 1 **(B)** 2
(C) 3 **(D)** 4

Ans. Option (B) is correct.

Explanation: The number of types of gametes that would be produced, depends upon the number of heterozygous pairs.

No. of types of gametes = 2^n

(Here, n = no. of heterozygous pair)

Therefore, $2^1 = 2$

The types of gametes = ABC and ABc

18. Select the important goals of HGP from the given options:

(i) Store the information for data analysis.
(ii) Cloning and amplification of human DNA.
(iii) Identify all the genes present in human DNA.
(iv) Use of DNA information to trace human history.

(A) (i) and (ii) **(B)** (ii) and (iii)
(C) (i) and (iii) **(D)** (ii) and (iv)

Ans. Option (C) is correct.

Explanation: Goals of Human Genome Project (HGP) are:

(A) Identify all the estimated genes (20,000-25,000) in human DNA.
(B) Determine the sequences of the 3 billion chemical base pairs that make up human DNA.
(C) Store this information in databases.
(D) Improve tools for data analysis.
(e) Transfer related technologies to other sectors.
(f) Address the ethical, legal and social issues (ELSI) that may arise from the project.

19. 'A codon is a Triplet of bases' was suggested by:

(A) Marshall Nirenberg
(B) Har Gobind Khorana
(C) George Gamow
(D) Francis Crick

Ans. Option (C) is correct.

Explanation: George Gamow (1954) suggested that the code should be a triplet i.e., made up of different combination of three nucleotides. This will give $4 \times 4 \times 4 = 64$ codons, which are more than enough to code 20 amino acids.

20. The correct feature of double-helical structure of DNA as given by Watson and Crick is:

(A) Right-handed helix, pitch is 3.4 nm
(B) Left-handed helix, pitch is 3.8 nm
(C) Right-handed helix, pitch is 3.8 nm
(D) Left-handed helix, pitch is 3.4 nm

Ans. Option (A) is correct.

Explanation: The salient features of double -helical structure of DNA given by Watson and Crick are:

1. It is made of two polynucleotide chains.
2. The two chains have anti-parallel polarity.
3. The bases in two strands are paired through hydrogen bond (H-bonds). Adenine forms two hydrogen bonds with Thymine. Guanine is bonded with Cytosine with three H-bonds. As a result, uniform distance between the two strands of the helix is formed.
4. The two chains are coiled in a right-handed fashion. The pitch of the helix is 3.4 nm. There are roughly 10 bp in each turn. The distance between a bp in a helix is approximately equal to 0.34 nm.
5. The plane of one base pair stacks over the other in double helix. This in addition to H-bonds accounts for the stability of the helical structure.

21. Charging of tRNA during translation is necessary for:

(A) Binding of anticodons of tRNA to the respective codons of mRNA.
(B) Peptide bond formation between two amino acids.
(C) Movement of ribosomes from codon to codon.
(D) Binding of ribosomes to the mRNA.

Ans. Option (B) is correct.

Explanation: Formation of peptide bond requires energy obtained from ATP. For this, amino acids are activated (amino acid + ATP) and linked to their cognate tRNA in the presence of aminoacyl tRNA synthetase. So, the tRNA becomes charged.

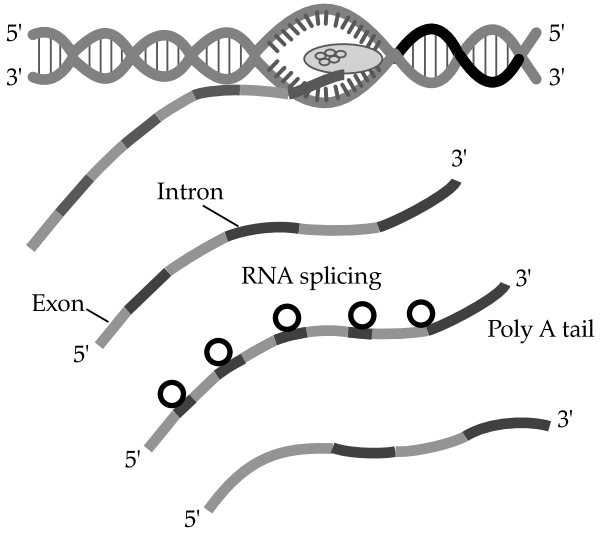
22. If *E. coli* were allowed to grow in the culture medium for 80 minutes by Matthew Meselson and Franklin Stahl in their experiments, the proportion of light and hybrid density DNA molecule would have been:

(A) 87.5% of light density DNA and 12.5% of hybrid density DNA.
(B) 75.0% of light density DNA and 25% of hybrid density DNA.
(C) 50% of light density DNA and 50% of hybrid density DNA.
(D) 12.5% of light density DNA and 87.5% of hybrid density DNA.

Ans. Option (A) is correct.

