Biology 12th

Stepwise Marking Scheme (M.S)

1. C) Inflammatory response ------1
2. (c) It transcribes RNA to DNA. ------1
3. (b) During pregnancy, ------1
4. (b) spontaneous generation ------1
5. (a) 6 ------1
6. (C) Pink ------1
7. (d) Inducible gene expression ------1
8. (d) Sample B is collected from untreated sewage ------1
9. (c) DNA helicase ------1
10. (b) Producers (grasses) are the first trophic levels in a food chain. Herbivores (rabbits, mice) eat producers, so they are second trophic level. ------1
11. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. -----1
12. (d) Assertion is false, but Reason is false. ------1
13. Cloning sites are required to link foreign DNA with the vector DNA. These sites are also called recognition sites as these are recognised by the restriction enzymes. ------1
    An ideal vector should have single or very few cloning sites. If more than one recognition site is present within the vector, it will generate several fragments which will lead to more complications in gene cloning. ------1
14. (i) A – Condom, …….0.5 B – Copper-T C – Implants ……..0.5
    Condoms are better for prevention against STDs. They are 98% effective against STD transmission. ------1
    (ii) In these methods depicted in question there is a protection against unwanted pregnancy which is not assured with natural methods of contraception like lactational amenorrhea where a chance meeting of gametes can occur. ------1
15. This diagram represents a food web. …….0.5
    It is an interconnected network of food chains that operates in an ecosystem. Organisms at I-IV are most likely to be deer, rabbit, frog and rat, respectively. …….0.5
    Green plants are producers which occupy the first trophic level in all food chains (except detritus). This is because they can utilise the solar energy to form organic compounds during photosynthesis. They make food for themselves and for other organisms also. This is the reason that every organism in a food chain depends on them either directly or indirectly. …….1
16. (i) Contact inhibition is the property possessed by normal cells. Due to this the growth of cells stops, when they come in contact with other cells. But in case of cancer cells, this property is inactive or lost. As a result of it, cancer cells divide continuously to give rise to a mass of cells called tumours. …….1
    (ii) Cancer patients often given a-interferon (biological response modifiers) as a part of their treatment because it activates patient's immune system and helps in destroying the tumour. …….1
    17 (i) The wings of these organisms perform the same function, i.e. flight, although they have different origins and different structures. These organs are thus identified as analogous. …….1
    (ii) It is seen that in spite of a large number of organisms unlike in appearance they show most of the organs made on the same body plan. This provides evidence of common ancestry. …….1

Or

In a typical nucleus, some regions of chromatin are stained light because of loose packing of chromatin and some regions of chromatin are stained dark because the chromatin is densely packed. 1

Euchromatin is transcriptionally active chromatin (lightly stained), ...0.5

while heterochromatin (darkly stained) is transcriptionally inactive. 0.5

18 The pBR322 plasmid contains two selectable markers: **ampicillin (amp^R) and tetracycline (tet^R) resistance genes**. If a gene is inserted into the tet^R gene site, bacteria will be resistant to ampicillin but sensitive to tetracycline, allowing differentiation between recombinant and non-recombinant colonies. 1

Selectable markers in pBR322 help in identification and selection of transformants. pBR322, an E. coli cloning vector, has two antibiotic resistance genes, i.e. for ampicillin and tetracycline, which act as selectable markers. 1

19 The two ecosystem services are

1. Forest ecosystem mitigates droughts and floods and provides oxygen. 1
2. The wildlife helps in pollination of crops, without which fruits/seeds are not produced. 1

20. (i) The process shown above is called tubectomy. 1

(ii) This process takes place in the female reproductive system, then, cutting and binding of Fallopian tube is done to prevent contact between sperm and egg. Thus, help in prevention of pregnancy. 1

21. Spermatogenesis starts at the age of puberty due to significant increase in the secretion of Gonadotropin Releasing Hormone (GnRH). This is a hypothalamic hormone. 0.5

The increased levels of GnRH then act at the anterior pituitary gland and stimulate secretion of two gonadotropins – Luteinising Hormone (LH) and Follicle Stimulating Hormone (FSH). 0.5

LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, in turn, stimulate the process of spermatogenesis. 0.5

FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis. 0.5

22. In the activated sludge process, the aeration tank provides an environment where microorganisms can thrive and decompose organic pollutants present in the wastewater. 0.5

Maintaining adequate oxygen levels in the aeration tank is crucial because the microorganisms, primarily aerobic bacteria, require oxygen to metabolise and break down organic matter. 1

If oxygen levels drop too low, the efficiency of organic degradation will decrease, and the process could shift to anaerobic conditions, leading to undesirable byproducts such as hydrogen sulphide and methane. 0.5

SECTION C SHORT ANSWERS

23 The mRNA sequence synthesised from the given DNA template strand (3'-TACGGTACCTAG-5') would be **5'-AUGCCAUGGAUC-3'**. 1

The **promoter region** is a specific DNA sequence where RNA polymerase binds to initiate transcription. It contains sequences like the TATA box in eukaryotes that help in the binding of RNA polymerase and the initiation of RNA synthesis. 1

Two key modifications of the primary RNA transcript are:

- **5' Capping**: Addition of a 7-methylguanylate cap to the 5' end of the RNA. 0.5
- **Polyadenylation**: Addition of a poly-A tail to the 3' end to stabilise the mRNA and facilitate its export from the nucleus. 0.5

24 (i) The wind pollinated flowers are usually conspicuous, having versatile anthers. The pollen grains are usually smooth walled, relatively light, small and dry and are produced in large quantities. The stigmas are comparatively large protruding and often feathery. 1.5
(ii) Flowers produce a sugary liquid called nectar which many insects consume on a large basis. When insects land on a flower, pollen grains tend to stick to their bodies. The insect then moves from one to another flower of the same species, pollen gets transferred to the stigma of flowers and hence causes pollination. 1.5

Or

(i) The mentioned couple should opt for Artificial Insemination (AI). In this method the semen is collected either from the donor or from husband and then artificially introduced into the vagina of female.This technique help those couples to have their children in which male is infertile or the sperm count is very low. 1
(ii) If the woman was unable to produce ovum then in this case the couple should opt for a test tube baby. Here, in this technique ovum from donor and sperm from husband are collected and are introduced to form a zygote under simulated condition in vitro (outside the body). Then the formed zygote is transferred or implanted into the female uterus/womb for further development. 1
(iii) Yes, the process of ART can be performed in those couples where either partner is suffering from AIDS. This reduces the risk of infection to the child when the pregnancy is desired. 1

25. Solution 1. *Adenine (A):* Given as 20%. 0.5

2. *Thymine (T):* Since A = T, thymine also makes up 20%. Now, the combined percentage of adenine and thymine is A + T = 20\% + 20\% = 40\% 0.5

3. *Cytosine (C) and Guanine (G):* Together, cytosine and guanine make up the remaining percentage of the DNA. Since A + T is 40%, the remaining percentage for C and G is C + G = 100\% - 40\% = 60\% 1

4. *Cytosine (C) and Guanine (G) individually:* According to Chargaff's rules, C = G. So, each of them makes up half of the remaining 60%:

C = G = \frac{60\%}{2} = 30\% 1

Answer:*
- Adenine (A) = 20%- Thymine (T) = 20%- Cytosine (C) = 30%- Guanine (G) = 30% These calculations illustrate how Chargaff's rules determine the nucleotide composition in DNA.

26. **Determine the frequency of the recessive phenotype:**

   - According to the Hardy-Weinberg principle, the frequency of the recessive phenotype (q2q^2q2) is 16% or 0.16. 1
2. **Calculate the frequency of the recessive allele (a):**
   - The frequency of the recessive allele (qqq) is the square root of the frequency of the recessive phenotype: q=0.16q = \sqrt{0.16}q=0.16 q=0.4q = 0.4q=0.4 1
3. **Calculate the frequency of the dominant allele (A):**
   - The frequency of the dominant allele (ppp) can be found using the equation p+q=1p + q = 1p+q=1: p=1−qp = 1 - qp=1−q p=1−0.4p = 1 - 0.4p=1−0.4 p=0.6p = 0.6p=0.6

