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How to stay focused in class and during self-study sessions?

Dr. Pranali Mishra

A doctor by profession and a teacher by passion. Round the clock award May 2021 99/100 Questions from my Question Bank in NEET 2021

A Learner needs to be focused and motivated throughout their preparation journey:

Maintain focus in classes:

The objective here is to grasp concepts that are being taught. For that, you have to follow these:

1. Be attentive and take notes
2. Cross-question everything you hear in your mind

   For eg: When you hear a new term or formula, rather than just writing it down, take a moment and ask yourself relevant questions

With this note-taking method, you will be able to focus more on your lectures.

Maintain focus in self-study sessions:

Some common problems and possible solutions for self-study sessions are:

1. **Lack of understanding the theory from a specific chapter**

If the chapter is really important and you have plenty of time, restart and study it again with a fresh mind. If the time is less, go through your notes again, revise important points topic-wise and solve questions alongside.

2. **Being unable to solve questions**

Always start with an easier question bank and then progress onto difficult questions. Choose a question bank with correct and elaborate solutions, as the inability to solve questions can be a reason for frustration among many of you.

3. **Being unable to remember facts**

Multiple revisions could enhance retention of important facts. Highlight the concepts that are hard to remember and revise them before solving questions. Whenever a question from difficult topics are encountered, the learner should be able to actively recall the theory of that topic.

Lifestyle tips to maintain focus during preparation for the learner

Meditate: Meditation helps you stay calm, think clearly, and work faster. The results may be minute at first, but in a couple of months, the results show.

How to meditate: Have some quiet time with your eyes closed in the morning or evening.

Get enough sleep: It is important to get at least 6 to 7 hours of sleep. Although different Learners have different schedules, sleeping between 10 PM and 2 AM can be benefactory to one's health.

Figure out your 'Power Zone': Every Learner has a 'Power Zone' in which they operate the best. Some do their best work early in the morning while others do so at night. You can utilise this time effectively by creating custom timetables.

Eat healthy and exercise: It is important to eat healthy and exercise for at least 30 minutes every day.

Set some time for hobbies: An hour a day of reading, writing, playing a sport, singing or playing an instrument can be a great break and will be more beneficial than simply changing tabs and scrolling through Instagram.

Mantra: When your brain is busy working hard, there is little room left for it to think about other things and get distracted!

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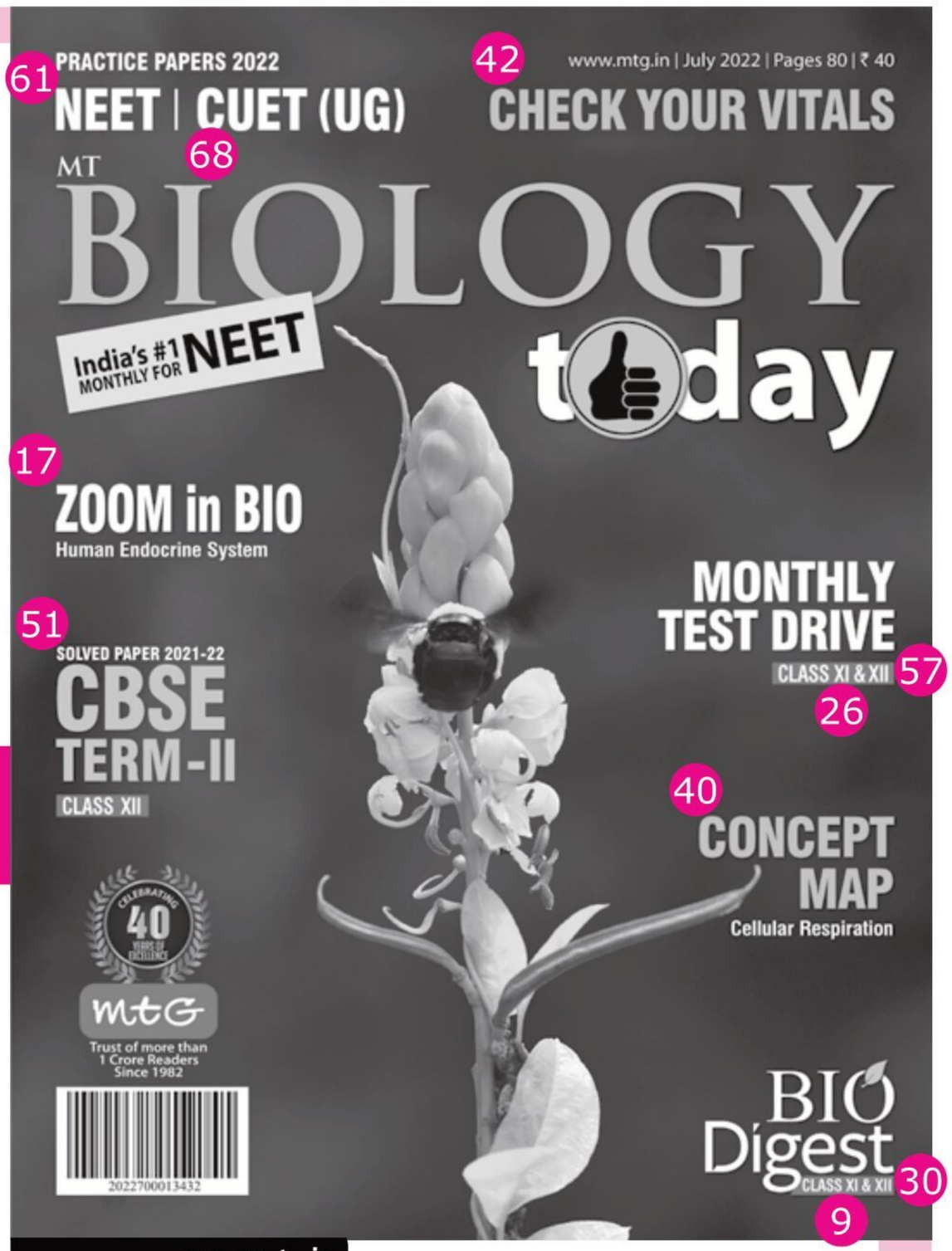

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Class XI

BIO Digest

This article covers high yield facts of the given topic.

Morphology of Flowering Plants

- Plant morphology (Gk. *morphe*-form, *logos*-study) is the branch of botany that deals with the study of forms and features of different plant organs like roots, stems, leaves, flowers, fruits, seeds, etc.
- A flowering plant has a long, cylindrical, unbranched or branched axis that bears a number of lateral appendages. Plant axis is differentiated into an **underground root system** and an **above ground shoot system**.
- Flowering plants contain vegetative parts (*i.e.*, root, stem and leaves) and reproductive parts, (*i.e.*, flowers, fruits and seeds).
- Plants can be classified on the basis of height and nature of stem (**herbs**, **shrubs**, and **trees**), life span (**annuals**, **biennials** and **perennials**) and frequency of flowering or fruiting (**monocarpic** and **polycarpic**).

MORPHOLOGY OF ROOT

- The root is typically a non-green, underground, descending portion of the plant axis which gives rise to similar types of endogenous lateral branches and does not possess nodes and internodes. They are positively geotropic, positively hydrotropic and negatively phototropic.
- A typical root consists of **five major zones** :
  (i) **Root cap -** It covers the root apex and protects the young growing cells of the apical region.
  (ii) **Meristematic zone -** It is present just above the root cap and made up of compact cells having dense protoplasm with large nucleus.
  (iii) **Region of cell elongation -** It is situated above the meristematic zone. Here the cells elongate rapidly and increase the length of the root.
  (iv) **Root hair zone** or **zone of differentiation -** Here different types of primary tissues differentiate. Unicellular and ephemeral root hairs are formed from the epidermal cells in this zone.
  (v) **Zone of mature cells-** Constitutes the major portion of root, where cells do not undergo any further change.
- There are three types of root systems occurring in plants: **tap root system**, **fibrous root system** and **adventitious root system**. A comparative account between the three is summarised in the given table.

Table: Comparison between tap root system, fibrous root system and adventitious root system

	Tap root system	Fibrous root system	Adventitious root system
(i)	It is formed from the radicle of the embryo.	It is formed in place of tap root system at the base of main stem.	It may develop from any part of the plant other than radicle.

(ii)	It is always underground.	It is always underground.	It may be underground or aerial.
(iii)	It consists of a single primary (main) root.	Primary root is short lived. Instead underground roots arise in groups from base of stem.	Primary root is absent and it consists of roots forming a cluster.
(iv)	Primary root produces distinct secondary roots, tertiary roots and rootlets in acropetal succession.	The main roots are of equal length and give off small branches. Main roots and their branches are thin and thread like.	The roots may be thick, thin or variously modified.
(v)	It may be surface or deep feeder, the deep feeder being the usual feature.	It is usually surface feeder.	It is usually surface feeder.
(vi)	It is commonly found in dicots.	It is commonly found in monocots.	It is found both in dicots and monocots.

Modifications of Roots

- Primary functions of roots are anchorage (or fixation) of the plant and absorption of water and minerals from the soil for their transport to the shoot system. However, roots undergo morphological modifications to perform various functions such as food storage, mechanical support, etc., as discussed briefly in the given flow chart.

Modification of Root

Tap root system

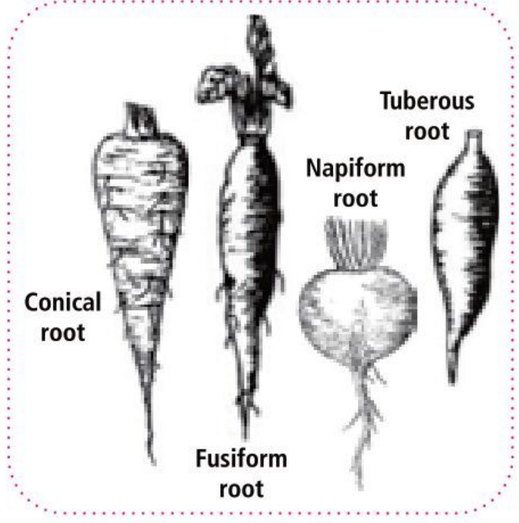
For storage of food

(i) **Fusiform,** swollen in the middle, and tapers towards both ends, *e.g.*, radish.

(ii) **Napiform,** swollen at base, almost spherical and suddenly tapers towards apex, *e.g.*, turnip, beet.

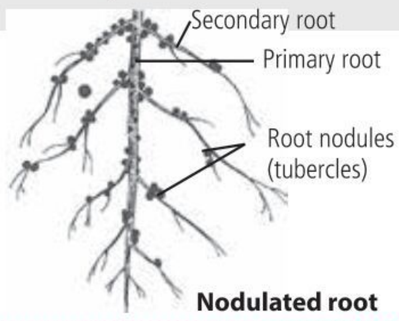
(iii) **Conical,** broad at base, and gradually tapers towards apex, *e.g.*, carrot.

(iv) **Tuberous** or **tubercular,** swollen, and without any definite shape, *e.g.*, *Mirabilis*.



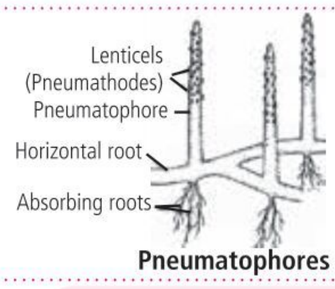
Nodulated (Tuberous)

Root nodules are present on the roots and their branches which help to perform biological N_2-fixation. *e.g.*, leguminous plants.



Pneumatophores (Respiratory roots)

Upright aerial roots which develop on the horizontal roots at short intervals. *e.g.*, mangrove plants such as *Avicennia, Heritiera*.



Haustoria or sucking roots

They are parasitic and suck food, water and minerals from host plant, *e.g., Cuscuta, Viscum.*

For vital functions

Reproductive

Adventitious roots develop buds that grow into new plants under favourable conditions, *e.g., Dahlia.*

Assimilatory

Green, photosynthetic roots, *e.g., Tinospora.*

Epiphytic

Thick, irregular roots hang down in air and absorb water from moist air *e.g., Vanda*.

Floating

Spongy roots, respiratory in function, *e.g., Jussiaea*

Adventitious root system

Tuberous root

Tuberous

These roots arise from nodes of stem and become tuberous and fleshy for storage of food *e.g., Ipomoea*

Nodulose

Swollen at tips, *e.g., Curcuma amada.*

Nodulose root

For storage of food

Fasciculated root

Fasciculated

Tuberous roots in clusters, *e.g.,Dahlia, Asparagus.*

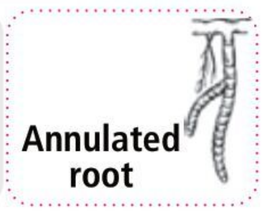
Moniliform

Swollen at regular intervals, *e.g., Momordica.*

Moniliform root

Annulated

These roots arise from nodes of stem and become tuberous and fleshy for storage of food *e.g., Ipecae*


Annulated root

For mechanical support

Prop

These are thick pillar-like roots which grow vertically downwards from horizontal stem branches. *e.g., Ficus benghalensis*.

Prop roots

Stilt

The roots develop obliquely from basal nodes of stem, *e.g.*, maize, *Sorghum*, screw pine, etc.

Stilt roots

Climbing or Clinging

These are non-absorptive roots found in climbers. They attach to their support firmly by forming claws, swollen discs etc. *e.g., Hedera, Pothos* etc.

Climbing roots

INTEXT PRACTICE QUESTIONS

1. **What are the primary functions performed by roots?**
2. **Give an example of moniliform root.**

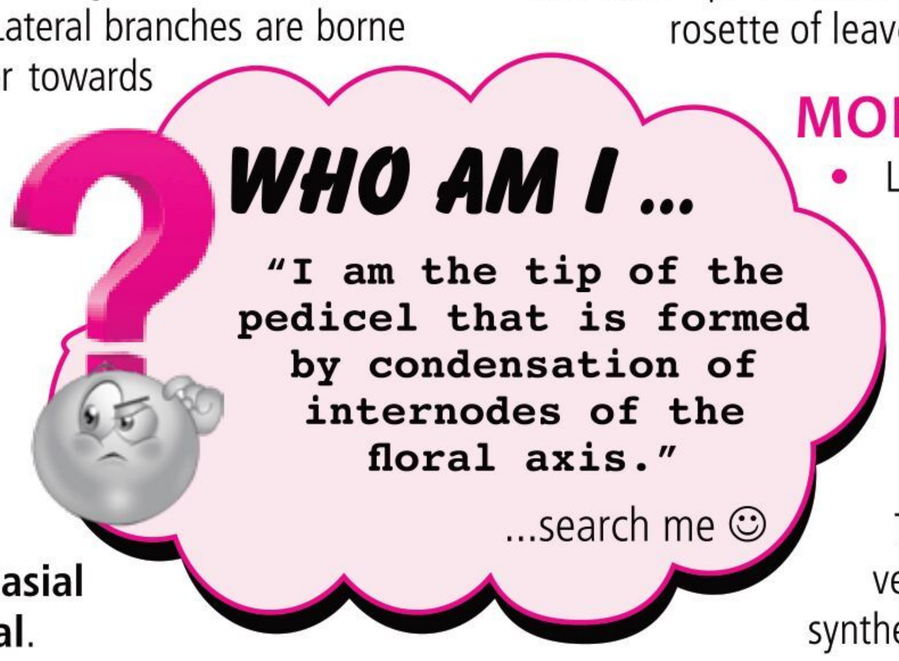
- **Rootless plants** - Many plants growing in aquatic habitats do not possess roots because there is little requirement for absorption of water and mineral salts that is fulfilled by the general surface of plant itself. ***e.g., Wolffia, Utricularia, Ceratophyllum*** etc.
- **Plants that are all roots -** *Podostemon*, a hydrophytic plant, is made mainly of green (photosynthetic) flattened roots growing along rocky surface in shallow water which are fixed on rocks at intervals by holdfasts called **heptera**. However, these plants develop small flowering shoots at intervals on the root from time to time.

MORPHOLOGY OF STEM

- Stem is an ascending part of the plant body that develops from the plumule of the embryo and is usually negatively geotropic and positively phototropic.
- Stem grows by means of a terminal bud which represents a condensed immature or embryonic shoot possessing a growing point.
- The buds are generally small in size. The largest bud is that of cabbage. According to their nature/structure buds can be **vegetative** (form leafy shoots only), **floral** (reproductive buds that develop into flowers) and **mixed** (both vegetative and floral branches).

Branching Patterns of the Stem

- There are two main patterns of branching shown by the stem of a plant — dichotomous and lateral.
- In **dichotomous branching**, the growing point gets divided into two in the region of branching. The dichotomous branching is rare in angiosperms, ***e.g., Asclepia syriaca, Pandanus (screw pine), Hyphaene*** (a palm).
- In **lateral branching**, the growing point does not get divided. Lateral branching is of two kinds: racemose and cymose.
- In racemose or monopodial branching the terminal bud continues its activity indefinitely. Lateral branches are borne in acropetal succession, *i.e.*, older towards the base and younger towards the tip, ***e.g., Pinus, Eucalyptus***, etc.
- In cymose or sympodial branching, the terminal bud stops its activity after forming a small portion of axis. Further growth of axis is continued by one or more axillary branches. Cymose branching is of three types : **Uniparous** or **monochasial**, **biparous** or **dichasial** and **multiparous** or **polychasial**.



Modifications of Stem

- Stems of flowering plants attain diverse forms in order to perform various functions. These are of three types - **underground, aerial** and **subaerial.**
- **Underground modifications** : (a) **Stem tuber :** Swollen end of underground branch of main stem which possesses eyes/nodes, ***e.g., Solanum tuberosum.*** (b) **Sucker :** Formed from the nodes of underground stem and comes up obliquely in the form of leafy shoot, ***e.g., Chrysanthemum***. (c) **Rhizome :** A perennial fleshy underground stem having nodes and internodes, ***e.g.,*** ginger. (d) **Corm :** A subspherical, underground stem growing vertically inside soil, possesses adventitious roots at base and axillary buds in axils of scale leaves, ***e.g., Colocasia.*** (e) **Bulb :** Highly reduced disc like stem with numerous fleshy scale leaves covering a central terminal bud, adventitious roots arise from the under surface ***e.g.,*** onion.
- **Aerial modifications**: (a) **Stem tendrils :** Fine, sensitive thread like structures which can coil around a support ***e.g., Cucurbita*** (b) **Phylloclades :** Flattened (***e.g., Opuntia***) or cylindrical (***e.g., Casuarina***) green, fleshy structures which have taken over the photosynthetic function of leaves. (c) **Cladodes (Cladophylls) :** Green stems of limited growth, generally one or two internodes long and perform the function of photosynthesis, ***e.g., Asparagus*** (one internode long). (d) **Thorns :** Stiff, hard pointed structures that perform defensive functions and check transpiration, ***e.g., Citrus.***
- **Subaerial modifications** : (a) **Runners :** Green, above ground horizontal branches which develop at the bases of erect shoots which are called crowns, ***e.g., Oxalis***. (b) **Stolons :** Elongated horizontal arched runners; lower portion of nodes gives rise to roots, ***e.g., Fragaria*** (strawberry). (c) **Offset :** One internode long, short and thickened special horizontal branches, that develop a tuft or rosette of leaves at nodes, ***e.g., Pistia, Eichhornia***.

MORPHOLOGY OF LEAF

- Leaf is a green lateral flattened outgrowth borne on the node of a stem or its branch and is characteristically photosynthetic. Leaves originate from the shoot meristem as leaf primordia and gradually enlarge. They are the most important vegetative organs of a plant as they synthesise food in them.

- A leaf consists of three parts – leaf base, petiole and lamina.
- **Leaf base** (hypopodium) is the lowermost part of the leaf and is joined to the node of the stem. In **pulvinate** leaves, leaf base is swollen and is called as **pulvinus;** leaf is easy to pluck due to weak attachment with stem, ***e.g.***, gram. In some plants, leaf base consists of small appendages on both sides, these are called **stipules** which protect young leaves and axillary buds.
- **Petiole** (mesopodium) is a cylindrical or subcylindrical smooth or grooved stalk of the leaf which connects the lamina with the base. Leaf having petiole is called **petiolate** and the one without it is called **sessile.**
- **Lamina** (epipodium) or leaf blade is green, flattened part of leaf performing the important functions of photosynthesis, transpiration and respiration. Depending upon the incision of lamina, leaves can be **simple** (smooth or incised margins, incisions not deep upto midrib) or **compound** (incisions reach midrib dividing leaf into leaflets).
- **Venation** (arrangement of veins and veinlets on the lamina) is of two types (i) In **parallel venation,** the veins run parallel to each other, common in monocots and rare in dicots, ***e.g.***, *Eryngium*, etc. (ii) In **reticulate venation**, the main vein by forming a number of branches gives rise to a net like structure in the leaf, common in dicots and rare in monocots, ***e.g.***, *Smilax,* etc.
- **Phyllotaxy** (arrangement of leaves on the true stem and its branches) facilitates the leaves to obtain maximum light for photosynthesis. It may be of 3 types: (i) **Alternate** or **spiral :** Only one leaf is borne on a node and the leaves of the adjacent nodes roughly lie towards the opposite side, ***e.g.***, shoe flower. (ii) **Opposite :** Each node gives rise to two leaves, arranged opposite to each other ***e.g.***, *Syzygium, Calotropis*. (iii) **Whorled :** More than two leaves are formed from each node, which are arranged in a whorl, ***e.g.***, *Alstonia, Nerium*.

Types of Leaves

- On the basis of their origin and functions, leaves can be:
  (i) **Cotyledonary leaves :** Embryonic leaves (cotyledons) emerging at the time of seed germination, ***e.g.***, dicots and monocots.
  (ii) **Bract leaves (bracts) :** Leaves containing flower or inflorescence in their axil ***e.g.***, *Bougainvillea*.
  (iii) **Scale leaves :** Small, sessile, non-chlorophyllous, membranous structures, occurring on underground stems like rhizomes, bulbs, etc. ***e.g.***, *Zingiber officinale* and some aerial stems, ***e.g.***, *Ruscus*.
  (iv) **Floral leaves or sporophylls:** Sepals, petals, androecium and gynoecium all are considered as modified leaves and are called floral leaves or sporophylls.
  (v) **Foliage leaves :** Common green leaves of plants which form the main seat of photosynthesis.
  (vi) **Prophylls :** First few leaves on a stem which differ from other leaves are termed as prophylls.
  (vii) **Bracteoles :** Two small leaf-like structures which are found attached to the stalk of flower.

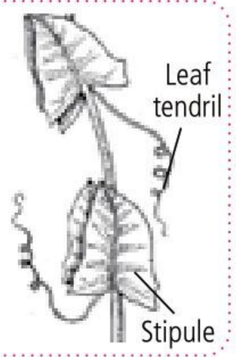
Modifications of Leaf

- A leaf or its part is occasionally modified into specialised structures to perform some functions.

Modification of leaf

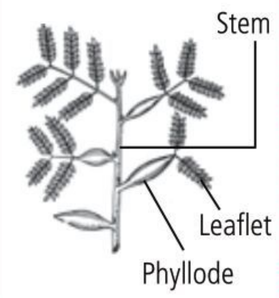
Leaf tendrils

Tendrils are wire-like sensitive structures that help the plants in climbing by coiling around a support. These can be **whole leaf tendrils**, ***e.g.***, *Lathyrus aphaca* (wild pea), **leaflet tendrils**, ***e.g.***, *Lathyrus odoratus* (sweet pea), **petiolar tendrils**, ***e.g.***, *Tropaeolum majus* (garden nusturtium), **Rachis tip tendrils**, ***e.g.***, *Lens culinaris* (lentil), **leaf tip tendrils**, ***e.g.***, *Gloriosa superba* (glory lily) and **stipular tendrils**, ***e.g.***, *Smilax*.



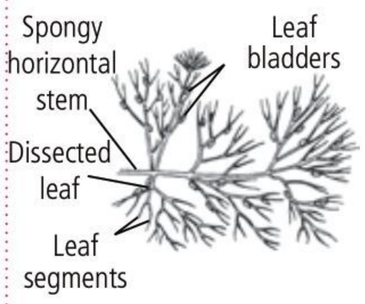
Phyllodes

Phyllodes are flat, green-coloured, photosynthetic leaf-like modifications of petiole of rachis, ***e.g.***, Australian *Acacia* (*Acacia auriculiformis*), *Parkinsonia*, etc.



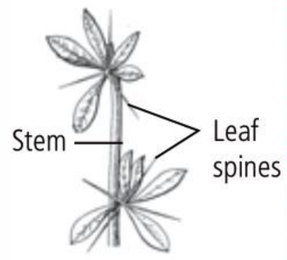
Leaf bladders

In insectivorous hydrophytes like *Utricularia* leaf is profusely dissected and some parts of it are modified into bladder like structures which help in catching water insects.



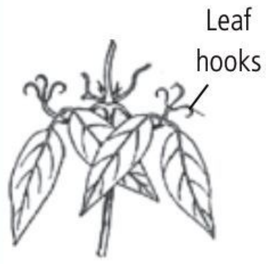
Leaf spines

Leaf gets modified into spine in order to protect the plant from grazing animals as well as reduce the rate of transpiration, ***e.g.***, *Berberis, Acacia*.



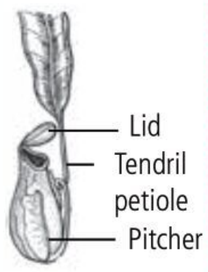
Leaflet hooks

The terminal leaflets of the compound leaves become transformed into three stiff claw-like and curved hooks. The hooks help the plant in climbing, ***e.g.***, *Doxantha unguis-cati*.



Leaf pitcher

In some insectivorous plants, the leaves or their parts are modified into special **insect catching organs**. They catch and digest insects to fulfil their nitrogen requirements, ***e.g.***, *Nepenthes*.



Succulent leaves

Succulent leaves occur in plants of saline and xerophytic habitats, ***e.g.***, *Aloe, Agave, Bryophyllum*.

INFLORESCENCE

- A group of flowers borne on a common axis is called inflorescence. The common axis bearing the flowers is called **peduncle**. Stalk of the individual flower is called **pedicel**. Flowers develop on the peduncle in the axils of bracts.
- Inflorescence can be racemose, cymose, mixed and specialised types.
- In **racemose type,** main axis of inflorescence has an indefinite (indeterminate) growth and it gives rise to (lateral or axillary) flowers in an **acropetal order** (*i.e.*, the youngest flower is at the apex while the oldest is at the base) or **centripetal order.** In **cymose** inflorescence, the growth of the main axis is limited as it is terminated by a flower, the arrangement of flowers is **basipetal** or **centrifugal.**

Types of Inflorescence

Racemose (Indefinite)
- Raceme *e.g., Raphanus*
- Panicle *e.g., Delonix*
- Spike *e.g., Achyranthes*
- Catkin *e.g., Morus*
- Spikelet *e.g.*, Wheat
- Spadix *e.g., Colocasia*
- Corymb *e.g., Iberis*
- Umbel *e.g., Coriandrum*
- Capitulum *e.g.*, Sunflower

Cymose (Definite)
- Monochasial : Helicoid *e.g., Drosera*
  Scorpioid : *e.g., Ranunculus*
- Dichasial *e.g., Clerodendrum*
- Polychasial *e.g., Calotropis*
- Cymose head *e.g., Anthocephalus*

Mixed
- Mixed spadix *e.g.*, Banana
- Thyrsus *e.g.*, Grapevine
- Corymb of capitula *e.g., Ageratum*

Special
- Cyathium *e.g., Euphorbia*
- Hypanthodium *e.g., Ficus*
- Verticillaster *e.g., Ocimum*

INTEXT PRACTICE QUESTIONS

3. **What are cladodes?**
4. **Define sporophylls.**
5. **What are the types of mixed inflorescence ? Give suitable examples.**

FLOWER

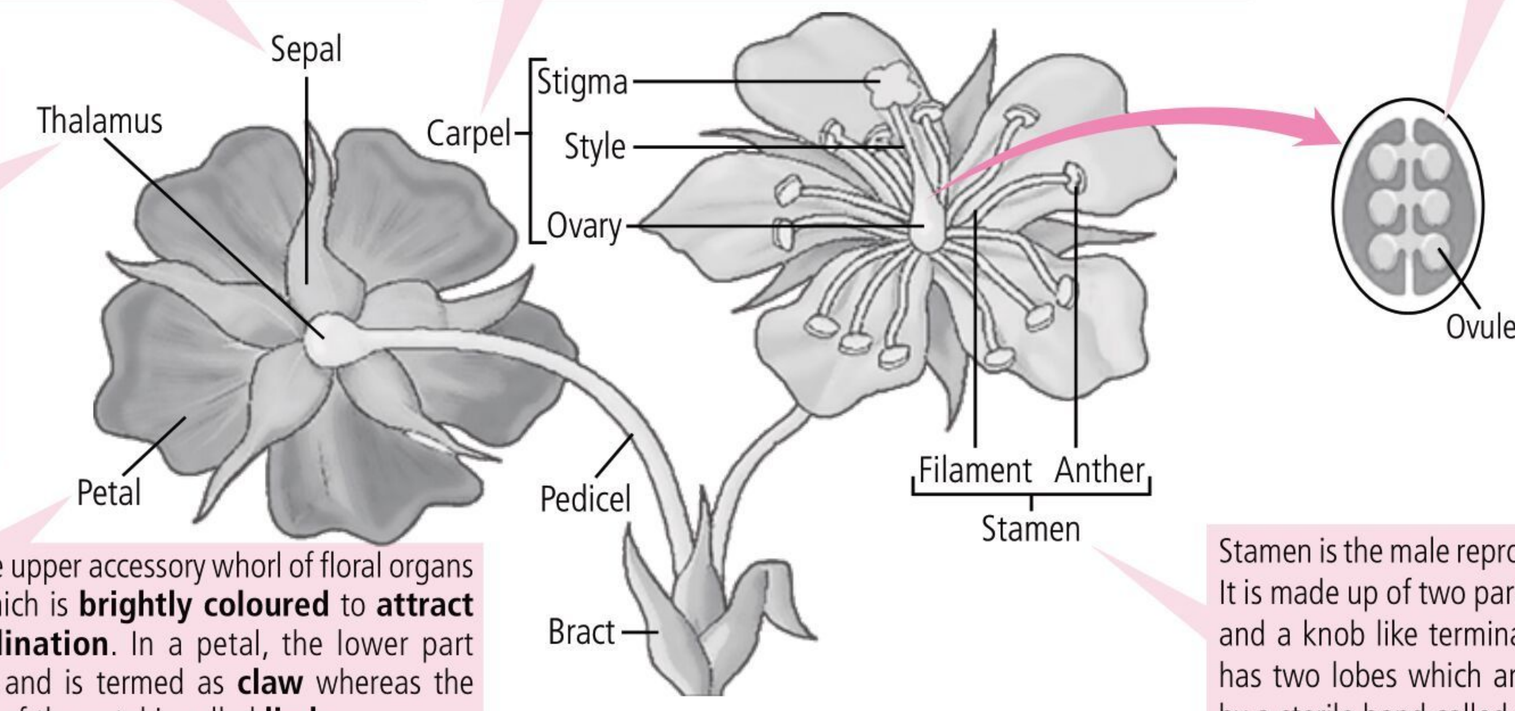
- It is **a specialised condensed shoot** meant for carrying out the **sexual reproduction**. It bears floral leaves and gives rise to seeds and fruits. The study of flowers is called **anthology**.
- Solitary flowers can be terminal (*e.g.*, poppy) or axially (*e.g., Petunia*) in position.

They constitute the lower accessory whorl of mostly green, flattened or foliaceous floral organs called **calyx** which is mainly meant for **protecting** other floral parts in the bud condition.

Carpel or female reproductive part forms the innermost whorl of a flower. The free occurring unit of gynoecium is called pistil, which consists of basal swollen **ovary**, a stalk like **style** and a terminal receptive part called **stigma**.

Ovary has one or more chambers or loculi bearing ovules. **Ovules** are attached to cushion-like **placenta**.

Thalamus is a modified branch, that represents the axis of the floral whorls with undeveloped or suppressed internodes between them.



They constitute the upper accessory whorl of floral organs called **corolla** which is **brightly coloured** to **attract insects for pollination**. In a petal, the lower part is usually narrow and is termed as **claw** whereas the expanded portion of the petal is called **limb**.

Fig. : Parts of a typical flower

Stamen is the male reproductive part of a flower. It is made up of two parts, a stalk like **filament** and a knob like terminal **anther.** Each anther has two lobes which are attached at the back by a sterile band called **connective.**

- Flower bears floral leaves (sepals, petals, stamens and carpels), carries on sexual reproduction and gives rise to seeds and fruits. **Pedicel** is the stalk of flower. The tip of the pedicel is called **thalamus** (**torus** or **receptacle)** which is formed by the **condensation of internodes of the floral axis.**
- **Actinomorphic flowers** can be cut into two equal parts in any vertical plane, *e.g., Solanum*. **Zygomorphic flowers** can be cut into two equal parts in only one vertical plane, *e.g., Pisum*. **Asymmetric flowers** cannot be cut into two equal parts in any plane, *e.g., Canna*.
- A flower with superior ovary is called **hypogynous,** with inferior ovary is **epigynous,** with sub-inferior ovary is **perigynous.** In **pentamerous** flower each whorl especially calyx and corolla possesses 5 members. In **trimerous** and **tetramerous** flowers, each whorl possesses 3 and 4 members, respectively.
- The mode of arrangement of sepals or petals or tepals in relation to one another in a flower bud is called **aestivation.** When these units are not overlapping it is **valvate aestivation.** When out of the total number of units, one is completely out, one is completely in and the rest are in and out it is **imbricate aestivation.** In **descending imbricate** (vexillary) **aestivation**, the standard petal is large and overlaps the two wing petals which in turn overlap the keel petal. In **ascending imbricate,** posterior petal is overlapped by two lateral ones which are being overlapped by two anterior ones**.** When of the total number of units, two are completely out, two are completely in and the fifth one is in and out, it is **quincuncial aestivation.** In **contorted** or **twisted aestivation** all units are in and out.
- On the basis of cohesion of their parts, stamens may be **monadelphous** (*e.g., Hibiscus, Abutilon*), **diadelphous** (*e.g., Pisum, Indigofera*), **polyadelphous** (*e.g., Citrus*), **syngenesious** (*e.g., Tridax, Helianthus*), **synandrous** (*e.g., Cucurbita, Coccinia*). When stamens adhere to either sepals or petals the condition is known as **episepalous** (*e.g, Quisqualis indica*) or **epipetalous,** (*e.g., Solanum*) respectively.
- **Placenta** refers to the parenchymatous cushion present inside the ovary where ovules are borne. Number, position, and arrangement of placentae inside an ovary is called **placentation.** It can be : **marginal** (placenta on ventral suture in monocarpellary ovary, *e.g.*, pea), **basal** (single placenta on floor of unilocular ovary, *e.g.,* sunflower), **axile** (placenta along axis, radial septa present, *e.g.*, *Hibiscus*), **free central** (placenta along axis, no radial septa, *e.g., Dianthus*) and **parietal** (placenta on inner wall of syncarpous ovary, *e.g., Brassica*).

FRUIT

- True fruit or **eucarp** is a structure formed from ripened ovary under the influence of ripening ovules and is meant for protecting them. It consists of pericarp formed from the wall of the ovary and seeds formed from ovules. *E.g.*, mango, brinjal, tomato, cucumber, pea, etc. When in formation of a fruit other floral parts, (*e.g.*, thalamus, base of sepal, petals, etc.) participate, it is called false fruit or **pseudocarp**, *e.g.*, apple, pear etc.
  A fruit formed without fertilisation, *i.e.*, a seedless fruit is called **parthenocarp**, *e.g.*, banana.

Types of Fruit

Fruits can be classified as:

- **Simple fruits :** Develop from mono or multicarpellary, syncarpous ovary. They can be classified into dry and fleshy fruits.

(i) **Dry fruits** are further classified into (a) **Dehiscent : Pod** (*e.g.,* gram), **Follicle** (*e.g, Delphinium*), **Siliqua** (*e.g.,* Mustard), **Silicula** (*e.g., Iberis*), **Capsule** (*e.g.*, cotton). (b) **Indehiscent : Cypsela** (*e.g.*, marigold), **Caryopsis** (*e.g.*, maize), **Achene** (*e.g., Mirabilis*), **Samara** (*e.g., Holoptelia*), **Nut** (*e.g., Litchi*). (c) **Schizocarpic : Lomentum** (*e.g., Mimosa*), **Cremocarp** (*e.g.,* coriander), **Double samara** (*e.g., Acer*), **Regma** (*e.g., Ricinus*), **Carcerulus** (*e.g., Althaea*).

(ii) **Fleshy fruits** are **Drupe** (*e.g.,* mango), **Berry** (*e.g.,* Tomato), **Pepo** (*e.g.,* cucumber), **Pome** (*e.g.,* pear), **Hesperidium** (*e.g.,* orange), **Balausta** (*e.g.*, pomegranate).

- **Aggregate fruits :** Develop from multicarpellary apocarpous ovary. Types of aggregate fruits are **Etaerio of achenes** (*e.g.*, rose), **Etaerio of follicles** (*e.g., Michelia*), **Etaerio of drupes** (*e.g.*, raspberry), **Etaerio of berries** (*e.g.*, custard apple).
- **Composite fruits :** Develop from complete inflorescence and include **Sorosis** (*e.g.*, pineapple) and **Syconus** (*e.g.,* banyan).

MONTHLY TEST DRIVE CLASS XI ANSWER **KEY**

1.	(b)	**2.**	(b)	**3.**	(d)	**4.**	(c)	**5.**	(d)
6.	(b)	**7.**	(c)	**8.**	(b)	**9.**	(b)	**10.**	(b)
11.	(a)	**12.**	(d)	**13.**	(a)	**14.**	(a)	**15.**	(d)
16.	(c)	**17.**	(d)	**18.**	(d)	**19.**	(d)	**20.**	(c)
21.	(d)	**22.**	(b)	**23.**	(c)	**24.**	(c)	**25.**	(b)
26.	(b)	**27.**	(b)	**28.**	(d)	**29.**	(a)	**30.**	(a)
31.	(c)	**32.**	(c)	**33.**	(b)	**34.**	(c)	**35.**	(d)
36.	(c)	**37.**	(b)	**38.**	(c)	**39.**	(a)	**40.**	(a)

SEED

- Morphologically, seed is the integumented, mature, megasporangium which is developed from fertilised ovule and contains an embryo. A seed may have one or two coverings called **seed coats–** outer, thick, hard, leathery **testa** and the inner, thin, papery **tegmen.**
- With the help of a stalk called **funicle,** a seed is attached to the fruit wall and funicle is attached to seed at **hilum. Raphe** is the part of funicle that is fused with the seed coats or integuments. **Chalaza** is that region from which the seed coats originate. **Micropyle** is a small opening present at one end of the seed. **Kernel** is obtained by removing the seed coat and it mainly consists of the embryo. Kernel may also contain endosperm (reserve food), present in **endospermic or albuminous seeds** like cereals, castor, coconut, etc. In **exalbuminous or non-endospermic seeds** like gram, pea, mustard, etc., endosperm is fully consumed by the embryo. There is one cotyledon in monocots and two cotyledons in dicots.

In some seeds (called perispermic seeds *e.g., Ricinus communis*), below the seed coat a very thin membrane is found over kernel called **perisperm** (the **persistent nucellus**). The embryonal axis is differentiated into radicle and plumule. In monocot seeds, the radicle is protected by a sheath called **coleorhiza** and the plumule is protected by **coleoptile.**

DESCRIPTION OF SOME IMPORTANT ANGIOSPERM FAMILIES

- Various morphological features are used to describe a flowering plant. After describing various parts of plant, a floral diagram and a floral formula are presented.
- **Floral formula** is the summarised account of the floral characters of a plant or a family represented by symbols, whereas **floral diagram** is a diagrammatic representation of the pooled up information from transverse sections of the flower bud in relation to mother axis.

