

**BK BIRLA CENTRE FOR EDUCATION**  
**SARALA BIRLA GROUP OF SCHOOLS**  
**SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL**  
**SCHOOL**  
**PRE-BOARD-I 2024-25**  
**BIOLOGY MARKING SCHEME (044)**



Class: XII  
 Date: 22/11/2024

Duration: 3 Hr  
 Max. Marks: 70

**SECTION-A**

- |    |                           |   |
|----|---------------------------|---|
| 1  | c) Self-pollinated        | 1 |
| 2  | c) Secondary oocyte       | 1 |
| 3  | c) 24%                    | 1 |
| 4  | b) CGTA                   | 1 |
| 5  | d) Convergent evolution.  | 1 |
| 6  | A.                        | 1 |
| 7  | B.                        | 1 |
| 8  | 6.6 X 10 <sup>9</sup> bp  | 1 |
| 9  | B                         | 1 |
| 10 | D. (i), (ii), and (iv)    | 1 |
| 11 | D                         | 1 |
| 12 | c) A-iv, B-iii, C-ii, D-i | 1 |
| 13 | A                         | 1 |
| 14 | A                         | 1 |
| 15 | A                         | 1 |
| 16 | B                         | 1 |

**SECTION B**

- 17 A. i) Part A: The hormone in part A is Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH), which are secreted by the anterior pituitary gland. 1+1  
 Part B: The hormone in part B is Estrogen and Progesterone, which are primarily secreted by the ovaries. Estrogen is secreted by the growing follicles, and progesterone is secreted by the corpus luteum.  
 ii) During the 6 to 15 days of the menstrual cycle (known as the proliferative phase), the following effects occur due to the hormones in part B: Estrogen (secreted by the developing follicles) causes the endometrium (the lining of the uterus) to regenerate and thicken. This prepares the uterus for potential implantation of a fertilized egg.

OR

The developmental stages of the zygote until implantation are as follows:

1.Fertilization      2.Cleavage      3.Blastocyst Formation      4.Implantation:

- 18 A.The gene pair with the greatest map distance will show the highest recombination frequency. 1+1  
 Therefore, B & C (8 units) and C & D (8 units) will show more recombination frequency compared to A & B (which are only 4 units apart).So, B & C or C & D will have more recombination frequency than A & B because the genes are further apart.

OR

B. (i) Translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and the stop codon (UAA) and codes for apolypeptide/ AUG AUC UCG      UAA.

(ii) Untranslated regions (UTR). The UTRs are present at both 5' -end (before start codon) and at 3' -end (after stop codon). They are required for an efficient translation process.

- 19 The condition your friend is experiencing is likely due to an allergic reaction. This sudden 1+1  
 response is known as anaphylaxis or an acute allergic reaction. Allergies occur when the immune system overreacts to a harmless substance, such as pollen, dust, or pet dander, releasing chemicals

like histamine that cause symptoms like sneezing, swelling, and difficulty breathing.

Antihistamines: Medications to block the effects of histamine, providing relief from sneezing and other symptoms.

- 20 These sequences are called palindromic sequences because the sequence of nucleotides reads the same in both directions on complementary strands (5' to 3' on one strand and 3' to 5' on the other). 1+1
- The enzyme that recognizes such sequences is restriction endonuclease, specifically EcoRI, which cuts the DNA at this sequence.

Significance in biotechnology:

- DNA cutting
- Recombinant DNA technology

- 21 A. i) In some ecosystems, the pyramid of biomass can be inverted, meaning the biomass of producers is smaller than the biomass of consumers. This occurs in aquatic ecosystems, such as ocean ecosystems, where the biomass of phytoplankton (the producers) is much smaller than the biomass of zooplankton and other consumers. 1+1

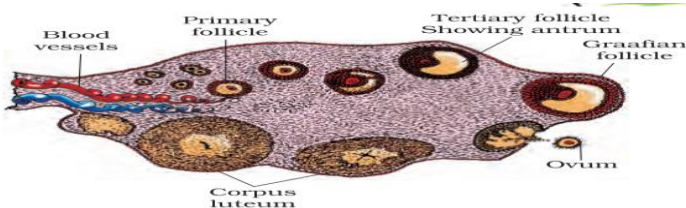
ii) No, the pyramid of energy will not be inverted. It will always be upright in all ecosystems. This is because energy transfer between trophic levels is inefficient, with about 90% of the energy lost as heat at each level. Only about 10% of energy is passed on to the next trophic level.

OR

B. i) Pyramid of numbers where insects feed on the leaves of a tree. In this scenario, there is one large tree (producer) at the base, which supports a large number of herbivorous insects (primary consumers). This is an example of a pyramid of numbers that is inverted or spindle-shaped, with the number of individuals increasing as we move up from the producer to primary consumers.

ii) No, the pyramid of energy will not have the same shape. The pyramid of energy will always be upright because energy flow decreases as it moves from producers to consumers.

