KCET-2020 (Biology)

1. Injection of an antidote against snakebite is an example of
   a. auto immunity
   b. innate immunity
   c. active immunity
   d. passive immunity

2. Certain tumours are called malignant, because
   a. they are not neoplastic
   b. they are confined to specific locations
   c. they invade and damage surrounding tissues
   d. they show contact inhibition

3. The transport of which neurotransmitter is interfered by cocaine?
   a. Dopamine
   b. Acetylcholine
   c. Serotonin
   d. GABA

4. In the life cycle of *Plasmodium*, fertilisation takes place in
   a. liver cells
   b. salivary glands of mosquito
   c. RBCs of humans
   d. stomach of mosquito

5. White rust resistant variety of *Brassica* is
   a. Pusa Komal
   b. Pusa Sadabahar
   c. Pusa Swarnim
   d. Pusa Shubhra

6. Which of the following plant tissues cannot be used as explant in tissue culture?
   a. Collenchyma
   b. Meristem
   c. Parenchyma
   d. Sclerenchyma

7. The hybridisation between naturally incompatible plants like potato and tomato can be achieved through
   a. mutation breeding
   b. artificial pollination
   c. somatic hybridisation
   d. conventional breeding

8. A chilly plant was severely infected with Chilly Mosaic Virus (CMV). Identify the technique that helps to raise virus free plants in the next generation from the above virus infected plant.
   a. Hydroponics
   b. Artificial hybridisation
   c. Meristem culture
   d. Self pollination

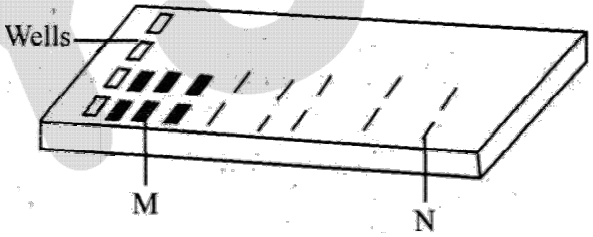
9. In sewage treatment, secondary treatment is considered highly significant, because
   a. it increases the organic content of sewage
   b. it helps to remove debris from the sewage
   c. it reduces the BOD level of sewage
   d. it helps in the production of biogas

10. Ruminant animals can digest cellulose in their food, whereas human beings are unable to do so. This is because
   a. methanogens are absent in human gut
   b. methanogens are present in human gut
   c. cellulose is a complex sugar
   d. cellulose reduces the bulk of food

11. From the given combinations of steps in PCR, identify the enzyme dependent step.
   a. Extension only
   b. Annealing and extension
   c. Annealing and denaturation
   d. Denaturation and extension

12. Biolistics method is suitable for gene transfer into _____.
   a. plant cells
   b. viruses
   c. animal cells
   d. bacteria

13. Identify the labels M and N in the following agarose gel electrophoresis representation.



   a. M - Smallest DNA bands, N - Largest DNA bands
   b. M - Digested DNA bands, N - Undigested DNA bands
   c. M - Hybridised DNA bands, N - Unhybridised DNA bands
   d. M - Largest DNA bands, N - Smallest DNA bands

14. In RNA interface, the dsRNA molecule prevents
   a. aminoacylation
   b. transcription of mRNA
   c. transport of RNA from nucleus to cytoplasm
   d. translation of mRNA

15. Now-a-days, the early diagnosis of bacterial or viral infection in humans is possible using
    a. CT Scan
    b. serum analyser
    c. DNA sequencer
    d. PCR

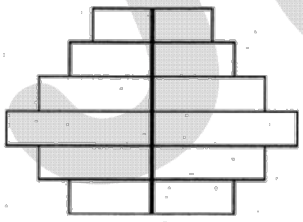
16. Which of the following features of plants is not helpful in adapting to desert life?
    a. Absence of trichomes on leaf surface
    b. Presence of thick cuticle on the leaf surface
    c. Leaves modified into spines
    d. Presence of sunken stomata

17. In the following equation of Verhulst-Pearl logistic growth, the letter 'r' denotes

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

    a. population density
    b. extrinsic rate of natural increase
    c. intrinsic rate of natural increase
    d. carrying capacity

18. The shape of the pyramids reflects the growth status of the population. Identify the type of age pyramid represented below for human population.



    a. Declining
    b. Ascending
    c. Expanding
    d. Stable

19. Identify the possible link 'M' in the following food chain:

    Plant → Insect → M → Snake → Eagle

    a. *Ichthyophis*
    b. Rabbit
    c. Wolf
    d. Frog

20. The organisms which invade a bare area to initiate an ecological succession are known as
    a. pioneer species
    b. key stone species
    c. climatic species
    d. endemic species

21. Which one of the following is not included under in-situ conservation?
    a. Biosphere reserve
    b. National park
    c. Sanctuary
    d. Botanical garden

22. Which one of the following is a wrong statement?
    a. Ozone in upper part of the atmosphere is harmful to animals
    b. Most of the forests have been lost in tropical areas
    c. Greenhouse effect is a natural phenomenon
    d. Eutrophication is a natural phenomenon in fresh water lakes

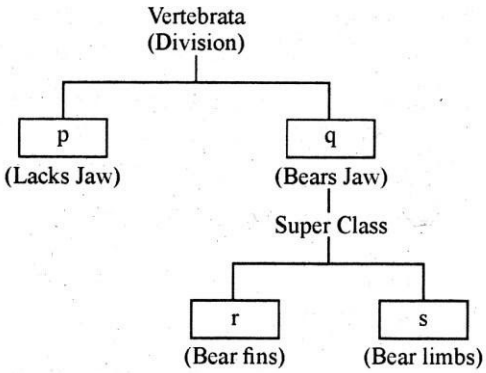
23. According to the Supreme Court of India, ruling with respect to 'Bharat Stage VI' Norms, from which date, these are supposed to be implemented in the country?
    a. 10th December, 2020
    b. 1st April, 2020
    c. 1st June, 2021
    d. 1st January, 2021

24. Match the following classes of fungi (Column-I) with the examples (Column-II).

Column I		Column II	
(1)	Phycomycetes	(p)	*Penicillium*
(2)	Ascomycetes	(q)	*Alternaria*
(3)	Basidiomycetes	(r)	*Albugo*
(4)	Deuteromycetes	(s)	*Puccinia*

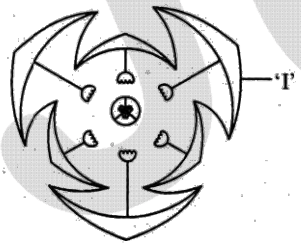
Choose the correct option:
    a. (1) - (r), (2) - (p), (3) - (s), (4) - (q)
    b. (1) - (p), (2) - (s), (3) - (r), (4) - (q)
    c. (1) - (q), (2) - (p), (3) - (s), (4) - (r)
    d. (1) - (r), (2) - (p), (3) - (q), (4) - (s)

25. Observe the following simplified scheme and choose the correct option that matches with the letters given in the boxes.



a. p - Agnatha, q - Gnathostomata, r - Tetrapoda, s - Pisces
b. p - Agnatha, q - Gnathostomata, r - Pisces, s - Tetrapoda
c. p - Gnathostomata, q - Agnatha, r - Tetrapoda, s - Pisces
d. p - Tetrapoda, q - Pisces, r - Gnathostomata, s – Agnatha

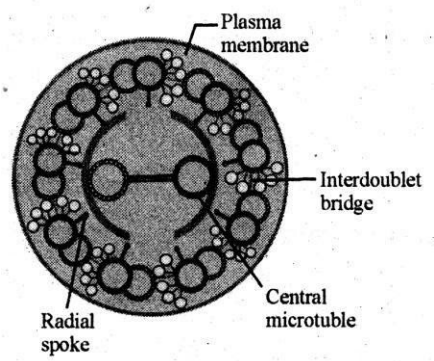
26. Identify the floral unit 'I' in the given floral diagram.



