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CLASS 9 • BIOLOGY • CHAPTER 9

Reproduction in Plants

Complete Exercise Solutions

Every MCQ answered and explained • every short and detailed question solved in full • exam-ready notes with the labelled flower diagram

Binary Fission | Budding & Spores | Vegetative Propagation | Flower Structure | Double Fertilisation

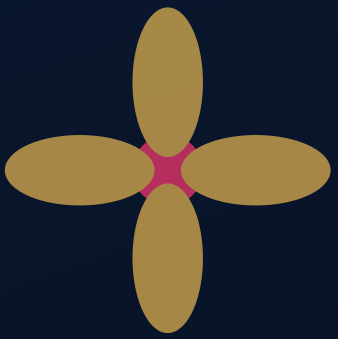


TABLE OF CONTENTS

What's Inside

How to use this guide

Every MCQ shows the correct option highlighted in green with a tick, followed by a clear explanation. Short and detailed answer questions are solved fully, in exam-ready language, so you can revise directly from this PDF.

1

Which of the following organisms commonly reproduce by binary fission?

A Yeast

B Bacteria ✓

C Rhizopus

D Plants

💡 EXPLANATION

Bacteria are single-celled prokaryotes that reproduce mainly by binary fission: the cell copies its single circular chromosome and simply splits into two identical daughter cells. Yeast reproduces by budding, Rhizopus by spore formation, and plants mainly by seeds or vegetative propagation.

2

What is the primary method of reproduction in yeast?

A Binary fission

B Spore formation

C Budding ✓

D Fragmentation

💡 EXPLANATION

Yeast, a unicellular fungus, reproduces mainly by budding: a small outgrowth (bud) forms on the parent cell, receives a copy of the nucleus, and eventually grows large enough to separate as a new, independent cell.

3

What happens in some bacteria during harsh conditions?

A Creation of a bud that detaches from the cell

B Formation of thick-walled endospores ✓

C Splitting of the cell into two identical daughter cells

D Fusion of two bacterial cells

💡 EXPLANATION

When conditions become unfavourable (extreme heat, cold, drought, or lack of nutrients), some bacteria form thick-walled, highly resistant structures called endospores. These allow the bacterium to survive in a dormant state until conditions improve, when it germinates back into an active cell.

4

Which of the following is an example of vegetative propagation through runners?

A Potato

B Strawberry ✓

C Onion

D Ginger

💡 EXPLANATION

Strawberry plants produce runners — horizontal stems that grow along the soil surface and root at their nodes to form new plantlets. Potato propagates through tubers, onion through bulbs, and ginger through rhizomes.

5

Which plant propagates through tubers?

A Onion

B Potato ✓

C Ginger

D Garlic

💡 EXPLANATION

The potato is a classic example of vegetative propagation through tubers — swollen underground stems bearing dormant buds (“eyes”) that sprout into new plants. Onion and garlic propagate through bulbs, and ginger through rhizomes.

6

Which of these does NOT help a plant with vegetative propagation?

A Rhizome

B Corm

C Runner

D Flower ✓

💡 EXPLANATION

Rhizomes, corms, and runners are all modified stems used in vegetative (asexual) propagation. The flower, by contrast, is the reproductive structure used for sexual reproduction, not vegetative propagation.

7

Which of the following is NOT a part of the carpel?

A Filament ✓

B Style

C Stigma

D Ovary

💡 EXPLANATION

The carpel (female reproductive part) is made up of the stigma, style, and ovary. The filament is part of the stamen, the male reproductive organ, not the carpel.

8

Which structure forms the female gametophyte in flowering plants?

A Pollen grain

B Ovule ✓

C Anther

D Sepal

💡 EXPLANATION

The female gametophyte, or embryo sac, develops inside the ovule from a surviving megaspore. The pollen grain is the male gametophyte, and the anther is where pollen (not the embryo sac) is produced.

9

The male gametophyte in flowering plants is known as:

A Pollen grain ✓

B Embryo sac

C Ovary

D Carpel

💡 EXPLANATION

The pollen grain, produced within the anther from a microspore, is the male gametophyte of a flowering plant. The embryo sac is the female gametophyte, found within the ovule.

10

In the life cycle of flowering plants, which structure is triploid (3n)?

