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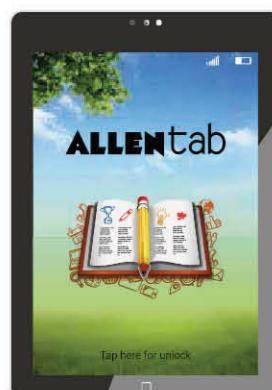
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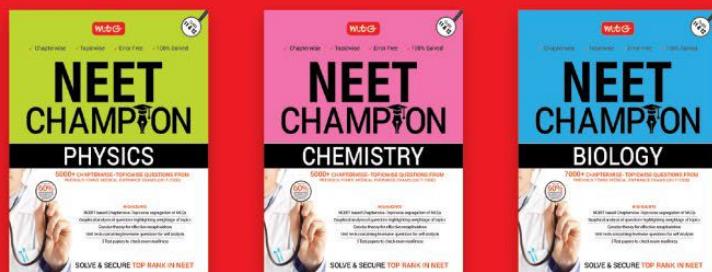


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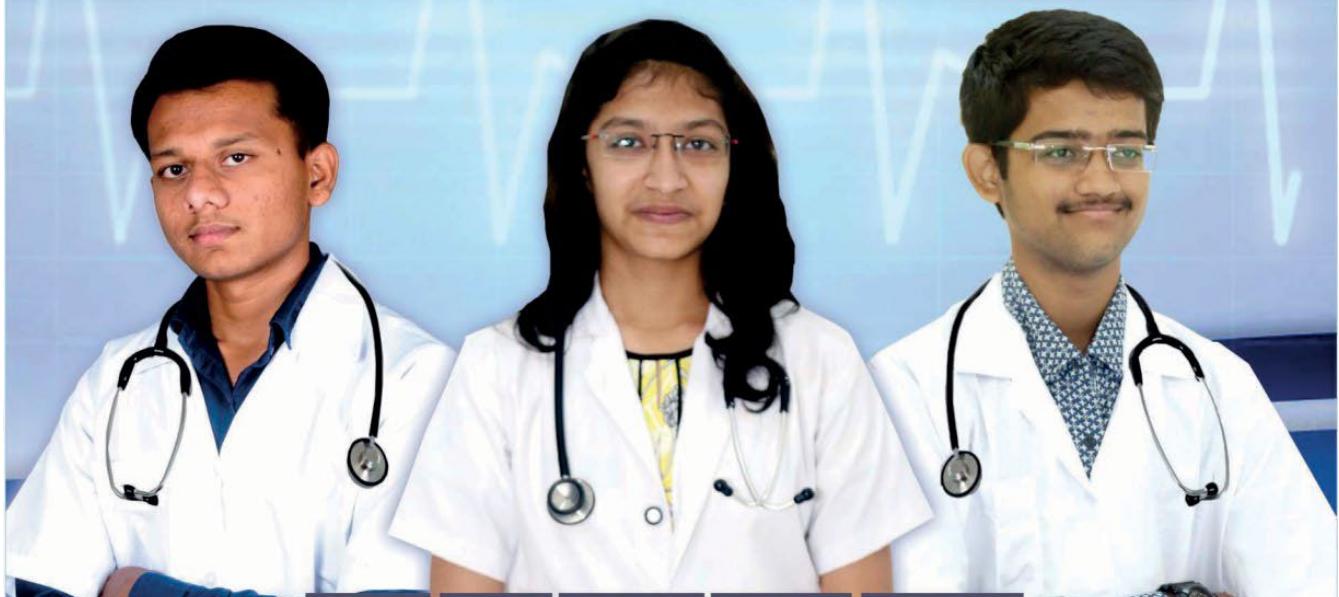
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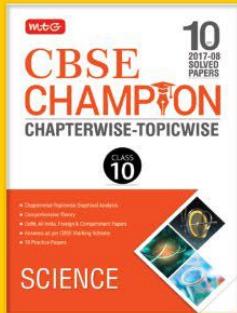
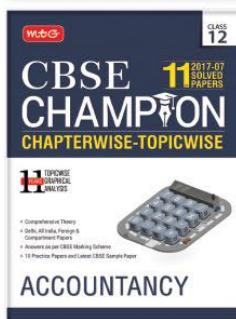
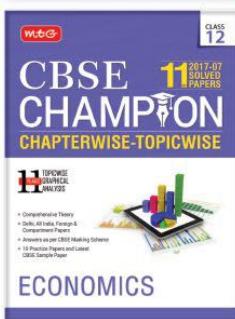
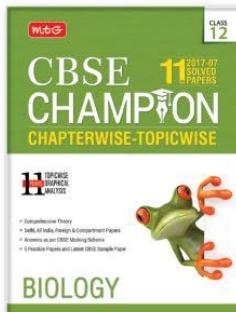
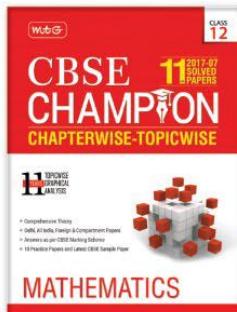
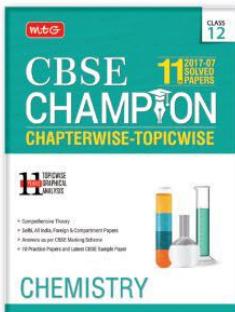
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HIGH YIELD FACTS



Class XI

Plant Growth and Development

- An organism starts its life as a single cell. Unicellular organisms grow and reproduce without increasing number of body cells but multicellular organisms undergo a far more complex process of **growth** and **development**.

GROWTH

- Growth in an organism consists of a permanent and more or less irreversible increase in size, commonly accompanied by an increase in dry mass and amount of cytoplasm. Growth in living beings is intrinsic or internal, in contrast to extrinsic growth observed in non-living objects.
- Plant growth is generally **indeterminate**, i.e., continued throughout life. In lower plants, growth is diffused, i.e., every cell can divide and enlarge but in higher plants, special body regions called **meristems** cause body growth.
- Growth in plants may broadly be categorised as:
 - Primary plant growth** - Results in elongation of plant parallel to its axis; contributed by root and shoot apical meristem and intercalary meristem.
 - Secondary plant growth** - Results in increase in girth of plant; contributed by lateral meristems such as vascular cambium and cork cambium.
- Growth is a quantitative or measurable phenomenon. The parameters used for measuring growth are increase in fresh weight, dry weight, length, area, volume and number of cells.
- Growth at cellular level is difficult to measure because it occurs due to increase in protoplasm.

Phases of Growth

- Plant growth takes place in three phases :
 - Formative phase:** It is the phase of cell division. As the formation of new cells require biosynthetic activity, the **respiration rate of cells in this phase is high**.
 - Phase of enlargement:** In this phase, the newly formed cells, produced in formative phase undergo enlargement. Cell enlargement may occur in all directions, e.g., isodiametric parenchymatous cells. However, in many parts, it takes place prominently in the linear direction so much so that this phase is also called **phase of cell elongation**.

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- (iii) **Phase of differentiation or maturation:** In this phase, the enlarged cells develop into special or particular type of cells by undergoing structural and physiological differentiation.

Growth Curve

- Growth curve refers to the graphic representation of total growth against time.
- When total growth is plotted against time, an S-shaped or sigmoid curve is obtained.

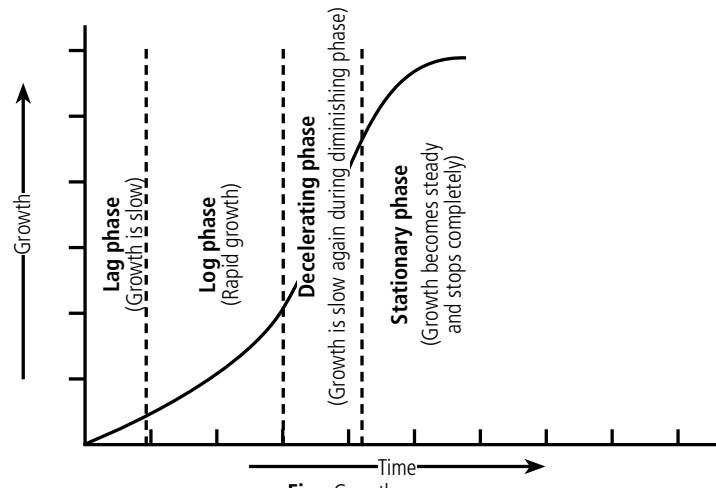


Fig.: Growth curve

Growth Rate

- Growth rate is defined as increase in growth per unit time, and can be expressed mathematically.
- The **rate of growth** can be measured by estimating the increase in size or area of an organ of the plant like leaf, flower, fruit, etc., in a unit time. The rate of growth is also called as **efficiency index**.
- For measurement and comparison between growth of various systems, absolute and relative growth rates are considered. The total growth per unit time is called **absolute growth rate**.
- The growth of a given system per unit time expressed per unit initial parameter is called **relative growth rate**.

$$\text{Relative growth rate} = \frac{\text{Growth in given time period}}{\text{Measurement at start of time period}}$$

- Suppose, two leaves have grown by 5 cm^2 in one day. Initial size of leaf A was 5 cm^2 while that of leaf B was 50 cm^2 . Though, their absolute growth is the same ($5 \text{ cm}^2/\text{day}$), relative rate of growth is faster in leaf A($5/5$) because of initial small size than in leaf B($5/50$).

Types of Growth (Based upon the growth rate)

Arithmetic growth

- Arithmetic growth is a type of growth in which the rate of growth is constant and increase in growth occurs in arithmetic progression, i.e., 2, 4, 6, 8, etc. In this, after mitosis, only one daughter cell continues to divide. Other takes part in differentiation and maturation. Here, a linear curve is obtained with positive value.
- It is found in root or shoot elongating at constant rate. Arithmetic growth is expressed as

$$L_t = L_0 + rt.$$

Here, L_t = Length after time 't', L_0 = Length at the beginning, r = Growth rate and t = Time of growth.

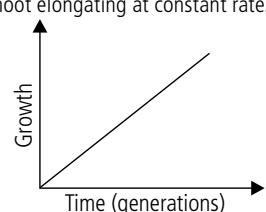


Fig.: Arithmetic growth curve

Geometric growth

- Geometric growth is the growth where both the progeny cells following mitosis retain the ability to divide and continue to do so. It occurs in early embryos and unicellular organisms when grown in nutrient rich medium. Number of cells is initially small so that initial growth is slow which is called lag phase. Later on, there is rapid growth at exponential rate. It is called log or exponential phase.

- The exponential growth curve can be represented by equation: $W_1 = W_0 e^{rt}$

- Where W_1 = Final size (weight, height, number, etc.)

W_0 = Initial size at the beginning of the time period
 r = Growth rate

t = Time of growth

e = Base of natural logarithms (2.71828).

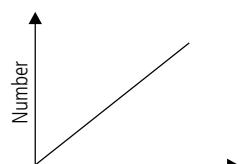


Fig.: Geometric growth curve

- Practically, in living organisms geometric growth curve is not observed because growth depends upon nutrition and it does not show a steady increase. Geometric growth cannot be sustained for long. Limited nutrient availability causes slowing down of growth and some cells may die. It leads to stationary phase. There may be actually a decline. As a result, sigmoid growth curve is obtained.
- S-shaped growth curve is typical of most living organisms in their natural environment. It is also applicable to cells, tissues and organs of plants.

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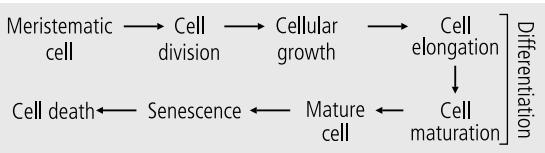
Factors Affecting Growth	
Nutrients Act as raw materials for synthesis of protoplasm as well as source of energy. Both types of nutrients, i.e., macro and micronutrients should be available for proper growth.	Water It is essential for cell elongation, maintenance of turgidity of growing cells and for providing medium for enzyme action.
Temperature An optimum temperature of 28-30°C is required for proper growth of plants. A temperature below this range inactivates enzymes while high temperature hinders growth.	Oxygen It is essential for aerobic respiration and hence energy.
Other factors Excess of salt, mineral deficiency and other stress factors also have detrimental effects on growth.	Light It is essential for tissue differentiation, synthesis of photosynthetic pigments and photoperiodism.
	Gravity Gravity determines the direction of shoot and root growth.

Differentiation, Dedifferentiation and Redifferentiation

- **Differentiation** : It refers to the permanent qualitative changes in structure, chemistry and physiology of cell wall and protoplasm of cells, tissues and organs. It occurs by the activation or repression of some genes.
- **Dedifferentiation** : It is the process of despecialisation of differentiated living cells so that they regain the capacity to divide and form new cells. A dedifferentiated tissue can act as meristem, e.g., interfascicular vascular cambium, cork cambium and wound cambium. In culture experiments, parenchyma cells dedifferentiate to produce a mass of dividing cells called callus.
- **Redifferentiation** : Structural, chemical and physiological specialisation of cells derived from dedifferentiated meristematic cells is called redifferentiation. It is similar to differentiation of cells and tissues formed by primary meristems. Secondary phloem, secondary xylem, cork and secondary cortex are some of the tissues formed through redifferentiation.

DEVELOPMENT

- Development is the sequence of changes that occur in the structure and functioning of an organism, organ, tissue or cell involving its formation, growth, differentiation, maturation, reproduction, senescence and death. A plant passes through developmental stages of seed germination, seedling, juvenile phase, maturation, flowering, seed formation and senescence.
- Conversion of one phase into next is also development, e.g., leaf initiation to leaf expansion, vegetative phase to flowering phase, etc. Development may even occur at sub-cellular level, e.g., appearance of chloroplasts in cells exposed to sunlight. Development ultimately leads to senescence and then death.
- Development in plants is not always straight. Sometimes, different structures may develop in different phases of growth as well as in response to environment.
- Therefore, development is under control of both **intrinsic**, i.e., genetic factors and growth regulators and **extrinsic factors**, i.e., light, temperature, water, oxygen and nutrition.



Flow chart : Sequence of developmental processes

Plasticity

It is the ability to change under the influence of internal or external stimuli. The **intrinsic plasticity** is observed in juvenile stage of plants such as cotton, coriander, larkspur, etc., whereas **environmental plasticity** is found in emergent hydrophytes, e.g., *Ranunculus* (buttercup). In both the types of plasticity, plants show heterophyly.

Heterophyly refers to the presence of different types of leaves on the same plant habitually in different phases of growth or under different environmental conditions.

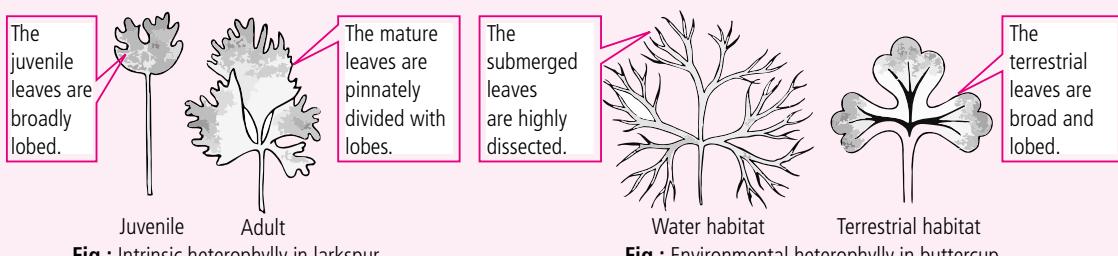


Fig.: Intrinsic heterophyly in larkspur

Fig.: Environmental heterophyly in buttercup

PLANT GROWTH REGULATORS

- Plant growth regulators (PGR) are small, simple molecules of diverse chemical composition, which though present in low concentration, regulate growth, differentiation and development. They are also referred to as **plant hormones** or **phytohormones**.
- Phytohormone** is technically defined as a chemical substance other than nutrient produced naturally in plants and is capable of being translocated to another region for regulating one or more physiological reactions even when present in low concentrations.
- Plant hormones are broadly divided into two groups:



Plant growth promoters

Perform growth promoting activities like cell division and enlargement, tropic growth, flowering, fruiting and seed formation. E.g., auxins, gibberellins and cytokinins.

Plant growth inhibitors

Usually induce dormancy and abscission, also induce responses to wounds, biotic and abiotic stresses. E.g., abscisic acid, ethylene.

- Besides these phytohormones, other compounds such as salicylic acid, jasmonic acid, brassinosteroids and some vitamins also regulate plant growth.

Growth Promoting Hormones

Auxins

- Nature:** Weakly acidic growth hormones having an unsaturated ring structure. Auxins refer to natural (IAA, PAA, IAN) and synthetic (Indole 3-butryric acid, NAA, 2, 4-D, 2, 4, 5-T) compounds having similar structure and properties.
- Discovery:** Darwin (1880) was first to find sensation of unilateral illumination in the coleoptile tip of canary grass. Later, Kogl and Smith (1931) isolated three chemicals from human urine which they named as auxin *a*, auxin *b* and heteroauxin. **Indole 3-acetic acid (IAA)** is the universal natural auxin.
- Location:** IAA is found in shoot apices, leaf primordia and developing seeds. **Amino acid tryptophan** is the precursor for synthesis of IAA or auxins.
- Bioassay:** Avena curvature test and root growth inhibition test are done for examining auxin effect.

Physiological functions

- Promote cell enlargement and division and initiate root formation on stem cuttings
- Cambial activity and xylem differentiation is also regulated by auxins
- Show apical dominance, i.e., inhibit the growth of lateral buds
- Prevent or delay premature abscission as well as induce synthesis of ethylene
- Produce tropic plant responses like phototropism and geotropism
- Stimulate respiration and enhance metabolism
- Increase storage of solutes inside the cells
- Show feminising effect on some plants

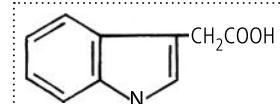


Fig.: Structure of indole-acetic acid (IAA)

Commercial uses

- In tissue and organ culture to form callus and initiate rooting
- To produce parthenocarpic fruits
- Auxins like 2, 4-D and 2, 4, 5-T acts as **weedicides** by being selectively harmful to broad leaved dicot weeds.
- Induce flowering in litchi and pineapple
- NAA increases the number of dwarf shoots and fruits in apple
- Prevent pre-harvest fruit drop of orange and apple (by low concentration of 2, 4-D) and tomato (by NAA).

Gibberellins

- Nature:** Weakly acidic growth hormones having gibbane ring structure.
- Discovery:** Kurosawa discovered the active substance, i.e., gibberellin from the filtrate of fungus, *Gibberella fujikuroi* causing bakane disease in rice plants. **GA₃** was the first gibberellin to be isolated in its pure form and remains the most extensively studied.

- Location:** The major sites of gibberellin production in plants are embryos, roots and young leaves near the shoot tip. Mevalonic acid (derived from acetyl Co-A) acts as precursor for synthesis of gibberellins. It is transported through simple diffusion as well as via conducting channels.
- Bioassay:** Barley endosperm test and germination of dwarf pea seeds are used as bioassays.

Physiological functions

- Stimulate stem elongation and leaf expansion
- Overcome natural dormancy of buds, tubers, seeds, etc.
- Induce elongation of reduced stem or bolting in rosette plants, e.g., henbane, cabbage, etc.
- Promote seed germination by inducing production of hydrolytic enzymes for solubilising reserve food
- Promote flowering in long day plants and those requiring vernalisation during non-inductive period
- Control fruit growth and development as well as induce parthenocarpy
- Promote formation of male flowers on female plants, e.g., Cannabis. They can also replace female flowers with male ones on monoecious plants of cucurbits.

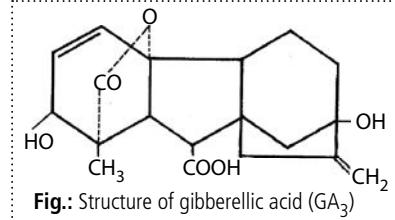


Fig.: Structure of gibberellic acid (GA₃)

Commercial uses

- Exogenous application of GA₄ and GA₇ mixture can increase the number and size of fruits, e.g., apple, grapes, tomato.
- Production of seedless pomaceous fruits by parthenocarpy.
- GA₇ delays senescence of fruits and delays its ripening thus, extending its shelf life and storage period.
- Application of gibberellins increases length of stem and yield of sugarcane.
- Promote early maturity resulting in seed production in juvenile conifers.
- Used for inducing germination in positively photoblastic seeds of tobacco and lettuce in complete darkness.

Cytokinins

- Nature:** These are basic hormones, being derivatives of either aminopurine or phenyl urea that promote cytokinesis.
- Discovery:** The first cytokinin was discovered by Miller *et al* (1955) from degraded autoclaved herring sperm DNA. It is called **kinetin** and does not occur naturally in plants.
- The first natural cytokinin was obtained from unripe maize grains, called **zeatin**, i.e., 6-(4-hydroxy-3-methyl-trans-2-butenoyl) amino purine. It is also found in coconut milk.
- Location:** It is mainly found in roots, however it is also synthesised in endosperm regions of seeds, growing embryos, young fruits and developing shoot buds.
- Bioassay:** Tobacco pith culture, retardation of leaf senescence and excised radish cotyledon expansion are used as bioassays for cytokinins.

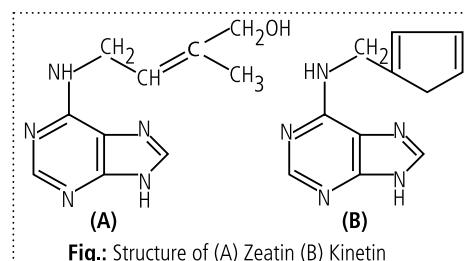


Fig.: Structure of (A) Zeatin (B) Kinetin

Physiological functions

- Promote cell division and cell elongation
- Essential for morphogenesis and differentiation of tissues and organs
- Delay senescence of intact plant parts by mobilisation of nutrients
- Overcome apical dominance caused by auxins and promote lateral bud development
- Induce accumulation of salts inside cells and help in phloem transport
- Promote femaleness in flowers and in certain cases can also replace photoperiodic requirement of flowering
- Overcome seed dormancy of various types
- Increase resistance to high or low temperature and disease

Commercial uses

- Form essential component of nutrient medium used in tissue culture as required for morphogenesis
- Application of cytokinin increases the shelf life of flowers and vegetables, keeping them fresh for longer periods.
- Used for developing resistance to pathogens and extremes of temperature, in plants

Growth Inhibiting Hormones

Ethylene

- **Nature:** It is the only gaseous phytohormone which stimulates transverse or isodiametric growth but retards the longitudinal one.
- **Discovery:** R. Gane (1934) found that substance causing ripening was ethylene. However, it was recognised as a plant hormone by Crocker *et al* (1935).
- **Location:** It is found in almost all parts of plants in minimal amount but maximum production occurs during ripening of fruits and in tissues undergoing senescence. **It is synthesised from amino acid methionine in plants.**
- **Bioassay:** The triple response of etiolated pea plant and gas chromatographic assay are used as bioassays.

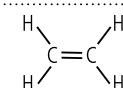


Fig.: Structure of ethylene

Physiological functions

- Promotes apical dominance and prolongs dormancy of lateral buds but breaks the dormancy of buds, seeds and storage organs
- Induces abscission and senescence of various parts, *i.e.*, leaves, flowers, fruits, etc.
- Induces epinasty, a phenomenon which decreases the sensitivity to gravity
- Helps in root initiation, growth of lateral roots and root hairs
- Stimulates flowering in pineapple and other related plants and helps in synchronising fruit set
- Induces ripening of fleshy climacteric fruits and dehiscence of dry fruits

Commercial uses

- Ethylene lamps are used for ripening of fleshy fruits, *e.g.*, banana, mango, apple, tomato, etc.
- Used to induce feminising effect in cucumber to increase number of female flowers and thus fruits
- Permits thinning of excess flowers and young fruits so as to allow better growth of remaining fruits

Abscisic acid

- **Nature:** It is a mildly acidic growth hormone which acts as a general growth inhibitor. It is also called as stress hormone since its production is stimulated under adverse environmental conditions such as drought, water logging, etc.
- **Discovery:** The hormone was first isolated by Addicott *et al* (1963) from cotton bolls.
- **Location:** It is found in many parts of the plant but is more abundant in chloroplast of green cells. **It is synthesised from mevalonic acid or xanthophyll.**
- **Bioassay:** Rice seedling growth inhibition test and inhibition of α -amylase synthesis in barley endosperm are used as bioassay.

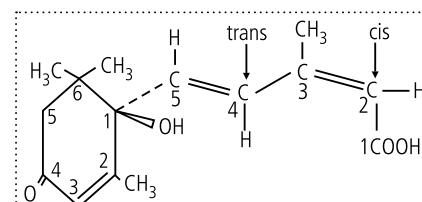


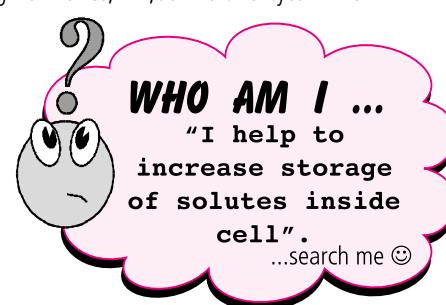
Fig.: Structure of abscisic acid

Physiological functions

- Induces dormancy of buds, seeds and underground stems, hence also called as **dormin**
- Promotes abscission of flowers and fruits
- Prevents transpiration by causing closure of stomata during dessication and stress
- Induces senescence of leaves by promoting degradation of chlorophyll and proteins
- Stops cambium activity (in vascular cambium) towards the approach of winter
- Inhibits seed germination by inhibiting gibberellin mediated amylase formation
- It is antagonist to gibberellin and counteracts the effect of growth promoting hormones, *i.e.*, auxins and cytokinins.

Commercial uses

- Used as **antitranspirant** (as application of even minute quantities of ABA on leaves causes partial closure of stomata), thus, preventing transpiration as well as reducing photosynthesis
- Induces flowering in some short day plants, even under unfavourable photoperiods
- External application on stem cuttings initiate rooting
- Induces parthenocarpic development in rose
- Used in prolonging dormancy of buds, storage organs and seeds.



Interaction Among Various Phytohormones

- Growth, differentiation and development processes of plants are regulated by two or more phytohormones either acting synergistically or antagonistically.
- The hormones auxins, gibberellins and cytokinins act synergistically in cell growth and division while this effect is antagonised by abscisic acid.
- Auxins, cytokinins and ethylene have feminising effect on dioecious and monoecious plants, while gibberellins promote maleness in plants.
- Cytokinins and auxins prevent senescence while it is induced by abscisic acid and ethylene.
- Cytokinins help in opening of stomata while abscisic acid causes its closure.
- Dormancy of buds and seeds is induced by ABA while it is overcome by gibberellins.
- Cambial activity and development of fruits is promoted by action of auxins, gibberellins and cytokinins. This is inhibited by ABA.

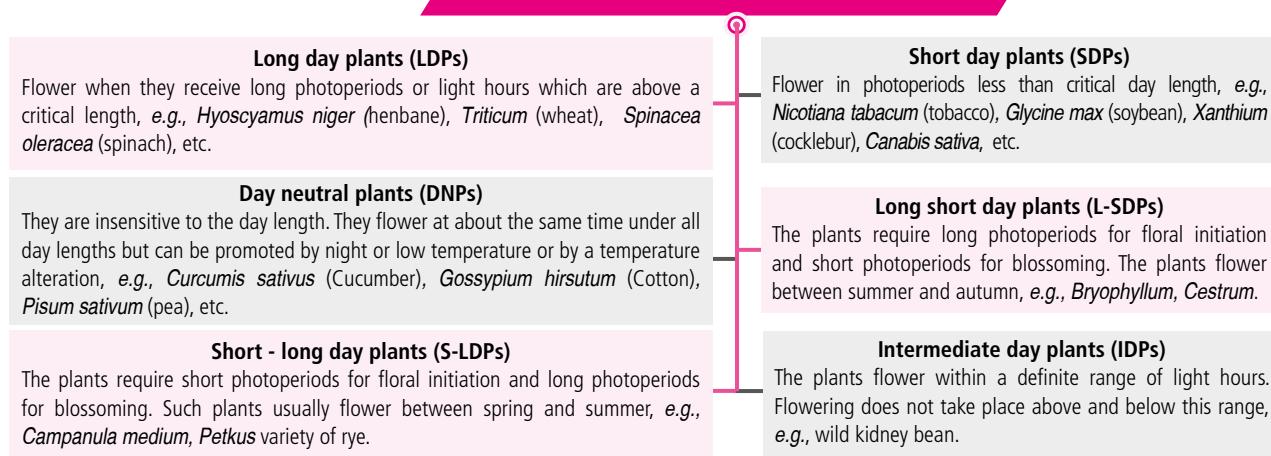
Table: Comparison of antagonistic action of ABA and Gibberellin/Cytokinin

Abscisic acid		Gibberellic acid/Cytokinin
(i)	It inhibits growth.	It promotes growth.
(ii)	Abscisic acid promotes dormancy of seeds, buds and tubers.	The hormone overcomes the natural dormancy of seeds, bulbs, tubers, etc., and allows them to germinate.
(iii)	It promotes flowering in some short day plants.	It promotes flowering in some long day plants.
(iv)	The inhibitor decreases the synthesis of RNA and protein. It can even cause their degradation.	The hormone promotes synthesis of RNAs and proteins.
(v)	Abscisic acid promotes stomatal closure.	It helps in opening of stomata.
(vi)	It prevents amylase activity.	It promotes amylase activity as during germination of cereal grains.
(vii)	Abscisic acid causes abscission of flowers and fruits.	The hormone promotes development of fruits.
(viii)	It promotes leaf senescence.	It prevents leaf senescence.
(ix)	Abscisic acid promotes rooting of cutting in some plants.	Gibberellic acid has no role in rooting.
(x)	It has no role in sexuality of flowers.	The hormone can bring about change in sexuality of flowers.

PHOTOPERIODISM

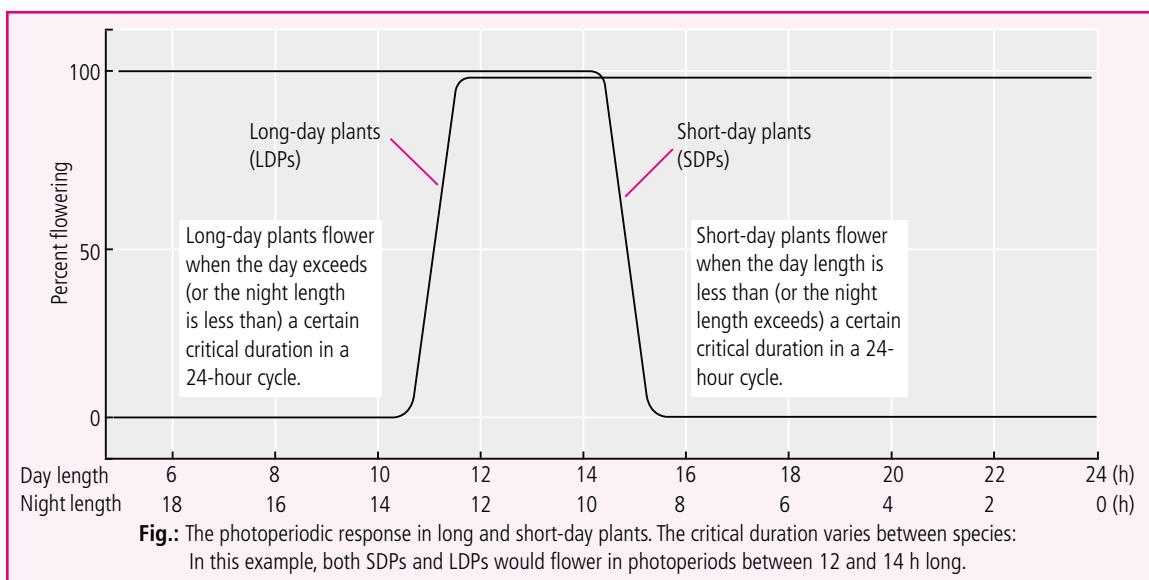
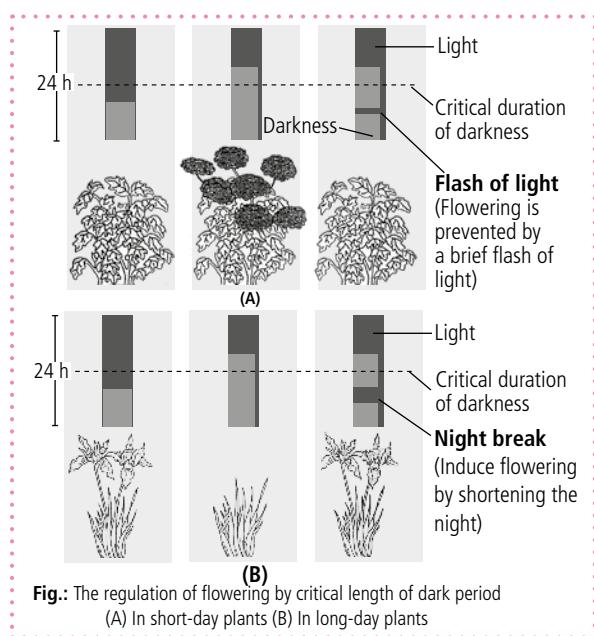
- The effect of photoperiods or daily duration of light hours (and dark periods) on the growth and development of plants, especially flowering, is called photoperiodism.
- It was first studied by **Garner** and **Allard** (1920) in 'maryland mammoth', a variety of tobacco that can be made to flower in summer by reducing light hours and could be made to remain vegetative in winter by providing extra light.

Types of Plants (On the basis of photoperiodic response to flowering)



Critical Photoperiod or Day Length

- Short day plants or long night plants require a long dark period (skotoperiods) and short photoperiods for flowering. Exposure to even a flash of light interrupting its dark period, prevents flowering.
- Similarly, in long day plants, the photoperiod should be long followed by short skotoperiods. For such plants, the exposure of light during dark period does not inhibit flowering. Rather, they can flower even on exposure to continuous light.
- The essential distinction between long day and short day plants is that, the flowering in LDPs is promoted only when day length exceeds a certain duration, called critical day length, whereas flowering in SDPs requires a day length that is less than critical day length.
- Thus, the **critical photoperiod** is that continuous duration of light which must not be exceeded in SDP and should always be exceeded in LDP to bring about flowering.

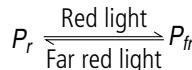


Photoperiodic Induction

- The photoperiod regulated processes in the leaves that result in the transmission of a floral stimulus to the shoot are collectively referred to as **photoperiodic induction**.
- The minimum number of appropriated photoperiods required for induction varies from one (e.g., *Xanthium*, *Pharbitis*) to twenty five (e.g., *Plantago lanceolata*).
- It can take place in a leaf that has been separated from the plant. For example, in *Perilla crispa*, a SDP, an excised leaf exposed to short days can cause flowering upon being grafted to a non-induced plant exposed to long days.
- The sensitivity of perceiving induction by plant leaf increases with the growth of leaf till its full expansion and decreases after maturity or onset of senescence.
- Chailakhyan** (1932) proposed that under favourable conditions of photoperiod, a hormonal stimulus is produced. This flowering hormone is identified as **florigen**.
- Since, the induction is perceived by leaves and flowers are formed elsewhere in the specialised regions, the stimulus is supposed to travel from leaves through the phloem to the flowering site. The degree of mobility of stimulus (flowering hormone) varies from plant to plant.

Photoperiodic Perception

- The photoperiodic stimulus is perceived by the fully mature leaves. However, too young leaves are insensitive towards the stimulus.
- The chemical which perceives the photoperiodic stimulus in leaves is called phytochrome.
- **Borthwick and Hendricks** (1952) reported a photoreceptive pigment called **phytochrome**. It is a bright blue or bluish green pigment which was first of all isolated from plasma membrane of alga *Mougeotia*.
- Phytochrome has a light absorbing or light detecting portion (the chromophore) attached to small protein of about 1,24,000 daltons. Phytochrome occurs in 2 forms; P_r and P_{fr} , i.e., red light and far red light absorbing forms respectively. Among these, P_{fr} is the physiologically active form. Both these forms are interconvertible.