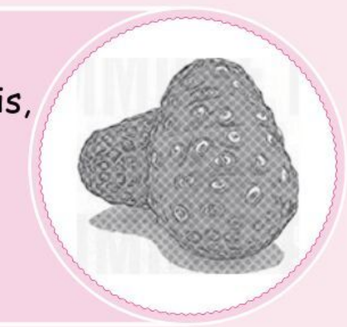
7 HEALING HERBS

ARNICA
- Anti-inflammatory.
- Considered A "Homeopathic aspirin".
- Good for pulled muscles, + achy, sore muscles.

OREGANO
- Remarkably effective against fungi.
- Historically used to treat indigestion, rheumatic arthritis + headaches.
- Used in easing menopausal symptoms.

SAGE
- Calms digestive discomfort + settles nerves.
- Capable of stopping some bacteria + viruses.
- Helps fight bad breath, gingivitis + tonsillitis.

NONI
- Contains xeronine, helpful for arthritis, gastric ulcers, sprains + injuries.
- Effective painkiller, working with endorphins to numb pain.
- Also works as a sedative.



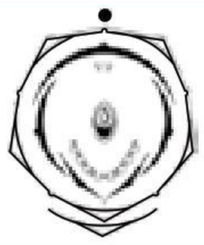
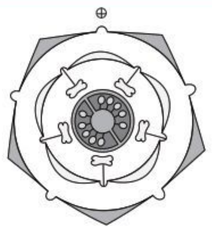
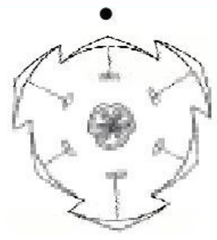
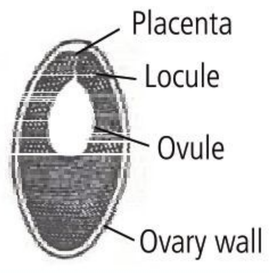
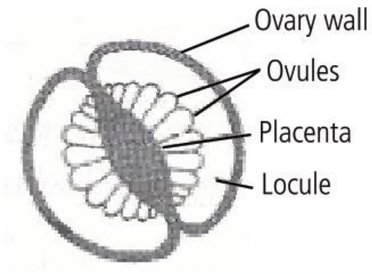
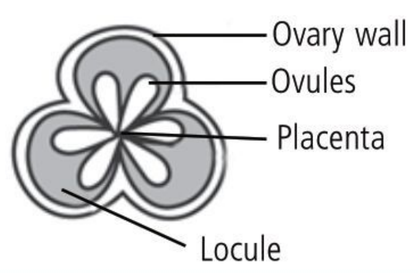
ROSEMARY
- Popular as a tonic, astringent + diaphoretic.
- Shown to inhibit development of cancer.

HOLY BASIL
- Works as an adaptogen.
- Have antibiotic, antiviral, + antifungal properties.
- Treat colds, headaches, digestive disorders, inflammation + heart disease.

RED CLOVER
- Reduces muscle spasms + clears lung congestion.
- Useful in treating skin problems, Acne, skin rashes + Eczema.
- Used in easing menopausal symptoms.

References : Vegetarian times Oct 1988, Better nutrition Nov 1999, Better nutrition Feb 1999, Better nutrition Apr 1999, Better nutrition Mar 1999, Better nutrition Dec 1999, Better nutrition Oct 1999, Yoga journal Dec 2003, Better nutrition May 1999

Table : **A comparative account of Families Fabaceae, Solanaceae and Liliaceae**

Characters	Fabaceae	Solanaceae	Liliaceae
Systematic position	Class – Dicotyledonae Subclass – Polypetalae Series – Calyciflorae Order – Rosales Family – Fabaceae	Class – Dicotyledonae Subclass – Gamopetalae Series – Bicarpellatae Order – Polemoniales Family – Solanaceae	Class – Monocotyledonae Series – Coronarieae Order – Liliales Family – Liliaceae
Inflorescence	Raceme or spike (panicle in *Dalbergia*)	Axillary or extra-axillary cyme, rarely solitary axillary (*Petunia*) or terminal (*Datura*)	Racemose, sometimes solitary or umbellate condensed cymes
Flower	Bisexual, zygomorphic, bracteate or ebracteate, pedicellate or sessile, perigynous or occasionally hypogynous, pentamerous	Bisexual, actinomorphic, ebracteate or bracteate, pedicellate, hypogynous, pentamerous, cyclic	Bisexual, actinomorphic, zygomorphic in few cases, bracteate or ebracteate, pedicellate, complete or incomplete, unisexual in *Ruscus and Smilax*, hypogynous, generally pentacyclic, trimerous
Calyx	Sepals five, gamosepalous, valvate or imbricate aestivation, usually campanulate	Sepals five, gamosepalous, valvate aestivation, persistent, accrescent (*Physalis*), campanulate or tubular, hairy	**Perianth :** Tepals six (3 + 3), often united into tube, valvate or imbricate aestivation, sepaloid or petalloid
Corolla	Petals five, polypetalous, papilionaceous, imbricate aestivation	Petals five, variously shaped, infundibulum, campanulate, rotate, united, valvate aestivation, plicate or folded like a fan in bud	
Androecium	Ten, usually diadelphous [(9) + 1], anthers dithecous, introrse, dehiscence longitudinal	Stamens five, epipetalous, filaments free, anthers bithecous, basifixed or dorsifixed, introrse, longitudinal or porous dehiscence.	Stamens six (3 + 3), free or monadelphous (*e.g.*, *Ruscus*), epiphyllous, basifixed, dorsifixed, or versatile anther, longitudinal dehiscence
Gynoecium	Ovary superior, monocarpellary, unilocular with many ovules, marginal placentation	Bicarpellary, syncarpous, ovary superior, bilocular, sometimes tetralocular due to false septum, placenta swollen with many ovules, axile placentation, ovary is obliquely placed	Tricarpellary, syncarpous, superior ovary, trilocular with 2-many ovules, axile placentation, rarely parietal, styles united or separate, stigma free or fused, trilobed
Fruit	Legume rarely lomentum	Berry or capsule	Capsule, rarely berry
Seeds	One to many, non-endospermic	Many, endospermous	Endospermous
Floral formula	% ♂ $K_{(5)}\ C_{1+2+(2)}\ A_{(9)+1}\ \underline{G}_1$	⊕♂ $K_{(5)}\ \overset{\frown}{C_{(5)}}\ A_5\ \underline{G}_{(2)}$	⊕♂ $\overset{\frown}{P_{3+3 \text{ or } (3+3)}}\ A_{3+3}\ \underline{G}_{(3)}$
Floral diagram			
T.S. Ovary			

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ZOOM IN

BI

The syllabus for NEET is very vast which impedes students from acquiring indepth knowledge and covering the entire syllabus at the same time. An important topic for NEET is therefore presented here in elaborate form to enable students grasp the topic, analyse the type of questions and SCORE HIGH.

HUMAN ENDOCRINE SYSTEM

Cell functions are broadly controlled by nervous and endocrine system. Endocrine system achieves coordination and integration by the release of physiologically active substances called **hormones** directly into the blood stream. It has slower action (*i.e.*, much longer latent period) and affects number of cells over a longer period.

In vertebrate body, glands are classified into exocrine and endocrine glands on the basis of presence and absence of ducts.

Types of Gland

Exocrine glands

- Glands with ducts
- Secretions of these glands are carried by ducts to a particular organ.
- *E.g.*, salivary glands, liver, etc.

Endocrine glands

- Ductless glands or glands of internal secretion.
- Their secretion get absorbed into immediate surrounding blood circulation to reach a specific organs to initiate particular metabolic change.
- Chemicals secreted are called hormones.
- *E.g.*, pituitary, hypothalamus, etc.

Endocrine Glands

Holocrine glands

Endocrine glands which secrete only hormones. *E.g.*, thyroid, parathyroid, adrenal, pituitary gland

Heterocrine glands

Glands which have dual functions (secretion of hormones and some other functions). *E.g.*, pancreas, testes, ovaries, etc.

Characteristics of Hormones

- Hormones are secretory products of ductless glands released directly into the circulation in **small amounts** in response to a **specific stimulus** and on delivery in circulation produces response on the target cells or organs.
- Hormones interact with their target cells *via* receptors, or by passing directly through cell membrane.
- As regulators, hormones stimulate or inhibit the rate and magnitude of biochemical reactions by their control of enzymes and thereby cause morphological, biochemical and functional changes in the target tissues. For example, a hormone does not provide energy but it modulates energy producing processes and regulates the circulating levels of energy producing substrates such as glucose, fatty acids, etc.
- Hormones have a **longer latent period** than that associated with neurons following their stimulation. For example, following the injection of oxytocin, milk ejection occurs in a few minutes; while following the application of a stimulus to a nerve, the muscle contracts within few milliseconds.
- Most hormones are metabolised rapidly after secretion and they get inactivated mainly in the liver and kidney.

Amino acid Derivative Hormones

- Epinephrine, nor-epinephrine,
- T_3, melatonin, serotonin

Protein Hormones

- Hormones generally water soluble and circulate unbound in plasma.
- Hormones are synthesised on ribosomes, attached to ER.
- *E.g.*, anterior pituitary hormones, parathormone, insulin, glucagon, etc.

Classification of Hormones

Steroid Hormones

- Hydrophobic, lipid soluble substances synthesised from cholesterol.
- *E.g.*, aldosterone, cortisol, androgenes, etc.

Peptide Hormones

- Hormones of posterior lobe of pituitary gland.
- *E.g.*,oxytocin and vasopressin

Hypothalamus secrete neurohormones that act on the cells of the pituitary gland.
Releasing hormones: GHRH, ARH, TRH, GnRH, PRH
Inhibitory hormones: GHIH, PIH, MSHIH

Pituitary gland secretes multiple hormones that regulate the endocrine activities of the adrenal cortex, thyroid gland and reproductive organs, *e.g.*, ACTH, TSH, FSH, LH, etc.

Thyroid gland secretes hormones that affect metabolic rate and calcium levels in body fluids, *e.g.*, **thyroxine, calcitonin, tri-iodothyronine.**

Thymus gland secrete **thymosin** involved in the stimulation and coordination of the immune response.

Adrenal gland secretes hormones involved with mineral balance, metabolic control and resistance to stress; the adrenal medulla release **epinephrine** and **nor-epinephrine** and adrenal cortex secretes **cortisol, aldosterone,** etc.

Pancreas secretes hormones that regulate the rate of glucose uptake and utilisation by body tissues, *e.g.*, **insulin, glucagon**.

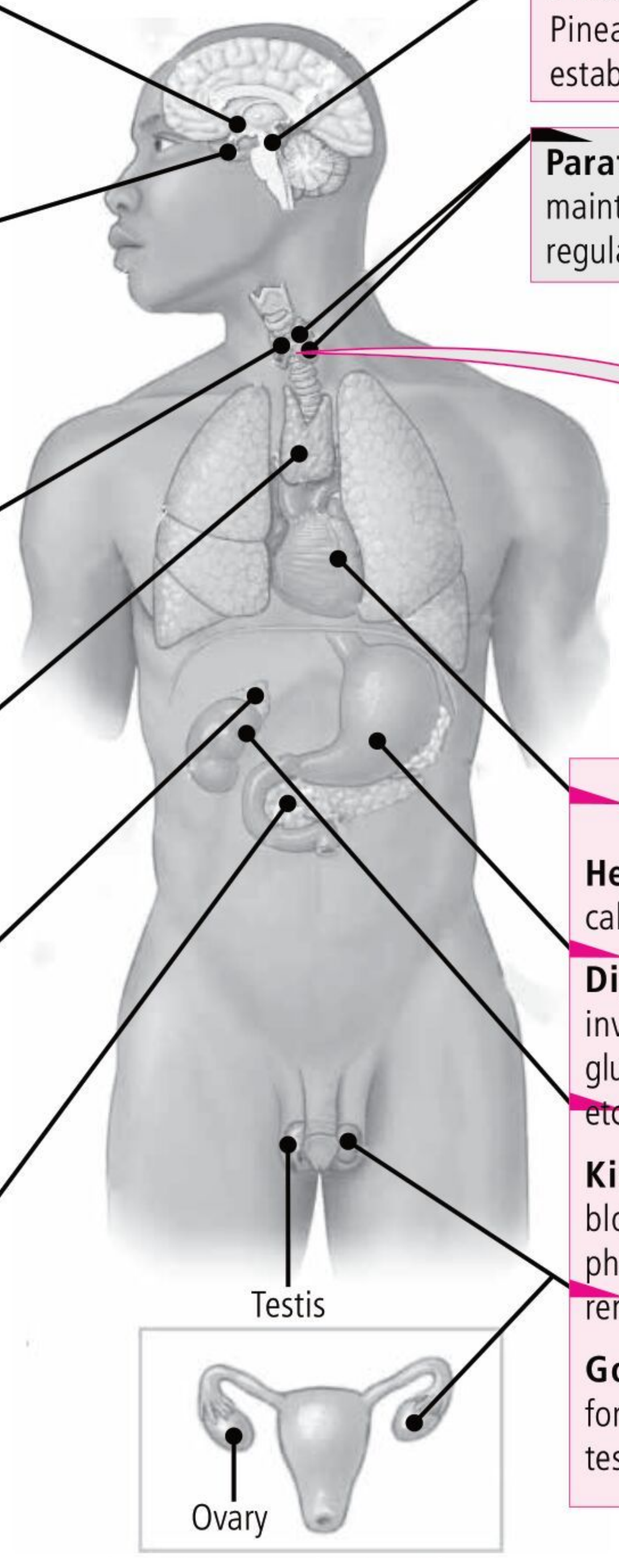


Fig.: Human Endocrine Glands

Pineal gland secretes **melatonin**, a sleep hormone. Pineal gland acts as biological, clock which helps to establish circadian rhythms.

Parathyroid glands secrete **parathormone** which maintains proper levels of calcium and phosphorus by regulating renal action.

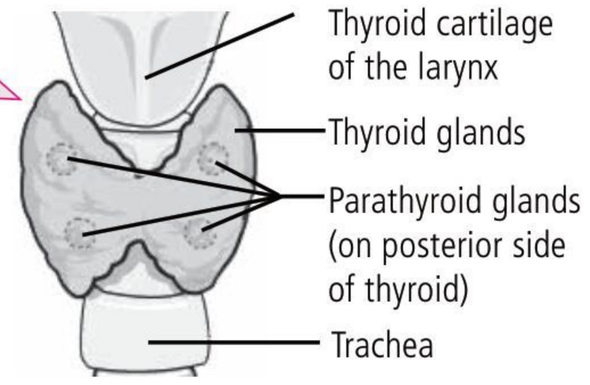


Fig.: Enlarged view of thyroid gland

Organs with secondary endocrine functions

Heart: Secretes hormones **ANF** from cells of atria, called **cardiocytes.**

Digestive Tract: Secretes numerous hormones involved in the coordination of system functions, glucose metabolism and appetite, *e.g.*, gastrin, secretin, etc.

Kidneys: Secrete hormones that regulate red blood cell production and the rate of calcium and phosphate absorption by the intestinal tract, *e.g.*, renin erythropoietin, calcitriol.

Gonads: Secrete hormones affecting gamete formation and sexual characteristics, *e.g.*, estrogen, testosterone, etc.

HUMAN ENDOCRINE GLANDS

Hypothalamus (Supreme Commander)

It is a neuroendocrine organ that produces several neurohormones and its target organ is pituitary. Hypothalamus is the basal part of diencephalon (a part of forebrain) and it regulates a wide spectrum of body functions.

The hormones produced by hypothalamus are of two types, the **releasing hormones** (which stimulate secretions of pituitary hormones) and the **inhibiting hormones** (which inhibit secretions of pituitary hormones).

Table : Hormones of hypothalamus

	Hormones	Functions
(i)	Adrenocorticotropic releasing hormone (ARH) or corticotropin releasing hormone	Stimulates the anterior lobe of the pituitary gland to secrete its adrenocortico -tropic hormone (ACTH).
(ii)	Thyrotropin releasing hormone (TRH)	Stimulates the anterior lobe of the pituitary gland to secrete its thyroid stimulating hormone (TSH) or thyrotropin.
(iii)	Growth hormone-releasing hormone (GHRH)	Stimulates the anterior lobe of the pituitary gland to release its growth hormone (GH) or somatotropin.
(iv)	Growth hormone-Inhibitory hormone (GHIH) or Somatostatin	Inhibits the secretion of growth hormone from the anterior lobe of the pituitary gland.
(v)	Gonadotropin releasing hormone (GnRH)	Stimulates the anterior lobe of the pituitary gland to secrete two gonadotropic hormones: (follicle stimulating hormone (FSH) and luteinising hormone (LH)).
(vi)	Prolactin releasing hormone (PRH)	Stimulates the anterior lobe of the pituitary gland to secrete its prolactin.
(vii)	Prolactin inhibitory hormone (PIH)	Inhibits the secretion of prolactin from the anterior lobe of pituitary gland.
(viii)	MSH releasing hormone (MSHRH)	Stimulates the intermediate lobe of the pituitary gland to secrete its melanocyte stimulating hormone (MSH).
(ix)	MSH inhibitory hormone (MSHIH)	Inhibits the secretion of melanocyte stimulating hormone from the intermediate lobe of the pituitary gland.

Pituitary Gland (Master Endocrine Gland)

It is **smallest endocrine gland** present in a depression called sella turcica of sphenoid bone in skull. It attached to the brain by a stalk called **infundibulum** which is continuous with the hypothalamus.

Morphologically there are two main lobes – **anterior lobe** or adenohypophysis or pars distalis and **posterior lobe** or neurohypophysis or pars nervosa. A third lobe called intermediate lobe or pars intermedia is a part of adenohypophysis.

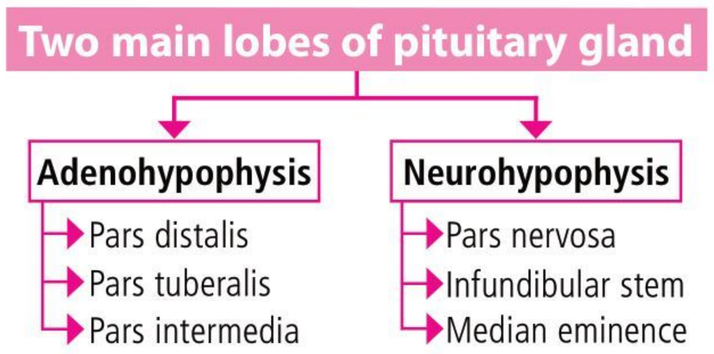
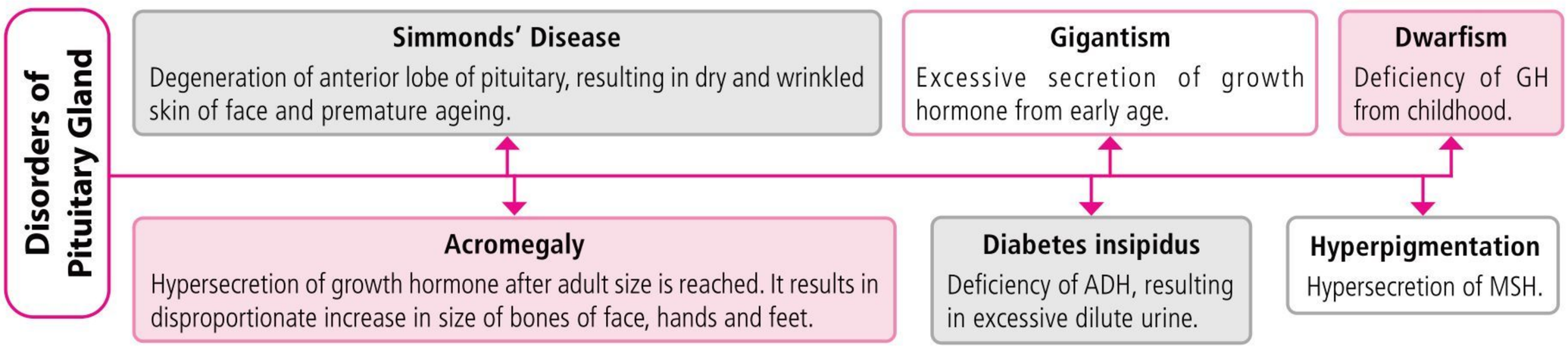


Table : Hormones of pituitary gland

	Hormones	Functions
Hormones of anterior lobe		
(i)	Growth hormone (GH) or Somatotropin hormone (STH)	Stimulates growth, promotes protein anabolism, etc.
(ii)	Thyroid stimulating hormone (TSH) or thyrotropin	Controls growth and activity of thyroid gland and influences iodine uptake.
(iii)	Adrenocorticotropic hormone (ACTH)	Stimulates adrenal cortex to produce its hormones.

(iv)	Gonadotropinc hormones (a) Follicle stimulating hormone (FSH) (b) Interstitial cell-stimulating hormone (ICSH) in males or Luteinising hormone (LH) in females	 Stimulates gamete production, secretion of sex hormones, development of follicles. Stimulates the Leydig's cells of testis and induces secretion of testosterone hormones in males and development of corpus luteum and ovulation in females.
(v)	Luteotropic hormone (LTH) or Prolactin	Stimulates the growth of mammary glands during pregnancy and secretion of milk after child birth.
Hormone of intermediate lobe		
(vi)	Melanocyte stimulating hormone (MSH)	Growth and development of melanocytes which gives colour to skin.
Hormones of posterior lobe		
(vii)	Oxytocin	Stimulates ejection of milk from mammary glands; and contraction of uterus during parturition.
(viii)	Antidiuretic hormone (ADH) or Vasopressin	Regulates water balance and stimulates contraction of smooth muscles, blood vessels and results in rise in blood pressure.



Pineal Gland

It develops from the ectoderm of the embryo. Pineal gland secretes a hormone called **melatonin** which plays a very important role in the regulation of 24 hours **(diurnal)** rhythm of our body. For example, it helps in maintaining the normal rhythms of sleep-wake cycle and in mammals it act as inhibitory factor for sexual maturation and also help to lightens skin colour. Serotonin is a neurotransmitter found in pineal gland.

Thyroid Gland

It is the **largest endocrine gland** and it develops from the endoderm of the embryo. It is present between the trachea and larynx.

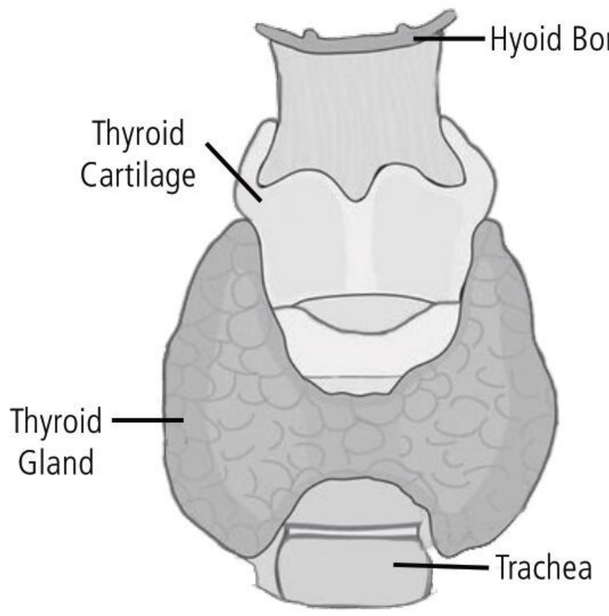


Fig.: Thyroid gland

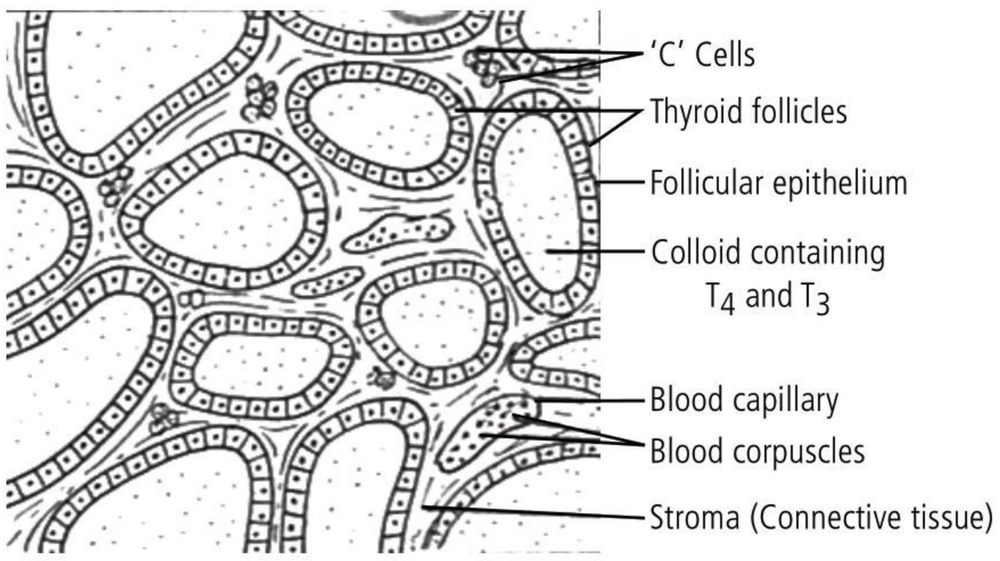


Fig.: T.S. of thyroid gland

It is a bilobed organ and two lobes are connected with isthmus. The microscopic structure of the thyroid gland shows **thyroid follicles** composed of cubical epithelium and filled with a homogenous material called **colloid.** Small amount of loose connective tissue forms **stroma** of the gland. Besides containing blood capillaries, the stroma contains small clusters of specialised **parafollicular cells** or **'C' cells.**

Thyroid gland secretes three hormones: Thyroxine, tri-iodothyronine and calcitonin. Thyroxine (T_4) and tri-iodothyronine (T_3) are secreted by thyroid follicular cells. Both are iodinated forms of an amino acid tyrosine. T_3 is more active and potent than T_3. T_4 gets converted into T_3 by removal of 1 iodine atom.

Calcitonin (Calcium lowering hormone) is secreted by C-cells of the thyroid gland. Calcitonin is secreted in response to high blood calcium level. Calcitonin suppress release of calcium ions from the bones and lowers the calcium level.

Functions of Thyroid Hormones

- Regulate the **metabolic rate** of the body and maintain **BMR** (basal metabolic rate)
- Regulate **growth** of body tissues and development of **mental faculties**
- Stimulate **tissue differentiation** (*e.g.*, promote metamorphosis of tadpoles into adult frogs)
- Regulate carbohydrate and fat metabolism

Disorders of Thyroid gland

Hyperthyroidism: Excessive secretion of thyroid hormones results in **Grave's disease** or **exophthalmic goitre** characterised by bulging eyes due to fluid accummulation, loss of weight, nervousness and rapid heart beat.

Hypothyroidism: Deficiency of thyroid hormones causes **cretinism** in infants. Symptoms are retarded growth, undeveloped sex organ, mental retardation. **Myxoedema** or **gull's disease** is caused by deficiency of thyroxine in adults. It is characterised by puffy appearance due to fat accumulation in subcutaneous tissue, lack of alertness, slow heart beat, etc.

Parathyroid Glands

The parathyroid glands develop from the endoderm of the embryo. The parathyroid glands consist of four separate glands located on the posterior surface of the lobes of the thyroid gland. They consist of two types of cells : **chief cells** (small) and **oxyphil cells** (large). The chief cells secrete **parathormone** or **Collip's hormone.** Parathyroids are under the feed back control of blood calcium level.

Parathyroid hormone (PTH) increases the Ca^{2+} level in the blood by withdrawing calcium from the bones into the plasma. PTH also stimulates resorption of Ca^{2+} by the renal tubules and increases Ca^{2+} absorption from the digested food. It is, thus, clear that PTH is a hypercalcemic hormone. A fall in blood calcium stimulates release of parathormone and rise in blood calcium inhibits secretion of parathormone. Parathormone is antagonistic to calcitonin.

Disorders of parathyroid gland

(i) **Hyposecretion** - Deficiency of PTH causes fall in Ca^{2+} level of blood. It causes convolusions and cramps, this is called parathyroid tetany or hypocalcemic tetany.

(ii) **Hypersecretion** - Excess of PTH draws more calcium from bones, causing their demineralisation leading to **osteoporosis**.

ANSWERS JUNE 2022

The three letter word is **T R O**.

T R O P H O Z O I T E

A U X O **T R O** P H

D Y S **T R O** P H I N

C I S **T R O** N

Winner : Baba subhdeb (West Bengal)

Thymus Gland

This gland is derived form the endoderm of the embryo. It is located in the mediastinum between the sternum and aorta. It is a soft, pinkish, bilobed mass of lymphoid tissue. It is a prominent gland at the time of birth but it gradually atrophies with age.

Hassall's corpuscles are spherical or oval bodies present in the thymus. They are **phagocytic** in function. Thymus secretes a hormone named **thymosin** which stimulates the development and differentiation of immunologically competent T-cells, increasing resistance to infections.

Adrenal Gland (Suprarenal Gland)

Adrenal glands are paired structures (conical, yellowish bodies) located on the top of kidneys. These are also called as glands of emergency.

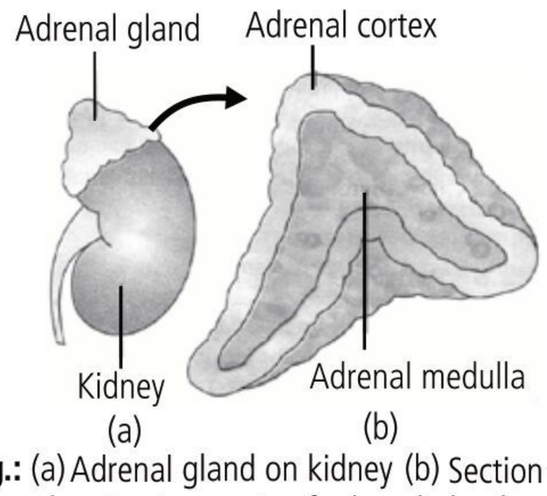


Fig.: (a) Adrenal gland on kidney (b) Section showing two parts of adrenal gland

Adrenal gland has two parts

Adrenal Cortex

- It is derived from the mesoderm of the embryo.
- It is divided into three layers: **(i) Zona glomerulosa** is the **outer zone** that lies just below the capsule. It secrete hormones called **mineralocorticoids,** that affect mineral homeostasis
  (ii) Zona fasciculata is the **middle and widest zone** and consists of cells arranged in long, straight columns which secrete **glucocorticoids** because they regulate glucose homeostasis.
  (iii) Zona reticularis is the **inner zone** and consists of cells arranged in branching cords which secrete **gonadocorticoids** or **sex corticoids**.

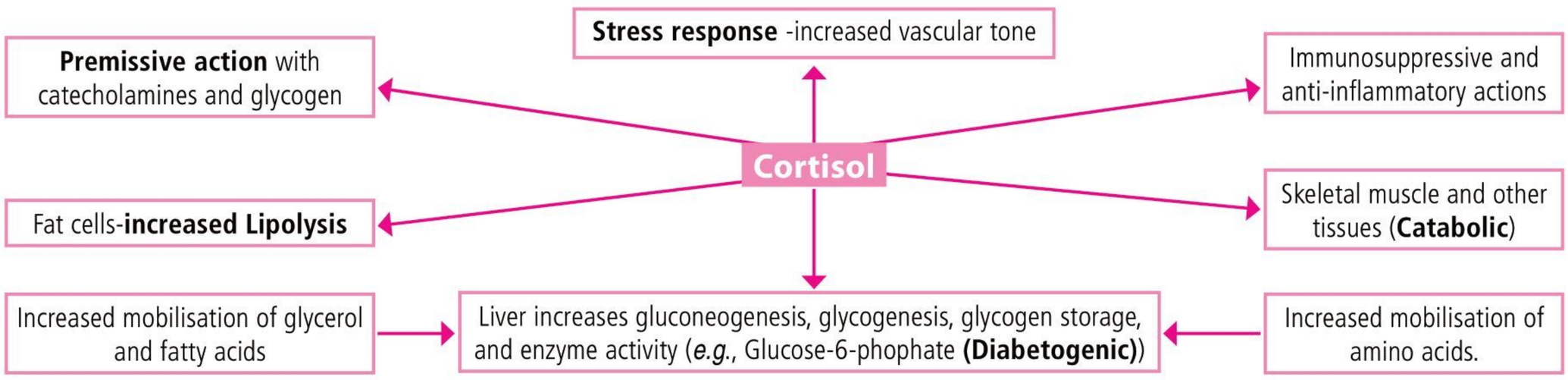
Adrenal Medulla

- It develops from the neuroectoderm of the embryo.
- The adrenal medulla secretes two hormones: **nor-epinephrine (nor-adrenaline)** and **epinephrine (adrenaline)** which are commonly called **catecholamines**. Nor-epinephrine and epinephrine are derived from the amino acid tyrosine.
  Adrenal medulla consists of **chromaffin cells.** These cells are modified postganglionic cells of sympathetic nervous system and are connected with preganglionic motor fibres of sympathetic nervous system.
  Sympathetic nervous system and adrenal medulla funciton as an integrated system and is called sympathetico-adrenal system.

Corticoids

(i) Mineralocorticoids: They maintain water and electrolyte balance and blood volume in the body by regulating mineral metabolism. The major mineralocorticoid is **aldosterone**, commonly called **salt-retaining hormone**. Low sodium level in body stimulates release of aldosterone. It causes retention of sodium from the kidney and increased urinary excretion of potassium.

(ii) Glucocorticoids : They affect carbohydrate metabolism however they also affect metabolism of proteins and fats.



Summary: The Principal actions of Glucocorticoids

(iii) Sexcorticoids: Sexcorticoids include both male and female sex hormones. **Androgens** are important for development of male foetus and stimulate the development of **male secondary sexual characters. Estrogen** controls the appearance of **female secondary sexual characters.**

Catecholamines

(a) Nor-epinephrine - It regulates the blood pressure under normal condition. It causes constriction of essentially all the blood vessels of the body. It causes increased activity of the heart, inhibition of gastrointestinal tract, dilation of the pupils of the eyes and so forth.

(b) Epinephrine - It is secreted at the time of emergency. Epinephrine has a greater effect on cardiac activity than nor-epinephrine. It causes only weak constriction of the blood vessels of the muscles in comparison with a much stronger constriction that results from nor-epinephrine.

Disorders of Adrenal Cortex

Addison's Disease
Due to deficiency of mineralocorticoids and glucocorticoids. Its symptoms include low blood sugar, low plasma Na^+, high K^+ plasma, increased urinary Na^+, nausea, vomiting, diarrhoea.

Cushing's Syndrome
Caused by excess of cortisol. It is characterised by high blood sugar, appearance of sugar in the urine, rise in plasma Na^+, fall in plasma K^+, rise in blood volume, high blood pressure, etc.

Conn's Syndrome
Due to excessive production of aldosterone. Its symptoms include a high plasma Na^+, low plasma K^+, rise in blood volume, high blood pressure and polyurea.

Adrenal Virilism
Appearance of male characters in female is called virilism. Excessive production of male sexcorticoids (androgens) produces male secondary sexual characters like beard, moustache, hoarse voice in woman.

Gynaecomastia
Development of enlarged mammary glands (breasts) in the males, due to excessive secretion of estrogens in males. Decreased testosterone may also lead to gynaecomastia.

Pancreas

It is derived from the **endoderm of the embryo**. Pancreas is a composite gland which acts as both exocrine and endocrine gland. The endocrine pancreas consists of groups of cells called **'Islets of Langerhans'**.

Table: Hormones of pancreas

	Hormones	Cells of Islets	Function
(i)	Insulin	β cells	Stimulates glycogenesis, promotes synthesis of proteins and fats. Acts on cells of liver muscle and adipose tissue.
(ii)	Glucagon	α cells	Stimulates glycogenolysis in the liver and muscles; increases the amount of sugar in blood.
(iii)	Somatostatin (SS)	δ cells	Suppresses the release of hormones from the pancreas and digestive tract.
(iv)	Pancreatic polypeptide (PP)	Pancreatic polypeptide cells	Inhibits the release of digestive secretion of the pancreas.

Disorders of Pancreas

Hyperglycemia (Diabetes mellitus)

It is due to insulin deficiency, resulting in elevation in blood sugar level hence glucose appears in urine. There is high blood cholesterol and ketone body formation. Symptoms are excessive urine production, thirst and eating.

Hypoglycemia

It is due to excess of insulin or deficiency of glucagon and blood glucose level falls below normal. Symptoms include weakness, profuse sweating, convulsions and requires urgent intake of sugar.

Kidneys

They develop from the **mesoderm** of the embryo.

Hormones of kidneys

Renin

Renin acts upon a plasma-protein, **angiotensinogen,** separating a compound, called angiotensin–II from it. **Angiotensin–II** accelerates heart beat and constricts arterioles, thereby increasing blood pressure.

It also stimulates secretion of aldosterone and enhances water and sodium reabsorption from nephrons.

Erythropoietin

The oxygen shortage stimulates the kidney cells to secrete a hormone named erythropoietin. It stimulates the bone marrow to increase the production of RBCs.

Calcitriol

Calcitriol is the active form of vitamin **cholecalciferol** (vitamin D). It promotes absorption of Ca^{2+} and phosphorus in the small intestine and accelerates bone formation.

Gonads

They develop from the mesoderm of the embryo. The gonads are sex glands. Both testis and ovary serve dual function, as they act as primary sex organs (produce gametes) as well as endocrine glands (secrete hormones).

Testis: It is composed of **seminiferous tubules** and **stromal** or **interstitial tissue.** The **Leydig's cells** or **interstitial cells**, secrete hormones called **androgens,** mainly **testosterone.**

Testosterone stimulates growth and development of **male sex organs** and **secondary sexual characters** like beard, moustache and low pitch voice, stimulates **spermatogenesis** and promotes growth of **bones** and **muscles.**

Male hypogonadism: It is due to deficiency of androgens (hypofunction of Leydig's cells), deficiency of sperm formation (hypofunction of sertoli cells) and masculature and male secondary sex organs do not develop.

Ovary: It is composed of ovarian follicles and stromal tissues. Hormones secreted by ovaries are: **estrogen** secreted by the **growing ovarian follicles**, **progesterone**, **relaxin** and **inhibin** secreted by corpus luteum.

Estradiol is the principal estrogen. It stimulates the development of female secondary sex characters and maturation of ova, development of uterine epithelium.

Progesterone stimulates further development of uterine lining and mammary gland, required for formation of placenta and maintenance of pregnancy.

Relaxin is secreted only during later stages of pregnancy and inhibin inhibits production of FSH and GnRH.

Female hypogonadism: Due to deficiency of estrogens (female sex hormones) pituitary gonadotropins (LH, FSH or both) or can represent primary ovary failure. It results in the lack of development of female secondary sexual characters.