A Egg

B Fusion nucleus

C Endosperm nucleus ✓

D Sperm

💡 EXPLANATION

During double fertilisation, one sperm nucleus (n) fuses with the two polar nuclei (n + n) of the embryo sac, producing the triploid (3n) endosperm nucleus, which develops into the food-storing endosperm tissue of the seed.

11

Double fertilization involves:

A Fertilization of the egg by two male gametes

B Fertilization of two eggs in the same embryo sac by two sperms

C Fertilization of the egg and the fusion nucleus by two sperms ✓

D Fertilization of the egg and the tube cell by two sperms

💡 EXPLANATION

Double fertilisation is unique to flowering plants: one sperm nucleus fuses with the egg cell to form the diploid zygote (future embryo), while the second sperm nucleus fuses with the two polar nuclei (the “fusion nucleus”) to form the triploid endosperm nucleus (future endosperm).

B

SECTION B

Short Answer Questions

Concise, exam-ready answers for every short-answer question in the exercise

1 Write a short note on budding in yeast.

Budding is a form of asexual reproduction seen in yeast, a unicellular fungus. A small bulge, or bud, develops on the outer surface of the parent cell. The nucleus of the parent divides mitotically, and one copy of the nucleus moves into the growing bud. The bud enlarges steadily, eventually forming a complete cell identical to the parent, and then separates to live independently. Under favourable conditions several buds may form before separating, producing a short chain of cells attached to one another.

2 Write a short note on spore formation in fungi.

Spore formation is the common method of asexual reproduction in fungi such as Rhizopus (bread mould). Special reproductive sacs called sporangia develop at the tips of upright hyphae known as sporangiophores. Inside each sporangium, large numbers of haploid spores are produced by mitotic division. When the sporangium matures and ruptures, the spores are released into the air. Each spore is light and resistant, and can be carried by wind or water to a new location, where under favourable moisture and nutrients it germinates into a new fungal hypha.

3 What are the advantages of spore formation in fungi and bacteria?

- Spores are produced in enormous numbers, increasing the chance that at least a few will land in a favourable environment.
- Being light in weight, they can be carried over long distances by wind, water, or animals, helping the organism colonise new habitats.
- Many spores (such as bacterial endospores) have thick, resistant walls that let them survive extreme heat, cold, drought, and lack of nutrients.
- Spore formation allows the organism to remain dormant through harsh conditions and resume active growth once the environment becomes favourable again, ensuring the survival of the species.

4 Describe how vegetative propagation occurs through runners.

A runner (or stolon) is a slender stem that grows horizontally along the surface of the soil, arising from the base of the parent plant. At intervals along its length, nodes touch the ground and develop adventitious roots and shoots, forming small plantlets. Each plantlet initially depends on the parent plant through the runner, but once it develops its own root system, the connecting runner withers and breaks, leaving the young plant to grow independently. Strawberry is a well-known example of a plant that propagates this way.

5 State how potatoes reproduce through tubers.

A potato tuber is a swollen underground stem that stores food in the form of starch. Its surface bears small dormant buds, called “eyes,” each of which is really a reduced node. When conditions are favourable, these eyes sprout, and each sprouted eye develops into a new shoot with its own roots, drawing on the stored food in the tuber until it becomes self-sufficient. In this way, a single tuber cut into pieces — each containing at least one eye — can give rise to several new potato plants, genetically identical to the parent.

6 Describe the advantages and disadvantages of vegetative propagation.

Advantages:

- Produces new plants genetically identical to the parent, preserving desirable characteristics.
- Faster than growing from seed, since the plant skips the slow seedling stage.
- Useful for plants that produce few or no viable seeds.
- Allows large-scale, predictable production of crops such as potato, sugarcane, and banana.

Disadvantages:

- Offspring are genetically identical clones, so there is no genetic variation — a single disease or environmental change can wipe out the entire population.
- Vegetatively propagated plants can be less hardy or adaptable than those grown from seed.
- Some methods, such as grafting, require skill and are labour-intensive.