- It is considered that during day time, P_{fr} form accumulates in plants which is inhibitory to flowering in SDPs and stimulatory to flowering in LDPs. During night, P_r form accumulates in plants which is stimulatory to flowering in SDPs and inhibitory to flowering in LDPs. If red light is given to SDP during night, P_r is converted into P_{fr} , which inhibits flowering in SDPs but if far red light is given after red light, P_{fr} form again is converted into P_r form, which induces flowering in SDPs.

Other physiological functions of phytochrome

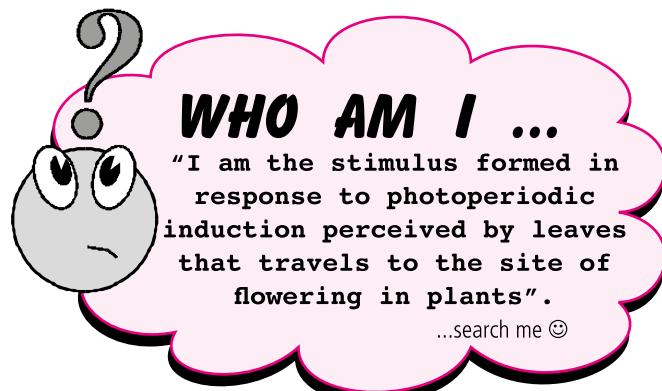
- Phytochrome is now well known to mediate several processes, e.g., elongation of leaf, stem and petiole, unfolding of hypocotyl hook and grass leaf, development of root, rhizome and bulb, germination of pollen, fern spores and seeds, and differentiation of stomata and tracheary elements.
- It is also known to participate in certain metabolic and other processes such as respiration, RNA synthesis, auxin catabolism, fat degradation, degradation of protein, abscission, epinasty, flower induction, photoperiodism and permeability.

Significance of Photoperiodism

- Photoperiodism determines the season in which a particular plant shall flower. For example, short day plants develop flowers in autumn-spring period (e.g., *Dahlia*, *Xanthium*) while long day plants produce flowers in summer (e.g., *Amaranthus*).
- Knowledge of photoperiodic effect is useful in keeping some plants in vegetative growth (many vegetables) to obtain higher yield of tubers, rhizomes, etc., or to keep the plant in reproductive stage to yield more flowers and fruits.
- A plant can be made to flower throughout the year by providing favourable photoperiod.
- It helps the plant breeders in effective cross-breeding in plants.
- It enables a plant to flower in different seasons.

VERNALISATION

- Besides the critical photoperiod length, some plants require low temperature for flowering, e.g., winter cereals.
- Such plants can be converted to spring cereals by providing low temperature treatment artificially. This process is referred to as **vernalisation**.
- The term vernalisation was coined by T.D. Lysenko (1928).
- It is defined as the **process of shortening of the juvenile or vegetative phase and hastening flowering** by a previous cold treatment. In vernalisation, by **cold treatment winter varieties are transformed into spring or summer varieties**, e.g., *Secale cereale*, *Triticum vulgare*, *Brassica oleracea*, *Beta vulgaris*, etc.
- The stimulus of vernalisation is perceived by apical meristem and all the meristematic cells, e.g., shoot tip, embryo tips, root apex, etc.
- As a result of vernalisation, a flowering hormone called **vernalin** is formed (reported by Melchers), but vernalin has never been isolated.
- Once a plant is vernalised, it can be devernalised by exposing the plant to temperature of 30°C or above.



Conditions Required for Vernalisation

Age of the plant

This varies from plant to plant, e.g., in wheat, vernalisation is done in germinating seeds. Similarly, *Hyoscyamus* (henbane) receives vernalisation after 10 days of vegetative growth.

Duration

1–1½ months low temperature treatment is necessary in most of the plants.

Temperature

1–6°C is the optimum temperature. -6°C is completely non-effective. Similarly, 7°C is also less effective.

Oxygen

As vernalisation is aerobic process, so it requires oxygen.

Water

Proper hydration is necessary for vernalisation.

Importance of Vernalisation

- Crops can be grown earlier. Juvenile or vegetative period is shortened and brings about early flowering.
- Plants can be grown in such regions where normally they do not grow.
- Yield of the plant is increased.
- Resistance to cold and frost is increased.
- Resistance to fungal diseases is increased.

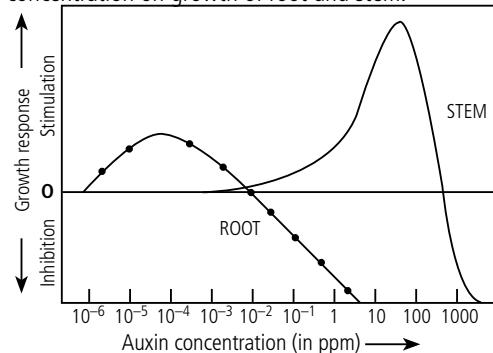
SPEED PRACTICE

1. The process of formation of interfascicular vascular cambium is an example of
 - (a) differentiation
 - (b) dedifferentiation
 - (c) redifferentiation
 - (d) plasticity.
2. Gibberellins overcome the natural dormancy of buds and seeds. The hormone antagonistic in this regard is
 - (a) cytokinin
 - (b) ethylene
 - (c) abscisic acid
 - (d) both (b) and (c).
3. The plant growth regulator that is derived from terpene is
 - (a) gibberellic acid
 - (b) kinetin
 - (c) IAA
 - (d) ethylene.
4. Which of the given plants requires short photoperiods for floral initiation and long photoperiods for blossoming?
 - (a) *Gossypium*
 - (b) *Campanula*
 - (c) *Hyoscyamus*
 - (d) *Chrysanthemum*
5. The arithmetic growth is one where
 - (a) rate of growth is constant
 - (b) the growth cannot be sustained for long
 - (c) it is represented by $W_1 = W_0 e^{rt}$
 - (d) all of these.
6. A plant shows decreased sensitivity to gravity along with following changes.
 - (i) Its roots become apogeotropic and stem become positively geotropic
 - (ii) Leaves show drooping
 - (iii) Seedlings develop tight epicotyl hook

Which hormone is responsible for the above phenomenal changes?

 - (a) Auxin
 - (b) Ethylene
 - (c) Gibberellin
 - (d) Abscisic acid

7. Consider the given graphical representation of effect of auxin concentration on growth of root and stem.



Select the correct statement explaining it.

- (a) The optimum auxin concentration required for root and shoot elongation is almost same.
 - (b) The lower concentration of auxin ranging between 1 to 10 ppm inhibits growth.
 - (c) Higher concentration of auxin is required for growth of stem, as compared to root.
 - (d) Auxin inhibits the growth of roots but stimulates the growth of shoot/stem.
8. Consider the following statements regarding long day plants.
 - I. Long day plants are induced to flower by photoperiods above a critical length.
 - II. Flowering in LDPs is prevented if skotoperiod is interrupted by light.
 - III. These plants can flower under alternate short cycles of light and darkness.

- IV. Long day plants flower in autumn-spring periods.
The correct statements are
 (a) I, III and IV (b) II, III and IV
 (c) II and IV (d) I and III.
9. Besides regulating photoperiodic responses in plants, phytochrome also contributes in
 (a) seed germination (b) abscission
 (c) photomorphogenesis (d) both (a) and (c).
10. Choose the incorrect statement for phytochrome.
 (a) P_{fr} form changes to P_r by absorbing 660 nm light.
 (b) P_r form changes to P_{fr} by absorbing 660 nm light.
 (c) Phytochrome is blue coloured cytoplasmic chromoprotein.
 (d) It takes part in photomorphogenesis.
11. The shelf life of vegetables, flowers and cut shoots can be prolonged by external application of
 (a) ethylene (b) high temperature
 (c) cytokinins (d) gibberellins.
12. The artificially synthesised auxin that acts as weedicide to remove broad leaved weeds in cereal crops is
 (a) 2, 4-D (b) 2, 4, 5-T
 (c) NAA (d) both (a) and (b).
13. Carefully read the statements related to vernalisation and choose the correct one(s).
 I. Vernalisation helps in increasing the vegetative period of plant.
 II. It increases yield, resistance to cold and some diseases.
 III. Kernel wrinkles of *Triticale* are removed by vernalisation.
 IV. The stimulus for vernalisation is perceived by meristematic cells.
 (a) I and III (b) II only
 (c) II, III and IV (d) IV only
14. Match the columns and select the correct option.
- | Column I | Column II |
|---|--------------------------------|
| A. Long day plant | (i) Petkus variety of rye |
| B. Short day plant | (ii) <i>Bryophyllum</i> |
| C. Short-long day plant | (iii) <i>Cosmos bipinnatus</i> |
| D. Long-short day plant | (iv) <i>Spinacea oleracea</i> |
| E. Day neutral plant | (v) Sunflower |
| (a) A-(iii), B-(ii), C-(i), D-(v), E-(iv) | |
| (b) A-(iv), B-(iii), C-(i), D-(ii), E-(v) | |
| (c) A-(ii), B-(iii), C-(iv), D-(v), E-(i) | |
| (d) A-(iv), B-(ii), C-(iii), D-(i), E-(v) | |
15. Read the following statements regarding florigen.
 I. It is a hypothetical hormone.
 II. It is produced only when the plants have completed juvenile stage.
 III. Florigen retards growth.
 Choose the correct statement(s).
 (a) I only (b) II only
 (c) I and III (d) I and II
16. Read the following statements and choose the correct ones.
 I. Heterophylly is the occurrence of different types of leaves on the same plant in different environmental conditions or growth phases.
 II. The ability to change the structures developing in different phases of growth is called plasticity.
 III. Intrinsic plasticity is found in emergent hydrophytes.
 IV. In plants, like larkspur, the juvenile leaves are broadly lobed while mature leaves are pinnately divided.
 (a) I, II and III (b) I and III
 (c) I, II and IV (d) All of these
17. Pruning of hedges makes them dense because
 (a) it release hormones in response to wound
 (b) it induces differentiation of new shoots from rootstock
 (c) the shoot apex grows faster after pruning
 (d) axillary or lateral buds grow due to removal of apical buds.
18. Select the incorrectly matched pair.
 (a) Auxin - Prevention of lodging of crop plants
 (b) Gibberellin - Off-season flowering
 (c) Abscisic acid - Overcome dormancy of buds
 (d) Ethylene - Ripening of fruits
19. Which of the following is the correct difference between auxin and gibberellin?
 (a) Auxin transport is both basipetal and acropetal whereas gibberellin transport is basipetal.
 (b) Auxin has feminising effect whereas gibberellin has masculinising effect in some plants.
 (c) Auxin mobilises food reserve during seed germination whereas gibberellin has no such effect.
 (d) Natural auxin promotes flowering in long day plants whereas natural gibberellin has no such effect.
20. Read the given statements and select the correct option.
Statement 1 : Auxin movement is basipetal in stem.
Statement 2 : Auxin is synthesised in shoot apices from amino acid tryptophan.
 (a) Both statements 1 and 2 are true and 2 is the correct explanation of 1.
 (b) Both statements 1 and 2 are true but 2 is not the correct explanation of 1.
 (c) Statement 1 is true but statement 2 is false.
 (d) Both statements 1 and 2 are false.
21. The root growth inhibition test done on sterilised seeds of cress show very little root growth in test solution, while those allowed to grow on moist paper shows normal growth.
 The above given test is a bioassay for
 (a) auxin (b) gibberellin
 (c) abscisic acid (d) cytokinin.

Contd. on page no. 80

MPP-6

MONTHLY Practice Problems

Class 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.

- Transport in Plants
- Mineral Nutrition

Total Marks : 160

Duration : 40 Min.

- Plant imbibants generate a steep water potential gradient in contact with water as they
 - (a) are hydrophobic colloids
 - (b) have highly negative water potential
 - (c) have highly positive water potential
 - (d) have decreased turgor pressure.
- A student was studying a section of root nodules from chick pea. He observed a large, pink cell in which small, irregular, polyhedral structures were present. These polyhedral structures and the pigment responsible for pink colour are respectively
 - (a) infection thread and myoglobin
 - (b) infected cortical cells and leghaemoglobin
 - (c) bacteroids and leghaemoglobin
 - (d) bacteroids and haemoglobin.
- Pressure flow hypothesis is related with the
 - (a) mass flow of ions against the concentration gradient through xylem
 - (b) transport of organic substances through phloem due to turgor pressure gradient
 - (c) rapid uptake and translocation of organic substances through apoplast pathway
 - (d) active transport of water due to root pressure in xylem.
- Which of the following statements is incorrect?
 - (a) Temperature above 20°C reduces stomatal opening in many species.
 - (b) Film forming antitranspirants are sufficiently permeable to CO₂ and O₂.
 - (c) Translocation of water is unidirectional while that of organic solutes is multidirectional.
 - (d) Leghaemoglobin acts as oxygen scavenger for nitrogenase.
- Match the column I with column II and select the correct option.

Column I	Column II
A. Sulphur	(i) Found in middle lamella
B. Calcium	(ii) Non-essential for plants
C. Iodine	(iii) Activates enzymes of respiration
D. Manganese	(iv) Constituent of coenzyme A, thiamine, biotin, etc.

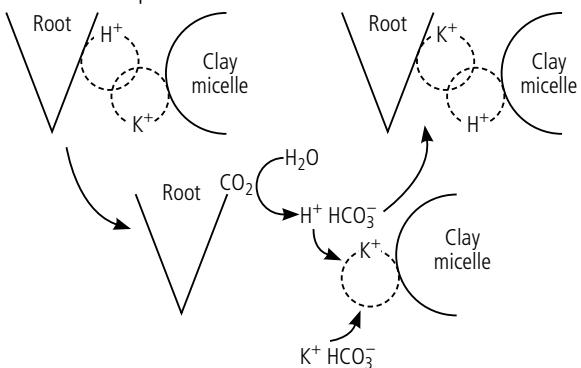
 - (a) A-(i), B-(iii), C-(ii), D-(iv)
 - (b) A-(iv), B-(ii), C-(iii), D-(i)
 - (c) A-(iv), B-(i), C-(ii), D-(iii)
 - (d) A-(iii), B-(i), C-(iv), D-(ii)
- Which of the following processes is used to remove salts from saline water and for extra-purification of water?
 - (a) Reverse osmosis
 - (b) Diffusion
 - (c) Osmosis
 - (d) Plasmolysis
- Identify the element 'X' from the given deficiency symptoms and diseases caused by it.
Interveinal chlorosis, little leaves disease, leaf rosette, stunted growth, white bud of maize.
 - (a) Zinc
 - (b) Iron
 - (c) Copper
 - (d) Boron
- The conditions responsible for guttation are
 - (a) late spring, water deficiency, negative pressure in xylem
 - (b) dry and water deficient conditions, high humidity
 - (c) humid conditions, high rate of water absorption, positive pressure in xylem
 - (d) rainy conditions, high water absorption, poorly aerated soils.

- 9.** Identify the incorrect pairs of differences between macronutrients and micronutrients and choose the correct option.

	Macronutrients	Micronutrients
(i)	They occur in plants in undetectable amounts.	They occur in plants in easily detectable quantities.
(ii)	They build up the plant body and its different protoplasmic constituents.	They act as cofactors.
(iii)	They have an important role in the development of osmotic potential.	They do not play any significant role in developing osmotic potential.
(iv)	They are toxic in slight excess.	They do not become toxic in slight excess.

- (a) (ii) and (iv) (b) (i) and (iv)
 (c) (i), (ii) and (iv) (d) All of these

- 10.** Which of the following options explains the theory of mineral absorption?



- (a) Absorption of ions into root along with the mass flow of water.
 (b) Adsorption of ions takes place by ion exchange from colloidal particle, in the soil.
 (c) Non-diffusible or fixed ions are responsible for the absorption of ions.
 (d) Absorption of ions take place as a result of electrochemical gradient.

- 11.** Bacteria are unable to survive in highly salted pickles because

- (a) salt inhibits their multiplication rate
 (b) bacteria do not get enough light for photosynthesis
 (c) they become plasmolysed and consequently get killed
 (d) the pickle do not contain nutrients necessary for bacterial growth.

- 12.** With reference to the reaction given below, consider the following statements and select the correct option stating which ones are true (T) and which ones are false (F).

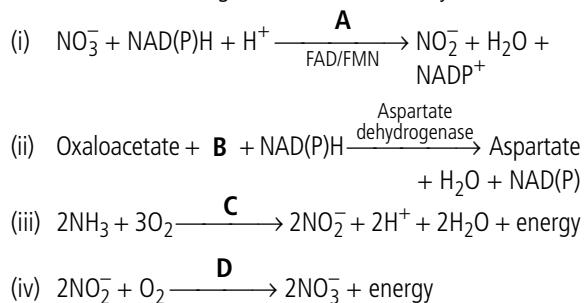


- I. This reaction occurs inside the chloroplast in the leaf cells and leucoplast of other cells.
 II. The enzyme which catalyses this reaction requires a reducing power which is NADH in illuminated cells and NADPH in others.
 III. The product formed in this reaction combines with organic acids to produce amino acids.
 IV. The enzyme which catalyses this reaction is found attached loosely to mitochondria.

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

- 13.** Despite being devoid of vessels, most of the tall trees of the world include conifers and redwoods. It is because
 (a) transpiration pull creates tension in tracheary elements
 (b) tracheids are wider than vessels
 (c) tracheidal xylem is least affected by gravitational pull under tension
 (d) root cells and tracheidal xylem both offers resistance to movement of water.

- 14.** Refer to the reactions given below and identify A, B, C and D.



A	B	C	D
(a) Nitrate reductase	NH ₄ ⁺	<i>Nitrosomonas</i>	<i>Nitrobacter</i>
(b) Nitrite reductase	NO ₂ ⁻	<i>Nitrosococcus</i>	<i>Micrococcus</i>
(c) Amino-transferase	H ₂ O	<i>Aspergillus flavus</i>	<i>Bacillus</i>
(d) Dehydrogenase	NH ₄ ⁺	<i>Nitrocystis</i>	<i>Rhizobium</i>

- 15.** Which of the following events involve osmosis?

- (i) Water absorption by the germinating seeds.
 (ii) Movement of water from soil to roots.
 (iii) Prevents the collapsing of certain organelles.
 (iv) Swelling of wood during rains.
 (v) Protect the plants in unfavourable conditions.
 (a) (i), (iv) and (v) (b) (ii), (iv) and (v)
 (c) (i), (iii) and (iv) (d) (ii), (iii) and (v)

- 16.** Consider the following statements and select the incorrect ones from given options.
- Root pressure is maximum during rainy season in plants of tropical countries.
 - Cohesion, adhesion and surface tension keep the water in place inside tracheary elements.
 - Deficiency of potassium causes scorched leaf tips.
 - The elements that are indispensable for the growth of plants are called beneficial elements.
- (a) I and III (b) IV only
 (c) I and IV (d) II, III and IV
- 17.** Which of the following best explains the water transportation from the roots to the leaves of a tall tree?
- Capillary rise of water through xylem vessels
 - Cohesion and transpiration pull
 - Root pressure
 - ATP hydrolysis
- 18.** Arrange the following steps of nodule formation in sequence by choosing the correct option.
- Degradation of cell wall of root hair and formation of infection thread enclosing bacteria
 - Bacteria collect over the root hair as a result of chemotropism
 - Dedifferentiation of infected cortical cells to form swelling or nodules
 - Curling of root hair around the bacteria
- (a) III → IV → I → II (b) II → IV → I → III
 (c) I → II → III → IV (d) IV → II → I → III
- 19.** The correct equation for water potential can be given as
- $\psi_w = \psi_s + \psi_p$
 - $\psi_w = \psi_m + \psi_s$
 - $\psi_w = \psi_p - \psi_s$
 - $\psi_w = \psi_m - \psi_p$
- 20.** Read the following statements and select the option which correctly fills the blanks.
- Boron and (i) are involved in the translocation of organic substances in the phloem.
 - (ii) is a component of chlorophyll that takes part in conversion of light energy into chemical energy.
 - Sesbania rostrata* has (iii) in its stem nodules.
 - Enzyme nitrate reductase is a metalloflavoprotein containing copper and (iv).
- | (i) | (ii) | (iii) | (iv) |
|----------------|------------|----------------------|-----------|
| (a) manganese | Phosphorus | <i>Frankia</i> | boron |
| (b) molybdenum | Potassium | <i>Rhizobium</i> | chlorine |
| (c) potassium | Magnesium | <i>Aerorhizobium</i> | iron |
| (d) magnesium | Iron | <i>Rhizobium</i> | potassium |
- 21.** The process of stomatal closing during night is given below. Arrange the steps in sequential order.
- Malate ions present in guard cell cytoplasm combine with H^+ to form malic acid.
 - Decrease in pH of the guard cell cytoplasm.
 - Diffusion of H^+ ions, out of the guard cell chloroplast.
 - Decrease in osmotic concentration of guard cell cytoplasm leading to exosmosis.
 - K^+ ions dissociate from malate and are transported into subsidiary cells.
 - Guard cells become flaccid.
- (a) (v) → (ii) → (i) → (iii) → (iv) → (vi)
 (b) (i) → (ii) → (iii) → (v) → (vi) → (iv)
 (c) (iii) → (ii) → (i) → (v) → (iv) → (vi)
 (d) (iii) → (v) → (ii) → (i) → (iv) → (vi)
- 22.** *Aulosira fertilissima* is the most active nitrogen fixer in rice fields while *Cylindrospermum* is active in fields of
- most legumes
 - sugarcane and maize
 - cotton and poppy
 - none of these.
- 23.** Match the following columns.
- | Column I | Column II |
|-------------------------------|---|
| A. Osmotic potential | (i) Controls entry and exit of water in cells |
| B. Matric potential | (ii) Causes movement of water across a semipermeable membrane |
| C. Diffusion pressure deficit | (iii) Provides rigidity to the cells, tissues and softer organs |
| D. Pressure potential | (iv) Essential for seed germination |
- (a) A-(iii), B-(iv), C-(ii), D-(i)
 (b) A-(ii), B-(iv), C-(i), D-(iii)
 (c) A-(ii), B-(i), C-(iii), D-(iv)
 (d) A-(ii), B-(iii), C-(i), D-(iv)
- 24.** Select the correctly matched pair.
- | | |
|----------------|---------------------------------|
| (a) Zinc | — Exanthema |
| (b) Molybdenum | — Khaira disease of rice |
| (c) Boron | — Brown heart in turnip |
| (d) Copper | — Whiptail disease of crucifers |
- 25.** Read the following statements and select the correct option.
- Statement A:** Plasmolysis can determine whether a cell is living or dead.
- Statement B:** Plasmolysis is shown only by living cells.
- Both statements A and B are correct and B is the correct explanation of A.
 - Both statements A and B are correct but B is not the correct explanation of A.
 - Statement A is correct but statement B is incorrect.
 - Both statements A and B are incorrect.

26. How many of the given microorganisms are free-living nitrogen fixing forms?

Trichodesmium, Azotobacter, Xanthomonas, Beijerinckia, Mycobacterium, Klebsiella, Anabaena, Frankia, Desulphovibrio

- (a) 7 (b) 3
(c) 6 (d) 4

27. Which of the following options correctly traces the path of water in roots, after its absorption?

- (a) Cortex → endodermis → pericycle → protoxylem → metaxylem → cell wall
(b) Cell wall → cortex → endodermis → pericycle → protoxylem → metaxylem
(c) Pericycle → soil → root hair → cortex → endodermis → protoxylem → metaxylem
(d) Cell wall → cortex → pericycle → endodermis → protoxylem → metaxylem

28. Match the column I with column II.

Column I	Column II
A. Mobile elements	(i) Carbon
B. Immobile elements	(ii) Aluminium
C. Framework elements	(iii) Hydrogen
D. Beneficial elements	(iv) Potassium (v) Sulphur (vi) Nitrogen (vii) Calcium (viii) Cobalt

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

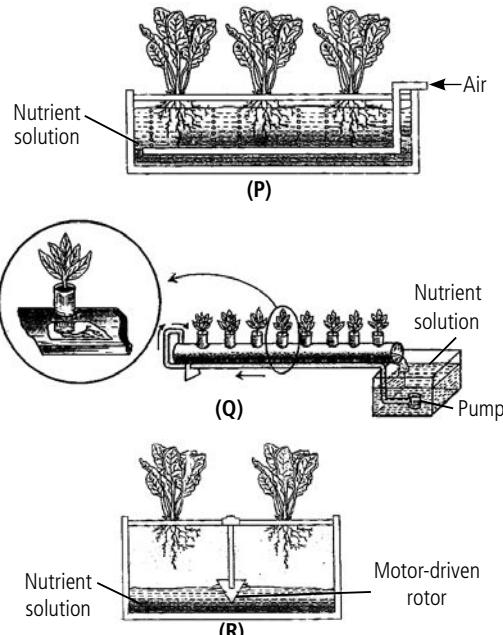
29. During translocation of organic nutrients, the hydrostatic pressure in phloem and xylem respectively is

- (a) positive, negative (b) negative, negative
(c) negative, positive (d) positive, positive.

30. Which of the following statements is incorrect?

- (a) Guard cells are kidney-shaped in dicots and dumb-bell shaped in monocots.
(b) Free-floating hydrophytes possess epistomatic leaves.
(c) Stomata are absent in xerophytes.
(d) Amphistomatic leaves are generally present in monocots.

31. Study the figures given below and choose the option that correctly represent the systems P, Q and R.



- (a) P-Aeroponics; Q-Tank system hydroponics
(b) Q-Aeroponics; R-Tank system hydroponics
(c) P-Tank system hydroponics; R-Film system hydroponics
(d) Q-Film system hydroponics; R-Aeroponics

32. Read the following statements and select the correct options

Statement A : Transpiration is considered to be a necessary evil for plants.

Statement B : 98-99% of absorbed water is lost by transpiration.

UNSCRAMBLED WORDS

AUGUST 2017

- 1-b-LAMINARIN 2-c- METAGENESIS
3-a-ENDONEURIUM 4-i- GLUTELINS
5-g-CRETINISM 6-j- PALYNOLOGY
7-d-SMACK 8-e- HOLOPARASITES
9-h-AZADIMACHTIN 10-f- COLOSTMUM

Winners: Shobhit Singh (Meerut), Shoubhik Koley (West Bengal), Meenakshi Sharma (Himachal Pradesh), Aarsh Gujjar (Gujarat), Sankasubhra Chakraborty (Kolkata)

Spelathon Winners

August-2017

1. Neha Joshi, Alappuzha
2. Dhruvi Jadav, Vadodra

- (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 statement B is incorrect.
 (d) Both statements A and B are incorrect.
- 33.** Choose the incorrect option from the given table representing minerals and their associated deficiency symptoms.

Deficiency symptoms					
	Minerals	Chlorosis	Necrosis	Die back	Late flowering
(a)	N	+	-	-	+
(b)	Ca	+	+	+	-
(c)	Mo	+	+	-	+
(d)	Cu	-	+	+	-

- 34.** Cellulosic cell wall is an example of
 (a) selectively permeable membrane
 (b) semipermeable membrane
 (c) permeable membrane
 (d) impermeable membrane.
- 35.** Read the given statements regarding transpiration and select the correct option.
 (a) The rate of transpiration decreases with decreasing relative humidity.
 (b) Lenticular transpiration occurs continuously during day and night.
 (c) Cuticular transpiration increases with the thickness of cuticle.
 (d) Transpiration is higher in leaves with compact mesophyll having more palisade tissues and few intercellular spaces.

- 36.** Select the correct option to fill up the blanks in the following statements.
 (i) Plasmolysis is generally demonstrated by using *Tradescantia* leaves because their cells contain _____.
 (ii) Sucrose being a _____ and chemically _____, is considered as the most suitable carbohydrate for translocation.

- (iii) _____ present in outer membrane of mitochondria allow the passage of small-sized proteins.
 (iv) Hydrophilic molecules can pass through cell membranes by _____.

	(i)	(ii)	(iii)	(iv)
(a)	anthocyanin	non-reducing, stable	Porins	facilitated diffusion
(b)	carotenoids	reducing, stable	Aquaporins	active transport
(c)	phycobilins	non-reducing, unstable	Vacuoles	simple diffusion
(d)	xanthophylls	hexose, inert	Tubules	active transport

- 37.** The conditions responsible for maximum transpiration pull are
 (a) open stomata, dry atmosphere, moist soil
 (b) closed stomata, high humid atmosphere, dry soil
 (c) open stomata, high humid atmosphere, low light intensity
 (d) closed stomata, humid atmosphere, well irrigated soil.

- 38.** Girdling experiment demonstrates that
 (a) phloem is responsible for translocation of food
 (b) xylem is responsible for ascent of sap
 (c) transpiration pull
 (d) both (a) and (b).

- 39.** Which of the following statements are true regarding apoplast pathway?
 (i) The pathway mediates the movement of substances outside the xylem.
 (ii) It is a living system of interconnected cytoplasmic bridges.
 (iii) The pathway is interrupted by lignosuberin layer.
 (iv) The pathway is directly affected by the metabolism of root cells.
 (a) (ii) and (iii) only (b) (i) and (iv) only
 (c) (i) and (iii) only (d) (ii) and (iv) only

- 40.** Which nutrient element in nitrogenase plays an essential role in nitrogen fixation?
 (a) Copper (b) Molybdenum
 (c) Manganese (d) Cobalt

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SELF CHECK

Check your score! If your score is

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EXCELLENT WORK ! You are well prepared to take the challenge of final exam.

90-75%

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You can score good in the final exam.

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You need to score more next time.

< 60%

NOT SATISFACTORY! Revise thoroughly and strengthen your concepts.

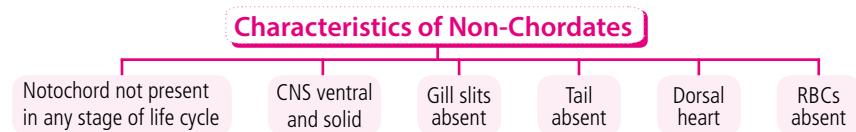
HIGH YIELD FACTS



Class XI

Animal Kingdom : Non-Chordates

- Large number of animals inhabit the Earth today and many more had lived here in the past. These animals vary in shape and size, habit and habitat, colour, weight as well as in their distribution.
- Kingdom Animalia is broadly divided into two groups., i.e., non-chordates (group of lower and simpler animals) and chordates (group of higher and complex animals). In this article we will study the lower group, i.e., non chordates (invertebrates).



BASIS OF CLASSIFICATION

- Although different animals have differences in structures and forms, yet there are common fundamental features, i.e., arrangement of cells, body symmetry, nature of coelom, pattern of digestive, circulatory, respiratory systems, that forms the basis of classification, etc.
- Various features used as basis for animal classification are:

I. Grades of Organisation

: Four grades of organisation are found in animals.

Protoplasmic or Acellular grade

All the activities are confined within the limits of plasma membrane. *E.g.*, Protozoans.

Tissue grade

Similar cells group together to form tissues. *E.g.*, Cnidarians and ctenophores.

Grades of organisation

Cellular grade

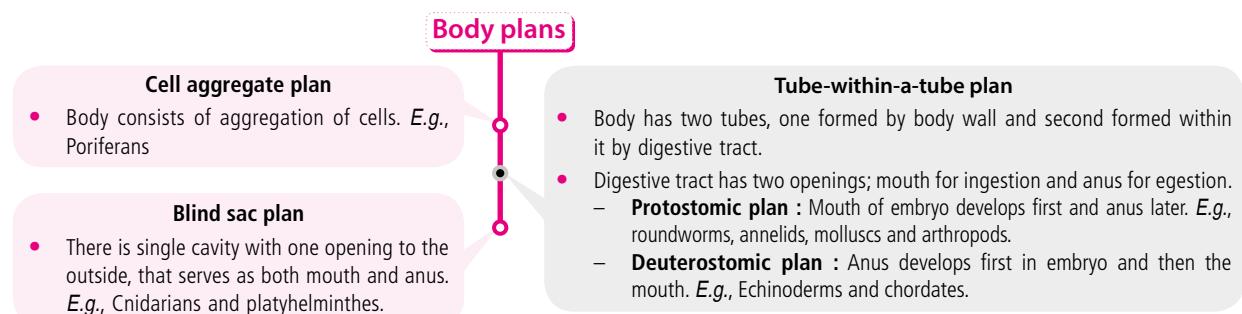
Body consists of many cells and cells exhibit minor division of labour for performing specialised functions. *E.g.*, Poriferans.

Organ - system grade

Organs join together in a system to perform some function. *E.g.*, Platyhelminthes to chordates.

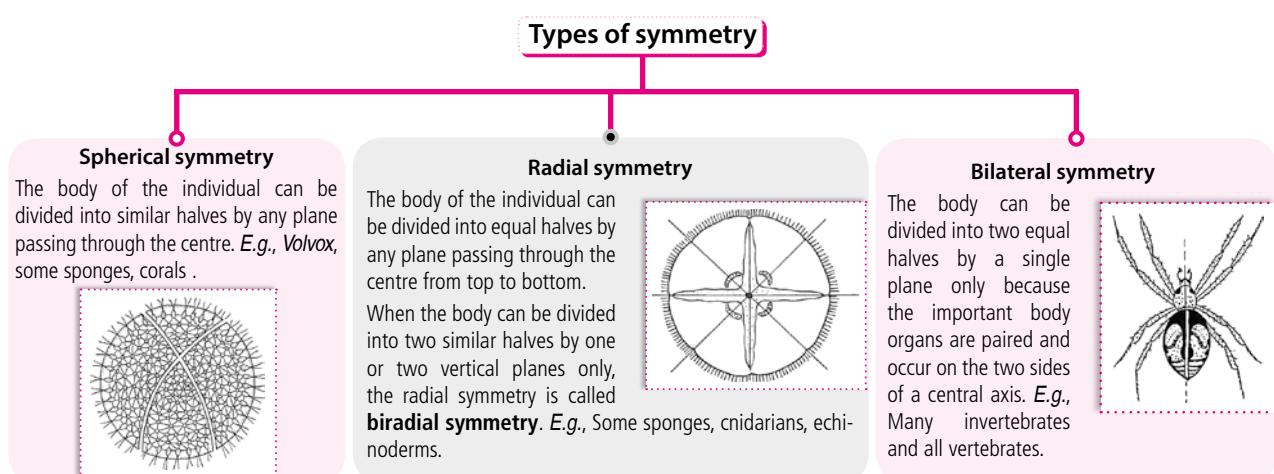
	Analysis of various PMTs from 2013-2017				
	2013	2014	2015	2016	2017
AIPM/T/NEET	3	3	2	1	2
AIMS	1	1	1	1	3
AMU	3	-	5	-	-
Kerala	-	3	4	-	-
K-CET	3	1	1	-	-
J & K	-	-	-	1	-

II. Body Plans : Animals have three types of body plans.



III. Symmetry : Similarity of parts of different regions and directions of the body is called body symmetry.

- A body is said to be **asymmetrical**, if it is not divisible into equal halves by any plane. Some sponges are asymmetrical. A body is said to be **symmetrical**, if it can be divided into equal halves by one or more planes.



IV. Germinal Layers: The germinal layers form the body of animals.

- (i) **Diploblastic** : Animals of this group have two germinal layers, *i.e.*, ectoderm and endoderm and an undifferentiated mesoglea is present in between the two layers. *E.g.*, Poriferans and cnidarians.
- (ii) **Triploblastic** : Animals of this group have three germ layers; ectoderm, mesoderm and endoderm. *E.g.*, Phylum Platyhelminthes to Phylum Chordata.

V. Coelom : It is a body cavity in between the body wall and gut lined by mesodermal epithelium.

- (i) **Acoelomate** : Animals do not have coelom. *E.g.*, Sponges, cnidarians, ctenophores and flat worms
- (ii) **Pseudocoelomate** : Body cavity in animals is derived from blastocoel of embryo. *E.g.*, Round worms
- (iii) **Eucoelomate** : Animals possess true coelom, body cavity arises as a cavity in embryonic mesoderm. The coelom is filled with coelomic fluid secreted by peritoneum. True coelom is of two types:
 - (a) **Schizocoelom** : Develops as split in mesoderm. *E.g.*, Annelids, arthropods, molluscs
 - (b) **Enterocoelom** : The mesoderm arises from the wall of the embryonic gut or enteron as hollow outgrowth which form this type of coelom. *E.g.*, Echinoderms and chordates.