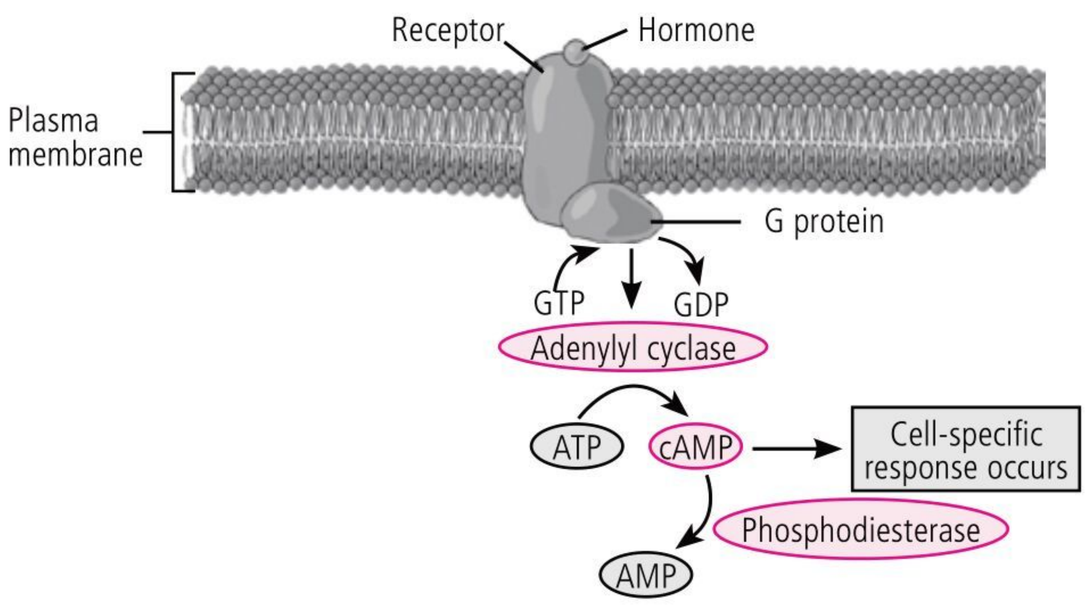
MECHANISM OF HORMONE ACTION

Hormones are of mainly two types- water soluble (***e.g.***, amino acid derivatives, peptides and protein hormones) and lipid soluble (***e.g.***, steroid hormones). Water soluble hormones require extracellular receptors that generate second messengers (***e.g.***, cAMP) for carrying out their activity. Lipid soluble hormones can pass through cell membranes and directly enter the cells.

Two mechanisms of hormone action

cAMP mediated hormone activity

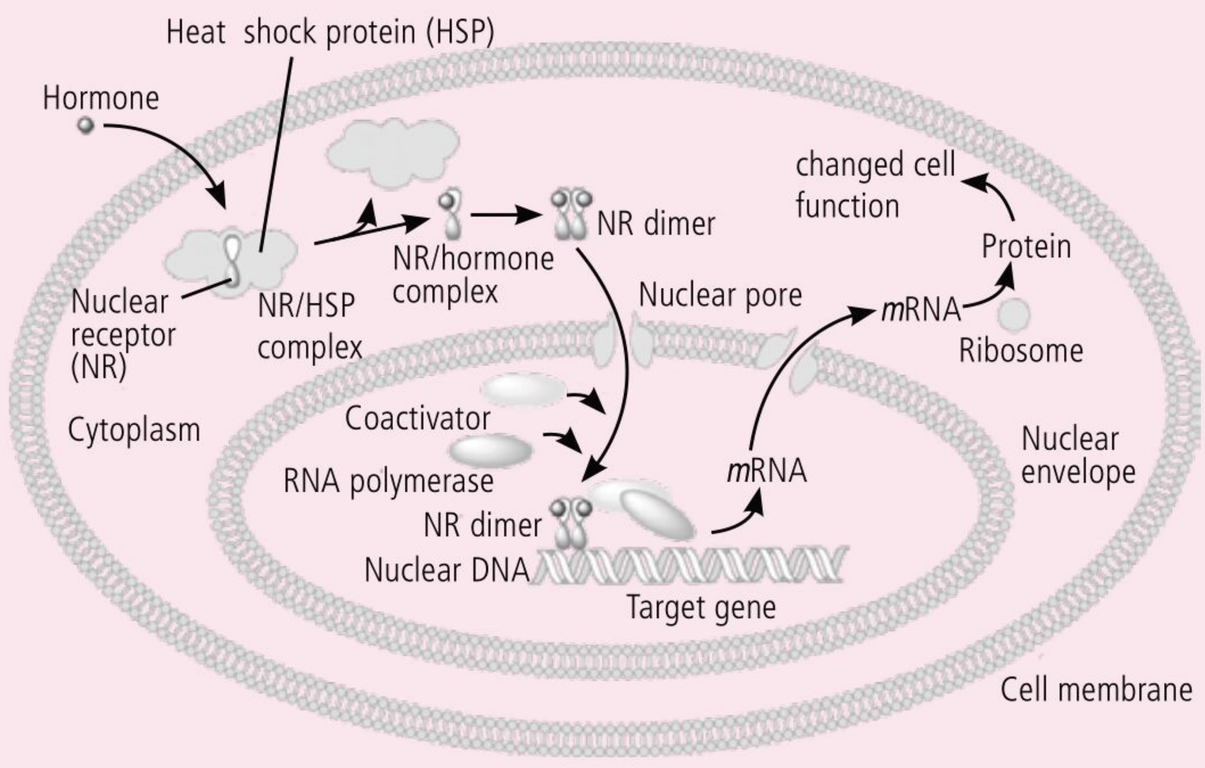
Most proteins and polypeptide hormones, many amino acid derivatives, specially catecholamines and some of prostaglandins (because of their large size, cannot enter the cells) binds to intracellular receptors. They acts as the **first messenger** and exert their effect by combining with specific fixed receptor site over the outer surface of the cell membrane, thereby activating the enzyme **adenylyl cyclase** on the inner surface of the membrane. This increases formation of intracellular cAMP from ATP. cAMP, the **second messenger**, is a basic regulator of cell metabolism, it acts by conversion of inactive protein kinases to their active form.



Transcription and translation effect

Steroid hormones being lipid soluble can easily enter into the target cells and exert their effect by combining to a specific cytoplasmic receptor protein in a target cell *i.e.*, cell that responds to the hormone. Each receptor molecule binds to hormone, forming a complex that enters the nucleus and becomes attached to the chromatin, the genetic material. The complex activates DNA, stimulates the transcription (*i.e.*, formation of *m*RNA) of a particular gene and specific messenger RNA (*m*RNA) synthesis increases.

The specific *m*RNA enters the cytoplasm, where it directs the ribosomes to synthesise specific proteins (translation). These proteins may be enzymes, structural proteins, receptor proteins or secretory proteins.



ROLE OF HORMONES IN HOMEOSTASIS

Hormones as

Messengers

Hypothalamus is a part of the fore brain. Its hypothalamic nuclei – masses of grey matter containing neurons, are located in the white matter in the floor of the third ventricle of the brain. The neurons (neurosecretory cells) of hypothalamic nuclei secrete some hormones called **neurohormones** (releasing factors) into the blood. The neurohormones are carried to the anterior lobe of the pituitary gland (= hypophysis) by a pair of hypophysial portal veins, where they stimulate pituitary to release various hormones.

Regulators

When the secretion of hormones is under the control of factors or other hormones it is called feed back control. The regulation of secretion of thyroxine from the thyroid gland is an example of such feed back control mechanism. Feed back control is of two types:

Positive feed back control : If the level of thyroxine is less than normal limits in the blood, thyroxine level stimulates the hypothalamus to secrete more of TRH which results in increased secretion of TSH which in turn stimulates increased secretion of thyroxine. Such regulatory effect is called positive feed back control.

Negative feed back control: The thyrotropin releasing hormone (TRH) from the hypothalamus stimulates the anterior lobe of the pituitary gland to secrete the thyroid stimulating hormone (TSH). The TSH in turn stimulates the thyroid gland to secrete thyroxine. A high amount of thyroxine in the blood exerts an inhibitory effect on hypothalamus in such a way that less of TRH and TSH is produced respectively. This eventually results in a decreased production of in thyroxine. This is called negative feed back control.

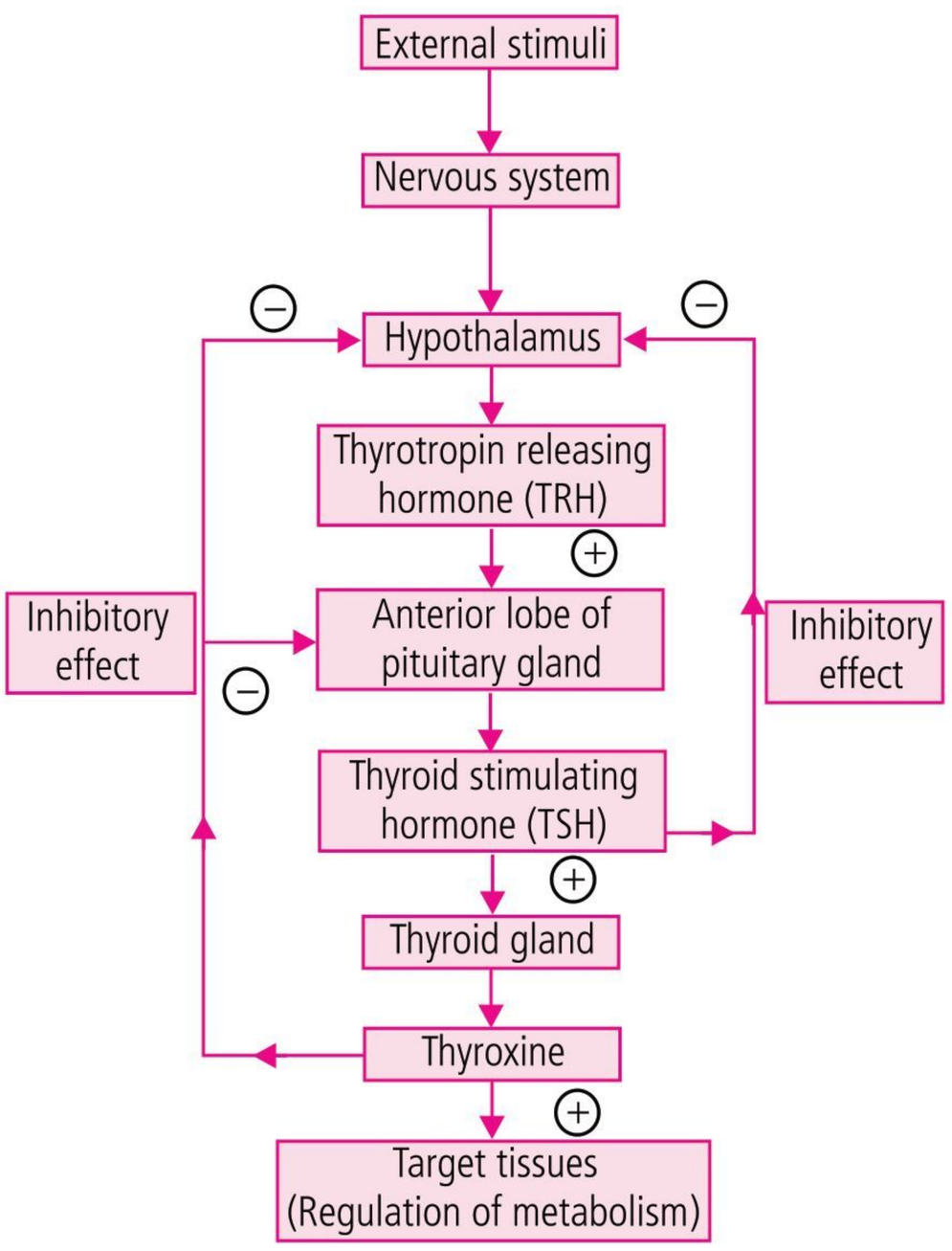


Fig.: Feed back control involving the hypothalamus, anterior lobe of pituitary gland, thyroid gland and target tissues

HEALTH TALK

Mad Cow Disease

Mad cow disease or bovine spongiform encephalopathy (BSE), is a disease that was first found in cattle. It is related to a disease in humans called variant Creutzfeldt-Jakob disease (vCJD). Both disorders are universally fatal brain diseases and transmitted through prion. A prion is a protein particle that lacks DNA (nucleic acid). Prion diseases are caused by the misfolded forms of the prion protein (PrP). They cause other PrP molecules to do the same. Prions can spread silently for years without causing any symptoms. Infection leads to tiny holes in parts of the brain, giving the tissue a sponge-like appearance when viewed with a microscope. These so-called spongy holes cause slow deterioration within the cow's brain and eventually other symptoms develop affecting the whole body. Cow suffering from this disease shows common signs such as incoordination, trouble in walking and getting up, may act very nervous or violent, which is why BSE is often called "mad cow disease". Currently, there is no reliable way to test for BSE in a live cow, however if cow has died, scientists can tell if it had BSE by looking at its brain under a microscope and seeing the spongy appearance. The human version of mad cow disease called variant Creutzfeldt-Jakob disease (vCJD) is believed to be caused by eating beef products contaminated with central nervous system tissue from cattle infected with mad cow disease. This disease was named after the researchers who first identified the classic condition The person affected with this disease show symptoms such as loss of intellect and memory, loss of balance and co-ordination, slurred speech, vision problems and blindness, abnormal jerking movements, etc. There is no cure for vCJD.

MONTHLY TEST DRIVE

XI

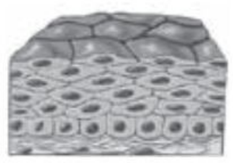
This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 160

Series 4 : Structural Organisation in Animals
Cell : The Unit of Life

Time : 40 Min.

1. Which of the following scientists studied different types of animal tissues including development of embryos and found that animal cells lack cell wall?
(a) Matthias Schleiden
(b) Theodore Schwann
(c) M. Schleiden and T. Schwann
(d) Rudolf Virchow

2. Which of the following figures show a stratified squamous epithelium?
(a) (b) 
(c) (d)

3. The cell organelle which takes part in synthesis of glycoproteins and glycolipids is
(a) peroxisome (b) glyoxysome
(c) aleuroplast (d) Golgi apparatus.

4. Male and female cockroach cannot be identified on the basis of
(a) boat-shaped 7^{th} sternum in females
(b) presence of anal styles in males
(c) 9 visible sterna in females
(d) genital pouch between 7^{th}, 8^{th} and 9^{th} sternum in females.

5. Read the following statements and select the correct option.
Statement A : Centrioles in a centrosome lie parallel to each other.
Statement B : Centrioles in a centrosome has a organisation like the cartwheel.
(a) Both statements A and B are correct.
(b) Both statements A and B are incorrect.
(c) Statement A is correct but statement B is incorrect.
(d) Statement A is incorrect but statement B is correct.

6. Identify the tissue from the given statements.
(i) Collagen fibres are present in rows between many parallel bundles of fibres.
(ii) Ligaments which attach one bone to another is an example of this tissue.
(a) Loose connective tissue
(b) Dense regular connective tissue
(c) Dense irregular connective tissue
(d) Hyaline cartilage

7. Match column I with column II and select the correct option from the given codes.

	Column I (Cell organelle)		**Column II (Function)**
A.	Endoplasmic reticulum	(i)	Protein synthesis
B.	Golgi apparatus	(ii)	Phagocytosis
C.	Lysosome	(iii)	Packaging
D.	Mitochondria	(iv)	Formation of ATP

(a) A-(iii), B-(i),C-(iv),D-(ii)
(b) A-(iii), B-(ii), C-(i),D-(iv)
(c) A-(i), B-(iii),C-(ii), D-(iv)
(d) A-(iv),B-(ii), C-(iii),D-(i)

8. Which of the following statements is incorrect?
(a) In cockroach, sensory receptors are found in anal cerci.
(b) Intercalated discs are present in smooth muscles.
(c) The contents of nucleolus is continuous with nucleoplasm.
(d) The convex side of Golgi apparatus is called forming face.

9. Which of the following is not present in mitochondrial matrix?
(a) 70S ribosomes (b) 80S ribosomes
(c) Circular DNA (d) RNA

10. Identify the mis-matched pair in relation to cockroach.
(a) Labium – Lower lip
(b) Maxilla – Jaw
(c) Labrum – Upper lip
(d) Hypopharynx – Tongue

11. Complete the following table by identifying X, Y and Z from the given options.

	Chromosome type	Position of centromere
(i)	Acrocentric	**X**
(ii)	**Y**	Sub-median
(iii)	Telocentric	**Z**

	X	Y	Z
(a)	Sub-terminal	Sub-metacentric	Terminal
(b)	Median	Metacentric	Terminal
(c)	Sub-terminal	Metacentric	Median
(d)	Terminal	Sub-metacentric	Sub-median

12. Complete the given paragraph by selecting the correct sequence of words.

In *Periplaneta americana*, the body is segmented and divisible into _____ distinct regions. The entire body is covered by hard _____ exoskeleton which has hardened plates called _____ in each segment. A dorsal _____ and a ventral _____ are joined to each other by a thin and flexible arthrodial membrane.

(a) three, proteinaceous, tergite, sternite, sclerite
(b) two, chitinous, sclerite, sternite, tergite
(c) two, proteinaceous, sclerite, sternite, tergite
(d) three, chitinous, sclerite, tergite, sternite

13. Which of the following are characteristic infoldings of prokaryotic cell membrane?

(a) Mesosomes (b) Inclusion bodies
(c) Polysomes (d) Chlorosomes

14. Find out the incorrect statement regarding cockroach.

(a) In female cockroach, each ovary consists of group of ten ovarian tubules containing a chain of developing ova.
(b) Haemolymph in cockroach is composed of colourless plasma and corpuscles.
(c) Female cockroach produces 9-10 oothecae, each containing 14-16 eggs.
(d) In cockroach, the nymph grows by moulting about 13 times to reach the adult form.

15. Fibril organisation in flagella and cilia is _____ and _____ respectively.

(a) 9 + 0, 9 + 0 (b) 9 + 2, 9 + 0
(c) 9 + 0, 9 + 2 (d) 9 + 2, 9 + 2

16. A slide was shown to the students and they identified it as a bone because

(a) cells of this tissue are enclosed in small cavities within the matrix secreted by them
(b) cells and fibres are loosely arranged in a semifluid ground substance
(c) cells are present in spaces called lacunae
(d) cells and fibres are compactly arranged in the matrix.

17. Match column I with column II and select the correct option.

	Column I		Column II
A.	Cristae	(i)	Flat membranous sacs in stroma
B.	Cisternae	(ii)	Infoldings in mitochondria
C.	Thylakoids	(iii)	Outermost layer of cell envelope
D.	Glycocalyx	(iv)	Disc-shaped sacs in Golgi apparatus
		(v)	Structural element of chloroplast
		(vi)	Arranged parallel to each other
		(vii)	Found as a loose sheath in slime layer
		(viii)	Increase surface area

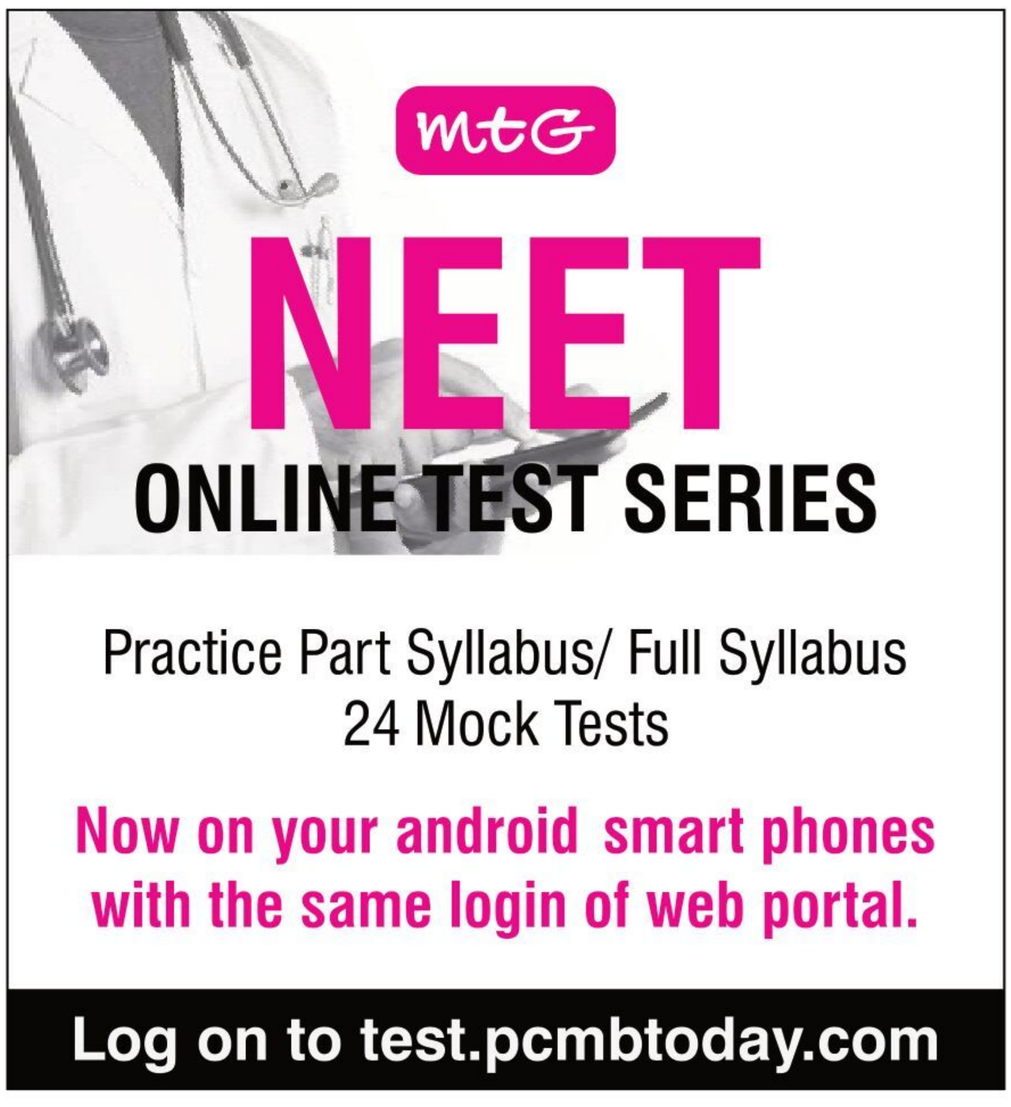
(a) A-(ii, viii), B-(i, v), C-(iv, vi), D-(iii, vii)
(b) A-(iii, vii), B-(i, v), C-(iv, vi), D-(ii, viii)
(c) A-(iv, vi), B-(ii, viii), C-(i, iii), D-(v, vii)
(d) A-(ii, viii), B-(iv, vi), C-(i, v), D-(iii, vii)

18. A tissue with specialised cells chondrocyte present at the tip of nose and outer ear joints is

(a) bone (b) tendons
(c) blood (d) cartilage.

19. Read the given statements and select the ones which are true (T) or false (F).

(i) Mitochondria of eukaryotes have 80S ribosomes.
(ii) DNA of single human cell is approximate 2 metre in length.



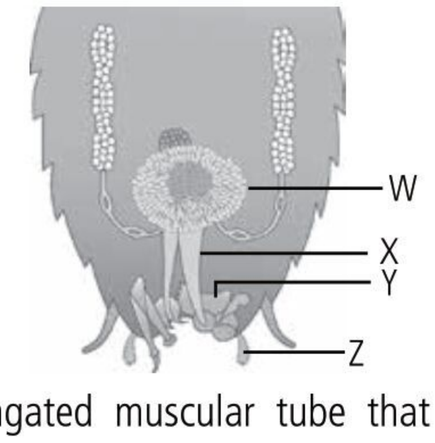
(iii) Plasmids are self replicating, extra chromosomal segments of single stranded, circular, naked DNA.

	(i)	(ii)	(iii)
(a)	F	T	T
(b)	T	T	F
(c)	T	F	T
(d)	F	T	F

20. **Statement A :** In cockroach, first pair of wings arise from mesothorax.
Statement B : The forewings in cockroach are adapted for flight.
(a) Both statements A and B are correct.
(b) Both statements A and B are incorrect.
(c) Statement A is correct but statement B is incorrect.
(d) Statement A is incorrect but statement B is correct.

21. Which of the following is common in both mitochondria and chloroplast?
(a) Presence of double stranded circular DNA
(b) Double membrane bound cell organelle
(c) Presence of 70S ribosomes
(d) All of these

22. Read the given statements and select the option that correctly matches with labelled part W-Z in the given figure.



(i) An elongated muscular tube that opens into male gonopore situated ventral to anus.
(ii) The identifying feature of male cockroach.
(iii) Site where sperms are stored.
(a) (i)-Z, (ii)-W, (iii)-X (b) (i)-X, (ii)-Z, (iii)-W
(c) (i)-Z, (ii)-Y, (iii)-W (d) (i)-X, (ii)-Y, (iii)-W

23. New mitochondria develops from pre-existing mitochondria by _____.
(a) division (b) sexual reproduction
(c) binary fission (d) budding

24. Which option is correctly matched with its function?
(a) Areolar tissue – Support framework for endothelium
(b) Tendon – Joins one bone to another
(c) Neuroglia – Make more than one half the volume of neural tissue
(d) Gap junction – Perform cementing to keep neighbouring cells together

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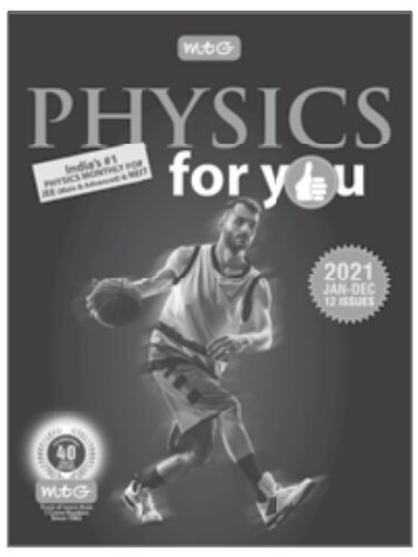

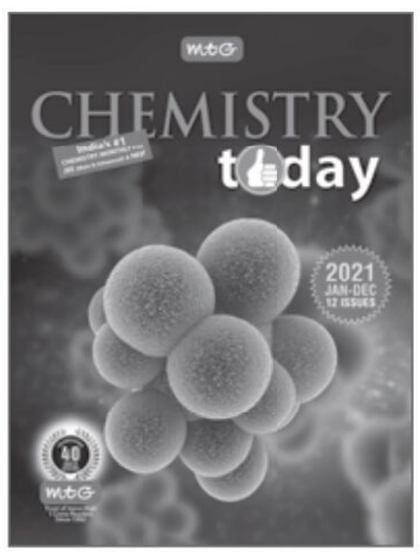

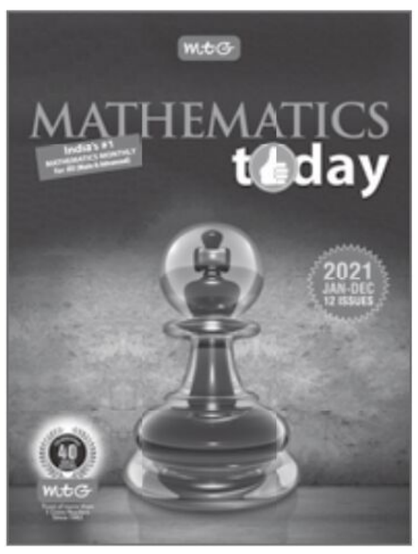

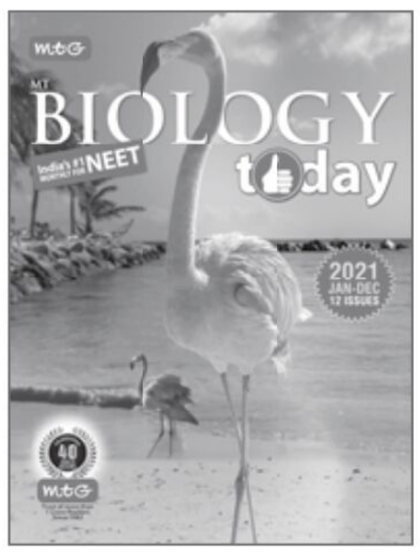

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25. Which of the following is the central part of proximal region of centriole?
(a) Spike (b) Hub
(c) Axoneme (d) Filament

26. Ciliated epithelium is present in
(a) stomach (b) bronchioles
(c) pancreas (d) blood vessels.

27. The larger subunit of 70S ribosome is
(a) 60S (b) 50S (c) 40S (d) 30S.

28. *Periplaneta americana* is
(a) ureotelic (b) guanotelic
(c) ammonotelic (d) uricotelic.

29. In which of the following, the cell wall is made up of cellulose, galactans and mannans?
(a) Algae (b) Fungi
(c) Bacteria (d) Protists

30. Cockroach is
(a) omnivorous (b) herbivorous
(c) carnivorous (d) sanguivorous.

31. In human beings, the cell membrane of erythrocytes comprises of (i) percent protein and (ii) percent lipids.

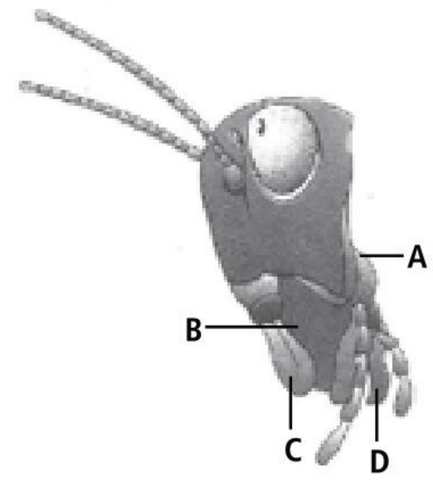
	(i)	(ii)
(a)	59	12
(b)	18	63
(c)	52	40
(d)	60	40

32. Consider the following statements (i) – (iv) and select the correct option stating which ones are true (T) and which ones are false (F).
(i) Malpighian tubules are present at the junction of midgut and hindgut in cockroaches.
(ii) Both male and female cockroach consist of abdomen with 10 segments.
(iii) In cockroach, a pair of thread like antennae arise from membranous sockets lying behind the eyes.

	(i)	(ii)	(iii)
(a)	T	F	T
(b)	F	F	T
(c)	T	T	F
(d)	F	T	F

33. Which part of nucleus is the principal site for the development of ribosomal RNAs?
(a) Nucleoplasm (b) Nucleolus
(c) Nuclear matrix (d) Nuclear envelope

34. Study the given figure and select the option that correctly identifies the labelled parts.



	A	B	C	D
(a)	Labium	Hypopharynx	Labrum	Maxilla
(b)	Mandible	Labrum	Hypopharynx	Maxilla
(c)	Maxilla	Mandible	Labrum	Labium
(d)	Hypopharynx	Labium	Maxilla	Mandible

35. Endomembrane system comprises of
(a) endoplasmic reticulum, Golgi complex, mitochondria and plastids.
(b) lysosomes, vacuoles, peroxisomes and Golgi complex.
(c) mitochondria, Golgi complex, lysosomes and endoplasmic reticulum.
(d) Golgi complex, lysosomes, vacuoles and endoplasmic reticulum.

36. Characteristics of skeletal muscles are
(a) cylindrical, branched, striated and uninucleate
(b) spindle shaped, branched, striated and multinucleate
(c) cylindrical, unbranched, striated and multinucleate
(d) spindle shaped, unbranched, non-striated and multinucleate.

37. The number of ommatidia in the eye of *Periplaneta americana* is
(a) 1000 (b) 2000 (c) 50 (d) 20.

38. Heart of cockroach is present along mid _____ line of thorax and abdomen.
(a) dorso-ventral (b) lateral
(c) dorsal (d) ventral

39. Which of the following is a single membrane bound organelle showing phagocytic activity?
(a) Lysosomes (b) Contractile vacuoles
(c) Chloroplast (d) Peroxisomes

40. Heart of cockroach is
(a) 13 chambered (b) 29 chambered
(c) 9 chambered (d) 6 chambered. ☺☺

Key is published in this issue. Search now! ☺

SELF CHECK

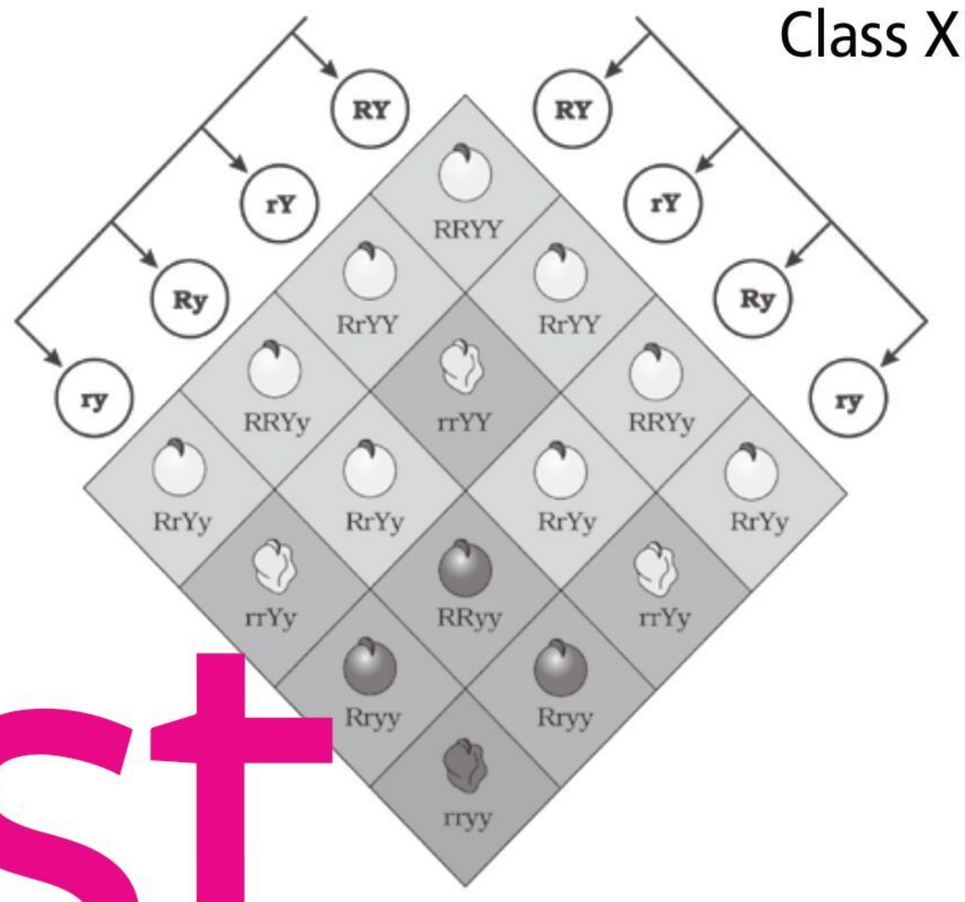
No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

Class XII

BIO Digest



This article covers high yield facts of the given topic.

Principles of Inheritance and Variation

- The term **genetics** was coined and used for the first time by **William Bateson** (1905). Genetics includes both **'heredity** and **variations'. Heredity** is the transmission of characteristics (structural, functional and behavioural) from the parents to the offspring or from one generation to another. **Inheritance** is the process by which characters or traits pass from one generation to the next. Inheritance is the basis of heredity. **Variations** tell us about differences in characteristics between two individuals.

TERMS RELATED TO GENETICS

- **Gene** is the inherited factor that determines the biological character of an organism. A pair of contrasting characters is called **allelomorph** or **allele.**
- **Dominant allele** is one of the factors of an allelic pair which can express itself whether present in homozygous or heterozygous state, *e.g.*, T (tallness in pea), R (round seed in pea).
- **Recessive allele** is the factor of an allele pair which is unable to express its effect in the presence of its contrasting factor in a heterozygous state, *e.g.*, t (dwarf in pea) in Tt.
- **Wild allele** is the one which was originally present in the population and is **dominant** and **widespread.** The recessive allele is less common and is believed to be formed through mutation of wild allele and is called **mutant allele**.
- In **homozygous condition,** organisms have two similar genes or alleles for a particular character in a homologous pair of chromosomes, *e.g.*, **TT** or **tt.**
- Organisms containing two different alleles or an individual containing both dominant and recessive genes of an allelic pair, *e.g.*, **Tt**, is said to be in **heterozygous condition.**
- When only one allelic pair is considered in cross breeding, it is called **monohybrid cross.** When two allelic pairs are used for crossing, it is called **dihybrid cross.**
- **Genotype** is the sum total of heredity or genetic make-up and **phenotype** is the external feature of an organism.

MENDELIAN GENETICS

- **Gregor Johann Mendel**, through his work on pea plants, discovered the fundamental laws of inheritance. Mendel is therefore, called **Father of Genetics**. He wrote about his work in his paper **"Experiments on Plant Hybridisation"** which was published in the fourth volume of **"Annual Proceedings of Natural History Society of Brunn"** in 1866. However, Mendel's work remained unnoticed and unappreciated for some 34 years.
- It was in 1900 that three workers independently rediscovered the principles of heredity already worked out by Mendel. They were **Hugo de Vries** of Holland, **Carl Correns** of Germany and **Erich von Tschermak** of Austria.

Mendel's Experiments

- Mendel had conducted several hybridisation experiments on **garden pea**, *Pisum sativum*. The number of characters studied by Mendel in pea plant were **seven**. The number of chromosomes in *Pisum sativum* is 14 (2n). Mendel restricted his experiments to one or few pairs of contrasting traits in each experiment.

Table: Seven pairs of contrasting traits of *Pisum sativum* and their inheritance pattern studied by Mendel

Character	Contrasting traits (dominant/recessive)	F_1 results	F_2 results	F_2 ratio
Seed shape	Round/Wrinkled	All round	5474 Round, 1850 Wrinkled	2.96:1
Seed colour	Yellow/Green	All yellow	6022 Yellow, 2001 Green	3.01:1
Pod shape	Full/Constricted	All full	882 Full, 299 Constricted	2.95:1
Pod colour	Green/Yellow	All green	428 Green, 152 Yellow	2.82:1
Flower colour	Violet/White	All violet	705 Violet, 224 White	3.15:1
Flower position	Axial/Terminal	All axial	651 Axial, 207 Terminal	3.14:1
Stem height	Tall/Dwarf	All tall	787 Tall, 277 Dwarf	2.84:1

Inheritance of One Gene/Monohybrid Cross

- It is a cross made to study simultaneous inheritance of a single pair of Mendelian factors.

