Maharashtra State Board
Biology
Sample Question Paper - 2
Academic Year: 2024-2025

General Instructions: The question paper is divided into four sections.

1. **Section A:** Q.No.1 contains Ten multiple-choice types of questions carrying One mark each. Q.No.2 contains Eight very short answer type of questions carrying One mark each.
2. **Section B:** Q.No.3 to Q.No.14 are Twelve short answer type questions carrying Two marks each. (Attempt any Eight).
3. **Section C:** Q.No.15 to Q.No.26 are Twelve short answer type questions carrying Three marks each. (Attempt any Eight).
4. **Section D:** Q.No.27 to Q.No.31 are Five Long answer-type questions carrying Four marks each. (Attempt any Three).
5. Use of Log table is allowed. Use of calculator is not allowed.
6. Figures to the right indicate full marks.
7. For each multiple-choice type question, it is mandatory to write the correct answer along with its alphabet. e.g., (a) ..... /(b) ..... /(c) ..... /(d) ..... ,etc. No mark(s) shall be given if ONLY the correct answer or the alphabet of the correct answer is written.
   Only the first attempt will be considered for evaluation.
8. Begin the answer of each section on a new page.

SECTION - A

Q1. Select and write the correct answer for the following multiple-choice type of questions:

1.1. Choose the correct alternative.

The muscular structure that separates the thoracic and abdominal cavity is _____.

1. Pleura
2. Diaphragm

3. Trachea
4. Epithelium

Solution

The muscular structure that separates the thoracic and abdominal cavity is **diaphragm**.

1.2. Which of the following requires maximum energy?

1. Secondary consumer
2. Decomposer
3. Primary consumer
4. **Primary producer**

Solution

Primary producer

1.3. The innermost layer of human eye is _____.

1. Choroid
2. Cornea
3. Sclero
4. **Retina**

Solution

The innermost layer of human eye is **Retina**.

1.4. Which of the following is the correct recognition sequence of restriction enzyme Eco RI?

1. 5' _ _ _ A _ G ↓ _ C _ T _ _ _ 3'

   3' _ _ _ T _ C _ ↑ _ G _ A _ _ _ 5'
2. 5' _ _ _ G _ _ G _ A _ T _ C _ C _ _ _ 3'

   3' _ _ _ C _ C _ T _ A _ G _ _ G _ _ _ 5'
3. 5' _ _ G _ T _ C _ ↓ _ G _ A _ C _ _ 3'

3' _ _ C _ A _ G _ ↑ _ C _ T _ G _ _ 5'

4. 5' _ _ _ G _ ↓ _ A _ A _ T _ T _ C _ _ _ 3'

   3' _ _ _ C _ T _ T _ A _ A _ ↑ _ G _ _ _ 5'

Solution

5' _ _ _ G _ ↓ _ A _ A _ T _ T _ C _ _ _ 3'

3' _ _ _ C _ T _ T _ A _ A _ ↑ _ G _ _ _ 5'

1.5. The earliest geological time period among the following is_____.

1. Cambrian
2. Permian
3. Jurassic
4. Quaternary

Solution

The earliest geological time period among the following is **Cambrian**.

1.6. Abscission means _____.

1. Yellowing of leaves
2. Death of tissues of leaves
3. Premature fall of flowers
4. Non-green patches on the leaves

Solution

Abscission means **Premature fall of flowers**.

1.7. Which statement is correct with respect to the food chain?

1. Every component of the food chain forms a trophic level.
2. Inter-relation between different food chains is known as a food web.
3. All the chains formed by nutritional relations are used to understand energy flow.
4. All of the above.

Solution

All of the above.

1.8. _____ is the largest part of the brain.

1. Cerebrum
2. Cerebellum
3. Cranial nerve
4. Spinal nerve
5. medulla oblongata

Solution

Cerebrum is the largest part of the brain.

1.9. The nucleic acid synthesis takes place in _____.

1. 3' - 5' direction
2. 5'-3' direction
3. Both ways
4. Any direction

Solution

The nucleic acid synthesis takes place in **5' - 3' direction**.

1.10. Genes involved in cancer are _____.

1. Tumour genes
2. Regulator genes
3. Oncogenes
4. Complementary genes

Solution

Genes involved in cancer are **Oncogenes**.

Q2. Answer the following questions:

2.1. Which hormone is responsible for fruit ripening?

Solution

Ethylene is responsible for fruit ripening.

2.2. Give advantages of vernalization.

Solution

i. Crop plants by shortening the juvenile phase attain early flowering.

ii. Crops can be cultivated in regions where they do not grow naturally.