a. Perianth
b. Sepal
c. Petal
d. Tepal

27. A student observes grass and *Hibiscus* plants in his garden during noon. To his surprise, only the leaves of grass were found rolled inwards. The reason could be
a. due to higher rate of transpiration
b. presence of more number of stomata on the grass leaves
c. undifferentiated mesophyll in grass leaves
d. presence of bulliform cells in the grass leaves

28. In the below diagram, identify the part which connects the peripheral microtubules to the central sheath.



a. Radial spok
b. Plasma membrane
c. Interdoublet bridge
d. Central microtubule

29. The element whose percentage weight is highest in both Earth's crust and human body is
a. calcium
b. hydrogen
c. carbon
d. oxygen

30. Identify the event in meiosis mediated by the enzyme recombinase.
a. Interkinesis
b. Synaptic pairing
c. Terminalization
d. Crossing Over

31. The deficiency of which of these elements interrupts photolysis of water during photosynthesis?
a. N and P
b. Mn and Cl
c. Zn and Cu
d. Ca and K

32. In C_4 plants, C_3 cycle takes place in
a. bundle sheath cells
b. mesophyll cells
c. bulliform cells
d. companion cells

33. During citric acid cycle, the various organic acid undergo decarboxylation. Which of the following organic acids of the above cycle have 4C, 5C and 6C respectively?
a. Pyruvic acid, α-ketogluetaric acid and citric acid
b. Oxaloacetic acid, citric acid and succinic acid
c. Succinic acid, α-ketoglutaric acid and citric acid
d. Pyruvic acid, malic acid and α-ketoglutaric acid

34. Consider the following statements regarding photosynthesis and respiration in plants and select the correct option.

I. RuBisCO has high affinity to oxygen in low CO_2 concentration.
II. The Calvin pathway occurs in the chloroplast of bundle sheath cells of C_4 plants.
III. Yeast poison themselves when the concentration of alcohol reaches 7%.
IV. Oxygen is a final hydrogen acceptor during aerobic respiration.

a. Statements I & IV are correct, III is wrong
b. Statements II & IV are correct, I is wrong
c. Statements I & II are correct, IV is wrong
d. Statements I & III are correct, II is wrong

35. Match the digestive glands given in Column-I with their respective enzymes given in Column-II and choose the correct combination from the given options.

Column I		Column II	
(1)	Pancreas	(p)	Pepsin
(2)	Gastric glands	(q)	Enterokinase
(3)	Small intestine	(r)	Ptyalin
(4)	Salivary glands	(s)	Trypsin

Choose the correct option:

a. (1) - (q), (2) - (s), (3) - (r), (4) - (p)
b. (l) - (p), (2) - (q), (3) - (r), (4) - (s)
c. (1) - (s), (2) - (p), (3) - (q), (4) - (r)
d. (1) - (r), (2) - (q), (3) - (p), (4) - (s)

36. Match the different types of leucocytes (Column-I) with their percentage of occurrence (Column-II) in a healthy adult human and choose the correct answer.

Column I		Column II	
(1)	Neutrophils	(p)	6 - 8 %
(2)	Lymphocytes	(q)	60 - 65 %
(3)	Monocytes	(r)	0.5 - 1%
(4)	Basophils	(s)	2 - 3 %
(5)	Eosinophils	(t)	20 - 25 %

Choose the correct option:

a. (1) - (q), (2) - (t), (3) (p), (4) - (r), (5) - (s)
b. (1) - (q), (2) - (r), (3) - (s), (4) - (t), (5) - (p)
c. (1) - (r), (2) - (s), (3) - (t), (4) - (q), (5) - (p)
d. (1) - (q), (2) - (t), (3) - (r), (4) - (s), (5) - (p)

37. In which part of the human of the human brain corpora quadrigemina is located?

a. Cerebral hemisphere
b. Forebrain
c. Hindbrain
d. Midbrain

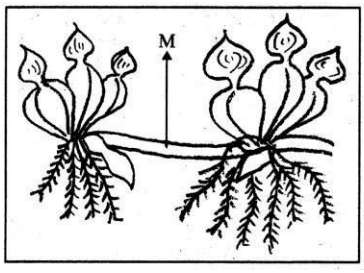
38. A girl after attaining sexual maturity shows development of growing ovarian follicles, development of mammary glands and high pitch of voice. These changes are attributed to _____ hormones.

a. androgens
b. melatonin
c. estrogens
d. progesterone

39. In apple, the chromosome number of gametes is 17. What is the chromosome number in its primary endosperm nucleus (PEN)?

a. 51
b. 34
c. 68
d. 17

40. Identify the vegetative propagule 'M' in the following diagram:



a. Runner
b. Bulbil
c. Offset
d. Rhizome

41. During an excavation of soil, pollen fossils were retrieved from the deepest layer of soil. The pollen grains remained as fossils because
a. pollen grains are asexual reproductive structures
b. the intine of pollen grains is made up of pectin
c. exine has spiny ornamentation
d. the exine of pollen grains is highly resistant to enzyme action

42. Identify the mismatch.
a. Primary Endosperm Nucleus - Triploid
b. Antipodals - Haploid
c. Zygote - Diploid
d. Synergids - Diploid

43. Identify the correct order of events in pollen-pistil interaction from the options given below:
I. Release of male gametes into the embryo sac.
II. Deposition of pollen grains on stigma.
III. Entry of pollen tube into embryo sac.
IV. Development of pollen tube
V. Entry of pollen tube into the ovule.

a. V → IV → III → II → I
b. IV → III → II → I → V
c. II → IV → V → III → I
d. II → IV → III → V→ I

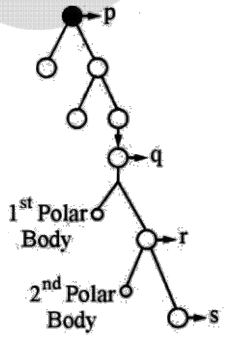
44. Match the months listed in Column-I with the organogenesis of foetus in Column-II.

Column I		Column II	
(i)	First month	(a)	Separation of eye lids
(ii)	Second month	(b)	Hairs on head
(iii)	Fifth month	(c)	Heart
(iv)	Six month	(d)	Limbs and digits

	(i)	(ii)	(iii)	(iv)
a.	(c)	(d)	(b)	(a)
b.	(c)	(d)	(a)	(b)
c.	(b)	(c)	(d)	(a)
d.	(d)	(b)	(c)	(a)

45. When the fallopian tube is blocked at ampullary region, the ovum fails to move from
a. infundibulum to isthmus
b. isthmus to infundibulum
c. ovary to ampulla
d. isthmus to uterus

46. Identify the cells represented as p, q, r and s in the schematic representation of oogenesis, shown below and choose the correct option.



a. p - Oogonia, q - Primary oocyte, r - Secondary oocyte, s - Ovum
b. p - Ovum, q - Oogonia, r - Primary oocyte, s - Secondary oocyte
c. p - Secondary oocyte, q - Primary oocyte, r - Ovum, s - Oogonia
d. p - Ovum, q - Secondary oocyte, r - Primary oocyte, s - Ovum

47. Which of the following contraceptives could be effective in avoiding pregnancy if used within 72 hours after casual unprotected intercourse?
    a. Progestogen – Estrogen combination
    b. Androgen – FSH combination
    c. Testosterone – Relaxin combination
    d. Relaxin – Oxytocin combination

48. Choose the correct statement regarding the GIFT (Gamete Intrafallopian Tube Transfer) procedure.
    a. Ova are collected from a female donor and are transferred to the uterus of recipient
    b. Ova collected from a female donor are transferred to the fallopian tube to facilitate zygote formation in the recipient
    c. Zygote is collected from female donor and transferred to the fallopian tube of recipient
    d. Zygote is collected from a female donor and transferred to the uterus of recipient

49. Which of the following characters was not studied by Mendel in his pea plant experiments?
    a. Leaf shape
    b. Stem height
    c. Pod shape
    d. Seed shape

50. In an organism, mutation in a single gene exhibits multiple phenotypic expressions. Identify the underlying genetic mechanism in the above instance.
    a. Multiple allelism
    b. Pleiotropy
    c. Incomplete dominance
    d. Polygenic inheritance

