CHAPTER › 15

Plant Growth and Development

NEET KEY NOTES

Growth

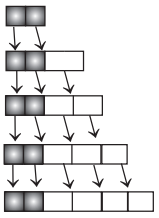
- **Growth** is considered as one of the most conspicuous events of living organisms. It is defined as an irreversible permanent increase in size of an organ or its part or an individual cell. Growth is accompanied by metabolic processes (both anabolic and catabolic) which occur at the expense of energy.
- Plant growth is unique as plants show unlimited growth throughout their life. It is due to the presence of meristems at certain locations in their body.
- The form of growth wherein new cells are always being added to the plant body by the activity of the meristem is called the **open form of growth**.
- The first step in the process of plant growth is seed germination under favourable conditions.
- The root apical meristem and the shoot apical meristem are responsible for the **primary growth of plants**. These contribute to the elongation of the plants along their axis.
- Dicotyledons and gymnosperms have lateral meristems, i.e. vascular cambium and cork combium. These cause an increase in the girth of the organs through **secondary growth** in which they are active.
- Growth can be measured by a variety of parameters such as increase in fresh weight, dry weight, length, area, volume and cell number.

Phases of Growth

- Growth period is generally divided into three phases, namely meristematic, elongation and maturation.
  - **Meristematic phase** includes rapidly and constantly dividing cells at root and shoot apical meristems.
  - **Elongation phase** includes the cells which lie just beneath the meristematic tissue and shows characteristics of cell enlargement increased vacuolation and deposition of new cell wall.
  - **Maturation phase** includes cells which attain their maximal size in terms of wall thickening and protoplasmic modifications. This phase lies proximal to the phase of elongation.

Growth Rate

- It is defined as the rate of increase in growth per unit time. Rate of growth can be expressed mathematically, i.e. increase may be arithmetic or geometrical.
  - **Arithmetic growth** In such growth pattern, after mitotic cell division only one cell continues to divide, while the other differentiates and matures, e.g. constantly elongating root.



It can be represented mathematically as

$$L_t = L_o + rt$$

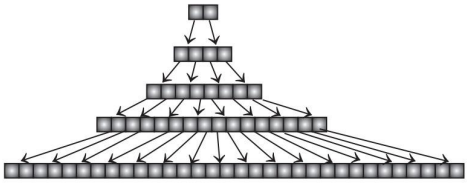
Where,

L_t = Length at time 't'

L_0 = Length at time 'zero'

r = Growth rate

- **Geometrical growth** Here, both the progeny cells resulted after mitosis, continue to divide. However, with limited nutrient supply, the growth slows down and becomes stationary.



It cab be represented mathematically as

$$W_1 = W_0\, e^{rt}$$

Where,

W_1 = Final size (weight, height, number)

W_0 = Initial size

r = Growth rate

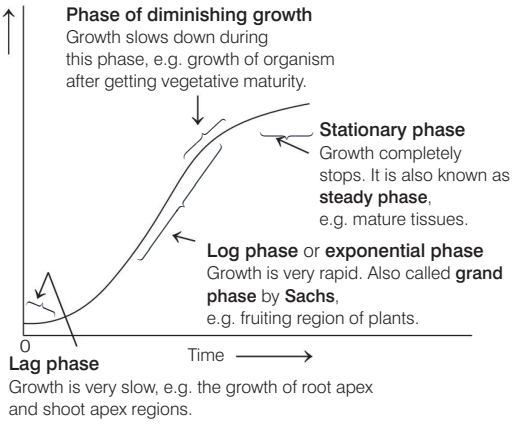
t = Time of growth

e = Base of natural logarithms

Here, r is the relative growth and is also a measure of the ability of the plant to produce new plant material (referred to as efficiency index).

Growth Curve

- It is the graphical representation of the total growth of plant against time. If total growth is plotted against time, a S-shaped or **sigmoid curve** is obtained. It is the typical growth curve of most living organisms in their natural habitat. The growth phases of sigmoid curve is discussed in the following figure



- Quantitative comparisons between growth of living systems can also be made in two ways, i.e.
  - **Absolute growth rate** which is measurement and the comparison of total growth per unit time.
  - **Relative growth rate** which is the growth of the given system per unit time expressed on a common basis, e.g. per unit initial parameter.

Conditions of Growth

The essential requirements of growth in plants are described as follows

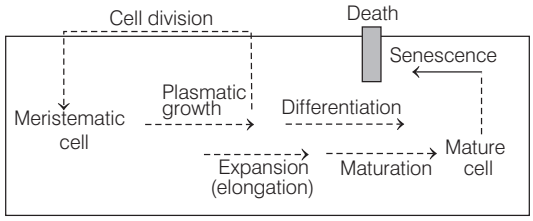
- **Water** helps in maintenance of turgidity of cells. It also provides a medium for enzymatic activities needed for growth.
- **Nutrients** are required by plants for the synthesis of protoplasm and act as a source of energy.
- **Temperature** range above optimum for plant growth may damage the protoplast or denature the enzymes.
- **Oxygen** is essential for aerobic respiration, hence availability of energy for biosynthetic activity depends on oxygen.
- **Light** and **gravity** also affect certain phases/stages of growth. Light is required for photosynthesis, flowering, etc. Gravity is required for growth movements of root, stem and branches.

Differentiation, Dedifferentiation and Redifferentiation

- The development of structures and organs of plant involves a switch from one developmental phase to another.
- The three processes that are associated with the specialisation of cells in different organisms including plants are as follows
  - **Differentiation** is the permanent localised qualitative change in size, biochemistry, structure and function of cells, tissues or organs, which lead to the maturation of cells and organs to perform specific functions, e.g. in plants, palisade parenchyma, tracheid, guard cells, root cap, fibre, trichome are differentiated cells.
  - **Dedifferentiation** is the process of despecialisation of differentiated cells, so that they regain the capacity to divide and form new cells, e.g. formation of meristems, interfascicular vascular cambium, cork cambium, etc.
  - **Redifferentiation** is the structural, chemical and physiological specialisation of cells being derived from dedifferentiated meristematic cells, which lose the capacity to divide but mature to perform specific functions, e.g. formation of secondary phloem, secondary xylem, cork cells and secondary cortex.

Development

- It includes a series of changes that an organism goes through during its life cycle from germination to senescence.
- The sequence of processes, which constitute the development of a cell of a higher plant is given below



Sequence of the developmental process in a plant cell

- Plants follow different pathways in response to their environment or phases of life to form different kinds of structures. This is called **plasticity**, e.g. heterophylly in cotton, coriander and larkspur. Heterophylly is the occurrence of different types of leaves on the same plant.

Plant Growth Regulators (PGRs)

These are described as plant growth substances, plant hormones or phytohormones. These are the small, simple organic molecules of diverse chemical composition produced naturally in higher plants to control growth and other physiological functions. These are required in a minute quantity by the plant.

Classification of Plant Growth Regulators

I. **On the basis of chemical composition**
- **Indole compounds**, Indole-3- Acetic Acid (IAA).
- **Adenine derivatives**, N^6–furfuryl amino purine, kinetin
- **Carotenoid derivative**, Abscisic Acid (ABA)
- **Terpenes**, Gibberellic Acid (mainly GA_3)
- **Gases**, Ethylene (C_2H_4)

II. **On the basis of functions they perform in a living plant body**
- **Plant Growth Promoters** (PGRs) that show growth promoting activities such as cell division, cell enlargement, tropic growth, pattern formation, flowering, fruiting, seed formation, etc., are called plant growth promoters, e.g. auxins, gibberellins and cytokinins.
- **Plant Growth Inhibitors** (PGIs) These perform function in response to wounds and stresses, i.e. of biotic and abiotic origin. These are also involved in various growth inhibiting activities like dormancy and abscission, e.g. abscisic acid.

Discovery and Physiological Effects of Plant Growth Regulators

1. Auxin

- It was isolated by **FW Went** from **tips of coleoptiles of oat seedlings**.
- Production of auxin generally takes place in the region of growing apices of the stems and roots from where they migrate to the site of their action.
- Auxin was first isolated from human urine. Auxins like Indole 3 Acetic Acid (IAA) and Indole Butyric Acid (IBA) have been isolated from plants, i.e. natural auxin. NAA (Naphthalene Acetic Acid) and 2, 4-D (2, 4-dichlorophenoxyacetic acid) are synthetic auxins.
- Functions of auxins are as follows
  - Growth of apical bud and inhibition of axillary buds. Such phenomenon is called **apical dominance**.
  - It promotes flowering and used in agriculture and horticulture practices.
  - It prevents leaf abscission and early fruit drop.
  - It induces parthenocarpy (development of fruit/plant without fertilisation), e.g. in tomatoes.
  - Acts as weedicides (e.g. 2, 4-D). It kills dicotyledonous weeds.
  - It controls xylem differentiation and is responsible for phototropism.

2. Gibberellin

- It was discovered by **E Kurosawa** in 1926 as an active substance produced by fungus, *Gibberella fujikuroi*. The fungus caused '**Bakanae or foolish seedling disease**' in rice in Japan. Infected seedlings exhibited abnormal elongation.
- More than 100 gibberellins are reported from different organisms and they are termed as GA_1, GA_2, GA_3, etc.
- All of them are known to be acidic in nature, thus they are termed as gibberellic acids. However, GA_3 is the most important gibberellic acid.
- Functions of gibberellin are as follows
  - It helps in increasing the internodal length, phenomenon is known as **bolting**.
  - It delays senescence.
  - It is used to speed up the malting process in brewing industry.
  - GAs hasten the maturity period and leads to early seed production.
  - It breaks dormancy of seed and promotes seed germination.

3. Cytokinin

- It was first discovered by **Skoog** and **Miller** in 1955 from coconut milk as an active substance that caused proliferation of callus.
- Cytokinins are growth promoters and are basic in nature.
- These have specific effects on cytokinesis (division of cytoplasm) and were discovered as **kinetin** (a modified form of adenine, a purine) from the autoclaved herring sperm DNA.
- **Zeatin** is a natural cytokinin present in coconut milk. These are derivatives of purines.
- Functions of cytokinin are as follows
  - Cell division in apical meristem.
  - It plays an important role in the formation of new leaves and chloroplast in leaves.
  - It helps the plant to overcome apical dominance. It promotes lateral shoot growth and adventitious shoot formation.
  - It promotes nutrient mobilisation.
  - It delays leaf senescence (falling of leaves).

4. Ethylene

- In 1910 **HH Cousins** confirmed the release of a volatile substance from ripened oranges that hastened the ripening of stored unripened bananas, which was later identified as ethylene.
- It is a simple gaseous plant growth regulator, which is synthesised from the amino acid methionine.
- Functions of ethylene are as follows
  - It promotes senescence and abscission of plant organ.
  - It promotes fruit ripening.
  - It breaks seed and bud dormancy.
  - It is also known as **climacteric hormone** since, it increases the respiration rate during ripening of fruits and increase in temperature occurs.
  - It promotes flowering in cucumbers thereby increasing the yield.
  - It is used to initiate flowering and causes fruit set in pineapples.
  - It also promotes internode and petiole elongation in deep water rice plants.
- **Ethephon** is the chief source of ethylene. It accelerates the formation of abscission layer in fruits and flower (thinning of cotton, cherry, walnut).