2.3. Name any two X-Linked recessive disorders.

Solution

1. **Colour blindness:** A Person is unable to distinguish between red and green colours.
2. **Haemophilia (Bleeder's disease):** Blood fails to clot or coagulates very slowly.

2.4. Which vector is mostly used in rDNA technology in plants?

Solution

pBR 322 is mostly used in rDNA technology in plants.

2.5. Name any two biodiversity hot spots in India.

Name any two "hotspot" regions in our country.

Name any two hotspots in India.

Solution 1

a. The Western Ghats

b. Sundaland

c. Indo Burma

d. Eastern Himalayas

Solution 2

The two biodiversity hotspots in India are:

1. **Western Ghats:** The Western Ghats, which stretch over Maharashtra, Karnataka, Kerala, Tamil Nadu, and Goa, are known for their abundant biodiversity and high levels of endemism.
2. **The Indo-Burma Region:** This region includes sections of northeastern India, Myanmar, Thailand, Laos, Vietnam, and southern China. It is known for its diverse habitats and distinctive species.

2.6. Give statement of the law of dominance.

Solution

"When two homozygous individuals with one or more sets of contrasting characters are crossed, the alleles (characters) that appear in F_1 are dominant and those which do not appear in F_1 are recessive".

2.7. Define Alleles.

Solution

The two or more alternative forms of a given gene (factor) are called alleles of each other.

2.8. Name two better yielding varieties of rice developed in India.

Solution

Jaya, Padma, Ratna.

SECTION – B

Attempt any EIGHT of the following questions:

Q3. Write short note on Gene pool.

Solution

i. The total genetic information encoded in sum total of genes in a Mendelian population is called gene pool.

ii. Simply, gene pool means the total number of genes of all individuals in a population.

iii. It contains both expressed genes and non-expressed genes.

Q4. Short answer question

Give a reason - Injury to medulla oblongata may prove fatal.

Solution

i. The medulla oblongata is a part of the brain stem.

ii. It controls involuntary vital functions like heartbeat, respiration, vasomotor activities, and peristalsis.

iii. It also controls non-vital reflex activities like coughing, sneezing, swallowing, vomiting, yawning, etc.

iv. Thus, damage or injury to medulla oblongata may disrupt these vital functions. Therefore, injury to medulla oblongata may prove fatal.

Q5. Give the economic importance of fishery.

Solution

Economic importance of fishes:

1. Fishes are caught, processed, raised, and marketed under fisheries. It provides good job opportunities and self-employment.
2. Culturing fishes on a large scale in ponds, lakes, and reservoirs boost the productivity and economy of the nation.
3. Fishes are a source of nutritious food as they are rich in proteins, vitamins (A, D, and K), carbohydrates, fats, and minerals.
4. They also yield a number of by-products that hold commercial value.
5. The by-products obtained from fishes include fish oil, fish meal, fertilizers, fish guano, fish glue, and isinglass, which are widely used in paints, soaps, oils, and medicines.
6. Prawns and lobsters have a market value all over the world.

Q6. Complete the chart:

S. No.	Gland	Hormone produced	Effect
(i)	Hypothalamus	_____	Acts on kidneys, stimulates reabsorption of water.

(ii)	_____	Somatotropin	Stimulates growth and development of all tissues
(iii)	Thyroid gland	_____	Regulates basal metabolic rate.
(iv)	_____	Thymosin	Maturation of T-lymphocytes.

Solution

S. No.	Gland	Hormone produced	Effect
(i)	Hypothalamus	**ADH - Anti Diuretic Hormone**	Acts on kidneys, stimulates reabsorption of water.
(ii)	**Anterior Pituitary gland**	Somatotropin	Stimulates growth and development of all tissues
(iii)	Thyroid gland	**Thyroxine**	Regulates basal metabolic rate.
(iv)	**Thymus gland**	Thymosin	Maturation of T-lymphocytes.

Q7. Write two applications of Auxins.

Solution

i. In most of the higher plants, growing apical bud inhibits the growth of lateral buds. This is called as apical dominance.

ii. Auxin stimulates growth of stem and root.

Q8. Short Answer Question:

Enlist the characteristics of genetic code.

Describe any three characteristics of the Genetic code.

Enlist the four characteristics of the genetic code.