51. A pure breeding pea plant with round yellow seeds was crossed with a pea plant having wrinkled green seeds. On selfing of F_1 hybrid of his cross, 64 progenies were obtained in the F_2 generation. Find out the number of F_2 progenies showing non-parental characters.
    a. 24
    b. 36
    c. 4
    d. 12

52. A man with blood group A marries a woman having blood group B. The maximum possible blood groups among their progenies are
    a. A, B, AB, O
    b. AB only
    c. A, B, AB
    d. A, B

53. The length of DNA helix in a typical nucleosome is
    a. 6.6 × 109 bp
    b. 200 bp
    c. 1000 bp
    d. 3.2 × 106 bp

54. Which of the following types of RNA carries amino acids towards the ribosome during translation?
    a. mRNA
    b. rRNA
    c. dsRNA
    d. tRNA

55. In eukaryotes, the entire base sequence of a gene do not appear in mature RNA because
    a. some gene sequences are removed by exonuclease
    b. transcription in eukaryotes consumes more energy
    c. coding sequences are removed during processing
    d. introns are removed during processing

56. Suppose DNA samples collected for DNA fingerprinting analysis are less than the required quantity. Which of the following techniques is helpful to make the samples sufficient for above analysis?
    a. DNA probing
    b. Electrophoresis
    c. Chromatography
    d. PCR

57. When *Escherichia coli* cells are cultured in a medium where lactose is absent, the 'i' gene of *Lac Operon* continues to produce repressor mRNA, because it is
    a. a structural gene
    b. a non-coding gene
    c. an operator gene
    d. a constitutive gene

58. For the given sequence of DNA, identify the complementary sequence of bases on its mRNA from the options given below:

    DNA 3′ – ATGCATGCATGC – 5′

    a. 5′ – GCATGCATGCAT – 3′
    b. 5′ – UACGUACGUACG –3′
    c. 5′ – TACGTACGTACG – 3′
    d. 3′ – UACGUACGUACG –5′

59. Which among the following was the biggest land dinosaur?
    a. *Triceratops*
    b. *Stegosaurus*
    c. *Tyrannosaurus rex*
    d. *Brachiosaurus*

60. In a population of plants, some were extremely tall and the remaining were extremely dwarf. No plants of the population showed intermediate height. The type of operation of natural selection in the above case is
    a. disruptive
    b. balancing
    c. directional
    d. stabilizing

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ANSWER KEYS

1. (d)	2. (c)	3. (a)	4. (d)	5. (c)	6. (d)	7. (c)	8. (c)	9. (c)	10. (a)
11. (a)	12. (a)	13. (d)	14. (d)	15. (d)	16. (a)	17. (c)	18. (a)	19. (d)	20. (a)
21. (d)	22. (a)	23. (b)	24. (a)	25. (b)	26. (d)	27. (d)	28. (a)	29. (d)	30. (d)
31. (b)	32. (a)	33. (c)	34. (a)	35. (c)	36. (a)	37. (d)	38. (c)	39. (a)	40. (c)
41. (d)	42. (d)	43. (c)	44. (a)	45. (a)	46. (a)	47. (a)	48. (b)	49. (a)	50. (b)
51. (a)	52. (a)	53. (b)	54. (d)	55. (d)	56. (d)	57. (d)	58. (b)	59. (c)	60. (a)

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Solution

1. (d)
The ability of the body to fight against the pathogen is called immunity.

The immunity which is developed after the direct exposure to the pathogen or antigen is called active immunity. In this immunity, a person's own cells produce antibodies in response to infection.

The immunity gained by an organism through vaccines or antidotes is known as passive immunity. In this type of immunity, there will be no exposure to the pathogen directly. Ready-made antibodies are directly injected into a person to protect the body against foreign agents such as the snake poison. Thus, injection of an antidote of a snake is an example of passive immunity.

When the immune system recognises the body cells as a foreign substance and attacks one's own healthy body cells, such immunity is known as autoimmunity.

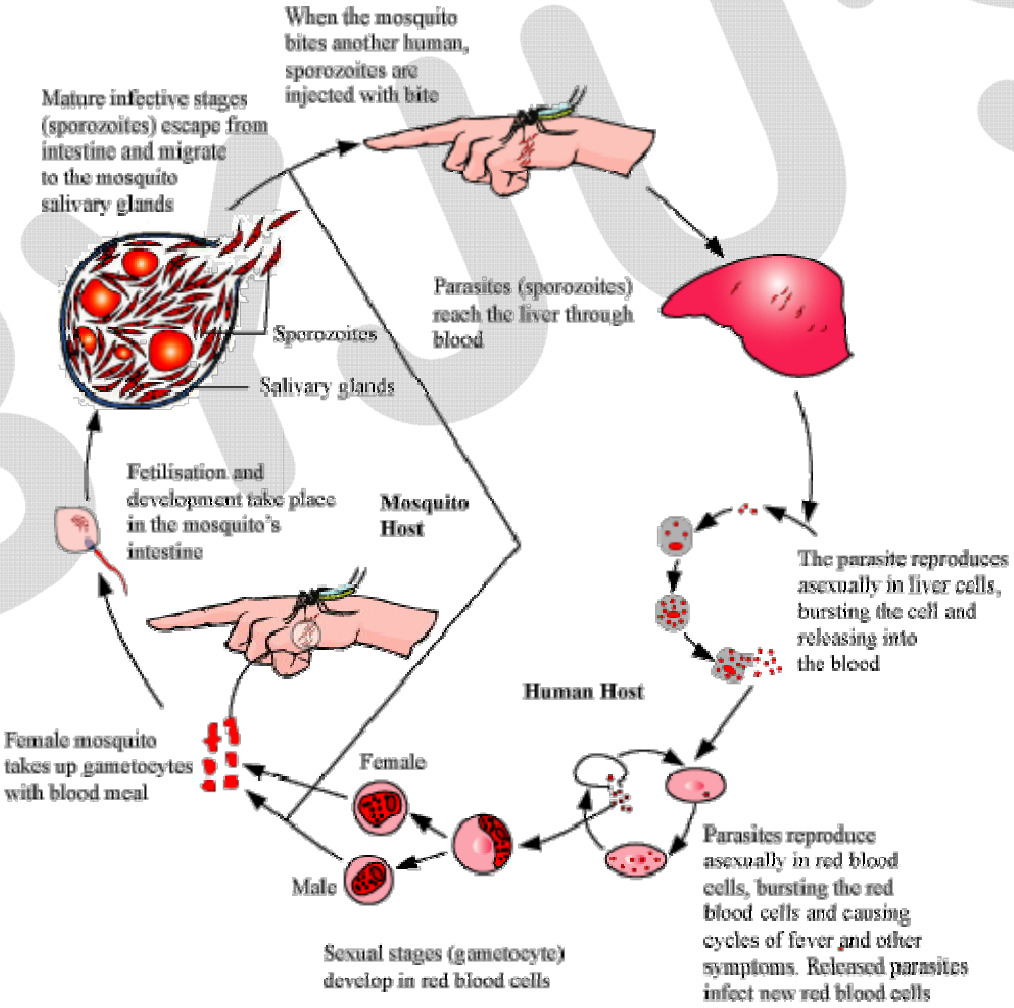
The immunity that is present since the time of birth is called innate immunity. This type of immunity is inherited from the parents and protects the individual throughout his life.

2. (c)
The uncontrolled growth of cells is called tumour or neoplasm. Tumours are considered to be either malignant or benign. Those tumours that are stagnant at one part of the body and do not spread are called benign tumours. But certain tumours invade and damage the surrounding tissues. Such tumours are known as malignant tumours. Only malignant tumours are properly designated as cancerous. Normal cells show a property called contact inhibition. Due to this property, when they are in contact with other cells the cell proliferation ceases. Cancer cells do not show the property of contact inhibition. A phenomenon in which the cancerous cells spread to distant sites in the body is called metastasis.

3. (a)
Dopamine, serotonin, acetylcholine and GABA (gamma-aminobutyric acid) are various types of neurotransmitters which are present in the synaptic knob of the neurons.