Explanation: An *E.coli* divides in every 20 minutes therefore, after 80 minutes it will be four generations. In the first generation, all the strands will be hybrid as the heavy isotope will be incorporated in the newly synthesised strand of DNA. i.e., the two DNA will be of intermediate nature. In the second generation, half (50%) will be hybrid and half (50%) will light. In the third generation the 1/4 will be hybrid and 3/4 will be light i.e., 25% will be hybrid and 75% will be light. Finally, in the fourth the above four generation, 12.5% will be hybrid and 87.5% will be light strand.

23. A diagramatic illustration of the process of transcription by RNA polymerase-II in eukaryote is given below. Choose the most appropriate statement with respect to the fate of the precursor of mRNA transcribed that will be:



(A) Translation will take place once the precursor of mRNA leaves the nucleus.
(B) Translation on mRNA will not take place once the precursor of mRNA leaves the nucleus.
(C) Translation will take place in the nucleus.
(D) The precursor of mRNA has to be processed further in next step before being translated.

Ans. Option (A) is correct.

Explanation: Translation is the process of protein synthesis and occurs on ribosomes where mRNA come from the nucleus. It attaches to the ribosome and translates the codon for protein synthesis.

In nucleus, the RNA polymerase II transcribes precursor of mRNA, the heterogeneous nuclear RNA (hnRNA). It is the fully processed hnRNA, called mRNA, is transported out of the nucleus for translation.

24. Identify the correct pair of codon with its corresponding pair of amino acid:

(A) UAA : Leucine
(B) UGA : Serine
(C) AUG : Histidine
(D) UUU : Phenylalanine

Ans. Option (D) is correct.

Explanation: UUU code for Phenylalanine (phe).

UAA and UGA are stop codon while. AUG codes for Methionine (met).

SECTION - B

Section B consists of 24 questions. Attempt any 20 questions from this section. This first 20 questions attempted would be evaluated.

Question No. 25 to 28 consists of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

25. Assertion (A): Very often persons suffering from Sexually Transmitted Diseases (STD) do not go for timely detection and proper treatment.

Reason (R): Absence or less significant symptoms in the early stages of STDs and the social stigma attached to the disease.

Ans. Option (A) is correct.

Explanation: Absence or less significant symptoms in the early stages of infection and the social stigma attached to the STDs deter the infected persons from going for timely detection and proper treatment leading to pelvic inflammatory diseases (PID), abortions, still births, ectopic pregnancies, infertility or even cancer of the reproductive tract.

26. Assertion (A): Vasectomy is a sterilisation procedure advised for females as a terminal method.

Reason (R): In vasectomy, a small part of the vas deferens is removed or tied by blocking gamete transport therefore preventing conception.

Ans. Option (D) is correct.

Explanation: Vasectomy is a sterilisation procedure in the male while that in the female is called tubectomy. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum while in tubectomy a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.

27. Assertion (A): Interstitial spaces outside the seminiferous tubule have blood vessels and sertoli cells.

Reason (R): Sertoli cells provide nutrition to the germ cells.

Ans. Option (D) is correct.

Explanation: The interstitial spaces are the regions outside the seminiferous tubules, contains small blood vessels and interstitial cells or Leydig cells.

Each seminiferous tubule is lined on its inside by two types of cells called male germ cells (spermatogonia) and Sertoli cells. Sertoli cells provide nutrition to the germ cells during spermatogenesis.

28. Assertion (A): Accumulation of phenylalanine in the brain results in mental retardation in Phenylketonuria.

Reason (R): The affected person lacks phenylalanine which is therefore not converted to tyrosine.

Ans. Option (A) is correct.

Explanation: Phenylketonuria is a disorder caused due to a recessive mutant allele on chromosome 12 (autosome). The affected individual lacks an

enzyme phenylalanine hydroxylase that converts the amino acid phenylalanine into tyrosine. As a result, phenylalanine and its derivatives accumulate in the cerebrospinal fluid leading to retardation and are secreted in the urine. It shows hair and skin pigmentation.

29. Choose the correct option for the features of functional mammary gland of all female mammals from the statements below:

(i) Glandular tissue with variable amount of fat.
(ii) Mammary lobes, 30 – 40 in number called alveoli.
(iii) Mammary ducts joining to form mammary tubules.
(iv) Mammary ampulla connected to lactiferous duct.

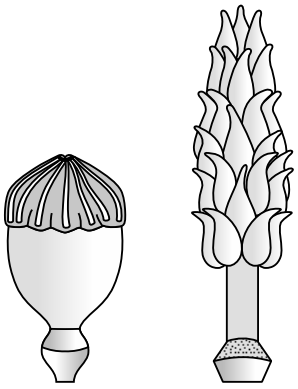
(A) (i) and (iii) **(B)** (ii) and (iii)
(C) (i) and (iv) **(D)** (ii) and (iv)

Ans. Option (C) is correct.

