Solution

Class 12 - Biology

2020-21 paper 5

Section A

1. **Name of cells:** Sertoli cells
   Location: Line up on the inner surface of seminiferous tubules.
2. 400 sperms
   100 ova
3. The genotype of parent = Tt.
   The genotype of dwarf progenies = tt
4. Surgical methods of contraception do not prevent gamete formation, rather they prevent transfer of gametes to reproductive channels and hence prevent conception.
5. This is example of mutualism.
   Mutualism is the way two organisms of different species exist in a relationship in which each individual benefits from the activity of the other. Similar interactions within a species are known as co-operation.
6. Phenylketonuria
7. Axial and violet.
8. Secondary metabolism (also called specialized metabolism) is a term for pathways and small molecule products of metabolism that are not absolutely required for the survival of the organism.
9. A nematode Meloidogyne incognita infect the roots of tobacco plants and causes a great reduction is yield.
10. The yeast *Monascus purpureus* is used for commercial production of stain. Stain competitively inhibits the enzyme responsible for cholesterol formation and thus helps in lowering the blood cholesterol level.
11. **(a)** Both assertion and reason are correct.
    Explanation: In Snapdragon flower, a cross between true-breeding white and red coloured flower produces a pink coloured flower in F1generation. This happens due to incomplete dominance of alleles over the other.

    OR

    (a) Both assertion and reason are correct
    Explanation: Duplicate genes are two or more genes found on different chromosomes that produce the same or nearly the same phenotypic effect in the dominant state. They produce the same intensity of effect even when present together.
12. **(a)** Both assertion and reason are correct.
    Explanation: The time between infection with the virus and the onset of symptoms of AIDS (the incubation period) ranges from a few months to ten years or more. Infected persons can spread the virus during the incubation period.
13. **(a)** Both Assertion and Reason are true
    Explanation: Synthesis of RNA from DNA is called transcription and it occurs in the nucleus of eukaryotic cells.
    DNA replication occurs in the cytoplasm of prokaryotes and in the nucleus of eukaryotes. Regardless of where DNA replication occurs, the basic process is the same.
    Synthesis of protein from RNA is called translation and it occurs in the cytoplasm of eukaryotic cells.
    Messenger RNA (mRNA) is a molecule in cells that carries codes from the DNA in the nucleus to the sites of protein synthesis in the cytoplasm (ribosome) where they can be joined together in specific order to make a specific protein.
14. **(a)** Assertion and reason both are correct statements and reason is correct explanation for assertion.
    Explanation: Genetic diversity: A single species might show high diversity at the genetic level over its distributional range. The genetic variation shown by the medicinal plant Rauwolfia vomitoria growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces. India has more than 50,000 genetically different strains of rice and 1,000 varieties of mango.

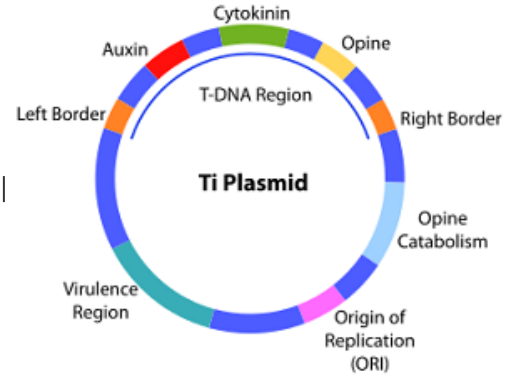
15. i. (c) Other organisms
    ii. (d) all of these
    iii. (a) revolution around the sun and tilted axis
    iv. (a) 18 – 25°C and 150 – 400 cm
    v. (b) Both Assertion and Reason are true but Reason is not the correct explanation of the Assertion
16. i. (b) Coleorhiza
    ii. (c) Primary endosperm nucleus
    iii. (a) Hypocotyl
    iv. (b) Scutellum
    v. (c) (D) stage in embryo development in dicot