Summary: 1
- Frequency of the dominant allele (A) = 0.6 or 60%
- Frequency of the recessive allele (a) = 0.4 or 40%

27. **Role of Decomposers:**
    - **Decomposers**, such as bacteria, fungi, and detritivores (e.g., earthworms and beetles), play a crucial role in the decomposition of leaf litter. These organisms break down complex organic matter in the fallen leaves into simpler compounds. For example, fungi secrete enzymes that decompose cellulose and lignin in the leaves, while bacteria further break down these simpler compounds into even smaller molecules. 1

2. **Contribution to Nutrient Cycling:**
    - As decomposers break down the leaf litter, they convert the organic matter into **humus**, a nutrient-rich substance that enriches the soil. This process releases essential nutrients, such as nitrogen, phosphorus, and potassium, back into the soil. These nutrients are then available for uptake by plants, supporting their growth and maintaining soil fertility. 1
3. **Impact on Ecosystem Health:**
    - The decomposition process contributes to the **overall health of the forest ecosystem** by recycling nutrients, which ensures that the soil remains fertile and capable of supporting diverse plant life. This, in turn, supports herbivores and other higher trophic levels, maintaining the balance and productivity of the ecosystem. Additionally, decomposers help in the breakdown of organic waste, preventing the accumulation of dead plant material and promoting a healthier forest environment. 1

Summary:

- Decomposers break down leaf litter into simpler compounds.
- This process releases essential nutrients into the soil, supporting plant growth.
- Healthy decomposition contributes to nutrient cycling and overall ecosystem health.

28. **Possible Gametes:**
    - Man (haemophilia): X^h or Y 1
    - Woman (normal): X^H or X^H
2. **Possible Offspring Genotypes for Daughters:** 1
    - X^H X^h (carrier)
3. **Probability of Daughters Being Carriers:** 1
    - Since all daughters will be X^H X^h, they will all be carriers.

Probability that a daughter will be a carrier: 100%

29 (i) Oogenesis is the process of formation of a mature female gamete. The production of eggs in females begins before birth, i.e. during the embryonic development stage, but is completed only after fertilisation. It takes place in ovaries. The process undergoes following phases. 1

(a) Multiplication phase Cells of germinal epithelium undergo mitotic division producing undifferentiated germ cells called oogonia or egg mother cells within each foetal ovary. These cells start dividing and enter prophase-I of meiotic division and get temporarily arrested at this stage. These cells are known as primary oocytes. 1

(b) Growth phase Each primary oocyte then gets surrounded by a single layer of granulosa cells and is called the primary follicle. About two million of these follicles exist in females before birth. A large number of these follicles degenerate during the phase from birth to puberty. Therefore, at puberty only 60,000-80,000 primary follicles are left in each ovary. The primary follicles get surrounded by more layers of granulosa cells and a new theca to form secondary follicles. 1

(c) During this phase, the secondary follicle transforms into tertiary follicle. These are characterised by a fluid cavity called antrum. The theca layer is organised into an inner theca interna and an outer theca externa. The primary oocyte within this tertiary follicle grows in size. The fully grown primary oocyte completes its first meiotic division producing two daughter nuclei in which a larger haploid cell is called secondary oocyte (ovum) and the tiny one is called first polar body. The secondary oocyte retains the bulk of the nutrient rich cytoplasm of the primary oocyte. 1

(ii) If the secondary oocyte is not fertilised, it passes into the uterus as an immature egg and the lining of the uterus, i.e. endometrium is shed during menstruation. 1

Or

(i) After fertilisation of ovum with sperm, the zygote is formed. The fertilised eggs stay in the Fallopian tube for about 3 to 4 days. But within 24 days, it starts to divide and move towards the uterus for implantation. As a result of change in different hormone levels and need of thick endometrium for zygote to implant, the menstrual cycle stops till the birth of the baby. 2

(ii) If LH released by the pituitary gland becomes low, the ovulation will not occur. As the luteinizing hormone surge, induces the rupture of Graafian follicle and thereby the release of ovum. 1