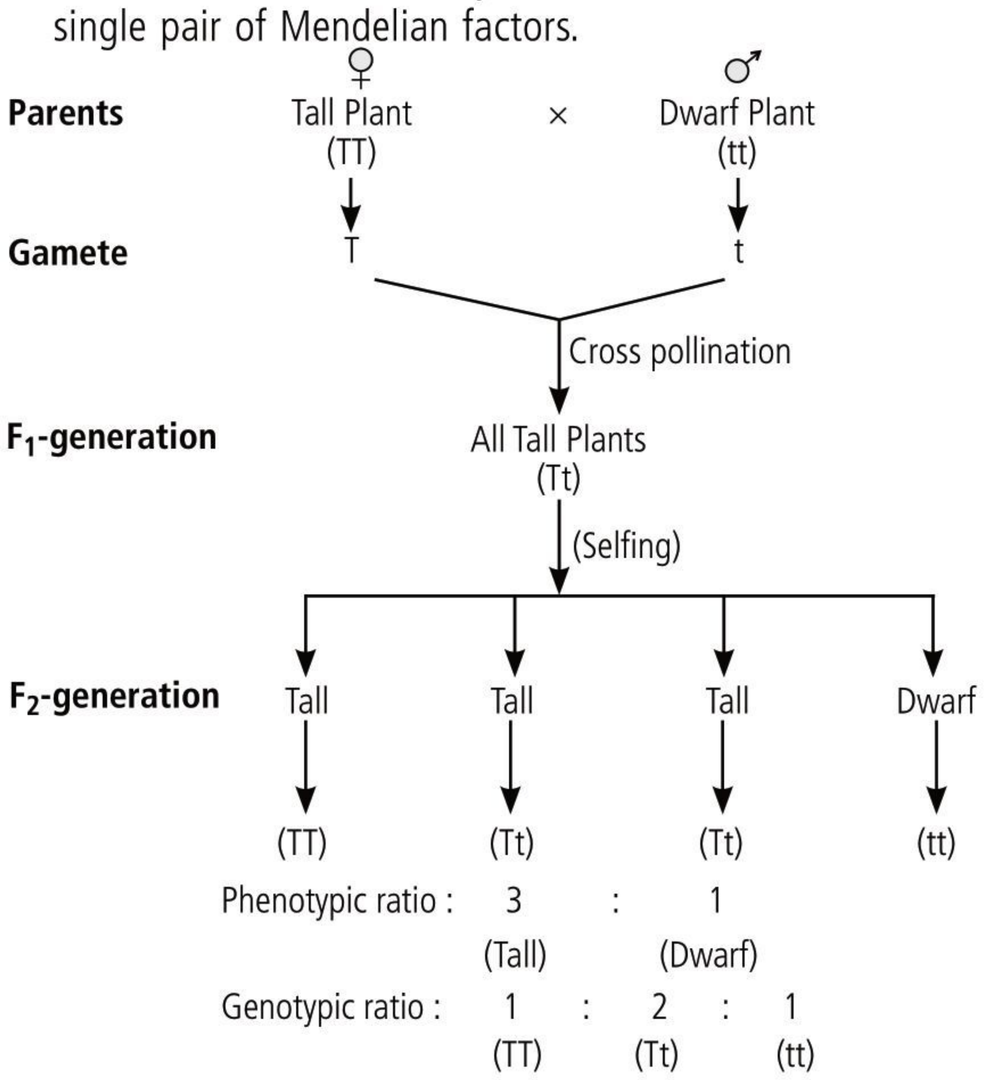


Fig. : Monohybrid cross in pea plant

Mendel's principles of inheritance based on monohybrid cross

- Based on his observations on monohybrid crosses Mendel proposed two general rules to consolidate his understanding of inheritance in monohybrid crosses. These rules are called the **Principles or Laws of Inheritance:** the First Law or **Law of Dominance** and the Second Law or **Law of Segregation**.

(i) **Law of dominance** states that only one factor expresses itself in F_1 generation. In a hybrid where both the contrasting alleles are present, only one factor/allele called **dominant** is able to express its effect while the other factor called **recessive** remains suppressed in F_1 generation. F_2 generation expresses both the dominant and the hidden recessive factors in the ratio of 3 : 1 in the monohybrid cross.

(ii) **Principle of segregation** states that when a pair of contrasting factors are brought together in a hybrid; these factors do not blend or mix up but simply associate themselves, remain together and separate at the time of gamete formation. This law is also known as "**law of purity of gametes**" because each gamete is pure in itself, *i.e.*, having either T (*i.e.*, gene for tallness) or t (*i.e.*, gene for dwarfness).

Inheritance of Two Genes/Dihybrid Cross

- Dihybrid crosses are made to study the inheritance of two pairs of Mendelian factors or genes.

WHO AM I ...

1. Thalamus Pg. 11
2. Supplementary gene Pg. 32
3. Turner's syndrome Pg. 38

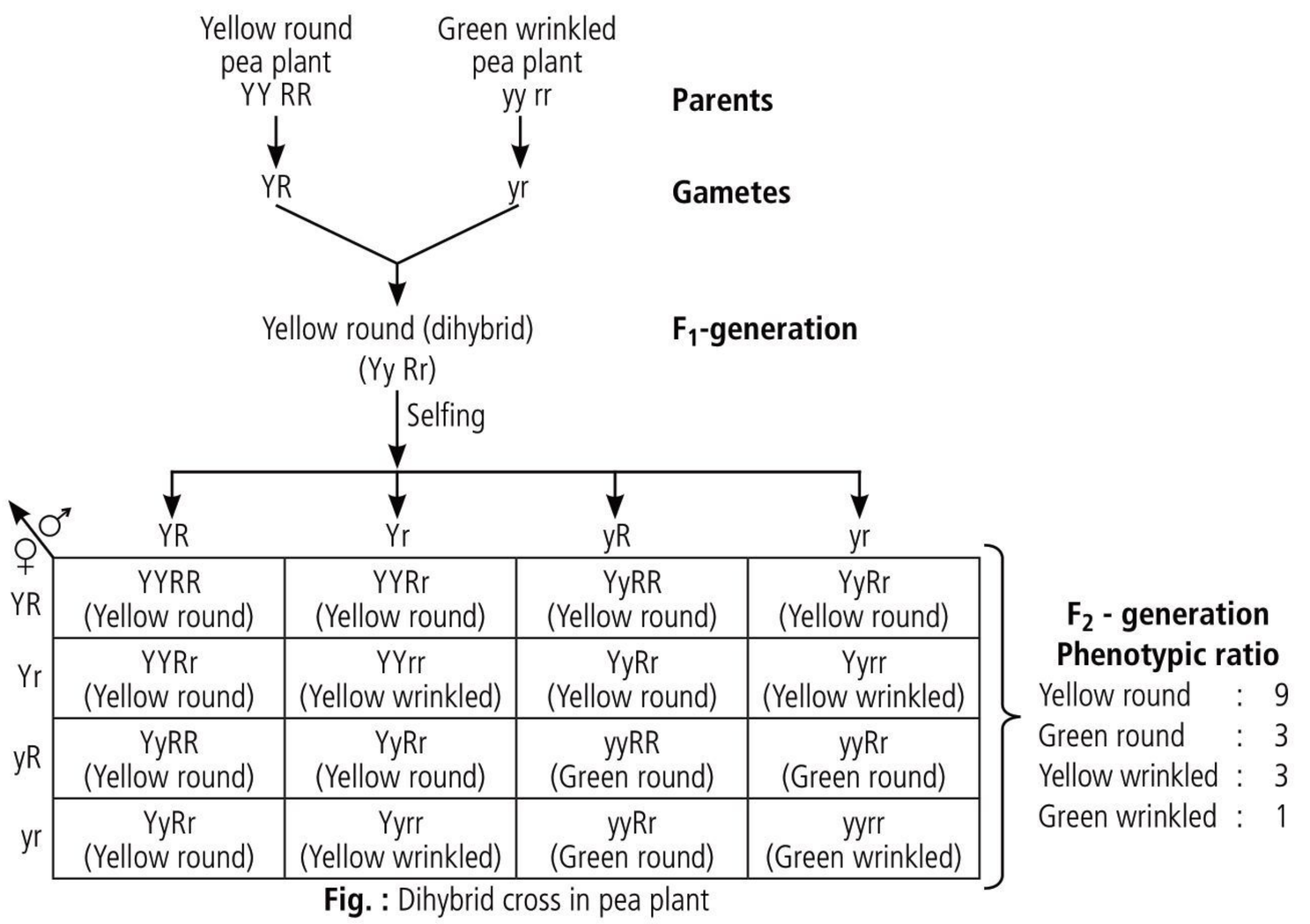


Fig. : Dihybrid cross in pea plant

Mendel's principle of inheritance based on dihybrid cross

- To verify his results of monohybrid crosses, Mendel crossed pea plants differing in two characters. Based upon this, Mendel proposed another set of generalisation called law of independent assortment.
- **Law of independent assortment** states that the genes of different characters located in different pairs of chromosomes are independent of one another in their segregation during gamete formation. **Mendelian recombinations** were mainly due to independent assortment.

Reciprocal Cross, Back Cross and Test Cross

- The **reciprocal crosses** involve two crosses concerning the same characteristic, but with reversed sexes.
- A cross of F_1 hybrid with either of the two parents is known as **back cross**.
- Crossing of F_1 individual having dominant phenotype with its homozygous recessive parent is called **test cross**. The test cross is used to determine whether the individuals exhibiting dominant characters are homozygous or heterozygous.
- A cross between tall heterozygous F_1 hybrid with dwarf homozygous recessive, produces tall and dwarf in equal proportion indicating that F_1 hybrids are heterozygous.

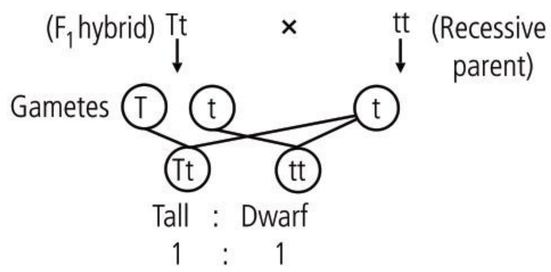
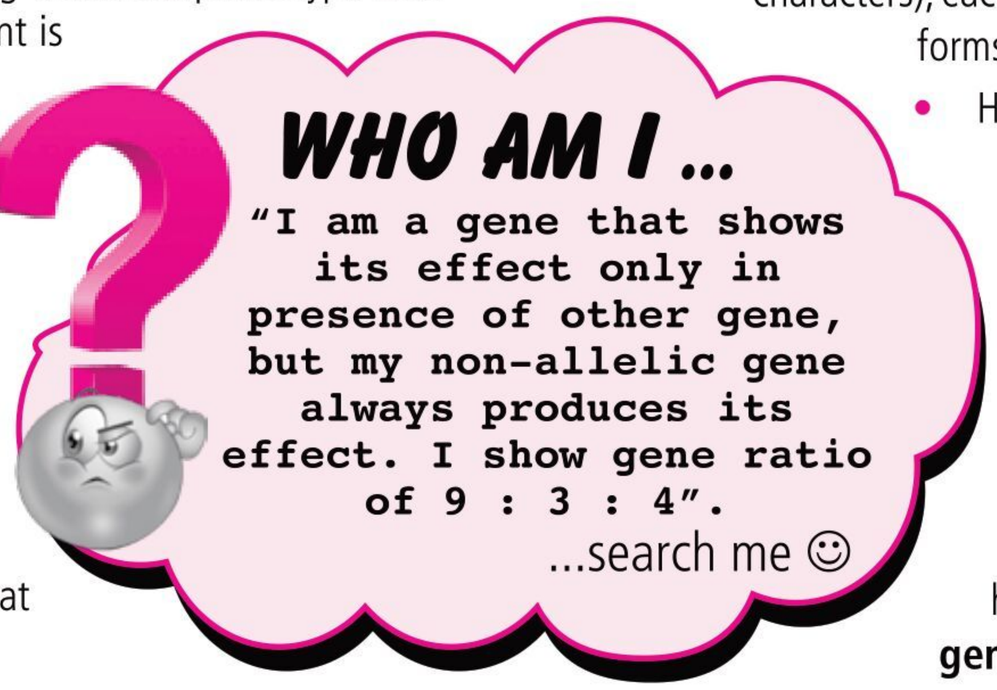


Fig.: Monohybrid test cross

Reasons for Mendel's Success

- Mendel chose garden pea that was easy to grow. It is **self-fertilising** in nature, but it is easy to cross-breed experimentally. The plant reproduces well and grows to maturity in a single season.
- He was fortunate in choosing a **diploid plant** because diploid organisms contain only two sets of chromosomes. If he had chosen a polyploid organism, an organism with more than two sets of chromosomes, he would not have obtained simple, understandable results.
- He chose to follow **seven visible features** (unit characters), each represented by two contrasting forms or traits.
- He restricted his examination to **very few pairs of contrasting traits** in each experiment.
- He also kept **accurate quantitative records**, a necessity in genetic experiments. From the analysis of his data, Mendel derived certain postulates that have become the principles of **genetic transmission**.



INTEXT PRACTICE QUESTIONS

1. Name the cross used to identify the genotype of a round seeded pea plant.
2. Which Mendel's law of inheritance was based on his study on dihybrid cross?

POST MENDELIAN GENETICS

- Mendel explained inheritance in terms of discrete hereditary factors (now called **genes**). However, all patterns of inheritance could not be explained on the basis of Mendel's principles alone.
- Though genes are inherited as units, many interact in different patterns to produce the trait. This is called **gene interaction**.

Gene Interaction

- Gene interaction is the influence of alleles and non-alleles on the normal phenotypic expression of genes. It is of following two types :

(i) Intragenic (Interallelic) gene interaction

- In the intragenic or interallelic interactions, the two alleles of a gene which are present on the same gene locus on the two homologous chromosomes, interact with each other in such a way as to produce an expression different from the normal dominant-recessive phenotype, ***e.g.***, incomplete dominance, codominance, multiple alleles, etc.
- **Incomplete dominance/Blending inheritance (Correns, 1903):** It is the phenomenon where none of the two alleles of a gene is dominant over each other and new phenotype is formed which is intermediate between the independent expression of the two alleles. This was first studied in flower colour of *Mirabilis jalapa* or four O'clock plant. The phenotypic as well as genotypic monohybrid ratio in F_2 generation is **1:2:1** ***i.e.***, pure dominant: hybrid : pure recessive. F_1 generation expresses a phenotype which is intermediate between those of the parents, ***e.g.***; pink flowers are obtained when red and white flowered plants are crossed.
- **Codominance:** It is the phenomenon of two alleles lacking a dominant-recessive relationship and both of them express themselves together and equally in the organisms. The codominant alleles are able to express themselves independently when present alone. Examples : (i) The roan coat colour in cattle is an example of codominant alleles. If a cattle with black coat is crossed with a cattle with white coat, the F_1 hybrids possess neither black nor white coat colour, but have roan coat colour, where black and white patches appear separately. The effect is produced due to juxtaposition of small patches of black and white colour. The phenotypic ratio is **1 : 2 : 1**. (ii) ABO blood group in humans comprises four blood groups, controlled by three alleles I^A, I^B and I^O. Both alleles I^A and I^B are codominant themselves but are dominant to allele I^O.
- **Multiple alleles :** These alleles are multiple forms (more than two alternatives) of a Mendelian factor or gene which occur on the same gene locus, distributed in different organisms in the gene pool with an organism carrying only two alleles and gamete only one allele. A well known and simplest example of multiple allelism is the inheritance of **ABO blood group** system in human beings (discovered by Dr. Karl Landsteiner). It is controlled by the gene *I*, that has three multiple alleles, I^A, I^B and I^O, out of which any two are formed in a person.
- **Lethal genes :** They are genes which control some vital function of the organism and cause death of the organism either in homozygous recessive or homozygous dominant condition. Types of lethal genes - (i) Dominant lethal genes are lethal in homozygous condition and produce some defective phenotype in heterozygous condition (***e.g.***, sickle cell anaemia, Huntington's chorea). (ii) Recessive lethal genes produce lethal effect only in homozygous condition and heterozygotes are normal (***e.g.***, Tay Sach's disease, albinism in corn). With the death of homozygous lethal, the **monohybrid ratio comes to 2 : 1**.

(ii) Intergenic (Non-allelic) gene interaction

- In intergenic or non-allelic interactions, two or more independent genes present on same or different chromosomes interact to produce a different expression from normal expression, ***e.g.***, epistasis, duplicate genes, complementary genes, supplementary genes, inhibitory genes, etc.
- **Complementary genes :** Two genes present on different loci produce the same effect when present alone but interact to form a new trait when present together, are called complementary genes. *E.g.*, in sweet pea (*Lathyrus odoratus*), there are two varieties controlled independently by two different genes *C* and *P*. The dominant alleles of both the genes are required for expression of flower colour. Complementary gene ratio is **9 : 7**.
- **Supplementary genes :** These are two non-allelic genes in which one type of gene produces its effect whether the other is present or not and the second (supplementary) gene produces its effect only in the presence of the first, usually forming a new trait. *E.g.*, in mice, two genes *C* and *A* govern the coat colour. In absence of dominant alleles of both genes, **albino** coat is produced. Gene *C*, in absence of *A* produces **black coat** colour but gene *A* in absence of *C* cannot express itself and produces **albino**. Gene *C* and gene *A* when present together supplement

each other and produce a different phenotype called **agouti**. Supplementary gene ratio is **9 : 3 : 4**.

- **Epistasis :** It is the interaction between genes present at two separate loci in which one gene suppresses or masks the expression of other gene. The gene that masks the effect of other gene is known as **inhibiting or epistatic gene** and the one which is being prevented from exhibiting itself is known as **hypostatic gene**.

Types of Epistasis

Dominant epistasis

- A dominant epistatic gene suppresses the expression of another gene at different locus regardless of allele condition (dominant or recessive). Dominant epistasis ratio is **12 : 3 : 1**.

Recessive epistasis

- A recessive epistatic gene suppresses the expression of non-allelic gene only when the former is in homozygous recessive state. Recessive epistasis ratio is **9 : 3 : 4**.

Dominant-recessive epistasis

- Dominant allele at one locus and recessive allele at another locus give rise to the same effect. Dominant-recessive epistasis ratio is **13 : 3**.

Duplicate genes

- Duplicate genes or factors are two or more independent genes present on different chromosomes which determine the same or nearly same phenotype so that either of them can produce the same character.
- They produce the same phenotype whether present in homozygous or heterozygous state. As a result, dominant phenotype is more abundant. **F_2 ratio is 15:1** , *e.g.*, fruit shape in Shepherd's purse.

Pleiotropic Genes

- When a single gene affects many aspects of phenotype or controls several phenotypes, it is said to be pleiotropic gene and this phenomenon is called **pleiotropy**. Pleiotropy is expressed in sickle cell anaemia, haemophilia, etc.

Quantitative or Polygenic Inheritance

- It is a type of inheritance controlled by generally three or more genes in which the dominant alleles have cumulative effect with each dominant allele expressing a part or unit of the trait, the full trait being shown only when all the dominant alleles are present. The genes involved in quantitative inheritance are called **polygenes.** Quantitative inheritance is, therefore, also called **polygenic inheritance.** It is also named as **multiple factor inheritance**.

Examples of quantitative inheritance

Kernel colour in wheat

- **Nilsson Ehle (1909)** and **East (1910, 1916)** gave first significant clue of quantitative inheritance by their individual works on wheat.
- **Two pairs of genes** controlling production of red pigment are operating in this cross. Each gene contains two alleles. One allele produces a given quantity of the red pigment, while its counterpart does not produce any pigment. All alleles are equally potent in the production or lack of production of pigment.
- When **three pairs of genes are** involved, the F_2 ratio is 1 : 6 : 15 : 20 : 15 : 6 : 1.

Parents : Red kernel AABB × White kernel aabb

Gametes : AB ; ab

F_1 generation : Intermediate red AaBb

Selfing

F_1 gametes :

♀ \ ♂	AB	Ab	aB	ab
AB	AABB Dark red	AABb Medium red	AaBB Medium red	AaBb Intermediate red
Ab	AaBb Medium red	AAbb Intermediate red	AaBb Intermediate red	Aabb Light red
aB	AaBB Medium red	AaBb Intermediate red	aaBB Intermediate red	aaBb Light red
ab	AaBb Intermediate red	Aabb Light red	aaBb Light red	aabb White

F_2 generation :

Dark red	: 1/16	Light red	: 4/16
Meidum red	: 4/16	White	: 1/16
Intermediate red	: 6/16		

Fig.: Results of polygenic inheritance of kernel colour in wheat

Height in man

- The inheritance of height in man is a more complex phenomenon involving perhaps **ten** or **more pairs** of genes. The character of tallness is recessive to shortness, thus, an individual having the genotype of more dominant genes will have the phenotype of shortness. Because, this quantitative trait is controlled by multiple pairs of genes and is variously influenced by a variety of environmental conditions, the heights of adults range from 140 cm to 203 cm.

CHROMOSOMAL THEORY OF INHERITANCE

- The chromosomal theory of inheritance, proposed by **Walter Sutton** and **Theodore Boveri**, states that the Mendelian factors or genes are located at specific loci on the chromosomes and it is the chromosomes which segregate and assort independently during meiosis and recombine at the time of fertilisation in the zygote. **T.H. Morgan** confirmed the findings of Sutton and Boveri.

Salient Features of Chromosomal Theory of Inheritance

(i) It constitute bridge between one generation and the next through sperm and ovum. Both the sperm and egg contribute equally in the heredity of the offspring.

(ii) Hereditary characters are governed by nuclear material and nucleus contains chromosomes, therefore chromosomes must carry the hereditary traits.

(iii) Loss of a complete or part of the chromosome produces structural and functional deficiency in the organism.

(iv) The chromosomes retain their number, structure and individuality throughout the life of an organism and from generation to generation.

(v) A gamete contains only one chromosome of a type and only one of the two alleles of a trait. The paired condition of both chromosomes as well as Mendelian factors is restored during fertilisation.

(vi) Homologous chromosomes synapse during meiosis and then segregate independently into different cells which establishes the quantitative basis for segregation and independent assortment of hereditary factors.

LINKAGE

- Linkage is the phenomenon of certain genes staying together during inheritance through generations without any change or separation due to them being present on the same chromosome. Linkage was first suggested by **Sutton** and **Boveri** (1902-1903) when they propounded the famous "chromosomal theory of inheritance".
- **Bateson and Punnett** (1906) while working on sweet pea (*Lathyrus odoratus*) found that the factors for certain characters do not show independent assortment. They suggested that the alleles coming from the same parent tend to enter the same gamete and get inherited together **(coupling).** Similarly, the same genes coming from two different parents, tend to enter different gametes and get inherited separately and independently **(repulsion).**
- **Morgan** (1910) while working on *Drosophila* stated that coupling and repulsion are two aspects of the same phenomenon, which he described as 'linkage'. In 1911, **Morgan** and **Castle** proposed 'the chromosome theory of linkage'**.** It states that :
  (i) Linked genes occur in the same chromosome.
  (ii) They lie in a linear sequence in the chromosome.
  (iii) There is a tendency to maintain the parental combination of genes except for occasional crossovers.
  (iv) Strength of the linkage between two genes is inversely proportional to the distance between the two, *i.e.*, two linked genes show higher frequency of crossing over, if the distance between them is higher and lower frequency if the distance is small.
- Genes that are present on the same chromosome make one **linkage group**.

Table: Differences between linked and unlinked genes

	Linked genes	Unlinked genes
(i)	These genes are placed on the same chromosome and do not show independent assortment at the time of gamete formation.	These genes are located on different chromosomes and undergo independent assortment (segregation).
(ii)	They show dihybrid ratio of 3 : 1.	They show dihybrid ratio 9 : 3 : 3 : 1.
(iii)	In dihybrid, they show test cross ratio of 1 : 1.	In dihybrid, they show a test cross ratio of 1 : 1 : 1 : 1.

Types of Linkage

Complete linkage

- A linkage or grouping of genes on a chromosome which is not altered and is inherited as such from generation to generation without any cross-over. It is rare but has been reported in certain cases like male *Drosophila*.

Incomplete linkage

- Phenomenon of an occasional crossing over between two homologous chromosomes so that one or more alleles present in a linkage group are replaced by other alleles. Produces both parental and recombinant individuals. Incomplete linkage has been reported in female *Drosophila*, sweet pea, etc.

CROSSING OVER

- Crossing over is recombination of genes due to exchange of genetic material between two synapsed homologous chromosomes. It is the **mutual exchange** of segments of genetic material between **non-sister chromatids** of two homologous chromosomes, so as to produce recombinations of genes. The non-sister chromatids in which exchange of segments has occurred are called **recombinants** or **cross-overs**.

Significance of crossing over

- It brings new combinations of genes which are different from parents thus introduces variations. The variations are helpful in **struggle for existence** and **adaptability** to changes in the environment.
- Useful **recombinations** are picked up by breeders for development of improved varieties.
- The frequency of crossing over is used for building **linkage maps** or **chromosome maps**.

LINKAGE MAPS

- A linkage or genetic or chromosome map is a linear graphic respresentation of the sequence and relative distances of

the various genes present in a chromosome. 1% crossing over between two linked genes is known as 1 map unit or centi Morgan (cM). 100% crossing over is termed as Morgan (M).

SEX DETERMINATION

- Sex determination is the method by which the distinction between males and females is established in a species.
- It is usually under genetic control of specific chromosomes called **sex chromosomes** or **allosomes.**
- There are five main genetic mechanisms of sex determination :
  (i) **XX-XY method :** XX – ♀, XY – ♂ *e.g.*, mammals, some insects like *Drosophila.*
  (ii) **XX-X0 method** : XX – ♀, X0 – ♂ *e.g.*, roundworm, insects.
  (iii) **ZW-ZZ method :** ZW – ♀ , ZZ – ♂ *e.g.*, birds, reptiles, fishes.
  (iv) **Z0-ZZ method :** Z0 – ♀, ZZ – ♂ *e.g.*, moths, butterfly.
  (v) **Haploid-diploid method :** An unfertilised egg develops into a haploid male and a fertilised egg develops into a diploid female, *e.g.*, honeybee.

SEX-LINKED INHERITANCE

- Sex-linked inheritance is the transmission of somatic characters and their determining genes alongwith sex determining genes present on the sex chromosomes, which are inherited together from one generation to the next.
- Most sex-linked genes are located on the X chromosome, forming **X-linkage**. A few genes occur on the Y chromosome, forming **Y-linkage**. The Y-linked traits are transmitted only through the male.
- Sex-linked traits are more apparent in males than in females. Females generally function as carriers of sex-linked disorders because recessive genes can express themselves in females only in the homozygous state, *e.g.*, colour blindness, haemophilia, etc.
- Besides sex linked inheritance, sex limited characters and sex influenced traits have also been observed.
- **Sex limited traits** are those traits which are expressed in a particular sex though their genes also occur in the other sex, *e.g.*, milk secretion in mammalian females.
- **Sex influenced traits** are the traits that are not due to particular genes but are by-products of sex hormones, *e.g.*, low pitched voice, beard, moustaches and pattern baldness in males.

Criss-cross Inheritance

- It is a type of sex-linked inheritance where a parent passes the traits to the grand child of the same sex through offspring of the opposite sex, that is, father passes the traits to grand son through his daughter **(diagynic)** while the mother transfers traits to her grand daughter through her son **(dia-andric)**.
- It was first studied by **Morgan (1910)** in case of eye colour in *Drosophila*. Criss-cross inheritance is applicable to most sex-linked disorders in humans, *e.g.*, red-green colour blindness, haemophilia.

MUTATION

- Mutation is the sudden inheritable discontinuous variation which appears in an organism due to permanent changes in their genotypes. Mutation theory was proposed by **Hugo de Vries**. Mutations bring about sudden and discrete changes in germplasm of organisms and add new variations in population. Depending upon the cause, mutations are of two types - chromosomal and gene mutation.

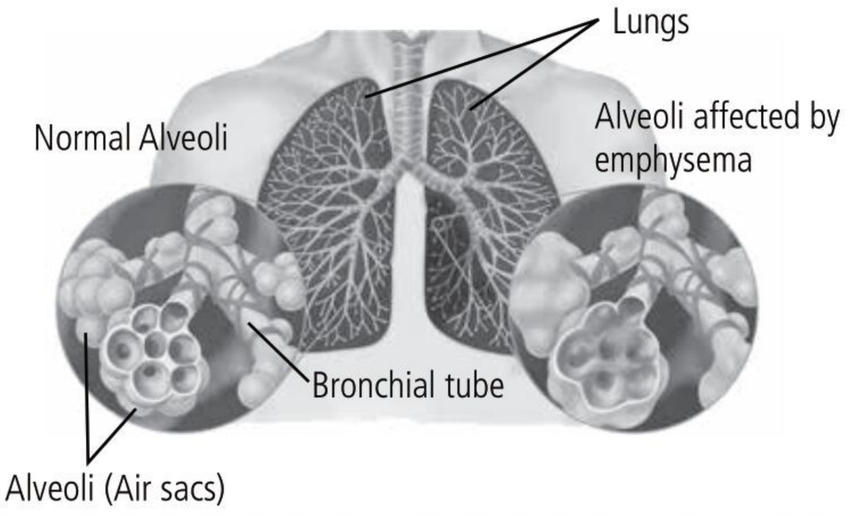
Chromosomal Mutations

- Chromosomal mutation is the change that occurs in the morphology of chromosome resulting in change in number or sequence of gene. It includes chromosomal aberration (changes in the chromosome structure) and genomic mutations (change in chromosome number).

Chromosomal aberrations

- **Deletion :** Loss of a segment (or part) from one or other end of chromosome (terminal) or within the chromosome (intercalary) followed by reunion of terminal segments.
- **Translocation :** Kind of interchromosomal rearrangement in which there is mutual exchange of chromosomal segments between non-homologous chromosomes.
- **Duplication :** Presence of same block of gene more than once in a haploid complement.
- **Inversion :** Chromosome breaks at two points, the broken piece rotates through 180° and reunites in reverse order. When centromere is present in the inverted segment, it is called **pericentric** otherwise called **paracentric** inversion.

QUIT Smoking !!



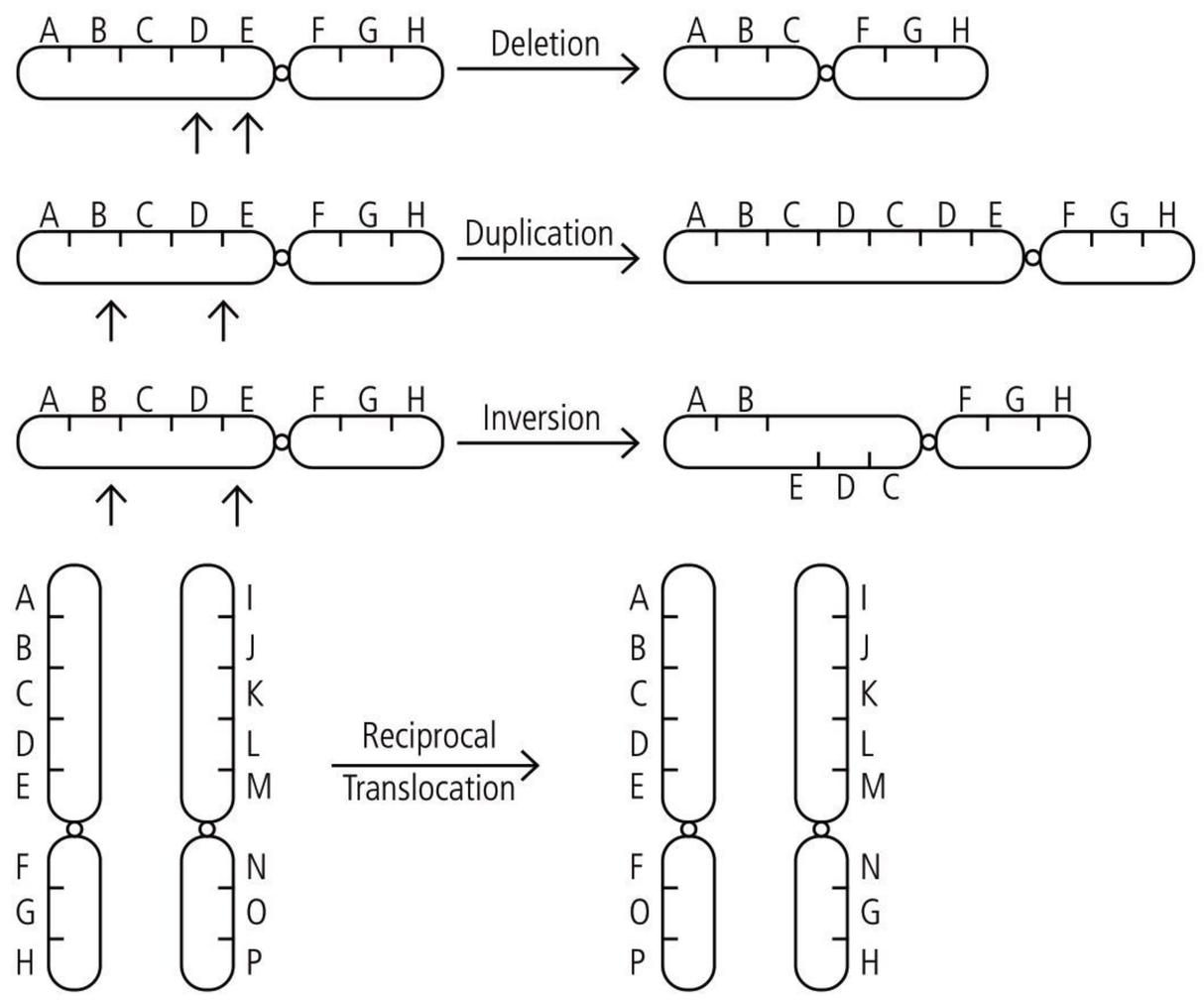


Fig.: Types of chromosomal aberrations

Genomic mutation

- Genomic mutations are change in the number of chromosomes.

Two types of genomic mutations

Euploidy

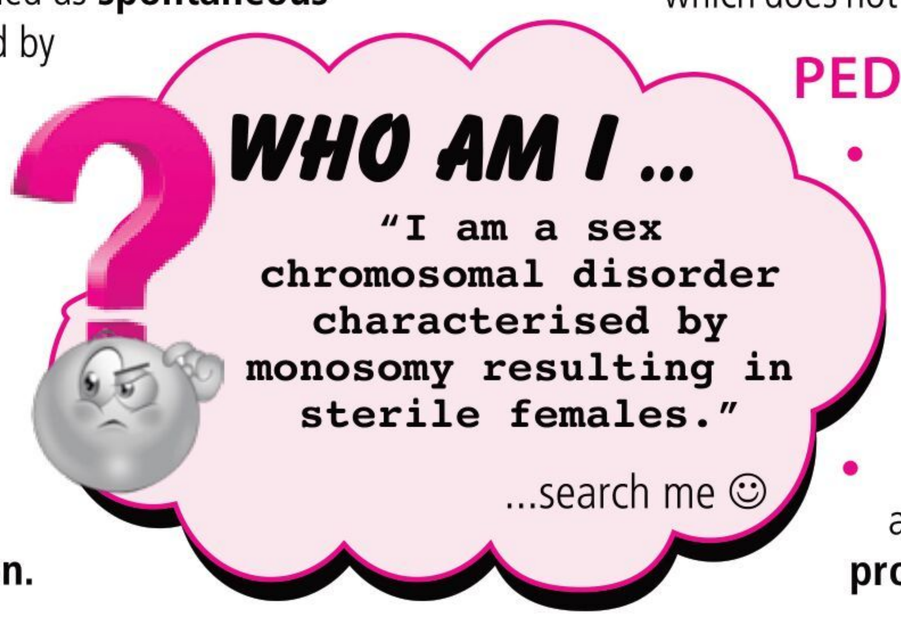
An organism either loses a complete set or acquires one or more additional set of chromosomes over and above the two sets of diploid complement. It is of 2 types-**monoploidy** and **polyploidy.**

Aneuploidy

Addition or loss of one or more chromosomes to/from complete diploid chromosome complement. It is of 4 types: **trisomy** (2n + 1), **tetrasomy** (2n + 2), **monosomy** (2n – 1) and **nullisomy** (2n – 2).

Gene Mutations

- The sudden stable change in the structure of a gene due to change in its nucleotide type or nucleotide sequence is called **gene mutation**.
- Gene mutations may occur naturally or automatically due to internal reasons. They are termed as **spontaneous mutations.** Others are produced by external factors or chemicals. They are known as **induced mutations.**
- Mutation which involves change in single nucleotide is called **point mutation.** Mutation from wild to new type is **forward mutation** and mutated gene to its wild form is **reverse** or **backward mutation.**
- **Substitution mutation :** A nitrogenous base of triplet codon is replaced by another nitrogenous base or its derivative, thus, changing the codon. Replacement of a purine/pyrimidine by another purine/pyrimidine in a polynucleotide chain is called **transition.** Replacement of purine by a pyrimidine or *vice versa*, is called **transversion**.
- **Frame-shift mutation :** The mutations caused by the addition or deletion of nitrogenous bases in the DNA or *m*RNA are known as frame-shift mutations because these shift the reading frame of codons from the site of change onwards. These are of 2 types : **deletion mutation** caused due to the loss of one or more nucleotides and **insertion mutation** caused by the addition of one or more extra nucleotides in a DNA molecule at one or more places.
- **Nonsense, Mis-sense and Same-sense mutations :** A **nonsense mutation** stops synthesis of polypeptide by producing a nonsense (terminator) codon (UGA, UAG, UAA). A **mis-sense mutation** changes a codon which alters a specific amino acid in a polypeptide often making the latter non-functional. A **same-sense** mutation changes a codon which does not alter the amino acid of a polypeptide.



PEDIGREE ANALYSIS

- **Pedigree** is a chart showing a record of inheritance of certain traits for two or more ancestral generations of human being or domesticated animal in the form of a diagram or family tree.
- The individual from which a pedigree is initiated is called **proband** or **propositus**.

- Pedigree analysis is useful in many ways like it helps to fill up the possible genotypes by knowing the phenotypes only.
- It helps to study the pattern of inheritance of a dominant or a recessive trait. The possible genetic makeup of a person for a trait can also be known with the help of pedigree.

GENETIC DISORDERS

- Broadly, genetic disorders may be grouped into two categories– gene-related or Mendelian disorders and chromosomal disorders.

Gene-related/ Mendelian Disorders

- These disorders are mainly determined by alteration or mutation in the single gene. These disorders are transmitted to the offspring on the same lines as per the principle of inheritance.
- Most common Mendelian disorders are cystic fibrosis, sickle-cell anaemia, colour blindness, haemophilia, phenylketonuria, thalassemia, albinism, muscular dystrophy, etc.

Chromosomal Disorders

- The chromosomal disorders are caused due to absence or excess or abnormal arrangement of one or more chromosomes. Chromosomal anomalies or disorders arise in various ways as **non-disjunction** (an error in nuclear division which involves a pair of chromosomes that failed to separate and are carried to one pole), translocation, deletion, duplication and inversion.

Table : Some chromosomal abnormalities

	Syndrome	Dominant/ Recessive	Autosomal/ Sex linked	Main clinical features
(i)	Down's syndrome	–	Autosomal, aneuploidy (Trisomy-21)	Rounded face, flat hands with small fingers, enlarged liver and spleen, mental retardation, broad forehead, permanently open mouth with large tongue.
(ii)	Edward's syndrome	_	Autosomal (Trisomy-18)	Multiple congenital malformations of many organs, receding mandible, small eyes, mouth and nose, severe mental deficiency, congenital heart defects and horseshoe or double kidney.
(iii)	Patau's syndrome	–	Autosomal (Trisomy-13)	Severe mental deficiency, small eyes, cleft lip and/or palate, deformed ears, extra fingers and toes, cardiac anomalies, brain anomalies and genitourinary abnormalities.
(iv)	Turner's syndrome	–	Sex chromosomal monosomy 44 + XO	Female with retarded sexual development, usually sterile, short stature, webbing of skin in neck region, cardiovascular abnormalities and hearing impairment.
(v)	Klinefelter's syndrome	–	Sex chromosomal aneuploidy (Tri/ tetrasomy of X chr.); 44 + XXY, 44 + XXXY	Male infertile with undeveloped testes, may have enlarged breast, taller than average stature, mild mental deficiency, long limbs and delayed puberty.
(vi)	Sickle-cell anaemia	Recessive	Autosomal, gene on chromosome 11	Aggregation of erythrocytes, more rapid destruction of erythrocytes leading to anemia. Abnormal haemoglobin in RBCs.
(vii)	Phenyl-ketonuria	Recessive	Autosomal, gene on chromosome 12	Failure of brain to develop in infancy, mental retardation, defective form of enzyme phenylalanine hydroxylase.
(viii)	Cystic Fibrosis (CF)	Recessive	Autosomal, gene on chromosome 7	Excessive thick mucus clogging in lungs, liver and pancreas anomalies. Failure of chloride ion transport mechanism through cell membrane.
(ix)	Huntington's Diseases (HD)	Dominant	Autosomal, gene on chromosome 4	Gradual degeneration of brain tissue in middle age, loss of motor control. Production of an inhibitor of brain cell metabolism.
(x)	Haemophilia A/B	Recessive	Sex-linked, gene on X-chromosome	Failure of blood to clot, defective form of blood clotting factor VIII/IX.
(xi)	Colour blindness	Recessive	Sex-linked, gene on X-chromosome	Failure to discriminate between red and green colour. Defect in either red or and green cone cells of retina.