Cocaine interferes with the transport of the neurotransmitter dopamine. Cocaine attaches to the dopamine transporter, the molecular channel that takes up free-floating dopamine from the synapse back into the sending neuron. As long as cocaine occupies the transporter, dopamine cannot re-enter the neuron. The concentration of dopamine hence builds up synapse, stimulating receiving-neuron receptors more and producing much greater dopamine impact on the receiving neurons than what occurs naturally. This causes a stimulating action on CNS, producing a sense of euphoria and increased energy. An excessive dosage of cocaine causes hallucinations.

4. (d)



The malarial parasite *(Plasmodium)* undergoes its life cycle in two different host organisms - female *Anopheles* mosquito and human. The sexual stage of its life cycle occurs in the female *Anopheles* mosquito, and asexual stage occurs in the human body.

When a female *Anopheles* mosquito bites a healthy person, the malarial parasite (in its infective sporozoite stage) is injected into his blood. The sporozoites are present in the salivary glands of the mosquito, enter the blood of the human and travel to the liver. In the liver, the sporozoites multiply asexually and form schizonts. These schizonts infect the RBC and multiply further to form the merozoites. The merozoites give rise to the male and female gametocytes. When a female *Anopheles* mosquito bites this individual, it takes up the gametocytes with the blood. In the stomach of the mosquito, the fertilisation of these gametes occurs. The mature infective stages called sporozoites then develop and migrate to the salivary glands of the mosquito. When this mosquito bites a healthy human again, the sporozoites are introduced into the human body, and the cycle continues.

5. (c)

The table given below gives the varieties of crops which are resistant to some diseases:

Crop	**Variety**	**Resistance to diseases**
Wheat	Himgirl	Leaf and stripe rust, hill bunt
Brassica	Pusa swarnim (Karan rai)	White rust
Cauliflower	Pusa shubhra, Pusa Snowball K-1	Black rot and Curl blight black rot
Cowpea	Pusa Komal	Bacterial blight
Chilli	Pusa Sadabahar	Chilly mosaic virus, Tobacco mosaic virus and Leaf curl

6. (d)

An explant is a piece of plant tissue or part which is used in tissue culture for regeneration. It is used to grow a new plant in a cultured medium. Meristem, collenchyma and parenchyma are made up of living cells. Thus they can be used as explants. Whereas sclerenchyma is made up of dead cells, thus it cannot be used as an explant.

7. (c)
Mutation breeding refers to the process by which the seed is exposed to radiation or chemicals in order to develop an improved mutant variant. It can help to improve individual plants yield and resistance properties.

Conventional breeding is the development of new varieties (cultivars) of plants by using natural processes and traditional methods such as selection and breeding of high yielding varieties. Since potato and tomato belong to two different species and thus cannot be hybridised by conventional breeding methods.

A pollination technique in which the desired pollen grains are used for pollination by artificial means is known as artificial pollination. Since potato and tomato are incompatible, even artificial pollination cannot be used as the pollen grains will not germinate to form the pollen tube on incompatible species.

The fusion of the protoplasm of two different plant cells in order to produce a hybrid variety is called somatic hybridisation. The protoplasts of two plants can be made to fuse with a chemical called Polyethylene glycol (PEG). Thus, somatic hybridisation would be the best suitable method in developing the hybridised variety between potato and tomato.

8. (c)
The cells which have the ability to divide and result in the growth of the plant are called meristem. The meristem is free from the virus even though the plant is infected with a virus. This is because the division of meristematic cells is faster than the rate of replication of the virus, less differentiation of meristematic cells, etc. Thus to develop a virus-free plant, culturing the meristem would be a suitable option.

Cultivation of plants without soil and just by the use of nutrient-rich water is called hydroponics.

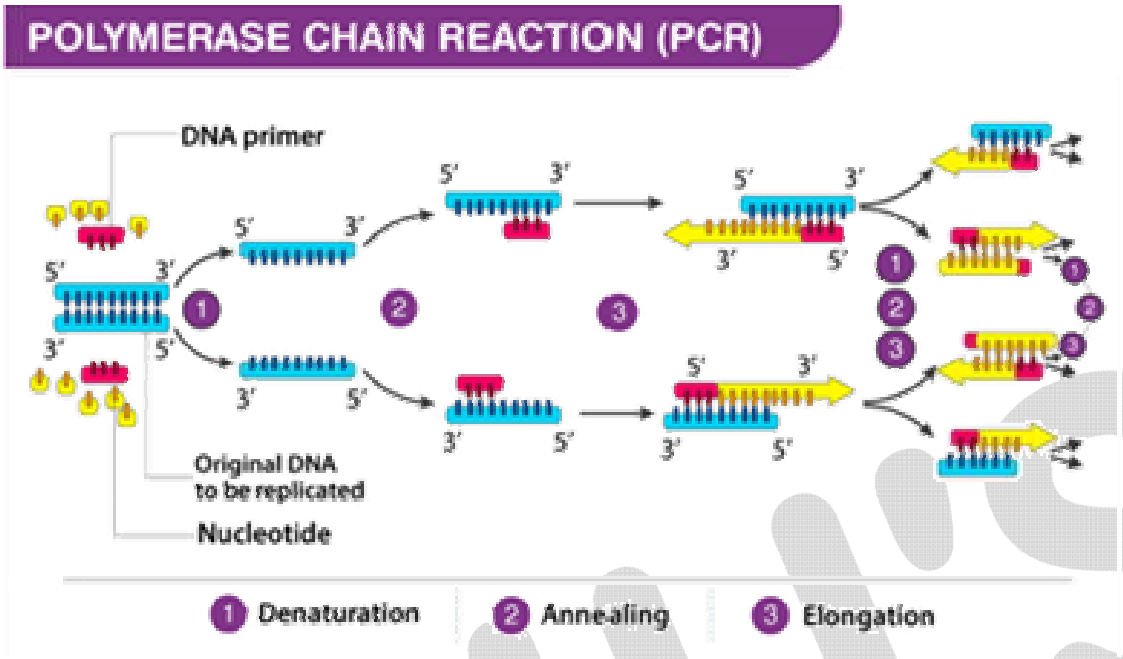
Transfer of pollen grains from the anther to the stigma of the same flower or different flowers of the same plant is called self-pollination.

A hybridisation technique in which the desired pollen grains are used for pollination by artificial means is called artificial hybridisation.

9. (c)
The primary stage of the sewage treatment includes the removal of floating wastes. This process is done mechanically and does not involve any living organisms. Whereas the secondary stage is also known as the biological stage and uses the microorganisms in order to break down the organic matter and decrease the biochemical oxygen demand (BOD) level of the sewage. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one litre of water were oxidised by bacteria. If the BOD level is high, the water is said to be polluted. Thus before the deposition of the sewage water into the water bodies, the BOD level has to be reduced. Biological treatment ensures that the deposition of the sewage water into the water body does not pollute the water body by reducing the BOD of the sewage water.

10. (a)
Methanogens are bacteria that produce methane during the breaking down of substrates like cellulose. Plants are the major food consumed by ruminant animals. Cellulose is a polymer of glucose found in the cell wall of plants. The gut of the ruminant animals have methanogens that help in the digestion of cellulose and produce methane.
Methanogens are absent in the case of human beings. Because of this reason, humans are unable to digest cellulose.

11. (a)



Polymerase chain reaction includes three steps - denaturation, annealing and elongation or extension.

Denaturation - the process by which the DNA strands unwind and denature to form two separate strands. This step occurs at a very high temperature.

Annealing - the process by which the DNA primer attaches to the DNA template strand by complementary base pairing.

Elongation - it is the process of addition of nucleotides. A thermostable enzyme called Taq polymerase. This enzyme is extracted from the bacteria called *Thermus aquaticus*.

12. (a)

During the transfer of genes in rDNA technology, the gene which is modified has to be taken up by the host cells. Many methods are used to transfer the modified genes into the host cell. One such method is the biolistic or gene gun method, which is suitable for plant cells. In this method, tiny metal balls (like micro-particles of gold or tungsten) coated with the recombinant gene are propelled into the plant cell at high velocity.