### SECTION C

- 22  3

- 23 i) Nutrient-rich: Tender coconut water provides vitamins (like vitamin C), antioxidants, and amino acids, supporting overall health. 1+1

ii) Pea seeds are non-endospermic (exalbuminous), meaning that they do not retain the endosperm at maturity. During seed development, the endosperm is absorbed, and the cotyledons store the nutrients. Castor seeds are endospermic (albuminous), meaning that they retain the endosperm as a storage tissue at maturity, which provides nourishment to the developing embryo during germination.

iii) Emasculation is the process of removing the stamens (male reproductive parts), specifically the anthers, from a flower before it matures and releases pollen. This is done to prevent self-pollination in cross-pollination experiments or controlled breeding programs.

- 24 i) Polarity: The diagram represents a growing polypeptide chain during translation, where x' is the 5' end and x is the 3' end. mRNA is read in the 5' to 3' direction, and the polypeptide is synthesized from the N-terminus (amino end) to the C-terminus (carboxyl end). 1+1

ii) Codon for alanine: GCU, GCC, GCA, or GCG (all code for alanine).

Anticodon for alanine: CGA, CGG, CGU, or CGC (complementary to the codons, found on the tRNA).

iii) Untranslated regions (UTRs) are present in mRNA and do not code for amino acids, but they play regulatory roles in translation and mRNA stability. 5' UTR: Found at the beginning of the mRNA, before the start codon (AUG). It helps in the initiation of translation and regulation. 3' UTR: Found after the stop codon. It influences mRNA stability, localization, and degradation.

- 25 Secondary treatment involves biological treatment of sewage to remove dissolved organic matter. 1+1

1. Aeration: +1
2. Formation of flocs:
3. Sedimentation:
4. Activated sludge.
5. Effluent release:

OR

Effluent from primary treatment of sewage: Biological treatment in aeration tanks  
Aeration process:

Floc formation:

- 26 Making bacterial cells ‘competent’ and its importance in recombinant DNA technology. 1+1  
 Competent cells: Bacterial cells are made competent to take up foreign DNA by treating them with specific chemicals (like calcium chloride) or using physical methods (like electroporation). +1  
 Chemical treatment: Cells are chilled in a calcium chloride solution and then briefly exposed to heat shock, which makes the membrane more receptive to DNA uptake.  
 Electroporation: An electric pulse creates temporary pores in the cell membrane, allowing DNA to enter. Importance in recombinant DNA technology: Competent cells are essential because they allow the uptake of recombinant plasmids (containing foreign DNA) into bacterial cells for gene cloning and the production of desired proteins.
- 27 Agarose gel electrophoresis results 1+1  
 a) Result on staining with ethidium bromide: When the DNA fragments are stained with ethidium bromide and exposed to UV light, they will appear as bands on the gel. The smaller DNA fragments (closer to 200 bp) will migrate faster and travel further down the gel, while the larger fragments (closer to 2500 bp) will move more slowly and stay near the top. The bands will appear at different positions based on fragment size. +1  
 b) Changes to obtain a 250 bp band at X: To obtain a band at position X (representing 250 bp), the voltage applied during electrophoresis may have been increased, or the concentration of agarose gel may have been modified (e.g., lower percentage gel). This would allow smaller fragments, like the 250 bp band, to migrate further and separate more distinctly. The band appears at position X due to the smaller size and higher mobility of the 250 bp fragment.
- 28 a) The birth rate is calculated as: 1+1  
 Birth rate = Initial population / Number of births +1  
 = 200 / 40 = 0.2 frogs per individual per year  
 b) Biomass: In certain ecosystems, population density is measured in terms of biomass rather than individual numbers. For example, in a forest, measuring the biomass of trees gives a more accurate estimate of resource use than counting individual trees.  
 Cover area: In some cases, population density is measured based on the percentage of area covered rather than the number of individuals. For example, in grasslands, it is more meaningful to assess the density of grass species by the area they cover rather than counting individual grass plants.

#### SECTION D

- 29 a) Four phenomena in which the Hardy-Weinberg theorem may not hold true: 1+2  
 The Hardy-Weinberg equilibrium assumes certain conditions: +1  
 Mutation: Introduction of new alleles into the population through mutations changes allele frequencies.  
 Non-random mating: If individuals preferentially mate with certain genotypes (e.g., assortative mating), allele frequencies change.  
 Genetic drift: In small populations, random changes in allele frequencies can lead to deviations from Hardy-Weinberg equilibrium.  
 Gene flow: Migration of individuals into or out of the population can introduce or remove alleles, disrupting equilibrium.
- b) Given: Frequency of allele A ( $p$ ) = 0.3  
 Frequency of allele a ( $q$ ) = 0.7

Heterozygous genotype frequency (Aa) = 0.49

According to Hardy-Weinberg, the frequency of the heterozygous genotype is calculated as:  
 $2pq = 2 \times 0.3 \times 0.7 = 0.42$

OR

c) The Hardy-Weinberg expression is derived based on the assumption that a population is in genetic equilibrium.

d) One example of adaptive radiation Darwin's finches on the Galápagos Islands are a classic example of adaptive radiation. From a common ancestor, these finches evolved into several different species, each adapted to different ecological niches. Their beaks evolved in size and shape depending on the type of food they consumed (e.g., seeds, insects), allowing them to thrive in different environments on the islands.