INTEXT PRACTICE QUESTIONS

3. Name the type of mutation caused by insertion of 1 nucleotide base in DNA.
4. Which organism shows XX-X0 method of sex determination?

CONCEPT MAP

CELLULAR RESPIRATION

- Cellular respiration is the oxidative breakdown of food materials within the cell which releases energy and biochemical intermediates.
- The energy is used in the synthesis of ATP and the biochemical intermediates are used for synthesis of organic compound that take part in growth, repair and metabolism.

ANAEROBIC RESPIRATION

- It is a type of respiration in which oxygen is not used as an oxidant and the organic food is broken down incompletely to liberate energy, by breaking of bonds between various types of atom.
- The common products of anaerobic respiration are **CO_2, ethyl alcohol** and **lactic acid**.
- Under anaerobic conditions, in lactic acid bacteria, fungi and some muscles, pyruvate is directly reduced by NADH to lactic acid, in the presence of the enzyme lactate dehydrogenase.

$$\text{Pyruvic acid} + \text{NADH} \xrightarrow[\text{FMN, } Zn^{2+}]{\text{Lactate dehydrogenase}} \text{Lactic acid} + NAD^+$$

- In yeast, pyruvate is broken down to ethyl alcohol and CO_2 by sets of reactions in the presence of enzymes pyruvate decarboxylase and alcohol dehydrogenase.

$$\text{Pyruvate} \xrightarrow[\text{Decarboxylase, TPP, } Mg^{++}]{\text{Pyruvate}} \text{Acetaldehyde} \xrightarrow[\text{NADH}]{\text{Alcohol dehydrogenase}} C_2H_5OH + NAD^+ \quad (CO_2 \text{ released})$$

AEROBIC RESPIRATION

- The oxidative breakdown of respiratory substrates with the help of atmospheric oxygen is known as **aerobic respiration**.
- It involves complete breakdown of substrates into CO_2 and water and release of lot of energy.

$$C_6H_{12}O_6 + 6O_2 \xrightarrow{\text{Enzymes}} 6CO_2 + 6H_2O + 686\ \text{KCal}$$

- The common pathway of aerobic respiration consists of three steps: glycolysis, Krebs cycle and terminal oxidation.

ATP BALANCE SHEET

Stage	ATP by substrate phosphorylation	Formation of $NADH/FADH_2$	ATP through ETS in mitochondria
Glycolysis in cytoplasm	2	2 NADH (one NADH on oxidation) through ETS form 3 or 2 ATP depending upon shuttle system.	2 × 3 = 6
Formation of acetyl CoA in matrix of mitochondria	–	2 NADH	2 × 3 = 6
Krebs cycle	2	2 FADH2 6 NADH	2 × 2 = 4 6 × 3 = 18
	4		34(or 32)

Total net gain of ATP = 36 or 38 depending upon type of aerobic respiration.

Glycolysis

- It is the process of partial oxidation of glucose or similar hexose sugar into two molecules of pyruvic acid through a series of ten enzyme mediated reactions, releasing energy as ATP and reducing power as $NADH_2$.
- It occurs in cytosol or cytoplasm.
- It is common to both aerobic and anaerobic respiration.
- It is regulated by three enzymes, catalysing non-equilibrium reactions: **hexokinase, phosphofructokinase** and **pyruvate kinase**.

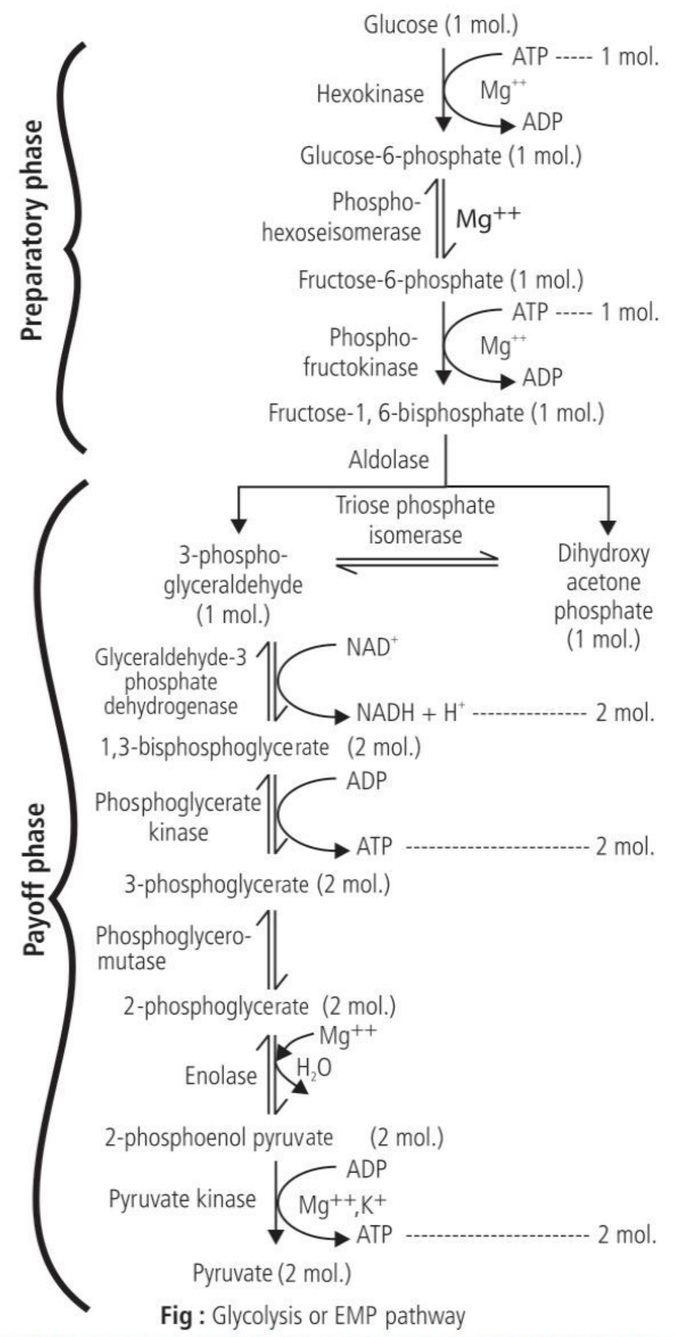


Fig : Glycolysis or EMP pathway

Terminal Oxidation

- It occurs towards the end of catabolic process.
- Involves passage of both electrons and protons of reduced co-enzymes to oxygen and produces water.
- Consists of two processes – **electron transport chain** and **oxidative phosphorylation**.
- An electron transport chain or system is a series of coenzymes and cytochromes that take part in passage of electrons from a chemical to its ultimate acceptor.
- In electron transport chain, the reducing equivalents from various metabolic intermediates are transferred to coenzymes NAD^+ and FAD to produce NADH and $FADH_2$ respectively.
- Oxidative phosphorylation is the synthesis of energy rich ATP molecules with the help of energy liberated during oxidation of reduced co-enzymes (NADH, $FADH_2$) produced in respiration. The enzyme required for this synthesis is called **ATP synthase**.

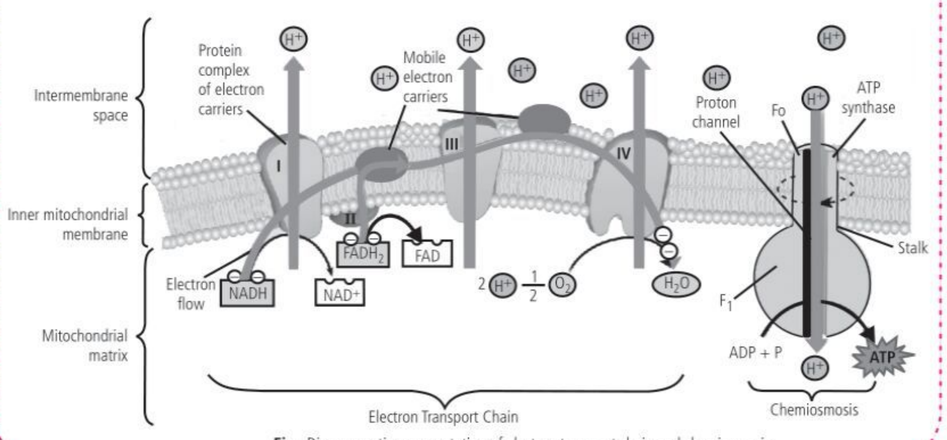


Fig.: Diagrammatic representation of electron transport chain and chemiosmosis

Kreb's Cycle

- Pyruvate formed in glycolysis undergoes oxidation to get converted to **acetyl CoA**.
- It is catalysed by multi-enzyme **pyruvate dehydrogenase complex (PDH)**.
- In this reaction (highly exergonic and irreversible *in vivo*) carboxyl group of pyruvate is lost as CO_2 while the remaining two carbons form acetyl CoA.

$$\text{Pyruvate} + \text{CoA} + NAD^+ \xrightarrow{\text{Pyruvate dehydrogenase complex}} CO_2 + \text{Acetyl CoA} + NADH + H^+$$

- Pyruvate oxidation is the gateway step or **link reaction** as acetyl CoA acts as a connecting link between glycolysis and Krebs cycle.
- Krebs cycle is also known as Citric acid cycle.
- It is a nearly universal central catabolic pathway in which compounds derived from the breakdown of carbohydrates, fats and proteins are oxidised to CO_2.
- It occurs in mitochondrial matrix.
- The Citric acid cycle is **amphibolic** since in addition to oxidation it is important in provision of carbon skeletons, for gluconeogenesis, fatty acid synthesis and interconversion of amino acids.

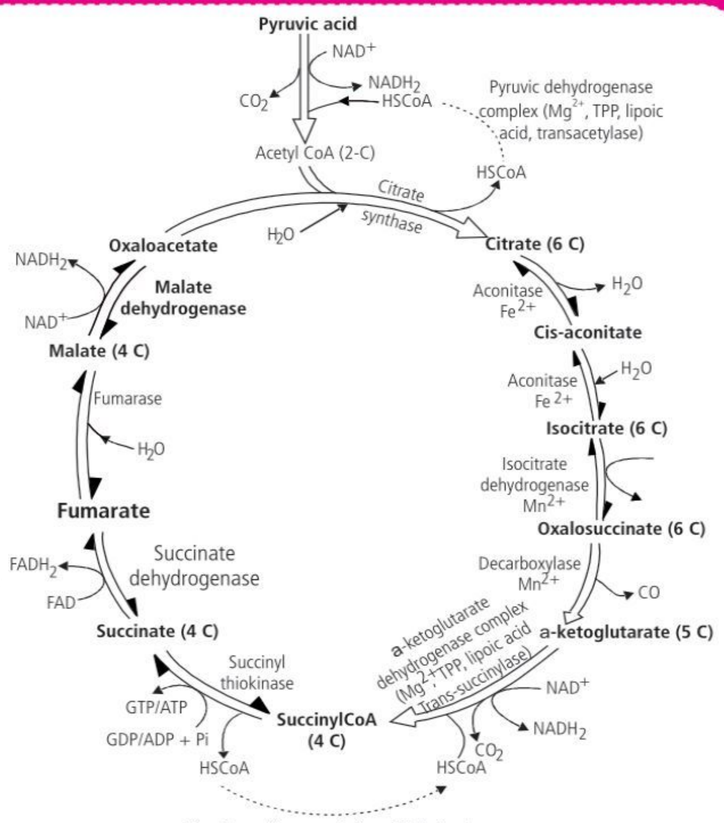


Fig.: Schematic representation of Krebs' cycle

Check Your Vitals for NEET

Maximise your chance of success in medical entrance exams by reading this article. This section is specially designed to optimise your preparation by practising more and more. It is a unitwise series having chapterwise question bank, allowing you to prepare systematically and become more competent.

- Recall question or single concept question – indicated by a single finger.
- Application question or question which requires 2 or 3 concepts - indicated by 2 fingers.
- Application question or question which requires 3 or more concepts - indicated by 3 fingers.

UNIT-VII : GENETICS AND EVOLUTION

CHAPTER-5 : PRINCIPLES OF INHERITANCE AND VARIATION

Multiple Choice Questions

1. If the factors responsible for pod shape and pod colour in a pea plant studied by Mendel to show inheritance of two genes were located closely on same chromosome, then which of the following would not have been explained?
(a) Law of dominance (b) Law of segregation
(c) Law of independent assortment
(d) Both (b) and (c)

2. When two homozygous black and white andalusian fowls were crossed, the F_1 individuals appeared blue and on selfing produces black, blue and white fowl in the ratio of 1 : 2 : 1. This is an example of
(a) dominance (b) incomplete dominance
(c) co-dominance (d) pleiotropism.

3. If a cross between two individuals produces offspring with 50% dominant character (A) and 50% recessive character (a), the genotypes of parents are
(a) Aa × Aa (b) Aa × aa
(c) AA × aa (d) AA × Aa.

4. The F_2 ratio in a dihybrid cross is modified from 9 : 3 : 3 : 1 to 9 : 7. This is due to the effect of
(a) duplicate genes (b) complementary genes
(c) supplementary genes (d) epistatic genes.

5. Due to non-disjunction of chromosomes during spermatogenesis, some sperms carry both sex chromosomes (22A + XY) and some sperms do not carry any sex chromosomes (22A + 0). If these sperms fertilise normal eggs (22A + X), what types of genetic disorders appear among the offspring?
(a) Klinefelter's syndrome and Turner's syndrome respectively
(b) Turner's syndrome and Klinefelter's syndrome respectively
(c) Down's syndrome and Turner's syndrome respectively
(d) Cri-du-chat syndrome and Down's syndrome respectively

6. Which of the following statements is not true for two genes that show 50% recombination frequency?
(a) The genes show independent assortment.
(b) The genes if present on same chromosome, undergo more than one crossovers in every meiosis.
(c) Genes may be present on different chromosomes.
(d) The genes are tightly linked.

7. Genic ratio between X chromosomes and autosomes in three *Drosophila* were reported as follows:

P. $\frac{X}{A} = 1$ Q. $\frac{X}{A} > 1$ R. $\frac{X}{A} = 0.5$

Based upon the genic ratio, deduce the sex of these insects.

	P	Q	R
(a)	Female	Superfemale	Male
(b)	Male	Female	Superfemale
(c)	Female	Male	Intersex
(d)	Supermale	Female	Male

8. If the recombination frequencies of fruitfly between genes b (black body) and vg (vestigial wings) is 18%, (b) black body and cn (cinnabar eye) is 9% and cn (cinnabar eye) and vg (vestigial wings) is 9.5%. Identify the correct sequence of genes in fruitfly.
(a) cn, b and vg (b) b, cn and vg
(c) vg, b and cn (d) cn, vg and b

9. The holandric type of inheritance refers to transfer of traits from
(a) father to son
(b) father to grandson through his daughter
(c) mother to daughter
(d) father to granddaughter through his son.

10. A man having a genotype AABbCcDD can produce P number of genetically different sperms and a woman with genotype UuVVWwXx generates Q number of genetically different eggs. The values of P and Q are equivalent to
(a) P = 4, Q = 8 (b) P = 4, Q = 4
(c) P = 8, Q = 4 (d) P = 8, Q = 8.

11. What did Mendel conclude from dihybrid cross in pea plant?
(a) Inheritance of one pair of alleles does not interfere in the inheritance of other pair of alleles.
(b) Out of the two contrasting alleles, only one is able to express its effect in the individual.
(c) Two factors of a character keep their identity distinct and separate at the time of gamete formation.
(d) One trait of the character which did not appear in first generation must lie hidden or unexpressed in it.

12. The progenies of a colour blind woman and a normal man will be
(a) 100% colour blind girls and 100% carrier boys
(b) 100% colour blind boys and 50% carrier girls
(c) 100% colour blind boys and 100% carrier girls
(d) 50% colour blind boys and 50% carrier girls.

13. Sex chromosomal disorders affect the males more than the females, because
(a) the X-linked characters show criss-cross inheritance
(b) recessive allele present on X-chromosome expresses singly in males and in homozygous form in females
(c) X-linked genes are inherited from father to son only
(d) all of these.

14. Read the given statements and select the correct ones.
(i) Genotype remains same throughout the life of an individual.
(ii) Individuals with different phenotype usually have same genotype.
(iii) Alleles of a gene occupy the same gene locus on the two homologous chromosomes.
(iv) Dihybrid cross is made between two organisms of a species to study the inheritance of two pairs of alleles of a single gene.
(a) (i), (ii) and (iii) (b) (i) and (iii)
(c) (iii) and (iv) (d) (i), (iii) and (iv)

15. The back cross in which F_1 hybrid is crossed with its dominant parent, is carried out
(a) to bring yield and quality from dominant parent
(b) to study the genotype of F_1 progeny
(c) to study linkage
(d) all of these.

Match The Columns

16. Match Column I with Column II.

	Column I		Column II
A.	Incomplete dominance	(i)	9 : 3 : 4
B.	Dominant epistasis	(ii)	9 : 7
C.	Supplementary genes	(iii)	1 : 2 : 1
D.	Complementary genes	(iv)	1 : 1
E.	Test cross	(v)	12 : 3 : 1

17. Match Column I with Column II (There can be more than one match for items in Column I).

	Column I		Column II
A.	Quantitative inheritance	(i)	Trisomic
B.	Pleiotropy	(ii)	Monosomic
C.	Hyperploidy	(iii)	Phenylketonuria
D.	Hypoploidy	(iv)	Human skin colour
E.	Male heterogamety	(v)	*Drosophila*
F.	Female heterogamety	(vi)	Pigeon
		(vii)	Nullisomic
		(viii)	Tetrasomic
		(ix)	Sickle cell anaemia
		(x)	Kernel colour in wheat
		(xi)	Moths
		(xii)	Cockroach

Passage Based Questions

18. **(A)** Complete the given passage with appropriate words or phrases.
The chromosomal theory of inheritance was proposed by (i) and experimentally proved by (ii). The theory states that (iii) constitute bridge between the present and next generation. Hereditary traits are carried by (iv), present in nucleus. Both (iv) and (v) occur in pairs in all somatic cells. The latter are located at specific loci on the chromosomes, which segregate and assort independently during (vi) and later fusion of gametes restores (vii) in the offspring. Both the chromosomes and alleles follow law of (viii) while only those gene pairs present on different chromosomes show (ix).

(B) Read the given passage and correct the errors, wherever present.
ABO blood group system in human beings is an example of incomplete dominance and multiple alleles. Human beings have six blood group phenotypes. The blood groups are determined by two types of antibody present on the surface coating of white blood cells. Blood group A individuals have antigen B and blood group B individuals have antigen A. The alleles I^A, I^B and *i* determine the blood group of a person. A person carries one of the three alleles. The maximum number of possible genotype is four.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer 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.

19. **Assertion :** In incomplete linkage, more parental types of offspring are produced as compared to recombinant ones.
Reason : Incomplete linkage occurs when genes are closely related to each other and do not separate during crossing over.

20. **Assertion :** Mendel's experiments on pea plant easily led him to conclude the laws of independent assortment.
Reason : Mendel luckily studied those traits whose genes were present on different chromosomes.

21. **Assertion :** Test cross is used to determine the genotype of a plant.
Reason : In test cross, the plant with unknown genotype is crossed with its recessive parent.

22. **Assertion :** Sickle cell anaemia is a sex-linked recessive disorder.
Reason : Sickle cell anaemia occurs due to the formation of abnormal haemoglobin caused by substitution of valine by glutamic acid.

23. **Assertion :** Pedigree analysis is study of pedigree for transmission of a particular trait.
Reason : Pedigree analysis is useful for the genetic counsellors to advice couples about the possibility of having children with genetic defects.

24. **Assertion :** Heterozygous individual produces offspring with different genotypes on selfing.
Reason : Heterozygous individual carries dissimilar alleles.

25. **Assertion :** Mendelian disorders are caused by allelic abnormalities.
Reason : Allelic abnormalities develop due to defective synapsis and disjunction.

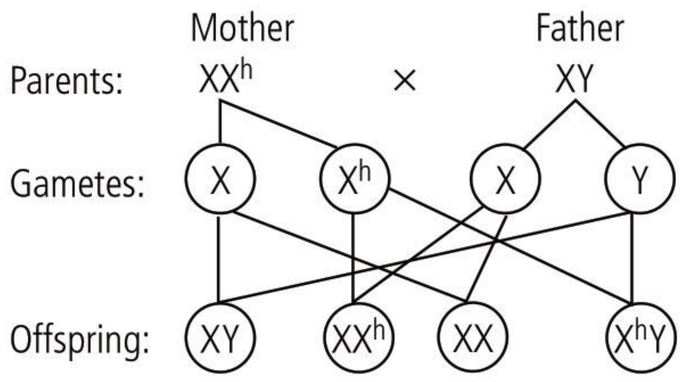
26. **Assertion :** Crossing over produces recombinations.
Reason: With the increase in age, crossing over increases.

27. **Assertion :** In phenylketonuria, heterozygous individuals can produce the enzyme phenylalanine hydroxylase.
Reason : Phenylketonuria is an inborn, autosomal recessive metabolic disorder.

28. **Assertion:** Mixed population is superior as it hides many of the defective recessive alleles.
Reason: Recessive allele forms an incomplete or defective polypeptide so that, the expression shows the effect of absence of dominant allele.

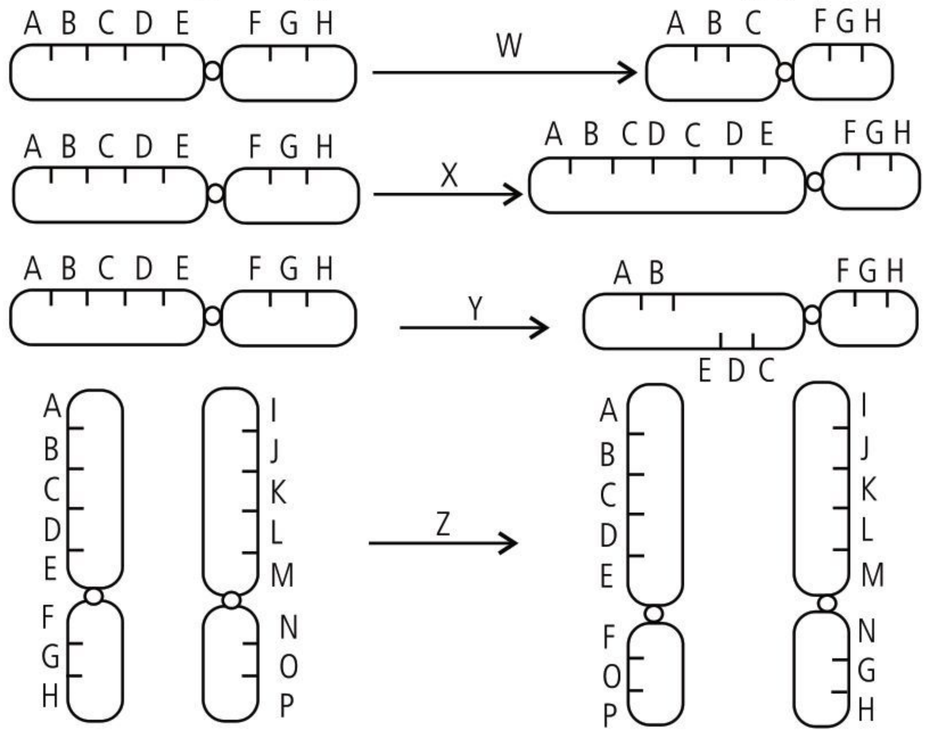
Figure Based Questions

29. Consider the given cross and answer the following questions.



(a) Identify the type of disease depicted by the given cross. Also name the type of inheritance shown.
(b) In the given cross, what would be the probability of having a carrier and diseased offspring?
(c) Name any other disease, which shows same type of inheritance pattern.

30. Refer to the given figure and answer the following questions.



(a) Identify the types of chromosomal aberration labelled as W, X, Y and Z in the given figure.
(b) Briefly describe aberration labelled as W and Y in the given figure.
(c) Which of the labelled chromosomal aberration(s) represent interchromosomal aberration?

CHAPTER-6 : MOLECULAR BASIS OF INHERITANCE

Multiple Choice Questions

1. Which of the following observations of Hershey and Chase experiment proved that DNA is genetic material?
(a) The bacteriophage labelled with radioactive sulphur made the bacterial DNA radioactive.
(b) The bacteriophage labelled with radioactive phosphorus did not make bacteria radioactive.
(c) Bacteriophage labelled with radioactive sulphur made only the bacterial proteins radioactive.
(d) Bacteriophage labelled with radioactive phosphorus made the bacterial DNA radioactive.

2. Select the mismatched pair with reference to eukaryotic transcription.
(a) RNA Pol I – Synthesises snRNA
(b) RNA Pol II – Synthesises *m*RNA

(c) RNA Pol III – Synthesises *t*RNA
(d) RNA Pol III – Synthesises 5S*r*RNA

3. Which of the following can be used to determine original source of DNA?
(a) A/T = 1 and G/C = 1
(b) A - T base pairs rarely equals C - G base pairs
(c) $\left(\frac{A+T}{G+C}\right)$ ratio is constant for a species
(d) All of these

4. Identify the correct sequence of DNA packaging in terms of ascending order of size.
(a) DNA → Nucleosome → Chromatin fibre → Solenoid → Chromatid → Chromosome
(b) DNA → Nucleosome → Chromatid → Solenoid → Chromatin fibre → Chromosome
(c) DNA → Nucleosome → Solenoid → Chromatin fibre → Chromatid → Chromosome
(d) DNA → Nucleosome → Solenoid → Chromatid → Chromosome → Chromatin fibre

5. Which of the following events takes place during post-transcriptional modification in eukaryotes?
(a) 7-methyl guanosine cap is added at 3′ end of RNA transcript.
(b) Addition of poly A segment at 5′ end of transcript.
(c) Exons are removed from primary transcript.
(d) Introns are removed from primary transcript.

6. Which DNA molecule among the following will melt at lowest temperature?
(a) 5′ - A-A-T-G-C-T-G-C-3′
3′ - T-T-A-C-G-A-C-G-5′
(b) 5′- A-A-T-A-A-A-G-C-T-3′
3′- T- T- A-T- T- T-C-G-A-5′
(c) 5′-G-C-A-T-A-G-C-T-3′
3′-C-G-T- A-T-C-G-A-5′
(d) 5′- A-T-G-C- T- G-A-T-3′
3′- T- A-C-G-A- C-T-A-5′

7. Select the correct statement regarding repression of genes.
(a) It refers to switching on of operon that usually remains turned off.
(b) It initiates transcription and translation of structural genes.
(c) It involves the blocking of operator gene of operon.
(d) None of these.

8. Arrange the various steps of DNA fingerprinting technique in the correct order.
(i) Separation of DNA fragments by electrophoresis
(ii) Digestion of DNA by restriction endonucleases
(iii) Hybridisation using labelled VNTR probe
(iv) Isolation of DNA
(v) Detection of hybridised DNA fragments by auto- radiography
(vi) Transferring the separated DNA fragments to nitrocellulose membrane
(a) (iv) → (ii) → (i) → (vi) → (iii) → (v)
(b) (iv) → (i) → (ii) → (iii) → (vi) → (v)
(c) (ii) → (i) → (iv) → (vi) → (iii) → (v)
(d) (iii) → (v) → (iv) → (ii) → (i) → (vi)

9. The bacteria growing in normal environment was selected for studying its growth rate. The bacteria was moved from an environment with a light nitrogen isotope (^{14}N) to an environment with heavy nitrogen isotope (^{15}N) and its growth was studied for a period of exactly one duplication. After this, the sample is again transferred to the environment with light nitrogen for a period of two duplications.
What is the composition of hybrid DNA after the experiment?
(a) 75% (b) 50% (c) 0% (d) 25%

10. Which of the following *m*RNA will get translated completely?
(a) AUGUUUCCUCAUUAGGGUGUU
(b) GUGUUUCCUCAUGGUUGAGUU
(c) AUGUUUCCUCAUGGUGUUUCC
(d) AUGUUUCCUUGAAUGGUUUAA

11. Which of the following is incorrect about anticodon?
(a) It helps in bringing a particular amino acid at its proper position during translation.
(b) It occurs only in *t*RNA.
(c) It is complementary to a codon.
(d) It determines the position of an amino acid in a polypeptide.

12. Which one of the following is not a part of transcription unit?
(a) Promoter (b) Terminator
(c) Inducer (d) Structural genes

13. In the experiment of Avery, MacLeod and McCarty, R-type bacteria was converted into S-type bacteria only when R-type bacteria is mixed with
(a) proteins of S-type bacteria
(b) DNA of S-type bacteria with DNase
(c) DNA of S-type bacteria without DNase
(d) carbohydrates of S-type.

14. Which of the following represents central dogma proposed by Crick?
(a) DNA ⟶ RNA ⟶ Protein
(b) DNA ⇌ RNA ⇌ Protein
(c) DNA ⇌ RNA ⇌ Protein
(d) RNA ⇌ DNA ⇌ Protein.

15. A bacterial culture of *E.coli* is transferred to a medium without lactose. Which of the following will occur in such case?
(a) Permease will be produced in high amount only.
(b) Transacetylase and permease will be produced only.
(c) β-galactosidase will be produced only.
(d) Enzymes of *lac* operon will be produced in a very low level.

Match The Columns

16. Match Column I with Column II.

Column I	Column II
A. Helicase	(i) Stabilises ssDNA
B. Single stranded uncoiled protein	(ii) Releases tension in binding DNA
C. Topoisomerase	(iii) Synthesises primers
D. Primase	(iv) Unwinds DNA strands

17. Match Column I with Column II. (There can be more than one match for items in Column I).

Column I	Column II
A. Initiation codon	(i) AUG
B. Phenylalanine	(ii) UAA
C. Template strand	(iii) UUU
D. Termination codon	(iv) Promoter present
E. Non-template strand	(v) Runs 5′ → 3′ direction
F. Arginine	(vi) GUG
	(vii) UGA
	(viii) AGG
	(ix) Antisense strand
	(x) CGU
	(xi) UUC
	(xii) Sense strand

Passage Based Questions

18. (A) Complete the given passage with appropriate words or phrases.

The double helical structure of DNA was proposed by (i) and (ii) on the basis of data obtained from (iii). According to their model, the two chains of double stranded helix run (iv) to each other. The backbone of each chain is made of (v). The (vi) of two chains form complementary pairs. The DNA usually shows (vii) coiling producing major and minor grooves alternately. The pitch of helix in B-DNA is 3.4 nm with (viii) base pairs in each turn. However, another right handed, (ix) has only a single turn of helix with (x) base pairs that lie 20° away from the axis.

(B) Read the given passage and correct the errors, wherever present.

DNA replication in eukaryotes is semiconservative, discontinuous and bidirectional whereas in prokaryotes, it is unidirectional and continuous. DNA replication occurs during M-phase of cell cycle. The main enzyme of DNA replication is DNA dependent RNA polymerase. Replication requires abundant energy that comes from breakdown of biphosphates of deoxyribonucleosides. DNA replication is quite slow process. It begins at a particular spot called *ori* site. Bacterial DNA has multiple *ori* site while eukaryotic DNA has single *ori* site.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer 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.

19. **Assertion :** DNA is preferred over RNA for storage of genetic information.
Reason : DNA undergoes rapid mutation and evolves very fast.

20. **Assertion :** One gene one enzyme hypothesis was changed into one gene one polypeptide hypothesis.
Reason : One gene one enzyme hypothesis states that structural gene specifies synthesis of many polypeptides.

21. **Assertion :** DNA polymorphism is the basis for genetic mapping of human genome as well as DNA fingerprinting.
Reason : Polymorphism in DNA arises due to mutations.

22. **Assertion :** The opposite strands of DNA chains are not identical but complementary to each other.
Reason : Specific base pairing occurs between a purine lying opposite to a pyrimidine.

23. **Assertion :** A peptide bond (–CO – NH–) is established between the amino group ($–NH_2$) of amino acid at P site, and carboxyl group (–COOH) of amino acid at A-site.
Reason : Peptide bond formation during translation is catalysed by a protein enzyme peptidyl transferase.

24. **Assertion:** The portion of DNA rich in G–C base pairs is called high melting area.
Reason: G–C base pair has 3 H-bonds.

25. **Assertion:** Inducer metabolites remove the repressor of an operon system during induction.
Reason: Induction is the switching on of an operon which normally remains turned off.

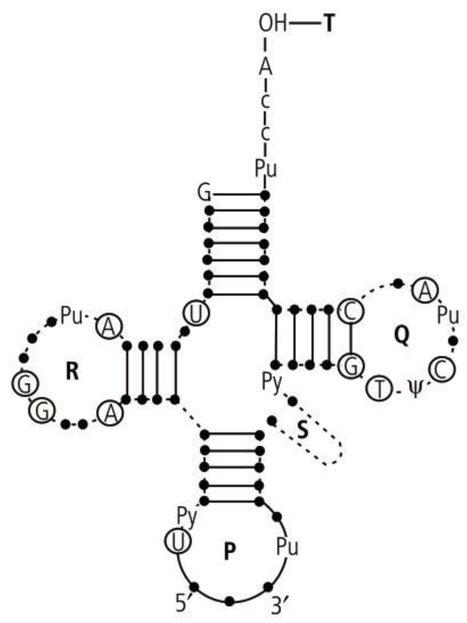
26. **Assertion:** In RFLP, different DNA samples are treated with same restriction enzyme to produce restriction fragments.
Reason: Different lengths of DNA sequences are produced from different DNA samples that are cleaved at same restriction sites.

27. **Assertion:** Genomic RNA, found in some viruses, act as a hereditary material.
Reason: Genomic RNA always replicate directly to produce RNA of its own type.

28. **Assertion:** Okazaki fragments are formed in the replication of leading strand.
Reason: The direction of growth in leading strand is 5′ → 3′ but in each Okazaki fragment it is 3′ → 5′.

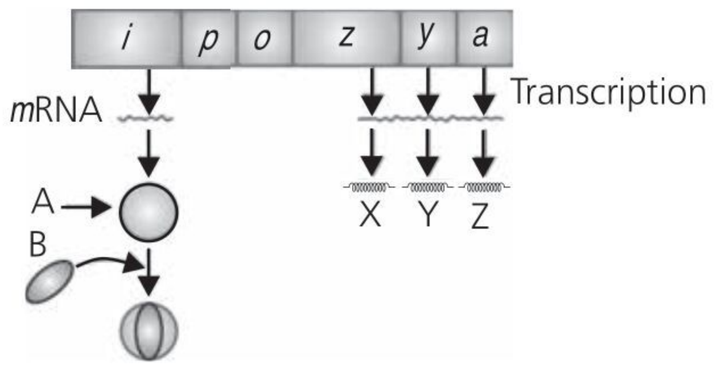
Figure Based Questions

29. Refer to the given figure and answer the following questions.



(a) Identify the parts P, Q, R, S and T in the given figure.
(b) State the function of Q and R in the molecule.
(c) What is the above molecule called? Name the site for recognition and attachment of *m*RNA codon.

30. Read the given figure and answer the following questions.



(a) Identify A, B, X, Y and Z in the given figure.
(b) Briefly describe the function of A.
(c) Which labelled part is involved in hydrolysing the lactose?

CHAPTER-7 : EVOLUTION

Multiple Choice Questions

1. The Hardy-Weinberg principle cannot operate if
(a) gene flow does not occurs between population
(b) frequent mutations occur in the population
(c) the population has no chance of interaction with other populations
(d) free interbreeding occurs among all members of the population.

2. The extinct human ancestor, whose fossil was discovered by Edward Lewis from Pliocene rocks of Shivalik Hills of India was
(a) *Ramapithecus* (b) *Australopithecus*
(c) *Dryopithecus* (d) *Homo erectus.*

3. Which of the following options gives one correct example each of convergent evolution and divergent evolution?

	Convergent evolution	Divergent evolution
(a)	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Wings of butterfly and birds
(b)	Eyes of octopus and mammals	Bones of forelimbs of vertebrates
(c)	Bones of forelimbs of vertebrates	Wings of butterfly and birds
(d)	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Eyes of octopus and mammals

4. An isolated population of humans with approximately equal numbers of blue-eyed and brown-eyed individuals was decimated by an earthquake. Only a few brown-eyed people remained to form the next generation. This kind of change in the gene pool is called
(a) Hardy-Weinberg equilibrium
(b) blocked gene flow
(c) bottle-neck effect (d) gene migration.

5. Refer to the main features of theory of natural selection.
(i) Limited food and space
(ii) Formation of new species
(iii) Variations (iv) Natural selection
(v) Struggle for existence
(vi) Inheritance of useful variations over many generations
(vii) Rapid multiplication
Select the correct sequence of speciation.
(a) (vii) → (i) → (vi) → (iii) → (iv) → (v) → (ii)
(b) (vii) → (i) → (v) → (iii) → (iv) → (vi) → (ii)
(c) (vii) → (i) → (v) → (iii) → (vi) → (iv) → (ii)
(d) (vii) → (i) → (iii) → (v) → (iv) → (vi) → (ii)

6. In a population of 1000 individuals, 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is
(a) 0.4 (b) 0.5 (c) 0.6 (d) 0.7.

7. *Archaeopteryx*, the missing link between reptiles and birds, had the following avian characters except
(a) the modified forelimbs into wings
(b) modified jaws into a beak
(c) presence of a long tail
(d) an intimate fusion of the skull bones.

8. Alligators distributed all over the North American continent and East Asia got separated due to certain barriers and developed some mutations, as a result of which they evolved into different species.
This is an example of
(a) parallel evolution (b) adaptive radiation
(c) restricted distribution (d) discontinuous distribution.

9. Which of the following is not an example of atavism?
(a) Long dense hairs in humans
(b) Conversion of some stamens and carpels to petal-like structures in *Oxalis*
(c) Well developed canine teeth in humans
(d) Leaves reduced to scales in *Rucus*.

10. Choose the correct series of human evolution.
(a) *Dryopithecus* → *Homo erectus* → *Australopithecus* → Cro-Magnon man
(b) *Australopithecus* → *Homo erectus* → Neanderthal man → *Homo sapiens*
(c) *Australopithecus* → *Ramapithecus* → *Dryopithecus* → *Homo sapiens*
(d) *Homo erectus* → *Australopithecus* → Cro-Magnon man → Neanderthal man

11. A small group of persons, leave their homes to find a new settlement which eventually cause a variation in their allele frequency. It explains
(a) bottleneck effect (b) founder effect
(c) gene migration (d) gene mutation.

12. Reproductive isolation due to behavioural differences of male and female individuals of different species, is categorised as
(a) mechanical isolation (b) psychological isolation
(c) seasonal isolation (d) gametic isolation.

13. Which of the following pairs is an example of divergent evolution?
(a) Leaf tendril of wild pea and leaf spine of barberry
(b) Pectoral fins of shark and flippers of dolphin
(c) Stings of honeybee and scorpion
(d) Tendrils of *Passiflora* and *Pisum sativum*

14. Select the incorrect statement from the following.
(a) Analogous organs show convergent evolution.
(b) Homologous organs have similar developmental pattern.
(c) Continuous variations are the basis of evolution.
(d) The movement of alleles among populations by the migration of breeding individuals cause genetic drift.