(iii) As progesterone prepares endometrium for pregnancy its absence or low level leads to heavy menstrual bleeding, the uterus will not be able to implant the foetus. Due to this miscarriages can happen. Thus, this female will not be able to conceive a child. 1

30 **Genetic Modification Process for Bt Cotton:**

- **Gene Insertion:** A gene from the bacterium *Bacillus thuringiensis*, which encodes for a protein toxic to certain insects, is inserted into the cotton plant's genome. This is typically done using a method such as Agrobacterium-mediated transformation or gene gun technology. 1
- **Protein Expression:** The inserted gene allows the cotton plant to produce the Bt toxin protein in its tissues. When pests consume the cotton, they ingest the toxin, which disrupts their digestive systems and ultimately kills them. 1

2. **Benefits and Concerns of Bt Cotton:**
   - **Benefits:**
     1. **Reduced Use of Chemical Pesticides:** Bt cotton reduces the need for chemical pesticides, which can be harmful to the environment and human health. This leads to a decrease in the overall pesticide load and potential environmental contamination. 0.5
     2. **Increased Crop Yield:** By reducing pest damage, Bt cotton can lead to higher crop yields and better quality cotton. This can improve the profitability for farmers and contribute to food security. 0.5
   - **Concerns:**
     1. **Development of Bt-Resistant Pests:** Over time, pests may develop resistance to the Bt toxin, which could render the Bt cotton ineffective and lead to a resurgence of pest problems. This necessitates careful management practices to delay resistance. 1
     2. **Impact on Non-Target Organisms:** There is concern that the Bt toxin may affect non-target organisms, including beneficial insects and other wildlife. The long-term ecological impact of Bt cotton on biodiversity and ecosystem. 1

OR

1. **Competition:**
   - **Definition:** Competition occurs when two or more species or individuals vie for the same limited resources, such as food, water, or shelter.
   - **Example:** In a forest ecosystem, both birds and squirrels may compete for nesting sites in trees.
   - **Effect:** Competition can lead to reduced growth rates, lower reproductive success, or even the exclusion of one species if it is less competitive. Over time, this interaction may drive evolutionary adaptations, such as changes in feeding habits or nesting preferences. 1

2. **Predation:**
    - **Definition:** Predation is an interaction where one organism (the predator) kills and consumes another organism (the prey).
    - **Example:** A lion preying on a zebra is a classic example of predation.
    - **Effect:** Predation helps regulate population sizes and can influence the behavior and evolution of prey species, such as developing better camouflage or faster running speeds. It also affects the predator population by providing a food source, thereby influencing their numbers and distribution.

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3. **Mutualism:**
    - **Definition:** Mutualism is a symbiotic interaction where both species benefit from the relationship.
    - **Example:** The relationship between bees and flowering plants is mutualistic. Bees pollinate the flowers while obtaining nectar as food.
    - **Effect:** Mutualism promotes the survival and reproduction of both species involved. Plants benefit from increased pollination, which enhances their reproductive success, while bees gain a food source, which supports their survival and productive processes.

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4. **Parasitism:**
    - **Definition:** Parasitism is a relationship where one organism (the parasite) benefits at the expense of another organism (the host), often causing harm to the host.
    - **Example:** Tapeworms in the intestines of mammals are parasites that absorb nutrients from the host's digestive system.
    - **Effect:** Parasitism can weaken or harm the host, potentially reducing its fitness and reproductive success. It may also lead to evolutionary adaptations in both parasites and hosts, such as the development of resistance mechanisms in hosts or enhanced parasitic strategies in parasites.

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5. **Summary of Effects:**
    - **Competition** can limit resources and drive adaptation.
    - **Predation** controls population dynamics and influences behavior and evolution.
    - **Mutualism** enhances survival and reproductive success for both species.
    - **Parasitism** harms the host and can lead to evolutionary changes in both parasite and host populations.

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These interactions are essential for maintaining the balance and health of ecosystems, influencing species distribution, population dynamics, and community structure.