Explanation:

(i) The mammary glands are paired structures (breasts) that contain glandular tissue and variable amount of fat.
(ii) The glandular tissue is divided into 15-20 mammary lobes containing cells called alveoli.
(iii) The mammary tubules of each lobe join to form a mammary duct.
(iv) Mammary ampulla is connected to lactiferous duct through which milk is sucked out.

30. Which condition of gynoecium (pistil) is shown the figures (i) and (ii)?



(i) **(ii)**

(A) **(i)** multicarpellary apocarpous, **(ii)** multicarpellary syncarpous
(B) **(i)** multicarpellary syncarpous, **(ii)** multicarpellary apocarpous
(C) **(i)** bicarpellary apocarpous, **(ii)** bicarpellary syncarpous
(D) **(i)** bicarpellary syncarpous, **(ii)** bicarpellary apocarpous

Ans. Option (B) is correct.

Explanation: These pictures show the gynoecium of (i) *Papaver* and (ii) *Michellia* flowers. Both have multicarpellary ovary. However, *Papaver* flower has fused syncarpous pistil whereas *Michellia* has free apocarpous pistil.

31. An IUD recommended to promote the cervix hostility to the sperms is:

(A) CuT **(B)** Multiload-375
(C) LNG-20 **(D)** Cu7

Ans. Option (C) is correct.

Explanation: Intra Uterine Devices (IUDs) presently available are:

(A) The non-medicated IUDs e.g., Lippes loop.
(B) Copper releasing IUDs e.g., CuT, Cu7, Multiload 375.
(C) The hormone releasing IUDs e.g., LNG- 20 and Progestasert.

These IUDs increase phagocytosis of sperms within the uterus and the Cu ions released suppress sperm motility and the fertilising capacity of sperms. The hormone releasing IUDs, in addition, make the uterus unsuitable for implantation and the cervix hostile to the sperms.

32. Identify the disease which is not a sexually transmitted disease?

(A) Gonorrhoea **(B)** Syphilis
(C) Amoebiasis **(D)** Chlamydiasis

Ans. Option (C) is correct.

Explanation: Amoebiasis (amoebic dysentery) is caused by a protozoa *Entamoeba histolytica* in the large intestine of human. Houseflies act as mechanical carriers and serve to transmit the parasite from faeces of infected person to food and food products, thereby contaminating them. Hence, drinking water and food contaminated by the faecal matter are the main source of infection. Symptoms of this disease include constipation, abdominal pain and cramps, stools with excess mucous and blood clots.

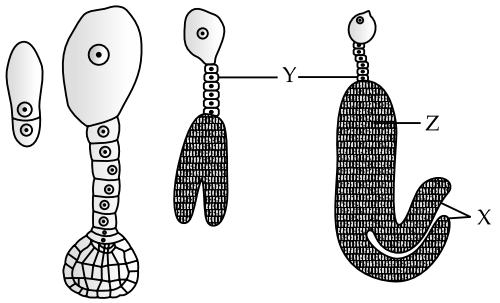
33. The nature of meiotic division during oogenesis in a human female is:

(A) equal cell division
(B) suspended cell division
(C) continuous cell division
(D) rapid cell division

Ans. Option (B) is correct.

Explanation: The process of formation of a mature female gamete is called oogenesis. Oogenesis is initiated during the embryonic development stage when gamete mother cells (oogonia) are formed within each fetal ovary. No more oogonia are formed and added after birth. These cells start meiotic division and get suspended at prophase - I stage, called primary oocytes. Meiosis resumes only once the puberty begins.

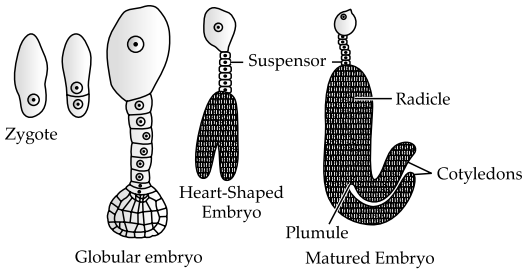
34. Choose the correct labellings for the parts X, Y and Z in the given figure of the stages in embryo development in a dicot:



(A) X is suspensor, Y is radicle and Z is cotyledon.
(B) X is radicle, Y is cotyledon and Z is suspensor.
(C) X is cotyledon, Y is suspensor and Z is radicle.
(D) X is zygote, Y is radicle and Z is cotyledon.

Ans. Option (C) is correct.

Explanation: Stages in embryo development in a dicot is:



35. Which of the following outbreeding devices are used by majority of flowering plants to prevent inbreeding depression?
(i) Pollen release and stigma receptivity are not synchronised.
(ii) Different positions of anther and stigma.
(iii) Production of different types of pollen grains.
(iv) Formation of unisexual flowers along with bisexual flowers.
(v) Preventing self-pollen from fertilising the ovules by inhibiting pollen germination.
(A) (i), (ii) and (v) **(B)** (ii), (iii) and (v)
(C) (i), (iii) and (v) **(D)** (iii), (iv) and (v)

Ans. Option (A) is correct.