15. The age of gymnosperm is represented by
(a) Mesozoic Era (b) Devonian Period
(c) Permian Period (d) Cenozoic Era.

Match The Columns

16. Match Column I with Column II.

Column I	Column II
A. Raymond Dart	(i) Peppered moth
B. Hugo de Vries	(ii) Tuang baby
C. Adaptive radiation	(iii) Saltation
D. Industrial melanism	(iv) Darwin's finches

17. Match Column I with Column II. (There can be more than one match for items in Column I).

Column I	Column II
A. Connecting link	(i) Australian Marsupials
B. Missing link	(ii) Prosimians
C. Adaptive radiation	(iii) *Ornithorhynchus*
D. Analogous organs	(iv) Flippers of Dolphin and pectoral fins of shark
E. Primates	(v) *Ichthyostega*
	(vi) Simians
	(vii) *Protopterus*
	(viii) Sting of honey bee and scorpion
	(ix) Darwin's finches
	(x) *Seymouria*

Passage Based Questions

18. (A) Complete the given passage with appropriate words or phrases.
The process by which the organisms that appear physically, physiologically and behaviourally better adapted to the environment, survive and reproduce is called _(i)_. This process depends upon the existence of _(ii)_ within the population. In _(iii)_ selection, average sized individuals are favoured over small sized ones, reduces _(iv)_ and thus evolutionary change does not occur. Graphical curve obtained from such population is _(v)_. During progressive selection, the _(vi)_ size of population changes. _(vii)_ selection favours both small and large sized individuals. It produces two peaks in distribution of traits, leading to development of different _(viii)_. (vii) selection is rare in nature but plays an important role in _(ix)_. Evolution of DDT resistant mosquitoes is an example of _(x)_ selection.

(B) Read the given passage and correct the errors, wherever present.
Coacervates hypothesis was proposed by Sidney Fox. These were living structures that led to the formation of the first living organisms. Microsphere formation is another hypothesis given by Oparin. A microsphere is a non-living collection of organic micromolecules with single layered outer boundary. Prokaryotes were originated from protocells in aerobic atmosphere whereas eukaryotes were originated from primitive prokaryotes in 2.5 billion years ago.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer 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.

19. **Assertion :** Genetic drift is an evolutionary force.
Reason : Genetic drift occurs in all types of population but is markedly visible in population of large size.

20. **Assertion :** Primitive atmosphere of earth was reducing.
Reason : Hydrogen atoms present in primitive atmosphere combined with all oxygen atoms to form water, leaving no free oxygen.

21. **Assertion :** The body structure was quite similar in both Java ape man and Peking man.
Reason : Both are discovered from Pleistocene rocks in the same year.

22. **Assertion :** Balanced polymorphism occurs when different forms co-exist in the same population in a stable environment.
Reason : In humans, the existence of A, B, AB and O blood groups represent balanced polymorphism.

23. **Assertion :** Cro-Magnon man is regarded as most primitive ancestor of *Homo erectus*.
Reason : Cro-Magnon man was first tool maker and used tools of chipped stones.

24. **Assertion :** Pteridosperms are fossil plants which are intermediate between ferns and seed plants.
Reason : Pteridosperms are connecting links.

25. **Assertion:** Mutations or discontinuous variations are the raw material of evolution.
Reason : Mutations are caused by change in genetic make up.

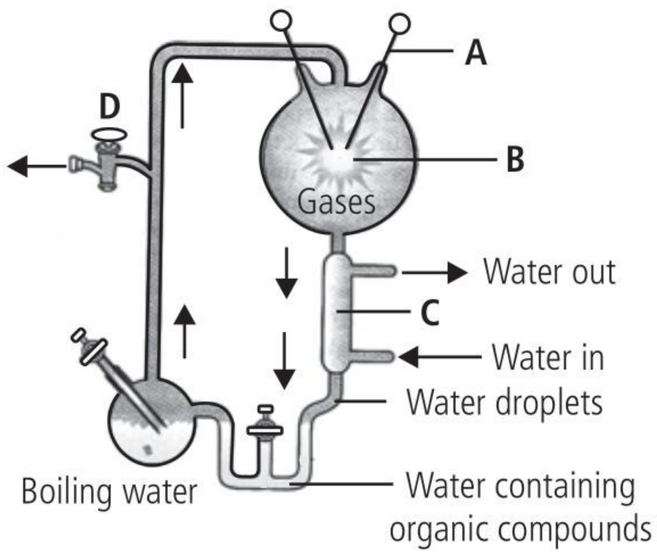
26. **Assertion :** Seasonal isolation is a type of prezygotic isolation in populations.
Reason : The breeding period of mating individuals is different for different species in seasonal isolation.

27. **Assertion :** Homologous organs show convergent evolution.
Reason : Homologous organs have different origin and similar function.

28. **Assertion :** Industrial melanism supports evolution by natural selection.
Reason : After industrialisation, white moths were selectively picked up by predator birds whereas black moths escaped unnoticed resulting in more population.

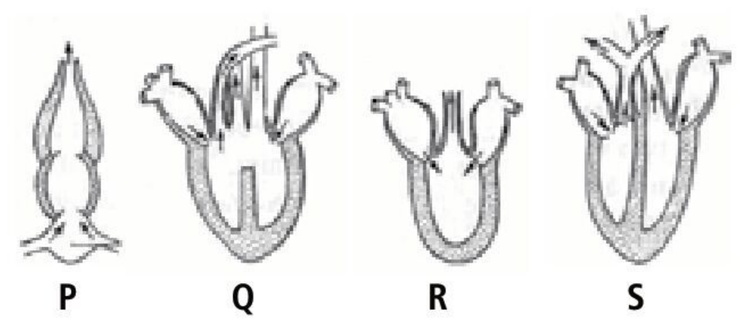
Figure Based Questions

29. Refer to the given figure and answer the following questions.



(a) Identify the given figure and the labelled parts A, B, C and D.
(b) In the given experiment, which gases were used to simulate primitive atmosphere?
(c) Briefly describe the experiment given in the figure.

30. Refer to the figures given below and answer the following questions.



(a) Identify the diagrammatic structures P, Q, R and S.
(b) What do these structures signify?
(c) Give an example of organs showing similar relationship.
(d) What type of evolution do these structures represent?

SOLUTIONS

CHAPTER-5 : PRINCIPLES OF INHERITANCE AND VARIATION

1.	(c)	2.	(b)	3.	(b)	4.	(b)	5.	(a)
6.	(d)	7.	(a)	8.	(b)	9.	(a)	10.	(a)
11.	(a)	12.	(c)	13.	(b)	14.	(b)	15.	(b)

16. A-(iii), B-(v), C-(i), D-(ii), E-(iv)

17. A-(iv, x), B-(iii, ix), C-(i, viii), D-(ii, vii), E-(v, xii), F-(vi, xi)

18. **(A)** (i) Sutton and Boveri (ii) T.H. Morgan
(iii) gametes (iv) chromosomes
(v) genes (vi) meiosis
(vii) diploid chromosome number
(viii) segregation
(ix) law of independent assortment

(B) ABO blood group system in human beings is an example of ~~incomplete dominance~~ codominance and multiple alleles. Human beings have ~~six~~ four blood group phenotypes. The blood groups are determined by two types of ~~antibody~~ antigens present on the surface coating of ~~white~~ red blood cells. Blood group A individuals have antigen ~~B~~ A and blood group B individuals have antigen ~~A~~ B. The alleles I^A, I^B and i determine the blood group of a person. A person carries ~~one~~ two of the three alleles. The maximum number of possible genotype is ~~four~~ six.

19.	(c)	20.	(a)	21.	(a)	22.	(d)	23.	(b)
24.	(a)	25.	(c)	26.	(c)	27.	(a)	28.	(b)

29. **(a)** The above cross shows the inheritance of haemophilia, which is a sex-linked recessive disorder. It shows criss-cross type of inheritance.

(b) In the given cross, the ratio of carrier and diseased offspring would be 1 : 1. If the carrier female (XX^h) marries a normal male (XY), four types of children are produced as given by the cross (XX, XX^h, X^hY, XY). In other words, 50% boys as well as 50% girls receive the gene for haemophilia through the X^h chromosome of their mother. However, the defect does not appear in the girls because of the presence of the allele for normal blood clotting is found on one of the X-chromosome (XX^h). Therefore, the girls remain carrier. 50% of the males who receive the defective gene for haemophilia (X^hY) suffer from the disease as the Y-chromosome does not carry any allele for it.

(c) Colourblindness is another sex-linked recessive disorder, that shows criss-cross inheritance.

30. **(a)** W-Deletion; X-Duplication; Y-Inversion; Z-Reciprocal translocation

(b) In the given figure, W represents deletion. It is the loss of segment of a chromosome which is produced by a double break in the chromosomes followed by the union of remaining parts, *e.g.*, ABCDEFGH/ABCFGH (segment DE is missing).
The chromosomal aberration labelled as Y represents inversion. Here part of the chromosome segment gets inverted by 180°. For example, chromosome ABCDEFGH develops inversion in the part CDE to form ABEDCFGH.

(c) Reciprocal translocation (Z) and duplication (X) in the given figure represent interchromosomal aberrations.

CHAPTER-6 : MOLECULAR BASIS OF INHERITANCE

1. (d) **2.** (a) **3.** (c) **4.** (c) **5.** (d)
6. (b) **7.** (c) **8.** (a) **9.** (d) **10.** (c)
11. (d) **12.** (c) **13.** (c) **14.** (a) **15.** (d)

16. A-(iv), B-(i), C-(ii), D-(iii)

17. A-(i, vi), B-(iii, xi), C-(iv, ix), D-(ii, vii), E-(v, xii), F-(viii, x)

18. **(A)**

(i)	Watson	(ii)	Crick
(iii)	X-ray crystallography	(iv)	antiparallel
(v)	sugar phosphate	(vi)	nitrogenous bases
(vii)	right handed	(viii)	10
(ix)	A-DNA	(x)	11

(B) DNA replication in eukaryotes is semiconservative, ~~discontinuous~~ semidiscontinuous and bidirectional whereas in prokaryotes. It is ~~unidirectional~~ bidirectional and continuous. DNA replication occurs during ~~M-phase~~ S-phase of cell cycle. The main enzyme of DNA replication is DNA dependent ~~RNA~~ DNA polymerase. Replication requires abundant energy that comes from breakdown of ~~biphosphates~~ triphosphates of ~~deoxyribonucleosides~~ deoxyribonucleotides. DNA replication is quite ~~slow~~ rapid process. It begins at a particular spot called *ori* site. Bacterial DNA has ~~multiple~~ single *ori* site while eukaryotic DNA has ~~single~~ multiple *ori* site.

19. (c) **20.** (c) **21.** (b) **22.** (a) **23.** (d)
24. (a) **25.** (b) **26.** (b) **27.** (c) **28.** (d)

29. **(a)** P-Anticodon loop, Q-TΨC loop, R-DHU loop, S-Variable arm and T-Amino acid attaching site

(b) In the given figure, Q is the T Ψ C loop that provides site for attachment to ribosome while R is DHU loop which acts as binding site for aminoacyl synthetase enzyme, during protein synthesis.

(c) The above molecule is called adapter molecule. Anticodon loop (part P) is the site that has three bases out of seven which help in recognising and attaching to the codon of *m*RNA.

30. **(a)** A-Repressor protein, B-Inducer, X-β-galactosidase, Y-Permease and Z-Transacetylase

(b) The given figure is of the *lac* operon in the presence of an inducer. A represents the repressor protein that is meant for blocking the operator gene so that the structural genes are unable to transcribe *m*RNAs. It has two allosteric sites, one for attaching to operator gene and other for binding to the inducer. After coming in contact with inducer the repressor undergoes conformational change and is unable to combine with operator, which allows the transcription of *z*, *y* and *a* gene.

(c) β-galactosidase (X) is involved in hydrolysing lactose by breaking lactose into glucose and galactose.

CHAPTER-7 : EVOLUTION

1. (b) **2.** (a) **3.** (b) **4.** (c) **5.** (b)
6. (c) **7.** (c) **8.** (d) **9.** (d) **10.** (b)
11. (b) **12.** (b) **13.** (a) **14.** (d) **15.** (a)

16. A-(ii), B-(iii), C-(iv), D-(i)

17. A-(iii, vii), B-(v, x), C-(i, ix), D-(iv, viii), E-(ii, vi)

18. **(A)**

(i)	natural selection	(ii)	phenotypic variation
(iii)	stabilising	(iv)	variation
(v)	bell shaped	(vi)	mean
(vii)	Disruptive	(viii)	populations
(ix)	evolution	(x)	directional

(B) Coacervates hypothesis was proposed by ~~Sidney Fox~~ Oparin. Coacervates were ~~living~~ non-living structures that led to the formation of the first living ~~organisms~~ cells. Microsphere formation is another hypothesis gives by ~~Oparin~~ Sidney Fox. A microsphere is a non-living collection of organic ~~micromolecules~~ macromolecules with ~~single~~ double layered outer boundary. Prokaryotes were originated from protocells in ~~aerobic~~ anaerobic atmosphere whereas eukaryotes were originated from primitive prokaryotes in ~~2.5~~ 1.5 billion years ago.

19. (c) **20.** (a) **21.** (c) **22.** (b) **23.** (d)
24. (c) **25.** (b) **26.** (b) **27.** (d) **28.** (b)

29. **(a)** The given figure is the diagrammatic representation of Miller's experiment.
A-Electrode; B-Spark discharge; C-Condenser; D-Vacuum pump

(b) In the given experiment methane (CH_4), ammonia (NH_3), water vapour and hydrogen (H_2) were used to simulate primitive atmosphere.

(c) Stanley Miller in 1953 took an air tight apparatus and circulated four gases - CH_4, NH_3, H_2 and water vapour through it and passed electrical discharges from electrodes at 800°C. Then he passed the mixture through a condenser. He performed this experiment continuously in this way for few days and analysed the composition of the liquid inside the apparatus. He found a large number of simple organic compounds including some amino acids such as alanine, glycine and aspartic acid. Miller, thus, proved that organic compounds would have formed in the primitive reducing environment of Earth, which were further the essential building blocks of living organisms.

30. **(a)** P-Heart of fish; Q-Heart of reptiles; R-Heart of amphibians; S-Heart of mammal/bird.

(b) All these hearts show the same fundamental structure, hence are homologous organs. Since, these are adapted to function differently in different environment, they represent divergent evolution.

(c) The forelimbs of man, cheetah, whale and bat are examples of homologous organs. They have the same basic structural plan but perform different functions. In man they are used for grasping, in cheetah for running, in whale for swimming and in bat for flying.

(d) These structures represent divergent evolution. ☺☺

CBSE TERM-II

SOLVED PAPER 2021-2022

Held on **30th May**

CLASS **12**

General Instructions : Read the following instructions very carefully and strictly follow them :

Time Allowed : 90 minutes

Maximum Marks : 35

(i) This question paper consists of 13 questions.
(ii) All questions are compulsory.
(iiii) The question paper has three sections – Section A, B and C.
(iv) Section A has 6 questions of 2 marks each.
(v) Section B has 6 questions of 3 marks each.
(vi) Section C has a case-based questions of 5 marks
(vii) There is no overall choice in the question paper. However, internal choices have been provided in some questions. Attempt only one of the alternative in such questions.
(viii) Wherever necessary, neat proportional and properly labelled diagrams should be drawn.

SECTION - A

1. Explain, giving two reasons, how immune response by "vaccine" is different from that by "antitoxin in humans.

2. **(a)** Mention the common bacterium found in the anaerobic sludge during sewage treatment and also in the rumen of cattle. How is this bacterium commercially useful?

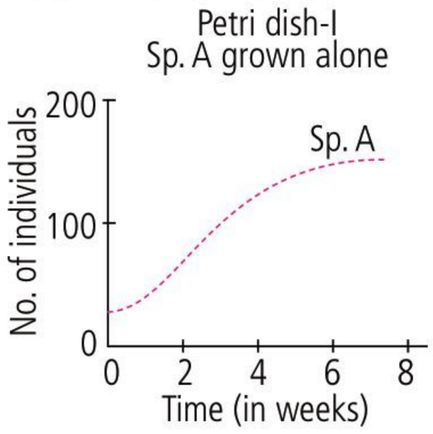
OR

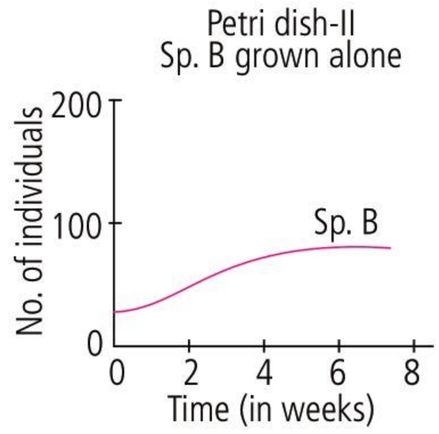
(b) Name the effective biocontrol agents of several plant pathogens belonging to group of viruses. Also write the ways they support the environment.

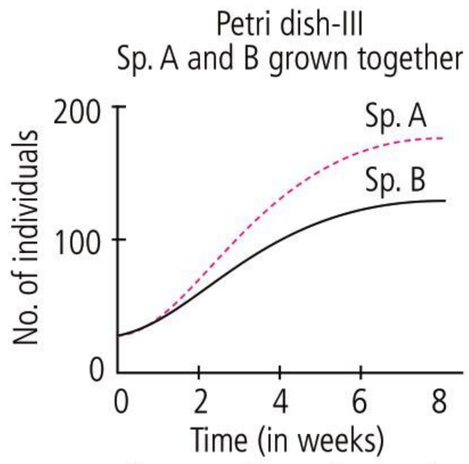
3. Some of the microbes used as biofertilisers are prokaryotes. Name the taxonomic group they come under. With the help of an example, mention how they act as biofertilisers.

4. Different species belonging to genus *Trichoderma* are useful to humans as well as to plants. Justify their roles by giving one instance of each.

5. The figure given below show the results of a lab experiment in which two microbial species A and B belonging to same genus were grown in three petri dishes having same culture medium. In Petri dish-I, Species-A was grown alone for 8 weeks. In Petri dish-II, Species-B was grown alone for 8 weeks. In Petri dish-III, both the species were grown together with the same number as Petri dish-I and Petri dish-II for 8 weeks.

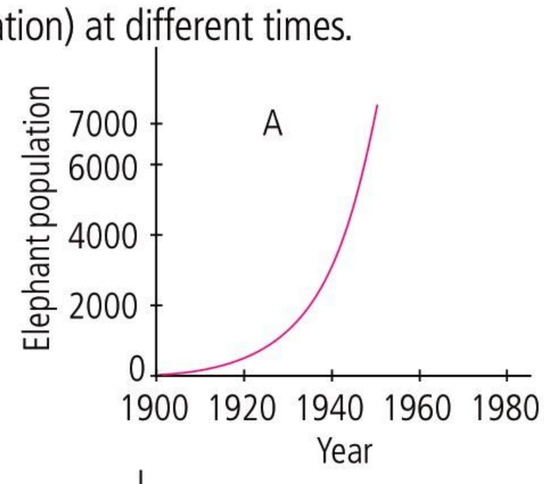


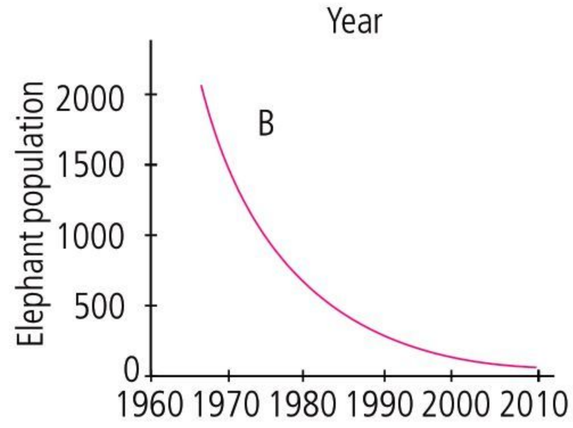




What conclusion will you draw from the graphs in terms of impact of interaction on growth? Explain, giving reason.

6. **(a)** The graph given below, A and B, represent population of elephants in two different National Parks (a hypothetical situation) at different times.





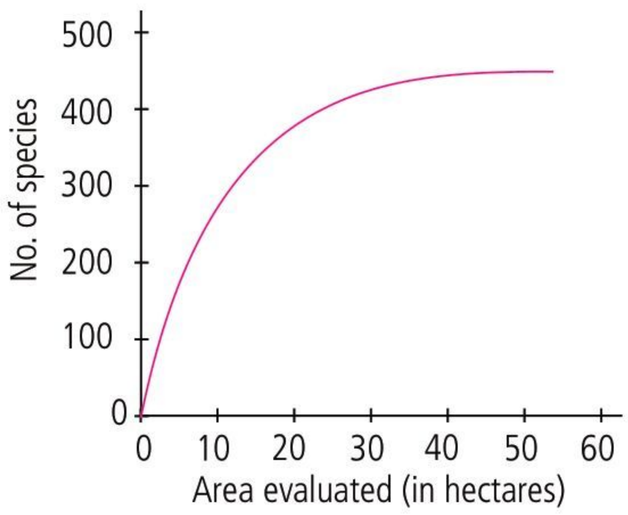
Study the graphs and comment upon the pattern of growth observed. Mention the possible reason for such patterns seen in nature.

OR

(b) As per a recent newspaper report, a particular country showed declining population growth rate. According to you, what could be the two most possible reasons for this decline and why?

SECTION -B

7. (a) The graph given below shows species-area relationship of a certain region.



(i) Study the graph and explain what it represents.

(ii) After a while, a small area was taken for constructing a road which divided the region into two. Write the impact this construction would have on species richness of the region.

OR

(b) How did Dr. David Tilman relate experimentally, the stability of a community and its species richness? Explain.

8. What are the consequences of loss of biodiversity in a region? Explain.

9. *Bacillus thuringiensis* plays an important role in Integrated Pest Management strategy. Explain how. Name any two crops that are protected efficiently from pests.

10. With the help of a storyboard or a flowchart only, explain all the stages of how human insulin is produced through r-DNA technology.

11. (a) Explain the roles of (i) primary, and (ii) secondary lymphoid organs that are responsible for developing defence to combat the action of pathogens/foreign antigens which enter our body.

(b) Doctors generally advise not to undergo surgery of tonsils. Why?

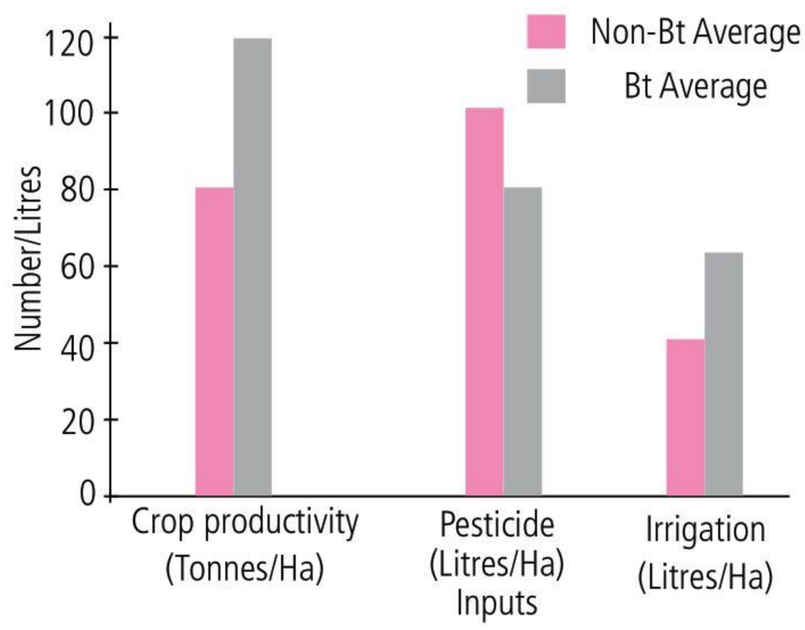
12. Causative agents of HIV-AIDS and COVID-19 belong to the same group of viruses. To diagnose and amplify the genetic material for further study of COVID-19 virus, 'RT-PCR' test is carried out.

(a) What does 'RT-PCR' stand for?

(b) Explain the various steps of PCR technique.

SECTION -C

13. (a) There are two different farm lands, one where Bt-cotton crop was cultivated and the other where non Bt-cotton crop (indigenous) was cultivated. Farmers responsible for this experimental cultivation were free to use the farming practices of their choice. During the cultivation period, the data was collected with respect to the amount of pesticide used, water required for irrigation and at harvesting time, the crop productivity. Based on the data collected, a bar graph was plotted which is shown below.



Answer the following questions:

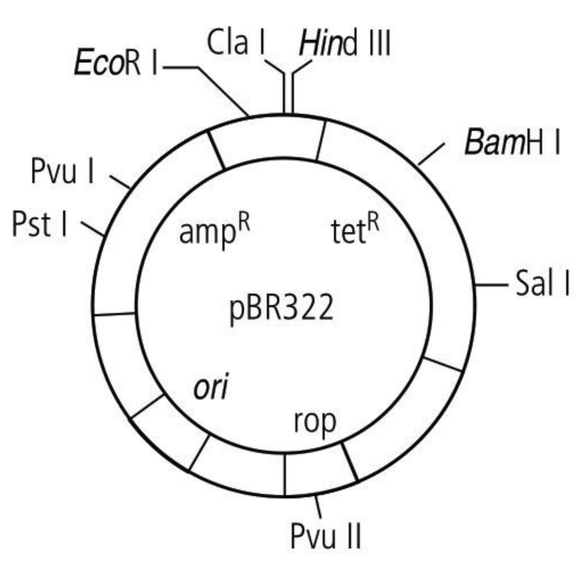
(i) Write your interpretation, with reason, on the basis of the three parameters plotted in the graph.

(ii) Which one of the crops would you like to cultivate in your farm and why?

(iii) Which one out of these two crops would a farmer from Rajasthan like to cultivate and why?

OR

(b) Gene of interest/alien gene is introduced by a cloning vector into a host cell to bring about a desired phenotypic expression in a host cell. The cloning vectors used are plasmid and bacteriophages. Biotechnologists in their labs, for desired results engineered specialised cloning vectors. One such vector is pBR322. Study the diagram carefully and answer the questions that follows.



(i) What do '*Eco*R I', '*Bam*H I' and '*Hind* III' represent? State their functions.

(ii) Identify the gene you would select for the role of a selectable marker in pBR322. Explain why.

(iii) Write the property/characteristic of plasmid and bacteriophage that makes them efficient cloning vectors.

(iv) Biotechnologists always insert '*ori*' gene in their engineered cloning vector. Justify the statement.

(v) Will the experiment be successful if the alien DNA is ligated at *Hind* III restriction site? Give reason in support of your answer.

SOLUTIONS

1. The immune response by "vaccine" is different from that by "antitoxin" in humans due to the following reasons:

(i) Vaccines are antigenic preparation made out of pathogen, which when introduced into body, causes antibody formation against antigen, whereas antitoxins are preformed antibodies which are injected for quick immune response.

(ii) Vaccines provide active immunity whereas antitoxin provide passive immunity. So vaccines provide relief only after long period as they are based on the property of 'memory' of the immune system and generates memory B and T cells that recognises the pathogen quickly whereas antitoxin provide immediate relief.

2. **(a)** The common bacterium present in the anaerobic sludge during sewage treatment and also in the rumen of cattle is *Methanobacterium*, commonly called as methanogens.

In the rumen of cattle, these bacteria help in the breakdown of cellulose and play an important role in the nutrition of cattle. The cow dung rich in *Methanobacterium* is commercially used for the generation of biogas, commonly called gobar gas from dung and sewage. It has capability to produce methane and fuel gas inside gobar gas plant.

NEET-UG: 41% rise in female aspirants in 5 yrs

In the last five years, female candidates in the National Eligibility cum Entrance Test (Undergraduate) or NEET-UG 2022 have registered an increase of nearly 41%.

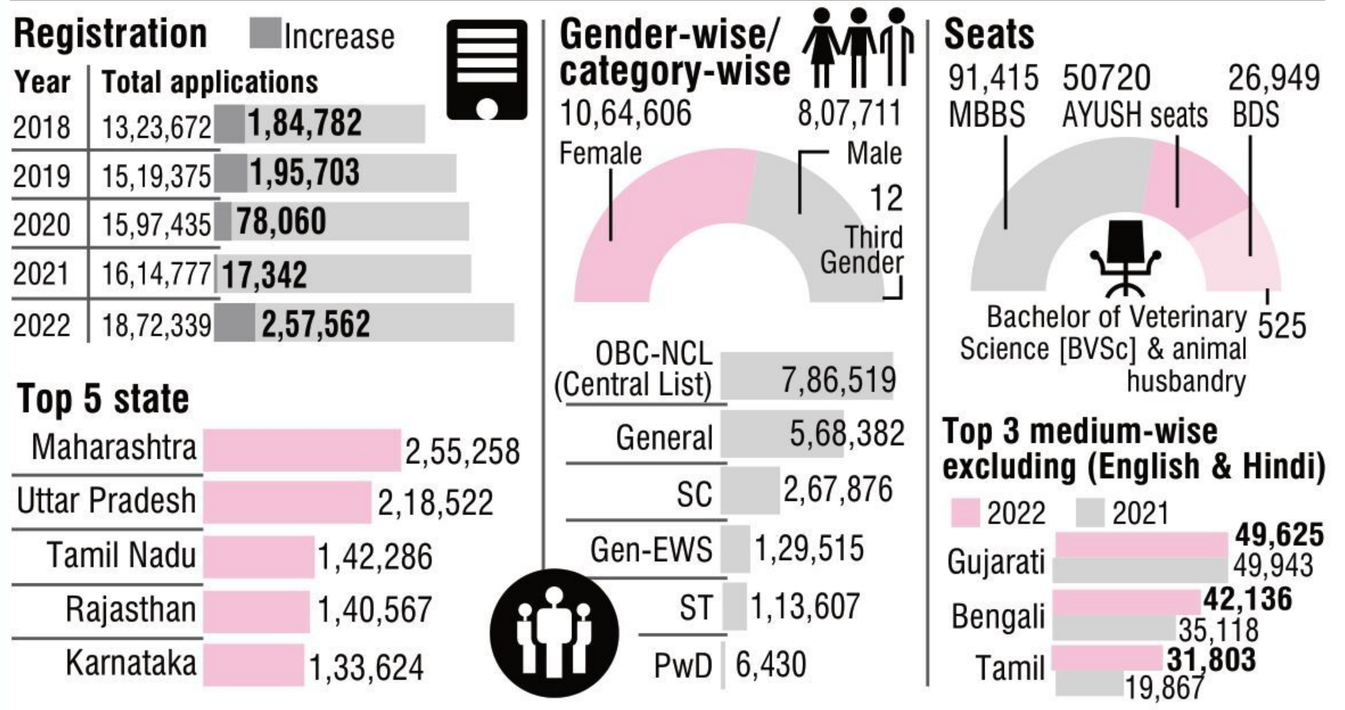
Analysing the 2022 registration data accessed, the number of registrations has shown significant growth in the last five years, up from 11.4 lakh in 2017 to 18.7 lakh this year. While the year-on-year increase in numbers of candidates in the past decade averaged around 1.5 lakh, there was a significant dip in this trend in 2020 and 2021 during the pandemic when the numbers increased by 78,060 and 17,342, respectively.

The exam is administered in 13 languages, including 12 Indian languages. While the number of candidates taking the exam in Hindi has more than doubled in the last five years – up from 1.2 lakh in 2017 to 2.5 lakh in 2022, other languages too have witnessed a gradual increase in the number of candidates preferring to appear in their mother tongue. After Hindi, those taking the exams in Gujarati are the second highest with nearly 50,000 aspirants, followed by Bengali with over 42,000 candidates and Tamil with over 31,800 candidates.

NEET-UG is the qualifying entrance exam for admission to bachelor of medicine and bachelor of surgery (MBBS), bachelor of dental surgery (BDS), bachelor of ayurveda, medicine and surgery (BAMS), bachelor of siddha medicine and surgery (BSMS), bachelor of unani medicine and surgery(BUMS), and bachelor of homeopathic medicine and surgery (BHMS) and BSc (H) Nursing courses of various medical colleges, which include premier medical colleges like AIIMS and Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry.

State-wise the largest number of registrations have been received from Maharashtra (2.5 lakh), followed by Uttar Pradesh (2.1 lakh). The other four states which have over one lakh registrations are Karnataka (1.3 lakh), Kerala (1.2 lakh), Rajasthan (1.4 lakh) and Tamil Nadu (1.4 lakh). In fact, nearly 55% of the total candidates have registered for the exam from these six states. And if the three states – Bihar, Madhya Pradesh and West Bengal - with over 90,000 registrations each are accounted for, 70% of the candidates are coming from nine of 37 states/ UTs.

The three most opted for cities to take the exams this year are Kota (37,774), Patna (36,114) and Jaipur (34,090).



OR

(b) The effective biocontrol agents of several plant pathogens belonging to group of viruses are the baculoviruses that belong to genus *Nucleopolyhedrovirus* are useful in controlling many insects and other arthropods. These viruses support the environment as they have species-specific, narrow spectrum insecticidal applications. They have been shown to have no negative impact on plants, animals, birds, mammals, fishes or even on non-target insects. Hence, due to this, the beneficial insects are being conserved to aid in an overall integrated pest management (IPM) programme.

3. Prokaryotic microbes used as biofertilisers are come under taxonomic group monera. These microbes enrich the nutrient quality of soil. The bacteria *Rhizobium* lives in symbiotic association with the roots of leguminous plants. These bacteria fix atmospheric nitrogen into organic forms which is used by plant as nutrient. Other free-living bacteria like *Azospirillum* and *Azotobactor* also helps in nitrogen fixation, thus enriching the nitrogen content of the soil.

4. Useful role in humans : Fungus *Trichoderma polysporum* is used to produce a bioactive molecule, cyclosporin 'A'. It has antifungal, anti-inflammatory and immunosuppressive properties. It inhibits activation of T-cells and therefore, prevents rejection reaction in organ transplantation.

Useful role in plants : *Trichoderma* is used as biocontrol agent in the treatment of plant diseases. It is free living fungus, found commonly in root ecosystem, exerts biocontrol over several plant pathogens.

5. The given graph shows that species A and B are mutualists. Mutualism is an interaction between two organisms of different species where both the interacting species are benefitted from each other. Species A when grown alone in petridish I showed less number of individuals, however, its population increased when grown along with species B in petridish III. Similar observations were made for species B. Hence, it can be concluded that they exhibit mutualism.

6. **(a)** The graph A represents the exponential or geometric growth pattern of the elephant population. In this National park, the elephants are provided unlimited resource (food and space) in the habitat and hence, they reached enormous numbers in absence of checks.

The graph B represents a declining curve where the number of elephant are decreasing from 1970 to 2010. There could be many reasons behind such graph like: lack of nutrient resources, competition, fragmentation, urbanisation, poaching etc. The surge in poaching for Ivory that began around 1970s and 1980s has been the main reason of the decline, while habitat loss due to fragmentation and urbanisation poses an increasingly serious, long-term threat to the species.

OR

(b) There can be two most possible reasons for a country to show declining population growth rate:

(i) More death rate or mortality than birth rate or natality.

(ii) Emigration, *i.e.*, number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration exceeds immigration, *i.e.*,number of individuals of the same species that have come into the habitat from elsewhere.

Hence, the population decreases when there is more number of death plus the number of emigrants (D + E) than the number of births plus the number of immigrants (B + I).

7. **(a)** (i) : The graph represents the Species-Area relationship. It states that within a region, species richness increases with increasing explored area but only upto a certain limit.

$S = CA^Z$

The relationship between species richness and area turned out to be rectangular hyperbola for a wide variety of taxa.

where S = Species richness

A = Area

Z = Slope of the line (regression coefficient)

C = Y – intercept

(ii) If the region is divided into two for road construction, there could be negative impact on species richness of the region like:

(a) Habitat loss and fragmentation: The degradation of habitat threatens the survival of many species. When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territory and certain animals with migratory birds are negatively affected, leading to decline in species richness and driving animals and plants to extinction.

MONTHLY TEST DRIVE CLASS XII ANSWER KEY

1.	(d)	**2.**	(c)	**3.**	(b)	**4.**	(d)	**5.**	(a)
6.	(a)	**7.**	(c)	**8.**	(d)	**9.**	(c)	**10.**	(c)
11.	(a)	**12.**	(b)	**13.**	(a)	**14.**	(b)	**15.**	(a)
16.	(d)	**17.**	(c)	**18.**	(b)	**19.**	(a)	**20.**	(d)
21.	(a)	**22.**	(d)	**23.**	(b)	**24.**	(c)	**25.**	(d)
26.	(a)	**27.**	(a)	**28.**	(d)	**29.**	(d)	**30.**	(b)
31.	(c)	**32.**	(b)	**33.**	(d)	**34.**	(a)	**35.**	(c)
36.	(b)	**37.**	(c)	**38.**	(c)	**39.**	(c)	**40.**	(a)

(b) Co-extinction : When a species become extinct the plant and animal species associated with it in an obligatory way also become extinct.

OR

(b) Dr. David Tilman's long term ecosystem experiment showed that a community with more species, tends to be more stable than those with less species. A stable community does not show much variation in productivity from year to year and is resistant or resilient to occasional disturbances (natural or man made and it also resistant to invasions by alien species. Dr. David Tilman used outdoor plots to give experimental evidence of a stable community. He found that plots with more species showed less year-to-year variation in total biomass. He also showed that in his experiments, increased diversity contributed to higher productivity.

8. The loss of biodiversity in a region may lead to:

(a) decline in ecosystems' productivity (the amount of food energy that is converted into the biomass.

(b) lowered resistance to environmental perturbations such as drought.

(c) Increased variability in certain ecosystem processes such as plant productivity, water use and pest and disease cycle.

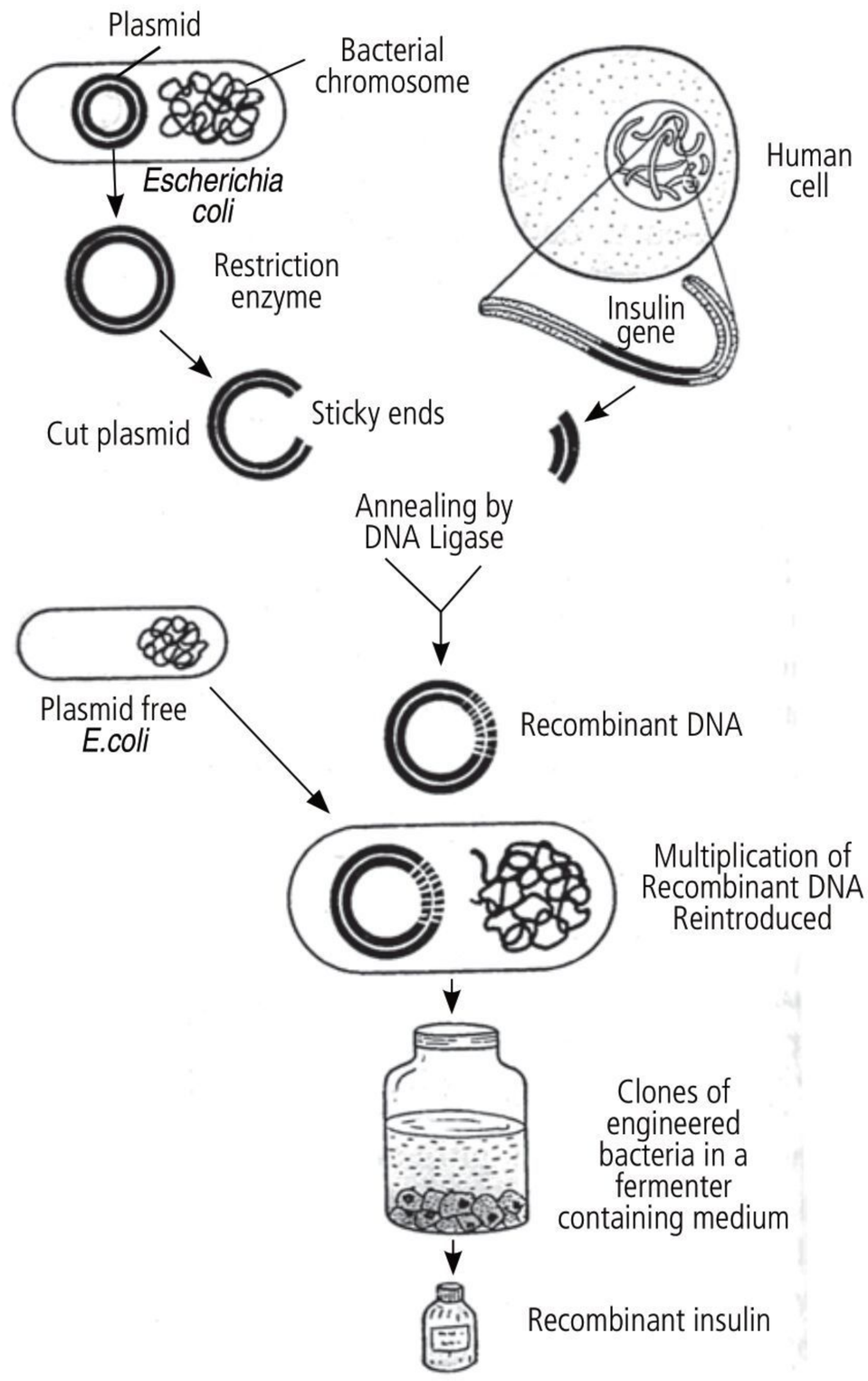
(d) Extinction of plants and animals due to habitat loss, fragmentation and biodiversity loss.

