Haryana Board Class 12 Biology Question Paper with Solutions(Memory Based)

Time Allowed :3 Hour	Maximum Marks :60	Total Questions :24

General Instructions

Read the following instructions very carefully and strictly follow them:

- Answers to this Paper must be written on the paper provided separately.
- You will not be allowed to write during the first 15 minutes
- This time is to be spent in reading the question paper.
- The time given at the head of this Paper is the time allowed for writing the answers,
- The paper has four Sections.
- Section A is compulsory - All questions in Section A must be answered.
- You must attempt one question from each of the Sections B, C and D and one other question from any Section of your choice.

1. Explain the various phases of the menstrual cycle.

Correct Answer: The menstrual cycle is a monthly cycle in females that prepares the body for pregnancy. It consists of four main phases: menstrual phase, follicular phase, ovulation phase, and luteal phase.

Solution:
Concept: The **menstrual cycle** is a regular natural process that occurs in the female reproductive system. It prepares the uterus for possible pregnancy and usually lasts about **28 days**. The cycle is regulated by hormones and occurs from puberty until menopause.
Step 1: Menstrual Phase

- This phase lasts about **3–5 days**.
- If fertilization does not occur, the **uterine lining breaks down**.
- Blood and tissues are discharged from the body through the **vagina**.

Step 2: Follicular Phase

- This phase begins on the first day of menstruation and continues until ovulation.
- The **ovaries develop follicles** that contain immature eggs.
- The uterine lining starts to **thicken again**.

Step 3: Ovulation Phase

- Around the **14th day** of the cycle, a mature egg is released from the ovary.
- This process is called **ovulation**.
- The egg moves into the **fallopian tube**, where fertilization may occur.

Step 4: Luteal Phase

- After ovulation, the ruptured follicle forms a structure called the **corpus luteum**.
- It releases hormones that maintain the **uterine lining**.
- If fertilization does not occur, the lining breaks down and the cycle begins again.

Quick Tip

The menstrual cycle normally lasts about **28 days** and includes four phases: **Menstrual, Follicular, Ovulation, and Luteal**.

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2. Define Double Fertilization and explain its significance in flowering plants.

Correct Answer: Double fertilization is a process in flowering plants in which one male gamete fuses with the egg cell to form a zygote, while the other male gamete fuses with two polar nuclei to form endosperm.

Solution:
Concept: Double fertilization is a unique characteristic of **angiosperms (flowering plants)**. It involves two fertilization events occurring within the embryo sac of the ovule, leading to the formation of both the embryo and the endosperm.
Step 1: Definition of Double Fertilization
Double fertilization is the process in which two male gametes participate in fertilization inside the embryo sac.

- One male gamete fuses with the **egg cell** to form the **zygote**.
- The second male gamete fuses with the **two polar nuclei** to form the **endosperm**.

Step 2: Fertilization Events

- **Syngamy:**
$$\text{Male gamete} + \text{Egg cell} \rightarrow \text{Zygote}$$
- **Triple Fusion:**
$$\text{Male gamete} + \text{Two polar nuclei} \rightarrow \text{Endosperm}$$

Since two fertilization events occur, the process is called **double fertilization**.
Step 3: Significance of Double Fertilization

- It leads to the formation of the **zygote**, which develops into the embryo.
- It produces the **endosperm**, which provides nourishment to the developing embryo.

- It ensures efficient use of nutrients by forming endosperm only after fertilization.
- It is an important feature that distinguishes **flowering plants** from other plant groups.

Quick Tip

In flowering plants:
First fusion → Zygote (embryo formation)
Second fusion → Endosperm (nutrition for embryo)

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3. What is Megasporogenesis? Describe the development of a female gametophyte.

Correct Answer: Megasporogenesis is the process by which megaspores are formed from a megaspore mother cell through meiosis, leading to the development of the female gametophyte (embryo sac) in flowering plants.

Solution:
Concept: In flowering plants, the female gametophyte develops inside the ovule. The process begins with the formation of megaspores through **meiosis**, followed by their development into the **embryo sac**.
Step 1: Megasporogenesis
Megasporogenesis is the process of formation of **megaspores** from a **megaspore mother cell (MMC)** inside the ovule.

- The megaspore mother cell undergoes **meiotic division**.
- This produces **four haploid megaspores**.
- Usually, **three megaspores degenerate**, and only one functional megaspore remains.