Explanation: Continued self-pollination result in inbreeding depression. Flowering plants have developed many devices to discourage self pollination and to encourage cross-pollination.

(1) In some species, pollen release and stigma receptivity are not synchronized. Either the pollen is released before the stigma becomes receptive or stigma becomes receptive before the release of pollen. It prevents autogamy.

(2) In some species, the arrangement of anther and stigma at different positions prevents autogamy.

(3) It is a genetic mechanism which prevent pollen of one flower to germinate on the stigma of same flower.

(4) Production of unisexual flowers for example, in monoecious plants such as castor & maize, the male and the female flowers are present on the same plant prevents autogamy but not geitonogamy. On the other hand, in dioecious plants like papaya, the male and female flowers are present on different plants prevents both autogamy and geitonogamy.

36. Histone proteins that help in forming the nucleosomes in the nucleus are rich in basic amino acids such as:
(A) Arginine and tyrosine
(B) Lysine and histidine
(C) Arginine and lysine
(D) Histidine and tryptophan

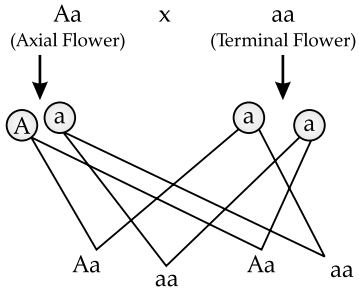
Ans. Option (C) is correct.

Explanation: Histones are rich in the basic amino acid residues lysines and arginines. Both of these amino acid residues carry positive charges in their side chains.

37. In *Pisum sativum*, the flower position may be axial (allele A) or terminal (allele a). What would be the percentage of the offspring with respect to axial flower position, if a cross is made between parents Aa × aa ?
(A) 25% **(B)** 50%
(C) 75% **(D)** 100%

Ans. Option (B) is correct.

Explanation: The parent pea plants is heterozygous for axial position (Aa) i.e., it contain a recessive gene (a) for terminal position from each of the parent plant.



Aa = axial , aa = terminal, Aa = axial and aa = terminal
Hence, 50% plants will be with terminal position (aa). Also, 50% plants will have axial position (Aa).

38. In humans, rolling of tongue is an autosomal dominant trait (R). In a family both the parents have the trait of rolling tongue but their daughter does not show the trait, whereas the sons have the trait of rolling of tongue.

The genotypes of the family would be:

	Mother	Father	Daughter	Son
(A)	Rr	Rr	rr	rr
(B)	Rr	Rr	rr	RR
(C)	rr	Rr	RR	rr
(D)	RR	rr	Rr	Rr

Ans. Option (B) is correct.

Mother	Father	Daughter	Son
Rr	Rr	rr	RR

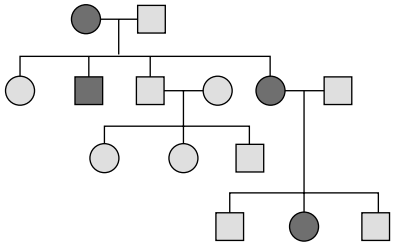
Explanation: Tongue rolling is an autosomal dominant trait. Tongue rolling (R) is dominant over non-tongue rolling (r).

Mother Rr × Father Rr

RR	Rr
Rr	rr

Offspring phenotype = 3 tongue roller and 1 non-roller.

39. Study the pedigree analysis of human given below and identify the type of inheritance along with an example:



(A) Sex-linked recessive, Haemophilia

(B) Sex-linked dominant, Vitamin D resistant rickets

(C) Autosomal recessive, Sickle-cell anaemia

(D) Autosomal dominant, Myotonic dystrophy

Ans. Option (D) is correct.

Explanation: Autosomal dominant, are the traits whose encoding gene is present on any one of the autosomes, and the wildtype allele is recessive to its mutant allele, which means the mutant allele is dominant. For example, Myotonic dystrophy.

40. Possibility of the blood groups of the children in a family where the father is heterozygous for blood group 'A' and the mother is heterozygous for blood group 'B', would be:

(A) Blood groups 'A', 'B'

(B) Blood groups 'A', 'B', 'O'

(C) Blood group 'AB', 'O'

(D) Blood groups 'A', 'B', 'AB', 'O'

Ans. Option (D) is correct.

Explanation: Father is heterozygous for blood group 'A' and mother is heterozygous for blood group 'B' .

The genotype of father and mother will be I^A i and I^B i respectively

Father = I^Ai × Mother = I^Bi

	I^A	i
I^B	I^AI^B Blood Group AB	I^Bi Blood Group B
I	I^Ai Blood Group A	ii Blood Group O

Hence, phenotypes of all offsprings = A, B, AB and O blood group.

41. The correct statement with respect to Thalassemia in humans is:

(A) α-Thalassemia is controlled by a single gene HBB.

(B) The gene for α-Thalassemia is located on chromosome-16.