(e) Excessive exploitation of a species whether plant or animal reduces size of its population so that it becomes vulnerable to extinction.

9. *Bacillus thuringiensis* is used as biocontrol agent. It is available as dried spores which are mixed with water and sprayed onto vulnerable plants, where they are eaten by insect larvae. *Bacillus thuringiensis* forms a protein crystal which contain a toxic insecticidal protein. These Bt toxin protein exist as inactive prototoxins but once caterpillar ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystal. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually cause death of the insect. The Bt toxin is coded by *cry* gene.

The two crops that are protected efficiently from pests are Bt cotton and Bt corn plant.

10. Steps involved in gene transfer for the production of human insulin are as follows:



11. (a) Primary lymphoid organs are sites where immature lymphocytes differentiae into antigen-sensitive lymphocytes. Two primary lymphoid organ are:

(i) Bone morrow – All lymphocytes are produced and mature in bone morrow.

(ii) Thymus – T lymphocytes are matured in thymus of lymphocytes with antigen, which then proliferate to become effector cells. Secondary lymphoid organs provide sites for interaction. Spleen and lymph nodes are secondary lymphoid organs.

(i) Spleen acts as filter to blood by trapping blood borne microbes.

(ii) Lymph nodes trap microorganisms or antigens from lymph and tissue fluid. Antigens trapped are responsible for the activation of lymphocytes present there and cause the immune response.

(b) Doctors generally do not advise to undergo surgery of tonsil because they are secondary lymphoid organs. They act as filters to protect the body from antigens and aid in the activation of white blood cells which provides immunity.

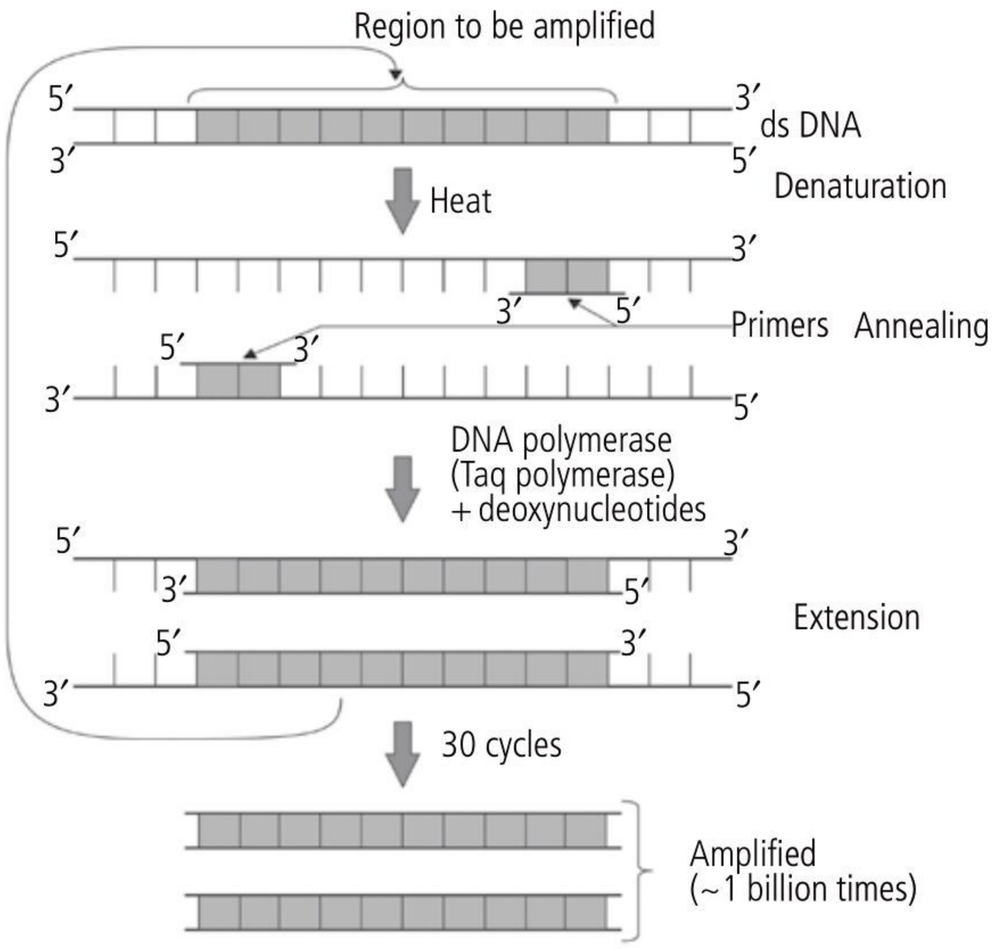
12. (a) RT-PCR stands for Reverse transcriptase – Polymerase chain reaction'.

(b) The various steps of polymerase chain reaction are:

(i) Denaturation : The target DNA is heated to a high temperature of 92–94°C resulting in the separation of its two strands. Each single strand of the DNA then acts as a template for DNA synthesis.

(ii) Primer annealing : The two oligosaccharide primers hybridise to each of the single stranded template DNA, since the sequence of the primer is complementary to the 3′ end of the template DNA.

(iii) Extension of primer : The *taq* DNA polymerase synthesises the DNA region between the primers, using DNTPs (deoxynucleoside triphosphate) and Mg^{2+}.



13. (a) (i) On the basis of three parameters, the following interpretations can be drawn by looking at the graph:

1. Average crop productivity was much higher in case of Bt crop (120 tonnes/Ha) as compared to the Non-Bt crop (80 tonnes/Ha). This is due to the fact that Bt crop is resistant to insects, nematodes, lepidopterans etc. and hence leads to higher productivity.
2. The input of pesticide in case of Bt crop is less as compared to Non-Bt crops. This is due to the fact that Bt crops are resistant to insects. The Bt toxin genes are incorporated which are insect group specific.
3. The Bt crop needs more water for their growth hence the amount of irrigation in litres/Ha is more in Bt crop as compared to non Bt-crop.

(ii) Looking at the higher productivity and lesser input of pesticides in Bt crops, I would like to cultivate Bt crop in my farm as plant productivity is higher and input of pesticides is lesser in Bt crops.

(iii) A farmer from Rajasthan would like to grow non-Bt crop as there is scarcity of water in Rajasthan and non-Bt crop requires less water.

OR

(b) (i) '*Eco*RI', '*Bam*HI' and '*Hind* III' are type II restriction enzymes. They are used in recombinant DNA technology. They recognise specific sites within the DNA and cut these sites.

(ii) Plasmid pBR322 has two resistance gene – ampicillin resistance (amp^R) and tetracycline resistance (tet^R) which are considered useful for selectable markers. The presence of restriction sites within the markers tet^R and amp^R permits an easy selection for recombinant and non-recombinant cells.

(iii) The plasmid and bacteriophages are efficient cloning vectors as they have ability to replicate within bacterial cells independent of the control of chromosomal DNA.

(iv) Biotechnologists always insert '*ori*' gene in their engineered cloning vector because *ori* is the sequence of DNA bases which is responsible for initiating replication. It is also responsible for controlling the copy number of the linked DNA.

(v) The experiment will not be successful if the alien DNA is ligated at *Hin*d III restriction site because there is no selectable marker at that site.

☺☺

TRIO

The same THREE LETTERS will complete these four words.

Can you find the three-letter sequence?

H Y – – –

– – – I U M

C A R O T E N – – –

P L – – – Y

Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month.
Winners' names will be published in next issue.

MONTHLY TEST DRIVE

This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 160

Series 4 : Evolution
Human Health and Diseases

Time : 40 Min.

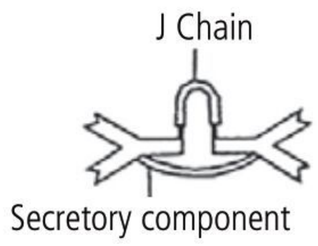
1. One of the possible early sources of energy was/were
(a) CO_2 (b) chlorophyll
(c) green plants (d) UV rays and lightning.

2. A person is suffering from diarrhoea with stools which are white like rice water and frequent vomiting. The pathogen responsible for this condition is
(a) *Giardia intestinalis* (b) *Entamoeba histolytica*
(c) *Vibrio cholerae* (d) *Fasciolopsis buski.*

3. Select the option which correctly places the following under homologous and analogous organs.
(i) Tendrils of *Bougainvillea* and *Cucurbita*
(ii) Eye of octopus and mammals
(iii) Flippers of penguins and dolphins
(iv) Forelimbs of cheetah and bat

	Homologous organs	**Analogous organs**
(a)	(i), (ii)	(iii), (iv)
(b)	(i), (iv)	(ii), (iii)
(c)	(ii), (iii)	(i), (iv)
(d)	(ii), (iv)	(i), (iii)

4. The human immunoglobulin in the given figure



(a) is bound to mast and basophil cells all over the body
(b) is found on the B cell surface
(c) acts as a mediator in an allergic response
(d) is found in saliva, mucus and colostrum.

5. According to Oparin's hypothesis of biogeny, the early protocell that gave rise to the first living cells were
(a) microspheres (b) coacervates
(c) proteinoids (d) stromatolites.

6. The cancers that are derived from mesoderm and include the cancers of tendons and adipose tissue are collectively called
(a) sarcomas (b) carcinomas
(c) melanomas (d) leukemias.

7. Which of the following is an avian feature of the *Archaeopteryx* ?
(a) Pneumatic bones (b) Each finger has a claw
(c) Intimate fusion of skull bones
(d) Free caudal vertebrae present

8. Which of the following conditions can be a result of alcoholism?
(a) Infertility (b) Liver Cirrhosis
(c) Diuresis (d) All of these

9. Match column I with column II and select the correct option.

Column I (Evolution of plants)		**Column II (Period)**
A.	Ginkgos	(i) Jurrasic period
B.	Ferns	(ii) Silurian period
C.	Zosterophyllum	(iii) Permian period
D.	Arborescent lycopods	(iv) Cretaceous period

(a) A-(i), B-(iii), C-(ii),D-(iv)
(b) A-(ii), B-(iv), C-(i),D-(iii)
(c) A-(iv), B-(i),C-(ii),D-(iii)
(d) A-(iv), B-(ii), C-(i),D-(iii)

10. A psychotropic drug that can cause a fall in blood pressure and bradycardia is
(a) valium (b) cocaine
(c) morphine (d) both (b) and (c).

11. Darwin realised about the inadequacies of the Natural selection theory because
(a) it did not explain presence of vestigial organs in animals
(b) environmental struggle could not be explained

(c) it failed to explain differential reproduction
(d) it could not explain inheritance of useful variations.

12. Read the following statements and select the correct option stating which ones are true (T) and which ones are false (F).

I. AIDS virus is a retrovirus that can replicate its genome with the help of reverse transcriptase enzyme inside host cell.
II. SCID is an autoimmune disease that occurs in individuals since birth.
III. Anaphylactic shock is a severe allergic reaction that can cause a quick rise in blood pressure and prove fatal.
IV. For the production of monoclonal antibodies, spleen cells of mouse are fused with myeloma cells that have the capacity to produce the desired antibodies.

	I	II	III	IV
(a)	T	T	F	F
(b)	T	F	F	F
(c)	T	F	T	T
(d)	F	F	T	T

13. Read the following statements and select the correct option.

Statement A - Egg laying and pouched mammals are only found in Australia.

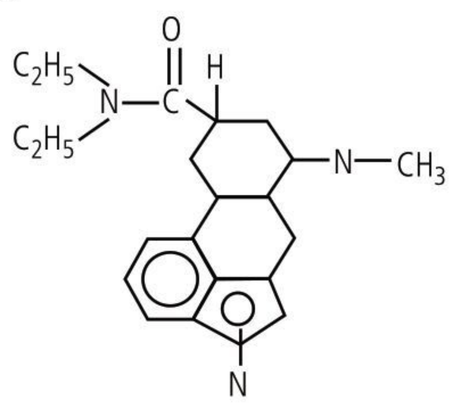
Statement B - Due to non-availability of a land route, placental mammals could not reach Australia.

(a) Both statements A and B are correct and B is the correct explanation of A.
(b) Both statements A and B are correct but B is not the correct explanation of A.
(c) Statement A is correct but B is incorrect.
(d) Both statements A and B are incorrect.

14. Select the mismatched option.

	Disease	Causative agent	Vector
(a)	Dengue fever	*Flavi-ribo* virus	*Aedes aegypti*
(b)	Amoebic dysentery	*Entamoeba histolytica*	*Anopheles*
(c)	Kala-azar	*Leishmania donovani*	*Phlebotomus argentipes*
(d)	Filariasis	*Wuchereria bancrofti*	*Culex*

15. The drug which has the following chemical structure produces effects such as



(a) hallucinations and horrible dreams
(b) alertness and elevated self confidence
(c) inability to concentrate and induces lethargy
(d) wakefulness and suppress hunger.

16. When a child gets vaccinated with salk vaccine for poliomyelitis, it is

(a) natural active immunity
(b) artificial passive immunity
(c) natural passive immunity
(d) artificial active immunity.

17. Which of the following differences are correct between allopatric and sympatric speciation?

S.No.	Allopatric speciation	Sympatric speciation
(i)	Occurs from segment within a population.	Occurs in spatially isolated population.
(ii)	Rarely the isolating mechanism breaks down.	Isolating mechanism more suspectable to breakdown.
(iii)	Speciation is slow.	Speciation is rapid.
(iv)	Barrier is physical.	Barrier is genetic and ecological.
(v)	Interspecific crossings barrier are fewer.	Interspecific crossings barriers are more pronounced.

(a) (i), (iii) and (v) (b) (ii) and (iii)
(c) (iii), (iv) and (v) (d) (ii), (iii) and (v)

18. Identify the mismatched pair.

(a) Herbert Spencer – Survival of the fittest
(b) Alfred Wallace – An essay on Principles of Population
(c) Sewall Wright – Genetic Drift
(d) Ghiselin – Pseudospecies

19. The type of natural selection that formed two sub-population of sunflowers in the Sacramento Valley of California over a period of 12 years was

(a) disruptive selection (b) directional selection
(c) stabilising selection (d) both (a) and (c).

20. Study the following table and identify the correct option for A, B and C.

	Fossil	Cranial capacity	Time of appearance
I.	*Australopithecus*	**A**	5 mya
II.	*Homo sapiens neanderthalensis*	1400 cc	**B**
III.	**C**	900 cc	1.5 mya

	A	B	C
(a)	700 cc	34000 years ago	*Homo erectus*
(b)	500 cc	11000 years ago	*Homo habilis*
(c)	800 cc	50,000 years ago	*Ramapithecus*
(d)	500 cc	100,000 years ago	*Homo erectus*

21. Malignant malaria is caused by _____ and it has a recurrence of fever after every _____ hours.
(a) *Plasmodium falciparum*, 48
(b) *Plasmodium vivax*, 48
(c) *Plasmodium malariae*, 72
(d) *Plasmodium ovale*, 48

22. The complement proteins present in the serum of the blood and on plasma membranes destroy the microbes by
(a) phagocytosis (b) inflammation
(c) cytolysis (d) all of these.

23. Stabilising selection favours
(a) both extreme forms of a trait
(b) intermediate forms of a trait
(c) environmental differences
(d) one extreme form over the other extreme form and over intermediate forms of a trait.

24. Which of the following is not a procedure used by antibodies to inactivate the antigen?
(a) Opsonisation (b) Neutralisation
(c) Proliferation (d) Precipitation

25. Which of the following statements are incorrect ?
(i) Hugo de Vries called mutations as saltation because they brought speciation.
(ii) Genetic drift is directional and can cause elimination of certain alleles in the population.
(iii) Gene flow will not occur if gene migration happens multiple times.
(iv) Founder effect results in formation of a different genotype in a new settlement.
(a) (i) and (iv) (b) (iii) and (iv)
(c) (i) and (iii) (d) (ii) and (iii)

26. Mucosal associated lymphoid tissue (MALT) consists of
(a) lymphocytes, macrophages and dendritic cells
(b) erythrocytes, lymphocytes and neutrophils
(c) dendritic cells, macrophages and monocytes
(d) macrophages, neutrophils and dendritic cells.

27. During industrial revolution in Great Britain, the population of black moths increased more than the white moths because of
(a) natural selection (b) reproductive isolation
(c) hybridisation (d) both (a) and (b).

28. A person can suffer from fungal infection of skin, hair and nails if the causative agent is
(a) *Trichophyton* (b) *Microsporum*
(c) *Epidermophyton* (d) all of these.

29. According to Hardy-Weinberg Principle, gene frequencies in a population will remain constant if there
(a) are no mutations and gene flow
(b) is no genetic drift
(c) is no genetic recombination and natural selection pressure
(d) all of these.

30. Antigen binding part in an antibody consists of
(a) variable region of heavy chains and constant region of light chain
(b) variable region of heavy chain and variable region of light chain
(c) constant region of heavy chain and constant region of light chain
(d) constant region of heavy chain and variable region of light chain.

31. Which of the following was/were not a part of the Millers' experiment?
(a) Electric discharges from electrodes at 800°C
(b) Condenser
(c) Methane, ammonia, carbon dioxide and water vapour
(d) Stopcock

Contributed by : Baba subhdeb, (West Bengal)

SOLUTIONS TO JUNE 2022 WORD GRID

S	P	K	L	Q	M	J	M	L	S	A	V	X	U	C
B	P	H	T	S	Y	O	P	R	O	S	I	E	K	O
I	L	A	E	S	C	I	O	P	H	Y	T	E	S	L
O	E	P	M	R	O	P	I	O	I	D	S	N	K	O
P	I	T	I	M	B	I	B	I	T	I	O	N	V	S
I	O	E	L	P	I	A	T	V	C	Q	L	M	S	T
R	T	N	E	O	O	Y	R	A	D	U	L	A	L	R
A	R	G	C	M	N	K	G	I	Z	Z	A	R	D	U
C	O	F	A	C	T	O	R	T	U	G	L	O	I	M
Y	P	L	D	H	C	H	I	A	S	M	A	T	A	O
E	Y	A	S	A	P	O	S	T	E	R	N	U	M	S
S	M	G	L	R	K	S	L	O	T	A	G	A	R	E
T	G	E	M	A	S	C	U	L	A	T	I	O	N	N
K	I	L	T	O	T	I	P	O	T	E	N	C	Y	R
P	Q	T	L	O	V	S	C	L	T	E	A	N	K	S

1. Mycobiont
2. Radula
3. Herbarium
4. Gizzard
5. Sciophytes
6. Cofactor
7. Chiasmata
8. Imbibition
9. Angina
10. Sternum
11. Emasculation
12. Colostrum
13. Pleiotropy
14. Opioids
15. Totipotency
16. Biopiracy
17. Ecads
18. Rosie
19. Hapten
20. Agar

32. Which of the following options consists exclusively of bacterial diseases?
(a) Anthrax, genital warts, syphilis, cholera
(b) Tuberculosis, gonorrhoea, typhoid, pneumonia
(c) Mumps, diphtheria, cholera, leucorrhoea
(d) Scarlet fever, botulism, chicken pox, pneumonia

33. Which one is not a vestigial organ?
(a) Wings of kiwi (b) Coccyx in man
(c) Pelvic girdle of python (d) Flipper of seal

34. Cell mediated immunity differs from antibody mediated immunity by
(a) providing immunity against cancer
(b) defending the body against viruses and bacteria
(c) consisting of B-lymphocytes
(d) not responding to transplants.

35. Spallanzani performed experiment on animal and vegetable broth to disapprove
(a) theory of panspermia
(b) chemogeny
(c) theory of spontaneous generation
(d) theory of eternity of life.

36. Select the correct option that correctly fills the blanks.
I. _____ is a type of organ transplantation between individuals of same species but not genetically identical.
II. A species that has two or more varieties of subspecies is called _____ species.
III. According to _____ theory, a single mutation can at times give rise to a new species.
IV. _____ cannot induce an immune response by themselves but can do so in combination with a carrier.

	I	II	III	IV
(a)	Xenograft	sibling	mutation	Interferons
(b)	Allograft	polytypic	mutation	Haptens
(c)	Isograft	parapatric	Lamarck's	Perforins
(d)	Xenograft	sibling	Darwin's	Interferons

37. Which of the following statements is incorrect?
(a) Due to continental drift, when South America joined North America, the animals lived there were overridden by North American fauna.
(b) Darwin's finches of Galapagos Islands developed different modified beaks due to divergent evolution.
(c) *Homo sapiens neanderthalensis* was probably lived in Ethiopia and Tanzania.
(d) Hepatitis B vaccine is produced from yeast.

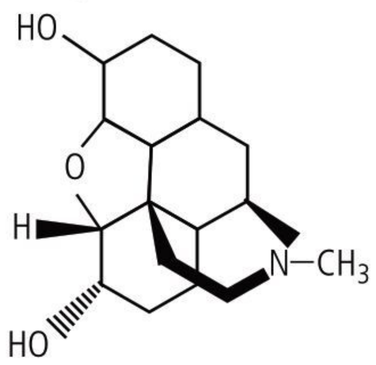
38. Which of the following is not a physiological barrier of innate immunity?
(a) Gastric juice (b) Saliva
(c) Mucus (d) Tears

39. Identify correctly matched figure with its description.

A.

B.

C.

D. 

(a) A is leaf of plant from which drug commonly called as smack is obtained.
(b) B is a plant from which hallocinogenic drugs are obtained.
(c) C is a disease caused by ringworm.
(d) D is chemical structure of cannabinoids obtained from the inflorescence of plant *Cannabis sativa*.

40. Match column I with column II and select the correct option.

	Column I		Column II
A.	Dr. P. L. Sclater	(i)	Synthetic theory of evolution
B.	Robert Gallo	(ii)	Complement system
C.	Georges Cuvier	(iii)	Biogeographical realms
D.	Jules Bordet	(iv)	HTLV-I
E.	G.L. Stebbins	(v)	Theory of catastrophism

(a) A-(iii), B-(iv), C-(v), D-(ii), E-(i)
(b) A-(i), B-(iii), C-(ii), D-(v), E-(iv)
(c) A-(ii), B-(iii), C-(v), D-(iv), E-(i)
(d) A-(i), B-(iv), C-(ii), D-(iii), E-(v)

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SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

PRACTICE PAPER

NEET 2022

BOTANY (SECTION-A)

1. Person with blood group O is considered as universal donor because
(a) both A and B antibodies are present in the plasma but no antigens on RBC
(b) both A and B antigens are present on the RBC but no antibodies are present in the plasma.
(c) no antigen present on RBC and no antibody present in plasma
(d) only antigen A present on RBC and antibody B present in plasma.

2. Identify the correct sequence of taxonomic categories in the ascending order.
(a) Kingdom → Phylum → Class → Order → Family → Genus → Species
(b) Genus → Species → Order → Family → Class → Phylum → Kingdom
(c) Species → Genus → Family → Order → Class → Phylum → Kingdom
(d) Kingdom → Phylum → Order → Class → Family → Genus → Species

3. If the child's blood group is 'B', then the blood group of the parents cannot be
(a) AB and O (b) A and O
(c) A and B (d) B and O.

4. Which one of the following is a stop codon?
(a) UAU (b) UGU
(c) UUU (d) UGA

5. Which of the following is not an example of *ex – situ* conservation?
(a) Sacred groves
(b) Zoological parks
(c) Botanical garden
(d) Wildlife safari park

6. Identify the meiotic stage in which synaptonemal complex dissolves partially.
(a) Pachytene (b) Diplotene
(c) Diakinesis (d) Zygotene

7. The osmotic potential and water potential of pure water is
(a) zero and 100 (b) 100 and zero
(c) zero (d) 200 and 100.

8. Select the mismatched pair.
(a) Nitrification – *Nitrobacter*
(b) Nitrogen fixing bacteria – *Clostridium*
(c) Denitrification – *Thiobacillus*
(d) Ammonification – *Pseudomonas*

9. The chromosome in which centromere is situated at the terminal area is called
(a) metacentric (b) submetacentric
(c) acrocentric (d) telocentric.

10. Which of the following simple tissues is made up of dead cells?
(a) Collenchyma (b) Parenchyma
(c) Sclerenchyma (d) Both (a) and (c)

11. In phaeophyceae, the mode of sexual reproduction is
(a) isogamy (b) anisogamy
(c) oogamy (d) all of these.

12. Casparian strips are found in
(a) periderm (b) endodermis
(c) hypodermis (d) epidermis.

13. Which moss is known as peat moss?
(a) *Funaria* (b) *Sphagnum*
(c) *Marchantia* (d) *Riccia*

14. A woman with 45 chromosomes shows short stature and sterility. These are the characteristics of
(a) Down's syndrome (b) Albinism
(c) Turner's syndrome (d) Klinefelter's syndrome.

15. *t*RNA and hnRNA are synthesised by
(a) RNA pol III and RNA pol I
(b) RNA pol II and RNA pol I
(c) RNA pol II and RNA pol III
(d) RNA pol III and RNA pol II.

16. According to Central Pollution Control Board (CPCB), the size of the particulate matter that is responsible for causing harm to human health is
(a) 10 μm (b) 2.5 μm (c) 12 μm (d) 5 μm.

17. Biofortification is
(a) the method of producing thousands of plants through tissue culture
(b) breeding crops with higher levels of vitamins and minerals
(c) the fusion of isolated protoplasts from two different varieties of plants
(d) the capacity to generate a whole plant from explant.

18. If a haemophilic man marries a woman who is also the carrier of haemophilia, then their daughters will be
(a) all normal
(b) three fourth haemophilic and one fourth normal
(c) one half haemophilic and one half carrier
(d) all haemophilic.

19. If 20 J of energy is trapped at producer level, then how much energy will be available to fish in the following food chain?
Phytoplankton → Zooplankton → Fish → Man
(a) 0.02 J (b) 0.2 J (c) 0.002 J (d) 2 J

20. Placentation in *Argemone* and *Dianthus* are respectively
(a) free central and marginal
(b) parietal and marginal
(c) axile and free central
(d) parietal and free central.

21. Exine of pollen grain is made up of
(a) cellulose and pectin (b) lipids and carotenoids
(c) tectum (d) sporopollenin.

22. The Montreal Protocol was signed in
(a) 1985 (b) 1982 (c) 1987 (d) 1988.

23. The Verhulst–Pearl logistic growth is expressed by the equation :
(a) $\frac{dN}{dt} = rN$ (b) $\frac{dN}{dt} = rN\left(\frac{N-K}{N}\right)$
(c) $\frac{dt}{dN} = rN\left(\frac{K-N}{N}\right)$ (d) $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

24. Which of the following events is the characteristic feature of metaphase?
(a) Chromosomes lie at the equator and attached to the spindle fibres by their kinetochores.
(b) Chromosomes cluster at opposite spindle poles.
(c) Chromosomal material condenses to form compact mitotic chromosomes.
(d) Centrosome radiates out microtubules called asters.

25. In angiosperms, the embryo sac contains
(a) 7 nuclei and 8 cells (b) 8 nuclei and 8 cells
(c) 8 nuclei and 7 cells (d) 7 nuclei and 7 cells.

26. Kranz anatomy is observed in the leaves of
(a) *Sorghum* (b) rice
(c) potato (d) barley.

27. The correct floral formula of *Petunia* is
(a) $\oplus \male P_{3+3} A_{3+3} \underline{G}_{(3)}$
(b) % $\male K_{(5)} C_{1+2+(2)} A_{(9)+1} G_1$
(c) $\oplus \male K_{(5)} \overbrace{C_{(5)} A_5} G_{(2)}$
(d) Br $\oplus \male P_{3+3} A_{3+3} G_3$

28. Which one of the following options contains only the dominant traits of garden pea studied by Mendel?
(a) Round seed shape, violet flower, terminal flower position
(b) Tall stem, green pod colour, constricted pod shape
(c) Axial flower position, inflated pod shape, yellow seed colour
(d) Violet flower, constricted pod, terminal flower position

29. Which of the following is not an example of synthetic auxin?
(a) NAA (b) IAA
(c) 2, 4-D (d) Both (b) and (c)

30. Ozone hole is measured in
(a) decibel (b) dobson units (DU)
(c) parts per million (PPM) (d) cubic centimeter.

31. Prothallus of pteridophytes is
(a) conspicuous, small, multicellular, free-living, photosynthetic thalloid gametophyte
(b) inconspicuous, small, multicellular, free-living, photosynthetic thalloid gametophyte
(c) inconspicuous, large, unicellular, free-living, photosynthetic thalloid gametophyte
(d) inconspicuous, small, multicellular, free-living, non-photosynthetic thalloid sporophyte.

32. In a monocot leaf stomata are present
(a) only on abaxial surface
(b) only on adaxial surface
(c) on both the surfaces
(d) more on abaxial surface.

33. The wheat grain has an embryo with one large, shield shaped cotyledon known as
(a) scutellum (b) coleoptile
(c) epiblast (d) coleorhiza.

34. The respiratory quotient value of 0.7 is obtained for
(a) anaerobic respiration (b) glucose
(c) proteins (d) tripalmitin.

35. Which one of the following belongs to the Family Muscidae?
(a) House fly (b) Fire fly
(c) Grasshopper (d) Cockroach

UNSCRAMBLED WORDS

JUNE 2022

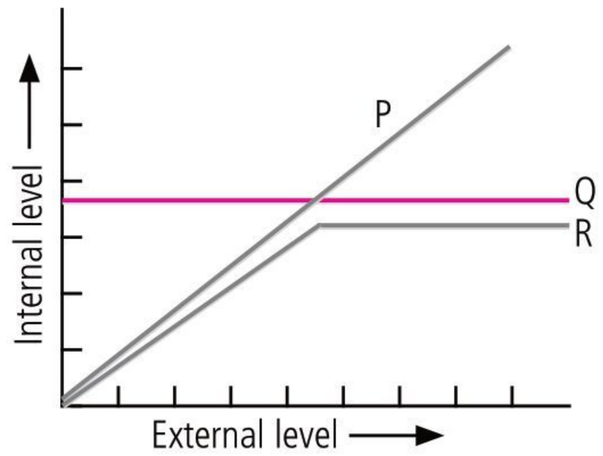
1-d-PHOTORESPIRATION 2-f- AXONEME
3-h-THROMBOCYTE 4-g- ANTHERIDIUM
5-c-VERNALISATION 6-i- FIMBRIAE
7-j- NUCLEOSOME 8 -e-TOTIPOTENCY
9-b- COMMENSALISM 10-a- REFORESTION

Winner : *Jiban deep Ghosh (West Bengal)*

SECTION-B

Attempt any 10 Out of 15 Questions

36. Identify P, Q and R in the given diagrammatic representation of response of organisms to abiotic factors and select the correct option.



(a) P can maintain constant internal environment.
(b) Q changes its body temperature according to that of environment.
(c) R has the ability to regulate its body temperature to a limited extent only.
(d) P consumes larger amount of energy to maintain constant body temperature.

37. A pea plant heterozygous for stem height is selfed and 1200 seeds are produced during the cross that are subsequently germinated. How many seedlings would have the parental phenotype?
(a) 800 (b) 1600 (c) 600 (d) 900

38. Read the following statements and select the correct ones.
(i) PS I is located on both the grana and stroma lamellae.
(ii) In PS II, the reaction centre has an absorption peak at 700 nm.
(iii) The splitting of water is associated with the PS II.
(iv) PS I absorbs light energy, gets excited and starts the Z scheme of transfer of electrons.
(a) (i) and (iii) (b) (i) and (iv)
(c) (ii) and (iii) (d) (ii) and (iv)

39. Match column I with column II and select the correct option.

	Column I		Column II
A.	RER	(i)	Lipid synthesis
B.	Lysosome	(ii)	Formation of glycoproteins
C.	Golgi complex	(iii)	Protein synthesis
D.	SER	(iv)	Suicide bags

(a) A-(i), B-(iv), C-(ii), D-(iii)
(b) A-(iv), B-(ii), C-(iii), D-(i)
(c) A-(i), B-(ii), C-(iii), D-(iv)
(d) A-(iii), B-(iv), C-(ii), D-(i)

40. Which of the following statements is/are not correct?
(i) Cleistogamous flowers are closed and undergo self pollination.
(ii) *Hydrilla* and *Vallisneria* pollinates by water.
(iii) In entomophilous flowers, pollen grains are produced in very large number and the flowers are devoid of nectar.
(iv) In anemophilous flowers, stigmas are unbranched and sticky.
(a) (i) and (iv) (b) (ii) and (iii)
(c) (iii) and (iv) (d) (ii) and (iv)

41. Read the following statements and select the incorrect ones.
(i) Translation occurs in cytoplasm.
(ii) Eukaryotic *m*RNA is usually polycistronic.
(iii) The direction of the growth of lagging strand is 5′ – 3′.
(iv) Prokaryotic DNA replication occurs inside the cytoplasm.
(a) (ii) and (iii) (b) (ii) and (iv)
(c) (i) and (iii) (d) (iii) and (iv)

42. Which of these organelles does not contain ribosomes?
I. Rough endoplasmic reticulum
II. Chloroplast
III. Golgi apparatus
IV. Mitochondria
(a) I and II only (b) I and IV only
(c) IV only (d) III only

43. Consider the following statements with reference to facilitated transport.
A. Requires ATP energy
B. Transport saturates
C. Highly selective
D. Requires special membrane properties
E. Uphill transport
Of the above statements
(a) A, B and C are relevant but D and E are irrelevant
(b) B, C and E are relevant but A and D are irrelevant
(c) C, D and E are relevant but A and B are irrelevant
(d) B, C and D are relevant but A and E are irrelevant.

44. The process which makes major difference between C_3 and C_4 plants is
(a) glycolysis (b) Calvin cycle
(c) photorespiration (d) respiration.

45. One mineral activates the enzyme catalase and the other is a constituent of the ring structure of chlorophyll. These minerals are respectively
(a) iron and magnesium
(b) iron and manganese
(c) magnesium and manganese
(d) calcium and magnesium.

46. Conversion of pyruvic acid into ethyl alcohol is facilitated by the enzymes
(a) carboxylase
(b) phosphatase
(c) dehydrogenase
(d) decarboxylase and dehydrogenase.

47. One hormone is used to speed up the malting process in barley, another is used to promote flowering in pineapple, while the third helps in the delay of leaf senescence. These are respectively
(a) auxin, gibberellin and cytokinin
(b) gibberellin, cytokinin and auxin
(c) gibberellin, auxin and cytokinin
(d) cytokinin, auxin and gibberellin.

48. Primary endosperm nucleus (PEN) is formed by the fusion of
(a) 2 polar nuclei + 1 synergid cell nucleus
(b) 1 polar nucleus + 1 antipodal cell nucleus + 1 synergid cell nucleus
(c) 2 polar nuclei + 1 male gamete nucleus
(d) 2 antipodal cell nuclei + 1 male gamete nucleus.

49. If five CO_2 molecules enters the Calvin cycle, then the number of ATP and NADPH required will be
(a) 12 ATP and I5 NADPH (b) 15 ATP and 10 NADPH
(c) 15 ATP and 15 NADPH (d) 10 ATP and 15 NADPH.

50. Which of the following is correct?
(a) Population change = (Birth + immigration) – (death + emigration)
(b) Population change = (Birth + immigration) + (death + emigration)
(c) Population change = (Birth + emigration) + (death – immigration)
(d) Population change = (Birth – immigration) – (death + emigration)

ZOOLOGY (SECTION-A)

51. Which one of the following is an example of analogous organs?
(a) Forelimbs of man, cheetah, whale and bat
(b) Thorns of *Bougainvillea* and *Cucurbita*
(c) Flippers of penguins and dolphins
(d) Heart of different vertebrates

52. Which group of animals belongs to the Subphylum Urochordata?
(a) *Herdmania, Doliolum, Amphioxus*
(b) *Petromyzon, Ascidia, Salpa*
(c) *Amphioxus, Herdmania, Chelone*
(d) *Ascidia, Salpa, Doliolum*

53. Which of the following amino acid contains hydroxymethyl group?
(a) Methionine (b) Serine
(c) Arginine (d) Histidine

54. Identify a microorganism that can produce biomass of protein.
(a) *Methylophilus methylotrophus*
(b) *Monoscus purpureas*
(c) *Trichoderma polysporum*
(d) *Aspergillus niger*

55. Read the following statements and select the incorrect option.
(a) Enzymes get denatured at high temperature.
(b) Enzymes are highly specific.
(c) Enzymes are mostly proteins but some are lipids too.
(d) Enzymes require optimum pH and temperature for maximum activity.

56. The simple ciliated epithelial cells occur in
(a) terminal bronchioles and fallopian tube
(b) pancreatic duct and thyroid follicle
(c) Fallopian tube and PCT
(d) lining of the stomach and intestine.

57. Widal test is used for the diagnosis of
(a) anthrax (b) tuberculosis
(c) typhoid (d) pneumonia.

58. Which of the following is the correct sequence of spermatogenesis?
(a) Spermatogonia – Spermatids – Spermatocyte – Spermatozoa
(b) Spermatogonia – Spermatocyte – Spermatids – Spermatozoa
(c) Spermatids – Spermatogonia – Spermatocyte – Spermatozoa
(d) Spermatocyte – Spermatogonia – Spermatids – Spermatozoa

59. The crossing between Bikaneri ewes and Merino rams results in
(a) Hisardale (b) Dorset
(c) Lohi (d) Nali.

60. ELISA is widely used diagnostic test for
(a) pneumonia (b) typhoid
(c) AIDS (d) tuberculosis.

61. Outbreeding can be helpful in
(a) accumulation of superior genes
(b) overcoming inbreeding depression
(c) producing purelines of animals
(d) breeding of related animals.