VI. Segmentation : It is the division of body into distinct portions called segments.

Metameric segmentation-external divisions correspond to internal divisions. Segmentation is mostly external in arthropods, internal in chordates and both external and internal in annelids.

Segmentation

Pseudometamerism-segmentation is external, it is found in tapeworms.

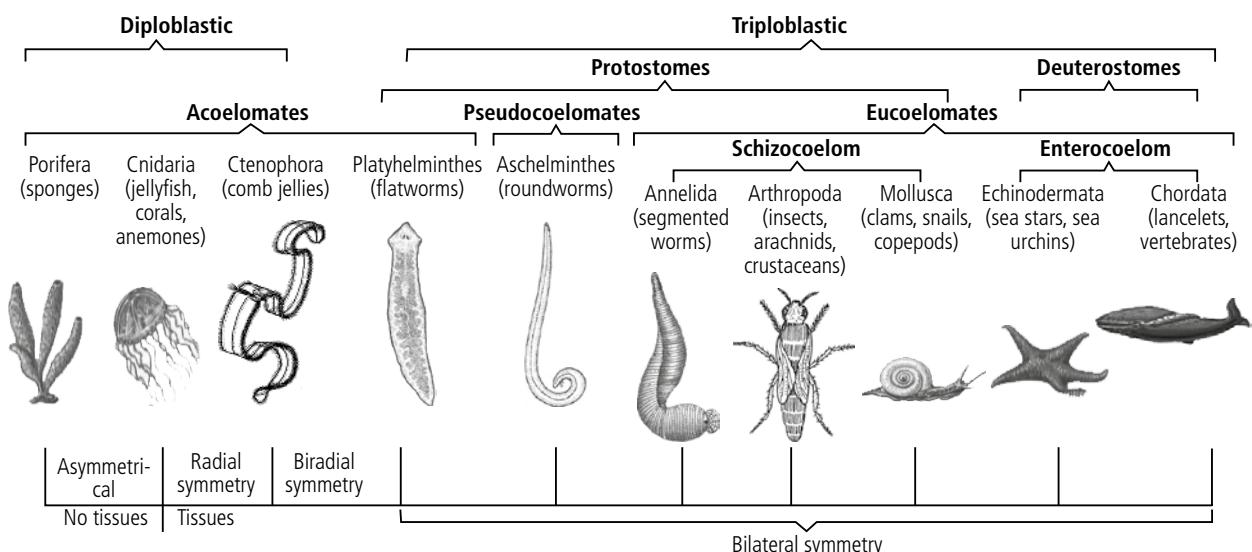
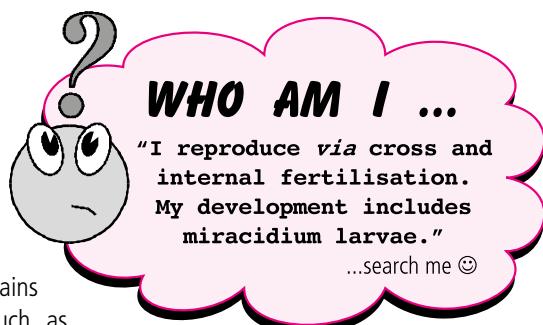


Fig.: A broad classification of animalia based on common fundamental features.

DISTINGUISHING FEATURES OF DIFFERENT PHYLA PHYLUM PORIFERA

(Sponges; Pore bearing animals)

- Body is provided with two types of pores; ostia (inhalant pores) and oscula (exhalant pores).
- The body wall consists of three layers: (a) Pinacoderm, (b) Choanoderm and (c) Mesohyl layer.
- Mesohyl layer contains spongin fibres and spicules. It also contains amoebocytes which are modified into different types of cells such as archaeocytes (totipotent cells), trophocytes (nurse cells), germ cells, phagocytes, etc.
- Canal system in sponges consist of pores and canals. It is of three types:



Canal system

Asconoid canal system

- Simplest type of canal system. Water enters the body cavity spongocoel through ostia and flows to outside through osculum. E.g., *Leucosolenia*

Syconoid canal system

- It is complex system of pores and canals. Body wall consists of two types of canals, incurrent and radial canals. E.g., *Sycon*

Leuconoid canal system

- It is the most complex type of canal system which is found in *Spongilla* and some other sponges. In class Demospongiae, the leuconoid condition is derived from a larval stage, called the rhagon. **The canal system of rhagon larva does not occur in any adult sponge.** Because of its derivation from rhagon stage in Demospongiae, the leucon type of canal system is also called the **rhagon type**.

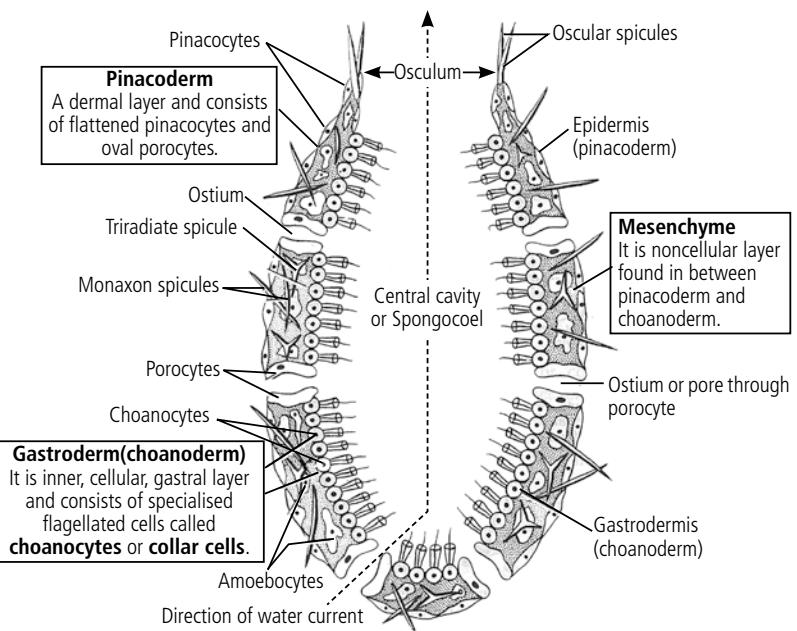


Fig.: Longitudinal section of *Leucosolenia*

- Digestion is intracellular, respiration and elimination of metabolic wastes (chiefly NH₃) occur by diffusion across plasma membrane.
- Both sexual and asexual reproduction. Reproduces asexually by budding and gemmules. Sponges are hermaphrodite and fertilisation is internal.
- Holoblastic cleavage and development includes free swimming **larva amphiblastula** (in *Sycon*) and **parenchymula** (in *Leucosolenia*).

Classification

Divided into three classes on the basis of skeleton

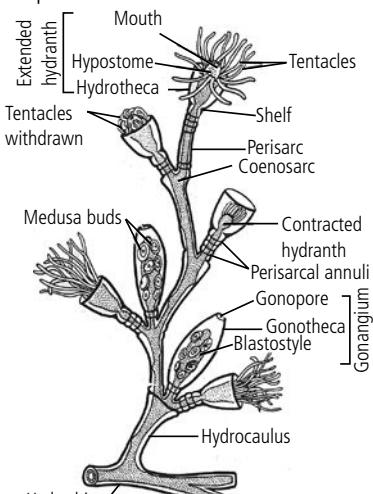
Class

1. Calcarea (Skeleton of calcareous spicules).	<i>Leucosolenia, Sycon</i>	
2. Hexactinellida (Skeleton of siliceous spicules, which have six rays).	(a) <i>Euplectella</i> (Venus flower basket)	Given as costly marriage gift in Japan as symbol of union of wife and husband.
	(b) <i>Hyalonema</i> (Glass rope sponge)	Fixed in mud by root tuft of long twisted spicules.
3. Demospongiae (Skeleton of spongin fibres or of spongin fibres with siliceous spicules or may be absent).	(a) <i>Euspongia</i> (The bath sponge)	Its skeleton is used for bathing, washing automobiles, cleaning furniture, mopping, etc.
	(b) <i>Spongilla</i> (Fresh water sponge)	
	(c) <i>Cliona</i> (Boring sponge)	Can penetrate the rocks and break them into pieces.
	(d) <i>Chalina</i> (Deadman's fingers or Mermaid's gloves)	

PHYLUM CNIDARIA (= COELENTERATA)

- Shows polymorphism**, i.e., presence of more than one type of individuals in their colonies for performing different functions in same species. **Two main types of zooids are – polyps and medusae**. A third type of zooid (blastostyles) may be present in some.
- Body wall consists of outer epidermis and inner gastrodermis and non-cellular gelatinous mesoglea in between.
- Epidermis contains specialised cnidoblasts (stinging cells), that has nematocyst (stinging organ) for offence and defence.
- Digestive tract is incomplete. Digestion is both intracellular and extracellular.
- Statocyst as balancing organ, develops first time in cnidarians**.
- Holoblastic cleavage. Development includes **planula** larva (in *Obelia*), **scyphistoma** and **ephyra** (in *Aurelia*).
- Obelia* shows alternation of generation, i.e., metagenesis between asexual (medusae) and sexual (polyp) phases in life cycle. Both phases are diploid.

Classification : Phylum Cnidaria is divided into three classes on the basis of dominance of polyp or medusae form.

Class	Feature	Examples
1. Hydrozoa	Either only polyps or polyps and medusae are present.  Fig.: Obelia	<i>Obelia</i> (Sea-fur) - Polyps are mainly nutritive in function and medusae, which arise from blastostyles, have gonads for sexual reproduction. <i>Physalia</i> (The Portuguese-man-of-war) - Have three types of zooids : (i) Dactylozooids – for catching food and also are the organs of defence. (ii) Gastrozooids - nutritive in function and (iii) Gonozooids - reproductive in function. Other examples: <i>Hydra</i> , <i>Porpita</i> , <i>Vellela</i> , <i>Millepora</i>

2. Scyphozoa	<p>They are represented by medusae.</p> <p>Fig.: Aurelia</p>	<i>Aurelia</i> (Jellyfish), <i>Rhizostoma</i>
3. Anthozoa	<p>Represented by the polyp form.</p> <p>Fig.: Pennatula</p>	<p><i>Gorgia</i> (Sea fan) - Two types of zooids are: autozooids (for feeding) and siphonozooids (for driving water current through colony).</p> <p><i>Adamsia</i> (Sea anemone) - Shows commensalism with hermit crab.</p> <p><i>Pennatula</i> (Sea pen) - Colony is dimorphic, i.e., have siphonozooids and autozooids.</p> <p><i>Meandrina</i> (Brain coral) - Surface of the colony has many convolutions as found in human brain.</p> <p><i>Astrea</i> (Star coral), <i>Fungia</i> (Mushroom coral), <i>Tubipora</i> (Organ-pipe coral)</p>

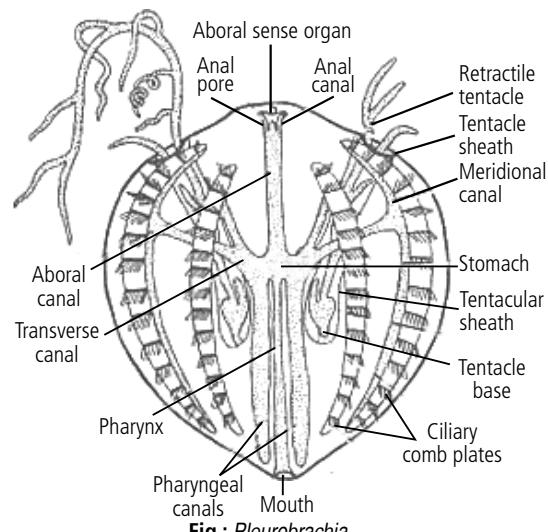
Table : Differences between polyp and medusa

	Polyp	Medusa
(i)	Polyp is fixed.	Medusa is free swimming.
(ii)	Polyp is cylindrical in shape.	Medusa is an umbrella like and formed by blastostyle.
(iii)	Sense organs are absent.	There are 8 sense organs called the statocysts, each meant for equilibrium.
(iv)	Polyps are without gonads.	Medusa has four gonads.
(v)	Polyps feed and protect the colony.	Medusa brings about sexual reproduction and dispersal of species.
(vi)	Polyp belongs to asexual generation. Fig.: Polyp	Medusa represents the sexual generation. Fig.: Side view of Medusa

PHYLUM CTENOPHORA

(The Comb Jellies or Sea Walnuts)

- All ctenophores are exclusively marine.
- Show **bioluminescence**, i.e., ability to emit light.
- Possess special adhesive cells called **colloblasts** (= lasso cells), which are present on tentacles and help in food capture.
- Locomotion by comb like 8 ciliary plates called comb plates.
- Development indirect with **cydippid larva**.
- E.g., *Pleurobrachia* (The Sea gooseberry), *Beroe*, *Ctenoplana*



PHYLUM PLATYHELMINTHES

(The Flatworms)

- The flatworms are mostly parasitic, but some are free-living.
- Rod shaped bodies, **rhabdites** are present, which help in capturing food and provide protection.
- Metabolic waste (mainly NH₃) excreted out through **flame cells (solenocytes/protonephridia)**.
- A ladder-like nervous system, consisting of brain and two main longitudinal nerve cords connected at intervals by transverse commissures are present. Fertilisation is cross and internal. In tapeworms, self fertilisation is found.

Classification
Divided into 3 classes on the basis of mode of life

Turbellaria

- Mostly free living flatworms.
 - E.g., *Dugesia* (*Planaria*)
-

Fig.: Planaria; A. Dorsal side, B. Ventral side

Cestoda

- Endoparasites of vertebrates. Body is generally divided into proglottids. E.g., *Taenia solium* (pork tapeworm), *Echinococcus* (dog tapeworm), *Taenia saginata* (beef tapeworm).
-

Fig.: Tapeworm

Trematoda

- Ecto- or endoparasitic worms (flukes).
 - E.g., *Fasciola* (liver fluke), *Schistosoma*
-

Fig.: *Fasciola hepatica*

Characteristic features of parasitic platyhelminthes

- Their thick tegument is resistant to digestive enzymes and antitoxins of host's body.
- They possess adhesive organs such as hooks and suckers to have a firm grip on or in host's body.
- Tapeworms lack digestive organs because digested and semi-digested food of host gets directly absorbed through body surface.
- Possess remarkable osmotic adaptability, as they can live successfully in different media.
- Locomotory and sense organs are absent.
- They perform anaerobic respiration.

PHYLUM ASCHELMINTHES OR NEMATHELMINTHES

(Round Worms)

- Alimentary canal complete with muscular pharynx.
- Excretory system consists of gland cells or of canal or of both. In *Ascaris* excretory system is in form of 'H' shaped canals and **renette cell**.
- Nervous system consists of circumpharyngeal ring that gives rise to nerves forwards as well as backwards.
- Sense organs are - papillae (tactile in nature), amphids (chemoreceptors) and phasmids (glandulosensory in nature).
- Roundworms are dioecious, i.e., sexes are separate.
- Fertilisation is internal.
- Indirect development includes filariform, microfilaria and rhabditiform larvae in *Ancylostoma*, *Wuchereria* and *Ascaris* respectively.

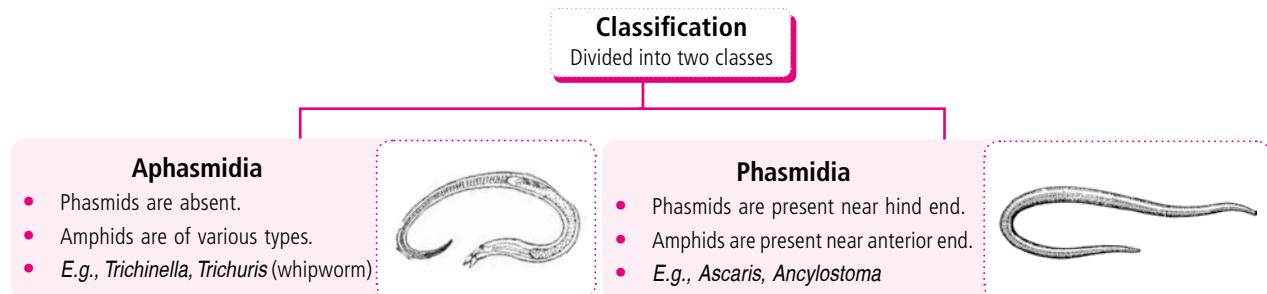


Table: Differences between male and female *Ascaris*

Male		Female
It is smaller than female.		It is larger than male.
Posterior end is curved.		Posterior end is straight.
A cloaca for receiving anus and genital opening is present. The cloaca opens outside through cloacal aperture.	<p>Fig.: <i>Ascaris lumbricoides</i>. Adult worms in lateral view. A - Male, B - Female</p>	There are separate anus and genital aperture. No cloaca is present.
Two equal chitinous spicules (pineal setae) project through cloacal aperture.		Spicules (pineal setae) are absent.

List of some pathogenic Aschelminthes

- ***Wuchereria* (The Filarial worm)** - An endoparasite in lymphatic vessels and lymph nodes of human beings (primary host). The mosquito (*Culex*) is an intermediate host. It causes **elephantiasis** (filariasis), in which limbs or other body parts grow to enormous size.
- ***Ancylostoma duodenale* (The Hook worm)** - It is found as an endoparasite in the small intestine of human beings. It causes ancylostomiasis disease.
- ***Enterobius (Oxyuris)* - The Pin worm.** *Enterobius vermicularis* is found in the caecum, colon or vermiform appendix of the human beings.
- ***Trichinella* (The Trichina worm)** - Adult *Trichinella spiralis* is found in the small intestine of human beings and some other mammals like pigs, domestic animals and rodents. The disease caused by *Trichinella spiralis* is called **trichinellosis**.
- ***Dracunculus* (The Guinea worm)** - *Dracunculus medinensis* occurs in the subcutaneous tissue of man. The disease caused by this worm is called **dracunculiasis**.

PHYLUM ANELIDA

(The Segmented Animals)

- Animals are **metamERICALLY segmented**, i.e., body divided both externally and internally.
- Respiration is cutaneous. In some annelids branchial respiration occur.
- Closed type of blood vascular system. Blood is red due to presence of respiratory pigment **haemoglobin** or **erythrocrorin**.
- Excretory waste is excreted through **nephridia**.
- Nervous system consists of a nerve ring, mid ventral nerve cord with ganglia.
- Sexes are both unisexual (e.g., *Nereis*) and bisexual (e.g., Earthworm, Leech).
- Development may be direct or indirect. Indirect development includes **trochophore** larva.

Classification : Phylum Annelida is divided into 5 classes on the basis of number and presence or absence of setae.

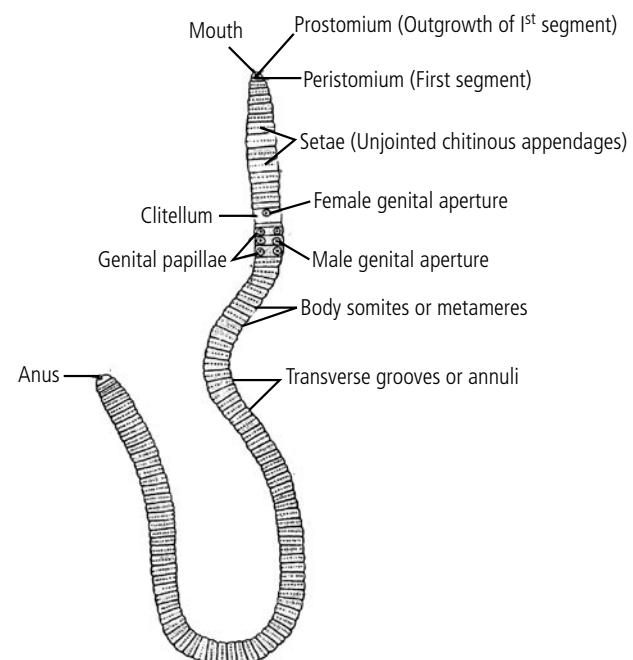
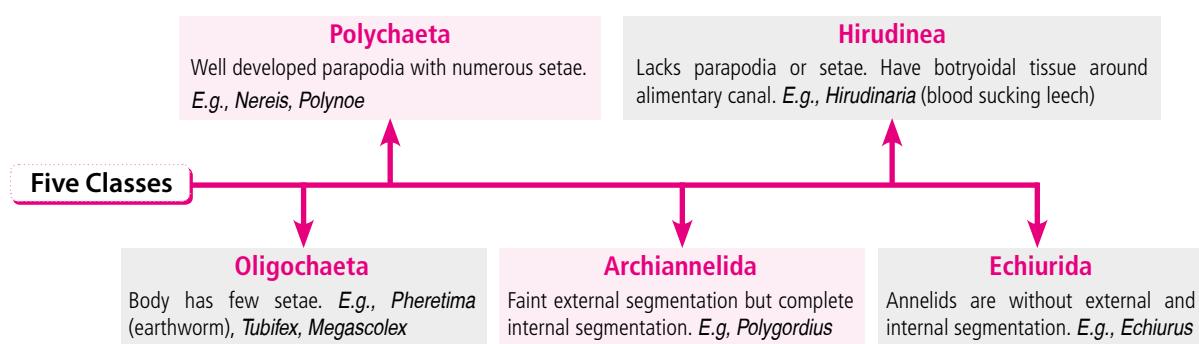


Fig.: Earthworm (Ventral view)



Hirudinaria : Blood sucking leech. The saliva of leech contains anticoagulant **hirudin** that prevents blood clotting during blood meal.

PHYLUM ARTHROPODA

(Animals with Jointed Appendages)

- Body is externally segmented into head, thorax and abdomen.
- Exoskeleton of dead chitinous cuticle, that is shed at intervals, called **ecdysis** or **moult**ing for growth and development.
- Complete digestive tract with alimentary canal divided into foregut, midgut and hindgut.
- Circulatory system open with many chambered heart, arteries and blood filled spaces called **sinuses** or **lacunae**.
- **Gaseous exchange occurs by gills** or **bookgills** and **tracheae** or **book-lungs**.
- Excretory organs are **green glands** or **Malpighian tubules**.
- Development may be direct or indirect. Parthenogenesis in some arthropods.

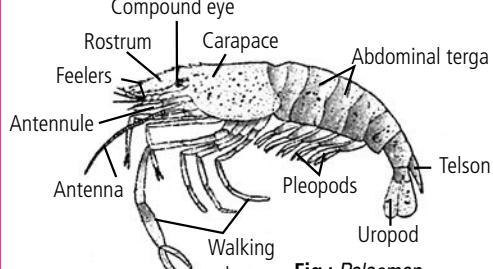
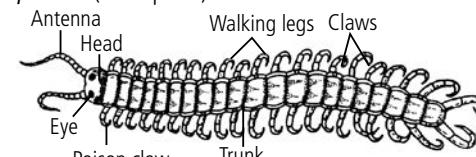
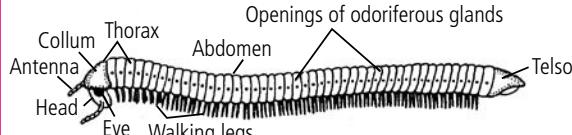
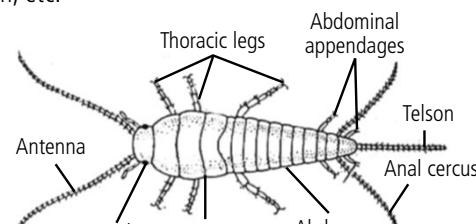
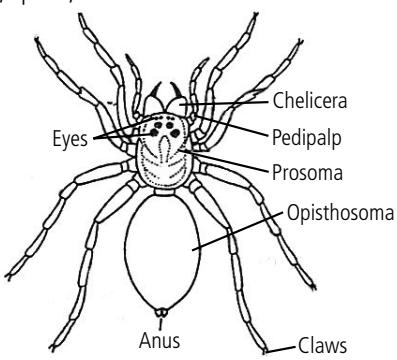
Economically important insects - *Apis* (honeybee), *Bombyx* (silkworm), *Laccifer* (lac insect)

Vectors - *Anopheles*, *Culex*, *Aedes*

Gregarious pest - *Locusta* (locust)

Living fossil - *Limulus* (King crab)

Classification : Phylum Arthropoda is divided into 7 classes on the basis of body divisions and presence or absence of certain appendages.

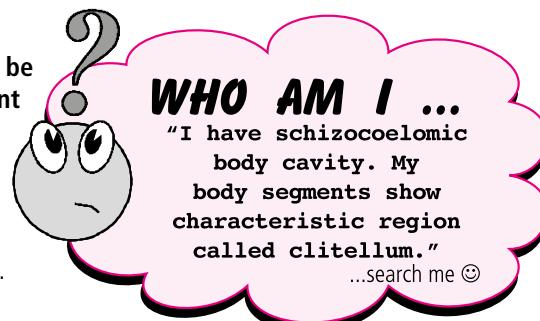
Class	Character	Examples
1. Crustacea	<ul style="list-style-type: none"> Body divisible into cephalothorax and abdomen. Cephalothorax covered by thick carapace. 2 pairs of antennae and one pair of compound eyes. 	<i>Palaemon</i> (Prawn), <i>Cancer</i> (Crab), <i>Balanus</i> (Acorn barnacle), <i>Daphnia</i> (Water flea)  <p>Fig.: Palaemon</p>
2. Chilopoda	<ul style="list-style-type: none"> Body divisible into head, and trunk. Each trunk segment bears a pair of legs. The first pair of legs modified into poison claws. 	<i>Scolopendra</i> (Centipede) 
3. Diplopoda	<ul style="list-style-type: none"> Body divisible into head, thorax and abdomen. There is single pair of antenna. Except first, each thoracic segment bears a pair of legs and each abdominal segment bears 2 pairs of legs. 	<i>Julus</i> (Millipede) 
4. Hexapoda (Insecta)	<ul style="list-style-type: none"> Body divisible into head, thorax and abdomen. Thorax consists of 3 segments, with 3 pairs of legs and usually 2 pairs of wings. Chief excretory waste is uric acid. 	Silverfish, cockroach, locust, termite, butterfly, aphid, silk moth, etc.  <p>Fig.: Lepisma (Silverfish)</p>
5. Arachnida	<ul style="list-style-type: none"> Body divisible into cephalothorax and abdomen. Antennae are absent. Respiratory organs are book lungs or tracheae or both. 	Scorpion, spider, tick  <p>Fig.: Spider</p>

6.	Onychophora	<ul style="list-style-type: none"> Single pair of antennae, eyes and jaws Unjointed clawed legs 	
7.	Merostomata	<ul style="list-style-type: none"> Abdomen ending in sharp spine or telson Excretion by coxal glands 	

PHYLUM MOLLUSCA

(Soft Bodied Animals)

- Body unsegmented with head, muscular foot and visceral hump.
- Shell secreted by mantle, made up of calcium carbonate. **Shell may be mostly external, internal (e.g., slug, squid, cuttlefish) or absent (e.g., Octopus).**
- Open type of circulatory system, comprising of dorsal heart, arteries, veins and sinuses. Blood is usually blue due to copper containing blue coloured **respiratory pigment called haemocyanin**.
- Respiration occurs through gills (**ctenidia**), mantle and pulmonary sac.
- Excretion by paired metanephridia (kidneys).
- Nervous system comprises of paired cerebral, pleural, pedal and visceral ganglia.
- Sense organs are eyes, **statocysts** (balancing organs) and **osphradium** (for testing physical and chemical nature of water).
- Development may be direct or indirect. Indirect development includes **glochidium** or **trochophore, veliger** larvae.



Classification Divided into 6 classes

Monoplacophora

- Spoon or cup-shaped shell.
- Have characters of both Annelida and Mollusca. E.g., *Neopilina*, a connecting link between annelids and molluscs.

Scaphopoda

- Tubular shell, open at both the ends.
- E.g., *Dentalium*

Pelecypoda/Bivalvia

- Bivalve shell. E.g., *Unio*, *Mytilus* (Sea mussel), *Pinctada* (Pearl oyster), etc.

Amphineura

- A non-ganglionated nerve fibre is present around mouth with 2 pairs of interconnected nerve cord. E.g., *Chaetopleura* (Chiton)

Gastropoda

- Univalve shell, includes largest number of molluscs.
- E.g., *Pila*, *Limax*, *Aplysia*, *Doris*, *Limnaea*, etc.

Cephalopoda

- Head and foot regions are combined and modified into a structure having eyes and eight tentacles. E.g., *Sepia*, *Loligo*, *Octopus*, etc.

In *Sepia*, left arm of male is hectocotylised to transfer sperms into female. *Sepia* contains an ink-sac and when attacked, it ejects ink-like fluid that forms smoke cloud.

PHYLUM ECHINODERMATA

(Spiny Skinned Animals)

- All echinoderms are **marine**.
- Echinoderms bear spines (protective in function) and pedicellariae (keep body surface clear of debris and minute organisms).
- Echinoderms have characteristic water vascular system (ambulacrals system). It consists of perforated plate called **madreporite**, pores of which allow water to enter into the system and tube feet which helps in capturing food, locomotion and respiration.
- Respiratory organs include - **dermal branchiae** (starfish), **peristomial gills** (sea urchins), **genital bursae** (brittle stars), **cloacal respiratory tree** (holothurians).
- Body has a central disc which is attached to the substratum. Arms are branched.

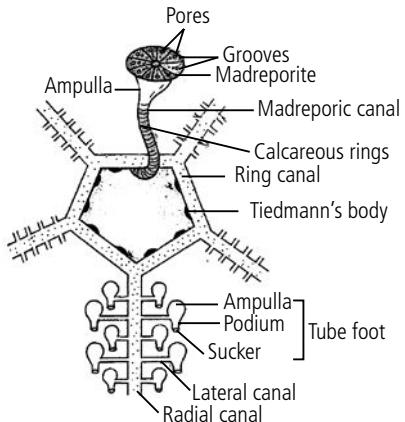
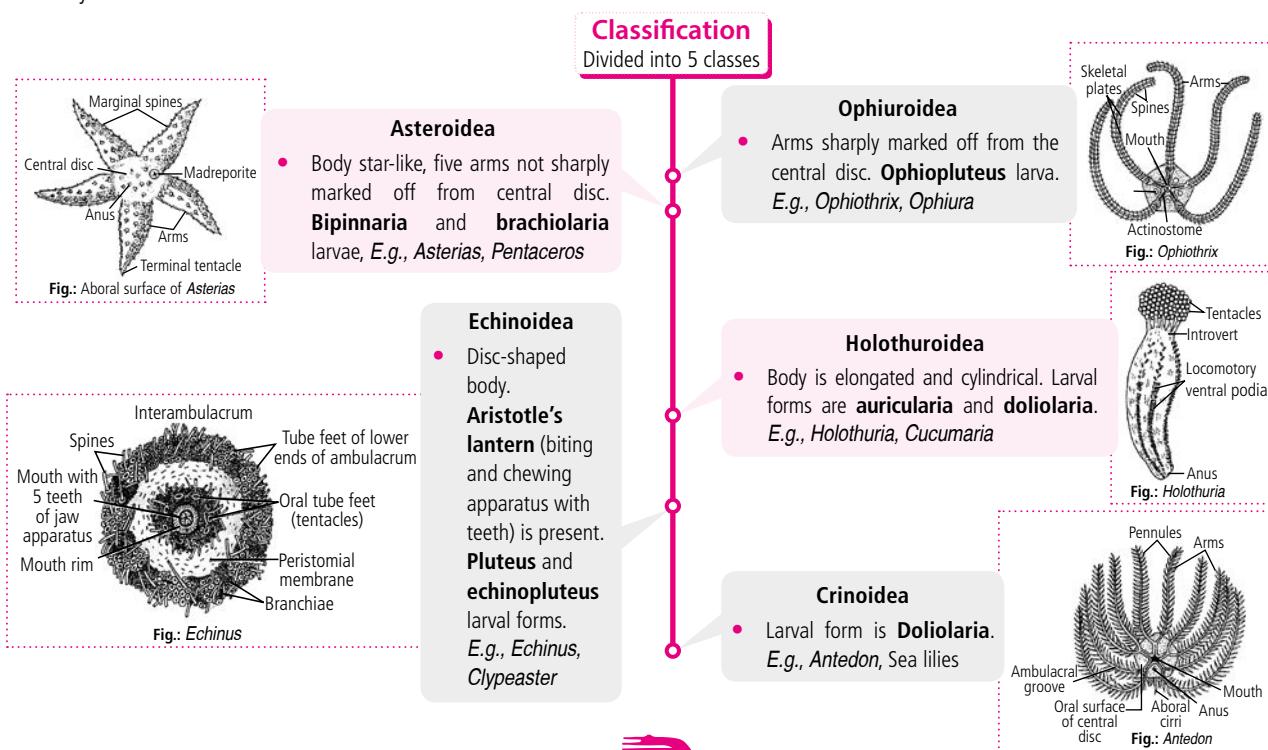


Fig.: Water vascular system of starfish



SPEED PRACTICE

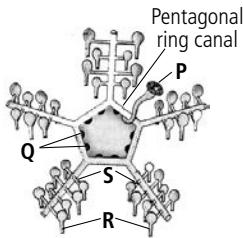
1. Read the given passage and select the option that correctly fills any two blanks.

The body of annelids is metamerically segmented. The first segment is called (i). They have (ii) coelom. Blood vascular system is (iii) type and blood is red due to the presence of

(iv). Chief nitrogenous waste is (v).

- | | |
|-------------------------|-------------------|
| (a) (i) peristomium | (ii) schizocoelic |
| (b) (iii) open | (v) ammonia |
| (c) (iv) erythrocytosis | (v) urea |
| (d) (i) prostomium | (iii) closed |

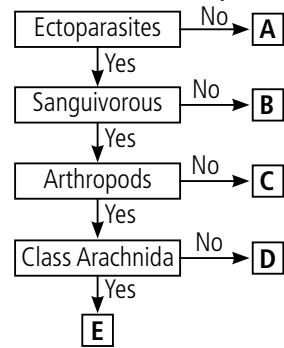
- 2.** Refer to the given figure and select correct statement regarding P, Q, R and S.
- R : Chief locomotory organ in echinoderms
 - P : Permits entry and exit of water into ambulacrals system
 - S : Continuously exchange water with radial canals
 - Q : Regulate pressure inside ambulacrals system



- 3.** Read the given statements and select correct one.
- Fertilisation is exclusively cross and internal in Platyhelminthes.
 - Snail is the primary host whereas sheep is the secondary host in life cycle of *Fasciola*.
 - Life cycle of *Enterobius* is monogenetic.
 - Excretion is exclusively ammonotelic in Aschelminthes.

- 4.** Identify the class of Phylum Echinodermata from the given features.
- Body elongated and cylindrical
 - Ambulacrals grooves absent
 - Spines and pedicellaria absent
 - Larval form auricularia
- Asteroidea
 - Echinoidea
 - Holothuroidea
 - Crinoidea

- 5.** Study the given flow chart and identify the animals A-E.



- | | | | | |
|---|---|--|---|--|
| A
(a) <i>Taenia</i>
(b) <i>Musca</i>
(c) <i>Ancylostoma</i>
(d) <i>Ascaris</i> | B
<i>Scolopendra</i>
<i>Fasciola</i>
<i>Aphid</i>
<i>Trichinella</i> | C
<i>Aedes</i>
<i>Dugesia</i>
<i>Hirudinaria</i>
<i>Pediculus</i> | D
<i>Culex</i>
<i>Aphid</i>
<i>Xenopsylla</i>
<i>Boophilus</i> | E
<i>Boophilus</i>
<i>Xenopsylla</i>
<i>Sarcopetes</i>
<i>Anopheles</i> |
|---|---|--|---|--|

- 6.** Match column I with column II and select the correct option.