Section B

17. (i) Maternal mortality rate
    (ii) In vitro fertilization
    (iii) Gamete intra fallopian transfer
    (iv) Assisted reproductive technologies.
18. The genotype of 50% of the offspring would resemble one parent and the rest of the other parent. All the F_1 offsprings of the cross are heterozygous so allowing self-pollination is sufficient to raise F_2 offspring. Also, he intended to understand the inheritance of the selected trait over generations.
19. mainly children, become blind every year, 50% of whom die within a year of becoming blind. Nearly nine million children die of malnutrion every year. Vitamin A deficiency (VAD) severely affects their immune system.
    Golden Rice has been engineered to contain the genes necessary to make up the biochemical pathway for pro-vitamin A production. Moreover, the genetic construct was designed to be expressed exclusively in the rice endosperm, ie in the edible part of the seed. The intensity of the golden colour is an indicator of the concentration of beta-carotene in the grain.
20. There are two advantages -
    (i) Any gene can be used for transfer.
    (ii) Change in genotype is precisely controlled.

    OR

    Because Penicillin is Intracellular Product, if use we E.Coli to overproduce this intracellular product cause increasing of number of product and cellular weight results metabolic imbalance and physically cell disruption and loss of cells. Penicillin will kill the antibiotic sensitive E.coli cells.
21. After splicing, tailing occurs at the $3'$ end of hnRNA.
22. A Ti or tumour inducing plasmid is a plasmid that often, but not always, is a part of the genetic equipment that Agrobacterium tumefaciens and Agrobacterium rhizogenes use to transduce their genetic material to plants.



    OR

    - By treating bacteria with cold calcium chloride or lysozyme.
    - Escherichia coli, Bacillus subtilis
23. The biological wealth of this planet benefits us from the diversity of life is :
    i. We respire oxygen from the air to keep alive and about 20% of oxygen in the atmosphere is produced by Amazon forest through photosynthesis.

ii. Food like cereals, pulses, fruits it all use to come from plants even tannins, lubricants, dyes, resins, perfumes all are the products come from nature.

24. Flowers of some plants open or close in response to light and darkness, the phenomenon is called photonasty. The movement can be due to changes in turgor or changes in growth (therefore K+ ion concentration usually controls such movement in plants).
25. Following are the observations made by the German naturalist, Alexender von Humboldt during his extensive explorations in South American jungles:
    1. Within a region, species richness increases with increase in the explored area but only up to a limit.
    2. The relationship between species richness and area for a wide variety of taxa is a rectangular hyperbola.

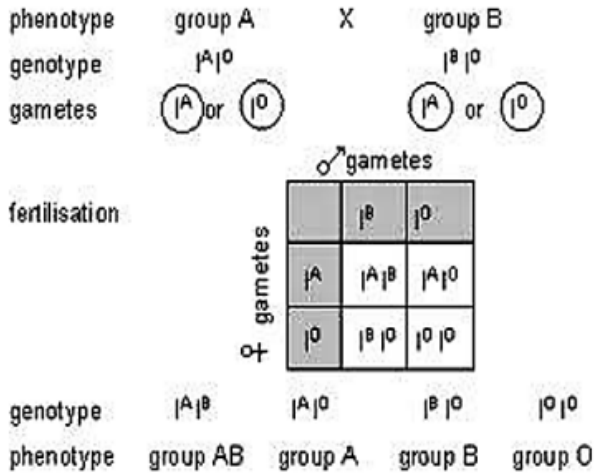
Section C

26. a. Loss(deletion) or gain (insertion / duplication /addition) or change in position of DNA segments / chromosome cause the mutation.
    b. Mutation due to change in a single base pair of DNA is point mutation, while insertion or deletion of one or two bases changes the reading frame from the point of insertion or deletion is frameshift mutation.
27. i. The doctor was assertive, patient and pragmatic.
    ii. It is possible if the parents are heterozygotes, i.e. Ai x Bi. If the child receives i from both the parents, it becomes ii, and expresses the O blood group. See the chart below:

Summary of possible Child blood types

Parent A blood type	Parent B blood type	possible Child Blood type
A	A	A, O
A	B	A, AB, B, O
A	AB	A, AB, B
AB	AB	A, AB, B
B	B	B, O
B	AB	A, AB, B
O	O	O
O	A	A, O
O	AB	A, B
Rh+	Rh-	RH+, Rh-
Rh-	Rh-	Rh-
Rh+	Rh+	Rh+, RH-

    iii. DNA fingerprinting
    iv. A or B or AB



28. There are many wrong beliefs and misconceptions about the AIDS. AIDS cannot be acquired by the following activities:

i. Insect bites
ii. Crowded transport
iii. Shaking hands
iv. Sharing towels
v. Coughing and sneezing
vi. Kissing and embracing
vii. Sharing utilities and telephone
viii. Swimmingpools and toilets.

29.

Euchromatin	Heterochromatin
1. The chromatin fibres in this region are loosely coiled as compared with hetero chromatic regions.	1.The chromatin fibres in this region are more tightly folded than euchromatic regions.
2. Euchromatin is deeply stained in divisional cycle but less stained in interphase.	2. Heterochromatin is deeply stained in interphase but less stained in divisional cycle.
3. The region is genetically active and contains unique DNA.	3. Heterochromatic regions are unable to synthesise mRNA in vitro.
4. Euchromatic regions are able to synthesise mRNA in vitro.	4. Heterochromatic regions are unable to synthesise mRNA in vitro size mRNA in vitro.
5. Euchromatic regions are seen to their DNA earlier than heterochromatin. They replicate during 'S' phase.	5. Heterochromatic regions are seen to replicate during the onset of divisional cycle.
6. Due to addition or loss of this region phenotype is affected.	6. Addition or loss of this region does not affect phenotype.
7. This region is not sticky.	7. This region is sticky.
8. The crossover frequency is more in euchromatin.	8. Crossover frequency is less than euchromatin.
9. Euchromatin does not show heteropycnosis.	9. Heterochromatin shows heteropycnosis.
10. Euchromatin is less affected than hetero-chromatin by temperature, sex, age, etc.	10. Heterochromatin is more affected than euchromatin by temperature, sex, age of parents, proximity to the centromere.

30. - Cellular barrier (Phagocytic)
- Macrophages arise by enlargement of monocytes. They are of two types - fixed and wandering. Fixed macrophages are located in the lining of blood and lymph capillaries in spleen, liver and bone marrow and are phagocytic in action.
The wandering macrophages occur in the connective tissue throughout the body and move to the site of infection like the leucocytes and dispose off the microbes.

OR

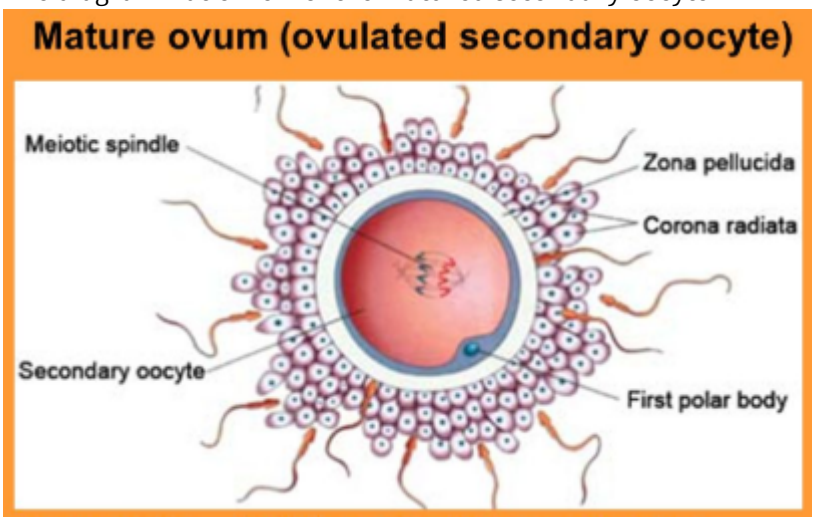
Ascariasis is an infection of the small intestine caused by Ascaris lumbricoides (A. lumbricoides), which is a species of roundworm. Roundworms are a type of parasitic worm.
Symptoms: Most of the time, there are no symptoms. If there are symptoms, they may include: Bloody sputum, Cough, Low-grade fever, Passing worms in stool,Shortness of breath, Skin rash Stomach pain,Wheezing, Worms exiting through the nose or mouth.