13. (d)

The given diagram represents the gel electrophoresis technique. It is used to separate DNA fragments based on their sizes. The DNA fragments that have larger sizes travel a shorter distance than the smaller size DNA fragments from the wells under the influence of an electric field. Hence, 'M' represents the largest DNA bands since it has travelled a less distance from the well when compared to the distance travelled by the fragment 'N'.

14. (d)

Translation is the process of synthesising polypeptides by polymerisation of amino acids from information contained in mRNA. During translation, the adapter molecules called tRNA are complexed with amino acids (aminoacylation). The tRNAs carry the amino acids to the site of protein synthesis. The mRNA molecules are also transported to the site of protein synthesis (ribosomes) through a highly organised enzyme-mediated process.

RNA interference is a process by which a complementary double-stranded RNA is formed in order to silence an mRNA. This prevents the mRNA from further translating into protein as double-stranded RNA molecules cannot be translated.

15. (d)

PCR (polymerase chain reaction) is a technique that helps in the amplification of DNA. A small amount of DNA can be amplified by PCR. The pathogens that are difficult to culture in-vitro or require a long time to culture can be easily traced with this technique. So, this method helps in the early diagnosis of bacterial or viral infections in humans.

A serum analyser is used to analyse the components of the blood serum. Generally, these tests are not as accurate as PCR and may not give early diagnostic results.

CT scan (computed tomography scan) is a medical imaging procedure that uses a computer-processed technique to observe the cross-sectional images of a tissue or organ without cutting.

DNA sequencer is a scientific device used to sequence DNA.

16. (a)

Due to the less availability of water, the desert plants have modified themselves in order to prevent any water loss from its surface. The thick cuticle, leaves modified as spine and sunken stomata ensure that the rate of transpiration is reduced.

Trichomes are tiny hair-like structures present on the epidermis. Their functions include defence against insects, protection from excessive transpiration and high heat. Some trichomes modify to function as glands to secrete essential oils and resins. Hence, their absence is not helpful in adapting to desert life.

17. (c)

Verhulst-Pearl logistic growth is expressed by:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

where

N = population density at time t

K = the maximum number of organisms that can be supported by a habitat without environmental degradation is called carrying capacity

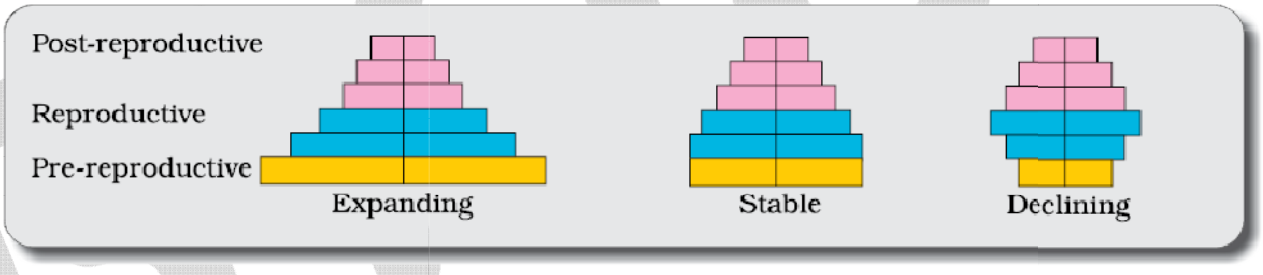
r = the number of birth rates minus the number of death rates in a population is called the intrinsic rate of natural increase.

18. (a)

If the number of organisms in the pre-reproductive age is less than that of the reproductive age, the population is said to be declining.

If there are equal numbers of organisms in the reproductive and pre-reproductive age, it is called a stable population.

If the number of organisms in the pre-reproductive age is more than the reproductive age, the population is said to be expanding.



19. (d)

A primary consumer consumes the plant. Thus insects are primary consumers since lots of insects feed on plant material. Frog is an example of secondary consumers since it feeds on insects and hence it should come after insect in the given food chain. Wolf and snakes are tertiary consumers. The secondary consumers are eaten by tertiary consumers. Thus in the given food chain, the frog will eat insect and in turn, the frog will be eaten by the snake.

Ichthyophis is a limbless amphibian which looks like a snake. Some species of *Ichthyophis* can feed on small snakes.

20. (a)

The organisms which invade a bare area to initiate an ecological succession are called pioneer species.

Those species that have a large impact over its environment compared to its abundance are called keystone species. Without the members of this keystone species, the ecosystem would either cease to exist or would become very different.

Species that are limited or confined to a particular region and nowhere else in the world are called endemic species.

21. (d)

Conservation of organisms in its natural habitat is called in-situ conservation. Biosphere reserves, national parks and sanctuaries are examples of in-situ conservation.

Ex-situ conservation is a type of conservation in which the threatened animals and plants are taken out from their natural habitat and placed in special settings where they can be protected and given special care. In a botanical garden, the plants grown are not grown in its natural habitat. Thus, it is an example of ex-situ conservation.

22. (a)

Ozone is present in the upper part of the atmosphere called the stratosphere. It is not harmful to animals. It acts as a shield absorbing ultraviolet radiation from the sun. Only the ozone present in the lower part of the atmosphere is harmful. Ozone can destroy certain plant tissues, cause haemorrhages, eye irritation, etc.

The greenhouse effect is a natural phenomenon which is responsible for the warming of Earth's surface and atmosphere. But due to the exploitation of nature by humans like the deforestation in tropical areas, the greenhouse effect is aggravated.

Eutrophication is the natural ageing of a lake due to biological enrichment of its water. It can be fastened because of the activities of human beings.

23. (b)

There are a set of norms laid down by the government, which has to be followed by every automobile industry in order to control air pollution. The vehicles have to adhere to these norms. Currently, the vehicles that are being released in the market are Bharat Stage-VI (BS-VI) vehicles. This norm was effective from 1st April 2020.

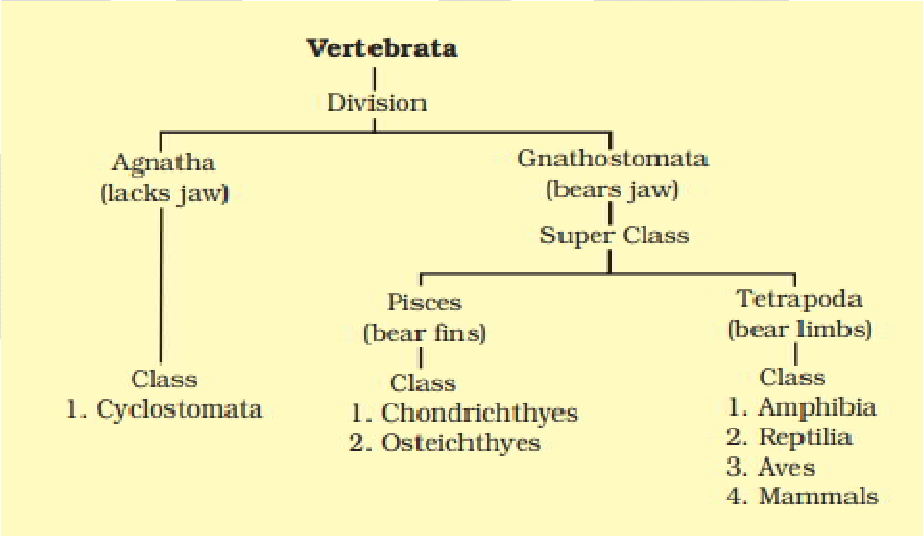
24. (a)

The following are the classes of fungi with examples:

Column I		Column II	
(1)	Phycomycetes	(r)	*Albugo*
(2)	Ascomycetes	(p)	*Penicillium*
(3)	Basidiomycetes	(s)	*Puccinia*
(4)	Deuteromycetes	(q)	*Alternaria*

25. (b)

Vertebrates that lack jaws are known as Agnatha, and those vertebrates with jaws are called Gnathostomata. The Gnathostomata is divided into two superclasses based on the presence of limbs or fins for locomotion. Those organisms that have limbs for locomotion are called Tetrapods. Those organisms that bear fins for locomotion are called Pisces. The Pisces are aquatic, whereas the Tetrapods are mostly terrestrial.