Column I	Column II
A. Calcarea	(i) <i>Hyalonema</i>
B. Hexactinellida	(ii) <i>Cliona</i>
C. Demospongiae	(iii) <i>Grantia</i>
	(iv) <i>Spongilla</i>

- A-(iii); B-(i), (ii), (iv)
- A-(i), (iii); B-(ii); C-(iv)
- A-(ii); B-(i), (iii); C-(iv)
- A-(iii); B-(ii); C-(i), (iv)

- 7.** Select the incorrect pair regarding Phylum Arthropoda.

- | | |
|------------------------|----------------|
| (a) <i>Scolopendra</i> | - Poison claws |
| (b) Silverfish | - Ammonotelic |
| (c) Scorpion | - Book lungs |
| (d) <i>Balanus</i> | - Carapace |

- 8.** Which of the following is a respiratory organ in semiterrestrial form of molluscs?
- Ctenidia
 - Mantle
 - Pulmonary sac
 - Book gills
- 9.** In sea cucumber, respiratory pigment is
- haemocyanin
 - erythrocyrin
 - haemoglobin
 - absent.

- 10.** Study the given table and identify A, B, C and D.

Phylum	Feature	Function		
Porifera	A	Help in opening and closing of osculum		
Ctenophora	Lasso cells	B		
	C	Gynaecophoric canal		
Mollusca	D	Testing chemical nature of water		
	A	B	C	D
	(a) Collencytes	Capture food	Aschelminthes	Radula
	(b) Myocytes	Protection from prey	Annelida	Ospharidium
	(c) Myocytes	Capture food	Platyhelminthes	Ospharidium
	(d) Thesocytes	Protection from prey	Platyhelminthes	Radula

- 11.** Female *Ascaris* is
- monodelphic
 - didelphic
 - monorchic
 - diorchic.

- 12.** Blind sac body plan occurs in
- Euplectella*
 - Physalia*
 - Lacifer*
 - Lepisma*.

- 13.** Match column I with column II and select the correct option.

Column I	Column II		
A. <i>Scyphistoma</i>	(i) <i>Sycon</i>		
B. <i>Onchosphere</i>	(ii) <i>Ancylostoma</i>		
C. <i>Filariform</i>	(iii) <i>Aurelia</i>		
D. <i>Amphiblastula</i>	(iv) <i>Taenia</i>		
A	B	C	D
(a) (iii)	(iv)	(ii)	(i)
(b) (iv)	(iii)	(ii)	(i)
(c) (iii)	(ii)	(iv)	(i)
(d) (iv)	(ii)	(i)	(iii)

- 14.** Select the option that correctly states true (T) and false (F) for the given statements.

- Ophiura* has enterocoelic coelom.
- Shell of *Unio* is made up of calcium pectate.
- Respiratory siphon is absent in larva of *Anopheles* mosquito.
- Alimentary canal is complete in *Ascaris*.

1	2	3	4
(a) F	T	T	F
(b) T	F	F	T
(c) T	F	T	T
(d) T	T	F	F

- 15.** Which of the following sponge can break the rock into pieces?

- Euplectella*
- Cliona*
- Chalina*
- Euspongia*

- 16.** Which of the following features developed for the first time in cnidarians?

- (a) A complete digestive tract
- (b) A balancing sense organ, statocyst
- (c) Power of regeneration
- (d) Intracellular digestion of food

- 17.** Refer to the given figure and select incorrect statement regarding W, X and Y.



- (a) W is unisexual and its larva is called trochophore.
- (b) X is bisexual and expels out nitrogenous waste through nephridia.
- (c) Y is bisexual and has 5 pairs of eyes on dorsal surface.
- (d) Fertilisation is external in W whereas internal in X and Y.

- 18.** Study the given table and select the set of incorrect differences.

	Polyp	Medusa
1.	Fixed	Free swimming
2.	There are 8 sense organs called the statocysts, each meant for equilibrium.	Sense organs are absent.
3.	Without gonads.	Has four gonads.
4.	Brings about sexual reproduction and dispersal of species.	Feed and protect the colony.
5.	Belongs to asexual generation.	Represents the sexual generation.

- (a) 1 and 2
- (b) 2, 3 and 4
- (c) 2 and 4
- (d) 3, 4 and 5

- 19.** Select the option which has all the following characteristics.

- (i) True coelom present (ii) Closed blood vascular system
- (iii) Ammonotelic excretion
- (a) *Sepia, Nereis* (b) *Trichuris, Limulus*
- (c) *Ophiura, Balanoglossus*
- (d) *Loligo, Neopilina*

- 20.** Strobilisation occurs in

- (a) *Aurelia* (b) *Taenia*
- (c) both (a) and (b) (d) none of these.

- 21.** Members of which of the following phylum are exclusively marine?

- (a) Platyhelminthes (b) Cnidaria
- (c) Mollusca (d) Ctenophora

- 22.** Which of the following pair comprises of schizocoelic coelom?

- (a) *Pinctada* and *Antedon* (b) *Chaetopterus* and *Pecten*
- (c) *Echinus* and *Locust* (d) *Limulus* and *Trichinella*

- 23.** Select the correct statement.

- (a) Larva of *Culex* is bottom-feeder whereas that of *Anopheles* is surface feeder.
- (b) In annelids, anus develops first and then mouth.

- (c) Liver flukes have thin tegument and show aerobic respiration.
- (d) Phagocytes in poriferans provide food to developing cells, hence called nurse cells.

- 24.** Which of the following larval stages of liver fluke reproduces parthenogenetically?

- (a) Miracidium (b) Rediae
- (c) Cercariae (d) Metacercariae

- 25.** Read the given statement and select correct option.

Statement A : *Euchlora rubra* is an evidence of cnidarian origin of ctenophores.

Statement B : *Euchlora rubra* has nematocyst on tentacles.

- (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 statement B is incorrect.
- (d) Both statements A and B are incorrect.

- 26.** Function of parenchyma in flatworms is to help in

- (a) transport of gases
- (b) transport of food material
- (c) digestion of food
- (d) circulation of body fluid.

- 27.** Which of the following organisms shows polymorphism?

- (a) *Physalia* (b) *Velella*
- (c) *Porpita* (d) All of these

- 28.** Which one of the following groups come under social insects?

- (a) Cockroaches (b) Houseflies
- (c) Termites (d) Mosquitoes

- 29.** Select the correct option containing group of diploblastic organisms.

- (a) *Cestum, Dugesia, Porpita*
- (b) *Chalina, Velella, Amphitrite*
- (c) *Spongilla, Millepora, Pleurobrachia*
- (d) *Porpita, Doris, Clypeaster*

- 30.** Select the incorrect match.

- | | |
|----------------------------|-----------------------|
| (a) Syconoid canal system | - <i>Sycon</i> |
| (b) Leuconoid canal system | - <i>Leucosolenia</i> |
| (c) Asconoid canal system | - <i>Leucosolenia</i> |
| (d) Rhagon canal system | - <i>Demospongiae</i> |

ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (a) | 2. (a) | 3. (c) | 4. (c) | 5. (c) |
| 6. (a) | 7. (b) | 8. (c) | 9. (d) | 10. (c) |
| 11. (b) | 12. (b) | 13. (a) | 14. (c) | 15. (b) |
| 16. (b) | 17. (d) | 18. (c) | 19. (a) | 20. (c) |
| 21. (d) | 22. (b) | 23. (a) | 24. (b) | 25. (a) |
| 26. (b) | 27. (d) | 28. (c) | 29. (c) | 30. (b) |





NEET

FOUNDATION

Class-11

Maximise your chance of success in NEET 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-V : HUMAN PHYSIOLOGY

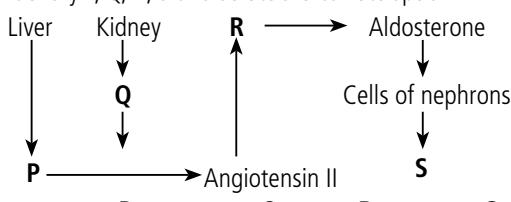
CHAPTER-19 : EXCRETORY PRODUCTS AND THEIR ELIMINATION

Multiple Choice Questions

- 👉 1. In urea cycle, the fifth and final enzyme that helps in formation of urea and ornithine is
 - (a) arginase
 - (b) argininosuccinase
 - (c) ornithine transcarbamoylase
 - (d) arginosuccinate synthase.
- 👉 2. Select the incorrect statement.
 - (a) Last two pairs of ribs protect kidneys.
 - (b) Podocytes are present on the outer parietal layer of Bowman's capsule.
 - (c) Lumen of efferent arteriole is narrower than that of afferent arteriole.
 - (d) Juxamedullary nephrons control plasma volume when water supply is short.
- 👉 3. Net filtration pressure of kidney can be derived by the equation : (Where GBHP → Glomerular blood hydrostatic pressure, BCOP → Blood colloidal osmotic pressure; CHP → Capsular hydrostatic pressure)
 - (a) NFP = GBHP + (BCOP – CHP)
 - (b) NFP = BCOP – (GBHP + CHP)
 - (c) NFP = GBHP – (BCOP + CHP)
 - (d) NFP = BCOP + (GBHP – CHP).
- 👉 4. Which of the following part of renal tubule correctly matches with the osmotic concentration of filtrate present in it with respect to blood plasma?
 - (a) PCT → Hypotonic
 - (b) Ascending limb of loop of Henle → Hypertonic
 - (c) Descending limb of loop of Henle → Hypotonic
 - (d) DCT → Isotonic
- 👉 5. Which of the following are not reabsorbed in proximal convoluted tubule?
 - (a) Potassium and chloride
 - (b) Phosphates and creatine
 - (c) Bicarbonates and hormones
 - (d) Sulphates and creatinine
- 👉 6. Which of the following is an incorrect option regarding tubular secretion?
 - (a) Urea → Diffusion → Ascending limb of loop of Henle
 - (b) K⁺ → Passive transport → PCT
 - (c) Penicillin → Active transport → PCT
 - (d) HCO₃⁻ → Active transport → DCT
- 👉 7. Antidiuretic hormone is released from the hypothalamus when osmolarity of blood
 - (a) increases above 300 mOsmolL⁻¹
 - (b) decreases below 300 mOsmolL⁻¹
 - (c) increases above 160 mOsmolL⁻¹
 - (d) decreases below 100 mOsmolL⁻¹.

- 8.** Which of the following conditions causes filling of urinary bladder?
- Relaxation of detrusor muscle of urinary bladder and internal sphincter.
 - Constriction of detrusor muscle of urinary bladder and internal sphincter.
 - Relaxation of detrusor muscle of urinary bladder and constriction of internal sphincter.
 - Contraction of detrusor muscle of urinary bladder and relaxation of internal sphincter.

- 9.** Identify P, Q, R, S and select the correct option.



- | | P | Q | R | S |
|-----|-----------------|-------|-----------------|--|
| (a) | Angiotensin I | Renin | Adrenal cortex | Increased Na ⁺ reabsorption |
| (b) | Angiotensinogen | Renin | Adrenal cortex | Increased Na ⁺ reabsorption |
| (c) | Angiotensinogen | Renin | Adrenal medulla | Decreased Na ⁺ reabsorption |
| (d) | Angiotensin I | Renin | Adrenal cortex | Decreased Na ⁺ reabsorption |

- 10.** A person diagnosed with inflammation of renal pelvis and the medullary tissue of the kidney, is suffering from
- renal calculi
 - renal tubular acidosis
 - renal failure
 - pyelonephritis.

Match The Columns

- 11.** Match Column I with Column II.

- | Column I | Column II |
|-------------------------------|-----------------------------|
| A. Proximal convoluted tubule | (i) Transitional epithelium |
| B. Urinary bladder | (ii) Squamous cells |
| C. Afferent arteriole | (iii) Cuboidal epithelium |
| D. Bowman's capsule | (iv) Juxtaglomerular cells |

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

- | Column I | Column II |
|------------------------|-------------------------------------|
| A. Sudoriferous glands | (i) Carbon dioxide |
| B. Lungs | (ii) Vitamins |
| C. Liver | (iii) Iron |
| D. Colon | (iv) Amino acids |
| | (v) Calcium |
| | (vi) Cholesterol |
| | (vii) Volatile components of spices |
| | (viii) Glucose |

Passage Based Question

- 13.** Complete the given passage with appropriate words or phrases.

Nephrons are structural and functional units of kidneys. Each nephron consists of two parts, (i) and (ii). (iii) is a tuft of capillaries, and is the site of glomerular filtration. A double walled cup-shaped structure called (iv) leads to proximal convoluted tubule. Maximum reabsorption of salts by active transport occurs in (v). (vi) limb of Henle's loop is impermeable to water but permeable to electrolytes. Thick segment of the ascending limbs of loop of Henle opens into (vii), which joins collecting duct. Collecting ducts unite to form larger ducts called (viii). Sodium ions are actively reabsorbed from filtrate in DCT under the influence of (ix). From DCT, filtrate enters the collecting duct, where (x) is reabsorbed and filtrate becomes more concentrated.

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 :

- if both A and R are true and R is the correct explanation of A
- if both A and R are true but R is not the correct explanation of A
- if A is true but R is false
- if both A and R are false.

- 14. Assertion :** Blood osmotic pressure of shark approaches sea water osmotic pressure.

Reason : Sharks retain large quantity of urea in their blood.

- 15. Assertion :** In absence of bile salts, cholesterol precipitates alongwith lecithin and form gallstone.

Reason : Bile salts keep cholesterol and lecithin in solution.

- 16. Assertion :** Distal part of descending limb of Henle's loop has thinly scattered microvilli and abundant mitochondria.

Reason : Distal part of descending limb of Henle's loop exhibit active role in ionic movement.

- 17. Assertion :** Walls of atria of the heart release ANF in response to increase in blood volume and pressure.

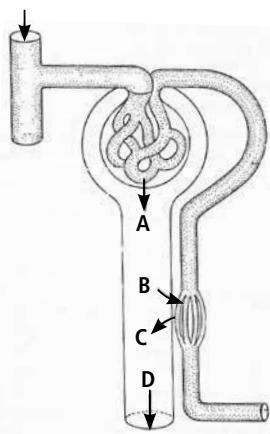
Reason : ANF stimulate release of renin thereby stimulating NaCl reabsorption in collecting duct.

- 18. Assertion :** Fruits increase acidity of urine.

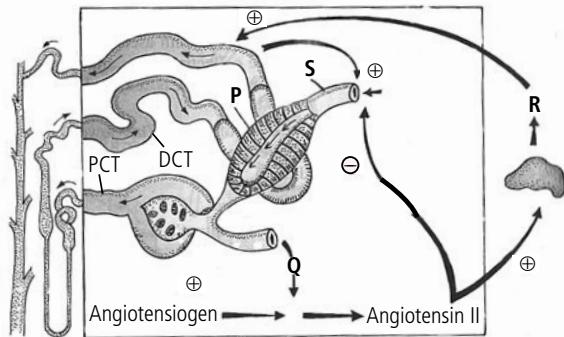
Reason : Vegetables increase alkalinity of urine.

Figure Based Questions

- 19.** Refer to the given figure showing the process of urine formation and answer the following questions.



- (a) What does A, B, C and D refer to?
 (b) Name three intrinsic mechanisms that control A.
 (c) Write differences between B and C.
- 20.** Study the given figure and answer the questions that follow.



- (a) Identify P, Q, R and S in the given figure.
 (b) State the relationship between P and Q and how does Q controls urine formation.

CHAPTER-20 : LOCOMOTION AND MOVEMENT

Multiple Choice Questions

- 1.** Sternum is connected to ribs by
 (a) bony matter (b) white fibrous cartilage
 (c) hyaline cartilage (d) areolar tissue.
- 2.** Which of the following pairs is correctly matched?
 (a) Hinge joint - Between tarsal bones
 (b) Gliding joint - Between carpal bones
 (c) Cartilaginous joints - Between skull bones
 (d) Fibrous joints - Between metacarpals and phalanges
- 3.** Which one of the following sets of ions are required in the chemical events for muscle contraction?
 (a) Na^+ and K^+ only
 (b) Mg^{2+} and Ca^{2+} only

- (c) Na^+ and Mg^{2+} only
 (d) All of these

- 4.** The vertebral formula of humans is
 (a) $\text{C}_7\text{T}_{12}\text{L}_5\text{S}_1\text{C}_1$ (b) $\text{C}_7\text{T}_{12}\text{L}_5\text{S}_5\text{C}_4$
 (c) $\text{C}_7\text{T}_{12}\text{L}_5\text{S}_{(5)}\text{C}_{(4)}$ (d) $\text{C}_7\text{T}_{12}\text{L}_{(5)}\text{S}_{(5)}\text{C}_4$.
- 5.** Identify the disease in which bone loses minerals and fibres and becomes more prone to fractures, mainly due to imbalances of certain hormones and deficiencies of calcium and vitamin D.
 (a) Rheumatoid arthritis (b) Osteoporosis
 (c) Osteoarthritis (d) Gouty arthritis
- 6.** The functional unit of myofibril, sarcomere is present between
 (a) A-band (b) H-zone
 (c) I-band (d) Z-lines.
- 7.** Read the statements regarding muscle proteins.
 (i) Actin filament constitute a thin myofilament and is made up of two F-actin strands.
 (ii) The complex protein, tropomyosin is distributed at regular intervals on the troponin.
 (iii) Myosin filament is thick myofilament which is a polymerised protein.
 (iv) The globular head of meromyosin consists of light meromyosin (LMM).
 Of the above statements,
 (a) (i) , (ii) and (iv) are correct
 (b) (i) and (iii) are correct
 (c) (ii) and (iv) are correct
 (d) (ii), (iii) and (iv) are correct.
- 8.** Scapula is a large triangular flat bone situated in the dorsal part of the thorax between
 (a) the second and fifth ribs
 (b) the second and seventh ribs
 (c) the third and sixth ribs
 (d) the third and eighth ribs.
- 9.** Acromian process is characteristically found in the
 (a) pectoral girdle of human (b) humerus of human
 (c) pelvic girdle of human (d) skull of human.
- 10.** The cervical vertebra axis, provides head with sideways rotation. This can be because
 (a) it is articulated to skull through occipital condyles
 (b) it is fused with 1st vertebra
 (c) it is joined through elastic pads of fibrocartilage with other vertebrae, which provide mobility
 (d) it contains odontoid process that fits into the odontoid canal of atlas.

Match The Columns

11. Match Column I with Column II.

Column I	Column II
A. Adductor	(i) Deltoides
B. Abductor	(ii) Masseter
C. Rotator	(iii) Latissimus dorsi
D. Elevator	(iv) Pectoralis

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

Column I	Column II
A. Axial skeleton	(i) Glenoid cavity
B. Pelvic girdle	(ii) Ilium
C. Pectoral girdle	(iii) Palatine bone
D. Skull	(iv) Ear ossicles
E. Sternum	(v) Atlas and axis
	(vi) Sphenoid bone
	(vii) Acetabulum
	(viii) Clavicle
	(ix) Xiphoid process
	(x) Manubrium

Passage Based Question

13. Complete the given passage with appropriate words or phrases.

Ribs and sternum are the parts of (i) skeleton. There are 12 pairs of ribs. Each rib is connected dorsally to (ii) and ventrally to (iii). The first seven pair ribs are called (iv) as they have two articulation surfaces. (v) are attached to thoracic vertebrae and the sternum by hyaline cartilage. There are (vi) pairs of vertebrochondral ribs. (vii) and (viii) pairs of ribs are called floating ribs. (ix), ribs and (iii) together form the rib cage.

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 both A and R are false.

14. **Assertion :** Skeleton serves as a storage depot.

Reason : Skeleton stores carbohydrate and protein.

15. **Assertion :** There are similarities between the locomotion of unicellular organisms and multicellular animal.

Reason : Ciliary, flagellar and amoeboid movement occurs only in unicellular organisms.

16. **Assertion :** The extra oxygen consumption in human body after strenuous exercise is known as oxygen debt.

Reason : The extra oxygen is required by the body to oxidise the accumulated lactic acid produced during strenuous exercise.

17. **Assertion :** Triceps is said to be an extensor muscle for elbow joint.

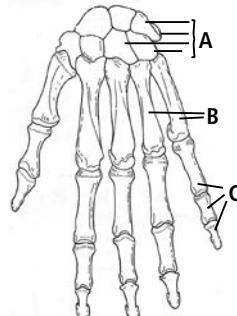
Reason : Triceps relax during extension of forearm at the elbow joint.

18. **Assertion :** Biceps is said to be a flexor muscle for elbow joint.

Reason : Biceps contract during flexion at the elbow joint.

Figure Based Questions

19. Observe the given figure and answer the following questions.



(a) Identify A, B and C in the given figure.

(b) Name the different bones that constitute part A.

(c) Name and describe the type of joint present between B and C.

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



(a) What does the given figure show? Identify A, B and C.

(b) Name the ion required for polymerisation of C.

(c) Briefly describe A and B.

CHAPTER-21 : NEURAL CONTROL AND COORDINATION

Multiple Choice Questions

1. Which one of the following cranial nerves transmit impulses to central nervous system?

- (a) Abducens
- (b) Trochlear
- (c) Oculomotor
- (d) Auditory

2. The lateral ventricles of the brain open into the third ventricle via
 (a) foramen of Panizza (b) foramen of Monro
 (c) foramen of Magendie (d) none of these.

3. How many pairs of cranial nerves are mixed?
 (a) 3 (b) 5
 (c) 4 (d) 7

4. Which of the following functions is not carried out by glial cells?
 (a) Receiving and conducting electrochemical signals
 (b) Giving metabolic support to neurons
 (c) Produce insulating sheath around axons
 (d) Removing debris after the death of a neuron

5. Given below is a table comparing the function of sympathetic and parasympathetic nervous system for four features (a - d). Which one of the following features is correctly described?

	Feature	Sympathetic nervous system	Parasympathetic nervous system
(a)	Salivary glands	Stimulates secretion	Inhibits secretion
(b)	Pupil of the eye	Dilates	Constricts
(c)	Heart rate	Decreases	Increases
(d)	Intestinal peristalsis	Stimulates	Inhibits

6. Refractory period comes in between
 (a) resting potential and depolarisation
 (b) depolarisation and repolarisation
 (c) action potential and depolarisation
 (d) two cycles of impulse conduction.

7. The path taken by light rays in the eye is
 (a) Cornea → conjunctiva → aqueous humour → lens (through pupil) → vitreous humour → retina
 (b) Cornea → lens (through pupil) → aqueous humour → vitreous humour → retina
 (c) Cornea → vitreous humour → lens (through pupil) → aqueous humour → retina
 (d) Cornea → aqueous humour → lens (through pupil) → vitreous humour → retina.

8. When sound waves strike pinna and vibration reaches organ of Corti (sensory ridge) on basilar membrane, then
 (a) the receptor cells depolarise and open voltage-gated ion channels which transduce signal to auditory nerve

- (b) receptor cells bend accordingly and transmit impulses to the auditory nerve
 (c) sensory hair bend and stimulate the sensory cells to generate the impulse of hearing which is carried to brain by auditory nerve
 (d) sensory hair undergo bending and sensory cells on tectorial membrane get stimulated, creating impulse.

9. Select the answer with correct matching of the structure, its location and function.

	Structure	Location	Function
(a)	Eustachian tube	Anterior part of internal ear	Equalises air pressure on either sides of tympanic membrane
(b)	Cerebellum	Mid brain	Controls respiration and gastric secretions
(c)	Hypothalamus	Fore brain	Controls body temperature, urge for eating and drinking
(d)	Blind spot	Near the place where optic nerve leaves the eye	Rods and cones are present for image formation

10. When a neuron is in resting state, i.e., not conducting any impulse, the axonal membrane is
 (a) comparatively more permeable to Na^+ ions and nearly impermeable to K^+ ions
 (b) equally permeable to both Na^+ and K^+ ions
 (c) impermeable to both Na^+ and K^+ ions
 (d) comparatively more permeable to K^+ ions and nearly impermeable to Na^+ ions.

Match The Columns

11. Match Column I with Column II.

Column I	Column II
A. Myelodysplasia	(i) Degeneration of neurons in the cerebral cortex
B. Alzheimer's disease	(ii) Abnormality in development of spinal cord
C. Parkinson's disease	(iii) Decreased production of acetylcholine
D. Huntington's chorea	(iv) Degeneration of dopamine releasing neurons

- 12.** Match Column I with Column II (There can be more than one match for items present in Column I).

Column I	Column II
A. Prosencephalon	(i) Arbor vitae
B. Limbic system	(ii) Crura cerebri
C. Rhombencephalon	(iii) Corpus callosum
D. Mesencephalon	(iv) Emotional brain
	(v) Purkinje's cells
	(vi) Pituitary gland
	(vii) Corpora bigemina
	(viii) Mamillary bodies

Passage Based Question

- 13.** Complete the given passage with appropriate words or phrases.

Spinal cord is a posterior part of the CNS, which runs mid-dorsally within the vertebral column. It lies in the (i) of vertebral column. The spinal cord is surrounded by three protective meninges. The (ii) is filled with cerebrospinal fluid. The inner butterfly shaped area is the (iii) of the spinal cord, surrounded by (iv). Each spinal nerve connects with the cord through two nerve roots. The (v) consists of a bundle of sensory axons, and these axons extend into (vi) of the grey matter. (vii) are short neurons confined to the grey matter of the cord. Cell bodies of (viii) are located in the anterior horn of grey matter.

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 both A and R are false.

- 14. Assertion :** Cochlea is the main hearing organ.

Reason : Scala media of cochlea bears an upper Reissner's membrane and lower basilar membrane.

- 15. Assertion :** Repeated elicitation of a reflex may suspend the reflex response for some time.

Reason : Impulses can flow only in a single direction in a reflex arc.

- 16. Assertion :** Motor end plate is a neuromuscular junction.

Reason : Motor end plate is the junction between motor neuron and muscle fibre.

- 17. Assertion :** Circular smooth muscles of iris contract when bright light falls on the eye.

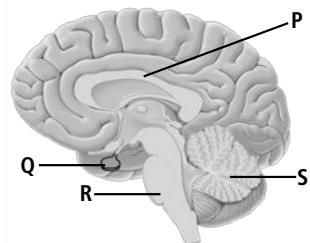
Reason : Pupil gets constricted by the contraction of circular smooth muscles of iris.

- 18. Assertion :** All sensory neurons are said to be efferent in nature.

Reason : Sensory neurons transmit nerve impulses from one neuron to another within the CNS.

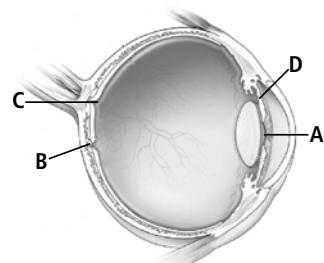
Figure Based Questions

- 19.** Refer to the given figure showing median section of human brain and answer the following questions.



- (a) Identify and describe the part P.
- (b) Identify Q and the region of brain in which it is located.
- (c) What does labelled part 'R' represent? To which part of brain does it belong? Write its two functions.
- (d) What does the label 'S' show?

- 20.** Observe the given figure and answer the following questions.



- (a) Identify the labelled parts A, B, C and D.
- (b) Identify the parts of an eye (A–D) from the given characters:
 - (i) It controls the amount of light entering into the eye by contracting and dilating.
 - (ii) It is the region of most distinct vision, and is devoid of rods and blood vessels.
 - (c) Briefly describe the labelled part D.

CHAPTER-22 : CHEMICAL COORDINATION AND INTEGRATION

Multiple Choice Questions

- Q1.** Select the correct statement about the hormones in humans.
- (a) Glucagon is secreted by β -cells of islets of Langerhans and stimulates glycogenolysis.
 - (b) Secretion of thymosin increases with ageing.

- (c) Somatostatin secreted by pancreas inhibits release of other pancreatic hormones.
- (d) FSH stimulates the secretion of prolactin.

2. Cortisol is secreted by the adrenal cortex in response to stress. In addition to its function in a stress response, it also functions in negative feedback by

- (a) inhibiting the hypothalamus so that corticotropin releasing hormone (CRH) secretion is reduced
- (b) inhibiting the anterior pituitary to release ACTH
- (c) both (a) and (b)
- (d) none of these.

3. Feeling the tremors of an earthquake, a scared resident of seventh floor of a multi-storey building starts climbing down the stairs rapidly. Which hormone initiated this action?

- (a) Adrenaline (b) Glucagon
- (c) Gastrin (d) Thyroxine

4. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency?

- (a) Relaxin – Gigantism
- (b) Prolactin – Cretinism
- (c) Parathyroid hormone – Tetany
- (d) Insulin – Diabetes insipidus

5. MSH of pars intermedia is responsible for

- (a) darkening of skin in lower vertebrates
- (b) light colouration of skin in lower vertebrates
- (c) darkening of skin in human beings
- (d) both (a) and (c).

6. Which one of the following statements is correct?

- (a) Endocrine glands regulate neural activity, and nervous system regulates endocrine glands.
- (b) Neurons regulate endocrine activity, but not *vice versa*.
- (c) Endocrine glands regulate neural activity, but not *vice versa*.
- (d) Neither hormones control neural activity nor the neurons control endocrine activity.

7. According to the accepted concept of hormone action, if receptor molecules are removed from target organs, then the target organ will

- (a) continue to respond to the hormone without any difference
- (b) not respond to the hormone
- (c) continue to respond to the hormone but will require higher concentration
- (d) continue to respond to the hormone but in the opposite way.

8. A health disorder that results from the deficiency of thyroxine in adults and characterised by (i) a low metabolic rate, (ii) increase in body weight and (iii) fat accumulation in subcutaneous tissues is

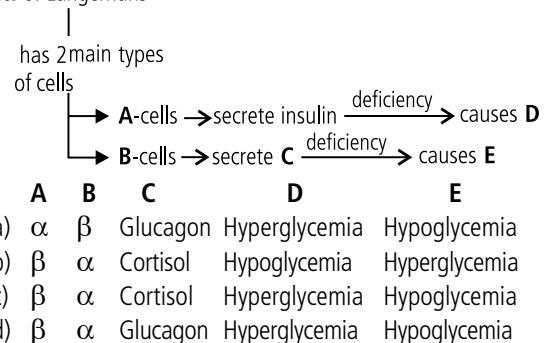
- (a) simple goitre (b) myxoedema
- (c) cretinism (d) Grave's disease.

9. The blood calcium level is lowered by the deficiency of

- (a) calcitonin (b) parathormone
- (c) thyroxine (d) both (a) and (b).

10. Select the option that correctly identifies A – E in the given flow chart.

Islets of Langerhans



Match The Columns

11. Match Column I with Column II.

Column I	Column II
A. Parathormone	(i) Cushing's syndrome
B. Hydrocortisone	(ii) Acromegaly
C. Thyroid hormone	(iii) Osteoporosis
D. Somatotropin	(iv) Gull's disease

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

Column I	Column II
A. Adenohypophysis	(i) Oxytocin
B. Thyroid gland	(ii) Insulin
C. Neurohypophysis	(iii) Growth hormone
D. Adrenal gland	(iv) Serotonin
E. Pancreas	(v) Triiodothyronine
F. Pineal gland	(vi) Somatostatin
	(vii) Adrenocorticotropic hormone
	(viii) Norepinephrine
	(ix) Melatonin
	(x) Antidiuretic hormone
	(xi) Aldosterone
	(xii) Thyrocalcitonin

Passage Based Question

13. Complete the given passage with appropriate words or phrases.

Hormones are of mainly two types - water soluble and (i). Water soluble hormones require (ii) receptors that generate second messengers such as (iii) to carry out their function and amplify the signal. (i) hormones easily pass through the plasma membrane of cell and bind to specific (iv) receptors to form a hormone receptor complex in the (v). This complex binds to regulatory sites on (vi), activates (vii) and directs synthesis of (viii). The action of (i) hormone is (ix) as compared to water soluble hormones.

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 both A and R are false.

14. **Assertion :** A tumor of adrenal cortex may cause Addison's disease.

Reason : This happens due to over secretion of cortisol by the tumor.

15. **Assertion :** Aldosterone increases the volume of blood and other extracellular fluids.

Reason : The secretion of aldosterone is stimulated by a fall in the circulating volume of blood.

16. **Assertion :** Synthesis of a hormone slows or halts when its level in the blood rises above normal.

Reason : Secretion of hormone may be under the negative feedback control of a metabolite.

17. **Assertion :** Insulin stimulates glycogenolysis and gluconeogenesis resulting in hyperglycemia.

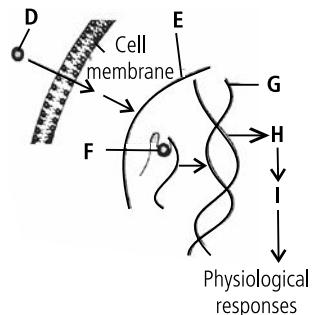
Reason : Prolonged hyperglycemia leads to complex disorder called diabetes insipidus.

18. **Assertion :** Failure of secretion of thyroid gland hormones since childhood causes cretinism.

Reason : Thyrotropin hormone maintains BMR and promotes growth of body tissues.

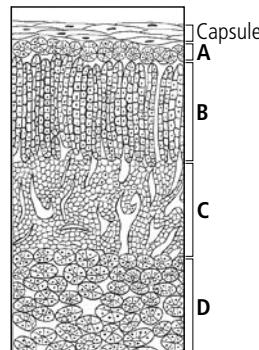
Figure Based Questions

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



- (a) Identify D, E, F, G, H and I in the given figure.
(b) Briefly explain the hormone action illustrated in the given figure.
(c) Give examples of some hormones which shows the illustrated hormone action.

20. Observe the given figure and answer the questions that follows.



- (a) Identify the gland from given section and its parts labelled from A - D.
(b) Mention one hormone secreted by each of the parts A, B and C.
(c) Name the cells constituting D. State any two hormones secreted by D, along with their functions.