(C) β-Thalassemia is controlled by two closely linked genes HBA-1 and HBA-2.

(D) In β-Thalassemia the production of α-globin chain is affected.

Ans. Option (B) is correct.

Explanation: Thalassemia is an autosome-linked recessive blood disease transmitted from parents to offspring when both the partners are unaffected carrier for the gene.

α-Thalassemia is controlled by two closely linked genes HBA-1 and HBA-2 located on chromosome 16 of each parent.

β-Thalassemia is controlled by a single gene HBB on chromosome 11. The production of β-globin chain is reduced due to mutation of one or both the alleles of the gene.

42. A region of coding stand of DNA has the following nucleotide sequence:

5' – TACGCCG – 3'

The sequence of bases on mRNA transcribed by this would be:

(A) 5' – UACGCCG – 3' **(B)** 3' – UACGCCG – 3'

(C) 5' – ATGCGGC – 3' **(D)** 3' – ATGCGGC – 3'

Ans. Option (A) is correct.

Explanation: As the sequences of bases on mRNA is same as the coding strand except it has uracil (U) instead of thymine (T).

43. A DNA molecule is 160 base pairs long. If it has 20% adenine, how many cytosine bases are present in this DNA molecule?

(A) 48 **(B)** 64

(C) 96 **(D)** 192

Ans. Option (C) is correct.

Explanation: No. of bases in 160 base pairs

$= 160 \times 2 = 320$ bases.

Given, Adenine (A) = 20%

$= (20/100) \times 320 = 64$ bases

As, Adenine (A) = Thymine (T) therefore; T = 64 bases

A + T = 64 +64 = 128 bases

Total bases of Cytosine (C) and Guanine (G)

$= 320 - 128 = 192$ bases

As, C = G hence, the number of cytosine bases present in this DNA molecule is

= 192/2 = 96 bases

44. A template strand in a bacterial DNA has the given base sequence:

5' – AGGTTTAACG – 3'

What would be the RNA sequence transcribed from this template strand ?

(A) 5' – CGUUAAACCU – 3'

(B) 5' – AGGUUUUUCG – 3'

(C) 5' – TCCAAATTGC – 3'

(D) 5' – AGGTTTAACG – 3'

Ans. Option (A) is correct.

Explanation: As mRNA is formed from template strand hence, the sequence of mRNA is complementary to template strand.

45. In the presence of allolactose, the lac repressor in the operon of *E.coli*:

(A) binds to the operator

(B) cannot bind to the operator

(C) binds to the promoter

(D) binds to the regulator

Ans. Option (B) is correct.

Explanation: In the presence of an inducer, such as lactose or allolactose, the repressor is inactivated by interaction with the inducer. As lactose binds itself to active repressor and changes its structure, the repressor fails to bind to the operator. The RNA polymerase starts transcription of operon by binding to the promoter site of the promoter and transcription proceeds.

46. Taylor and colleagues performed experiments on ..... using radioactive ..... to prove that the DNA in chromosomes replicate semi-conservatively.

Select the correct option for the blanks.

(A) *Vicia faba*, Uridine

(B) *E. coli*, Uridine

(C) *Vicia faba*, Thymidine

(D) *E coli*, Thymidine

Ans. Option (D) is correct.

Explanation: In 1958, Taylor and colleagues performed experiments on *E. coli* using radioactive thymidine to prove that the DNA in chromosomes replicate semi-conservatively.

47. The reactive hydroxyl group in the nucleotide of RNA is:

(A) 5' OH **(B)** 4' OH

(C) 3' OH **(D)** 2' OH

Ans. Option (D) is correct.

Explanation: 2' – OH group present in RNA (in every nucleotide) makes it more reactive than DNA.

48. Given below are the pairs of contrasting traits in *Pisum sativum* as studied by Mendel. Identify the incorrect pair of traits:

	Character	Dominant	Recessive
(A)	Stem height	Tall	Dwarf
(B)	Seed shape	Round	Wrinkled
(C)	Pod colour	Yellow	Green
(D)	Flower position	Axial	Terminal

Ans. Option (C) is correct.

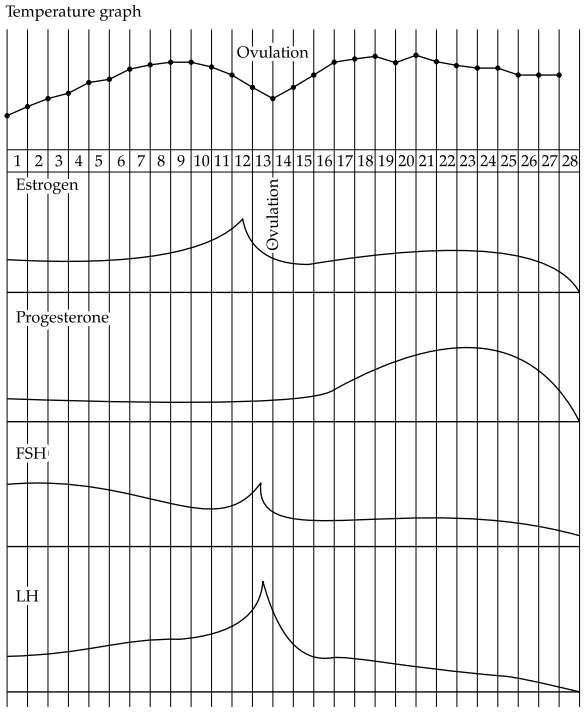
Explanation: Green pod colour is dominant whereas yellow colour is recessive.