5. Abscisic Acid (ABA)

- During mid 1960 three independent researchers reported by **Carins, Frederick Addicott** and **PF Wareing** that the purification and chemical characterisation of three different kinds of inhibitors, i.e. inhibitor-B, abscission-II and dormin.
- Later all three were proved to be chemically identical and was named abscisic acid.
- It is slightly acidic growth hormone that functions as a growth inhibitor by interacting with other growth hormones.
- Functions of abscisic acid are as follows
  - It stimulates the closure of stomata and increases the tolerance of plants to various kinds of stresses. Therefore, also called as **stress hormone**.
  - It inhibits seed germination.
  - It plays an important role in seed development and maturation and induces seed dormancy.
  - It accumulates during unfavourable conditions and helps seed to withstand desiccation.
  - It acts antagonastically or opposite to gibberellic acid.

Photoperiodism

- The effects of photoperiods or daily duration of light hours (and dark periods) on the growth and development of plants, especially flowering is called photoperiodism. According to the photoperiodic responses, three classes of plants have been recognised.
- These classes are as follows
  - **Short day plants** These plants initiate flowering when exposed to photoperiods shorter than the critical day length. They require long and uninterrupted dark periods for flowering, e.g. tobacco, soybean, sugarcane, etc.
  - **Long day plants** These plants initate flowering on exposure to photoperiods longer than the critical day length. These plants require a relatively small dark period, e.g. wheat, sugarbeet, radish, etc.
  - **Day-neutral plants** These plants do not require specific photoperiods to flower. Such plants flower in almost all the photoperiods ranging from a few hours to 24 h of uninterrupted light period, e.g. maize, cotton, etc.
- **Critical duration** is that length of photoperiod above or below which flowering occurs, e.g. **xanthium** is SDP and its critical day length is 15 hours, i.e. below 15 hours flowering will take place.

Vernalisation

- There are plants in which flowering is either quantitatively or qualitatively dependent on exposure to low temperature. The phenomenon in which flowering is promoted by exposing a plant to a period of low temperature is termed as vernalisation. It prevents

precocious reproductive development late in the growing season and enables plants to have sufficient time to reach maturity.

- Vernalisation can be summarised as the process of shortening of vegetative phase and hastening of flowering by cold treatment. By using this method, winter varieties can be transformed into spring or summer varieties.
- **Devernalisation** is the high temperature treatment which nullifies vernalisation. It can be obtained by using gibberellic acid.

Seed Dormancy

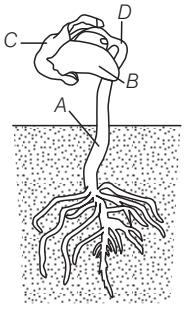
- It is defined as the inactive state of a seed where the growth of embryo remains suspended and does not resume even on exposure to favourable conditions.
- Various methods are used for breaking dormancy such as mechanical abrasions using knives, sand paper, etc., or vigorous shaking, subjecting the seed to chilling conditions, application of GA_3, changing the environmental conditions like light and temperature, etc.

Mastering NCERT

MULTIPLE CHOICE QUESTIONS

TOPIC 1 ~ *Growth*

1 Identify *A, B, C* and *D* in the given figure and choose the correct option.



(a) A–Hypocotyl, B–Cotyledon, C–Seed coat, D–Epicotyl hook
(b) A–Epicotyl, B–Cotyledon, C–Hypocotyl, D–Seed coat
(c) A–Epicotyl, B–Seed coat, C–Hypocotyl, D–Cotyledon
(d) A–Hypocotyl, B–Seed coat, C–Epicotyl, D–Cotyledon

2 Choose the correct option for the characteristic of growth.
(a) It is an irreversible permanent increase in size of an organ or its parts or even of an individual cell
(b) It is accompanied by metabolic processes
(c) It occurs at the expense of energy
(d) All of the above

3 Plant growth is unique because
(a) plants bear the capacity for unlimited growth
(b) plants bear the capacity for limited growth
(c) plants have diffused growth that differs from animals
(d) None of the above

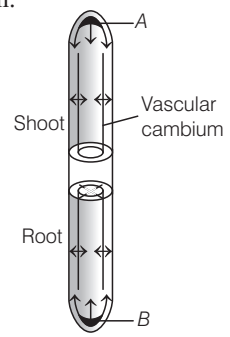
4 The cells of …… have the capacity to divide and self-perpetuate.
(a) permanent tissue (b) quiescent centre
(c) meristems (d) subapical part

5 The type of growth where new cells are always being added to the plant body by the activity of meristem is called
(a) closed form of growth (b) diffused form of growth
(c) open form of growth (d) discontinuous form of growth

6 Primary growth of plants is contributed by
(a) root apical meristem (b) shoot apical meristem
(c) Both (a) and (b) (d) None of these

7 The tissues responsible for secondary growth in plants are
(a) vascular cambium (b) cork cambium
(c) lateral meristem (d) All of these

8 Identify *A* and *B* in the given figure and choose the correct option.



(a) A–Root apical meristem; B–Shoot apical meristem
(b) A–Shoot apical meristem; B–Root apical meristem
(c) A–Permanent tissue; B–Radicle tissue
(d) A–Radicle tissue; B–Apical tissue

9 Growth at cellular level is the increase in the amount of
(a) cell wall (b) cell membrane
(c) protoplasm (d) All of these

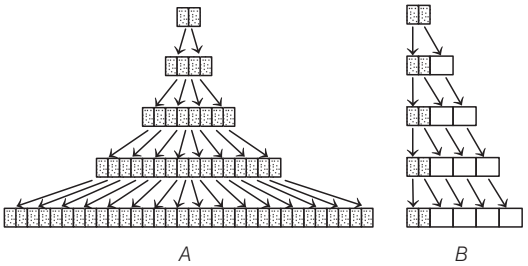
10 The period of growth does not include
(a) meristematic phase (b) elongation phase
(c) death phase (d) maturation phase

11 Constantly dividing cells, both at the root apex and shoot apex represent
(a) elongation phase of the growth
(b) meristematic phase of the growth
(c) maturation phase of the growth
(d) None of the above

12 The cells in the root and shoot apex
(a) are rich in protoplasm
(b) have conspicuous nuclei
(c) have cell walls which are primary in nature, thin and cellulosic with abundant plasmodesmatal connections
(d) All of the above

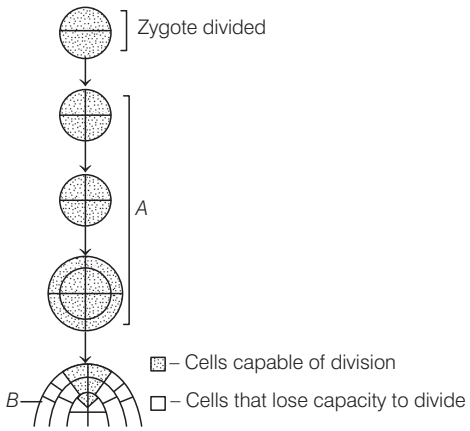
13 The cells proximal (just next away from the tip) to the meristematic zone represent the phase of
(a) division (b) maturation
(c) elongation (d) differentiation

14 In the given diagram, what does *A* and *B* indicate?



Choose the correct option.
(a) A–Mitosis; B–Meiosis
(b) A–Arithmetic growth; B–Geometric growth
(c) A–Geometric growth; B–Arithmetic growth
(d) A–Multiplicative phase; B–Replicative growth

15 In the given diagram, identify the type of growth phases of a zygote represented as *A* and *B*.



(a) A–Arithmetic phase; B–Geometric phase
(b) A–Arithmetic phase; B–Arithmetic phase
(c) A–Geometric phase; B–Geometric phase
(d) A–Geometric phase; B–Arithmetic phase

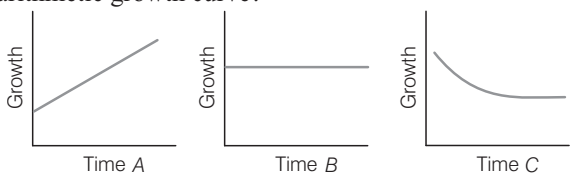
16 Arithmetic growth is linear because
(a) One daughter cell remains meristematic and other differentiates and mature
(b) Both daughter cells remain meristematic
(c) Both daugther cells get matured
(d) All of the above

17 In expression, $L_t = L_0 + rt$ of arithmetic growth rate, L_t, L_o and r represent

	L_t	L_0	r
(a)	Length at time zero	Length at time 't'	Elongation per unit time
(b)	Length at time 't'	Length at time zero	Elongation per unit time
(c)	Length at time 't'	Length at time zero	Growth rate

(d) Both (b) and (c)

18 Among the following graphs, which shows the arithmetic growth curve?



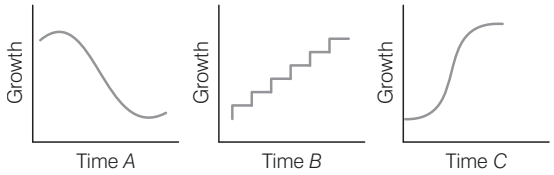
(a) *A* and *B* (b) *B* and *C* (c) *A* and *C* (d) Only *A*

19 In geometrical growth, lag phase is represented by
(a) initial rapid growth (b) later rapid growth
(c) initial slow growth (d) later slow growth

20 In geometrical growth, exponential phase is represented by
(a) rapid consumption of nutrients
(b) rapid increase in cell number
(c) highest growth rate
(d) All of the above

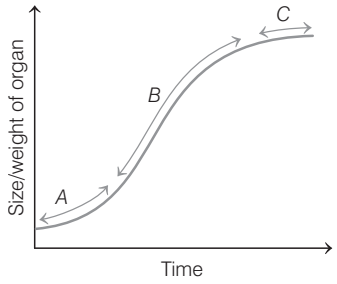
21 Typical growth curve in plants is ***NEET 2016***
(a) sigmoid (b) linear
(c) stair-steps-shaped (d) parabolic

22 Which of the following graphs show(s) the sigmoid growth curve?



(a) Only *C* (b) Only *A*
(c) Only *B* (d) None of these

23 Identify *A, B, C* in the given graph and choose the correct option.



(a) A–Log phase, B–Lag phase, C–Steady state phase
(b) A–Lag phase, B–Log phase, C–Steady state phase
(c) A–Lag phase, B–Steady state phase, C–Log phase
(d) A–Log phase, B–Steady state phase, C–Lag phase

24 In geometrical growth (from beginning to last) the correct sequence of growth phases and their occurrence are

I. lag phase II. stationary phase
III. exponential phase

(a) I → II → III (b) I → III → II
(c) III → II → I (d) III → I → II

25 Grand phase or the fastest phase of growth in S-shaped growth curve is

(a) lag phase
(b) stationary phase
(c) diminishing growth phase
(d) exponential growth phase

26 In the expression, $W_1 = W_0 e^{rt}$ (geometrical growth), W_1, W_0, r and t represents

	W_0	W_1	r	t
(a)	Initial size	Final size	Growth rate	Time of growth
(b)	Final size	Initial size	Growth rate	Time of growth
(c)	Final size	Initial size	Growth rate	Time of single cell division
(d)	Initial size	Final size	Growth rate	Time of single cell division