SOLUTIONS

CHAPTER-19 : EXCRETORY PRODUCTS AND THEIR ELIMINATION

1. (a) 2. (b) 3. (c) 4. (d) 5. (d)

6. (b) 7. (a) 8. (c) 9. (b) 10. (d)

11. A - (iii); B-(i); C-(iv); D-(ii)

12. A-(iv, viii); B-(i, vii); C-(ii, vi); D-(iii, v)

13. (i) malpighian corpuscle
(ii) renal tubule (iii) Glomerulus
(iv) Bowman's capsule (v) proximal convoluted tubule
(vi) Ascending (vii) distal convoluted tubule
(viii) ducts of Bellini (ix) aldosterone
(x) water

**FIND
MORE
FREE
MAGAZINES**

FREEMAGS.CC

14. (a) 15. (a) 16. (d) 17. (c) 18. (b)
19. (a) In the given figure, A refers to glomerular filtration, B refers to tubular reabsorption, C refers to tubular secretion and D refers to urinary excretion.
- (b) Three important intrinsic mechanisms that provide autoregulation of glomerular filtration rate are:
- myogenic mechanism
 - juxtaglomerular mechanism
 - neural control.
- (c)
- | | Tubular Reabsorption | Tubular Secretion |
|-------|---|--|
| (i) | It is the absorption of selected materials from the nephric filtrate into the blood of peritubular blood capillaries. | It is the removal of selected materials from the blood of the peritubular blood capillaries into the nephric filtrate. |
| (ii) | The reabsorption of glucose, amino acids, inorganic ions (Na^+ , K^+ , Cl^- , etc.), water vitamins, etc., takes place. | The removal of ammonia, urea, uric acid, creatine, creatinine, hippuric acid, etc., takes place. |
| (iii) | It occurs by diffusion and active transport. | It occurs only by active transport. |
20. (a) In the given figure, P, Q, R and S refer to juxtaglomerular apparatus, renin, aldosterone and afferent arteriole respectively.
- (b) Juxtaglomerular apparatus consist of juxtaglomerular cells and macula densa. Juxtaglomerular cells secrete renin. Renin converts angiotensinogen (present in the blood) into angiotensin. The latter increases blood pressure. Angiotensin also stimulates the secretion of aldosterone by the adrenal cortex, thus influencing the reabsorption of sodium ions by the distal convoluted tubule and that of water through the collecting duct.
- CHAPTER-20 : LOCOMOTION AND MOVEMENT**
1. (c) 2. (b) 3. (d) 4. (c) 5. (b)
 6. (d) 7. (b) 8. (b) 9. (a) 10. (d)
 11. A - (iii), B-(i), C-(iv), D-(ii)
 12. A - (iv, v), B-(ii, vii), C-(i, viii); D-(iii, vi); E- (ix, x)
 13. (i) axial (ii) vertebral column
 (iii) sternum (iv) bicephalic
 (v) True ribs (vi) three
 (vii) 11th (viii) 12th
 (ix) Thoracic vertebrae
 14. (c) 15. (c) 16. (b) 17. (c) 18. (a)
 19. (a) Given figure is showing bones of a hand. A, B and C refer to carpals, metacarpals and phalanges respectively.
 (b) Each wrist is composed of eight carpals which are arranged in two rows : scaphoid, lunate, triquetrum and pisiform in proximal row and trapezium, trapezoid, capitate and hamate in distal row.
 (c) Joints present between metacarpals and phalanges (metacarpophalangeal joint) are ellipsoid joints. Ellipsoid joint is a biaxial joint as it allows movement in two planes, back and forth and side-to-side. In an ellipsoid joint an oval shaped condyle of one bone fits into an elliptical cavity in another bone.
 20. (a) The given figure shows a thin myofilament. A, B and C refer to troponin, tropomyosin and F-actin respectively.
 (b) F-actin is the polymeric form of globular protein G-actin. G-actin polymerise in the presence of Mg^{2+} to form F-actin.
 (c) Troponin (A) is a complex of 3 polypeptides. Troponin T (TpT) binds to tropomyosin as well as to the other two troponin components. Troponin I (TpI) inhibits the F-actin-myosin interaction and also binds to other components of troponin. Troponin C (TpC) is a calcium-binding polypeptide. The strong affinity of the troponin for calcium ions is believed to initiate the contraction process.
 Tropomyosin (B) is a double stranded α -helical rod. It is fibrous molecule that attaches to F-actin in the groove between its filaments. In the resting state, the tropomyosin molecules are believed to lie on top of the active sites of the actin strands so that attraction cannot occur between the actin and myosin to cause contraction.
- CHAPTER-21 : NEURAL CONTROL AND COORDINATION**
1. (d) 2. (b) 3. (c) 4. (a) 5. (b)
 6. (b) 7. (d) 8. (c) 9. (c) 10. (d)
 11. A-(ii), B-(iii), C-(iv), D-(i)
 12. A - (iii, vi), B-(iv, viii), C-(i, v), D-(ii, vii)
 13. (i) neural canal (ii) subarachnoid space
 (iii) grey matter (iv) white matter
 (v) dorsal nerve root (vi) posterior horn
 (vii) Interneurons (viii) motor neurons
 14. (b) 15. (b) 16. (a) 17. (b) 18. (d)
 19. (a) P is the corpus callosum, a large bundle of myelinated fibres that connect right and left cerebral hemispheres.
 (b) Q is the pituitary gland, present in diencephalon region of forebrain.
 (c) R shows the medulla oblongata. It is the part of hind brain. It has regulatory centres for heart rate, breathing and control various involuntary movements.
 (d) 'S' shows the arbor vitae, a branching tree like arrangement of grey and white matter in cerebellar hemispheres.

20. (a) A-Pupil; B-Fovea centralis; C-Blind spot; D-Iris
 (b) (i) Pupil (ii) Fovea centralis
 (c) Part 'D' is iris. It is a circular muscular diaphragm containing the pigment giving eye its colour. It separates aqueous humour region into anterior and posterior chambers and has an opening in centre called pupil which controls the amount of light entering the eye.

CHAPTER-22 : CHEMICAL COORDINATION AND INTEGRATION

1. (c) 2. (c) 3. (a) 4. (c) 5. (d)
 6. (a) 7. (b) 8. (b) 9. (a) 10. (d)
 11. A - (iii); B-(i); C-(iv); D-(ii)
 12. A-(iii, vii), B-(v, xii), C-(i, x), D-(viii, xi), E-(ii, vi), F-(iv, ix)
 13. (i) lipid soluble (ii) extracellular
 (iii) cAMP (iv) intracellular
 (v) nucleus (vi) chromosome
 (vii) gene (viii) mRNA
 (x) slower
 14. (d) 15. (b) 16. (a) 17. (d) 18. (c)
 19. (a) D-Steroid hormone; E-Nucleus; F-Hormone-receptor complex; G-Genome; H-mRNA; I-Protein
 (b) The given figure shows the mechanism of steroid hormone action through intracellular receptors.
 Steroid hormones, being hydrophobic molecules, diffuse freely into all cells and act within the cell cytoplasm. In the cytoplasm they form a hormone receptor complex by

binding to specific receptor proteins. Hormone-receptor complex then diffuses in the nucleus where it binds to a specific regulatory site on the chromosome and activates certain genes. The activated gene transcribes mRNA which directs the synthesis of proteins and usually enzymes in the cytoplasm. The enzymes promote the metabolic reactions in the cell.

- (c) Estrogen, progesterone, testosterone, aldosterone and thyroxine.
 20. (a) From the given structure, the gland is identified as adrenal gland. The parts are A-Zona glomerulosa, B-Zona fasciculata, C-Zona reticularis, D-Adrenal medulla.
 (b) The hormones secreted by A (Zona glomerulosa) are mineralocorticoids (e.g., aldosterone), B (Zona fasciculata) are glucocorticoids (e.g., cortisol), C (Zona reticularis) are gonadocorticoids (e.g., androgen).
 (c) The large, granular and round cells of adrenal medulla are modified postganglionic cells of sympathetic nervous system which are called as chromaffin cells or phaeochromocytes. Adrenal medulla secretes 2 hormones that are as follows:
 (i) **Noradrenaline** : It regulates blood pressure under normal conditions. It constricts the blood vessels of body and increases heart activity, dilates pupil, etc.
 (ii) **Adrenaline** : It is also known as emergency hormones as it is secreted during stress and is responsible for fight or flight response.



UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

Column I

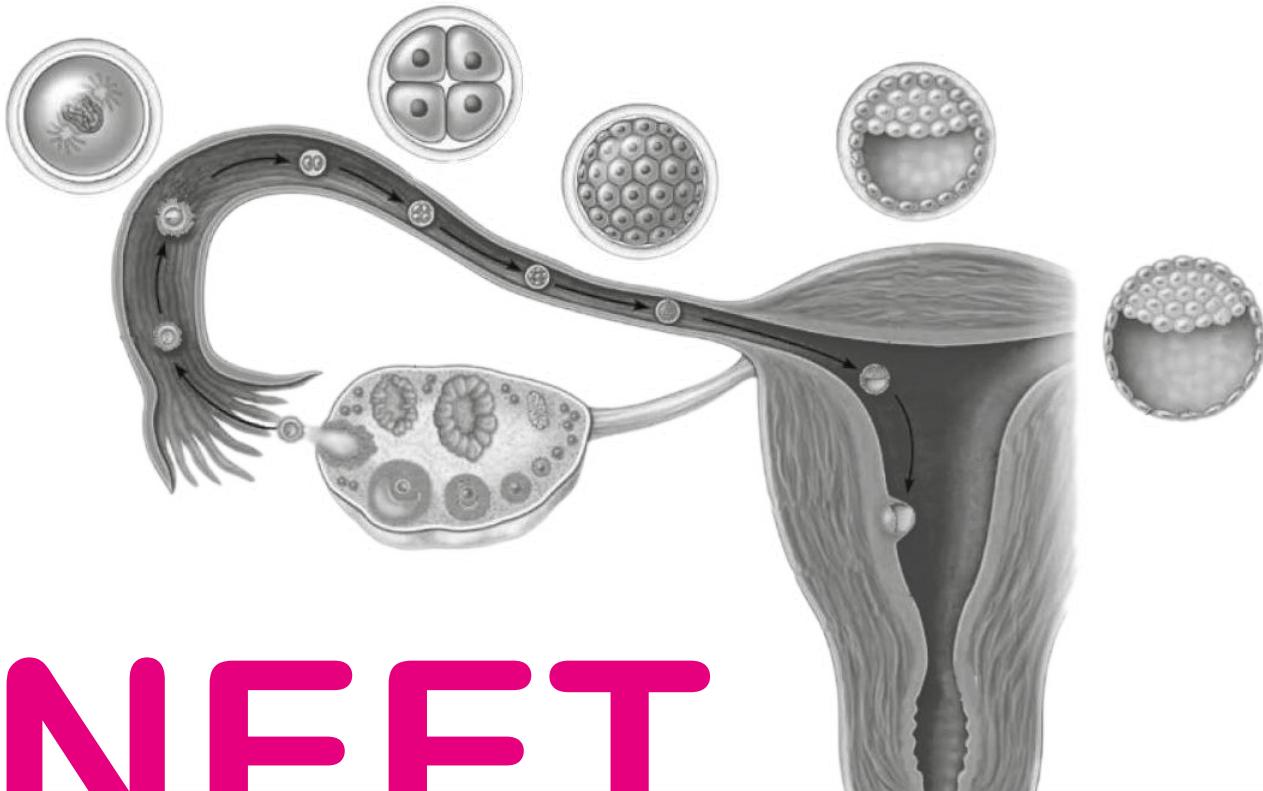
1. HMAEMANIETP
2. SPEIASTSI
3. LEHIOCRMEAT
4. MANEASILMS
5. YEHLOTYKT
6. YPASCROIS
7. STMOALCAAIOE
8. POHROTISIO
9. HOCAONEMRD
10. TMEOPYLYCHAI

Column II

- | | |
|-----|--|
| (a) | A condition showing abnormal rise in RBC count. |
| (b) | An inner cellular layer of sponge consisting of highly specialised flagellated cells. |
| (c) | A childhood disease where bones contain insufficient amount of calcium and phosphorus. |
| (d) | The type of indehiscent fruit found in maize. |
| (e) | The production of only females by the process of parthenogenesis in insects. |
| (f) | A small canal connecting both the scala vestibuli and scala tympani at the tip of cochlea. |
| (g) | A synthetic drug used by athletes to improve performance. |
| (h) | A disorder in which the inflammation of ovary is caused by an infection. |
| (i) | The phenomenon of suppressing the expression of a gene by a nonallelic gene. |
| (j) | An interaction between two different species where one inhibits the growth of the other. |

Readers can send their responses at editor@mtg.in or post us with complete address by 25th of every month to win exciting prizes.

Winners' names will be published in next issue.



NEET ESSENTIAL

CONCEPTION AND PREGNANCY IN HUMANS

Sexual reproduction is characterised by formation of haploid gametes by two different parents (male and female), followed by their fusion either in an external or internal medium. Internal fertilisation is an essential part of reproduction in humans wherein the fusion of female gamete (ovum) with the male gamete (sperm) takes place inside the female reproductive tract, following the act of sexual intercourse (it release sperms into the female reproductive tract). In humans, the stage of fertilisation is referred to as **conception** and the further developmental stages involving the growth of zygote to fetus constitutes the gestation period or **pregnancy**. This occurs in several steps and interruption of any of them may lead to its failure or termination of pregnancy.

PRE-FERTILISATION EVENTS

(i) Arrival of Sperms

During coitus, male discharges semen (mixture of spermatozoa and accessory fluids) into the female's vagina, close to the cervix.

(ii) Transport of Ovum from Ovary to the Ampulla

- The secondary oocyte released from mature Graafian follicle of an ovary by ovulation is received by the nearby Fallopian funnel and sent into the Fallopian tube by movements of fimbriae and their cilia.
- The fimbriae of Fallopian tube encircle and rub the surface of the ovary as a result of contraction of its smooth muscle. The activity of smooth muscle is increased by estrogen and decreased by progesterone.

- The ciliated cells in the mucosa of infundibulum of Fallopian tube propels the ovum and its surrounding cells into the ampulla.
- The ovum is held up at ampullary-isthmic junction for 2-3 days. It is also the site for fertilisation.
- This secondary oocyte can be fertilised only within 24 hours after its release from the ovary.
- If no fertilisation occurs, then the secondary oocyte degenerates.

(iii) Transport of Spermatozoa from Vagina to the Ampulla

- From the vagina, sperms travel up the uterus but only small number reach the Fallopian tube for fertilisation.
- Primarily the sperm movements are assisted by contraction of uterus and Fallopian tubes, but later on they move by their own motility.
- Sperms swim at approximately 1.5 – 3 mm/min. through female genital tract to reach the site of fertilisation. It takes them approx. 30-60 minutes to reach there.

(iv) Capacitation of Sperms

- Capacitation is the phenomenon of sperm activation.
- Secretions of female genital tract enables the sperm to fertilise the egg.
- These secretions remove coating substances deposited on the surface of sperm, mainly on acrosome and exposes its receptor sites. Thus, sperm becomes active to penetrate the egg.
- This process of capacitation takes about 5-6 hours.

Sperms are activated by nutrients present in the secretions of seminal vesicles, prostate gland and bulbourethral glands (Cowper's glands) in the semen. These secretions neutralises the acidity of vagina as sperms are more active in alkaline medium.

FERTILISATION (FUSION OF OVUM AND SPERM)

- The sperms reach the Fallopian tube and surround the secondary oocyte, where second meiotic division is already in progress.
- Though, secondary oocyte is surrounded by numerous sperms but only one sperm succeeds in fertilising the oocyte.
- Second meiotic division of secondary oocyte is completed by the entry of the sperm and after this it is called ovum (egg).
- This process of fertilisation is called **conception** and woman is said to have conceived.

Physical and Chemical Events of Fertilisation

(i) Acrosomal Reaction

- After sperms reach the secondary oocyte in the Fallopian tube, their outer membrane as well as acrosomal membrane ruptures.
- The capacitated sperm undergoes acrosomal reaction, wherein it releases enough lytic enzymes called **sperm lysins** locally so as to enable it to penetrate cumulus cells and zona pellucida that surround the ovum.
- The enzymes released by acrosome digest a path through the material that holds granulosa cells together.
- Acrosomal reaction results in fusion of plasma membrane of sperm with that of the secondary oocyte, allowing the sperm content to enter the oocyte.
- The sperm moves by lashing its tail and reaches the outer surface of zona pellucida, that has special receptors for binding with sperm head.
- Head of sperm fuses with microvilli surrounding the secondary oocyte.

Important sperm lysins

Hyaluronidase

Acts on ground substances of follicular cells

Corona penetrating enzyme

Dissolves corona radiata

Zona lysin or acrosin

Digests zona pellucida

Essential factors for acrosomal reaction are optimum pH, Ca^{2+} , Mg^{2+} and temperature. Fertilisation does not occur in absence of Ca^{2+} .

(ii) Cortical reaction

- Immediately after the sperm has penetrated the oocyte, the lysosomes in outer region of secondary oocyte, also known as **cortical granules**, release their enzymes that hardens and thickens zona pellucida forming **fertilisation membrane**. This is referred to as cortical reaction.
- It prevents **polyspermy**, i.e., entry of more than one sperm into the oocyte and ensures monospermy.

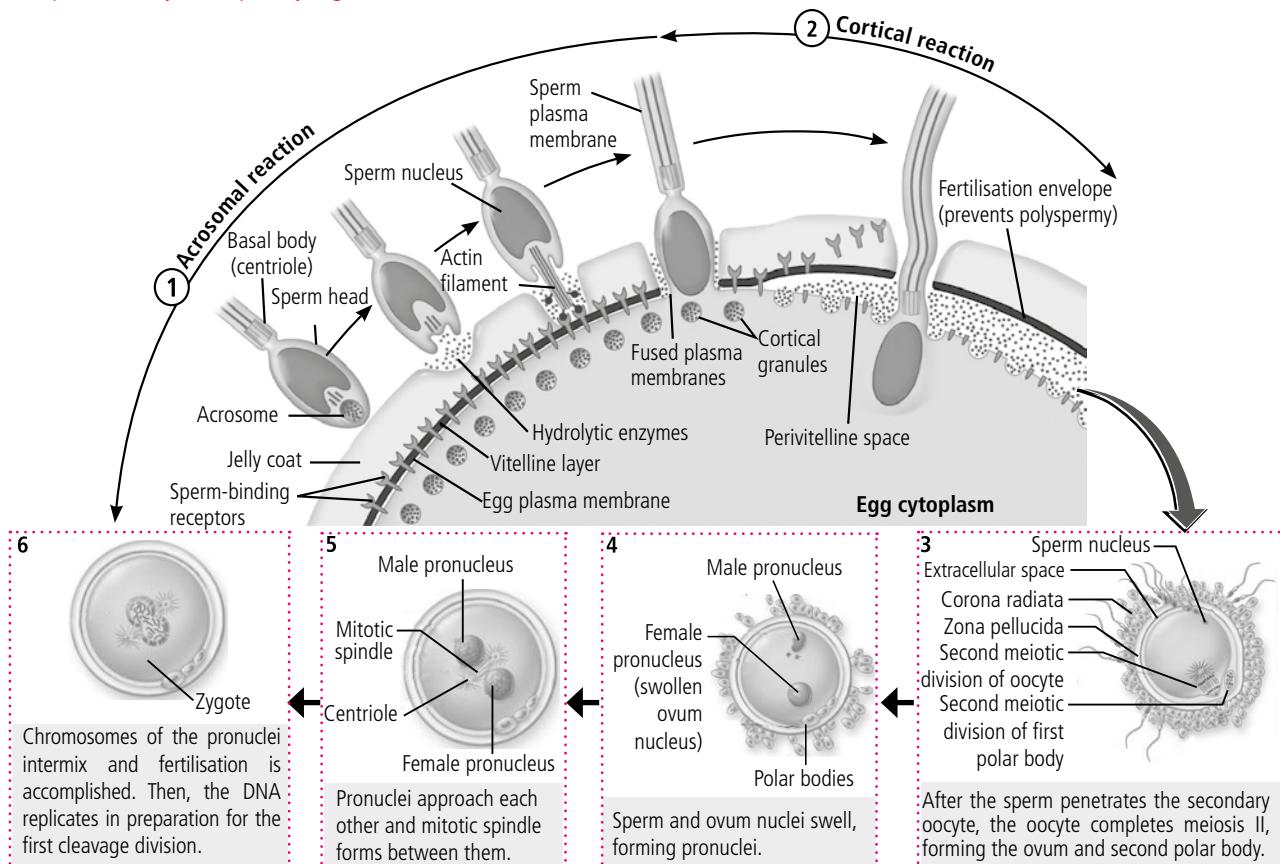
(iii) Sperm entry

- At point of contact with sperms, a projection termed as **fertilisation cone** or **cone of reception** is formed for receiving the sperm.

- The entry of sperm stimulates completion of second meiotic division of secondary oocyte resulting in formation of ovum and second polar body. The second polar body degenerates immediately.
- The distal centriole of sperm divides and forms two centrioles to generate mitotic spindle formation for cell division and tail of sperm is lost within the cytoplasm of ovum.

(iv) Karyogamy (Amphimixis)

- The nucleus of sperm swells as its chromatin becomes less tightly coiled. At this stage, the nuclei of the sperm and secondary oocyte are called pronuclei.
- The male and female pronuclei move towards each other, their nuclear membranes disintegrate. Mixing up of chromosomes of sperm and an ovum is known as **karyogamy** or **amphimixis**, i.e., the actual act of fertilisation.
- The fertilised egg is now called zygote, a diploid, unicellular cell with 46 chromosomes. In human beings, fertilisation takes place mostly at ampullary region of the oviduct.



Significance of Fertilisation

- It restores diploid number of chromosomes.
- It introduces variations, by combining characters of two parents.
- It results in sex determination of the embryo.
- It introduces centrioles which are lacking in mature egg.
- It initiates cleavage, a series of rapid mitotic divisions of zygote.
- Fertilisation membrane developed after entry of one sperm prevents the entry of other sperm into ovum.

FERTILIZIN - ANTIFERTILIZIN INTERACTION

According to fertilizin theory proposed by F.R. Lillie, an ovum secretes a chemical called **fertilizin** and sperms have protein substance on their surface called **antifertilizin**. Fertilizin is composed of glycoprotein (= monosaccharides and amino acid) and antifertilizin is composed of acidic amino acids. The fertilizin of egg interacts with antifertilizin of sperm of same species, making the sperms stick to the egg's surface. Adhesion of sperm and egg of same species through chemical recognition is called **agglutination**.

Role of zona pellucida during implantation

Zona pellucida prevents implantation of blastocyst at an abnormal site. Sticky and phagocytic cells of the trophoblast are not exposed till blastocyst reaches proper implantation site. As the blastocyst is formed, zona pellucida becomes thinner and finally disappears.

Cleavage

Series of rapid mitotic divisions converting single celled zygote into small ball of cells called **blastula**.

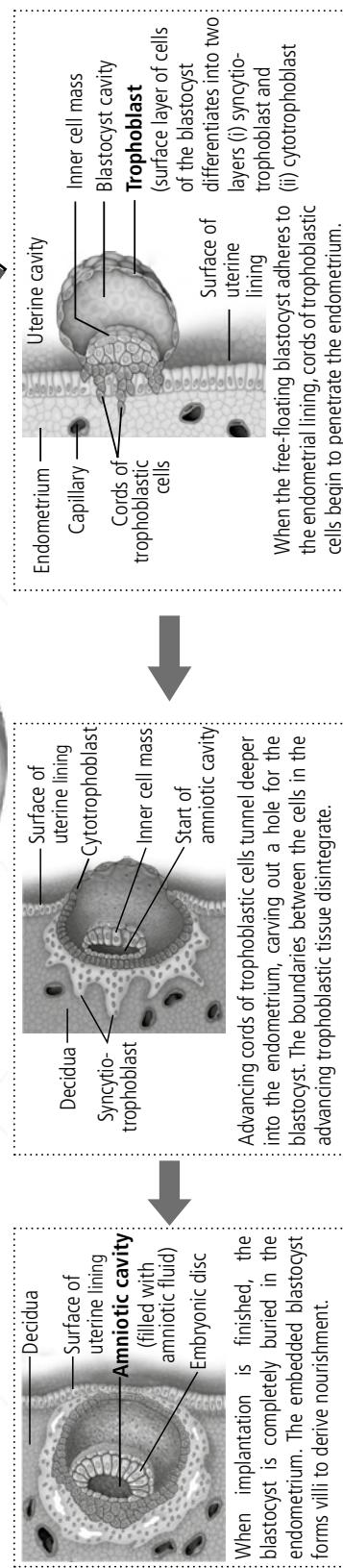
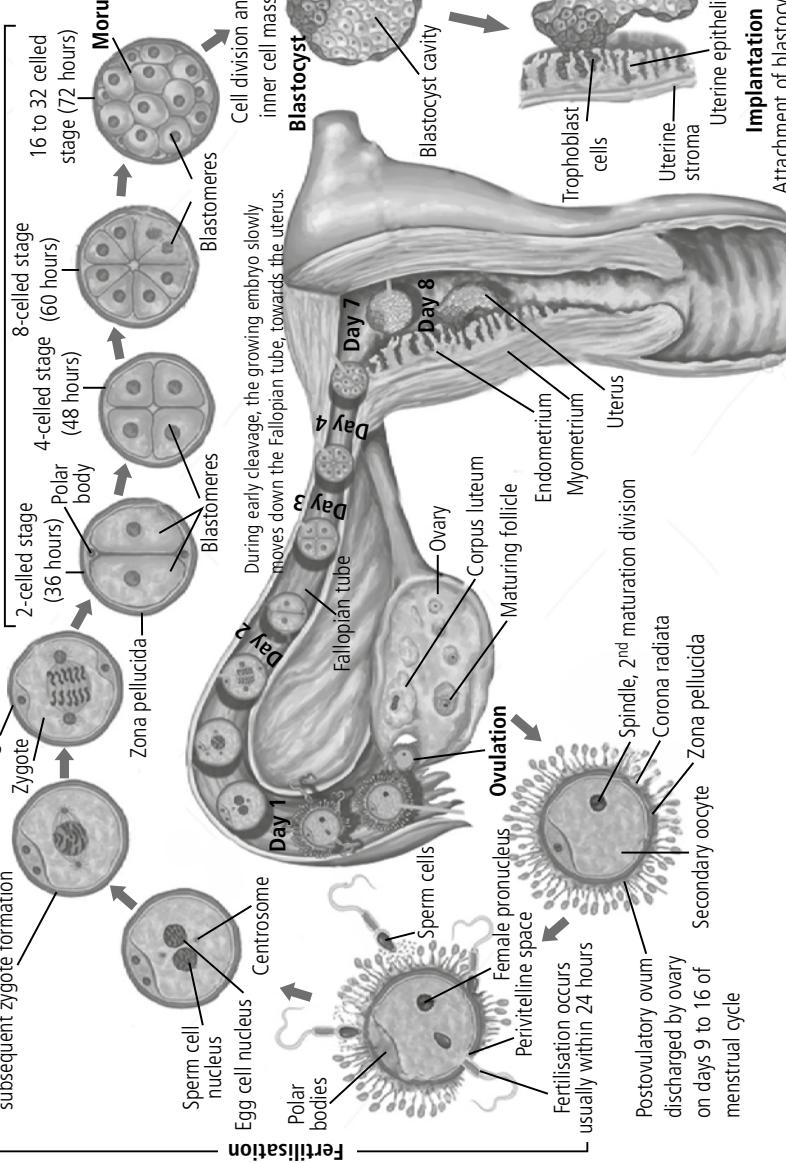


Fig: Diagram showing ovulation, fertilisation, cleavage and embryonic development

Effect of Fertilisation

- If fertilisation occurs, the zygote develops into blastocyst that gets embedded in endometrium of uterus, within 8 days of ovulation.
- The trophoblastic cells begin to secrete human chorionic gonadotropin (hCG), which has similar functions to that of LH of pituitary. hCG prevents breakdown of corpus luteum, which continues to secrete progesterone and estrogen and these bring about increased growth of endometrium and prevents menstruation, thus maintaining pregnancy.
- Prevention of loss of endometrial lining and absence of menstruation are the earliest signs of pregnancy.
- During pregnancy, presence of hCG in urine forms basis of pregnancy testing.

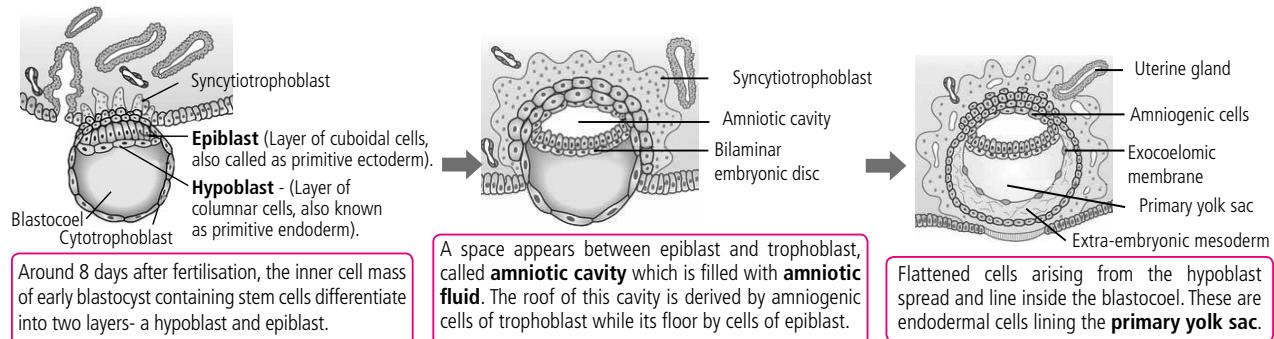
The placenta, gradually takes over from corpus luteum from about 10th week of pregnancy, when it begins to secrete progesterone and estrogen, essential for normal pregnancy. Failure of corpus luteum before placenta is fully formed is common sign of miscarriage at about 10-12 weeks of pregnancy.

EMBRYONIC DEVELOPMENT

- Embryo refers to the organism formed during early stages of development, i.e., from conception until the end of the 8th week of pregnancy.
- It involves following stages, after the implantation of blastocyst into the uterine endometrium.

Gastrulation

Transformation of the blastocyst into the gastrula with primary germ layers by rearrangement of cells is called **gastrulation**.



Development of extra-embryonic membranes

- The outer cells of trophoblast grow and develop into an outer layer or membrane called **chorion**.
- Meanwhile, two cavities appear within the inner cells mass and the cells lining these give rise to two further 'membranes', the **amnion** and the **yolk sac**.
- As with the chorion, the use of the term 'membrane' here does not refer to membranes like those surrounding cells. These structures are called membranes because they are relatively thin, but they are made of cells.
- The amnion is a thin membrane covering the embryo like an umbrella and has a protective function.
- Amnion is formed by amniogenic cells on the inside and somatopleuric extra-embryonic mesoderm on the outside.
- Between the amnion and the embryo is the **amniotic fluid** which is secreted by the cells of the amnion and fills the amniotic cavity. As the embryo increases in size, the amnion expands so that it is always pressed up against the uterus wall opposite the embryo. The cells of the inner cell mass, between the early amnion and the yolk sac, form a structure called the **embryonic disc**, which gives rise to the embryo.
- The cells of the disc differentiate at an early stage (when the diameter is less than 2 mm) and form an outer layer of cells, the **ectoderm** and an inner layer, the **endoderm**. At a later stage the **mesoderm** is formed and these three 'germ' layers give rise to all the tissues of the developing embryo. The development of three layers in this way is called **gastrulation**. It occurs 10-11 days after fertilisation.
- During the early stages of embryonic development exchange of materials between embryo and mother across the chorionic villi is adequate, but soon a fourth membrane, the **allantois**, develops from the embryonic hindgut. The chorion, amnion, yolk sac and allantois are called **extra embryonic membranes**.

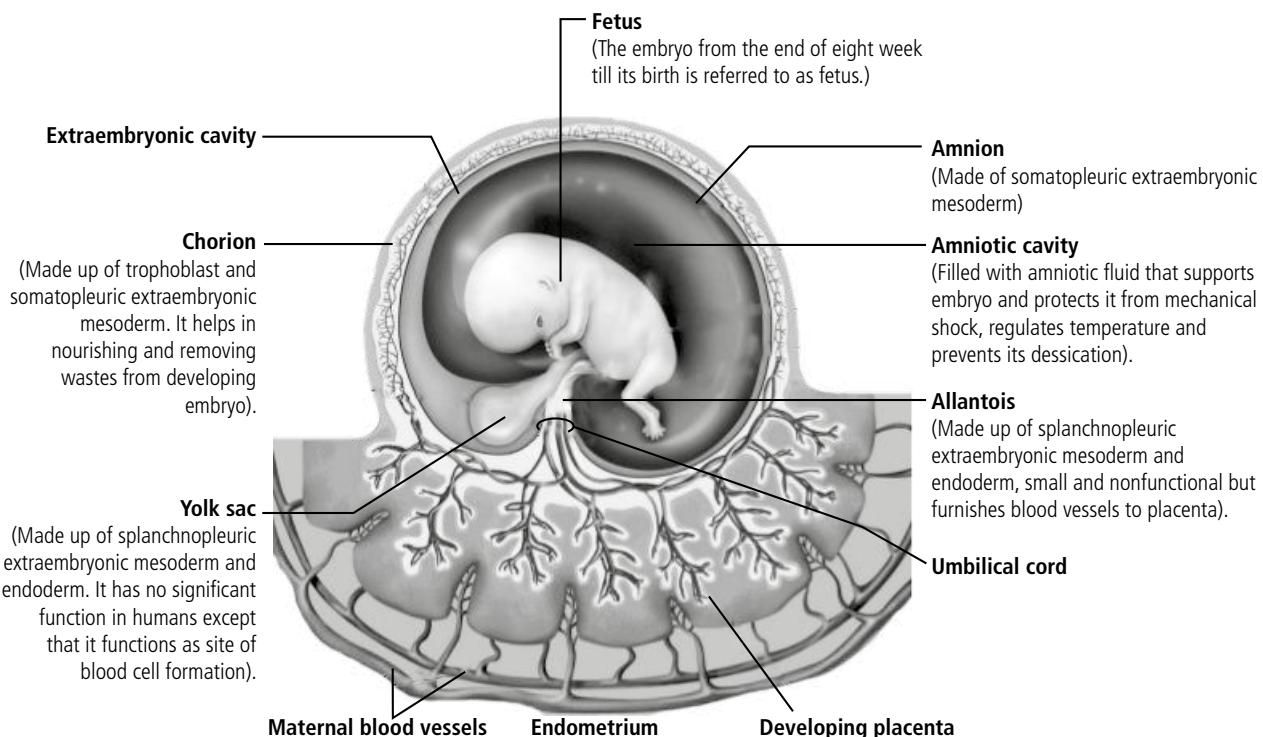


Fig.: The extraembryonic membranes

Fate of three germ layers

Each germ layer gives rise to the specific tissues, organs and organ systems.

Ectoderm derivatives

Epidermis of skin, hair, nails, enamel of teeth, salivary glands, nervous system, mammary glands, parts of eye, ear, pituitary, pineal and mammary glands, etc.

Mesoderm derivatives

Connective tissues like adipose tissue, ligaments, tendons, etc. Dentine of teeth, heart, kidneys, coelomic epithelium, notochord, mesenteries, reproductive system, etc.

Endoderm derivatives

Epithelium of mouth, stomach, lungs, Eustachian tube, middle ear, prostate, vagina, thyroid, parathyroid and thymus glands, etc.

Table : Important developmental changes in the human embryo during the gestation period

Time from fertilisation	Organs formed
Week 1	<ul style="list-style-type: none"> Fertilisation Cleavage starts about 24 hours after fertilisation and forms a blastocyst 4—5 days after fertilisation. Forms more than 100 cells. Implantation takes place 6—9 days after fertilisation.
Week 2	<ul style="list-style-type: none"> The three primary germ layers (ectoderm, endoderm and mesoderm) develop.
Week 3	<ul style="list-style-type: none"> Woman will not have a period. This may be the first sign that she is pregnant. Beginning of the backbone Neural tube develops from ectoderm as a groove. Gradually its sides curve around to form a hollow tube that becomes swollen at one end to form the brain. This is the first organ to appear.

Week 4	<ul style="list-style-type: none"> Heart, blood vessels, blood and gut start forming Umbilical cord develops
Week 5	<ul style="list-style-type: none"> Brain developing 'Limb buds', small swellings which are the beginnings of the arms and legs Heart is a large tube and starts to beat, pumping blood, that can be seen on an ultrasound scan.
Week 6	<ul style="list-style-type: none"> Eyes and ears start to form
Week 7	<ul style="list-style-type: none"> All major internal organs start developing Formation of face Eyes have some colour Mouth and tongue develop Beginnings of hands and feet
By week 12	<ul style="list-style-type: none"> Fetus fully formed with all organs, muscles, bones, toes and fingers Sex organs well developed Fetus is moving
By week 20	<ul style="list-style-type: none"> Hair beginning to grow, including eyebrows and eyelashes Fingerprints developed Fingernails and toenails growing Firm hand grip Between 16 and 20 weeks baby usually felt moving for first time
Week 24	<ul style="list-style-type: none"> Eyelids open. Legal limit for abortion in most circumstances.
By week 26	<ul style="list-style-type: none"> Has a good chance of survival if born prematurely.
By week 28	<ul style="list-style-type: none"> Baby moving vigorously Responds to touch and loud noises Swallowing amniotic fluid
By week 30	<ul style="list-style-type: none"> Usually lying head down ready for birth
40 weeks (9 months ±7 days)	<ul style="list-style-type: none"> Birth (Through parturition in normal circumstances)

PLACENTA

- The placenta is an organ found only in mammals and is the only organ in animals composed of cells derived from two different organisms, the fetus and the mother.
- Placenta forms the intimate connection between chorionic membrane of fetus and uterine wall of mother. Therefore, it is also called **chorionic placenta**.
- The outer surface of chorion develops numerous finger like projections called chorionic villi which penetrate the uterine wall tissues.
- The blood vessels of chorionic villi remain bathed in maternal blood due to erosion of uterine mucosa and endothelial lining.
- The placenta is connected to embryo through an umbilical cord that helps in transport of substances to and from the embryo.
- Human placenta is called **haemochorial** (based on the intimacy between fetal and maternal parts of placenta) and **metadiscoidal** (based on distribution of villi on chorion).
- It takes over from the chorionic villi as the main site of exchange of materials after 12 weeks of pregnancy.