SECTION - C

Section C consists of one case followed by 6 questions. Besides this 6 more questions are given. Attempt any 10 questions from this section. This first 10 questions attempted would be evaluated.

CASE

A group of medical students carried out a detailed study on the impact of various factors on the different hormones during the menstrual cycle in a human female. They collected the data with different factors. Given below is the graph plotted from the data collected showing the morning temperature and concentration of hormones FSH, LH, estrogen and progesterone during normal menstrual cycle in a woman.



Study the graph and answer the given questions (Question nos. 49-54):

49. The early morning recording of temperature in the graph during actual menstruation and during ovulation respectively are:

(A) low, high **(B)** high, low

(C) low, low **(D)** high, high

Ans. Option (C) is correct.

Explanation: Due to hormonal fluctuations there is a slight rise in basal core body temperature, early morning during menstrual cycle and during ovulation.

50. The time of ovulation is of importance in cases of:

(i) couples having difficulty in conception.

(ii) to know the safe period for prevention of pregnancy.

(iii) to inhibit the process of ovulation.

(iv) to stimulate ovarian follicular development.

(A) (i) and (iv) **(B)** (ii) and (iv)

(C) (i) and (ii) **(D)** (iii) and (iv)

Ans. Option (C) is correct.

Explanation: The timing of sexual intercourse in relation to ovulation strongly influences the chance of conception and to not get pregnant because this is the unfertile period in a menstrual cycle. For most women, ovulation occurs approximately 14 days before the next menstrual cycle starts. If periods are mostly regular, it is easy to calculate the days of ovulation As an egg can be fertilised only four days before ovulation and three days after ovulation, this knowledge can help a couple who are likely to conceive. However for the others this is not the safe period, and so they should avoid intercourse during this period to avoid pregnancy.

51. The increase in the level of progesterone is maximum under the influence of LH during:

(A) Secretory phase **(B)** Follicular phase

(C) Menstruation **(D)** Proliferative phase

Ans. Option (A) is correct.

Explanation: Progesterone levels peak in the middle of the secretory or luteal phase. The corpus luteum secretes large amounts of progesterone, which is essential for maintenance of the endometrium for implantation of the fertilized ovum and other events of pregnancy.

52. Which of the following hormone/hormones is/are showing rapid surge leading to changes in Graafian follicle just before ovulation?

(A) LH **(B)** FSH

(C) FSH and Estrogen **(D)** FSH and LH

Ans. Option (A) is correct.

Explanation: Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).

53. The human corpus luteum starts regressing ..... days after ovulation. (Identify the correct choice for the blank.)

(A) 10 – 11 **(B)** 14 – 15

(C) 16 – 17 **(D)** 18 – 20

Ans. Option (B) is correct.

Explanation: The corpus luteum usually regresses 14 to 15 days after ovulation.

54. As per the data plotted in the graph, in which period of the menstrual cycle is the chance of the fertilisation very high in human female?

(A) 3^{rd} – 9^{th} days **(B)** 10^{th} – 17^{th} days

(C) 18^{th} – 23^{th} days **(D)** 23^{rd} – 28^{th} days

Ans. Option (B) is correct.

Explanation: The highest chance of fertilization at the time of ovulation i.e., when an egg is released from your ovaries, usually occurs 12 to 14 days before the next period starts.

55. A plant breeder crossed a pure bred tall plant having white flowers with a pure bred dwarf plant having blue flowers. He obtained 202 F_1 progeny and found that they are all tall having blue flowers. Upon selfing these F_1 plants he obtained a progeny of 2160 plants. Approximately how many of these likely to be short having blue flowers?

(A) 1215 **(B)** 405

(C) 540 **(D)** 135

Ans. Option (D) is correct.

Explanation: It is a dihybrid cross hence, the ratio of F_2 generation will be 9:3:3:1.