27 Efficiency index in the geometrical growth is the ability of plants to produce

(a) cell wall
(b) new enzyme
(c) new plant material
(d) young ones through mitosis

28 Developing embryo (*in vitro*) shows

(a) geometric growth (b) arithmetic growth
(c) logistic growth (d) Both (a) and (b)

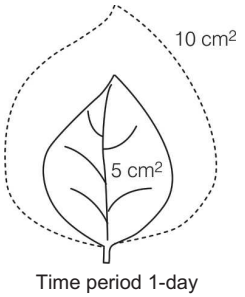
29 Quantitative comparisons between the growth of living system can be made in

(a) two ways (b) three ways
(c) only one way (d) four ways

30 Measurement and comparison of total growth of a plant per unit time is called

(a) absolute growth rate
(b) qualitative growth rate
(c) relative growth rate
(d) exponential growth rate

31 In the given figure, find out the absolute and relative growth rate and choose the correct option.



	Absolute Growth Rate (AGR)	**Relative Growth Rate** (RGR)
(a)	1 cm^2	1 cm^2
(b)	100 cm^2	5 cm^2
(c)	5 cm^2	100 cm^2
(d)	0.5 cm^2	100 cm^2

32 Auxanometer is used to measure

(a) growth in the length of plant organ
(b) growth in the width of plant organ
(c) population of the pest-attacking plants
(d) Both (a) and (b)

33 Which of the following are the factors for plant growth?

(a) H_2O and O_2
(b) Light, temperature and gravity
(c) Nutrients
(d) All of the above

34 Water is required in plant growth for

(a) enzymatic reactions (b) cell enlargement
(c) extension growth (d) All of these

TOPIC 2 ~ *Differentiation, Dedifferentiation and Redifferentiation*

35 Permanent localised qualitative change in size, biochemistry, structure and function of cells, tissues or organs is called
(a) cell division (b) meristematic division
(c) differentiation (d) dedifferentiation

36 Differentiation in the cells derived from root apical and shoot apical meristems and cambium cause them to
(a) differentiate (b) mature
(c) perform specific functions (d) All of these

37 What are the structural changes which occur during differentiation of tracheary elements?
(a) The cells lose their protoplasm
(b) Cells develop very strong elastic lignocellulosic secondary cell walls
(c) The cell increases its protoplasm
(d) Both (a) and (b)

38 The tracheary elements develop elastic lignocellulosic secondary cell walls to
(a) withstand high temperature
(b) carry water to long distances under extreme tension
(c) withstand high light conditions
(d) Both (a) and (b)

39 The living differentiated cells, regain the capacity of division under certain conditions which is called
(a) redifferentiation (b) dedifferentiation
(c) differentiation (d) reverse division

40 The formation of which of the following is the example of dedifferentiation?
(a) Procambium and vascular cambium
(b) Cork cambium and interfascicular cambium
(c) Cork cambium and vascular cambium
(d) Procambium and cork cambium

41 If a part of pith from the stem of a plant is used as an explant and cultured on nutrient medium, which of the following processes is responsible for the formation of an undifferentiated mass of cells called callus?
(a) Growth
(b) Differentiation
(c) Dedifferentiation
(d) Redifferentiation

42 Name the process when dedifferentiated cells again loss the ability to divide and get mature
(a) cell enlargement
(b) redifferentiation
(c) dedifferentiation
(d) differentiation

43 Growth of the plant is
(a) determinate (b) indeterminate
(c) continuous (d) Both (a) and (b)

44 The final structure at maturity of a cell/tissue is determined by
(a) type of cells
(b) type of cell division
(c) location of cells within the tissue
(d) nutrients in cells

45 The cells positioned away from the root apical meristems differentiate as …*A*… , while those pushed to the periphery mature as …*B*… .
(a) A– root cap cells, B– epidermis
(b) A– endodermis, B– epidermis
(c) A–root cap cells, B– endodermis
(d) A–epidermis, B– endodermis

TOPIC 3 ~ *Development*

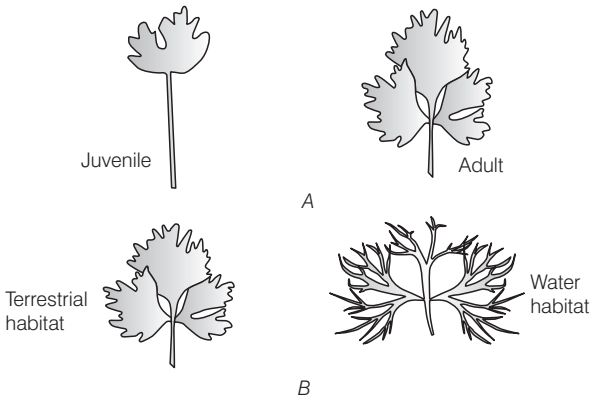
46 The term that includes a series of changes that an organism goes through during its life cycle from germination of the seed to senescence is
(a) maturation (b) development
(c) growth (d) differentiation

47 Identify the correct sequence from the following events of development process in a plant cell choose the correct option.
I. Plasmatic growth II. Differentiation
III. Maturation IV. Senescence
(a) I → II → III → IV (b) I→ II → IV → III
(c) IV → III → II → I (d) IV → I → II → III

48 The ability of plants to follow different pathways to form different structures in response to environment is called
(a) plasticity
(b) elasticity
(c) growth
(d) development

49 Heterophylly can be observed in
(a) cotton
(b) coriander
(c) larkspur
(d) All of the above

50 Diagrams *A* and *B* indicate the shape of leaves in larkspur and buttercup, respectively. Choose the correct option.



(a) The juvenile and adult leaves of larkspur differ in colour from those in mature plant
(b) Leaves of buttercup differ in size due to its environment
(c) There is no variation in sizes of leaves of larkspur and buttercup
(d) None of the above

51 When transition from juvenile to adult is gradual then this type of development is called
(a) homoblastic development
(b) heteroblastic development
(c) homo and heteroblastic development
(d) hetero and homoblastic development

52 The study of different aspects or appearances of plants in different seasons of the year is called
(a) ecology (b) ecosystem
(c) phenology (d) demography

53 Which of them are not extrinsic factors for growth of plants?
(a) Light, O_2
(b) Temperature, CO_2
(c) Nutrient, water
(d) Growth regulator and genetic factor

TOPIC 4 ~ *Plant Growth Regulators*

54 Which one includes growth promoters?
(a) Auxin, cytokinin, ABA
(b) GA, cytokinin, C_2H_4
(c) C_2H_2, ABA
(d) Auxin, cytokinin, GA_3

55 Which one includes growth inhibitors?
(a) ABA, cytokinin
(b) GA, IAA
(c) ABA, C_2H_4
(d) None of the above

56 I. Cell division
II. Cell enlargement
III. Pattern formation
IV. Tropic growth and seed formation
V. Flowering and fruiting
VI. Response to wound
VII. Response to stresses of biotic and abiotic origin

Which one is correct ?

	Functions of growth promoters	Functions of growth inhibitor
(a)	I, II, VII	III, IV, V, VI
(b)	VI, II	I, III, IV, V
(c)	I, II, III, IV, V	VI, VII
(d)	VI, VII	I, II, III, IV, V

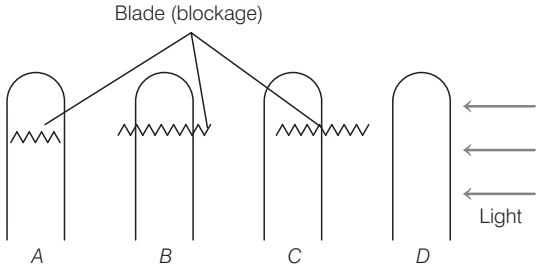
57 Canary grass experiment for phototropism was first conducted by
(a) Went
(b) Darwin and Darwin
(c) Cousins
(d) Kurosawa

58 Hormone involved in phototropism is
(a) Auxin (b) Gibberelin
(c) Kinetin (d) 2, 4-D

59 In coleoptile tissue, auxin is
(a) not transported because it used where it is made
(b) transported by diffusion
(c) transported from base to tip by as mosses
(d) produced by growing apices of stem which migrate to the region of its action

60 Dr. F Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly cut coleoptile stumps what is the significance of this experiment? ***CBSE-AIPMT 2014***
(a) It made possible the isolation and exact identification of auxin
(b) It is the basis for quantitative determination of small amounts of growth-promoting substances
(c) It supports the hypothesis that IAA is auxin
(d) It demonstrated polar movement of auxins

61 Given below are the representation of four coleoptiles for experiment.



Which coleoptile will bend towards the light? Choose the correct option.

(a) A and B (b) C and D
(c) A and D (d) C and B

62 'Bakanae' (foolish seedling) disease of rice seedlings, was caused by *Gibberella fujikuroi*, which is a

(a) fungi (b) protozoan
(c) bacteria (d) virus

63 You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones would you add to the medium to secure shoots as well as roots?

CBSE-AIPMT 2015

(a) IAA and gibberellin
(b) Auxin and cytokinin
(c) Auxin and abscisic acid
(d) Gibberellin and abscisic acid

64 Cytokinesis promoting active substance kinetin identified and crystallised by

(a) Skoog and Miller (b) Cousins
(c) E Kurosawa (d) Darwin

65 The Plant Growth Regulator (PGR), ethylene is

(a) volatile (b) gaseous in nature
(c) Both (a) and (b) (d) None of these

66 Which hormone was first isolated from human urine?

(a) Auxin (b) ABA
(c) Ethylene (d) Gibberellic acid

67 Movement of auxin is

(a) basipetal (b) acropetal
(c) centripetal (d) Both (a) and (b)

68 High concentration of auxin is present in

(a) root apex (b) stem apex
(c) node (d) petiole

69 Natural and synthetic auxins (IAA, NAA, IBA, 2,4-D) have been used extensively in

(a) agriculture (b) horticulture
(c) sericulture (d) Both (a) and (b)

70 Which of the following effects of auxins on plants is the basis for their commercial application?

(a) Callus formation
(b) Curvature of stem
(c) Induction of root formation in stem cuttings
(d) Induction of shoot formation

71 Fruit and leaf drop at early stages can be prevented by the application of ***NEET 2017***

(a) cytokinins (b) ethylene
(c) auxins (d) gibberellic acid

72 'Apical dominance' in plants is the result of

(a) cytokinin (b) auxin
(c) gibberellin (d) $CH_2—CH_2$

73 The full form of IAA is

(a) Indole-3-acetic acid (b) Indole-2-acetic acid
(c) Inolacetic acid (d) Indole abscisic acid

74 Removal of auxin source demonstrates that leaf abscission is ..... by auxin and apical dominance is …… by auxin.

(a) Promoted, promoted (b) inhibited, inhibited
(c) promoted, inhibited (d) inhibited, promoted

75 Removal of shoot tips is very useful technique to boost the production of tea leaves. This is because ***NEET (Odisha) 2019***

(a) gibberellins prevent bolting and are inactivated
(b) auxins prevent leaf drop at early stages
(c) effect of auxins is removed and growth of lateral buds is enhanced
(d) gibberellins delay senescence of leaves