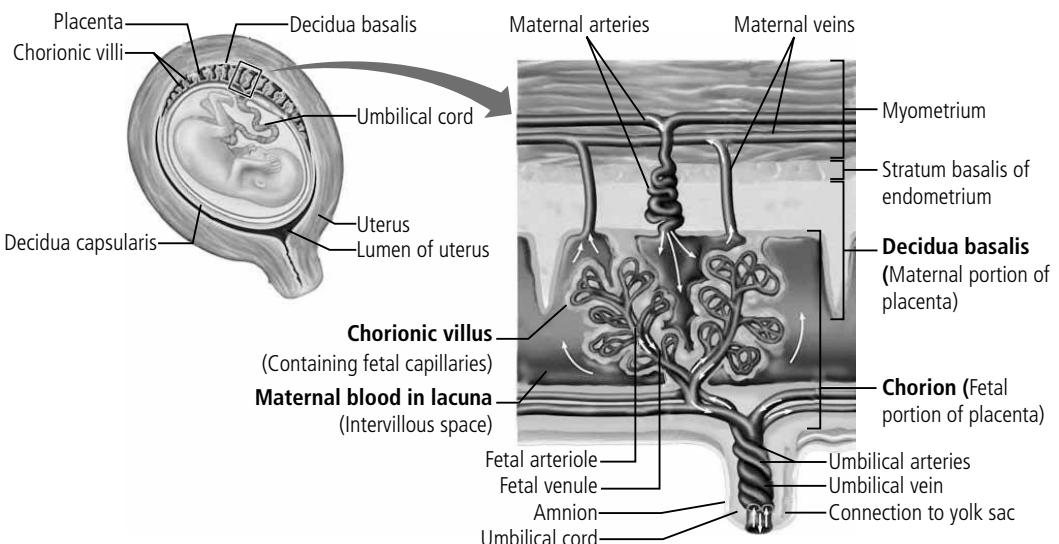


Fig.: Structure of placenta and umbilical cord

Functions of Placenta

- (i) **Nutrients** - Nutritive elements like glucose, amino acids, lipids, etc., all can cross placenta from mother to fetus.
- (ii) **Respiration** - Oxygen required for gaseous exchange diffuses from mother's blood to fetal blood. The fetal haemoglobin has high affinity for oxygen and hence efficiency of exchange increases. CO_2 passes in reverse direction.
- (iii) **Excretion** - Nitrogenous wastes produced by fetus diffuses from fetus to mother through placenta, and is removed by mother's kidneys.
- (iv) **Endocrine organ** - From third month of pregnancy, placenta takes over completely from corpus luteum as main source of progesterone and estrogen. Different hormones secreted by placenta are:
 - (a) **Human chorionic gonadotropin (hCG)** - stimulates and maintains corpus luteum to secrete progesterone.
 - (b) **Human chorionic somatomammotropin (hCS)**, previously called as **human placental lactogen (hPL)** - stimulates the growth of mammary glands during pregnancy.
 - (c) **Relaxin** - facilitates parturition by softening connective tissue of pubic symphysis.

PARTURITION

- The duration of pregnancy in human beings is approximately 9 months and is called **gestation period**. At the end of pregnancy, contractions of uterus cause expulsion of fetus.
 - **Parturition is process of expelling the full term young one from mother's uterus at the end of gestation period.**
 - During the final month of pregnancy, the uterus becomes more and more sensitive to oxytocin, a peptide hormone produced in the hypothalamus and released from the posterior pituitary gland. It causes contraction of the smooth muscle of the myometrium, the muscular lining of the uterus. The increased sensitivity is partly due to the synthesis of more and more oxytocin receptors in the myometrium, possibly a result of high levels of estrogen. Oxytocin levels also rise as a result of the level of progesterone decreasing late in pregnancy.
 - A third factor may be an influence of the fetus. The hypothalamus of the fetus releases ACTH from its pituitary gland. This stimulates the fetal adrenal gland to release corticosteroids which cross the placenta and enter the mother's circulation, causing a decrease in progesterone production and an increase in secretion of prostaglandins.
 - Prostaglandins are secreted by the uterus and stimulate contraction of the uterus. The reduction in progesterone level also removes the inhibitory effect of progesterone on contractions of the myometrium.
 - Oxytocin causes contraction of the smooth muscle of myometrium and prostaglandins increase the power of these contractions. The release of oxytocin occurs in 'waves' during labour. The muscular contractions it causes, force the fetus out of the uterus. The onset of contractions of the myometrium marks the beginning of '**'labour pains'**'. There are three stages to labour.
- (i) **First stage (Stage of dilation)** - It is the time from the onset of labour pain to the complete dilation of the cervix. This stage lasts 6-12 hours. During this stage, regular contractions of the uterus, usually rupturing of the amniotic sac and complete

dilation of the cervix occur. The first result of labour pain is the opening of the cervix. The amniotic fluid ("water") starts flowing out through the vagina.

(ii) **Second stage (Stage of expulsion)** - It is the time from complete cervical dilation to delivery of the baby. It lasts 10 minutes to several hours. The baby passes through the cervix and vagina and is 'delivered' or born.

(iii) **Third stage (Placental stage)** - It is the time after the delivery until the placenta or "afterbirth" is expelled by powerful uterine contractions. These contractions also constrict blood vessels that were torn during delivery thereby reducing the possibility of haemorrhage.

LACTATION

Production of milk in the mammary glands is called **lactation**. The breasts increase in size during pregnancy due to the development of the milk glands, controlled by progesterone, and ducts, controlled by estrogen.

Human placental lactogen, controls growth and development of breasts. However, for milk to be produced, the hormone **prolactin** must be present. This is secreted by the anterior pituitary gland. Throughout pregnancy the presence of estrogen and progesterone inhibits the secretion of prolactin and therefore the formation of milk. At birth, when the estrogen and progesterone levels fall due to loss of the placenta, prolactin is no longer inhibited and it stimulates the alveoli to secrete milk. The ejection of milk from nipple involves a simple reflex action called milk ejection reflex.

Colostrum - The first milk secretion of breasts, following birth is called colostrum. It is yellowish fluid, rich in protein globulin, but low in fat and passes antibody IgA from mother to fetus, (*i.e.*, imparts passive immunity).

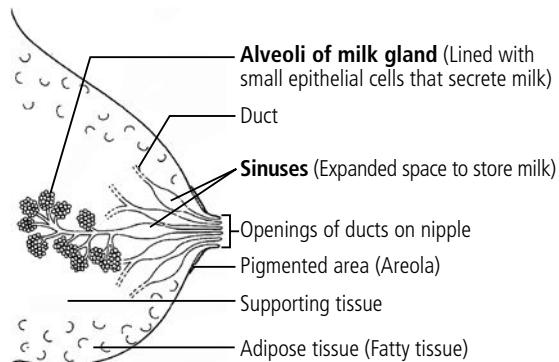


Fig.: The human female breast showing the milk glands where milk is secreted and the ducts and sinuses carrying milk to the nipple

POWER EXERCISE

New MCQs

1. Match column I with column II and choose the right answer.

Column I

A. Parturition

B. Gestation

C. Ovulation

D. Implantation

E. Conception

Column II

1. Attachment of zygote to endometrium

2. Release of egg from Graafian follicle

3. Delivery of baby from uterus

4. Duration between pregnancy and birth

5. Formation of zygote by fusion of the egg and sperm

(a) A – 2, B – 4, C – 1, D – 5, E – 3

(b) A – 4, B – 3, C – 1, D – 5, E – 2

(c) A – 5, B – 1, C – 2, D – 3, E – 4

(d) A – 3, B – 4, C – 2, D – 1, E – 5

2. Function of hyaluronidase is to

(a) dissolve corona radiata

(b) act on ground substances of follicle cells

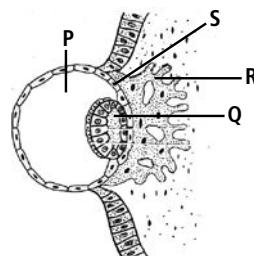
(c) digest zona pellucida

(d) increase ratio of protein synthesis and respiration.

3. The placenta of human beings belongs to the category of

(a) haemochorialis (b) syndesmochorialis
(c) endotheliochorialis (d) epitheliochorialis.

4. The given figure shows the post fertilisation event occurring 7 days after fertilisation. Identify the correct labelling for parts P, Q, R and S.



P	Q	R	S
(a) Blastocyst	Amniotic cavity	Trophoblast	Uterine epithelium
(b) Blastocyst cavity	Inner cell mass	Syncytiotrophoblast	Cytotrophoblast
(c) Blastocyst	Embryonic disc	Cytotrophoblast	Syncytiotrophoblast
(d) Blastocyst cavity	Amniotic cavity	Syncytiotrophoblast	Cytotrophoblast

- 5.** The initial step in the activation of ovum during the process of fertilisation is
 (a) the formation of the fertilisation cone
 (b) the fertilizin-antifertilizin reaction
 (c) the penetration of sperm in the egg
 (d) the formation of the fertilisation membrane.

- 6.** Select the incorrect pair of differences between cleavage and mitosis.

	Cleavage	Mitosis
(i)	Interphase is short.	Interphase is of long duration.
(ii)	Growth occurs during interphase.	Growth does not occur.
(iii)	Oxygen consumption is high as it is very rapid process.	Oxygen consumption is low as it is slow process.
(iv)	DNA synthesis is slower.	DNA synthesis is faster.
(v)	Nuclear-cytoplasm ratio remains same.	Nuclear cytoplasmic ratio increases.

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

- 7.** Signals from fully developed fetus and placenta ultimately lead to parturition which requires the release of
 (a) estrogen from placenta
 (b) oxytocin from maternal pituitary
 (c) oxytocin from fetal pituitary
 (d) relaxin from placenta.

- 8.** Formation of protective plug during pregnancy is stimulated by
 (a) estrogen
 (b) progesterone
 (c) relaxin
 (d) human chorionic gonadotropin.

- 9.** Which one of the following statements with regard to embryonic development in humans is correct?
 (a) Cleavage divisions bring about considerable increase in the mass of protoplasm.
 (b) In the second cleavage division, one of the two blastomeres usually divides a little sooner than the second.
 (c) With more cleavage divisions, the resultant blastomeres become larger and larger.
 (d) Cleavage divisions result in a solid ball of cells called morula.

- 10.** Abnormal implantation of blastocyst is prevented by
 (a) corona radiata (b) epiblast
 (c) zona pellucida (d) hypoblast.

- 11.** Choose the correct statement.
 (a) hPL plays a major role in parturition.
 (b) Fetus shows movements first time in the 7th month of pregnancy.

- (c) Signal for parturition comes from fully developed fetus and placenta.
 (d) Embryo's heart starts forming by the end of 2nd month of pregnancy.

- 12.** Given statements show various steps of fertilisation.

- (i) Hardening of zona pellucida by enzymes released from cortical granules.
 (ii) Release of sperm lysins stored in acrosome.
 (iii) Activation of sperm by secretions of female genital tract.
 (iv) Formation of fertilisation cone.
 (v) Fusion of male and female pronuclei.

The correct sequence of steps is

- (a) (ii) → (i) → (iii) → (iv) → (v)
 (b) (iii) → (ii) → (i) → (iv) → (v)
 (c) (iii) → (i) → (ii) → (v) → (iv)
 (d) (i) → (iv) → (ii) → (iii) → (v)

- 13.** Which among the given is a mesodermal derivative?

- (a) Heart, teeth enamel, salivary gland
 (b) Nails, cornea, sclera
 (c) Heart, notochord, bone
 (d) Adipose tissue, spleen, pituitary gland



- 14.** Identify the human developmental stage shown here and also the related right place of its occurrence in a normal pregnant woman, and select the right option for the two, together.

Developmental stage	Site of occurrence
(a) Late morula	– middle part of Fallopian tube
(b) Blastula	– end part of Fallopian tube
(c) Blastocyst	– uterine wall
(d) 8-celled morula	– starting point of Fallopian tube

- 15.** Identify the extraembryonic membrane in humans where early blood cell formation takes place.

- (a) Yolk sac (b) Amnion
 (c) Chorion (d) Allantois

Exam Section

- 1.** Which of the following hormones is not secreted by placenta?

- (a) Prolactin (b) hCG
 (c) Relaxin (d) Progesterone

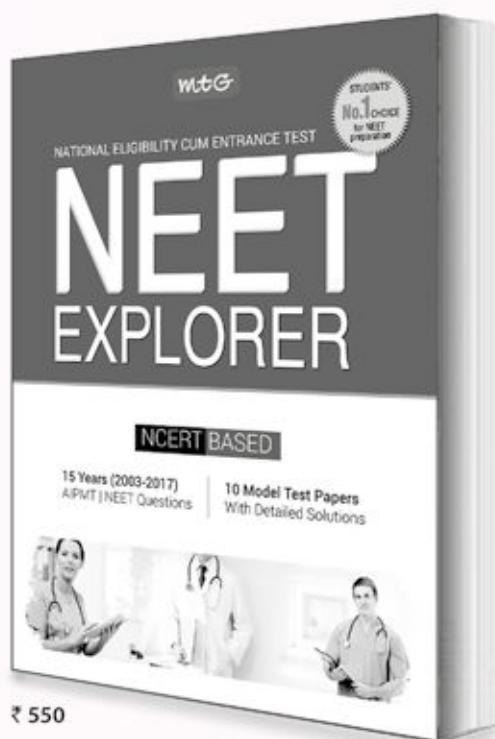
(JIPMER 2017)

- 2.** The post-fertilisation change involves _____.

- (a) haploid gametic maturation
 (b) introduction of centrioles in the ovum
 (c) inhibition of meiosis-II
 (d) formation of vitelline membrane

(MH CET 2017)

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3. Match column I with column II and select the correct option using the codes given below.

Column I	Column II
A. Mons pubis	(i) Embryo formation
B. Antrum	(ii) Sperm
C. Trophectoderm	(iii) Female external genitalia
D. Nebenkern	(iv) Graafian follicle
(a) A-(iii), B-(iv), C-(ii), D-(i)	
(b) A-(iii), B-(iv), C-(i), D-(ii)	
(c) A-(iii), B-(i), C-(iv), D-(ii)	
(d) A-(i), B-(iv), C-(iii), D-(ii)	

(NEET Phase-II 2016)

4. Fertilisation in humans is practically feasible only if
 (a) the ovum and sperms are transported simultaneously to ampillary-isthmic junction of the cervix
 (b) the sperms are transported into cervix within 48 hrs of release of ovum in uterus
 (c) the sperms are transported into vagina just after the release of ovum in Fallopian tube
 (d) the ovum and sperms are transported simultaneously to ampillary-isthmic junction of the Fallopian tube.

(NEET Phase-I 2016)

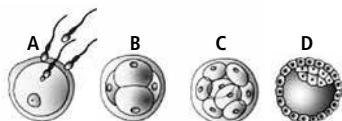
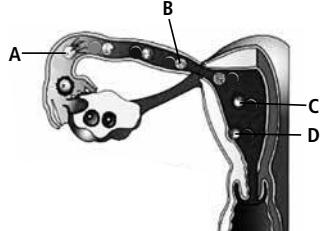
5. Which of the following layers in an antral follicle is acellular?
 (a) Stroma (b) Zona pellucida
 (c) Granulosa (d) Theca interna

(AIPMT 2015)

6. The hormones that are produced in women only during pregnancy are
 (a) estrogen, human chorionic gonadotropins, human placental lactogen
 (b) estrogen, progesterone, oxytocin
 (c) human placental lactogen, human chorionic gonadotropin, relaxin
 (d) human placental lactogen, human chorionic gonadotropin, thyroxine.

(AMU 2015)

7. Select the correct explanation for the labels A, B, C and D.



- (a) A represents the fertilised zygote.
 (b) B represents the stage of morula formation.
 (c) C represents the blastocyst.
 (d) D represents the blastocyst implantation.

(AIIMS 2015)

8. The correct sequence of embryonic development is

- (a) Blastula - Morula - Zygote - Gastrula - Embryo
 (b) Zygote - Blastula - Morula - Gastrula - Embryo
 (c) Zygote - Morula - Blastula - Gastrula - Embryo
 (d) Gastrula - Morula - Zygote - Blastula - Embryo.

(WB JEE 2014)

9. Formation of activation calyx in the egg takes place
 (a) before fertilisation (b) after fertilisation
 (c) at the time of cleavage
 (d) at the time of amphimixis.

(Karnataka CET 2013)

10. Which one of the following is not the function of placenta?
 (a) Facilitates removal of carbon dioxide and waste material from embryo
 (b) Secretes oxytocin during parturition
 (c) Facilitates supply of oxygen and nutrients to embryo
 (d) Secretes estrogen during pregnancy

(NEET 2013)

11. Ontogenically liver and pancreas are

- (a) ectodermal (b) mesodermal
 (c) endodermal (d) none of these.

(AMU 2013)

12. The 'cells of Rauber' are

- (a) secretory cells of endometrium in uterus
 (b) inner cell mass of blastocoel
 (c) outer cells of trophoblast in contact with uterine wall
 (d) cells of trophoblast, in contact with inner cell mass of blastocyst.

(AIIMS 2012)

13. In a normal pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was
 (a) high level of circulating FSH and LH in the uterus to stimulate implantation of the embryo
 (b) high level of circulating hCG to stimulate endometrial thickening

Spellathon

1. Make as many biological terms as possible using the given letters. Each word should contain the letter given in circle.
2. Minimum 4 letter word should be made.
3. In making a word, a letter can be used as many times as it appears in the box.
4. Make at least 1 seven letter word.



Send your response at editor@mtg.in or post to us with complete address by 25th of every month to win exciting prizes. Winners' name will be published in next issue.

- (c) high levels of FSH and LH in uterus to stimulate endometrial thickening
 (d) high level of circulating hCG to stimulate estrogen and progesterone synthesis. *(AIPMT Prelims 2012)*
- 14.** The 32 cells stage of the human embryo is
 (a) smaller than the fertilised egg
 (b) same size as the fertilised egg
 (c) two times of the size of the fertilised egg
 (d) four times the size of the fertilised egg. *(AMU 2009)*
- 15.** Which extraembryonic membrane in humans prevents desiccation of the embryo inside the uterus?
 (a) Yolk sac (b) Amnion
 (c) Chorion (d) Allantois *(AIPMT 2008)*

Assertion & Reason

The following questions consist of two statements each : assertion (A) and reason (R). To answer these questions, mark the correct alternative as directed below :

- (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 both A and R are false.

1. Assertion : Movements of the sperms are assisted by contraction of uterus and oviduct.

Reason : Due to secretions of female genital tract, sperms cannot swim for long.

2. Assertion : Cortical enzymes secreted on the plasma membrane prevents polyspermy.

Reason : Cortical enzymes make the plasma membrane impermeable.

3. Assertion : Primitive streak is a faint groove on the dorsal surface of epiblast.

Reason : Primitive streak establishes right and left sides of an embryo.

4. Assertion : Human placenta is called chorionic placenta.

Reason : In humans, chorion takes part in formation of placenta.

5. Assertion : Corticotropin releasing hormone establishes timing of birth.

Reason : Corticotropin releasing hormone is secreted by hypothalamus in both pregnant and non-pregnant women.

Short Answer Type Questions

1. Fill in the blanks.

- (i) Both epiblast and hypoblast form _____.
 (ii) Amniogenic cells that form roof of amniotic cavity are derived from _____.
 (iii) Projection of secondary oocyte that receives sperm is _____.

- 2.** Why is acrosomal reaction necessary for fertilisation?
3. 'Cleavage is a significant phenomenon in embryonic development'. Justify.
4. Draw a diagram of human fetus within the uterus.

ANSWER KEY

New MCQ

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

Exam Section

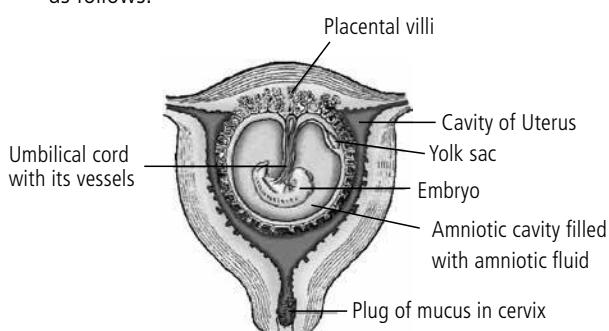
- | | | | | |
|----------------|----------------|----------------|----------------|----------------|
| 1. (a) | 2. (b) | 3. (b) | 4. (d) | 5. (b) |
| 6. (c) | 7. (d) | 8. (c) | 9. (b) | 10. (b) |
| 11. (c) | 12. (d) | 13. (d) | 14. (b) | 15. (b) |

Assertion & Reason

- | | | | | |
|---------------|---------------|---------------|---------------|---------------|
| 1. (c) | 2. (d) | 3. (b) | 4. (a) | 5. (c) |
|---------------|---------------|---------------|---------------|---------------|

Short Answer Type Questions

- (i) embryonic disc (ii) trophoblast
 (iii) cone of reception / fertilisation cone
- During acrosomal reaction, sperm lysins are released from acrosome that help to dissolve corona radiata, zona pellucida and ground substance of follicle cells. Due to this, plasma membrane of sperm fuses with plasma membrane of secondary oocyte and the content of sperm enters the oocyte.
- Significance of cleavage is as follows:
 Cleavage brings about (i) the distribution of the cytoplasm of the zygote, amongst the blastomeres, (ii) increased mobility of the protoplasm, which facilitates morphogenetic movements necessary for cell differentiation, germ layer formation and the formation of tissue and organs, (iii) the restoration of the cell size and the nucleocytoplasmic ratio characteristic of the species. (iv) unicellular zygote is converted into multicellular embryo.
- Diagrammatic representation of human fetus with uterus is as follows:



CBSE BOARD

UNITWISE PRACTICE PAPER 2018

UNIT - II

- Principles of Inheritance and Variation
- Molecular Basis of Inheritance
- Evolution

GENERAL INSTRUCTIONS

- All questions are compulsory.
- This question paper consists of five sections A, B, C, D and E. Section A contains 5 questions of one mark each, Section B contains 5 questions of two marks each, Section C contains 12 questions of three marks each, Section D contains 1 question of VBQ type with four marks and Section E contains 3 questions of five marks each.
- There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.
- Wherever necessary, the diagrams drawn should be neat and properly labelled.

Time Allowed : 3 hours

Maximum Marks : 70

SECTION - A

- Mendel succeeded in all his experiments on pea plant for selected traits and concluded the three laws without any exception. What main factor would you attribute behind his success?
- Name the type of speciation that occurs when a part of population becomes isolated from the main population.
- Write the positively charged and negatively charged components of a nucleosome.
- State any two important differences between phenomenon of codominance and dominance.
- Name the DNA polymerase required in eukaryotes for
 - initiation of DNA replication
 - repairing of mitochondrial DNA.

SECTION - B

- Wings of an insect are analogous to wings of a bird. Yes or no. Give reason to support your answer.
- What is an adapter molecule? State the significance of the following in an adapter molecule.
 - DHU loop
 - TΨC loop
- Mention how the various factors affect linkage.
- Explain the biogenetic law with the help of an example.

- Differentiate between XX-XY type and ZW-ZZ type of sex-determination mechanism.

OR

State the role of any two enzymes involved in DNA replication.

SECTION - C

- (a) Draw a schematic representation of transcription unit showing its important components.
(b) State the function of structural gene in a transcription unit.
- A cross between a normal couple resulted in a son who was haemophilic and a normal daughter. In course of time, when the daughter was married to a normal man, to their surprise, the grandson was also haemophilic.
(a) Represent this cross in the form of a pedigree chart. Give the genotypes of the daughter and her husband.
(b) Write the conclusion you draw from the inheritance pattern of this disease.
- (a) Darwin's theory of natural selection is based on the salient features of 'Survival of the fittest'. Explain this theory of mechanism of evolution with the help of an example.
(b) Theory of continuity of germplasm discarded the concept of theory of inheritance of acquired characters. Give reasons for this.

- 14.** Discuss the objectives of human genome project.
- 15. (a)** (i) Which period of palaeozoic era is called as "Age of amphibians"?
- (ii) In which era of geological time scale were dinosaurs originated?
- (iii) State the significance of coelacanth in palaeozoic era.
- (b)** Rearrange the following in an ascending order of evolution:
Horsetails, Mosses, Herbs, Conifers, Marine algae.
- 16.** Linkage and crossing over of genes are alternative to each other. Justify the statement.
- 17. (a)** Give a schematic representation of evolution of man.
(b) Mention any two characteristics of Cro-Magnon man.
(c) State any three characteristics of Heidelberg man. Mention its evolutionary significance also.
- 18. (a)** A cross was carried out between two pea plants showing the contrasting traits of height of the plant. The result of the cross showed 50% of parental characters.
(i) Work out the cross with the help of a Punnett square.
(ii) Name the type of the cross carried out.
(b) How does a test cross helps in identifying the genotype of the organism? Explain.
- 19. (a)** Genetic code is universal and degenerate. Explain.
(b) Of the total number of codons, how many codons code for amino acids?
(c) Discuss the role of AUG in protein synthesis.
- 20. (a)** Name the kind of diseases/disorders along with any one of the symptom that are likely to occur in humans if :
(i) mutation in the gene that codes for an enzyme phenylalanine hydrolase occurs
(ii) there is an extra copy of chromosome 21
(iii) the karyotype is XXY.
(b) Give an example of autosomal recessive trait. Discuss its inheritance pattern with the help of a cross.
- 21.** How does the gene '*I*' control ABO blood groups in humans? Write the effect that the gene imparts to red blood cells.
OR
- Given below is a schematic representation of *lac* operon:
-
- (a)** Identify 'i' and 'p'.
(b) Name the 'inducer' for this operon and explain its role.
- (c)** What kind of regulation does this *lac* operon shows? Explain.
- 22. (a)** What is satellite DNA? Discuss the role of satellite DNA in DNA fingerprinting technique.
(b) Expand VNTR and state how is it different from a DNA probe?
- SECTION - D**
- 23.** Supriya disclosed her wish to marry Sumit to her parents. Her parents opposed her decision as Sumit's family is known to inherit haemophilia. Supriya told her parents that Sumit is not haemophilic, still her parents resisted and opposed her decision. But she convinced her parents by giving proper scientific explanation for this.
(a) Why is haemophilia a cause of concern for Supriya's parents?
(b) What values do Supriya reflect from this incident?
(c) Is her parents' fear justified? How do you think she might have convinced them? Explain.
- SECTION - E**
- 24.** Illustrate the steps of DNA packaging in eukaryotes.
OR
- What do you mean by reproductive isolation? Discuss its various sub-types.
- 25.** Explain the process of protein synthesis.
OR
- State three principles of Mendel's law of inheritance. Using Punnett square demonstrate the law of independent assortment in a dihybrid cross involving two heterozygous parents.
- 26.** Discuss the Hershey and Chase experiment. State the conclusion they drew after the experiment.
OR
- Who proposed the 'Mutation theory of evolution'? What does it state? List the salient features of mutation theory.
- SOLUTIONS**
- The main reason behind Mendel's success is that he unknowingly selected those traits that were present on different chromosomes or were distantly located on same chromosome. Hence, he did not encounter linkage.
 - Allopatric speciation occurs when a part of population gets geographically isolated from the main population.
 - The positively charged component of a nucleosome is histone and negatively charged component is DNA.

4. Differences between phenomenon of codominance and dominance are as follows :

	Codominance	Dominance
(i)	Both the alleles are equally dominant.	Only one allele is dominant.
(ii)	The alleles show their independent effects even in heterozygous condition.	The dominant allele shows its independent effect in heterozygous condition, whereas other (recessive) allele shows its effect only in homozygous condition.

5. (a) DNA polymerase α - initiation of DNA replication.
 (b) DNA polymerase γ - repairing of mitochondrial DNA.
6. Yes, wings of an insect are analogous to wings of a bird. The basic structure of the wings of an insect is different from that of the wings of a bird, but their function is similar, i.e., help in flying.
7. The tRNA is referred to as adapter molecule as it adapts the genetic code for the formation of primary structure of protein. It has the ability to attach itself to the mRNA molecule via initiation and elongation factors, thus, assisting to incorporate the correct amino acid on the growing polypeptide chain. Since, the tRNA acts as a mediator between two incompatible systems, it is called an adapter molecule. In an adapter molecule :
 (a) DHU loop acts as the binding site for aminoacyl synthetase enzyme.
 (b) TΨC loop is the site for attaching to ribosome.
8. Linkage is affected by the following factors:
 (i) The strength of linkage increases with the increase in age.
 (ii) A rise in temperature decreases the strength of linkage.
 (iii) Radiations like UV rays and X rays decreases the strength of linkage.
 (iv) Distance between two genes if increased, then the linkage strength decreases.
9. Biogenetic law states that "Ontogeny repeats phylogeny". Here ontogeny is the life history of an organism while phylogeny is the evolutionary history of the race of that organism. It can be simply explained as that the organism repeats its ancestral history during its development. For example, in development of a frog, its first stage (i.e., tadpole) shows a fish like tailed larva. It swims with the help of tail and respires by gills, thus, signifying the evolution of frog from fish like ancestor.
10. Differences between XX-XY and ZW-ZZ type of sex determination mechanism are as follows:

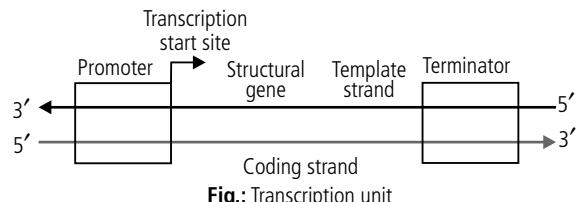
	XX-XY type	ZW-ZZ type
(i)	Male produces two types of sperms.	Male produces only one type of sperm.
(ii)	Female forms only one type of ovum.	Female forms two types of ova.
(iii)	Male contains heteromorphic sex chromosomes (XY).	Female contains heteromorphic sex chromosomes (ZW).
(iv)	Example: humans.	Example : birds.

OR

The important role of two enzymes involved in DNA replication are:

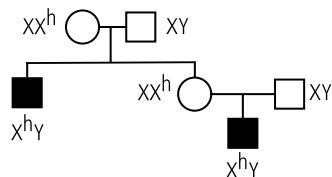
- (i) Enzyme helicase acts on the *ori* site and unwinds the two strands of DNA by dissolving hydrogen bonds.
 (ii) The enzyme topoisomerase releases tension created by supercoiling developed due to unwinding of strands.

11. (a) A schematic representation of transcription unit is as follows:



- (b) Structural gene is the area involved in transcription or formation of RNA. It refers to the DNA sequences that codes for any RNA or protein product other than a regulatory protein. This part of DNA strand has $3' \rightarrow 5'$ polarity.

12. (a) The pedigree chart of the cross is represented as:



Thus, from the above pedigree, the genotypes of daughter and her husband can be deduced as XX^h and XY respectively.

- (b) From this, it can be concluded that haemophilia is a sex-linked disease showing criss-cross pattern of inheritance where a parent passes the traits to the grandson. Here, the female is the carrier of the disease haemophilia.

13. (a) During the struggle for existence, only those individuals could survive which exhibit variations that are more beneficial in facing the hardships and rigours of environment or which can adapt themselves to the changing environmental conditions. Only the fittest organism survives in changing

environmental conditions and the unfit ones are destroyed. During the evolution of reptiles, giant reptiles, dinosaurs, etc., appeared. Majority of them were herbivorous, but due to certain climatic changes, the vegetation disappeared and, therefore, most of them became extinct. However, small animals who could change their feeding habits from herbivorous to carnivorous diet survived, because they could easily get adapted to the changed environment. These, therefore, survived and reproduced successfully and hence, were selected by nature.

(b) August Weismann put forth the theory of continuity of germplasm. He discarded the theory of inheritance of acquired characters due to following reasons. (i) The characters influencing the germ cells are inherited. (ii) There is continuity of germplasm only and the protoplasm of somatic cells is not transmitted to the next generation. Hence the acquired characters are not carried to next generation.

He gave many examples in support of this theory such as he cut off the tails of rats for as many as 22 generations and bred them but yet tailless rats were not born. Similarly, a wrestler's powerful muscles are not transmitted to the offsprings. Neither the boring of pinna and nose in Indian women is inherited to the next generation.

14. The objectives of human genome project are:-

- (i) Identification of all the genes (approximately 20,000-25,000) in human DNA.
- (ii) To determine the sequences of the 3 billion chemical base pairs that make up human DNA.
- (iii) To store this information in databases.
- (iv) To improve tools for data analysis.
- (v) To find out transfer-related technologies so as to transfer data to other sectors, such as industries.
- (vi) To solve any ethical, legal and social issues (ELSI) that may arise from the project.
- (vii) Close association of HGP with the rapid development of a new area in biology, i.e., bioinformatics.
- (viii) Sequencing of model organisms.

15. (a) (i) The carboniferous period of palaeozoic era is called as "Age of amphibians".

- (ii) Dinosaurs were originated during jurassic period of mesozoic era.
- (iii) Coelacanth is a connecting link between fishes and amphibians. They were ancestors of modern day frogs and salamanders.

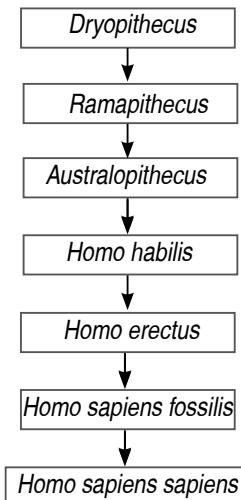
(b) The correct sequence in ascending order of evolution is as follows:

Marine algae → Mosses → Horsetails → Conifers → Herbs.

16. Linkage is the tendency of two different genes on the same chromosome to remain together during the separation of homologous chromosomes at meiosis. Linked genes do not exhibit the dihybrid ratio of 9:3:3:1. It produces offspring with parental characters. Crossing over is the exchange of genes occurring during meiotic prophase I to break old linkage and establish new ones. It produces recombination resulting in new varieties. Thus, they are alternatives of one another, i.e., if linkage is present in between genes, no crossing over occurs between them and if crossing over occurs between the two genes, then they are not linked. For example, in *Drosophila* a yellow bodied white eyed female was crossed with brown bodied red eyed male, F₁ progeny produced was intercrossed. The resulting F₂ phenotypic ratio of *Drosophila* deviate significantly from Mendel's dihybrid ratio of 9:3:3:1.

This signifies that the genes for eye colour and body colour are closely located on the 'X' chromosome and are linked. Therefore, they are inherited together. Recombinants were formed due to crossing over but with low recombination frequency.

17. (a) A schematic representation of evolution of man is given below:



(b) The two characteristics of Cro-Magnon man are:

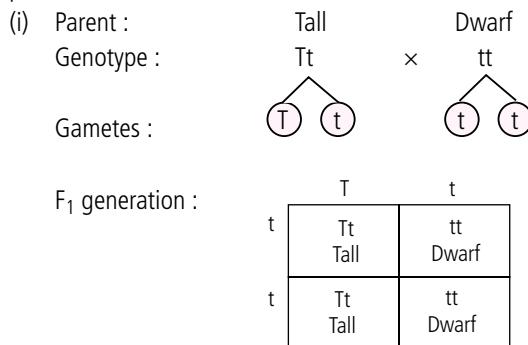
- (i) they could walk and run faster.
- (ii) they made excellent tools and ornaments using stones, bones and elephant tusks.

(c) The three characteristics of Heidelberg man are:

- (i) they had lower jaw with all human like teeth.
- (ii) they used tools and fire.
- (iii) they are believed to have a cranial capacity of about 1300 cc.

Heidelberg man due to its above characteristics is considered as an intermediate between *Pithecanthropus* and Neanderthal man, in the course of evolution of modern living man.

- 18. (a)** Two contrasting characters of height of pea plant are tall and dwarf. In the given cross, if 50% of the progeny shows parental characters, then it must be a cross between a heterozygous tall and a homozygous recessive dwarf parent.