Step 2: Development of Female Gametophyte
The functional megaspore undergoes **mitotic divisions** to form the female gametophyte or **embryo sac**.

- The nucleus of the functional megaspore divides **three times**.
- This produces **eight nuclei**.
- These nuclei organize themselves to form a **seven-celled embryo sac**.

Structure of the Embryo Sac:

- **One egg cell**
- **Two synergids**
- **Three antipodal cells**
- **Two polar nuclei** in the central cell

This structure forms the **female gametophyte** in flowering plants.

Quick Tip

The typical embryo sac in flowering plants is **8-nucleate and 7-celled**, formed from a single functional megaspore.

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4. Discuss different contraceptive methods and their roles in population control.

Correct Answer: Contraceptive methods are techniques used to prevent pregnancy. They help control population growth and promote reproductive health.

Solution:
Concept: Contraception refers to the deliberate prevention of pregnancy. Various contraceptive methods are used to control birth rates and ensure family planning. These methods help reduce unwanted pregnancies and contribute to population control.
Step 1: Barrier Methods
Barrier methods prevent the sperm from reaching the egg.

- **Condoms** (used by males)
- **Diaphragms** or cervical caps

These methods also help prevent **sexually transmitted diseases (STDs)**.
Step 2: Hormonal Methods
Hormonal contraceptives contain hormones that prevent ovulation.

- **Oral contraceptive pills**
- **Hormonal injections or implants**

These methods regulate the menstrual cycle and prevent the release of eggs.
Step 3: Intrauterine Devices (IUDs)
These are small devices inserted into the uterus to prevent fertilization or implantation.

- Example: **Copper-T**

Step 4: Surgical Methods
Permanent methods of contraception involve minor surgical procedures.

- **Vasectomy** (in males)
- **Tubectomy** (in females)

These procedures prevent the transport of gametes.
Step 5: Role in Population Control

- Helps regulate **family size**.
- Prevents **unwanted pregnancies**.

- Improves **maternal and child health**.
- Contributes to **sustainable population growth**.

Quick Tip

Contraceptive methods play an important role in **family planning**, **population control**, and improving overall **reproductive health**.

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5. State and explain Mendel's Law of Independent Assortment using a dihybrid cross.

Correct Answer: Mendel's Law of Independent Assortment states that the alleles of different genes assort independently during gamete formation.

Solution:
Concept: Gregor Mendel proposed several laws of inheritance based on his experiments with pea plants. One of these is the **Law of Independent Assortment**, which explains how different traits are inherited independently of each other.
Step 1: Statement of the Law
The **Law of Independent Assortment** states that the alleles of two different genes segregate independently during the formation of gametes. Therefore, the inheritance of one trait does not affect the inheritance of another trait.
Step 2: Dihybrid Cross Example
Consider a cross between pea plants differing in two traits:

- **Seed shape:** Round (R) is dominant over wrinkled (r).
- **Seed color:** Yellow (Y) is dominant over green (y).

Parental Generation (P):

$$RRYY \text{ (Round, Yellow)} \times rryy \text{ (Wrinkled, Green)}$$

Gametes:

$$RY \quad \text{and} \quad ry$$

First Filial Generation (F_1):

$$RrYy$$

All offspring show the dominant traits (Round and Yellow).
Step 3: Second Filial Generation (F_2)
When the F_1 plants ($RrYy$) are crossed with each other:

$$RrYy \times RrYy$$

The gametes produced are:

$$RY,\ Ry,\ rY,\ ry$$

The phenotypic ratio obtained in the F_2 generation is:

$$9 : 3 : 3 : 1$$

- 9 Round Yellow
- 3 Round Green
- 3 Wrinkled Yellow
- 1 Wrinkled Green

This ratio shows that the two traits assort independently.

Quick Tip

A **dihybrid cross** involving two traits produces a characteristic **9:3:3:1 phenotypic ratio**, demonstrating Mendel's Law of Independent Assortment.

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6. Explain the Semi-conservative mode of DNA replication with the Meselson and Stahl experiment.

Correct Answer: In the semi-conservative mode of DNA replication, each new DNA molecule consists of one parental strand and one newly synthesized strand. This was experimentally demonstrated by Meselson and Stahl.