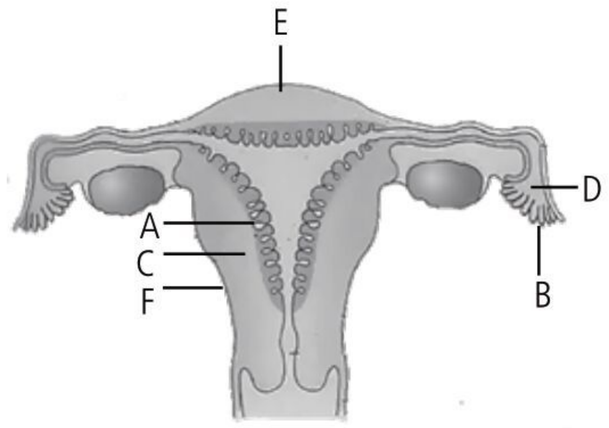
62. The mode of reproduction in *Paramecium* is
(a) multiple fission (b) budding
(c) fragmentation (d) binary fission.

63. Which of the following sets of diseases is caused by bacteria?
(a) Mumps and leprosy
(b) Chikungunya and yellow fever
(c) Plague and Dysentery
(d) Yellow fever and diphtheria

64. Which type of tissue correctly matches with its location?

	Tissue	**Location**
(a)	Dense connective tissue	Tendons and Ligaments
(b)	Areolar tissue	Heart
(c)	Specialised connective tissue	Blubber
(d)	Adipose tissue	Trachea

65. Identify the parts labelled as A, B, C, D, E and F in the given figure of female reproductive system and select the correct option.



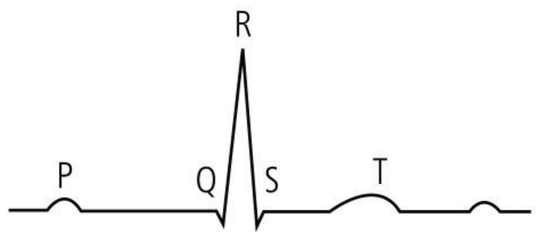
(a) B-Infundibulum, F-Perimetrium, E-Ampulla
(b) A-Endometrium, D-Fimbriae, C-Perimetrium
(c) C-Myometrium, D-Infundibulum, E-Fundus
(d) B-Fimbriae, C-Perimetrium, D-Infundibulum.

66. Cocaine is obtained from
(a) *Papaver somniferum* (b) *Cannabis sativa*
(c) *Atropa belladona* (d) *Erythroxylum coca.*

67. Which of the following is a hormone releasing IUD?
(a) Progestasert (b) Multiload 375
(c) Lippes loop (d) Cu7

68. Identify the mismatched pair.
(a) Methanogens – Archaebacteria
(b) Heterocyst – *Nostoc*
(c) Vibrio – spherical bacteria
(d) *Streptococcus* – Streptokinase

69. The given diagram represents the ECG of a normal human. Which one of its components is correctly interpreted below?



(a) QRS complex – Ventricular depolarisation
(b) T wave – Atrial repolarisation
(c) P wave – Ventricular repolarisation
(d) Q wave marks the end of systole

70. Which of the following is not an example of basidiomycetes?
(a) *Puccinia* (b) *Ustilago*
(c) *Agaricus* (d) *Rhizopus*

71. *cryIIAb* and *cryIAb* obtained from *Bacillus thuringiensis* are effective against
(a) cotton bollworms and corn borer
(b) cotton bollworms only
(c) nematodes
(d) corn borer and cotton bollworms.

72. An example of endomycorrhiza is
(a) *Glomus* (b) oak
(c) peach (d) pine.

73. During oogenesis, the second meiotic division results in the formation of
(a) a second polar body and a haploid ovum
(b) two second polar bodies and a haploid ovum
(c) a second polar body and a diploid ovum
(d) a haploid ovum only.

74. Select the option that correctly represents the enzymatic composition of intestinal juice?
(a) Aminopeptidase, Amylase, Rennin
(b) Lipase, Maltase, Dipeptidase
(c) Chymotrypsin, Lactase, Pepsin
(d) Lipase, Rennin, Sucrase

75. Which one of the following animals is correctly matched with its characteristics?
(a) *Antedon* – Radially symmetrical and fertilisation is external.
(b) *Ancylostoma* – Rasping organ called radula is present.
(c) *Aplysia* – Bilaterally symmetrical, diploblastic and pseudocoelomate.
(d) *Limulus* – Body is cylindrical and is composed of proboscis, collar and trunk.

76. The enzyme enterokinase helps in conversion of
(a) protein into polypeptides
(b) trypsinogen into trypsin
(c) caseinogen into casein
(d) pepsinogen into pepsin.

77. Vital capacity is
(a) TV + IRV (b) TV + ERV
(c) RV + ERV (d) TV + IRV + ERV.

78. The fetal ejection reflex in humans triggers the release of
(a) oxytocin from fetal pituitary
(b) human chorionic gonadotropin (hCG) from placenta
(c) human placental lactogen (hPL) from placenta
(d) oxytocin from maternal pituitary.

79. Bipolar neurons are found in
(a) retina (b) choroid
(c) cornea (d) sclera.

Mnemonic...

Globular proteins → GHARMII

G - Globin (Protein part of Haemoglobin)
H - Histone (Eukaryotic DNA)
A - Albumin (Maintain BCOP*)
R - Rubisco (Enzyme in Calvin cyle)
M -Myoglobin (Pigment in muscles for O_2 transport)
I - Insulin (Pancreatic hormone)
I - Immunoglobulins (Antibodies)
(*BCOP – Blood colloidal osmotic pressure)

80. What is the partial pressure of oxygen in atmospheric air?
(a) 159 (b) 104 (c) 40 (d) 95

81. Grafted kidney may be rejected in a patient due to
(a) passive immune response
(b) innate immune response
(c) humoral immune response
(d) cell-mediated immune response.

82. Which cell must be present in mucus secreting organs?
(a) Goblet cell (b) Paneth cell
(c) Oxyntic cell (d) Peptic cell

83. Elution means
(a) making the DNA bands visible under UV radiation
(b) separation of DNA fragments on agarose gel
(c) isolating alien DNA from the choice organism
(d) cutting and extraction of DNA bands from the agarose gel.

84. Concanavalin A is
(a) a pigment (b) an alkaloid
(c) an essential oil (d) lectin.

85. RNA interference which is employed in making tobacco plant resistant to *Meloidogyne incognita* is essentially involved in
(a) preventing the process of replication of DNA
(b) preventing the process of translation of *m*RNA
(c) preventing the process of splicing of hnRNA
(d) preventing the process of transcription.

SECTION-B

Attempt any 10 Out of 15 Questions

86. Select the correct statement.
(a) PCT is lined by simple columnar epithelium that increases surface area for reabsorption.
(b) The ascending limb of loop of Henle is impermeable to water but permeable to electrolytes.
(c) In juxtamedullary nephrons loop of Henle is very short and extend very little into the medulla.
(d) Collecting duct is lined by squamous epithelium.

87. In a population of 2000 individuals, 500 belong to the genotype AA. What would be the frequency of heterozygotes in this population?
(a) 0.8 (b) 0.5 (c) 0.6 (d) 0.3

88. Select the correctly matched pair.
(a) Pivot joint – Between carpal and metacarpal of thumb.
(b) Saddle joint – Between humerus and pectoral girdle
(c) Hinge joint – Joint present in elbow and knee
(d) Fibrous joint – Joints between the vertebrae

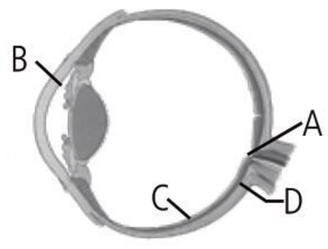
89. Select the option which correctly matches the endocrine gland with the hormone it secretes and its function.

	Endocrine gland	Hormone	Function
(a)	Parathyroid gland	PTH	It decreases the Ca^{2+} levels in blood.
(b)	Adrenal gland	Norepinephrine	It increases the activity of heart.
(c)	Pineal gland	Melatonin	It increases pupillary dilation.
(d)	Thymus	T_4	It promotes production of antibodies.

90. Read the following statements and select the correct option stating which ones are true (T) and which ones are false (F).
A. In Phylum Porifera, fertilisation is mainly external and development is indirect.
B. In Phylum Ctenophora, bioluminescence is a well marked character.
C. In *Nereis*, Parapodia are present for swimming.
D. Cnidarians exhibit tissue level organisation and are triploblastic.

	A	B	C	D
(a)	F	T	F	T
(b)	T	T	F	F
(c)	F	T	T	F
(d)	T	F	T	F

91. The diagram of human eye is given below. Identify the functions/ characteristics of the parts labelled as A, B, C and D in the diagram and select the correct option.



(a) D – Sclera – It contains many collagen fibres and maintains the shape of the eye ball.
(b) B – Vitreous chamber – It is the space between the cornea and the lens.
(c) C – Retina – It contains three layers of neural cells and two types of photoreceptor cells.
(d) A – Fovea – Photoreceptor cells are not present in this region.

92. Select the correctly matched pair.
(a) Bacteria infected cell – Interferon
(b) T cell – antibodies
(c) Physiological barrier – NK cells
(d) Cellular barrier – PMNL-neutrophils

QUIZ BOWL **ANSWERS JUNE 2022**

Algae	Fungi	Bacteria	Cyanobacteria
7	8	1	2
11	9	6	3
10	12	–	4, 5

93. Select the incorrect statement regarding electrophoresis.
(a) DNA fragments are separated according to their size.
(b) The smaller the fragment size, the farther it moves in the agarose gel.
(c) Positively charged molecules move towards anode and negatively charged molecules move towards cathode.
(d) The separated DNA fragments can be seen only after staining the DNA with ethidium bromide.

94. Select the incorrect statements.
(a) Euglenoids behave like heterotrophs in absence of sunlight.
(b) In *Gonyaulax*, the cell walls are embedded with silica and thus indestructible.
(c) In Phycomycetes, asexual reproduction takes place by zoospores or aplanospores.
(d) *Trypanosoma* is an example of flagellated protozoan.

95. Select the correct statements regarding viroids.
(i) Viroids were discovered by T.O. Diener as free infectious DNA.
(ii) Viroids are smaller than viruses.
(iii) Viroids lack the protein coat present in viruses.
(iv) Viroids are known to cause diseases in animals only.
(a) (ii) and (iii) (b) (i) and (iii)
(c) (i) and (ii) (d) (ii) and (iv)

96. Which of the following is wrongly matched in the given table?

	Microbe	Application
(a)	*Propionibacterium sharmanii*	Production of swiss cheese
(b)	*Trichoderma polysporum*	Immunosuppressive agent
(c)	*Penicillium roqueforti*	Production of antibiotic
(d)	*Acetobacter aceti*	Production of acetic acid

97. Match the hominids with their correct brain size.
(A) *Homo habilis* (i) 900cc
(B) *Homo neanderthalensis* (ii) 1350 cc
(C) *Homo erectus* (iii) 650-800cc
(D) *Homo sapiens* (iv) 1400cc
Select the correct option.

	(A)	(B)	(C)	(D)
(a)	(iv)	(iii)	(i)	(ii)
(b)	(iii)	(i)	(iv)	(ii)
(c)	(iii)	(ii)	(i)	(iv)
(d)	(iii)	(iv)	(i)	(ii)

98. Match the following regarding the morphology of cockroach and choose the correct option.

List-I		List-II	
(i)	Tergites	A.	Forewings
(ii)	Tegmina	B.	Upper lip
(iii)	Hypopharynx	C.	Dorsal sclerite
(iv)	Labium	D.	Tongue
(v)	Labrum	E.	Lower lip

(a) (i)-D, (ii)-E, (iii)-C, (iv)-B, (v)-A
(b) (i)-B, (ii)-C, (iii)-E, (iv)-D, (v)-A
(c) (i)-E, (ii)-A, (iii)-C, (iv)-D, (v)-B
(d) (i)-C, (ii)-A, (iii)-D, (iv)-E, (v)-B

99. In a cardiac cycle, if the stroke volume is 70 mL and heart rate is 72 beats/minute, then cardiac output is
(a) 142 mL/minute (b) 72 mL/minute
(c) 1070 mL/minute (d) 5040 mL/minute

100. Which one of the following options gives the correct categorisation of six animals according to the type of nitrogenous waste they give out?

	Ammonotelic	Ureotelic	Uricotelic
(a)	Pigeon, humans	Aquatic amphibia, lizards	Cockroach, frog
(b)	Frog, lizards	Aquatic amphibia, humans	Cockroach, pigeon
(c)	Aquatic amphibia	Frog, humans	Pigeon, lizards, cockroach
(d)	Aquatic amphibia	Cockroach, humans	Frog, pigeon, lizards

ANSWER KEY

1.	(a)	**2.**	(c)	**3.**	(b)	**4.**	(d)	**5.**	(a)
6.	(b)	**7.**	(c)	**8.**	(d)	**9.**	(d)	**10.**	(c)
11.	(d)	**12.**	(b)	**13.**	(b)	**14.**	(c)	**15.**	(d)
16.	(b)	**17.**	(b)	**18.**	(c)	**19.**	(b)	**20.**	(d)
21.	(d)	**22.**	(c)	**23.**	(d)	**24.**	(a)	**25.**	(c)
26.	(a)	**27.**	(c)	**28.**	(c)	**29.**	(b)	**30.**	(b)
31.	(b)	**32.**	(c)	**33.**	(a)	**34.**	(d)	**35.**	(a)
36.	(d)	**37.**	(c)	**38.**	(a)	**39.**	(d)	**40.**	(c)
41.	(a)	**42.**	(d)	**43.**	(d)	**44.**	(c)	**45.**	(a)
46.	(d)	**47.**	(c)	**48.**	(c)	**49.**	(b)	**50.**	(a)
51.	(c)	**52.**	(d)	**53.**	(b)	**54.**	(a)	**55.**	(c)
56.	(a)	**57.**	(c)	**58.**	(b)	**59.**	(a)	**60.**	(c)
61.	(b)	**62.**	(d)	**63.**	(c)	**64.**	(a)	**65.**	(c)
66.	(d)	**67.**	(a)	**68.**	(c)	**69.**	(a)	**70.**	(d)
71.	(a)	**72.**	(a)	**73.**	(a)	**74.**	(b)	**75.**	(a)
76.	(b)	**77.**	(d)	**78.**	(d)	**79.**	(a)	**80.**	(a)
81.	(d)	**82.**	(a)	**83.**	(d)	**84.**	(d)	**85.**	(b)
86.	(b)	**87.**	(b)	**88.**	(c)	**89.**	(b)	**90.**	(c)
91.	(c)	**92.**	(d)	**93.**	(c)	**94.**	(b)	**95.**	(a)
96.	(c)	**97.**	(d)	**98.**	(d)	**99.**	(d)	**100.**	(c)

CUET (UG)

PRACTICE PAPER 2022

Section II of CUET (UG) is Domain specific. In this section of Biology 40 questions to be attempted out of 50.

Max. Marks : 200 Time : 45 minutes

Multiple Choice Questions (MCQs)

1. Identify from the following group of animals, which exhibit estrous cycle.
(a) Monkey, ape, man and elephant
(b) Lion, deer, dog and cow
(c) Lion, dog, monkey and ape
(d) Cow, monkey, elephant and ape

2. *Cuscuta* is an example of
(a) ectoparasitism (b) brood parasitism
(c) predation (d) endoparasitism.

3. Select the wrong statement.
(a) *Bt* toxin gene *cry*IAc controls corn borer.
(b) The genetically modified *Bacillus thuringiensis* is used as biopesticide on the commercial scale.
(c) Human protein, alpha-1-antitrypsin is used to treat emphysema.
(d) The first transgenic cow Rosie, produced alpha lactalbumin, enriched milk.

4. The pioneer species in xerarch and hydrarch succession are respectively
(a) lichens and sedges
(b) phytoplanktons and sedges
(c) lichens and zooplanktons
(d) lichens and phytoplanktons.

5. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is
(a) Indian Council of Medical Research (ICMR)
(b) Council for Scientific and Industrial Research (CSIR)
(c) Research Committee on Genetic Manipulation (RCGM)
(d) Genetic Engineering Approval Committee (GEAC).

6. Good ozone is found in upper part of the atmosphere called _____ whereas, bad ozone is found in lower part of atmosphere called _____.
(a) stratosphere, mesosphere
(b) mesosphere, troposphere
(c) thermosphere, mesosphere
(d) stratosphere, troposphere

7. A typical angiosperm embryo sac at maturity is
(a) 8-nucleate and 8-celled
(b) 8-nucleate and 7-celled
(c) 7-nucleate and 8-celled
(d) 7-nucleate and 7-celled.

8. The Earth Summit held in Rio de Janeiro in 1992 was called
(a) for immediate steps to discontinue use of CFCs that were damaging the ozone layer
(b) to reduce CO_2 emissions and global warming
(c) for conservation of biodiversity and sustainable utilisation of its benefits
(d) to assess threat posed to native species by invasive weed species.

9. The important component of oral contraceptive pills is
(a) progesterone-estrogen
(b) growth hormone
(c) thyroxine
(d) luteinising hormone.

10. Amensalism can be represented as
(a) Species A (+) ; Species B (0)
(b) Species A (–) ; Species B (0)
(c) Species A (+) ; Species B (+)
(d) Species A (–) ; Species B (–).

11. Which of the following correctly represents the flow of genetic information?
(a) DNA $\rightarrow$ RNA $\rightarrow$ Protein
(b) RNA $\rightarrow$ DNA $\rightarrow$ Protein
(c) RNA $\rightarrow$ Protein $\rightarrow$ DNA
(d) Protein $\rightarrow$ RNA $\rightarrow$ DNA

12. If 30J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following food chain?

Plant $\rightarrow$ Mice $\rightarrow$ Snake $\rightarrow$ Peacock

(a) 0.3J (b) 0.03J
(c) 0.0003J (d) 0.003J

13. 'Hisardale' is a new breed of sheep developed by crossing between
(a) bikaneri ewes and merino rams
(b) merino ewes and bikaneri rams
(c) deccani ewes and bikaneri rams
(d) merino ewes and apennine rams.

14. *Eco*R I is a/an _____ enzyme.
(a) ligase (b) polymerase
(c) endonuclease (d) gyrase

15. Which of the following statements is true about tapetum?
(a) It provides nutrition to sporogenous tissue and developing microspores.
(b) The cells of tapetum are larger in size with dense cytoplasm and have more than one nucleus.
(c) It is the innermost wall layer surrounding the sporogenous tissue of microsporangium.
(d) All of these

16. During sewage treatment, biogas is produced which includes
(a) hydrogen sulphide, methane, sulphur dioxide
(b) hydrogen sulphide, nitrogen, methane
(c) methane, hydrogen sulphide, carbon dioxide
(d) methane, oxygen, hydrogen sulphide.

17. Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other?
(a) *Hydrilla* (b) Fig
(c) Banana (d) *Viola*

18. If there are two alleles D and d with frequencies p and q respectively. According to the Hardy-Weinberg's principle, the frequency of Dd will be
(a) $2p^2q^2$ (b) p^2
(c) q^2 (d) $2pq$

19. The relation between species richness and area is described on a logarithmic scale by the equation_____ [where S = species richness, A = area, Z = slope of the line (regression coefficient), C= Y-intercept].
(a) $\log S = \log C - Z \log A$
(b) $\log S = Z \log A$
(c) $\log S = \log C + Z \log A$
(d) $\log S = \log C$

20. In the experiment conducted by Meselson and Stahl using heavy N^{15} to prove semi-conservative nature of replication, DNA of the first generation was found to have
(a) N^{14} only (b) N^{15} only
(c) N^{14} and N^{15} (d) none of these.

21. MALT constitutes about _____ percent of the lymphoid tissue in human body.
(a) 20% (b) 70% (c) 10% (d) 50%

22. Which of the following is put into anaerobic sludge digester for further sewage treatment?
(a) Primary sludge
(b) Floating debris
(c) Effluents of primary treatment
(d) Activated sludge

23. Vegetative propagation in water hyacinth takes place by
(a) rhizome (b) bulbil
(c) leaf bud (d) offset.

24. The first clinical gene therapy was given for treating
(a) diabetes mellitus
(b) chicken pox
(c) rheumatoid arthritis
(d) adenosine deaminase deficiency.

25. Construction of a recombinant DNA involves
(a) cleaving DNA segments with ligase and rejoining them with endonuclease
(b) cleaving and rejoining DNA segments with ligase alone
(c) cleaving and rejoining DNA segments with endonuclease alone
(d) cleaving DNA segments with endonuclease and rejoining them with ligase.

26. The spark-discharge apparatus to test chemical evolution of life was designed by
(a) Oparin and Haldane
(b) Urey and Miller
(c) Jacob and Monad
(d) Fox and McCauley.

27. A person admitted to hospital as he had myocardial infarction. A cardiologist injected him 'streptokinase', why?
(a) It stimulates heart beat.
(b) It reduces hypertension.
(c) It acts as clot buster.
(d) It reduces the level of blood cholesterol.

28. Which of the following represents intrinsic rate of natural increase for the Norway rat?
(a) 0.015 (b) 0.0205
(c) 0.12 (d) 0.5

29. During the process of sexual reproduction in flowering plants, double fertilisation involves
(a) fertilisation of egg cell by two male gametes
(b) fertilisation of egg cell and a central cell by two male gametes brought by same pollen tube
(c) fertilisation of egg cell and a central cell by two male gametes brought by different pollen tubes
(d) fertilisation of two egg cells by two male gametes brought by same pollen tube.

30. Identify the DNA segment which is not a palindromic sequence.
(a) 5′ GGATCC 3′ / 3′ GGTACC 5′
(b) 5′ GAATTC 3′ / 3′ CTTAAG 5′
(c) 5′ GCGGCCGC 3′ / 3′ CGCCGGCG 5′
(d) 5′ CCCGGG 3′ / 3′ GGGCCC 5′

31. The drugs used to quickly reduce the symptoms of allergy are
(a) anti-histamine and adrenaline
(b) histamine and thyroxine
(c) adrenaline and α-interferon
(d) all of these.

32. The chronological order of human evolution from early to the recent is
(a) *Australopithecus* → *Ramapithecus* → *Homo habilis* → *Homo erectus*
(b) *Ramapithecus* → *Australopithecus* → *Homo habilis* → *Homo erectus*
(c) *Ramapithecus* → *Homo habilis* → *Australopithecus* → *Homo erectus*
(d) *Australopithecus* → *Homo habilis* → *Ramapithecus* → *Homo erectus.*

33. Which of the following correctly represents a nucleotide?
(a) Pentose sugar + nitrogen base + phosphate
(b) Nitrogen base + phosphate
(c) Deoxyribose sugar + nitrogen base
(d) Purines + pyrimidines

34. A childless couple can be assisted to have a child through a technique called GIFT. The full form of this technique is
(a) Gamete Internal Fertilisation and Transfer
(b) Germ cell Internal Fallopian Transfer
(c) Gamete Inseminated Fallopian Transfer
(d) Gamete Intra Fallopian Transfer.

Assertion & Reasoning Based MCQs

For question numbers 35-38, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

35. **Assertion :** In eukaryotes, both intron and exon are transcribed to form hnRNA.
Reason : Both exons and introns forms a part of functional *m*RNA.

36. **Assertion :** The principle of vaccination is based on the property of memory cells of the immune system.
Reason : Vaccines generate memory B cells and T cells that recognise the pathogen quickly.

37. **Assertion :** Inbreeding increases homozygosity in individuals.
Reason : Inbreeding depression caused due to continued inbreeding.

38. **Assertion :** Baculovirus are biocontrol agents of genus *Nucleopolyhedrovirus*.
Reason : They are effective against insects and other arthropods.

Match the Following

39. Match the entries in Column I with those of Column II and choose the correct answer.

Column I	Column II
A. Cleistogamy	(i) Pollination within the same flower
B. Geitonogamy	(ii) Bud pollination
C. Autogamy	(iii) Pollination between flowers in the same plant
D. Xenogamy	(iv) Wind pollination
	(v) Cross pollination

(a) A-(iii), B-(i), C-(v), D-(ii)
(b) A-(i), B-(v), C-(ii), D-(iii)
(c) A-(ii), B-(iii), C-(i), D-(v)
(d) A-(v), B-(iv), C-(iii), D-(ii)

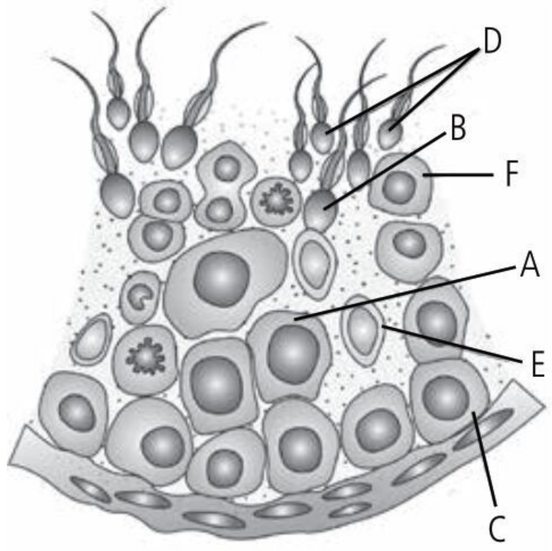
40. Match Column I with Column II and choose the correct option.

Column I	Column II
I. Thomas Malthus	A. Branching descent
II. Hugo de Vries	B. Studies on populations
III. Charles Darwin	C. Use and disuse theory
IV. Lamarck	D. Saltation

(a) I - D, II - A, III - C, IV - B
(b) I - B, II - D, III - A, IV - C
(c) I - B, II - D, III - C, IV - A
(d) I - C, II - B, III - A, IV - D

Case Based MCQs

Case I : Read the passage given below and answer the following questions from 41 to 45.
Given below is the diagrammatic sectional view of a seminiferous tubules having a male germ cells at different stages of spermatogenesis.



41. First meiotic division takes place in
(a) A (b) B (c) F (d) E.

42. A contains
(a) 22 autosomes and X-chromosome
(b) 22 autosomes and Y-chromosome
(c) 22 autosomes and X or Y-chromosome
(d) 22 pairs of autosomes and XY chromosomes.

43. F after meiotic division produces
(a) four haploid spermatids
(b) one haploid spermatid
(c) two haploid spermatids
(d) two diploid spermatids.

44. Select the correct sequence for the development of sperm.
(a) $A \rightarrow C \rightarrow B \rightarrow D \rightarrow E$
(b) $C \rightarrow A \rightarrow F \rightarrow B \rightarrow D$
(c) $C \rightarrow E \rightarrow A \rightarrow F \rightarrow D$
(d) $E \rightarrow A \rightarrow F \rightarrow D \rightarrow C$.

45. In spermatogenesis, reduction division of chromosome occurs during conversion of
(a) $C \rightarrow A$ (b) $A \rightarrow F$
(c) $F \rightarrow B$ (d) $B \rightarrow D$

Case II : Read the passage given below and answer the following questions from 46 to 50.

X is an autosome-linked recessive blood disease transmitted from parents to the offspring when both the partners are unaffected carrier for the gene. The defect could be due to either mutation or deletion which ultimately results in reduced rate of synthesis of one of the globin chains that make up haemoglobin.

46. Identify the disease X.
(a) Haemophilia (b) Phenylketonuria
(c) Colourblindness (d) Thalassemia

47. A type of disease X, in which production of α-globin chain is affected is controlled by the gene
(a) HBB (b) HBA1
(c) HBA2 (d) both (b) and (c).

48. Now, select the location of gene identified in question no. 47.
(a) Chromosome 16 (b) Chromosome 11
(c) Chromosome 10 (d) Chromosome 20

49. Disease X is differs from sickle-cell anaemia in
(a) quantitatively production of few globin molecules
(b) quantitatively production of more globin molecules
(c) qualitative production of non-functional globin molecules
(d) qualitative production of incorrectly functioning globin molecules.

50. Select the gene and its location for the disease X in which production of β-globin chain is affected.
(a) HBA1, 15 (b) HBB, 11
(c) Hb^S, 20 (d) Hb^A, 2

SOLUTIONS

1. (b)

2. **(a) :** *Cuscuta* is an obligate stem parasite which is a good example of ectoparasitism. It is commonly found growing on hedge plants. It lost chlorophyll and leaves in the course of evolution. It attaches and wraps itself around the stem of host plant and produces haustoria that gets inserted into the vascular system of host. The parasitic plant sucks all the nutrients from the host plant with the help of haustoria. *Cuscuta* is known to receive even the flower inducing hormone or florigen from the host.

3. (a) : Through genetic engineering *Bt* toxin genes were isolated from *Bacillus thuringiensis* and incorporated into several crop plants. The choice of gene depends upon the crop and targeted pest, as most *Bt* toxins are insect group specific. The toxin is coded by a gene *cry*. *cry*IAc and *cry*IIAb protect against cotton bollworm and *cry*IAb introduced in *Bt* corn protect from corn borer.

4. (d)

5. (d) : Indian Government has set up organisation such as GEAC (Genetic Engineering Approval Committee) which makes decisions regarding the validity of GM research and safety of introducing GM organisms for public services.

6. (d)

7. (b) : A typical angiosperm embryo sac is 7 celled and 8 nucleate structure.

8. (c) : 'The Earth Summit' held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

9. (a) : Oral contraceptive pills contains both progesterone and estrogen.

10. (b) : Amensalism is an interaction in which one species is harmed and other is unaffected.

11. (a) : Francis Crick (1958) proposed that DNA determines the sequence of amino acids in a polypeptide (protein) through *m*RNA. This is called central dogma of protein synthesis which involves transcription and translation. It explains the flow of information from DNA to *m*RNA (transcription) and then decoding the information present in *m*RNA in the formation of polypeptide chain or proteins (translation).

$$\text{DNA} \xrightarrow{\text{Transcription}} m\text{RNA} \xrightarrow{\text{Translation}} \text{Proteins}$$

12. (b) : According to the ten percent law given by Lindeman (1942), only 10% of the total energy is transferred at each trophic level. From producers, 10% of total energy is transferred to the primary consumers (herbivores). Herbivores are eaten by primary carnivores. Only 10% of the herbivores productivity is utilised for raising productivity of primary carnivores. The rest is consumed in ingestion, respiration, maintenance of body heat and other activities. Higher carnivores similarly are able to retain only 10% of energy present in primary carnivores.

Accordingly, if plant trapped 30 J of energy, mice will have 3 J, snake will have 0.3 J and hence, peacock will have 0.03 J of energy.

13. (a) : Hisardale is the new breed of sheep developed by crossing between Bikaneri ewes and Merino rams.

14. (c) : *Eco*R I is an endonuclease enzyme which was isolated from the bacterium *Escherichia coli* RY13.

15. (d) : Tapetum is the innermost wall layer of anther which surrounds the sporogenous tissue of microsporangium. Cells of this layer are larger in size, contain one or more diploid nuclei or a polyploid nucleus. Tapetal cells provide nutrition to sporogenous tissue and developing microspores.

16. (c)

17. (b) : *Yucca* has an obligate mutualism with a species of moth, *i.e., Pronuba*. The only pollinator of this plant is the *Yucca* moth. The *Yucca* moth is likewise dependent upon the *Yucca* plant as *Yucca* moth caterpillars need to eat *Yucca* seeds only, otherwise they starve.

18. (d) : The frequency of allele DD = p^2, dd = q^2 and for Dd = 2 pq. It can be explained by following Punnett square :

	D (p)	d (q)
D (p)	DD (p^2)	Dd (pq)
d (q)	Dd (pq)	dd (q^2)

19. (c) : German naturalist and geographer Alexander von Humboldt while exploring the wilderness of South American jungles found that within a region the species richness increased with increasing area but upto a certain limit. On this basis, he proposed species area relationship curve. The relationship between species richness and area turned out to be rectangular hyperbola for a wide variety of taxa whether they are birds, bats, freshwater fish or flowering plants. On a logarithmic scale, it is a straight line. It is described by the equation:

$\log S = \log C + Z \log A$

Here S is species richness, Z is slope of line or regression coefficient, C is Y intercept and A is area.

20. (c) : Semi - conservative replication of DNA was proved by work of Meselson and Stahl (1958). They grew *E.coli* for many generations in medium with N^{15} till the bacterial DNA became completely labelled with N^{15}. Then they transferred it to N^{14} containing medium and first generation showed DNA with both N^{14} and N^{15} in equal amount. It proved semi-conservative nature of replication, *i.e.*, the two resulting double strands are identical and each of them consists of one original and one newly synthesised strand.

21. (d) : MALT are significant aggregations of lymphoid tissues which are seen in relation to the mucosa of the major tracts like respiratory, alimentary canal and urinogenital tracts. It constitutes about 50 percent of the lymphoid tissue in human body.

22. (d) : The sediment in a settling tank is called activated sludge. A small part of it is pumped back into the aeration tank to serve as the inoculum. While the remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters.

23. (d) : In water hyacinth, vegetative reproduction occurs *via* the breaking of offsets. The offsets are easily broken by wind or wave action and are readily transported *via* wind or water movement. These offsets rapidly give rise to a group of individuals at the newly reached place causing extensive growth of population.

24. (d)

25. (d) : Construction of a recombinant DNA involves cleaving DNA segments with endonuclease and rejoining them with ligase.

26. (b)

27. (c) : Enzyme streptokinase is produced by the bacterium *Streptococcus* and modified by genetic engineering to be used as a clot buster for removing clots from blood vessels of patients who have undergone mycardial infarction leading to heart attack.

28. (a)

29. (b)

30. (a) : Palindromic nucleotide sequence in the DNA molecule is the sequence of base pairs that reads same when orientation of reading is same, *i.e.*, 5′ to 3′ on both strands or 3′ to 5′ on both strands. Hence, (a) is the correct answer, since it does not read same from both the sides.

31. (a) : Allergy is an exaggerated response of the immune system to certain antigens present in the environment. Anti-histamine, adrenaline and steroids quickly reduce the symptoms of allergy that include sneezing, watery eyes, running nose and difficulty in breathing.

32. (b)

33. (a) : Nucleotides are the basic units of nucleic acids. A nucleotide is a condensation product of three components : a pentose sugar, a phosphate group and a nitrogenous base. The pentose sugar is ribose ($C_5H_{10}O_5$) in ribonucleotides and deoxyribose ($C_5H_{10}O_4$) in deoxyribonucleotides.

34. (d)

35. (c) : Eukaryotic transcripts possess extra segments called introns or intervening sequences or non-coding sequences. They do not appear in mature or processed *m*RNA. The functional coding sequences are called exons. Splicing is removal of introns and fusion of exons to form functional *m*RNA.

36. (a) **37. (b)**

38. (b) : Baculoviruses are pathogens that attack insects and other arthropods. The majority of baculoviruses used as biological control agents are in the Genus *Nucleopolyhedrovirus.* These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications.

39. (c) **40. (b)**

41. (a) : The spermatogonium (C) present on inside wall of seminiferous tubules multiplies by mitotic division and increase in number. Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called primary spermatocytes (A) periodically undergoes meiosis. A primary spermatocyte after completion of first meiotic division forms secondary spermatocyte (F), which on further divisions form spermatids (B) and spermatozoa (D) respectively.

42. (d) : Primary spermatocyte (A) are diploid having 22 pairs of autosomes and XY chromosomes.

43. (c) : Two secondary spermatocyte (F) is produce from primary spermatocyte (A) through first meiotic division. The secondary spermatocytes undergoes the second meiotic division to produce four equal haploid spermatids. Thus, each secondary spermatocyte produce two haploid spermatids.

44. (b) : The correct sequence of development stages of sperm are as follows:
C (Spermatogonium) $\rightarrow$ A (Primary spermatocyte) $\rightarrow$ F (Secondary spermatocyte) $\rightarrow$ B (Spermatid) $\rightarrow$ D (Spermatozoa)

45. (b) : The first meiotic division is reductional division in which diploid primary spermatocyte (A) changes into two haploid secondary spermatocyte (F).

46. (d) : The disease X could be Thalassemia.

47. (d) : The production of α-globin chain is affected in α-Thalassemia. α-Thalassemia is controlled by two closely linked genes HBA1 and HBA2.

48. (a) : Genes responsible α-Thalassemia, HBA1 and HBA2 is located in chromosome number 16.

49. (a) : Thalassemia (X) differs from sickle-cell anaemia in that the former is quantitative problem of synthesising too few globin molecules while the latter is a qualitative problem of synthesising an incorrectly functioning globin.

50. (b) : In β-Thalassemia, production of β-globin chain is affected. The gene HBB for β-Thalassemia is located in chromosome number 11.

UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

Column I	Column II
1. NEAPSYS	(a) Highest level of biological classification.
2. RENTILD	(b) The cytoplasm of striated muscle cells.
3. LNCGGOAU	(c) An abnormal but non-cancerous collection of cells.
4. MASPCOLSAR	(d) A transition area between two biological communities, where two communities meet and integrate.
5. TEURYBP	(e) A junction at which two neurons communicates with each other.
6. AMLENE	(f) The beginning of sexual maturation in humans.
7. NOTEOCE	(g) The hardest substance of human body.
8. MNDIKGO	(h) A specialised stem, leaf or petiole with whip like structure used by climbing plants for support and attachment.
9. VOECOLTOUIN	(i) A hormone which raises the concentration of glucose in bloodstream.
10. NBEING	(j) The type of species interaction in which two organisms reciprocally influencing the evolution of each other.

Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month.
Winners' names will be published in next issue.

WORD GRID

Readers are requested to send their responses of word grid to be the winner.

Find and encircle the words in the given grid, running in one of the possible directions; horizontal, vertical or diagonal by reading the clues given below.

H	I	L	U	M	S	T	E	R	L	E	O	F	M	J
M	P	K	P	A	T	R	E	C	C	I	O	N	A	A
S	Y	O	E	M	H	A	D	N	L	H	N	G	T	V
E	R	O	N	E	Y	N	B	K	A	A	E	K	R	A
M	I	P	L	N	L	S	A	M	D	P	P	Q	E	N
E	M	E	Y	O	A	A	P	H	O	T	I	C	P	R
N	I	R	S	R	K	M	R	J	D	E	L	M	O	A
O	D	O	I	R	O	I	I	E	E	N	R	H	I	S
N	I	N	S	H	I	N	O	O	G	A	M	Y	Z	T
T	N	N	N	E	D	A	N	L	Z	W	M	V	S	E
Q	E	P	L	A	S	T	S	C	I	T	Y	J	E	R
J	U	R	A	S	S	I	C	K	I	T	U	N	F	S
X	S	U	P	E	R	O	V	U	L	A	T	I	O	N
M	O	R	P	H	I	N	E	T	O	R	P	E	D	O
O	M	E	S	O	S	O	M	E	T	U	M	V	W	I

Clues

1. A collection of secretions from the male accessory glands and sperm from testes.

2. A chemical reaction that transfers an amino group to a ketoacid.

3. A sub-specie of tiger.

4. The process of inducing a women to release more than one egg in a month.

5. An organised membrane bound vesicle found in stroma of chloroplast.

6. A zone of deep sea where day light fails to penetrate.

7. An organism in which electric organs are present.

8. The geological period in which dominant land animals like dinosaurs existed.

9. The smallest anterior petals in vexillary aestivation.

10. The structure formed by the invagination of plasma membrane in prokaryotes.

11. The breakdown of cell caused by damage to its plasma membrane.

12. A functioning unit of DNA containing a cluster of genes under the control of single promoter.

13. An aromatic six-membered structure found in DNA.

14. The term used for absence of menstruation.

15. A type of DNA connects the adjacent nucleosomes.

16. A proteinaceous infectious particle.

17. An attachment point in seed through which it is attached to the funicle.

18. The chief alkaloid of opium, used clinically to relieve pain, but produces dependency on long-term use.

19. A type of sexual reproduction involving fusion of a large non-motile female gamete and a small motile male gamete.

20. A radial microtubule arrays radiating from the centriole.

*Please send entries of solutions both with words and scanned copy of the grid by 10th of every month.