7 Name the four whorls present in a flower and also tell the components of each whorl.

- Calyx — outermost whorl, made up of green, leaf-like sepals; protects the flower bud before it opens.
- Corolla — second whorl, made up of petals, usually brightly coloured to attract pollinators.
- Androecium — third whorl, the male part, made up of stamens; each stamen has a filament (stalk) and an anther (produces pollen grains).
- Gynoecium (carpel) — innermost whorl, the female part, made up of one or more carpels; each carpel has a stigma (receives pollen), a style (connecting tube), and an ovary (contains ovules).

8 Briefly describe the formation of the egg cell and polar nuclei within the embryo sac of a flower.

Inside the ovule, a diploid megaspore mother cell undergoes meiosis to produce four haploid megaspores, of which usually only one survives. This surviving megaspore enlarges, and its nucleus divides mitotically three times without cell division, producing eight haploid nuclei within one large cell — the embryo sac. Three nuclei move to the micropylar end; the middle one becomes the egg cell, flanked by two synergid cells. Three nuclei move to the opposite (chalazal) end, forming the antipodal cells. The two remaining nuclei migrate to the centre of the embryo sac as the two polar nuclei, which later fuse with a sperm nucleus during double fertilisation to form the triploid endosperm nucleus.

9 Differentiate between the following:

i. Asexual and sexual reproduction

Asexual reproduction involves a single parent and produces offspring genetically identical (clones) to that parent, without any fusion of gametes.	Sexual reproduction involves two parents (or two gametes) whose genetic material fuses at fertilisation, producing genetically varied offspring.

ii. Binary fission in bacteria and amoeba

In bacteria, the single circular chromosome replicates and the cell simply elongates and splits into two identical daughter cells by forming a septum across the middle.	In amoeba, the nucleus first divides by mitosis; the cytoplasm then divides (cytokinesis), producing two daughter cells, each with a nucleus formed by true mitotic division.

iii. Stolon and rhizome

A stolon (runner) is a stem that grows horizontally above the ground, rooting at its nodes to form new plants, e.g. strawberry.	A rhizome is a stem that grows horizontally underground, storing food and producing new shoots from its nodes, e.g. ginger.

iv. Bulb and corm

A bulb is a short underground stem surrounded by thick, fleshy modified leaves (scales) that store food, as in onion.

A corm is a short, solid, swollen underground stem that stores food in the stem tissue itself, without fleshy leaf scales, as in Colocasia and gladiolus.

v. Cutting and grafting

In cutting, a piece of stem, root, or leaf is cut from a parent plant and placed in soil or water, where it develops its own roots and grows into a complete new plant.

In grafting, a piece of one plant (the scion) is joined onto the stem/root system of another plant (the stock) so the two grow together as a single plant, combining the traits of both.

vi. Vegetative propagation and artificial propagation

Vegetative propagation is the natural (or human-assisted) growth of new plants from vegetative parts — stem, root, or leaf — of a parent plant, e.g. natural runners and tubers.

Artificial propagation refers specifically to methods carried out deliberately by humans, such as cutting, layering, and grafting, to multiply plants for agricultural or horticultural purposes.

vii. Male and female gametophytes

The male gametophyte is the pollen grain, developing from a microspore, and it eventually produces the male gametes (sperm nuclei).

The female gametophyte is the embryo sac, developing within the ovule from a megaspore, and it contains the egg cell along with the other nuclei.

viii. Calyx and corolla

The calyx is the outermost whorl of a flower, made up of green sepals that protect the developing bud.

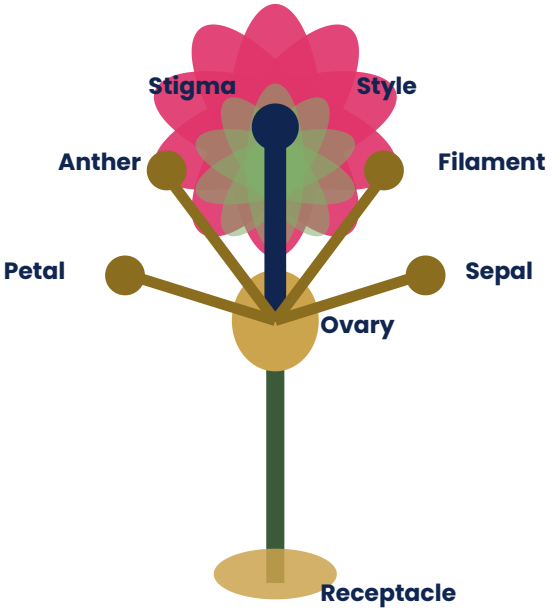
The corolla is the whorl just inside the calyx, made up of usually colourful petals that attract pollinators.

ix. Stamen and carpel

The stamen is the male reproductive organ of a flower, consisting of a filament and an anther that produces pollen.