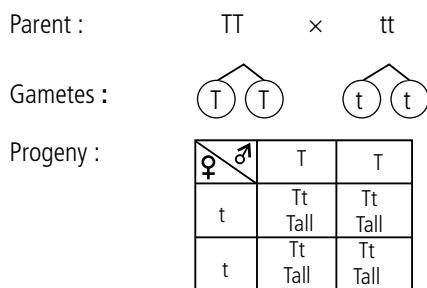


$$\text{Phenotypic ratio} = \text{Tall} : \text{Dwarf} = 1 : 1$$

- (ii) This type of cross is known as test cross.

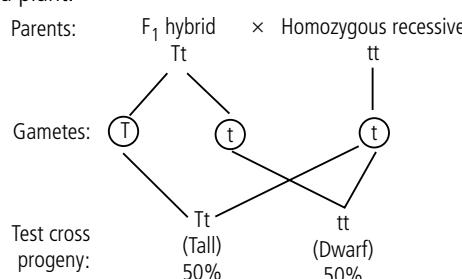
(b) Test cross is a type of cross used to identify whether an individual is homozygous or heterozygous for dominant character. The individual is crossed with homozygous recessive parent for the trait being investigated.

Tall plant could have two possible genotypes : TT and Tt
Case I : Tall (homozygous) pea plant crossed with dwarf pea plant.



If plant produces tall plants as offspring, then the genotype of this type of plant is TT, i.e., homozygous tall plant.

Case II : Tall (heterozygous) pea plant is crossed with dwarf pea plant.



If plant produces both tall and dwarf plants in the ratio of 1 : 1, then genotype of plant is Tt, i.e., heterozygous tall pea plant.

- 19. (a)** Genetic code is universal, i.e., a codon specifies the same amino acid from a virus to a tree or human being. Example: mRNA from chick oviduct introduced in *Escherichia coli* produces ovalbumin in the bacterium exactly similar to one formed in chick.

Genetic code is degenerative, i.e., all other amino acids, except tryptophan and methionine, are specified by two (e.g., phenylalanine – UUU, UUC) to six (e.g., arginine – CGU, CGC, CGA, CGG, AGA, AGG) codons. They are therefore, called degenerate or redundant codons. In degenerate codons, generally the first two nitrogen bases are similar while the third one is different.

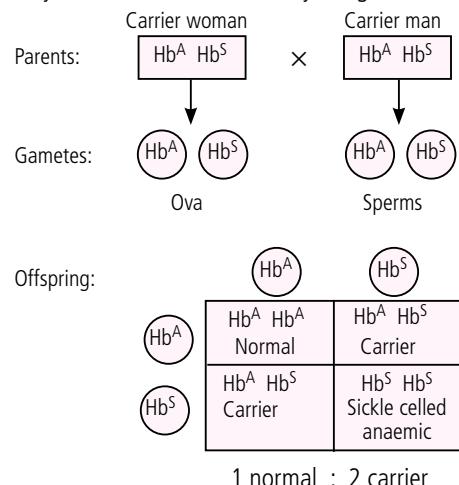
(b) Out of 64 codons, 61 codons code for amino acids and rest 3 codons do not code for any amino acids, they function as stop codons.

(c) AUG has dual functions, i.e., it functions as initiation codon in protein synthesis and also codes for methionine (Met).

- 20. (a)** The disorders along with the symptoms are given below:

- (i) Phenylketonuria causes mental retardation
- (ii) Down's syndrome-partially open mouth with furrowed tongue
- (iii) Klinefelter's syndrome-development of feminine characters like development of breasts in male.

(b) Sickle cell anaemia is an autosomal recessive disorder. This occurs due to formation of abnormal haemoglobin-S. In this disorder, the erythrocytes become sickle shaped due to presence of S-haemoglobin. The gene for normal haemoglobin is represented by Hb^A while that for sickle shaped by Hb^S. This can be shown by the given cross:



$$1 \text{ normal} : 2 \text{ carrier}$$

1 sickle celled individual ($Hb^S Hb^S$) is also obtained from the cross, but it dies during childhood, therefore, ratio of 1 normal to 2 carriers is obtained.

21. ABO blood groups are controlled by the gene *I*. The plasma membrane of the red blood cells has sugar polymers (antigen) that protrude from its surface. The kind of sugar present on its surface is controlled by the alleles of gene *I*. The gene *I* has three alleles I^A , I^B and *i*. The alleles I^A and I^B produce a slightly different form of the sugar while allele *i* does not produce any sugar. Each person possesses a combination of any of these three *I* gene alleles, which determines the type of polymer or antigen to be present on the RBCs of that person. Alleles I^A and I^B are completely dominant over *i*. But when I^A and I^B are present together, they both express their own types of sugar (antigen) because of codominance. Hence, red blood cells have both A and B types of sugars. Since there are three different alleles, there are six different combinations of these three alleles that are possible, and therefore, a total of six different genotypes are there in human ABO blood group.

OR

(a) In the given *lac* operon, 'i' is identified as regulator gene and 'p' as promoter gene.

(b) 'Inducer' for the given operon is 'lactose'. Its role is to bind with repressor, change the latter into non-DNA binding state so as to free the operator gene and switch on the *lac* operon.

(c) In the absence of an inducer (i.e., lactose), the repressor binds to the operator gene making it non-functional. RNA polymerase enzyme cannot move over it to reach the structural genes. Thus, structural genes are inactivated and transcription cannot take place.

As regulatory gene exerts a negative control over the working of structural genes, therefore regulation of *lac* operon is called negative regulation.

22. (a) A small stretch of DNA sequences that repeats several times and shows a high degree of polymorphism is called as satellite DNA. Short nucleotide repeats in DNA are very specific in each individual and vary in number from person to person but are inherited. Each individual inherits these repeats from his/her parents which are used as genetic markers in DNA fingerprinting.

(b) VNTR stands for Variable Number of Tandem Repeats. VNTRs are short nucleotide repeats in DNA that are specific to each individual and vary in number from person to person. DNA probes are radioactive and have repeated base sequences complementary to VNTRs so as to detect their presence.

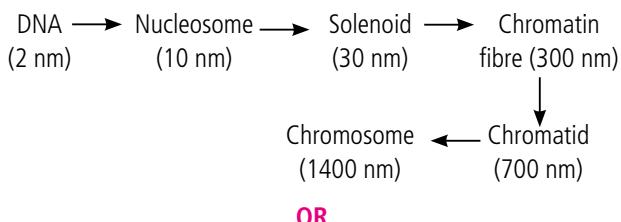
23. (a) Haemophilia is a sex-linked recessive disorder caused due to the presence of recessive gene *h*, carried by X-chromosome. The haemophilic patient lacks blood clotting factor VIII and IX, essential for process of clotting. Hence, the patient may continue to bleed even from a minor cut and may die due to excessive blood loss. Since the gene causing the disease is sex linked and shows criss-cross inheritance, it is known to run in families. This is the major reason of concern for Supriya's parents.

(b) Supriya seems to be mature, thoughtful, intelligent and well aware of the inheritance pattern of genetic disease. She is optimistic and bold to stand and justify her decision with proper scientific explanation.

(c) No, her parents' fear is not justified. Her parents are not aware of the inheritance pattern of the disease haemophilia. Since, Supriya knows that Sumit is not haemophilic she might have convinced her parents by explaining that the haemophilic gene '*h*' is carried by 'X' chromosome only. In case of males, a single ' X^h ' allele present on X-chromosome causes the disease, but as Sumit is not haemophilic and does not bear ' X^h ' gene, it indicates that he cannot pass on the disease to his children. On the other hand, Supriya's family is not known to have this disorder. It is only when she is carrying an allele X^h in one of her X-chromosomes (acts as carrier), there is probability of occurrence of haemophilia in further generations, i.e., sons. In such case, only sons would show diseased condition while daughters would be the carrier, as females become haemophilic only when both of its X-chromosomes carry the gene $X^h X^h$. However, the latter condition is rare.

24. DNA packaging in eukaryotes is carried out with help of lysine and arginine rich basic proteins called histones. The unit of compaction is nucleosome. There are five types of histone proteins - H_1 , H_2A , H_2B , H_3 and H_4 . Four of them (H_2A , H_2B , H_3 and H_4) occur in pairs to produce histone octamer, called nu body or core of nucleosome. Their positively charged ends (due to basic amino acids) towards the outside attract negatively charged strands of DNA. DNA connecting two adjacent nucleosomes is called linker DNA. It bears H_1 histone protein. Nucleosome chain gives 'a beads on string' appearance under electron microscope. A typical nucleosome contains 200 bp of DNA helix with a diameter of 10 nm. It represents the functional euchromatin, which further coils to form cylindrical solenoid having 6 nucleosomes per turn. The solenoid have a thickness of 30 nm. Further, coiling of solenoid gives rise to thick chromatin fibre forming loops upto 300 nm in length. These fibres are compressed to form 250 nm wide fibre which further coils to form a chromatids each of 700 nm in diameter, which are held over a scaffold of non-histone chromosomal proteins to form a chromosome.

The various stages in DNA packaging in an eukaryotic nucleus can be summarised as :



OR

Reproductive isolation is the mechanism which checks the populations of two different species from interbreeding. The two main sub-types may be considered under reproductive isolation are : pre-mating isolation and post-mating isolation.

- I. Pre-mating or pre-zygotic isolation: The principal factors operating under this sub-type are:
 - Mechanical isolation: The morphology of reproductive organs (of male and female) of the two populations may be very complicated and unlike; with the result, copulation between males of one population and females of another, fails to occur.
 - Psychological isolation: The behavioural differences restrict random mating of male and female individuals of different species.
 - Seasonal isolation : The breeding period of mating individuals is different for different species.
 - Gametic isolation : In free living aquatic forms, where the fertilisation is external, the gametes produced by different species usually do not attract each other and this kind of barrier is known as gametic isolation.
- II. Post-mating or post-zygotic isolation : The main factors operating under this sub-type are:
 - Incompatibility: In some instances, mating takes place between populations, but fertilisation may not take place; or even fertilisation may occur, but no hybrid progeny will be formed.
 - Hybrid inviability: Here, normal fertilisation occurs, and hybrid offspring is also formed, but the hybrid has reduced viability. The hybrid inviability may appear at any stage of development.
 - Hybrid sterility : In many cases, hybrids may be vigorous and live to sexual maturity, but are sterile.
 - Hybrid breakdown: In some instances, not only vigorous F_1 hybrids are produced, but these hybrids also produce F_2 individuals of backcross progeny. Unfortunately, hybrid breakdown results

in the F_2 and backcross generations, as these individuals have reduced vigour or fertility or both. It is very significant as it is the main mechanism to give rise to a new species.

25. The process of decoding of the message from *mRNA* to protein with the help of *tRNA*, ribosome and enzymes is called protein synthesis or translation. Protein synthesis occurs over ribosomes. The 4 main steps in protein synthesis are: activation, initiation, elongation and termination of polypeptide chain.

The newly synthesised *mRNA* joins the smaller subunit of ribosome at 5' end. *mRNAs* carry the codon and *tRNAs* carry the anticodon for the same codon. Activation of amino acid is catalysed by the enzyme aminoacyl *tRNA synthetase* in the presence of ATP. In presence of ATP an amino acid combines with its specific aminoacyl-*tRNA synthetase* to produce aminoacyl adenylate enzyme complex. This reacts with *tRNA* to form aminoacyl-*tRNA* complex. Activated *tRNA* is taken to ribosome *mRNA* complex for initiation of protein synthesis. Initiation of protein synthesis is accomplished with the help of 3 initiation factors (IF3, IF2, IF1) in prokaryotes and 9 in eukaryotes (eIF2, eIF3, eIF1, eIF4A, eIF4B, eIF4C, eIF4D, eIF5, eIF6). The ribosome binds to the *mRNA* at the start codon (AUG) that is recognised only by the initiator *tRNA*. A polypeptide chain forms as *tRNAs* deliver amino acids to the ribosome. Large ribosomal subunit binds the initiation complex forming two (A and P) binding sites for *tRNA* molecules. The first site is P site or peptidyl site which is occupied by *tRNA^{met}*. The second site is A or aminoacyl site and is positioned over the second codon. Now, the ribosome proceeds to the elongation phase of protein synthesis. During this stage, complexes composed of an amino acid linked to *tRNA*, sequentially bind to the appropriate codon in *mRNA* by forming complementary base pairs with the *tRNA* anticodon. The ribosome moves from codon to codon along the *mRNA*. Amino acids are added one by one, translated into polypeptide sequences dictated by DNA and represented by *mRNA*. The enzyme peptidyl synthetase catalyses the formation of peptide bond between the carboxylic group of amino acid at P site and amino group of amino acid at A site. Enzyme translocase brings about the movement of *mRNA* by one codon. The termination of protein synthesis occurs when a non-sense codon reaches at A site of ribosome. The chain detaches from the ribosome. A release factor binds to the stop codon, terminating translation and releasing the complete polypeptide from the ribosome. Two subunits of ribosomes dissociate with the help of dissociation factor.

OR

The three principles of Mendel's law of inheritance are :

- Law of dominance : This law explains that when two individuals of a species, differing in a pair of contrasting forms of a trait are crossed, the form of the trait that appears in the F_1 hybrid is dominant and the alternate form that remains hidden, is called recessive.
- Law of segregation : This law states that the members of the allelic pair that remained together in the parent, segregate during gamete formation and only one factor enters a gamete.
- Law of independent assortment : This states that in the inheritance of two pairs of contrasting characters, the factors of each pair of characters segregate independently of the factors of the other pair of characters.

The principle or law of independent assortment can be studied by means of dihybrid cross between heterozygous parents having $YyRr$ genotype. This can be demonstrated through Punnett square as follows:

Parents:		♀ $YyRr$ Yellow Round	\times	♂ $YyRr$ Yellow Round	
♀	♂	YR YYRR YYRr	Yr YYrr YyRr	yR YyRR YyRr	yr yyRr yyrr
YR	YR	YYRR	YYRr	YyRR	YyRr
Yr	Yr	YYRr	YYrr	YyRr	Yyrr
yR	yR	YyRR	YyRr	yyRR	yyRr
yr	yr	YyRr	Yyrr	yyRr	yyrr

Phenotypic ratio obtained is:

Yellow round : 9

Yellow wrinkled : 3

Green round : 3

Green wrinkled : 1

Thus, the phenotypic ratio of a dihybrid cross is 9 : 3 : 3 : 1. The occurrence of four types of plants (parental types) in the F_2 generation of dihybrid cross shows that the factors of each of the two characters assort independently of the other as if the other pair of factor are not present.

26. Alfred D. Hershey and Martha Chase, chose T_2 bacteriophage as their experimental material. They decided to see which of the bacteriophage components-protein or DNA-entered bacterial cells and directed reproduction of the virus.

Hershey and Chase experiment was based on the fact that DNA but not the protein contains phosphorus, and similarly sulphur is present in proteins (cysteine and methionine) but not in DNA. They incorporated radioactive isotopes of phosphorus (^{32}P) into phage DNA and that of sulphur (^{35}S) into proteins of separate phage cultures. These phage types were used independently to infect the bacterium *Escherichia coli*. After sometime, the cultures were agitated in a blender to separate the empty phage capsids from the surface of bacterial cells and the two were separated by centrifugation. Hershey and Chase showed that in bacterial cells, infected with virus containing radioactive phosphorus (^{32}P), radioactivity was associated with bacterial cells and also, appeared in the progeny phage. However, in bacterial culture where radioactive sulphur (^{35}S) was used, all radioactive material was limited to phage 'ghosts' (empty viral protein coats). These results indicated that the DNA of the bacteriophage and not the protein enters the host, where viral replication takes place. Therefore, they concluded that DNA is the genetic material of T_2 bacteriophage. It directs protein coat synthesis and allows replication to occur.

OR

The 'Mutation theory of evolution' was proposed by Hugo de Vries. This theory states that evolution is a jerky process where new varieties and species are formed due to mutations, that serve as raw material of evolution. The salient features of mutation theory are:

- Mutations or discontinuous variations are the raw material of evolution.
- Mutations appear all of a sudden. They become operational immediately.
- Unlike Darwin's continuous variations or fluctuations, mutations do not revolve around the mean or normal character of the species.
- The same type of mutations can appear in a number of individuals of a species.
- All mutations are inheritable.
- Mutations appear in all conceivable directions.
- Useful mutations are selected by nature, while lethal mutations are eliminated. However, useless and less harmful ones can persist in the progeny.
- Accumulation of variations produce new species. Sometimes a new species is produced from a single mutation.
- Evolution is a jerky and discontinuous process.



MPP-6 | MONTHLY Practice Problems

Class XII

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.

- **Biotechnology : Principles and Processes**
- **Biotechnology and Its Applications**

Total Marks : 160

- It has been seen, that sometimes the DNA or gene fragments, present in a reaction self-ligates. The enzyme used to prevent the self-ligation of DNA fragments during the procedure of rDNA technology is
 - Restriction endonuclease
 - DNA polymerase I
 - Alkaline phosphatase
 - DNA ligase.
- Which one of the following is a correct statement?
 - "Bt" in Bt cotton indicates that it is a genetically modified organism produced through biotechnology.
 - The anticoagulant hirudin is being produced from *Brassica napus*.
 - During insertional inactivation, recombinant colonies produce blue colour.
 - Agrobacterium tumefaciens* produces crown galls in almost all monocot plants.
- Consider the steps involved in the production of humulin given below.
 - Artificial synthesis of human insulin gene
 - Culturing recombinant *E.coli* in bioreactors
 - Purification of humulin
 - Insertion of human insulin gene into plasmid
 - Introduction of recombinant plasmid into *E.coli*
 - Extraction of recombinant gene product from *E.coli*
 - I → IV → V → II → VI → III
 - II → I → III → IV → VI → V
 - I → II → IV → III → V → VI
 - VI → V → III → IV → II → I
- Select the incorrect statement regarding different types of cloning vectors.
 - M13 phage vectors are used for obtaining single-stranded copies of cloned DNA.
 - Two selectable markers in pBR322 are *tet*^R and *amp*^R.
 - The upper limit of DNA to be inserted in YAC is about 250–1000 Kbp.
 - Yeast episomal plasmid (YEp) is an example of shuttle vector.



Time Taken : 40 Min.

- In a rDNA technology experiment, when a plasmid vector cut by *Hind* III enzyme was incubated with donor gene cut by *Eco*RI, the recombinant molecule was not produced. Which of these could be a probable reason?
 - The size of the donor gene is > 200 kb.
 - Both enzymes produce blunt ends.
 - The recognition sequences of *Hind* III and *Eco*RI are different.
 - None of these
- For vectorless transformation, microparticles coated with DNA, to be bombarded with gene gun into host cells are made up of
 - silver or platinum
 - platinum or zinc
 - silicon or platinum
 - gold or tungsten.
- Select the correct option to fill up the blanks in the following statements regarding pBR322.
 - It is one of the most popular plasmid vector comprising of approximately (i).
 - It has unique restriction site for (ii) different enzymes.
 - It also possesses gene that encodes for (iii) protein which is involved in reducing copy number.

(i)	(ii)	(iii)
(a) 4,363 bp	12	rop
(b) 5,000 bp	10	rop
(c) 4,363 bp	14	rep
(d) 1,254 bp	6	rep
- Identify the incorrectly matched pair.
 - Bacterial artificial chromosome – 300 - 350 Kb
 - cos + plasmid – 200 Kb
 - Yeast artificial chromosome – > 1 Mb
 - Plasmids – < 15 Kb
- A technique for molecular diagnosis of a disease based on the principle of antigen-antibody interaction is
 - polymerase chain reaction
 - northern blotting
 - enzyme linked immunosorbent assay
 - none of these.

- 10.** Refer to the following table representing genetically engineered microbes and their applications.

Microbes	Applications
<i>Escherichia coli</i>	Production of A
B	Production of an endotoxin
C	Nitrogen fixation by incorporating 'nif' genes in cereal crops.
<i>Pseudomonas putida</i>	Digestion of D

Identify the missing links A, B, C and D.

- | A | B | C | D |
|---------------------------|-------------------------------|-------------------------------|---------------|
| (a) Human insulin | <i>Trichoderma</i> | <i>Pseudomonas putida</i> | Enzymes |
| (b) Bovine growth hormone | <i>Rhizobium meliloti</i> | <i>Bacillus thuringiensis</i> | Proteins |
| (c) Monoclonal antibodies | <i>Bacillus thuringiensis</i> | <i>E.coli</i> | Cell wall |
| (d) Human insulin | <i>Bacillus thuringiensis</i> | <i>Rhizobium meliloti</i> | Hydro-carbons |

- 11.** Restriction modification systems of bacteria exist to

- (a) protect bacteria from invading foreign DNA
- (b) promote conjugation
- (c) help the bacterial chromosome to replicate
- (d) encourage recombination of new genetic material.

- 12.** Consider the following table for comparison between PCR and gene cloning.

	Parameter	PCR	Gene cloning
I.	Efficiency	More	Less
II.	Requirements	DNA, <i>Taq</i> polymerase, primers	Restriction enzyme, ligase, vector, bacteria
III.	Manipulation	<i>In vivo</i> only	<i>In vitro</i> only
IV.	Time required	2-4 days	4 hours
V.	Automation	No	Yes

How many of the above differences are correct?

- (a) Four
- (b) Three
- (c) Two
- (d) All of these

- 13.** A genetically modified crop in which an existing biosynthetic pathway is modified to obtain a desired product is

- (a) Flavr Savr
- (b) *Brassica napus*
- (c) Bt cotton
- (d) Golden rice.

- 14.** All commonly used cloning vectors differ in their cloning capacities. Arrange the following vectors in order of their increasing cloning capacities.

Bacterial artificial chromosomes (BAC), Cosmid, λ phages, plasmids, Yeast artificial chromosome (YAC)

- (a) BAC \rightarrow Cosmid \rightarrow λ Phage \rightarrow Plasmid \rightarrow YAC

- (b) YAC \rightarrow BAC \rightarrow Cosmid \rightarrow λ Phage \rightarrow Plasmid

- (c) Plasmid \rightarrow λ Phage \rightarrow Cosmid \rightarrow BAC \rightarrow YAC

- (d) Plasmid \rightarrow Cosmid \rightarrow λ Phage \rightarrow BAC \rightarrow YAC

- 15.** Consider the following statements regarding Flavr-Savr transgenic tomato and identify them as true or false statements.

- I. In Flavr-Savr tomato, gene producing polygalacturonase enzyme was over expressed.

- II. Fruits of Flavr-Savr tomato over ripe very fast.

- III. Fruits of Flavr-Savr tomato remain fresh for longer periods than the fruits of normal tomato variety.

- IV. In terms of taste and quantity of total soluble solids, Flavr-Savr seems inferior to normal varieties.

I II III IV

- (a) F F T F

- (b) T F F T

- (c) T F F T

- (d) F T T T

- 16.** Match the recombinant protein/drugs in column I to their correct therapeutic use in column II.

Column I

- A. Tissue plasminogen activator (i) Treatment of haemophilia-A

- B. Blood clotting factor IX (ii) Treatment of cystic fibrosis

- C. Blood clotting factor VIII (iii) Prevent acute kidney transplantation rejection

- D. DNase (iv) To dissolve clots in myocardial infarction

- E. OKT-3 (v) Treatment of haemophilia-B

A B C D E

- (a) (i) (iv) (v) (iii) (ii)

- (b) (ii) (iv) (iii) (i) (v)

- (c) (iv) (v) (i) (ii) (iii)

- (d) (iv) (iii) (ii) (i) (v)

- 17.** Which of the following statements about the foreign genetic material in genetically modified crop plants or animals is false?

- (a) It alters the phenotype of the GM plant or animal.

- (b) It must be inserted again in each generation.

- (c) It may be subjected to artificial selection by breeders and farmers.

- (d) It may be subjected to natural selection.

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

Statement A : A genetic probe is helpful in the detection of specific DNA sequence.

Statement B : Genetic probe is a radiolabelled DNA, which has base sequence complementary to the DNA fragment being detected.

- (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 statement B is incorrect.
- (d) Both statements A and B are incorrect.

19. A scientist treated the genome of a tumor virus with *Bam* HI and electrophoresed the product on an agarose gel. He observed only one band on the gel equivalent to the size of its genome. This is because

- (a) restriction sites are masked
- (b) *Bam* HI also requires ATP as energy is consumed
- (c) *Bam* HI requires 3'-adenosyl for recognising restriction sites
- (d) Tumor virus has ds RNA as genome and *Bam* HI do not cut RNA.

20. Read the following statements and identify them as true or false.

- (i) In Bt cotton, cry genes, *cry* IAc and *cry* IIAb have been incorporated.
- (ii) Bt cotton was developed by Maharashtra hybrid seeds company in collaboration with Monsanto.
- (iii) Golden rice contains two genes from daffodil and one from a bacterial species.
- (iv) Major drawback of stirred-tank bioreactor is that, it is not suited for large-scale production.
- (v) In the name of pBR322, pBR refers to the name of scientist who developed it.

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

21. Consider the following statements and find out the incorrect statement(s).

- (i) Mobile genetic elements were discovered by Barbara McClintock.
- (ii) Udder cell was used to produce the cloned sheep by nuclear transplantation method.
- (iii) Ian Wilmut, Keith Campbell and colleagues produced a cloned sheep called Dolly.

- (iv) In *Brassica napus*, hirudin accumulates in flowers.

- (a) (i) and (ii) (b) (i) only
- (c) (ii) and (iii) (d) (iv) only

22. Match column I with column II and select the correct code.

Column I		Column II	
A.	Micro-injection	(i)	Polyethylene glycol
B.	Electroporation	(ii)	Used for oocytes, eggs and embryo
C.	Biostatic method	(iii)	Calcium chloride
D.	Chemical mediated gene transfer	(iv)	High-velocity micro-projectiles

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

23. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of

- (a) insertional inactivation of alpha galactosidase in recombinant bacteria
- (b) inactivation of glycosidase enzyme in recombinant bacteria
- (c) non-recombinant bacteria containing intact beta galactosidase
- (d) insertional inactivation of alpha galactosidase in non-recombinant bacteria.

24. Consider the following features of type II restriction endonucleases and select the correct option.

Basis	Feature
I. Nature of enzyme	– Bifunctional, having both endonuclease and methylase activity
II. Protein structure	– Two different subunits
III. Restriction requirement	– Mg ²⁺
IV. Cleavage sites	– Within specific recognition sites
(a) I and II	(b) III and IV
(c) I and IV	(d) I, II and III

25. Consider the following pairs and choose the correct option.

- I. Southern blotting – DNA
 - II. Western blotting – RNA
 - III. Northern blotting – Protein
 - IV. Dot blotting – RNA and proteins
- (a) I and II are correct
 - (b) Only I is correct
 - (c) II and III are correct
 - (d) I, II, III and IV are correct.

26. A transgenic sheep tracy was produced to obtain α_1 antitrypsin (AAT), the absence of which causes
 (a) cystic fibrosis (b) emphysema
 (c) multiple sclerosis (d) SCID.

27. Consider the following microbes.

Bacillus anthracis, Vibrio cholerae
 Small pox virus, *Yersinia pestis*
Clostridium botulinum, E.coli,
Rhizobium, Pseudomonas denitrificans

How many of these can be potential pathogens for use as bioweapons?

- (a) 5 (b) 3 (c) 4 (d) 8

28. Identify the technique based on the characters given below.

- I. It is used to separate DNA fragments generated through restriction digestion.
 - II. In this technique, charged molecules are separated under the influence of an electrical field through a matrix.
 - III. The stained DNA fragments are seen on exposure to UV radiation.
- (a) Polymerase chain reaction
 (b) Electrophoresis
 (c) SDS - polyacrylamide gel electrophoresis
 (d) None of these

29. Read the following statements in context of humulin and choose the set of incorrect statements.

- I. Human insulin is made up of 51 amino acids arranged in two polypeptide chains A and B.
 - II. Polypeptide chain A have 30 aminoacids while B have 21 amino acids.
 - III. Chain A and B are interconnected by 5 disulphide bridges.
 - IV. Pro-insulin or immature insulin has three chains A, B and C (33 amino acids).
- (a) I only (b) I, II and III
 (c) I and IV (d) II and III

30. It is preferable to use yeasts rather than bacteria as recipient cells for recombination of eukaryotic DNA because yeast can

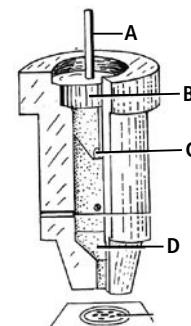
- (a) produce restriction enzymes
 (b) excise introns from the RNA transcript
 (c) remove methyl groups
 (d) reproduce at a faster rate.

31. Match the column I with column II and choose the correct answer.

Column I	Column II
A. Restriction endonucleases	(p) Kohler and Milstein
B. Polymerase chain reaction	(q) Alec Jeffreys
C. DNA fingerprinting	(r) Arber
D. Monoclonal antibodies	(s) Kary Mullis

- (a) A - (r), B - (s), C - (q), D - (p)
 (b) A - (r), B - (q), C - (p), D - (s)
 (c) A - (q), B - (p), C - (s), D - (r)
 (d) A - (q), B - (s), C - (r), D - (p)

32. Refer to the figure given below and identify A, B, C and D.



- | A | B | C | D |
|--------------------------|----------------------|--------------------|----------------------|
| (a) Gun powder cartridge | Stopping plate | Vent | Firing pin |
| (b) Vent | DNA coated pellets | Stopping plate | Gun powder cartridge |
| (c) Gun powder cartridge | Stopping plate | Firing pin | Vent |
| (d) Firing pin | Gun powder cartridge | DNA coated pellets | Stopping plate |

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

Statement A : Sticky ends produced by restriction enzymes may increase the efficiency of ligation.

Statement B: The compatible sticky ends of gene of interest and vector can base pair with one another forming a stable structure for DNA ligase to work on.

Contributed by : Rahul Kapoor (Ambala), Harsh Sharma (Gwalior)

SOLUTIONS TO AUGUST 2017 CROSSWORD

¹ M	A	G	N	E	T	O	S	O	M	E	² S			
³ K	E	⁴ E	L	⁵ F	⁶ P	A	⁷ P	P	U	S	C	⁸ V	⁹ P	
¹⁰ C	¹¹ E	R	V	I	X		Y			¹² A	I	E	R	
	N	G		B			R	¹³ Z	Y	M	O	S	I	¹⁴ S
	K	O		R		¹⁵ S	E	R	E	E	P	P	C	P
¹⁶ D	E	¹⁷ T	R	I	G	O	N	E		L	H	E	K	L
I	¹⁸ P	H	E	N	O	L	O	G	Y	O	Y	R	L	I
¹⁹ C	H	I	A	S	M	A	I	²⁰ A		B	T	A	E	C
E	A						D	X		L	E	L	S	I
R	L			²¹ B			S	O		A	S			N
²² C	I			U		²³ F	A	N	G	²⁴ S	M	U	²⁵ T	G
O	N	²⁶ M	A	R	A	S	M	U	S	T			O	
R	S			S		²⁷ A	C	R	O	S	I	N	F	
²⁸ M	E	D	I	A	S	T	I	N	U	M			U	
S		²⁹ P	E	R	F	O	R	I	N	³⁰ S	O	O	T	

- (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 statement B is incorrect.
- (d) Both statements A and B are incorrect.

34. Match the items of column I to those of column II.

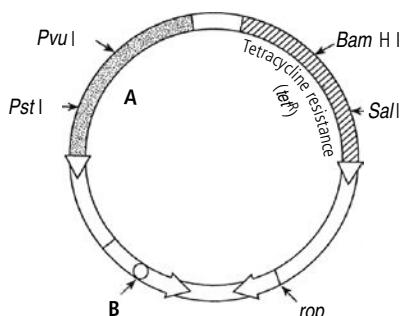
Column I	Column II
A. Super bug	(i) Ti plasmid
B. Golden rice	(ii) Gene gun
C. Direct gene transfer	(iii) Heat-shock
D. Indirect gene transfer	(iv) Electroporation
	(v) OCT
	(vi) Phytoene synthase
	(vii) XYL
	(viii) Carotene desaturase

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

35. Bt toxin kills the insect by

- (a) blocking the electron transport chain
- (b) damaging the surface of trachea
- (c) creating pores in the tracheal system
- (d) creating pores in the surface of mid gut epithelial cells.

36. Refer to the given figure and identify the functions of 'A' and 'B'.



A	B
(a) Provides resistance to tetracycline	Site of cleavage
(b) Site of cleavage	Acts as a selectable marker
(c) Replication origin	Reduces copy number
(d) Provide resistance to ampicillin	Initiates replication

- 37.** Genetically modified Bt brinjal has been developed in India for
- (a) enhancing shelf life
 - (b) enhancing mineral content
 - (c) drought resistance
 - (d) insect resistance.

38. Identify the name of the tool or technique by going through its applications given below.

- A. Used for the identification of cells that have been transformed.
- B. Used to detect a segment of DNA containing a certain sequence.
- C. Used for sequencing long DNA strands.
- D. Used to make exact copies of bacterial colonies on an agar plate.

A	B	C	D
(a) Selectable markers	Microinjection	Gene transfer	Replica plating
(b) Plasmids	Biostatic	Sanger's method	PCR
(c) cDNA	Reporter gene	Gilbert sequencing	Gene cloning
(d) Selectable markers	Probe	Shotgun sequencing	Replica plating

39. Biopatents are usually awarded for

- (i) strains of microorganisms
 - (ii) cell lines
 - (iii) various biotechnological procedures
 - (iv) genetically modified strains of plants and animals
 - (v) DNA sequences.
- (a) (i), (ii) and (iii) only
 - (b) (ii) and (iii) only
 - (c) (i), (iv) and (v) only
 - (d) (i), (ii), (iii), (iv) and (v)

40. A mixture of DNA fragments A, B, C and D were subjected to agarose gel electrophoresis. Their molecular weights are such that A – D = C, C > D and B > A. The position of these fragments from cathode to anode sides of the gel would be

- (a) A, B, C, D
- (b) B, A, C, D
- (c) D, A, B, C
- (d) C, B, A, D.

Key is published in this issue. Search now! ☺

SELF CHECK

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

CLASS
XII

PMT

PRINCIPLES OF INHERITANCE AND VARIATION

This paper contains 45 **multiple choice questions**. Each question has four choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct. (Mark only one choice).

Marks : $45 \times 4 = 180$

Negative Marking (-1)

1. Which of the following is a false statement?
 - (a) On selfing a dihybrid 25% progeny will be dihybrid.
 - (b) AaBbCC individual produces 4 types of gametes, genetically.
 - (c) Every test cross is a back cross but, every back cross is not a test cross.
 - (d) Human skin colour is controlled by six alleles.
2. In the given diagram which of the five marked crosses as X are test crosses?
 - (a) 3, 4 and 5
 - (b) 2 and 5
 - (c) 3 only
 - (d) 2, 3 and 5
3. A dihybrid is crossed with homozygous recessive individual of its type, the phenotypic ratio is
 - (a) 1 : 2 : 1
 - (b) 3 : 1
 - (c) 1 : 1 : 1 : 1
 - (d) 9 : 3 : 3 : 1.
4. In a dihybrid cross $AABB \times aabb$, F_2 progeny of $AABB$, $AABb$, $AaBB$ and $AaBb$ occur in the ratio of
 - (a) 1 : 1 : 1 : 1
 - (b) 9 : 3 : 3 : 1
 - (c) 1 : 2 : 2 : 1
 - (d) 1 : 2 : 2 : 4.