26. (d)

The parts of the flowers are represented using various shapes in a floral diagram. A floral diagram provides information about the number of parts of a flower, their arrangement and the relation they have with one another. Different parts of a flower like calyx, corolla, androecium and gynoecium are drawn in successive whorls. The outer part of the flower, which consists of the corolla and calyx is called the perianth. Perianth refers to the condition when there is no distinction between sepals and petals. The individual parts of the perianth are known as tepals. Hence, the individual floral unit marked in the diagram is tepal.

27. (d)

Grass is a monocotyledonous plant whereas *Hibiscus* is a dicotyledonous plant. Presence of bulliform cells is a characteristic feature of monocot leaves. Bulliform cells are epidermal cells present in the epidermis of monocot leaves. When the bulliform cells in the leaves absorb water and become turgid, the leaf surface gets exposed. When they are flaccid due to water stress, they make the leaves curl inwards to minimise water loss. Thus, the leaves of grass fold due to the presence of bulliform cells.

28. (a)

The given diagram represents the arrangement of microtubules in 9+2 fashion. This type of arrangement is observed in the cross-section of cilia and flagella. There are nine doublets of microtubules (peripheral microtubules) arranged on the periphery and two microtubules in the centre which are called central microtubules. The peripheral microtubules are connected to the central sheath by radial proteinaceous columns called radial spokes.
Interdoublet bridge is the linker which connects the peripheral microtubules.
The phospholipid layer present outside the cell, which is semi-permeable is called the plasma membrane.

29. (d)

The following are the percentage of some elements in Earth's crust and the human body:

Element	% Weight of	
	Earth's crust	Human body
Hydrogen (H)	0.14	0.5
Carbon (C)	0.03	18.5
Oxygen (O)	46.6	65.0
Nitrogen (N)	Very little	3.3
Sulphur (S)	0.03	0.3
Sodium (Na)	2.8	0.2
Calcium (Ca)	3.6	1.5
Magnesium (Mg)	2.1	0.1
Silicon (Si)	27.7	Negligible

From the above-given table, it can be inferred that oxygen is the element which is most abundant in both humans as well as Earth's crust.

30. (d)

Between the meiosis I and meiosis II, the phase where the cell rests is called the interkinesis or interphase II.

During the prophase I of meiosis I, the homologous chromosome crossover and recombination of genes occur. This process is facilitated by an enzyme called recombinase. This occurs in the pachytene stage of prophase I of meiosis I.

Termination of chiasmata is the final stage of meiotic prophase I in which the displacement of chiasmata to the ends of chromosomes occurs. The chromosomes are fully condensed and the meiotic spindle is assembled to prepare the homologous chromosomes for separation.

Synapsis refers to the process of attachment or pairing of homologous chromosomes in the zygotene stage of prophase 1 of meiosis 1.

31. (b)

Mn and Cl are essential elements for the photolysis of water during photosynthesis.

Ca is associated with the growth of the plant and is required by meristematic and differentiating tissues.

Potassium helps to maintain an anion-cation balance in cells and is involved in protein synthesis, opening and closing of stomata, activation of enzymes and in the maintenance of the turgidity of cells.

Zn and Cu are essential in maintaining the metabolism in plants. Zn activates various enzymes, especially carboxylases. It is also needed in the synthesis of auxins. Cu is involved in redox reactions.

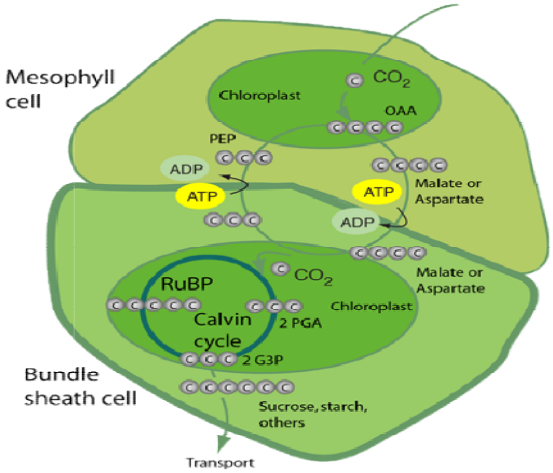
N and P are important for the overall development of plants in crop production. They are major constituents of many biomolecules.

32. (a)

Cells surrounding the vascular bundle are called the bundle sheath cells. The cells present between the upper and lower epidermis are called the mesophyll cells. In C_4 plants the fixation of carbon happens in the mesophyll cells, whereas the C_3 cycle or Calvin cycle occurs in the bundle sheath. This way, the C_4 plants are able to reduce the water loss due to transpiration. Diagramatic representation of the C_4 cycle is shown below.

The cells present in the epidermis of the monocot leaves that store water are called bulliform cells.

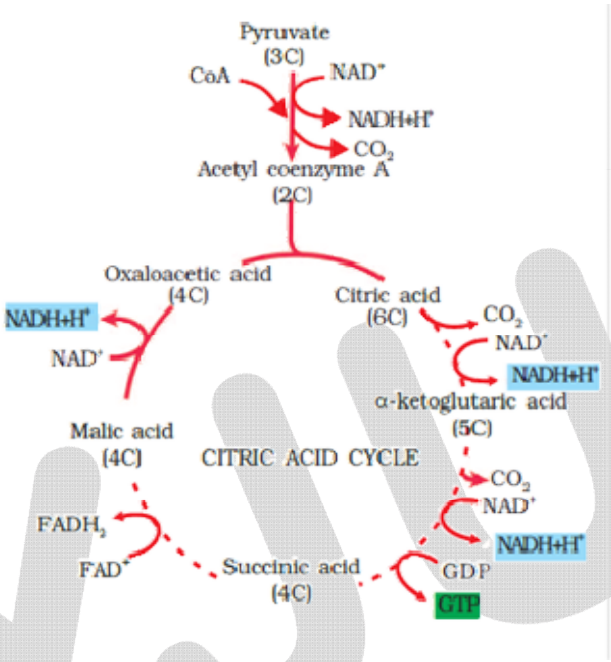
The companion cells are specialised parenchymatous cells which are part of phloem.



Diagramatic representation of C_4 cycle

33. (c)

In the citric acid cycle, a 4C oxaloacetic acid combines with 2C acetyl CoA to give rise to 6C citric acid. Isocitrate is an isomer of citric acid. The decarboxylation of citric acid produces a 5C α-Ketoglutaric acid. This further undergoes decarboxylation to give rise to 4C succinic acid and further converts to 4C malic acid and oxaloacetic acid. Pyruvic acid or pyruvate is a 3C compound. A representation of the citric acid cycle (Krebs cycle) is given below:



34. (a)

RuBisCO is an enzyme that acts as an oxygenase in low carbon dioxide concentration and acts as a carboxylase under high concentration of carbon dioxide. RuBisCO binds with oxygen at high temperatures and low CO_2: O_2 ratio and binds with carbon dioxide at low temperatures and high CO_2: O_2 ratio.

Yeasts poison themselves when the concentration of alcohol reaches around 13%.

The Calvin pathway occurs in the bundle sheath cells of the C_4 plants.

Oxygen is the final hydrogen ion and electron acceptor. The oxygen combines with the hydrogen ions and electrons to form water.