- Mode of transmission : Contaminated food and water which contain embryonated eggs of the parasite.

Section D

31. Post-zygotic events leading to implantation and placenta formation are as follows:
i. Fertilisation is the process of fusion of a sperm with an ovum.
a. The motile sperms move through the cervix, enter the uterus and reach the junction of the isthmus and ampulla (ampullary-isthmic junction) of the Fallopian tube.

b. The ovum released from the ovary also reaches the ampullary-isthmic junction, where fertilisation takes place.
c. Fertilisation can only occur if the ovum and sperms are transported simultaneously to this junction. This explains why all copulations do not lead to fertilisation and pregnancy.
d. The sperm comes in contact with the zona pellucida of the ovum and induces changes in the membrane, which blocks the entry of the other sperms. Thus, it ensures that only one sperm can fertilise an ovum, i.e. secondary oocyte.
e. The diagrammatic view of the matured secondary oocyte-



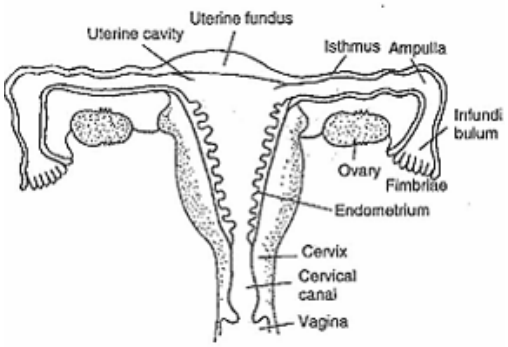
ii. The placenta is an organ that connects the developing foetus to the uterine wall for supporting pregnancy. After implantation, finger-like projections appear on the trophoblast called chorionic villi, which are surrounded by the uterine tissue and maternal blood. The chorionic villi and the uterine tissue become interdigitated with each other and jointly form a structural and functional unit between foetus and maternal body, i.e. placenta.

Functions of Placenta

a. It facilitates the supply of oxygen and nutrients to the embryo.
b. It also facilitates the removal of carbon dioxide and waste materials produced by the foetus.

OR

i.



ii. a. Follicular phase: It follows the menstrual phase and lasts for about 14 days. In the beginning, FSH and LH are secreted from the anterior pituitary upon a signal from hypothalamic GnRH, and stimulates follicular development as well as secretion of estrogen by the follicles.

- Initially, the increase in plasma estrogen levels inhibits FSH and LH through negative feedback. The decline in FSH tends to inhibit further follicle development except the dominant follicle selected for ovulation.
- Estrogen stimulates the proliferation of the endometrium, which becomes thicker by rapid cell multiplication.
- As the blood estrogen concentration continues to increase, it causes positive feedback stimulation on the pituitary and enhances the production of LH. Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge.

b. Luteal phase: The ovulation is followed by the luteal phase, which lasts for about 10 days in a 28-day cycle. During this phase, the remaining parts of Graafian follicle transform as the corpus luteum, which increases in size and is fully formed on the 19^{th} day.
   - Corpus luteum secretes progesterone hormone whose level in the blood increases (reaches maximum by 21^{st} day of cycle)
   - Progesterone stimulates the continued growth of the superficial layer of endometrium and endometrium becomes ready for implantation.
   - During pregnancy, all events of the menstrual cycle stop and there is no menstruation. In the absence of fertilization, the corpus luteum degenerates and causes the disintegration of the endometrium leading to menstruation, marking a new cycle.

32.