76 Parthenocarpy in tomatoes is induced by

(a) cytokinin (b) auxin
(c) gibberellin (d) $CH_2—CH_2$

77 An auxin which is widely used to kill the dicotyledonous weed is

(a) IAA (b) IBA (c) NAA (d) 2, 4-D

78 Among the following which is/are the function(s) of auxin?

(a) Cell elongation (b) Cell division
(c) Cell differentiation (d) All of these

79 To get a carpet like grass, lawns are mowed regularly this is done to

(a) remove the shoot apical meristem
(b) remove the axillary buds
(c) accelerate the growth of lateral bud
(d) Both (b) and (c)

80 Which of the following is not a plant growth inhibitor? ***JIPMER 2018***

(a) Dormin (b) IAA
(c) Ethylene (d) ABA

81 The plant hormone produced by *Rhizobium* for nodulation is
(a) IBA (b) NAA
(c) 2, 4-D (d) IAA

82 How many gibberellins are reported from different organisms such as plants and fungi?
(a) More than 50 (b) More than 75
(c) More than 100 (d) More than 25

83 Which one of the following is not an effect of gibberellin?
(a) Increase the length of grapes stalks
(b) Delay senescence of fruits
(c) Induce dormancy
(d) Increase the length of sugarcane stem

84 Fruits can be left on the tree longer, so as to increase the market period. This is due to the function of
(a) delayed senescence by auxin
(b) delayed senescence by $CH_2—CH_2$
(c) delayed senescence by cytokinin
(d) delayed senescence by GA

85 During seed germination, its stored food is mobilised by ***NEET 2013***
(a) ethylene (b) cytokinin
(c) ABA (d) gibberellin

86 Specific property attributed to GA is
(a) shortening of genetically tall plants
(b) elongation of genetically dwarf plants
(c) rooting or stem cuttings
(d) promotion of leaf and fruit fall

87 Internodal elongation just prior to flowering in sugarbeet, cabbage and in many plants with rosette habit is called
(a) prunning (b) bolting
(c) grafting (d) cutting

88 Cytokinins are mostly
(a) glucosides (b) phenolics
(c) amino purines (d) organic acids

89 Difference between kinetin and zeatin is
(a) kinetin is active, while zeatin is non-active
(b) zeatin is active, while kinetin is non-active
(c) zeatin is synthetic, while kinetin is natural
(d) zeatin is natural, while kinetin is synthetic

90 Natural cytokinins are synthesised in regions where rapid cell division occurs such regions are
(a) root apices (b) young fruit
(c) developing shoot buds (d) All of these

91 Which hormone (PGR) encounters apical dominance induced by auxin?
(a) IAA (b) Cytokinin
(c) C_2H_4 (d) NAA

92 The problem of necrosis and gradual senescence, while performing tissue culture can be overcome by
(a) spraying auxins
(b) spraying cytokinins
(c) suspension culture
(d) subculture

93 Cytokinin helps in delaying the leaf falling/senescence mainly by
(a) promoting nutrient mobilisation
(b) inhibiting cell division
(c) promoting cell elongation
(d) promoting cell differentiation

94 Cytokinins help to produce
(a) new leaves and chloroplast in leaves
(b) lateral shoot
(c) adventitious shoot
(d) All of the above

95 Which PGA is/are acidic in nature?
(a) Auxin (b) Cytokinin
(c) GA (d) All of these

96 Which plant hormone is found in gaseous form?
(a) Auxin (b) Cytokinin
(c) Ethylene (d) ABA

97 Large amount of ethylene is synthesised by
(a) developing roots and fruits
(b) developing shoots and flowers
(c) tissues undergoing senescence and ripening fruits
(d) young tissue and unripened fruits

98 Respiratory climacteric is related with
(a) ABA (b) ethylene
(c) auxin (d) GA

99 Surface area of roots by promoting root growth and root hair formation is increased by
(a) cytokinin (b) kinetin
(c) ethylene (d) ABA

100 It takes very long time for pineapple plants to produce flowers. Which combination of hormones can be applied to artificially induce flowering in pineapple plants throughout the year to increase yield? ***NEET 2019***
(a) Gibberellin and cytokinin
(b) Gibberellin and abscisic acid
(c) Cytokinin and abscisic acid
(d) Auxin and ethylene

101 Most widely used compound as a source of ethylene is
(a) nepthol (b) acetol
(c) ethephon (d) ethepcon

102 Ethephon
(a) hastens fruit ripening in tomatoes
(b) accelerates abscission
(c) increases number of female flowers in cucumber
(d) All of the above

103 A farmer grows cucumber plants in his field. He wants to increase the number of female flowers in them. Which plant growth regulator can be applied to achieve this?
(a) ABA (b) Ethylene
(c) GA (d) Cytokinins

104 The shedding of leaves, flowers and fruits due to changes in hormonal levels in plants, is referred to as
(a) senescence (b) abscission
(c) photoperiodism (d) vernalisation

105 In response to biotic and abiotic stress, growth inhibition activities are caused by
(a) ABA (b) CH_2—CH_2
(c) IAA (d) IBA

106 Which one of the following growth regulators is known as 'stress hormone'? ***CBSE-AIPMT 2014***
(a) Abscisic acid (b) Ethylene
(c) GA_3 (d) Indole acetic acid

107 In most situations, ABA acts
(a) agonist to auxin (b) antagonist to gibberellin
(c) antagonist to auxin (d) agonist to gibberellin

108 Which organelle synthesises the abscisic acid?
(a) Golgi body (b) ER
(c) Lysosome (d) Chloroplast

109 Abscisic acid
(a) inhibits seed germination
(b) stimulates closure of stomata
(c) induces seed dormancy
(d) All of the above

110 Identify the correct option for *A* and *B*.

	Compound	Function
I.	2, 4-D	*A*
II.	*B*	Fruit ripening

	A	B
(a)	Insecticide	Auxin
(b)	Insecticide	Cytokinin
(c)	Insecticide	GA
(d)	Weedicide	Ethylene

111 Which of the following is incorrectly matched?

(a)	Explant	–	Excised plant part used for callus formation
(b)	Cytokinin	–	Its high concentration causes root initiation in callus
(c)	Somatic embryo	–	Embryo produced froms a vegetative cell
(d)	Anther culture	–	Haploid plants

TOPIC 5~ *Photoperiodism*

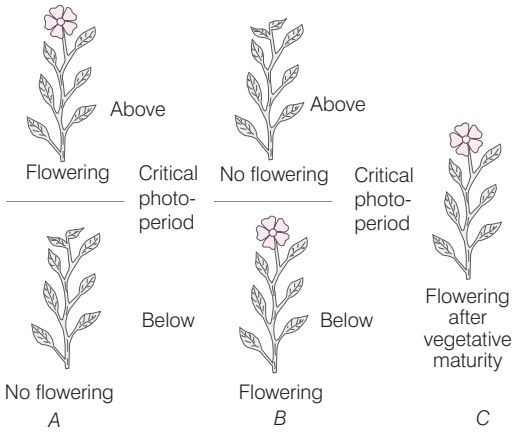
112 In plants, phototropism is the movement
(a) towards the light source
(b) away from the light source
(c) parallel to the light source
(d) lateral to the light source

113 Plants which require exposure to light for a period greater than critical day length are
(a) long day plants
(b) long-short day plants
(c) short day plants
(d) short-long day plants

114 Short day plants require light for a period
(a) less than critical duration
(b) equal than critical duration
(c) more than critical duration
(d) independent of critical duration

115 Day neutral plants
(a) show no flowering in any photoperiod
(b) show loss of activity during day time
(c) have no correlation between exposure to light duration and induction of flowering response
(d) None of the above

116 The given figure shows responses of different plants *A*, *B* and *C* to photoperiod (light). Choose the correct option.



	A	B	C
(a)	Long day plant	Day neutral plant	Short day plant
(b)	Short day plant	Day neutral plant	Long day plant
(c)	Long day plant	Short day plant	Day neutral plant
(d)	Short day plant	Long day plant	Day neutral plant

117 Effect of daily duration of light and dark periods on growth and development of plants especially on flowering is called

(a) vernalisation (b) photoperiodism
(c) phototaxis (d) Both (a) and (b)

118 Short day plant also called

(a) short night plant (b) long night plant
(c) intermediate night plant (d) None of these

119 What is the site of perception of photoperiod necessary for induction of flowering in plants?

NEET 2019

(a) Pulvinus (b) Shoot apex
(c) Leaves (d) Lateral buds

120 Choose the correct option.

(a) Flowering in certain plants depends on a combination of light and dark exposures on plant
(b) Shoot apices of plant themselves cannot perceive photoperiods, they modify themselves into flowering apices prior to flowering
(c) There is a hormonal substance that is responsible for flowering
(d) All of the above

121 A long day plant having a critical photoperiod of 13 hours will flower in which condition?

	Duration of light period	Duration of dark period
(a)	13	11
(b)	11	13
(c)	12	12
(d)	10	14

122 Which pigment is involved in photoperiodic changes in plants?

(a) Phytochrome
(b) Chlorophyll
(c) Cytochrome
(d) Anthocyanin

123 A few normal seedlings of tomato were kept in a dark room. After a few days they were found to have become white like albinos. Which of the following terms will you use to describe them?

CBSE-AIPMT 2014

(a) Mutated
(b) Embilised
(c) Etiolated
(d) Defoliated

TOPIC 6~ *Vernalisation and Seed Dormancy*

124 Vernalisation is ***JIPMER 2019***

(a) low pH treatment
(b) low temperature treatment
(c) high temperature treatment
(d) high pH treatment

125 Temperature required for vernalisation is

(a) 5-10°C (b) 5-15°C (c) 0-5°C (d) 3-17°C

126 Through their effect on plant growth regulators, what do the temperature and light control in the plants?

CBSE-AIPMT 2012

(a) Apical dominance (b) Flowering
(c) Closure of stomata (d) Fruit elongation

127 Hormone, which replaces the requirement of vernalisation is

(a) ethylene (b) auxin
(c) gibberellin (d) cytokinin

128 Examples of plants which require vernalisation is/are

(a) pea (b) sugarbeet
(c) cabbage (d) All of these

129 Vernalisation can be reversed by

(a) application of high temperature
(b) application of auxin
(c) application of more less temperature
(d) application of gibberellin

130 Vernalisation stimulates flowering in

CBSE-AIPMT 2012

(a) jimikand (b) turmeric (c) carrot (d) ginger

131 Stimulus of vernalisation is perceived by

(a) shoot tips (b) mature tissues
(c) embryo tips (d) Both (a) and (c)

132 Certain seeds which fail to germinate even when external conditions are favourable is due to

(a) photoperiodism (b) seed dormancy
(c) vernalisation (d) plasticity

133 Which of the following is/are factor causing seed dormancy?

(a) Impermeable and hard seed coat
(b) Chemical inhibitors like abscisic acids, phenolic acids and para-ascorbic acids
(c) Immature embryos
(d) All of the above

134 Which of the following method would not help in breaking seed dormancy?

(a) Mechanical abrasions using knives, sandpaper, etc
(b) Microbial action
(c) Subjecting the seed to auxin to remove effect of inhibitory substance
(d) Changing the environmental conditions like light and temperature

NEET

SPECIAL TYPES QUESTIONS

I. Assertion and Reason

■ **Direction** (Q. Nos. 135-143) *In each of the following questions, a statement of Assertion (A) is given by corresponding statement of Reason (R). Of the statements, Mark the correct answers as*

(a) If both A and R are true and R is the correct explanation of A
(b) If both A and R are true, but R is not the correct explanation of A
(c) If A is true, but R is false
(d) If A is false, but R is true

135 **Assertion** (A) Growth in plants is indeterminate.
Reason (R) Plant cells can divide and enlarge continuously for lifetime.