35. (c)
The following are the digestive glands with their correct enzymes:

Column I		Column II	
(1)	Pancreas	(s)	Trypsin
(2)	Gastric glands	(p)	Pepsin
(3)	Small intestine	(q)	Enterokinase
(4)	Salivary glands	(r)	Ptyalin

36. (a)
The table given below shows the different types of leucocytes with their percentage of occurrence in a healthy adult human:

Column I		Column II	
(1)	Neutrophils	(q)	60 - 65 %
(2)	Lymphocytes	(t)	20 - 25 %
(3)	Monocytes	(p)	6 - 8 %
(4)	Basophils	(r)	0.5 - 1%
(5)	Eosinophils	(s)	2 - 3 %

37. (d)
The cerebrum is made up of two hemispheres called the cerebral hemispheres. The brain is divided into three parts - forebrain, midbrain and hindbrain.
Forebrain constitutes cerebrum, thalamus and hypothalamus.
Midbrain constitutes the corpora quadrigemina which contains reflex centres involving eye movements and auditory responses.
Hindbrain constitutes the pons, medulla and cerebellum.

38. (c)

Estrogens are female sex hormone produced by the ovary. It acts on the stimulation of growth, activities of female secondary sex organs, development of growing ovarian follicles, the appearance of female secondary sex characters (e.g., high pitch of voice, etc.) and mammary gland development. Estrogens also regulate female sexual behaviour.

Androgens are male sex hormones which are responsible for the secondary sexual characteristics in male.

Melatonin is a hormone released by the pineal gland. It regulates the circadian rhythms (variations following a 24-hour cycle) of our body.

Progesterone is a hormone released by the corpus luteum which is responsible for maintaining the pregnancy in human females.

39. (a)

The apple plant is an angiosperm plant. The gametes are haploid cells and PEN in angiosperms is triploid. Thus if the number of chromosomes in gametes is 17, then thrice the number is seen in PEN. Therefore, the number of chromosomes in the PEN is 17 X 3 = 51.

40. (c)

The runner is a long thin stem that usually grows horizontally along the ground and produces roots and shoots at widely spaced nodes, as in *Oxalis, Cynodon* (lawn grass), etc.

Offsets are similar to runners. They are also horizontal stems on the ground and give rise to roots and vertical branches at the nodes. These are one internode long runners. The given diagram represents *Eichhornia* which is an example of an offset.

Bulbil is a condensed axillary bud. It acts as a reproductive structure and helps in vegetative reproduction. Bulbil is seen in *Agave.*

Rhizomes may be horizontal, oblique or upright stems that grow underground. The stem is differentiated into nodes and internodes. For example: Ginger.

41. (d)

The pollen grain consists of two layers - intine (inner layer) and exine (outer layer). The exine is covered by a chemically inert substance called sporopollenin which is one of the most resistant organic materials. Due to this, the pollen grains do not get destroyed by any external condition or enzymatic activity. So, pollen grains can remain as fossils.

42. (d)

The nucleus formed by the fusion of a male gamete and two nuclei of the central cell is called the primary endosperm nucleus (PEN). This process is known as triple fusion. Therefore the primary endosperm nucleus is triploid.

A zygote is formed by the fusion of haploid male and female gamete. Thus it will be diploid.

During the embryo sac formation, the haploid cells form the antipodal cells and synergids. Thus the pair that is mismatched is option (d).

43. (c)

Transfer of pollen grains from the anther to the stigma is called pollination. Once the pollen grains are deposited on the stigma, the vegetative cell gives rise to the pollen tube. The pollen tube then enters into the embryo sac. The generative cell divides and gives rise to the male gametes. These gametes travel through the pollen tube and enter into the embryo sac. So, the correct sequence is option (c).

44. (a)

The sequence of organogenesis during embryonic development is as follows:

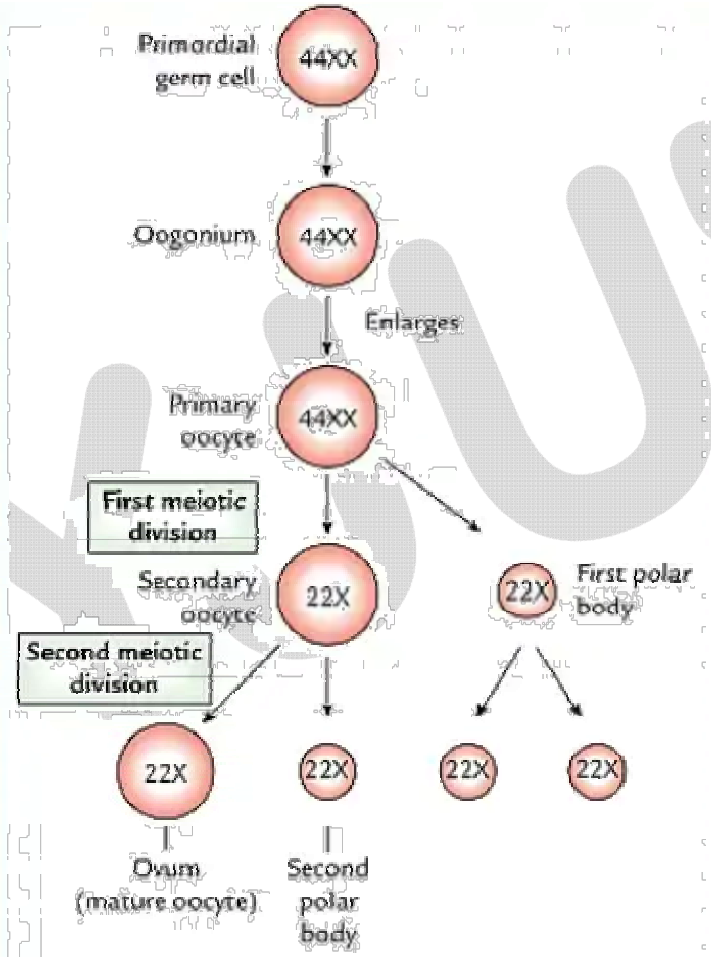
Column I		Column II (Organ development)	
(i)	First month	(c)	Heart
(ii)	Second month	(d)	Limbs and digits
(iii)	Fifth month	(b)	Hairs on head
(iv)	Six month	(a)	Separation of eye lids

45. (a)

The fallopian tube is divided into three regions - infundibulum, ampulla and isthmus. The funnel-shaped region of fallopian which is closer to the ovary is called the infundibulum.
The region of the fallopian tube which is closer to the uterus is called the isthmus. The region between the infundibulum and isthmus is called the ampulla. The ovum moves from the infundibulum to the isthmus through the ampullary region. Therefore if the ampulla is blocked, the ovum cannot move from infundibulum to isthmus.

46. (a)

In a girl child, the oogonium multiplies by mitosis in the foetal stage. The oogonium (p) undergoes the growth phase and gives rise to the primary oocyte (q). After the girl attains puberty, the primary oocyte undergoes first meiotic division to produce a large secondary oocyte (r) and the small 1st polar body. The polar body is degenerative in nature. During ovulation, the Graafian follicle rupture and releases the secondary oocyte. The secondary oocyte undergoes the second meiotic division in the fallopian tube resulting in the formation of ovum and a second polar body.



Oogenesis

47. (a)

Progestogen-estrogen combination prevents ovulation, changes the lining of the uterus and prevents implantation. Thus administering progestogen- estrogen within 72 hours of coitus would be an effective contraceptive method.

Relaxin helps in the process of relaxing the pelvis and widening of the cervix during parturition.

Androgens are male sex hormones that are responsible for the secondary sexual characters in males. Testosterone is a type of androgen hormone.

FSH is a hormone released by the pituitary gland that stimulates the growth of follicles in the ovary in females and also regulates spermatogenesis in the male.

Oxytocin is a hormone released by the pituitary gland and is responsible for contraction of the uterus during parturition.

48. (b)

In GIFT, the gamete (ova) is collected from the female donor and is transferred into the fallopian tube. At the ampullary-isthmus junction of the fallopian tube, the fertilisation process occurs.