Solution:
Concept: DNA replication is the process by which a DNA molecule produces two identical copies of itself. According to the **semi-conservative model**, each daughter DNA molecule contains one original (parental) strand and one newly synthesized strand.
Step 1: Semi-conservative Mode of Replication
During DNA replication:

- The double helix of DNA **unwinds and separates** into two strands.
- Each original strand acts as a **template** for the formation of a new complementary strand.
- As a result, each daughter DNA molecule contains **one old strand and one new strand**.

Thus, the replication is called **semi-conservative** because half of the parental DNA is conserved in each new molecule.
Step 2: Meselson and Stahl Experiment
In 1958, **Meselson and Stahl** conducted an experiment using the bacterium ***E. coli*** to prove the semi-conservative mode of DNA replication.

- Bacteria were first grown in a medium containing heavy nitrogen (^{15}N), which was incorporated into their DNA.

- These bacteria were then transferred to a medium containing normal nitrogen (^{14}N).
- DNA samples were taken after successive generations and analyzed using **density gradient centrifugation**.

Step 3: Results of the Experiment

- After the **first generation**, DNA showed an **intermediate density** (hybrid DNA containing one heavy and one light strand).
- After the **second generation**, two bands appeared: one **intermediate** and one **light**.

These results confirmed that each DNA molecule contained **one old strand and one newly synthesized strand**, supporting the **semi-conservative model** of DNA replication.

Quick Tip

The Meselson and Stahl experiment is known as the **"most beautiful experiment in biology"** because it clearly demonstrated the **semi-conservative nature of DNA replication**.

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7. Define Adaptive Radiation and give examples like Darwin's Finches.

Correct Answer: Adaptive radiation is the process in which a single ancestral species rapidly diversifies into many different species that occupy different ecological niches.

Solution:
Concept: Adaptive radiation is an important concept in evolution where organisms originating from a common ancestor evolve into multiple species adapted to different environments or ecological niches.
Step 1: Definition of Adaptive Radiation
Adaptive radiation is the evolutionary process in which a single ancestral species gives rise to several new species, each adapted to different habitats, food sources, or ecological conditions.
Step 2: Darwin's Finches Example
One of the most famous examples of adaptive radiation is observed in the **Darwin's finches** of the **Galápagos Islands**.

- Charles Darwin observed several species of finches on different islands.
- These finches evolved from a **common ancestral species**.
- Over time, they developed different **beak shapes and sizes** adapted for different types of food such as seeds, insects, and nectar.

Thus, the diversification of finches into multiple species is an example of adaptive radiation.
Step 3: Other Examples

- **Australian marsupials** evolving into different forms such as kangaroos, koalas, and wombats.

- **African cichlid fishes** diversifying into many species with different feeding habits.

Quick Tip

Adaptive radiation explains how a **single ancestral species can evolve into many species** adapted to different ecological niches.

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8. What is Innate Immunity? Differentiate between active and passive immunity.

Correct Answer: Innate immunity is the natural defense mechanism present in the body from birth. Active immunity is produced by the body in response to infection or vaccination, whereas passive immunity is obtained from external sources.

Solution:
Concept: The immune system protects the body against pathogens such as bacteria, viruses, and other harmful microorganisms. Immunity can be classified into **innate immunity** and **acquired immunity**.
Step 1: Innate Immunity
Innate immunity is the natural or inborn immunity present in an individual from birth. It provides the first line of defense against pathogens.
Examples of innate immunity include:

- Physical barriers such as **skin and mucous membranes**
- **Phagocytic cells** that destroy pathogens
- **Inflammatory responses**

Step 2: Active Immunity
Active immunity is developed when the body's immune system produces antibodies in response to an infection or vaccination.

- It develops **after exposure to an antigen**.
- The body produces **antibodies and memory cells**.
- It provides **long-lasting protection**.

Example: Immunity developed after vaccination.
Step 3: Passive Immunity
Passive immunity occurs when ready-made antibodies are transferred from another source to an individual.

- It provides **immediate protection**.
- The body **does not produce its own antibodies**.
- Protection is usually **short-lived**.

Example: Antibodies transferred from mother to baby through **placenta or breast milk**.
Step 4: Difference between Active and Passive Immunity

Feature	Active Immunity	Passive Immunity
Source of antibodies	Produced by the body	Received from another source
Duration of protection	Long-lasting	Short-term
Memory cells	Present	Absent
Example	Vaccination	Maternal antibodies

Quick Tip

Active immunity → Body produces antibodies.
Passive immunity → Ready-made antibodies are received from outside.