30 a) Concentration of nicotine in blood at 10 minutes.

1+2

At 10 minutes, the concentration of nicotine in the blood would peak because the smoker has taken multiple puffs, leading to the absorption of nicotine into the bloodstream. Nicotine is rapidly absorbed through the lungs and distributed throughout the body, causing a spike in blood nicotine levels.

+1+

1

b) Effect on carbon monoxide and hemoglobin-bound oxygen at 10 minutes. Carbon monoxide (CO) levels in the blood would increase because cigarette smoke contains CO. CO binds to hemoglobin more strongly than oxygen, reducing the amount of oxygen bound to hemoglobin (oxyhemoglobin). This leads to reduced oxygen transport to tissues, contributing to hypoxia

OR

c) Nicotine in cigarette smoke stimulates the release of adrenaline from the adrenal glands, which increases heart rate and constricts blood vessels. This leads to increased blood pressure. Additionally, the reduction in oxygen supply due to carbon monoxide forces the heart to work harder, further increasing heart rate and blood pressure.

d) Lung cancer: Cigarette smoke contains carcinogenic substances, such as tar, which damage the DNA in lung cells, leading to uncontrolled cell division and tumor formation. Emphysema: Cigarette smoke damages the alveoli (air sacs) in the lungs, causing them to lose elasticity. This results in the breakdown of alveolar walls, reducing the surface area for gas exchange and leading to difficulty in breathing.

31 A. Two reasons for infertility:

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Male: Low sperm count or poor sperm motility.

Female: Blocked fallopian tubes or ovulation disorders.

b) Technique to help the couple (male problem):

Intracytoplasmic Sperm Injection (ICSI): A single sperm is injected directly into an egg to achieve fertilization, helping couples where the male has fertility issues.

c) Copper-releasing IUDs:

•Copper-T and Cu-7: These devices release copper ions that create a hostile environment for sperm, preventing fertilization. They also inhibit the implantation of a fertilized egg in the uterus, acting as effective contraceptives.

d) Amniocentesis ban:

•Yes, the ban is necessary to prevent sex-selective abortions and gender discrimination. Amniocentesis was often used to determine the sex of the fetus, leading to selective termination of female fetuses, contributing to a skewed sex ratio in society.

OR

B. Cryptorchidism and male fertility

i) Three parameters affected by cryptorchidism: Sperm production: High temperature in the abdomen affects spermatogenesis, reducing sperm count. Sperm motility: Abnormal development of sperms can lead to poor motility. Hormone production: Impaired Leydig cell function leads to reduced testosterone levels, affecting libido and sperm production

ii) Process affected:

•Spermiation: This process, where mature spermatids are released from Sertoli cells into the seminiferous tubules, will be affected.

iii) Assisted reproductive technology (ART):

•Artificial insemination: Sperm from the male (or a donor) is introduced into the female reproductive tract to achieve fertilization.

iv) Technology for embryo development:

•In vitro fertilization (IVF): Embryos I and II can be implanted into the uterus using IVF. The embryos are developed in a laboratory and then transferred to the female's uterus for further development.

32 Conserving biodiversity

5

a) Two approaches:

1. In situ conservation: Protecting species in their natural habitat (e.g., national parks, biosphere reserves).

2. Ex situ conservation: Preserving species outside their natural habitat (e.g., zoos, botanical gardens, seed banks).

b) Bumble bee and Ophrys:

•Mutualism: Bumble bees pollinate Ophrys orchids, and in turn, the orchid provides nectar. If either species goes extinct, the other would struggle to survive due to the loss of a mutualistic relationship.

c) Ecosystem diversity in India vs. Norway:

•India has greater ecosystem diversity due to its varied climate zones, including tropical rainforests, deserts, mountains, and coastal regions. Norway, with its colder climate, has less ecosystem variety.

33 Oil spills and bacteria

5

a) Advantages of bacteria in biotechnological studies:

Bacteria can rapidly reproduce, allowing for quick genetic studies, can be genetically engineered to degrade harmful substances like hydrocarbons in oil. A polymerase functional only at low temperatures will reduce PCR efficiency since higher temperatures are needed for DNA denaturation and proper primer annealing.

c) Positive/negative environmental effects: Positive: Biodegradation of oil reduces the environmental impact of oil spills.

•Negative: Introduction of genetically modified bacteria into ecosystems could have unpredictable effects on local microbial communities.

OR

Bt-maize and Lepidopteran pests

a) Least susceptible species:

•Species III is the least susceptible, as it caused the greatest leaf damage, indicating that it was not significantly affected by the Bt toxin.

b) Most susceptible species:

•Species I is the most susceptible, as it caused the least damage. Its gut pH (10) might allow for better activation of the Bt toxin.

c) Different effects on species:

•The varying gut pH levels of the three species affect how the Bt toxin is activated. Species I, with a higher gut pH, is more affected, while Species III, with a lower gut pH, is less affected.