The carpel is the female reproductive organ, consisting of stigma, style, and ovary, which contains the ovules.

10 Label the given diagram of a flower.



Parts to label

- Stigma
- Style
- Anther
- Filament
- Petal (Corolla)
- Sepal (Calyx)
- Ovary
- Ovule
- Receptacle

C

SECTION C

Detailed Answer Questions

Full, structured explanations — written the way examiners expect them

1 Explain the process of binary fission in bacteria and describe how it leads to the formation of two daughter bacteria.

Binary fission is the most common method of asexual reproduction in bacteria, allowing a single bacterial cell to divide directly into two new cells. It proceeds through the following stages:

1. **Cell growth.** The bacterial cell first increases in size, and its single circular chromosome (DNA) begins to replicate, producing two identical copies.
2. **Chromosome segregation.** The two copies of the chromosome attach to different points on the cell membrane and move apart towards opposite ends (poles) of the elongating cell.
3. **Septum formation.** Once the chromosomes have separated, the cell membrane and cell wall begin to grow inward from the sides, forming a partition called a septum across the middle of the cell.
4. **Cytokinesis.** The septum continues to grow until it completely divides the cytoplasm into two, sealing off two separate cells.
5. **Separation.** The two new cells separate completely, each an independent bacterium with an identical copy of the parental chromosome and roughly half the parent cell's cytoplasm.

Because no gametes fuse and only one parent is involved, the two daughter bacteria are genetically identical to each other and to the original parent cell. Under favourable temperature and nutrient conditions, this process can

repeat every twenty to thirty minutes, allowing bacterial populations to grow extremely rapidly.

2 What do you mean by vegetative propagation? Differentiate among different plant structures modified for vegetative propagation.

Vegetative propagation is a form of asexual reproduction in plants in which new individuals develop from vegetative (non-reproductive) parts of a parent plant — its stem, root, or leaves — rather than from seeds. Since no gametes fuse, the new plants are genetically identical to the parent.

Several plant structures are specially modified to carry out vegetative propagation:

1. **Runners (stolons).** Horizontal stems that grow above the soil surface, rooting at their nodes to produce new plantlets, e.g. strawberry.
2. **Rhizomes.** Horizontal stems that grow underground, storing food and giving rise to new shoots at their nodes, e.g. ginger.
3. **Tubers.** Swollen underground stems that store food and bear dormant buds (“eyes”) capable of sprouting into new plants, e.g. potato.
4. **Bulbs.** Short underground stems surrounded by fleshy, food-storing leaf scales; a new plant grows from the central bud, e.g. onion.
5. **Corms.** Short, solid, swollen underground stems that store food directly in stem tissue and bear buds on their surface, e.g. gladiolus.

> Although all these structures are modified stems adapted for food storage and propagation, they differ in whether food is stored in the stem tissue itself (tuber, corm, rhizome) or in surrounding leaves (bulb), and in whether

they grow above ground (runner) or below ground (rhizome, tuber, bulb, corm).

3 Describe the ways by which humans can grow new plants by using the vegetative parts of the parent plants.

Humans have developed several deliberate techniques — known together as artificial vegetative propagation — to multiply useful or ornamental plants using their vegetative parts:

1. **Cutting.** A piece of stem, root, or leaf is cut from a healthy parent plant and placed in moist soil or water. Under suitable conditions it develops adventitious roots and grows into an independent plant, e.g. rose, sugarcane, money plant.
2. **Layering.** A stem is bent down while still attached to the parent plant and partly buried in soil, encouraging it to root at the buried point. Once rooted, the new plant is cut away from the parent, e.g. jasmine, bougainvillea.
3. **Grafting.** A cutting (scion) from a plant with desirable fruit or flowers is joined onto the rooted stem (stock) of a related, hardier plant, so the tissues fuse and grow as one, combining the scion's fruit quality with the stock's strong roots, e.g. mango, citrus.
4. **Tissue culture.** Small pieces of plant tissue are grown in a sterile nutrient medium under controlled laboratory conditions, allowing rapid, large-scale, disease-free production of genetically identical plantlets, e.g. banana, orchids.