9 = white flowered and tall plants

3 = white flowered and dwarf plants

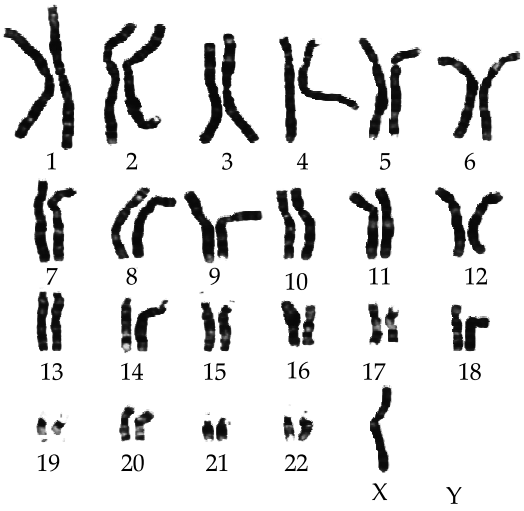
3 = blue flowered and tall plants

1 = blue flowered and dwarf plants

The given total number of F_2 progeny is 2160, so, the number of short plants with blue flowers (both recessive) will :

$1 \times 2160/16 = 135$ plants.

56. Given below is a karyotype of a human foetus obtained for screening to find any probable genetic disorder:



Based on the karyotype, the chromosomal disorder detected in unborn foetus and the consequent symptoms the child may suffer from are:

(A) Turner's syndrome: Sterile ovaries, short stature

(B) Down's syndrome: Gynecomastia, overall masculine stature

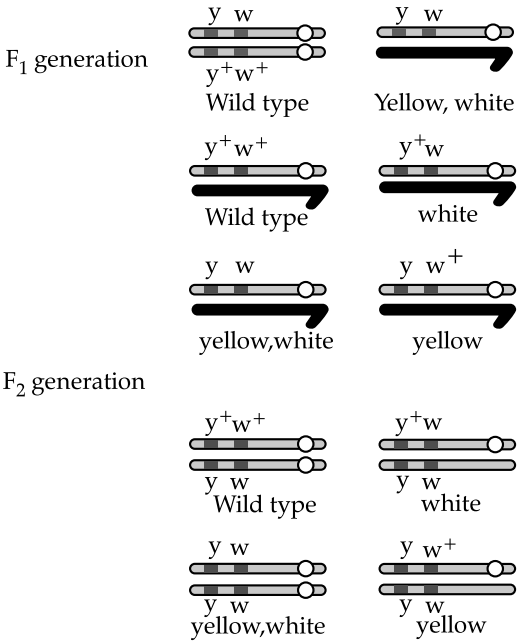
(C) Turner's syndrome: Small round head, flat back of head

(D) Down's syndrome: Furrowed tongue, short stature

Ans. Option (A) is correct.

Explanation: The karyotype is showing monosomy = 2n – 1 as there is no chromosome at 'Y' place. Hence, in this case the genetic constitution will be 44 + XO (i.e., 45 chromosomes).Therefore, the karyotype detects Turner's disorder. It is a genetic disorder caused due to the absence of one of the X-chromosomes. Such females are sterile as ovaries are rudimentary. Other features include lack of other secondary sexual characters, short stature and underdeveloped feminine characters.

57. In the dihybrid cross that was conducted by Morgan involving mating between parental generation for genes yellow bodied, white eyed female *Drosophila* and wild type male *Drosophila*, upto F_2 generation is given below:



Study the result obtained of the F_2 progeny. Select the correct option from the given choice for the F_2 progeny.

(A) Parental type, 1.3% : Strength of linkage high

(B) Recombinant types, 1.3% : Strength of linkage low

(C) Parental type 98.7% : Strength of linkage high

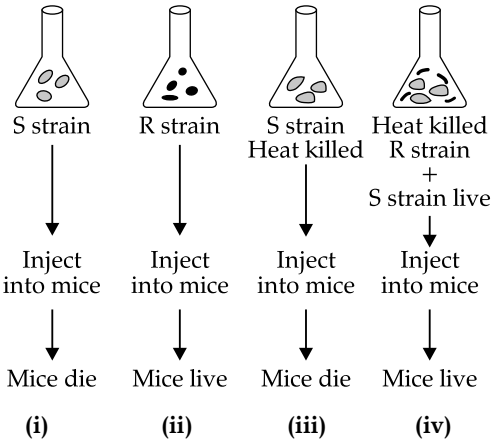
(D) Recombinant types, 98.7% : Strength of linkage low

Ans. Option (C) is correct.

Explanation: In a dihybrid cross, white eyed, yellow bodied female *Drosophila* was crossed with red eyed, brown bodied male *Drosophila*. The cross produced 1.3% recombinants and 98.7% progeny with parental type combination in the F_2 generation.

Due to linkage when two genes in a dihybrid cross were situated on the same chromosome, the proportion of parental gene combinations were much higher than the non-parental type.

58. Study the given diagrammatic representation of Griffith's experiment to demonstrate transformation in bacteria.



Select the option which is incorrectly representing the experiment:

(A) (i) and (iii) **(B)** (ii) and (iii)

(C) (iii) and (iv) **(D)** (ii) and (iv)

Ans. Option (C) is correct.

Explanation: Griffith (1928) used mice and a bacterial strain, *Streptococcus pneumoniae. Streptococcus pneumoniae* has two strains:

(a) Smooth (S) strain (Virulent): Has polysaccharide mucous coat. Causes pneumonia.