Recombinant proteins	**Therapeutic uses**
(a) Insulin	Used in diabetes mellitus
(b) OKT - 3	Therapeutic antibody, used for reversal of transplantation rejection.
(c) DNase	Treatment of cystic fibrosis
(d) Reo Pro	Prevention of blood clots
(e) Blood clotting factor VIII	Treatment of Haemophilia A
(f) Blood clotting factor IX	Treatment of Haemophilia B
(g) Tissue plasminogen activator	For acute myocardial infarction
(h) Interferon alpha (INF alpha)	Used for Hepatitis C
(i) Interferon beta (INF beta)	Used for multiple sclerosis
(j) Interferon gamma (INF gamma)	Used for granulomatous desease<

OR

i. Cutting of the desired gene at a specific location is done by incubating the DNA with specific restriction endonuclease. Restriction enzymes recognise a particular palindromic nucleotide sequence and cut the DNA at that site.

ii. Synthesis of multiple copies of the desired gene is carried out by Polymerase Chain Reaction (PCR)
Amplification of recombinant DNA gene is done using Polymerase Chain Reaction (PCR). It is carried out in the following steps:
   a. **Denaturation** -The double-stranded DNA is denatured by applying high temperature of 95°C for 15 seconds. Each separated strand acts as a template.
   b. **Annealing -** Two sets of primers are added, which anneal to the 3'end of each separated strand.
   c. **Extension -** DNA polymerase extends the primers by adding nucleotides complementary to the template provided in the reaction. Taq polymerase is used in the reaction, which can tolerate heat. All these steps are repeated many times to get several copies of the desired DNA.

33. Sewage or the municipal wastewaters are treated in Effluent Treatment Plant (ETP) prior to disposal in water bodies. The treatment consists of 3 steps: primary, secondary and tertiary.

i. Primary Treatment: It includes physical processing, such as sedimentation, floatation, shredding (fragmenting and filtering). This process removes most of the large floating and suspended solids.

ii. Secondary Treatment: It is a biological method to treat effluent.
Activated Sludge Method: Sewage, after primary treatment, is pumped into an aeration settling tank or oxidation pond. Here, it is mixed with air and sludge containing algae and bacteria-Bacteria consume the organic matter. The Process results in the release of CO_2 and the formation of sludge or biosolid. Algae produce oxygen for the bacteria. The water, which is now almost clear of organic matter, is chlorinated to kill microorganisms.

iii. Tertiary Treatment: It involves removal of mineral loads such as nitrates and phosphates by additional filtering and chemical treatment. The water, after the above treatment, is then released. It can be reused.

Another method of treatment is reverse osmosis. Water is rid of its salts by pumping it through a semi-permeable membrane under strong pressure.

OR

Biofertilisers are the organisms which increase the nutrient availability to the crop plants either directly or through soil enrichment. They play a role in increasing soil fertility and soil productivity. They are of three types-bacteria, cyanobacteria and mycorrhizal fungi. Bacteria and cyanobacteria function as biofertilisers because of their property of nitrogen fixation while mycorrhizal fungi preferentially withdraw minerals from decaying organic matter for the plant with which they are associated. Nitrogen fixation is the process of conversion of molecular or dinitrogen of the air into nitrogenous compounds.

Nitrogen-fixing bacteria and cyano-bacteria may be free-living or form a symbiotic association with the roots, stem & leaves of higher plants. For example, the Azolla-Anabaena association is of great importance to agriculture. *Azolla pinnata* is a free-floating freshwater fern which multiplies rapidly doubling every 5-7 days. The fern can co-exist with rice plants because it does not interfere with their growth. In some southeastern countries especially. China and in southern states in India rice fields are regularly provided with Azolla. Anabaena azollae residing in the leaf-cavities of fern> fixes nitrogen. A part of fixed nitrogen is excreted in cavities and available to the fern. The decaying fern plants, release the same for utilisation of the rice plants. When a field is dried at the time of harvesting the fern functions as green manure, decomposing and enriching the field for the next crop.