136 **Assertion** (A) Growth is invariably associated with differentiation.
Reason (R) Growth and differentiation are permanent changes which occur in an organism's body.

137 **Assertion** (A) Removal of shoot tip increases apical dominance.
Reason (R) Due to the accumulation of auxin in lateral parts, growth is enhanced.

138 **Assertion** (A) Gibberellin is useful in early seed production in conifers. ***AIIMS 2019***
Reason (R) Ethephon is responsible for early ripening in tomato and apple.

139 **Assertion** (A) Ethylene freely diffuses across the membrane of plant cells.
Reason (R) It causes climacteric ripening of fruit.

140 **Assertion** (A) Hormones are also called growth regulators.
Reason (R) These promote or inhibit plant growth.

141 **Assertion** (A) Plants have hormones called phytohormones.
Reason (R) These increase the rate of reactions, thus always accelerate growth and other related changes.

142 **Assertion** (A) Photomodulation of flowering is a phytochrome regulated process. ***AIIMS 2018***
Reason (R) Active form of phytochrome (Pfr) directly induces flowering in shoot buds.

143 **Assertion** (A) A farmer does not prefer to grow tobacco plant under long day conditions.
Reason (R) Tobacco is a short day plant.

II. Statement Based Questions

144 Study the following statements.
I. Increase in girth of plants is primary growth.
II. Increase in girth of plants occurs due to the apical meristem.
III. Secondary growth of plants occurs due to the lateral meristem.
IV. Vascular cambium and cork cambium are the lateral meristems of plants.
V. Elongation of a plant along the axis is called primary growth.
Choose the option containing the incorrect statements.
(a) I and II (b) III and IV
(c) IV and V (d) I and V

145 Study the following statements regarding plant growth and choose the correct one.
(a) One single maize root apical meristem can give rise to more than 17,500 new cells per hour
(b) Growth of pollen tube is measured in the terms of its length
(c) Growth of a dorsiventral leaf is measured by its surface area
(d) All of the above

146 Read the following statements about the phase of elongation.
I. It is characterised by increased vacuolation.
II. It shows cell enlargement.
III. In this phase, new cell wall is deposited.
IV. Growth is maximum.
Choose the option containing the correct statements.
(a) III, I and II (b) I, II and III
(c) II, IV and III (d) I, II, III and IV

147 Read the following statements about the phase of maturation.
I. In this phase, cells attain their maximal size.
II. Proper wall thickening and protoplasmic modifications occur in this phase.
III. It is characterised by rapid cell division.
Choose the correct option.
(a) I and II
(b) II and III
(c) I and III
(d) All of the above

148 Which of the following statements about growth rate is correct?
(a) The increased growth per unit time is termed as growth rate
(b) Rate of growth can be expressed mathematically
(c) An organism or a part of the organism can produce more cells in a variety of ways
(d) All of the above

149 Read the following statements.
I. Turgidity of cells helps in extension growth.
II. Oxygen helps in releasing metabolic energy essential for growth activities.
III. Nutrients (micro and macromolecules) are required by plants for the synthesis of protoplasm as well as act as source of energy.
IV. There is no optimum temperature needed for growth.
V. Environmental signals like light and gravity affect all phases of growth.

Choose the correct option.
(a) I, II, III are true and IV and V are false
(b) II and III are true and I, IV and V are false
(c) All statements are true
(d) All statements are false

150 Read the following statements about the functions of auxin and choose the correct option.
(a) Initiates rooting in stem cuttings
(b) Promotes flowering in pineapples
(c) Controls xylem differentiation
(d) All of the above

151 Select the correct statements regarding auxins.
I. Auxins promote flowering, e.g. in pineapple and promote abscission of older mature leaves and fruits.
II. Auxin controls xylem differentiation.
III. Apical dominance is due to more auxin in apical bud than in lateral ones.
(a) I and II (b) II and III
(c) I and III (d) I, II and III

152 Choose the correct statements.
(a) Auxins are generally produced by growing apices of stems and roots
(b) IAA (Indole Acetic Acid) and IBA (Indole Butyric Acid) have been isolated from plants
(c) NAA (Naphthalene Acetic Acid) and 2,4-D (2, 4-dichlorophenoxyacetic acid) are synthetic auxins
(d) All of the above

153 Which of the following statements regarding gibberellins is incorrect?
(a) GA_3 was one of the first gibberellins to be discovered
(b) All GAs are acidic
(c) Spraying GA on conifers causes late seed production
(d) Dwarfness can be controlled by treating the plant with GA_3

154 Read the following statements.
I. Cytokinins play a vital role in morphogenesis in plants.
II. In tissue cultue, both auxin and cytokinins are used for growth and differentiation.
III. In callus, shoot regeneration is promoted by cytokinin.
IV. In callus, root regeneration is promoted by auxin.
Which of the above statements are correct?
(a) I, II and III
(b) Only IV
(c) III and IV
(d) I, II, III, and IV

155 Which of the following statements is incorrect?
(a) Cytokinins are formed primarily in roots
(b) Auxin and cytokinin are antagonistic in apical dominance
(c) Kinetin (a modified DNA purine) was discovered from herring sperm
(d) Zeatin is an auxin

156 Identify the phytohormone responsible for the given functions.
I. Horizontal growth of seedlings.
II. Swelling of the axis and apical hook formation in dicot seed.
III. Promoting senescence and abscission of leaves and flowers.
IV. Highly effective in fruit ripening.
V. Promotes rapid internode/petiole elongation in deep water rice plants.
Choose the correct option.
(a) ABA (b) GA
(c) Cytokinin (d) Ethylene

157 The hormone 'X' does the following functions.
I. Acts as general plant growth inhibitor and an inhibitor of plant metabolism.
II. Plays an important role in seed development, maturation and dormancy.
III. Helps seeds withstand desiccation and other factors unfavourable for growth.
The hormone 'X' should be
(a) ABA (b) ethylene (c) GA (d) cytokinin

158 Read the following statements about effects of ethylene and choose the correct option.
I. More female flowers in cucumber.
II. α-amylase production in seed.
III. Acceleration of fruit ripening in tomato.
IV. Delay sprouting in potato tubers.
(a) I and II
(b) I and III
(c) II and IV
(d) III and IV

159 Read the following statements and choose the correct one.

(a) Kinetin is a degradative substance from DNA
(b) ABA is present in all plants including lower plants
(c) Low ratio of cytokinin to auxin favours shoot formation only
(d) ABA is synthesised catabolically through glycolytic pathway

160 Which of the following statements is incorrect?

(a) The role of PGR is only to exert intrinsic control
(b) Along with genomic control and extrinsic factor, they play an inportant role in plant growth and development
(c) Many of the intrinsic factors such temperature and light control the plant growth and development *via* PGR like vernalisation, flowering, dormancy, seed germination and plant movements
(d) Both light and temperature have a role on initiating flowering

161 Given below the functions of different plant growth hormones. Which of the following statements is incorrect?

(a) Cytokinins suppress the synthesis of chlorophyll
(b) Auxins control apical dominance
(c) Gibberellins promote shoot elongation
(d) Abscisic acid enables seeds to withstand desiccation

III. Matching Type Questions

162 Match the following columns.

	Column I (Meristematic tissues)		**Column II** (Location)
A.	Apical meristem	1.	Presents at terminal position
B.	Intercalary meristem	2.	Secondary growth
C.	Lateral meristem	3.	Localised growth

Codes

	A	B	C		A	B	C
(a)	1	2	3	(b)	1	3	2
(c)	3	2	1	(d)	3	1	2

163 Match the following columns.

	Column I (Phases of growth)		**Column II** (Definition)
A.	Formative phase	1.	Cell develops into special or particular type of cells
B.	Phase of enlargement	2.	Plastic extension through the enzymatic loosening of microfibrils
C .	Phase of differentiation	3.	New cells are produced by mitosis

Codes

	A	B	C		A	B	C
(a)	1	2	3	(b)	1	3	2
(c)	3	2	1	(d)	3	1	2

164 Match the following columns.

	Column I		**Column II**
A.	Differentiation	1.	Acts of maturation
B.	Redifferentiation	2.	Acts of again loosing cell division capacity and mature to perform special function
C.	Dedifferentiation	3.	Acts of gaining cell division capacity after differentiation

Codes

	A	B	C		A	B	C
(a)	1	3	2	(b)	3	2	1
(c)	1	2	3	(d)	3	1	2

165 Match the following columns.

	Column I (Factors influencing development in plants)		**Column II** (Classes of factors influencing development)
A.	Genetic factor	1.	Extrinsic factor
B.	Plant growth regulators	2.	Intrinsic factor
C.	Temperature, water, oxygen, nutrients		

Codes

	A	B	C		A	B	C
(a)	1	1	2	(b)	1	2	2
(c)	1	2	2	(d)	2	2	1

166 Match the following columns.

	Column I (PGRs)		**Column II** (Types)
A.	IAA	1.	Gases
B.	N_6-furfurylaminopurine	2.	Terpenes
C.	ABA	3.	Derivatives of carotenoids
D	GA_3	4.	Adenine derivatives
E.	C_2H_4	5.	Indole compounds

Codes

	A	B	C	D	E
(a)	1	2	3	4	5
(b)	5	4	3	2	1
(c)	5	4	1	2	3
(d)	4	5	1	2	3

167 Match the following columns.

	Column I (Scientists)		**Column II** (PGRs)
A.	Darwin and Darwin	1.	Kinetin
B.	E Kurosawa	2.	Gibberellin
C.	Skoog and Miller	3.	Auxin
D.	H H Cousins	4.	Ethylene

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	3	2	1	4
(c)	4	3	2	1	(d)	3	2	4	1

168 Match the following columns.

	Column I (Categories of PGRs)		Column II (PGRs)
A.	Plant growth promoters	1.	Auxin
B.	Plant growth inhibitor	2.	Gibberellin
		3.	Abscisic acid
		4.	Cytokinin

Codes

	A	B		A	B
(a)	1, 2, 3	4	(b)	4	1,2,3
(c)	3	1, 2, 4	(d)	1, 2, 4	3

169 On the basis of correlation, find the correct option from columns.

	Column I		Column II		Column III
I.	Foolish plant	A.	Volatile hormone	1.	Induces dormancy
II.	Induces senescence	B.	GA	2.	Ripens fruit
		C.	Zeatin	3.	Usually sterile plant

Codes

(a) I–A–2, II–C –1 (b) I–C–3, II–B –3
(c) I–B–3, II–A –2 (d) I–B–1, II–C –2

170 Match the following columns.

	Column I (Location)		Column II (PGRs)
A.	Human urine	1.	Cytokinin
B.	*Gibberella fujikuroi*	2.	Auxin
C.	Herring fish DNA	3.	Ethylene
D.	Ripening fruit	4.	ABA
E.	Aged leave of plants	5.	GA

Codes

	A	B	C	D	E
(a)	2	3	4	5	1
(b)	2	5	1	3	4
(c)	1	2	3	4	5
(d)	5	4	3	2	1

171 Match the following columns.

	Column I (Types of auxin)		Column II (Examples)
A.	Natural auxin	1.	IAA
B.	Synthetic auxin	2.	NAA
		3.	IBA
		4.	2,4-D

Codes

	A	B		A	B
(a)	1, 2	3, 4	(b)	3, 4	1, 2
(c)	1, 3	2, 4	(d)	2, 4	1, 3

172 Match the following columns.

	Column I (Hormones)		Column II (Types of PGR)
A.	Zeatin	1.	Flowering hormone
B.	Florigen	2.	Synthetic auxin
C.	IBA	3.	Cytokinin
D.	NAA	4.	Natural auxin

Codes

	A	B	C	D
(a)	3	4	1	2
(b)	2	1	4	3
(c)	1	2	3	4
(d)	3	1	4	2

173 Match the following columns.

	Column I		Column II
A.	*Crocus*	1.	Earlier and higher crop production obtained by keeping its seeds at low temperature between 1-10°C.
B.	Millet	2.	Growth regulator obtained from its endosperm.
C.	Coconut	3.	Needs high temperature for flowering.