> These methods let farmers and horticulturists reliably reproduce plants with known, desirable characteristics, produce crops faster than growing from seed, and propagate plants that rarely produce viable seeds.

4 Define sporophyte and gametophyte. State their roles in the life cycle of plants.

In plants, the life cycle alternates between two distinct generations:

1. **Sporophyte.** The diploid (2n) generation, whose cells contain two sets of chromosomes. Its main role is to produce haploid spores through meiosis. In flowering plants, the visible plant body — roots, stem, leaves, and flowers — is the sporophyte, and meiosis occurs within the anthers (producing microspores/pollen) and within the ovule (producing megaspores).
2. **Gametophyte.** The haploid (n) generation, containing a single set of chromosomes, developing from a spore produced by the sporophyte. Its main role is to produce gametes by mitosis. In flowering plants this generation is greatly reduced: the male gametophyte is the pollen grain, and the female gametophyte is the embryo sac within the ovule.

> This alternation of generations means the sporophyte produces spores that grow into gametophytes, and the gametophytes in turn produce gametes that fuse at fertilisation to form a new sporophyte, completing the cycle.

5 Explain the lifecycle of flowering plants, focusing on the alternation between the gametophyte and sporophyte generations.

The flowering plant we see — with its roots, stem, leaves, and flowers — is the sporophyte (2n) generation. Its life cycle proceeds as follows:

1. **Formation of the male gametophyte.** Within the anther, diploid microspore mother cells undergo meiosis to form haploid microspores, each developing into a pollen grain — the male gametophyte.
2. **Formation of the female gametophyte.** Within the ovule, a diploid megaspore mother cell undergoes meiosis to form four haploid megaspores; usually only one survives and, through repeated mitotic divisions, develops into the embryo sac — the female gametophyte, containing the egg cell.
3. **Pollination and pollen tube growth.** Pollination transfers pollen grains from anther to stigma. On germination, the pollen grain forms a pollen tube that grows down through the style towards the ovule, carrying two male gametes (sperm nuclei).
4. **Double fertilisation.** One sperm nucleus fuses with the egg cell to form the diploid (2n) zygote, the future embryo. The second sperm nucleus fuses with the two polar nuclei to form the triploid (3n) endosperm nucleus, the future endosperm — nutritive tissue for the embryo.
5. **Seed and fruit formation.** The fertilised ovule develops into a seed, and the ovary develops into a fruit. When the seed germinates, it grows into a new sporophyte plant, and the cycle begins again.

> In this way, the diploid sporophyte produces haploid spores (by meiosis), which grow into haploid gametophytes; the

gametophytes produce gametes (by mitosis), whose fusion at fertilisation restores the diploid sporophyte generation — completing the alternation of generations.

6 Describe how the female gametophyte (embryo sac) develops within the ovule of a flower.

The development of the embryo sac takes place inside the ovule and proceeds through the following stages:

1. **Megaspore mother cell.** Within the ovule, one cell of the nucellus enlarges and differentiates into a diploid megaspore mother cell.
2. **Meiosis.** This megaspore mother cell undergoes meiosis, producing four haploid megaspores arranged in a row.
3. **Degeneration.** Typically, three of the four megaspores degenerate and disintegrate, leaving only one functional megaspore.
4. **Free nuclear divisions.** The surviving megaspore enlarges considerably, and its nucleus divides mitotically three successive times without cell division, producing eight haploid nuclei within the single, enlarged embryo sac.
5. **Organisation of the embryo sac.** Three nuclei move to the micropylar end — the middle one becomes the egg cell, flanked by two synergid cells; three nuclei move to the chalazal end, forming the antipodal cells; the two remaining nuclei move to the centre as the polar nuclei.

> The mature embryo sac (female gametophyte) thus contains seven cells and eight nuclei in total: one egg cell, two synergids, three antipodals, and two polar nuclei. It is now ready to receive the male gametes delivered through the pollen tube during double fertilisation.

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