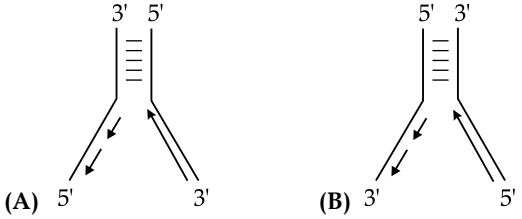
(b) Rough (R) strain (Non-virulent): No mucous coat. Does not cause pneumonia.

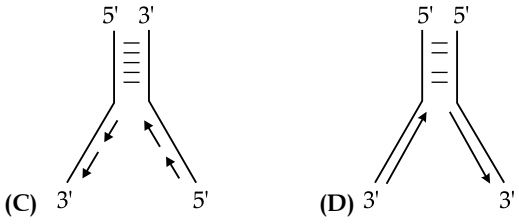
Experiment

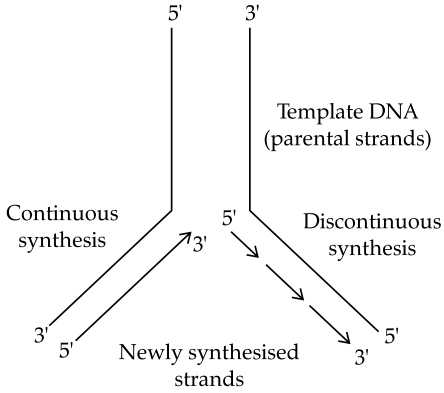
- S-strain → Inject into mice → Mice die
- R-strain → Inject into mice → Mice live
- S-strain (Hk) → Inject into mice → Mice live
- S-strain (Hk) + R-strain (live) → Inject into mice → Mice die

He concluded that there exists some 'transforming principle', that is transferred from heat-killed S-strain to R-strain. It enabled R-strain to synthesize smooth polysaccharide coat and become virulent. This must be due to the transfer of genetic material.

59. Which one of the following diagram correctly represents DNA replication in eukaryotes?



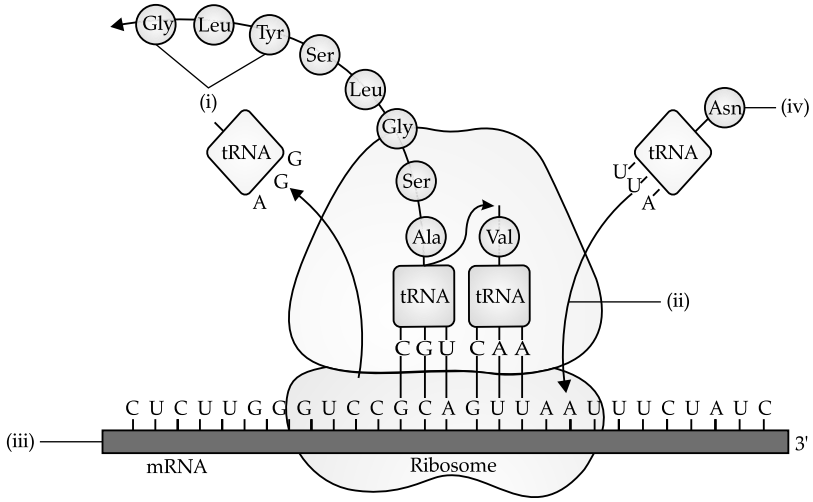




Ans. Option (D) is correct.

Explanation: DNA replication take place in the 5' to 3' direction because DNA polymerase acts on the 3'-OH of the existing strand for adding free nucleotides.

60. In the given figure of translation machinery of eukaryotes, select the correct labellings for (i), (ii), (iii) and (iv):



(A) **(i)** Codon, **(ii)** Anticodon, **(iii)** tRNA, **(iv)** 3'end of mRNA

(B) **(i)** Anticodon, **(ii)** Codon, **(iii)** 3' end of mRNA, **(iv)** 5' end of mRNA

(C) **(i)** Polypeptide chain, **(ii)** Large subunit of ribosome, **(iii)** 5' end of mRNA, **(iv)** tRNA

(D) **(i)** Ribozyme, **(ii)** Polypetide chain, **(iii)** tRNA, **(iv)** 5' end of tRNA

Ans. Option (C) is correct.

Explanation: Mechanism of translation: Charging of tRNA / aminoacylation of tRNA, small subunit of ribosome binds to mRNA (5′end). For initiation, initiation the ribosomes binds to the mRNA at the start codon (AUG) that is recognised only by initiator tRNA.

In the elongation phase, amino acid with tRNA sequentially bind to the appropriate codon on mRNA (forming complementary base pairs with tRNA anticodon). Ribosome moves from codon to codon along the mRNA and amino acids are added one by one in the two sides of the large subunit joined by peptide bond. Termination occurs when a release factor binds to the stop codon and releases the complete polypeptide.

❑❑