Codes

	A	B	C
(a)	1	2	3
(b)	3	2	1
(c)	3	1	2
(d)	1	3	2

174 Match the following columns.

	Column I (Classes of photoperiodic plants)		Column II (Examples)
A.	SDP	1.	Wheat
B.	LDP	2.	*Chrysanthemum*
C.	DNP	3.	Maize

Codes

	A	B	C
(a)	1	2	3
(b)	2	1	3
(c)	2	3	1
(d)	3	1	2

NCERT & NCERT Exemplar

MULTIPLE CHOICE QUESTIONS

NCERT

175 Any one parameter is not good enough to demonstrate growth through the life of a flowering plant because
(a) lateral meristems appear later in life
(b) apical meristems contribute to elongation, while lateral meristems increase girth
(c) increase in protoplasm is difficult to measure directly
(d) None of the above

176 Abscisic acid is also known as stress hormone because
(a) it is a plant growth inhibitor
(b) it is an inhibitor of plant metabolism
(c) it inhibits seed germination
(d) it increases the tolerance of plants to various kinds of stresses

NCERT Exemplar

177 Monocarpic plants are those which
(a) bear flowers with one ovary
(b) flower once and die
(c) bear only one flower
(d) All of the above

178 In order to increase the yield of sugarcane crop, which of the following plant growth regulators should be sprayed? ***NEET (Odisha) 2019***
(a) Ethylene
(b) Auxins
(c) Gibberellins
(d) Cytokinins

179 Coconut water contains
(a) ABA
(b) auxin
(c) cytokinin
(d) gibberellin

180 The affect of apical dominance can be overcome by which of the following hormone?
(a) IAA
(b) Ethylene
(c) Gibberellin
(d) Cytokinin

181 Apples are generally wrapped in waxed paper to
(a) prevent sunlight for changing its colour
(b) prevent aerobic respiration by checking the entry of O_2
(c) prevent ethylene formation due to injury
(d) make the apples look attractive

182 Match the following columns.

	Column I (Hormones)		**Column II** (Function)
A.	IAA	1.	Herring sperm DNA
B.	ABA	2.	Bolting
C.	Ethylene	3.	Stomatal closure
D.	GA	4.	Weed-free lawns
E.	Cytokinins	5.	Ripening of fruits

Codes

	A	B	C	D	E
(a)	4	3	5	2	1
(b)	5	3	4	2	1
(c)	4	1	5	3	2
(d)	5	3	2	1	4

183 Ethylene is used for
(a) retarding ripening of tomatoes
(b) hastening of ripening of fruits
(c) slowing down ripening of apples
(d) Both (b) and (c)

184 The term synergistic action of hormones refers to
(a) when two hormones act together but bring about opposite effects
(b) when two hormones act together and contribute to the same function
(c) when one hormone affects more than one function
(d) when many hormones bring about any one function

185 ABA acts as antagonistic to
(a) ethylene (b) cytokinin
(c) gibberellic acid (d) IAA

186 Growth can be measured in various ways. Which of these can be used as parameters to measure growth?
(a) Increase in cell number
(b) Increase in cell size
(c) Increase in length and weight
(d) All of the above

187 Plasticity in plant growth means that
(a) plant roots are extensible
(b) plant development is dependent on the environment
(c) stems can extend
(d) None of the above

188 The photoperiod in plants is perceived at
(a) meristem (b) flower
(c) floral buds (d) leaves

Answers

› Mastering NCERT with MCQs

1 (a)	2 (d)	3 (a)	4 (c)	5 (c)	6 (c)	7 (d)	8 (b)	9 (c)	10 (c)
11 (b)	12 (d)	13 (c)	14 (c)	15 (d)	16 (a)	17 (d)	18 (d)	19 (c)	20 (d)
21 (a)	22 (a)	23 (b)	24 (b)	25 (d)	26 (a)	27 (c)	28 (d)	29 (a)	30 (a)
31 (c)	32 (a)	33 (d)	34 (d)	35 (c)	36 (d)	37 (d)	38 (b)	39 (b)	40 (b)
41 (c)	42 (b)	43 (d)	44 (c)	45 (a)	46 (b)	47 (a)	48 (a)	49 (d)	50 (b)
51 (a)	52 (c)	53 (d)	54 (d)	55 (c)	56 (c)	57 (b)	58 (a)	59 (d)	60 (d)
61 (b)	62 (a)	63 (b)	64 (a)	65 (c)	66 (a)	67 (d)	68 (b)	69 (d)	70 (c)
71 (c)	72 (b)	73 (a)	74 (d)	75 (c)	76 (b)	77 (d)	78 (d)	79 (c)	80 (b)
81 (d)	82 (c)	83 (c)	84 (d)	85 (d)	86 (b)	87 (b)	88 (c)	89 (d)	90 (d)
91 (b)	92 (b)	93 (a)	94 (d)	95 (d)	96 (c)	97 (c)	98 (b)	99 (c)	100 (d)
101 (c)	102 (d)	103 (b)	104 (b)	105 (a)	106 (a)	107 (b)	108 (d)	109 (d)	110 (d)
111 (b)	112 (a)	113 (a)	114 (a)	115 (c)	116 (c)	117 (b)	118 (b)	119 (c)	120 (d)
121 (a)	122 (a)	123 (c)	124 (b)	125 (c)	126 (b)	127 (c)	128 (d)	129 (a)	130 (c)
131 (d)	132 (b)	133 (d)	134 (c)						

› NEET Special Types Questions

135 (a)	136 (a)	137 (d)	138 (b)	139 (b)	140 (a)	141 (c)	142 (c)	143 (a)	144 (a)
145 (d)	146 (d)	147 (a)	148 (d)	149 (a)	150 (d)	151 (d)	152 (d)	153 (c)	154 (d)
155 (d)	156 (d)	157 (a)	158 (b)	159 (a)	160 (c)	161 (a)	162 (b)	163 (c)	164 (c)
165 (d)	166 (b)	167 (b)	168 (d)	169 (a)	170 (b)	171 (c)	172 (d)	173 (c)	174 (b)

› NCERT & NCERT Exemplar Questions

175 (c)	176 (d)	177 (b)	178 (c)	179 (c)	180 (d)	181 (b)	182 (a)	183 (b)	184 (b)
185 (c)	186 (d)	187 (b)	188 (d)						

Answers & Explanations

3 (*a*) Plant growth is unique as plants have the capacity for unlimited growth, which is mainly due to the presence of meristematic cells at certain locations in their body.

6 (*c*) Root Apical Meristem (RAM) and Shoot Apical Meristem (SAM) principally contribute to the primary growth of the plants by facilitating the elongation of the plants along their axis.

7 (*d*) The tissues responsible for secondary growth in plants are vascular cambium, cork cambium and lateral meristem. Secondary growth in plants mainly pertains to an increase in the girth of plants (organs). It occurs in dicotyledonous plants and gymnosperms.

9 (*c*) Growth at cellular level principally occurs due to an increase in the amount of protoplasm.

10 (*c*) Death is not included in the period of growth. It is the permanent cessation of all biological functions that sustain a living organism. The period of growth is generally divided into three phases namely, meristematic, elongation and maturation phases.

11 (*b*) The constantly dividing cells present at the root apex and shoot apex represent the meristematic phase or formative or cell formation phase of growth.

13 (*c*) The cells proximal (just next away from the tip) to the meristematic zone represent the phase of elongation.

Increased vacuolation, cell enlargement and new cell wall deposition are the characteristics of the cells in this phase.

16 (*a*) Arithmetic growth is linear because in this type of growth rate, there is a sequential addition of new cells. One daughter cell remains meristematic (dividing), while the other cell differentiates and matures to perform special function.

18 (*d*) Among the given graphs, only graph 'A' represents the arithmetic growth curve as it is showing that only one daughter cell continues to divide thus forming a linear curve.

Other options are incorrect and can be corrected as

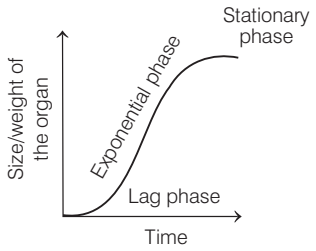
Graph 'B' is constant and graph 'C' is declining.

19 (*c*) Lag phase is represented by initial slow growth rate because it represents environmental adaptations which are slow in nature.

20 (*d*) In the log or exponential phase of geometrical growth, there is a rapid increase in size, cell number and mass of an organism, due to the rapid consumption of nutrients.

21 (*a*) Growth curve in plants is a sigmoid curve. A sigmoid curve is a characteristic of living organisms growing in a natural environment. It is typical of all cells, tissues and organs of a plant.

An ideal sigmoid growth curve typical of cells in culture and many higher plants and plant organs is given below



24 (*b*) In geometrical growth, the correct sequence of growth phases according to their occurrence is

$$\underset{\text{(I)}}{\text{Lag phase}} \rightarrow \underset{\text{(III)}}{\text{Exponential phase}} \rightarrow \underset{\text{(II)}}{\text{Log phase}}$$

The initial growth is slow (lag phase). It increases rapidly there, after at a exponential rate (log or exponential phase). However, due to the limited nutrient supply, the growth slows down leading to the stationary phase.

25 (*d*) The log phase or the exponential growth phase is also called as the grand or the fastest phase of growth. This is because there is rapid increase in cell number as the progeny cells retain their ability to divide and continue dividing till the nutrient supply is appropriate.

29 (*a*) Quantitative comparisons between the growth of living systems can be done in two ways, i.e. absolute growth rate and relative growth rate.

31 (*c*) In the given figure, AGR = 5cm^2 and RGR = 100cm^2 Absolute Growth Rate (AGR) is the comparison and measurement of total growth per unit time.