5. Which of the following statements are true about human ABO blood grouping?
 - (i) I^A and I^B are codominant and are dominant over i^0 .
 - (ii) Antigen is a protein and antibody is a glycoprotein.
 - (iii) It has six genotypes and four phenotypes.
 - (iv) O^+ is a universal donor and AB^- is a universal recipient.
 - (v) It is a case of polygenic inheritance.
 - (a) (i), (ii), (iv) and (v)
 - (b) (i), (iii) and (v) only
 - (c) (ii), (iii), (iv) and (v)
 - (d) (i) and (iii) only
6. Which of the following is a true statement?
 - (a) ϕ is symbol to represent a carrier of a recessive allele.
 - (b) A true breeding line is one that has undergone continuous self breeding, shows stable trait inheritance and expression for several generation and Mendel selected 7 true breeding pea plant varieties.
 - (c) Pod colour selected by Mendel shows yellow colour dominant over green colour.
 - (d) is symbol of mating between relatives, related by common descent.
7. Which of the following is an incorrect match?
 - (a) → Individual with unspecified sex
 - (b) → Dizygotic twins
 - (c) → Consanguineous mating
 - (d) → Proposita

Contributed by : Harpal Singh, Harpal's Biology Classes, Chandigarh, 09781124215

- 8.** Which of the following will not result in variations among siblings?
 (a) Independent assortment of genes
 (b) Crossing over
 (c) Linkage
 (d) Mutation
- 9.** Euphenics is defined as improvement of human race
 (a) by changing their environment
 (b) by use of recombination technology
 (c) by manipulation of Mendelian principles
 (d) all of these.
- 10.** A man with blood group B marries a woman with blood group A and their first child is having blood group B. What is the genotype of mother and father respectively?
 (a) $I^A i^0, I^B i^0$
 (b) $I^A I^A, I^B I^B$
 (c) $I^A i^0, I^B I^B$
 (d) Either (a) or (c)
- 11.** Dwarf pea plant is treated with gibberellic acid. It grew as a tall plant and was then crossed with a tall plant. Which of the following is true about its progeny?
 (a) All hybrid tall
 (b) 50% tall and 50% dwarf
 (c) All homozygous tall
 (d) Either (a) or (b)
- 12.** Gene behaves as recessive because
 (a) dominant gene suppresses its transcription to stop formation of enzymes
 (b) it produces incomplete peptide chain and dominant gene has no role in suppressing its expression
 (c) it produces incomplete or defective non-functional enzymes
 (d) Both (b) and (c).
- 13.** In the F_2 generation of a Mendelian trihybrid cross, the number of phenotypes and genotypes will be
 (a) phenotypes-4; genotypes-16
 (b) phenotypes-8; genotypes-64
 (c) phenotypes-8; genotypes-27
 (d) phenotypes-4; genotypes-9.
- 14.** Mendel proposed that the factor controlling any character is discrete and independent. His proposition was based on the
 (a) results of F_3 generation of a cross only
 (b) observations that the offspring of a cross made between the plants having two contrasting characters shows only one character without any blending
 (c) result of self pollination of F_1 offsprings in monohybrid cross with some recessive progeny
 (d) cross pollination of F_1 generation with recessive parent only.
- 15.** Height of a plant is controlled by quantitative inheritance (4 pairs of factors). Homozygous dominant individual has height 6 feet and homozygous recessive has height 2 feet. Find contribution of one dominant gene. Also find height of plant which is hybrid for four pairs of factors.
- 16.** Which of the following is true about alleles?
 I. Factors which code for a pair of contrasting traits.
 II. They are slightly different molecular form of the same gene.
 III. They always have same locus on homologous chromosomes.
 (a) I and III
 (b) II and III
 (c) I and II
 (d) I, II and III
- 17.** Which of the following is a false statement?
 (a) Sickle cell anaemia is an example of missense mutation and point mutation.
 (b) ABO blood grouping is an example of polygene.
 (c) In pea, gene controlling size of starch grain also shows pleiotropism and incomplete dominance.
 (d) In sickle cell anaemia 6th amino acid of β -chain, valine replaces glutamate.
- 18.** A cross between two tall plants resulted in offspring having few dwarf plants. What would be the genotypes of both the parents?
 (a) TT and Tt
 (b) Tt and Tt
 (c) TT and TT
 (d) Tt and tt
- 19.** What proportion of the offspring of a cross $AABBcc \times AaBbCc$ will be completely heterozygous, if all genes segregate individually?
 (a) $\frac{1}{4}$
 (b) $\frac{1}{16}$
 (c) $\frac{1}{2}$
 (d) $\frac{1}{8}$
- 20.** Exception to Mendel's law of independent assortment is
 (a) non-disjunction
 (b) codominance
 (c) linkage
 (d) multiple allelism.
- 21.** How many of the following statements are incorrect?
 (i) Mendel could not repeat his results with respect to inheritance of characters as in pea, while working on *Hieracium* because the plant shows apomixis.
 (ii) Epistasis is a type of intergenic interaction that may suppress the expression of a dominant allele.
 (iii) Mule is a sterile hybrid because it is unable to produce normal gametes.
 (iv) Improvement of human race by recombination technology is eugenics.
 (v) Recessive allele expressing itself, due to deletion of dominant allele from other homologous chromosome, is pseudodominance.
 (a) 1
 (b) 2
 (c) 3
 (d) 4
- 22.** Total genes in basic set of chromosome is
 (a) gene pool
 (b) genoid
 (c) genome
 (d) genotype.

- 23.** If a dihybrid is selfed, what proportion of progeny will be hybrid for one pair of factors?
- (a) $\frac{9}{16}$ (b) $\frac{1}{2}$ (c) $\frac{3}{16}$ (d) $\frac{1}{16}$
- 24.** Which of the following marriage is prohibited by genetic counselor?
- (a) Rh⁺ female and Rh⁺ male
 (b) Rh⁻ male and Rh⁺ female
 (c) Rh⁻ female and Rh⁺ male
 (d) All of these
- 25.** Study with respect to transfer of characters from generation to generation with and without modification, is best indicated as
- (a) inheritance (b) variations
 (c) genetics (d) biotechnology.
- 26.** One gene suppressing expression of the other non allelic gene is known as
- (a) dominance (b) incomplete dominance
 (c) epistasis (d) hypostasis.
- 27.** Which of the following individual/s will produce eight type of gametes?
- (a) AaBbDd (b) AABbCcDDEEFF
 (c) AaBBCcDDGg (d) All of these
- 28.** Which of the following is a false statement?
- (a) Mendel's contemporaries did not believe him because he could not prove particulate nature of factor.
 (b) Mendel's work was republished in year 1901 in 'Flora' journal.
 (c) In case of incomplete dominance, phenotypic and genotypic ratio is same in F₂ generation.
 (d) Gene controlling multiple phenotypes is polygenic.
- 29.** In *Drosophila*, there are 15 multiple alleles to control eye colour of various shades. How many different genotypes are possible in its population?
- (a) 120 (b) 30 (c) 60 (d) 379
- 30.** Which of the following is a wrong match?
- (a) Dihybrid test cross ratio – 1 : 1 : 1 : 1
 (b) Selfing of trihybrid for polygenic character – 8 phenotypes in progeny
 (c) Smallest possible mutation – Single nucleotide
 (d) Improvement of human race by recombination technology – Euthenics
- 31.** Mendelian genotypic ratio 1 : 2 : 1 is confirmed in
- (a) F₂ generation (b) F₃ generation
 (c) F₁ generation (d) F₄ generation.
- 32.** Which of the following is a true match?
- (a) 1 : 6 : 4 : 6 : 1 → dihybrid ratio of polygenic inheritance
 (b) Eight types of gametes → in tetrahybrid individual
 (c) Inhibitory gene → suppression with respect to expression of allelic gene
- 33.** (d) 1st, 4th, 5th, 7th chromosomes → carries genes of 7 Mendelian characters in pea plant
- 34.** If gene for haemolytic jaundice is dominant and 10% population carrying this gene develops the disease then, what percentage of progeny from a marriage between heterozygous for haemolytic jaundice and normal individual suffers from this disease?
- (a) 50% (b) 5% (c) 10% (d) 1/5th
- 35.** Which of the following statements are correct with respect to Turner's syndrome ?
- (i) Short statured sterile female
 (ii) An example of monosomy
 (iii) Individual has webbed neck and broad chest cage with poorly developed breast
 (iv) Commonly originates due to non disjunction of sex chromosomes during oogenesis
 (v) Sparse body hair, streaked gonads with 47 chromosomes per somatic cell.
- (a) (i), (ii) and (iii) (b) (i), (ii) and (v)
 (c) (i), (iii) and (v) (d) All except (v)
- 36.** 'Myotonic dystrophy' in human is controlled by
- (a) autosomal dominant gene
 (b) autosomal recessive gene
 (c) X-linked recessive gene
 (d) Y-linked dominant gene.
- 37.** Which of the following statement is incorrect?
- (a) Chromosomal theory of inheritance was given by Morgan and Castle.
 (b) Chromosomes are stained by acetocarmine or feulgen stain.
 (c) The principle of independent assortment can be studied when genes for different characters are present on different chromosomes.
 (d) Criss-cross inheritance is applicable to holandric as well as hologynic inheritance.
- 38.** Male fowl has sex chromosomes as
- (a) ZZ (b) ZW (c) XO (d) XY.
- 39.** Which of the following is an incorrect match?
- (a) Down's syndrome – Monosomy of sex chromosome
 (b) Thalassaemia – Autosomal recessive

MPP-6 CLASS XI **ANSWER** **KEY**

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

Kidney Transplantation

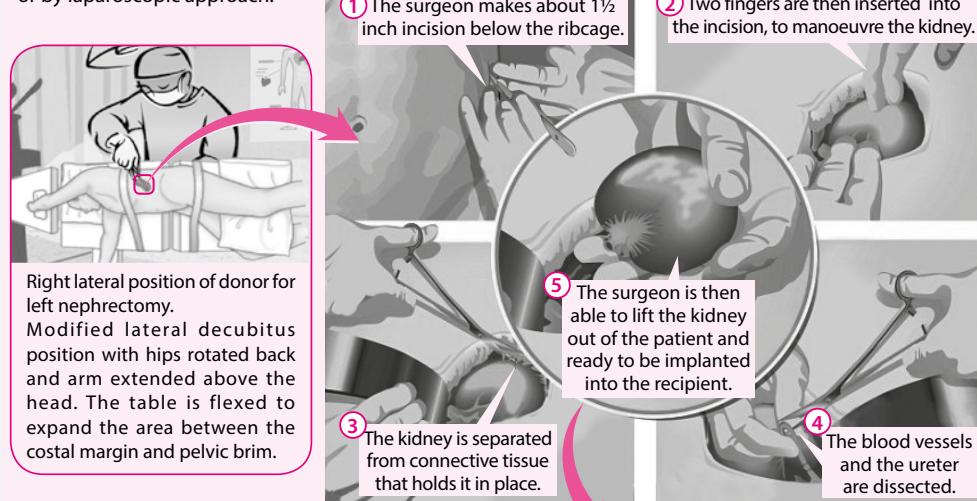
Kidney transplant is a surgery done to replace a diseased kidney with a healthy one from a donor. The healthy kidney or 'graft' takes over the functions of non-working kidneys. Before receiving a kidney transplant, the patient must undergo a detailed medical evaluation. This evaluation is done with the objective to determine whether the patient would benefit from a transplant and can withstand the surgery, graft rejection, medications, etc.

The transplantation is carried out under the supervision of a transplant team. It includes a transplant surgeon, a transplant nephrologist, nurses, an anesthesiologist, dietician and a psychiatrist.

Matching of Donor and Recipients

The kidney to be replaced may either come from a deceased organ donor or a living donor. The potential recipient for the donor kidney is screened for compatibility of both of them. It includes the blood type, body sizes of donor, a negative lymphocytotoxic cross match and the number of HLA antigens common between the donor and recipient based on tissue typing.

Living Donor Nephrectomy
The medically fit prospective donor is evaluated and assessed for the anatomical features of kidney. Once this is done, nephrectomy (*i.e.*, surgical removal of kidney) is safely performed. It is done either by an open surgery or by laparoscopic approach.



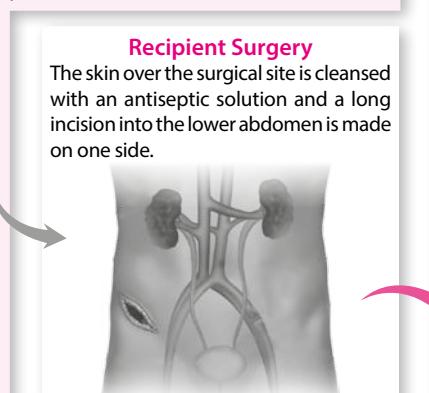
Preparation for Surgery of Recipient

An intravenous line is inserted in patient's arm or hand to supply medicines and catheters are put in neck and wrist to monitor the status of heart and blood pressure. Another urinary catheter is inserted into the bladder.

After the placement of central and arterial lines and induction of anaesthesia, the recipient is prepared for surgery (draped and positioned on the operating table, lying on back). A tube is inserted through the mouth into the lungs. This tube is attached to a ventilator that allows patient to breath during the procedure.

Recipient Surgery

The skin over the surgical site is cleansed with an antiseptic solution and a long incision into the lower abdomen is made on one side.

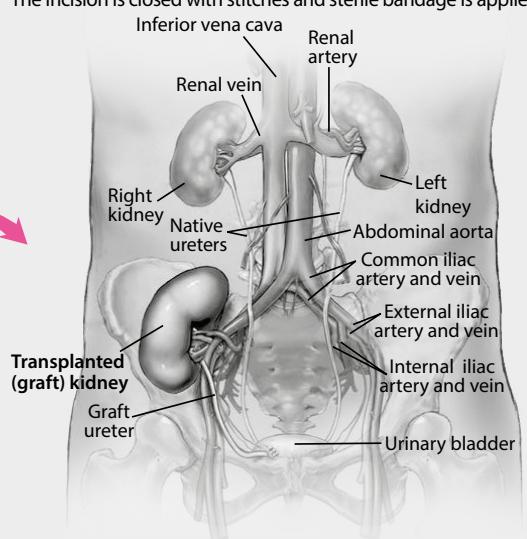


Post-Kidney Transplantation

After surgery, complications such as infection, blockage of blood vessels, bleeding, leakage or blockage of urine in ureter, etc., may occur. There is also a probability of kidney being rejected by the recipient as the patient's immune system reacts to the new foreign organ. For the survival of transplanted organ, immunosuppressants are given to trick the immune system. These medications do have serious side effects, therefore, everyone is not suitable for kidney transplantation.

Transplantation

The surgeon inspects the donor kidney and implants it into the recipient's abdomen. A right donor kidney will be implanted on the left side and vice versa. This allows the easy access to ureter for connection to bladder. The renal artery and vein of donor kidney are joined to the external iliac artery and vein and flow of blood through them is checked for bleeding at suture lines. The incision is closed with stitches and sterile bandage is applied.

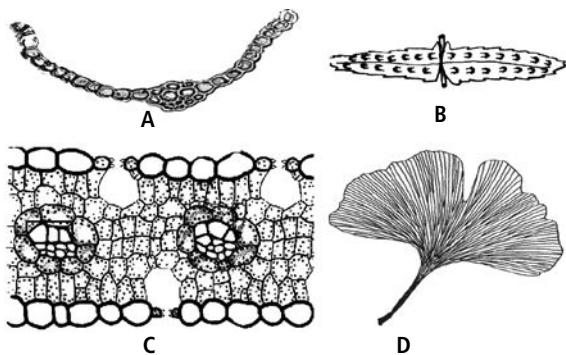


BIOLOGY OLYMPIAD PROBLEMS

1. In a lung cancer cell line, it is observed that a single point mutation (cysteine to phenylalanine) makes a protein defective in phosphorylation function. The loss of function is most likely due to
- increase in solubility of the protein in aqueous environment
 - alteration of protein conformation essential for protein-protein interaction
 - increase in the net charge of the protein leading to loss of active site
 - decrease in hydrophobic interactions of the protein with other proteins

(INBO 2017)

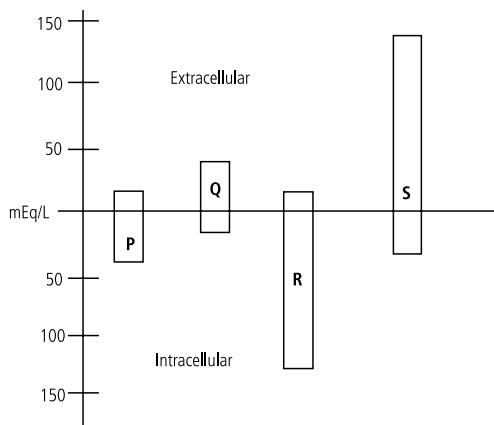
2. Diagrams A – D show the external or internal structures of leaves from different groups of plants. Match these diagrams with the plants described by statements I - IV.



- The sexual reproductive structures are formed on an independent non-dominant plant body.
 - Plants in this group have leaves with a haploid number of chromosomes.
 - Plants in this group are seed-bearing and amongst the earliest evolved extant trees.
 - The megagametophytes develop within enclosed ovules.
- I-B, II-A, III-D, IV-C
 - I-B, II-D, III-C, IV-A
 - I-C, II-A, III-B, IV-D
 - I-D, II-B, III-A, IV-C

(INBO 2017)

3. Concentrations of cations and anions present in intracellular and extracellular fluids of human body are depicted in the graph.



P, Q, R and S respectively are

- K^+ , Na^+ , Cl^- and organic anions
- proteins, bicarbonates, K^+ and Na^+
- Mg^{++} , proteins, bicarbonates and Na^+
- Ca^{++} , lactate, K^+ and Cl^- .

(INBO 2017)

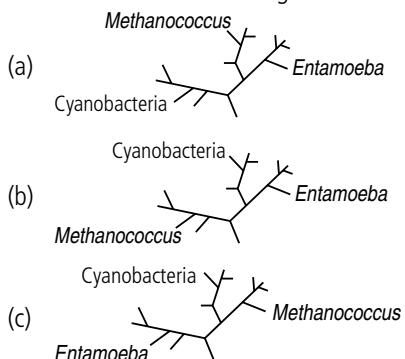
4. The bird like features of *Archaeopteryx*, the missing link between reptiles and birds are
- jaws modified into beaks
 - jaws bearing teeth
 - exoskeleton of feathers
 - spongy bones
 - many tail vertebrae
- (i), (iii) and (iv)
 - (i), (ii) and (v)
 - (i) and (iii) only
 - (ii) and (iii) only.

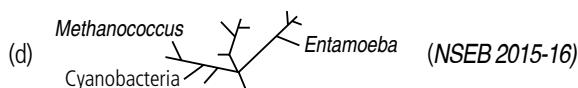
(NSEB 2015 - 16)

5. Respiration differs from photorespiration as the latter :
- takes place only during day and within the chloroplast
 - yields less ATP
 - utilises ATP
 - occurs in peroxisomes.

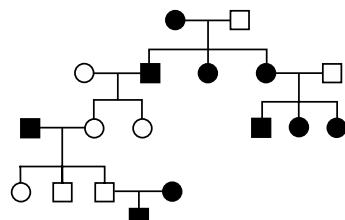
(NSEB 2015 - 16)

6. The three-domain phylogenetic classification of life is based on differences in 16S rRNA genes. It is correctly depicted in



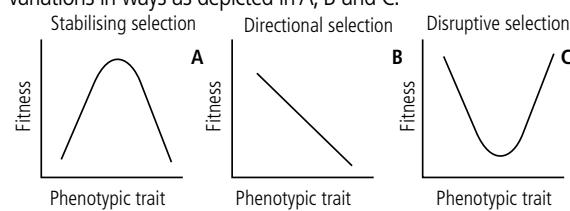


7. Study the following pedigree. The transmission of the trait indicates

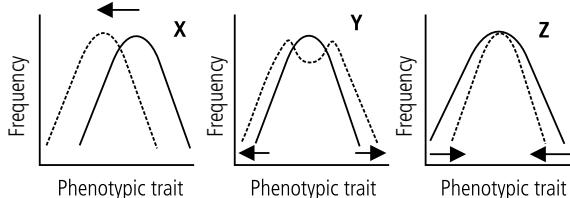


- (a) X-linked inheritance (b) autosomal dominance
 (c) autosomal recessive type (d) mitochondrial inheritance. (NSEB 2015 - 16)

8. Natural selection can act on characters with quantitative variations in ways as depicted in A, B and C.



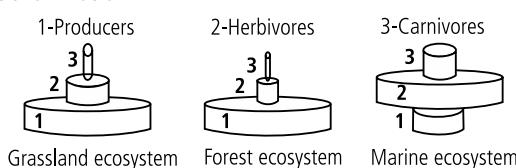
This can lead to the results depicted in the graphs X, Y and Z.



The bold lines show the distribution of phenotypes in the population before and the broken lines show the effect of the selection. The changes in the phenotypic traits observed in X, Y, Z are respectively due to:

- (a) A, B and C (b) C, A and B
 (c) B, C and A (d) C, B and A. (INBO 2015)

9. Typical pyramids of biomass (g/m^2) of three different ecosystems are shown below.



In a marine ecosystem, an inverted pyramid is observed. The possible reason for this is

- (a) the dominant producers in a marine ecosystem are bacteria and protists which divide rapidly to generate sufficient biomass to support herbivores

- (b) in a marine ecosystem, the plants are represented by algae in the inter-tidal area which constitute less biomass compared to the other trophic levels
 (c) unlike terrestrial ecosystems where carnivores regulate the population of herbivores resulting in higher producer biomass, there is no predatory control in a marine ecosystem
 (d) in a marine ecosystem, the herbivore population is very high hence the producer biomass remains low.

(INBO 2015)

10. A blind cave fish can detect the approach of another aquatic inhabitant predominantly by

- (a) olfactory sense organs
 (b) lateral-line sense organs
 (c) gustatory sense organs
 (d) thermosensory organs.

(INBO 2014)

SOLUTIONS

1. (b) : A single point mutation in a nucleotide causes change in an amino acid of protein or enzyme, that may lead to its partial or total unfolding or conformational change. This may result in loss of its function and ultimately to a diseased condition. Therefore, any point mutation leading to replacement of cysteine to phenylalanine results in loss of conformation of protein as cysteine residues often form disulphide bonds between them (due to oxidation) which helps in folding of protein sub-units and acquiring a specific conformation. This specific conformation is essential for binding of substrate or for interaction with other proteins. Similarly, single point mutation in lung cancer cell line makes the protein defective in phosphorylation function due to the alteration in its conformation.

2. (a) : The figure A represents the transverse section of a leaf of *Funaria* (moss), a bryophyte. Leaves of *Funaria* have multilayered midrib and single layered wings. In mosses, the predominant plant body, i.e., protonema (young stage) or leafy gametophore (adult stage) is haploid. Therefore, the leaves contain haploid (n) number of chromosomes. The figure B represents the leaf of a fern bearing sporangia on them. The fern belonging to pteridophytes has a well differentiated sporophytic plant body that is not dependent on gametophyte. The leaves in ferns are called sporophylls as they bear reproductive structures called sporangia

ANSWERS

WHO AM I ...

- | | |
|----------------------------------|--------|
| 1. Auxin | Pg. 15 |
| 2. Florigen | Pg. 18 |
| 3. <i>Fasciola</i> (Liver fluke) | Pg. 28 |
| 4. Earthworm | Pg. 35 |

containing spores in them. The spores may be similar or dissimilar in nature. The spore, on germination gives rise to independent and non-dominant gametophytic generation called prothallus. The prothallus bears both types of sex organs ; male antheridia and female archegonia. The figure C represents an angiospermic isobilateral leaf where the main plant body is a sporophyte while the gametophytic stage is reduced and dependent upon sporophyte. The megagametophytes, i.e., embryo sac containing egg remain enclosed within ovules or megasporangium. Figure D represents the leaf of a gymnospermic plant *Ginkgo* which is one of the oldest trees evolved and still living. It has short branches with fan-shaped leaves. The plant body is sporophytic and bears seeds which are naked (not enclosed in ovules).

3. (b) : The intracellular fluid (cytoplasm) comprises mostly of water, dissolved ions as K^+ , Mg^{2+} and water soluble molecules such as proteins, amino acids and other organic molecules like nucleic acids. On the contrary, extracellular fluid comprises of mainly cations and anions, e.g., high concentrations of Na^+ , Cl^- , HCO_3^- (bicarbonates). Therefore, from the given graph of various ions in extra and intracellular fluid, P, Q, R and S can be identified as proteins, HCO_3^- , K^+ and Na^+ respectively.
4. (c) : *Archaeopteryx* is a fossil organism that acts as a missing link between reptiles and birds. The avian or bird like characters of *Archaeopteryx* includes exoskeleton of feathers, jaws modified into a beak, fore limbs modified into wings etc. The reptilian characters include jaw with teeth, presence of caudal vertebrae, weak sternum etc.
5. (d) : Photorespiration is the light dependent process of oxygenation of ribulose biphosphate (RuBP) that releases CO_2 . This can occur during day as well as during night. Rate of photorespiration increases with increase in light intensity, concentration of O_2 , temperature etc. Photorespiration takes place in chloroplast in association with peroxisome and mitochondrion. This process does not produce ATP rather utilises ATPs which are also utilised during respiration (glycolysis).
6. (a) : The three-domain phylogenetic classification introduced by Carl Woese was based on the evolutionary relationships determined by the comparison of DNA, mRNA and rRNA sequences. The 16S rRNA gene sequences are specific and present ubiquitously in all bacteria. Therefore, these sequences are used as molecular markers. Based upon these sequences of oligonucleotides in 16S rRNA, it is concluded that archaea, bacteria and eukarya have evolved from a universal ancestor. However, bacteria evolved separately from eukarya which is more closely related to archaea than the bacteria. In the given cladogram,

cyanobacteria represents domain bacteria, *Methanococcus* represents archaea and *Entamoeba* represents eukarya.

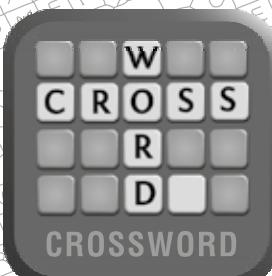
7. (d) : The given pedigree analysis shows the maternal inheritance pattern or mitochondrial inheritance. In this pattern, the mother with a mitochondrial gene mutation / disease passes this trait to all her children. Only the offsprings, where mother is not affected are normal, rest all of them show diseased condition.
8. (c) : The changes in the phenotypic traits as observed from the given graphs A, B and C conclude that, X shows directional selection in which a population changes towards one particular direction, Y shows changes in selection of two peaks leading to development of two populations, i.e., disruptive selection and Z shows average selection reducing variations, i.e., stabilising selection.
9. (a) : The pyramid of biomass is upright for terrestrial habitats, e.g., grassland and forest ecosystem. However, it is either inverted or spindle shaped in aquatic habitats, e.g., marine ecosystem. It is because in aquatic habitats the biomass of a trophic level depends upon the reproductive potential and longevity of its members. The biomass of producers, i.e., phytoplankton may be smaller than that of herbivores, i.e., zooplankton which may or may not be less than that of carnivores, i.e., small and large fishes. The phytoplankton include a vast variety of photosynthetic bacteria, protists such as diatoms, dinoflagellates, blue-green algae, etc. Their biomass rises and declines and is sensitive to changes in surface temperature, climate change as well as predation by herbivores.
10. (b) : A blind cave fish can detect the approach of another aquatic organism with the help of its lateral line sense organs. The lateral line system is a sensory array made up of series of mechanoreceptors called neuromasts located at many places. These are used to detect movement, vibration and pressure gradients in the surrounding water, thus gains a sense of its own movement as well as the movement of predators or prey and even the stationary objects. Neuromasts bear hair bundles, having cilia that gets stimulated by water currents or pressure from a single direction.



MPP-6 CLASS XII ANSWER KEY

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

CROSS WORD



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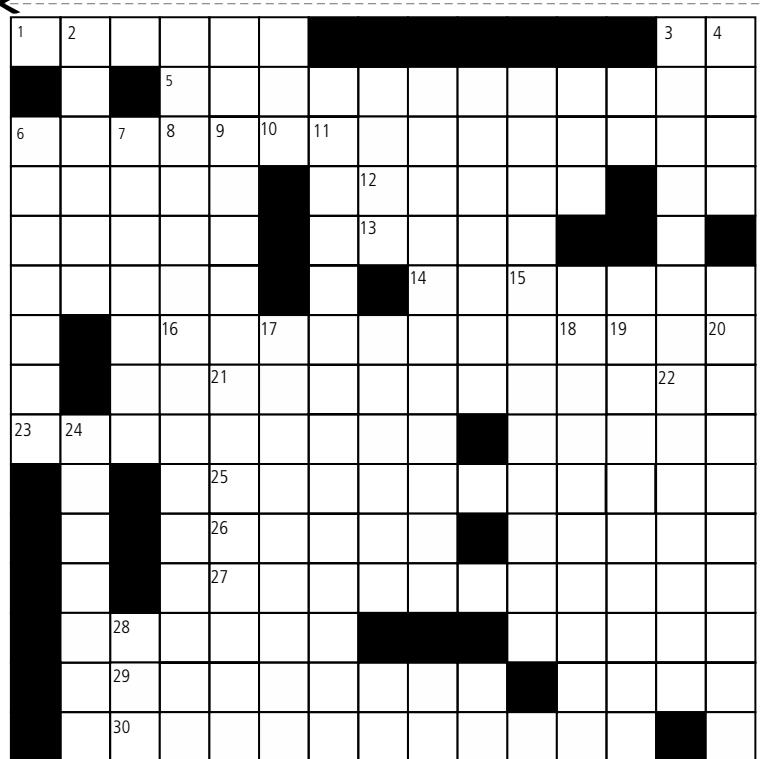
ACROSS

- A dry indehiscent fruit that develop from a single carpel and contains a single seed. (6)
- A type of microorganism which can survive in extremely nutrition deficient conditions. (12)
- The first commercial bioinsecticide produced by *Bacillus thuringiensis*. (8)
- The position occupied by a gene on a chromosome. (5)
- A trace mineral that significantly improves wound healing in humans. (4)
- An annelid that acts as sewage contamination. (7)
- The replication fork is the result of catalytic activity of this enzyme. (8)
- A muscle that helps in bending of limb by bringing the two parts of limb together. (6)
- An instrument used to cut thin sections of tissues for microscopic observations. (9)
- The absence of this mineral in water may delay the metamorphosis of axolotls. (6)
- The portion of plant having root system that is joined to a scion during grafting. (5)
- The balloon like outgrowth of parenchymatous cells, into the lumen of vessel. (6)
- The term used to describe all the plants living in a particular habitat, geographical region or time. (5)
- A phospholipid that contains choline and is abundant in the cell membrane of animals. (8)
- The vesicle like fragments formed from endoplasmic reticulum when cell is homogenised. (10)

DOWN

- A transparent layer of tissue, continuous with the sclera over the iris and lens. (6)
- A class of enzymes that catalyse the formation of covalent bonds between two compounds using energy. (6)
- A population of individuals belonging to same genetic stock but differing in vegetative characters to adapt to a specific environment. (4)
- Loosely arranged, colourless, parenchyma cells present in hydathode. (7)
- A protein present in the acrosome of sea urchin sperm that ensures the species specific fertilisation. (6)

Cut Here



- The substance carried by ductus choledochus. (4)
- One of the four classical signs of inflammation, that specify redness of the skin. (5)
- Small nucleotide sequences used to detect the presence of specific complementary sequences in nucleic acid sample. (5)
- A specialised structure in *Agaricus* where nuclear fission and meiosis occur. (8)
- A small, spongy, bilobed structure especially present at the narrow end of castor seed. (8)
- A geological period of palaeozoic era following ordovician period and extending to the beginning of devonian period. (8)
- The scientist who first plotted the action spectrum of photosynthesis. (9)
- The site where conversion of glucose into pyruvic acid takes place. (9)
- The resemblance of one organism to another as a means of protection from predators. (7)
- The first protein whose amino acids were sequenced by F. Sanger. (7)



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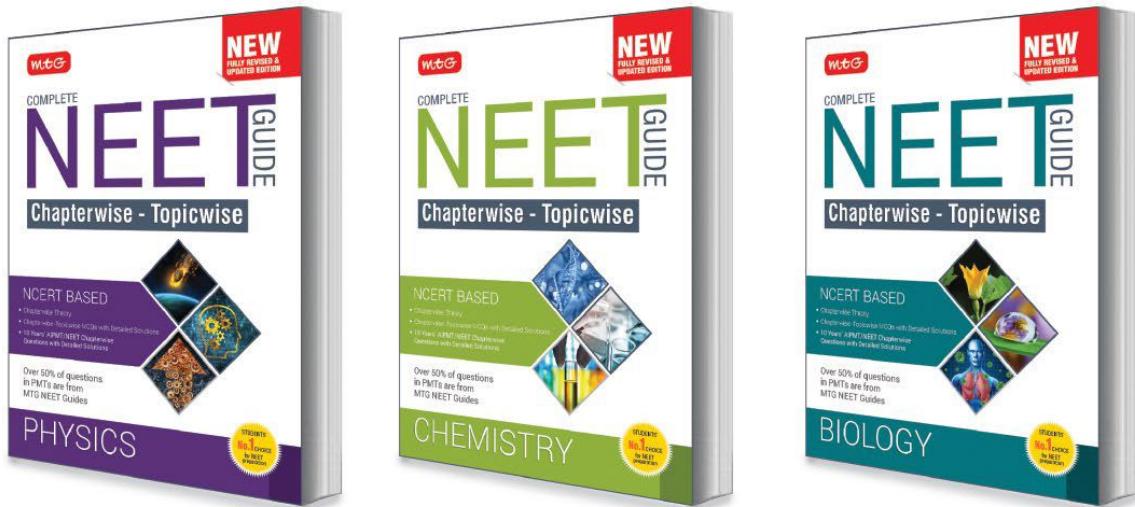


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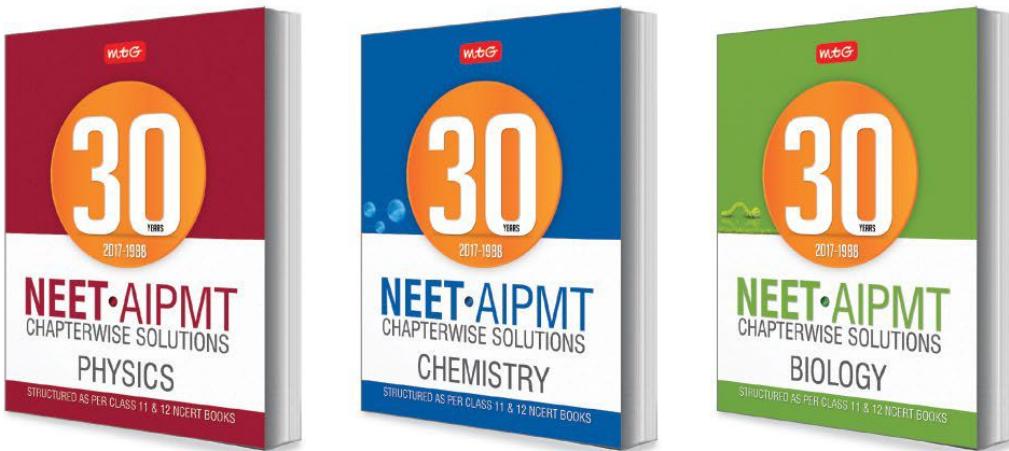
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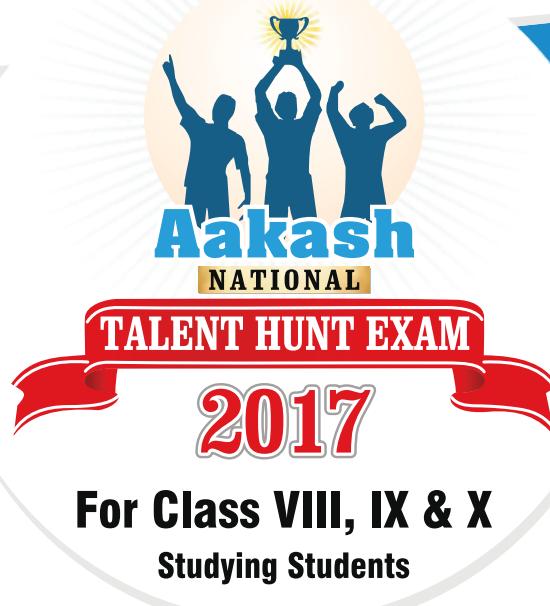
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