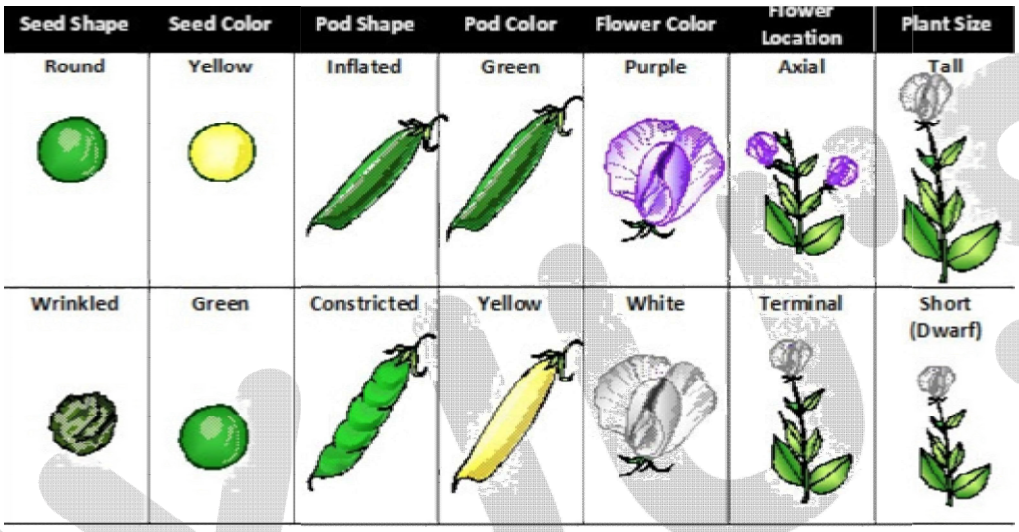
If the embryo with more than eight blastomeres is transferred to the uterus of the mother or the surrogate mother, then this is called intrauterine transfer.

If the zygote (with up to 8 blastomeres) is transferred to the fallopian tube, then it is called the zygote intrafallopian transfer (ZIFT).

49. (a)

Due to the various contrasting characteristics, Mendel chose garden pea plant for his experiment. The various characters that were included in his experiment were - stem height, pod shape, seed shape, seed colour, pod colour, the position of flower, the colour of the flower. All the characters considered by Mendel exhibited two variations. For example - the variations of the character stem height were tall and dwarf.

Seven characters were chosen by Mendel:



50. (b)

A single gene controlling various phenotypes is called pleiotropy. Phenylketonuria is a genetic disorder in which a base substitution occurs in chromosome 12 is affected. But it affects multiple systems such as brain development, decreased pigmentation and eczema. This is an example of pleiotropy.

If a single phenotype is controlled by several genes, then that type of inheritance is called polygenic inheritance. For example - the colour of the skin is controlled by several genes.

When the dominant allele fails to completely dominate the recessive allele, the phenomenon is called incomplete dominance. Example: Pink flower colour in snapdragon.

The phenomenon in which a gene which has more than two types of alleles is called multiple allelism. For example: The blood group has three different alleles (I^A, I^B and i).

51. (a)

The F_2 phenotypic ratio in a dihybrid cross is 9:3:3:1. The first and last term in ratio i.e, 9 and 1 represent the parental genotypes while the second and third term i.e, 3 and 3 represent the recombinant genotypes. Therefore, the number of F_2 progenies out of 64 progenies showing non-parental characters will be = $\frac{6}{16}$ X 64 = 24.

52. (a)

A woman with blood group A can have either of the genotypes - I^AI^O or I^AI^A. A man with a blood group B can have either of the genotypes - I^BI^O or I^BI^B. Since the given question doesn't mention the specific genotype, thus any of the above-mentioned genotypes can be crossed. As a result of which there is a maximum possibility of obtaining all the blood groups (A, B, AB, O) among their progeny.

53. (b)

The DNA is wound around the histone proteins to form the nucleosome. The histone molecule is a complex made up of eight histone proteins - two molecules each of histones H2A, H2B, H3, and H4. In every nucleosome, around 200bp of DNA helix is wrapped around the histone octamer.

54. (d)

RNA is a nucleic acid which is made up of a ribose sugar, nitrogenous bases (adenine, uracil, guanine and thymine) and phosphate group. Transcription of DNA strand results in the formation of mRNA. Messenger RNA or mRNA has the coding sequence which is required to produce the protein through the process of translation.

Double-stranded RNA occurs in some viruses such as reovirus, wound tumour virus, etc.

The tRNA or transfer RNA is an adapter molecule which is meant for transferring amino acids to ribosomes for the synthesis of polypeptides. They have special sites onto which the amino acids can bind and are taken to the site of protein synthesis.

rRNA or ribosomal RNA is the most abundant RNA found in a cell. The rRNA is a constituent of ribosomes.

55. (d)

In prokaryotes, the DNA undergoes transcription and forms the mRNA. Whereas in eukaryotes the DNA undergoes transcription to form hn-RNA (heterogeneous RNA), which consists of coding (exons) and non-coding sequences (introns). Through the process of splicing the coding and non-coding sequences are separated. The exons are joined together using ligase enzymes. Now the resulting strand consists of only the coding sequence. The strand thus formed is called mRNA. Therefore in eukaryotes, the entire base sequence of a gene does not appear in mature RNA due to loss of introns during the process of splicing.

56. (d)

The process of creating copies of DNA is called DNA amplification. The polymerase chain reaction is a technique used for DNA amplification. Here, the double-stranded DNA molecules are subjected to high heat for denaturation. The denaturation causes the two strands of DNA to separate from each other. An enzyme called DNA polymerase synthesises complementary DNA on the separated stand leading to the formation of two double-stranded DNA fragments. This cycle is continued until a sufficient number of DNA copies have been created.

Electrophoresis is a technique used to separate the DNA fragments based on their size or length.

DNA probes are short complementary nucleotide sequences which are used to detect the presence of complementary DNA molecules. The probe molecules and complementary molecules undergo base pairing. Usually, the probe molecules are labelled with fluorescent or radioactive molecules to detect successful pairing.

Chromatography is a technique used to separate different components from a mixture. This technique is used in analysis, isolation and purification of components. The separation in chromatography can be based on charge, size, pH, affinity, etc.

57. (d)

The function of *Lac Operon* is to control the expression of genes for lactose metabolism. An operon consists of structural genes, operator gene, promoter gene and regulatory gene.
The structural genes (lac z, lac y and lac a) code for enzymes responsible for permeability and metabolism of lactose.

The operator gene interacts with a protein molecule or regulatory molecule which prevents the transcription of structural genes.
The promoter gene has a site where RNA polymerase can attach so that the genes can be transcribed.
The regulatory gene produces a repressor protein. It is synthesised all the time from the 'i' gene.
Such genes that undergo transcription continuously are called constitutive genes.
In the absence of the inducer (lactose) the repressor protein produced from the 'i' gene binds with the operator gene and inhibits the transcription of structural genes.
In the presence of the inducer (lactose), the repressor binds with the inducer and does not bind with the operator gene. This results in the transcription of structural genes.

58. (b)

DNA undergoes transcription to form a complementary mRNA strand. The process of copying genetic information from the template strand of DNA into RNA is called transcription. The strand of DNA with polarity 3' → 5' serves as the template strand. The transcription starts from the 3' end of the DNA and a new molecule of mRNA with 5' → 3' polarity is formed alongside the template strand. Since transcription results in the formation of mRNA, the complementary base to adenine would be uracil and not thymine. Thus the correct sequence of the complementary mRNA strand would be

5′ – UACGUACGUACG –3′

59. (c)

Among the following, *Tyrannosaurus rex* was the biggest land dinosaur. One of the largest fossils of this species measures up to 42 feet with a weight of about 14-15 metric tons.

Stegosaurus was a herbivorous dinosaur that measured around 23-40 feet in length and weighed around 5-7 metric tons.

Triceratops were also herbivorous dinosaurs that measured around 26 to 30 feet in length and weighed around 6-12 metric tons.

60. (a)

In the population of plants, tall and dwarf are the extreme phenotypes and medium height is the intermediate phenotype.

When nature selects the extreme phenotypes, the population is said to be disruptive. Here most of the members with intermediate height will be eliminated.

If the intermediate phenotype is chosen then the population is said to be stabilising. The directional selection is also called balancing selection.

If either of the extreme phenotypes is selected by nature then the population is directional. This means that in this type of selection, nature can favour tall or dwarf individuals and more individuals of that type will be present in the next generation.