Initial surface area = $5\,\text{cm}^2$, Final surface area = $10\,\text{cm}^2$

$$\text{AGR} = \text{Final surface area} - \text{Initial surface area}$$
$$= 10 - 5 = 5\,\text{cm}^2$$

Relative Growth Rate (RGR) is the growth of the given system per unit time expressed on a common basis, e.g. per unit initial parameter.

$$\text{RGR} = \frac{\text{Final surface area} - \text{Initial surface area}}{\text{Initial surface area}} \times 100$$
$$= \frac{10-5}{5} \times 100 \Rightarrow 100 = 100\,\text{cm}^2$$

33 (*d*) Water (H_2O), oxygen (O_2) and nutrients are essential elements for plant growth. Apart from these temperature and light are also important factors for plant growth.

34 (*d*) Option (d) is correct because

Plant cells grow in size by cell enlargement which in turn requires water. Turgidity of cells helps in extension growth. Water also provides the medium to carry out all the enzymatic activities needed for growth.

36 (*d*) The cells derived from root apical and shoot apical meristems and cambium differentiate and mature to perform specific functions. This act leading to maturation of cells is termed as differentiation.

37 (*d*) During differentiation, cells undergo a few major structural changes both in their cell walls and protoplasm. For example, in order to form tracheary elements, the cells would lose their protoplasm. The cells also develop a very strong, elastic, lignocellulosic secondary cell walls.

39 (*b*) The living differentiated cells that have lost their capacity to divide may regain their capacity of division under certain conditions. This phenomenon is known as dedifferentiation.

40 (*b*) The formation of meristems, i.e. interfascicular cambium and cork cambium, from fully differentiated parenchyma cells in dicot stem and root at the time of secondary growth is an example of dedifferentiation.

41 (*c*) Dedifferentiation occurs in callus. The portion of pith taken as an explant comprises of parenchymatous cells (i.e. simple permanent tissues which have lost the capacity to divide). When such cells are cultured on solid culture media, the parenchymatous cells of pith become meristematic and start dividing resulting in a mass of undifferentiated cells called callus. This is an example of dedifferentiation.

42 (*b*) The phenomenon in which the products of dedifferentiated meristems/tissues which are able to divide and produce cells once again lose their capacity to divide but mature to perform specific function is called redifferentiated, e.g. secondary cortex and cork.

43 (*d*) Plants structures have indeterminate or determinate unlimited (open) growth because of the presence of meristem.

47 (*a*) Development is a term that includes a series of changes which an organism goes through during its life cycle, e.g. from germination of a seed to its senescence. It occurs in the following sequence

Plasmatic growth → Differentiation → Maturation → Senescence

48 (*a*) Plants follow different pathways in response to environment to form different kind of structures. This ability is called plasticity, e.g. heterophylly.

49 (*d*) Heterophylly refers to the presence of different leaf forms on the same plant. It can be observed in cotton, coriander and larkspur.

50 (*b*) Option (b) is correct as

The leaves of buttercup show heterophylly due to its environment.

Other options are incorrect and can be corrected as

- The juvenile plant leaves of larkspur are different in shape from those in mature plants.
- There is variations in sizes of leaves of larkspur and buttercup due to heterophylly.

51 (*a*) The development that takes place when the transition of juvenile phase to adult phase occurs in gradual manner, e.g. *Ipomea* called homoblastic development.

52 (*c*) The different aspects or appearances of plants in different seasons of a year is called phenology. These aspects of plants are controlled not only by seasons and other environmental factors, but also by metabolism, heredity and internal signals.

53 (*d*) Extrinsic factors of growth are light, O_2, temperature, CO_2, nutrient and water.

Intrinsic growth factors are of two types

- Chemical factors such as plant growth regulators.
- Genetic factors, e.g. chromosome, gene, etc.

56 (*c*) Growth promoters exhibit growth promoting activities such as cell division, cell enlargement, tropic growth, pattern formation, flowering, fruiting and seed formation, etc.

Growth inhibitors exhibit activities which take place in response to wounds and stress of biotic or abiotic origin.

Thus, option (c) is correct.

58 (*a*) Auxin hormone is involved in phototropism, i.e. the bending of plant towards the direction of light.

59 (*d*) Auxin is produced by growing apical part of the plant, i.e. apices of stems and roots in the coleoptile tissue. Then, it goes to the lateral parts (basipetal) and causes, the apical (root and shoot) parts of the plant to elongate. Auxin was isolated by FW Went from the tips of coleoptiles of oat seedlings in 1928.

60 (*d*) Dr. F Went's experiment demonstrated the polar movement of auxins, i.e. it showed that the plants grow towards light in response to a signal generated at the tip of coleoptile by the plant hormone, auxin.

61 (*b*) In the labelled figure 'C' and 'D', coleoptile (plant organ) will bend towards the light source due to auxin. This is because

Figure (A) shows incomplete blockage of auxin. But the movement of auxin from apical part to lateral part is not possible. Therefore, it does not favour the bending of coleoptile towards the light source.

Figure (B) shows complete blockage of auxin movement from apical part to lateral part. So, no bending of coleoptile will occur.

Figure (C) shows incomplete blockage, but the direction favours the bending of coleoptile towards the source.

Figure (D) shows no blockage, hence, the bending of coleoptile towards the light source will take place easily.

62 (*a*) Bakanae disease is caused by a fungus, *Gibberella fujikuroi*. The effect of gibberellins had been known in Japan for over a century where certain rice plants were found to suffer from 'Bakanae' (foolish seedlings) disease. The disease was found by Kurosawa (1926).

63 (*b*) When a tissue with a potential for differentiation is grown in an artificial medium, auxin and cytokinin in a specific ratio can be added into it so as to promote differentiation. This causes root and shoot formation.

Auxin initiates root formation, while cytokinin starts shoot formation.

64 (*a*) Skoog and Miller identified and crystallised kinetin, and deduced it to be responsible for inducing differentiation, growth in tobacco stem callus.

65 (*c*) Ethylene is a volatile and gaseous plant growth inhibitor hormone. It inhibits growth of plant in response to environmental factors or stress.

66 (*a*) Auxin (derived from Greek word *auxin,* which means to grow) was first isolated from human urine. Kogl and Haagen-Smit (1931) isolated three chemicals from human urine and named them as auxin.

67 (*d*) The movement of auxin is basipetal in stem, i.e. from apex to base and acropetal in roots, i.e. from tip to the shoot. Thus, movement of auxin is both basipetal and acropetal.

68 (*b*) High concentration of auxin is present in the growing apices of the stem, from where auxin migrates to its regions.

70 (*c*) Auxins stimulate root formation on the stem cuttings e.g. IAA, IBA, NAA, etc. This application of auxin is widely used for plant propagation on a commercial basis.

71 (*c*) Auxin delays abscission of leaves and fruits at early stages. Whenever leaf or fruit fall occurs, the organ concerned stops producing auxin. However, it promotes abscission of older, mature leaves and fruits.

72 (*b*) Apical dominance takes place due to the synthesis of auxins by apical buds.

In most of the higher plants, the growing apical bud contains auxin which inhibits the growth of the lateral (axillary) buds. This phenomenon is called apical dominance.

75 (*c*) Since, auxin is present at a high concentration in shoot apical meristem, removal of shoot tips is a very useful technique to boost the production of tea leaves. This is because effect of auxins is removed and growth of lateral buds is enhanced.

76 (*b*) Parthenocarpy is induced by auxin in tomato. Applications of auxins (e.g. IAA, IBA) and conjugate auxins (e.g. IBA, alanine) to unpollinated pistils induce their development into seedless or parthenocarpic fruit.

77 (*d*) Auxins are widely used as herbicides. 2, 4-D is one of the most common auxins used as a weedicide to kill dicotyledonous weeds. It does not affect mature monocotyledonous plants.

78 (*d*) Auxin elongates the cells present just below the apical part of shoot. It also promotes cell division and cell differentiation.

79 (*c*) Removal of shoot tips results in the growth of axillary/lateral buds. Thus, to accelerate the growth of the lateral buds and get carpet-like grass, lawns are mowed regularly.

80 (*b*) IAA is a plant growth promoter, while dormin, abscisic acid and ethylene are plant growth inhibitors. IAA (Indole 3-Acetic Acid) is an auxin. Auxins are synthesised in shoot apices, leaf primordia and developing seeds from the amino acid, tryptophan.

81 (*d*) *Rhizobium* produces auxin, i.e. IAA. It is a nitrogen-fixing bacterium that lives in the roots by forming root nodules. This bacterium produces plant hormone IAA (auxin), which is known to stimulate nodule formation in leguminous plants.

82 (*c*) More than 100 gibberellins have been reported from widely different organisms such as fungi and higher plants. These are denoted as GA_1, GA_2, GA_3 and so on.

83 (*c*) Gibberellins do not induce dormancy. Instead, these are used for breaking seed and bud dormancy.

84 (*d*) Gibberellin delays senescence. Thus, the fruits can be left on tree longer so as to extend the market period by exposing them to GA.

85 (*d*) Gibberellin causes seed germination as it induces aleurone cells to secrete enzyme α-amylase to break stored food in seed which gets mobilised by GA and causes seed germination.

86 (*b*) GA helps in elongation of genetically dwarf plants. It stimulates stem elongation and leaf expansion, but does not effect root. Thus, gibberellins restore normal size and growth to genetically dwarf varieties, e.g. in pear and maize.

87 (*b*) Gibberellin promotes bolting, the process in which internodal elongation just prior to flowering, in sugarbeet, cabbage and many plants with rosette habit.

88 (*c*) Cytokinins are Plant Growth Regulator (PGR), which are either amino purine or phenyl urea derivatives, that promote cytokinesis either alone or in conjunction with auxin.

89 (*d*) The first cytokinin discovered was kinetin a modified form of adenine. Kinetin does not occur naturally. Search for natural substances with cytokinin like activity led to the isolation of zeatin from corn-kernels and coconut milk.

Thus, zeatin is natural and kinetin is synthetic.

90 (*d*) Naturally, cytokinins are synthesised in those regions where rapid cell division occurs like root apices, developing shoot buds, young fruits, etc.

91 (*b*) Cytokinin encounters apical dominance induced by auxin by promoting cell division in lateral shoots. So, it is antagonistic to the action of auxin. It is also used to increase the growth of lateral buds in short plants.

92 (*b*) Aging/necrosis/senescence usually accompany loss of chlorophyll and rapid breakdown of protein.

Cytokinins increase protein and chloroplast synthesis. Hence, aging/necrosis/senescence problem in tissue culture is overcome by spraying cytokinins.

97 (*c*) Ethylene promotes senescence and abscission of plant organs especially leaves and flowers. Thus, large amount of ethylene is synthesised by the tissue which undergo senescence and the ripening fruits.

98 (*b*) Respiratory climacteric is related with ethylene. Climacteric is the sudden rise in respiration that normally takes place without external influences.

It is the stage of fruit ripening associated with increased ethylene production and a rise in cellular respiration.

99 (*c*) Ethylene promotes root growth and root hair formation. Thus, ethylene helps plants to increase their absorption surface area by promoting root growth and root hair formation.

100 (*d*) Auxin and ethylene can be applied to artificially induce flowering in pineapple plants throughout the year to increase yield.

Auxin induces flowering in plants and ethylene helps to synchronise flower and fruit growth in plant. Hence, this combination can be applied.

101 (*c*) The most widely used compound as a source of ethylene is ethephon. It in an aqueous solution, which is readily absorbed and transported within the plant and where it releases ethylene slowly.

102 (*d*) Ethephon hastens fruit ripening in tomatoes and apples and accelerates abscission of flowers and fruits. It also promotes growth of female flowers in cucumbers and increase the yield.

104 (*b*) Abscission, the shedding of body parts, commonly refers to the process by which a plants intentionally drop one or more of their parts, such as a leaf, fruit, flower or seed due to changes in their hormone levels.

105 (*a*) ABA (Abscisic acid) causes growth inhibition activities in response to biotic and abiotic stress. It was discovered for its role in regulating abscission and dormancy.

It acts as the general plant growth inhibitor and an inhibitor of plant metabolism when a plant is subjected to any type of biotic or abiotic stress.

106 (*a*) Abscisic Acid (ABA) is also known as 'stress hormone' or dormin because it is produced in much higher amounts, when plants are subjected to various kinds of stresses.

It often gives plant organs a signal that they are undergoing physiological stresses such as lack of water, saline soil, cold temperature and frost. ABA often causes responses that help plants protect themselves against these stresses.

107 (*b*) ABA plays an important role in seed development, maturation and dormancy. By inducing dormancy, ABA helps the seeds withstand desiccation and other stresses. Thus, in most situations, ABA is antagonistic to GA.

108 (*d*) ABA is commonly formed inside the chloroplast by xanthophyll.

110 (*d*) Option (d) is correct.

- 2, 4-D is an auxin, which is widely used as weedicide for dicotyledonous weeds.
- Ethylene promotes fruit ripening.

111 (*b*) Option (b) is the incorrect match and can be corrected as

- In tissue culture (in callus), high concentration of auxin and low concentration of cytokinin favours root formation.
- High concentration of cytokinin and low concentration of auxin favour stem formation.

Rest of the matches are correct.

114 (*a*) Plants exposed to light for a period less than critical duration before initiation of flowering are called short day plants, e.g. soyabean, tobacco, etc.

118 (*b*) Short Day Plants (SDPs) are also called long night plants because these plants require a long continuous and uninterrupted critical dark period for flowering.

119 (*c*) For induction of flowering in plants, photoperiod stimulus is percieved by the leaves of plants. As a result, floral hormones are produced in the leaves which are then translocated to the apical part and subsequently cause the initiation of floral primordial growth.

121 (*a*) A long day plant having a critical photoperiod of 13 hours will flower under conditions in which the duration of light is more than the critical period of time.

Thus, option (a) is correct as in this, the duration of light period is more than duration of dark period.

122 (*a*) Phytochrome is a pigment, which is universally present in green flowering plants and is responsible for inducing photomorphogenic photoperiodic changes and developmental processes. It exists in two forms Pr and Pfr.

123 (*c*) When a few normal seedlings of tomato become white (like albinos) after a few on being kept in dark, it means that the process etiolation has taken place. Etiolation is the process, in which flowering plants are grown in partial or complete absence of light.

Etiolation is mainly characterised by long and weak stem and smaller, sparse pale yellow coloured leaves due to longer internodes.

124 (*b*) Vernalisation is low temperature treatment.

It is the process of shortening of vegetative phase and initiation of reproductive phase by application of low temperature to moistened seeds and young plants.

It is used for a number of temperate plants like winter wheat, winter rye, cabbage, henbane, *Chrysanthemum* and even certain perennials like apples.

126 (*b*) Flowering is controlled by PGRs, which on being acted upon by temperature and light either promote or inhibit flowering.

Flowering is a transitional phase in the life cycle of a plant. It is controlled by two main factors

- Photoperiod or light period, i.e. photoperiodism.
- Exposure to low temperature, i.e. vernalisation.

127 (*c*) Vernalisation involves the cold treatment of certain plants to induce flowering. Vernalisation treatment of biennial plants for flowering can be replaced by gibberellin (GA_3).

128 (*d*) Common examples of plants which require vernalisation are winter rye, winter wheat, winter oat, winter barley, pea, sugarbeet, cabbage, henbane, viola, clover, *Chrysanthemum*, etc.

129 (*a*) Low temperature is required for vernalisation usually 0-5°C. To reverse the effect of vernalisation, high temperature (40°C) is applied. This phenomenon is called devernalisation.

130 (*c*) Vernalisation stimulates flowering in carrots. In biennial plants (monocarpic plants) like carrots, sugarbeet, cabbage, etc. Vernalisation (cold treatment) stimulates a subsequent photoperiodic flowering response.

131 (*d*) The stimulus for vernalisation is perceived only by the meristematic cells, which are mainly present in the shoot tips, embryo tips, root apex, etc.

134 (*c*) Option (c) is not helpful in breaking seed dormancy. This is because auxin does not inhibit seed dormancy. Rather seed dormancy can be inhibited by subjecting the seeds gibberellic acid.

135 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Growth in plants is of indeterminate type, i.e. plant grows throughout their life because of the presence of meristematic tissues at specific parts of the plant apical, intercalary and lateral regions. These tissues have the ability to divide continuously and contribute to localised plant growth.

136 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Growth is invariably associated with differentiation.

It is an irreversible increase in size, volume and weight of a part or whole of an organism. Differentiation is permanent localised qualitative change in size, biochemistry, structural and functional of cells, tissues or organs. Thus, both growth and differentiation lead to permanent changes in an organism's body and are invariably associated.

137 (*d*) Assertion is false, but Reason is true. Assertion can be corrected as

Removal of shoot tip increases the lateral dominance. Further, accumulation of auxin in lateral parts elongate cells and increases growth.

138 (*b*) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

Gibberellin is a plant hormone which is useful in early seed production in conifers because gibberellin increases α-amylase production in seed which helps in breakdown of seed dormancy and causes seed germination.

Ethephon is commercial name of ethylene hormone which is used to promote early ripening of fruits like tomato and apple.

139 (*b*) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

Ethylene freely diffuses across membrane because it is a gaseous plant hormone and is thought to be synthesised at or near its site of action which is different from the other plant hormones. It functions to bring about climacteric ripening of fruits.

140 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Hormones are also called growth regulators. These are produced in one part of a plant and then migrate to another part where they promote or inhibit plant growth by stimulating tissues of the location.

141 (*c*) Assertion is true, but Reason is false. Reason can be corrected as

In plants, growth regulators or plant hormones known as phytohormones can promote or inhibit various activities in plant growth and are thus are categorised as plant growth promoters, e.g. auxin, etc., and plant growth inhibitors, e.g. ethylene.

142 (*c*) Assertion is true, but Reason is false. Reason can be corrected as

Phytochrome is a flavoprotein that controls photomodulation in plants. Flower induction occurs due to florigen (a flowering hormone) not due to phytochrome.

143 (*a*) Both Assertion and Rearon are correct and Reason is the correct explanation of Assertion.

Farmers do not prefer to grow tobacco plants under long day conditions because tobacco is a short day plant.

144 (*a*) Statements I and II are incorrect and can be corrected as

- Elongation of plant along the axis is called the primary growth.
- Primary growth happens due to the presence of root apical meristem and shoot apical meristem.

Rest of the statements, i.e. statements III, IV and V are correct.

147 (*a*) Statements I and II are correct and statement III is incorrect for the phase of maturation and can be corrected as

- There is no cell division during maturation phase.

149 (*a*) Statements I, II and III are true, but statements IV and V are false and can be corrected as

- Optimum temperature for plant growth is needed.
- Environmental signals like light and gravity affect certain phases of growth.

153 (*c*) The statement in option (c) is incorrect and can be corrected as

Spraying juvenile conifers with GA_3 brings about early maturity period and thus leads to early seed production.

Rest of the statements are correct.

155 (*d*) The statement in option (d) is incorrect and can be corrected as

- Zeatin is a cytokinin and was the first natural cytokinin discovered from the corn-kernels and coconut milk.

Rest of the statements are correct.

158 (*b*) Statements I and III are correct. Statements II and IV are incorrect and can be corrected as

- Amylase production at the time of seed germination is an important function of GA.
- Potato tubers can be made to sprout early by exposing them to ethylene.

159 (*a*) The statement in option (a) is correct. Rest of the statements are incorrect and can be corrected as

- ABA is not present in lower plants except in mosses.
- Low ratio of cytokinin to auxin favours root formation in plants not shoot formation.
- ABA is formed by mevalonic acid pathway, not by glycolysis.

160 (*c*) Statement in option (c) is incorrect and can be corrected as

Temperature and light are extrinsic factors which control plant growth and development *via* PGR like vernalisation, flowering, dormancy, seed germination and plant movements.

Rest of the statements are correct.

161 (*a*) Statement in option (a) is incorrect and can be corrected as

Cytokinin delays senescence of leaves and enhances the synthesis of chlorophyll.

Rest of the statements are correct.

175 (*c*) Growth at the cellular level principally results from increase in the amount of protoplasm. Since increase in protoplasm is difficult to measure directly, therefore, growth is measured by a variety of parameters like increase in fresh weight, dry weight, length, area and volume, etc., and any one parameter is not good enough to demonstrate growth.

176 (*d*) ABA or Abscisic Acid stimulates the closure of stomata and increases the tolerance of plants to various kinds of stresses. Therefore, it is also known as stress hormone.

177 (*b*) Monocarpic plants flower once in their lifetime, set seeds and die. A few examples of such plants are bamboo, wheat, radish, etc.

178 (*c*) Gibberellin is sprayed on sugarcane to induce growth in the internodal area of the plant.

This increases its sugar production, as larger the internodal area larger will the sugar content, because the internodal area contains sap and sucrose is the main constituent in the sap of sugarcane stem.

179 (*c*) Coconut water is the liquid endosperm in an unripened coconut and is rich in the plant hormone cytokinin.

The other hormones like ABA, auxin and gibberellin are absent in coconut water.

180 (*d*) Cytokinin is antagonistic to the action of auxin and can thus overcome the phenomenon of apical dominance.

IAA helps in apical dominance, ethylene in ripening of fruits and gibberellin in overcoming bud and seed dormancy.

181 (*b*) Apples have lenticels on their skin to allow gaseous exchange for respiration. These are wrapped in wax paper after harvesting, so as to prevent respiration and overripening of the apples.

183 (*b*) Ethylene is a gaseous hormone which is highly effective for fruit ripening. It causes climacteric ripening by increasing the rate of respiration during ripening.

184 (*b*) Synergistic affect refers to the phenomenon that takes place when two hormones work together and increase the affect or functioning of each other, so as to generate an enhanced affect of both the hormones on the same function.

185 (*c*) ABA is a stress hormone and induces seed dormancy in plants. On the other hand, gibberellic acid breaks seed dormancy and induces seed germination.

So both act opposite to each other, i.e. are antagonistic to each other. Thus, ABA is antagonistic to gibberellic acid.

187 (*b*) Plasticity in plant growth means that plant development is dependent to the environment. This is because the plants have the ability to change their phenotype according to the changes in the environment.

188 (*d*) The site of perception of light/dark duration, i.e. photoperiodism are the leaves. Photoperiodism is the effect of light and its duration on the growth and development especially flowering in plants.