Solution

Genetic code of DNA has certain following characteristics:

i. **Genetic code is a triplet code:**
The sequence of three consecutive bases constitutes a codon, which specifies one particular amino acid. The base sequence in a codon is always in 5′ → 3′ direction. In every living organism, genetic code is a triplet code.

ii. **Genetic code has distinct polarity:**
Genetic code shows definite polarity i.e. direction. It is always read in 5′ → 3′ direction and not in 3′ → 5′ direction. Otherwise, the message will change e.g. 5′ AUG 3′

iii. **Genetic code is non-overlapping:**
Code is non-overlapping i.e. every single base is a part of only one codon. Adjacent codons do not overlap.

iv. **Genetic code is commaless:**
There is no gap or punctuation mark between successive/consecutive codons.

v. **Genetic code has degeneracy:**
Usually, the single amino acid is encoded by a single codon. However, some amino acids are encoded by more than one codon. e.g. Cysteine has two codons, while isoleucine has three codons. This is called the degeneracy of the code. Degeneracy of the code is explained by the Wobble hypothesis. Here, the first two bases in different codons are identical but the third one varies.

vi. **Genetic code is universal:**
In most living organisms, the specific codon specifies the same amino acid. e.g. Codon AUG always specifies the amino acid methionine.

vii. **Genetic code is non-ambiguous:**
The specific amino acid is encoded by a particular codon. Alternatively, two different amino acids will never be encoded by the same codon.

viii. **Initiation codon and termination codon:**
AUG is always an initiation codon in any and every mRNA. AUG codes for the amino acid methionine. Out of 64 codons, three codons viz. UAA, UAG, and UGA are termination codons that terminate/ stop the process of elongation of a polypeptide chain, as they do not code for any amino acid.

ix. **Codon and anticodon:**
A codon is a part of DNA e.g. AUG is codon. It is always represented as 5′ AUG 3′. Anticodon is a part of tRNA. It is always represented as 3′UAC 5′.

Q9. What are X-linked genes?

Solution

The genes which are present on the non-homologous region of X-chromosome are known as X-linked genes.

Q10. Short answer question.

Write a note on IVF.

Solution

IVF (In-vitro Fertilization):

It is a process of fertilization where an egg is combined with sperm outside the body in a test tube or glass plate to form a zygote under simulated conditions in the laboratory. The zygote or early embryos (with up to 8 blastomeres) could be then transferred into the fallopian tube for further development.

Q11. Give examples of X-linked traits.

Solution

Examples of X-linked traits are haemophilia, red-green colour blindness, myopia (near sightedness), Ichthyosis.

Q12.

12.1. Define 'Ecological succession'.

Solution

The gradual and predictable changes in the species composition of a given area are called ecological succession.

12.2. Define Stratification.

Solution

Vertical distribution of different species of plants and animals occupying different levels, is known as stratification.

Q13. Name two restriction enzymes used in PCR.

Solution

i. EcoRI

ii. Hind III

Q14. Give the main features of mutation theory.

Solution

Mutation theory was proposed by Hugo de Vries in 1901.

The main features of mutation theory are:

1. Mutations are large, sudden, random and discontinuous variations in a population.
2. These changes are inheritable and may not be directional.
3. Mutations provide the raw material for organic evolution.
4. Mutation may be useful or harmful. Useful mutations are selected by nature.
5. Accumulation of these mutations over a period of time leads to the origin and establishment of new species.
6. Harmful mutation may persist or get eliminated by nature.

SECTION – C

Attempt any EIGHT of the following questions:

Q15.

15.1. What are transgenic animals?

Solution

Animals that have their DNA manipulated to possess and express foreign gene are called transgenic animals. Examples of transgenic animals are mice, rats, rabbits, pigs, sheep, cows and fish.

15.2. Explain any four ways in which such animals can be beneficial for humans.

Solution

Uses of transgenic animals for humans are:

i. To study gene regulation, its effect on the normal functions of the body and its development.

ii. Study of genes, which are responsible for diseases in human and their treatment, e.g. cancer.

iii. Useful biological products can be produced by introducing the portion of DNA, which codes for a particular product into transgenic animals.

iv. Transgenic mice are used to test the safety of vaccines before being used in humans.

Q16. Write short note on Neanderthal man.

Solution

i. J.K. Fuhlrott (1856) collected the Neanderthal man fossil from the Neanderthal Valley in Germany.

ii. They existed between 1,00,000 and 40,000 years ago during the late Pleistocene.

iii. The cranial capacity was 1400 cc.

iv. There was Heavy built, short prominant, brow ridges, low forehead, deep jaws, chin absent, outwardly curved thigh bones.

v. There was no Chin.

vi. the thigh bones are bent outward.

Q17. Short answer question

List the properties of the nerve fibres.

Solution

i. **Excitability/Irritability:** Nerve fibres have polarized membranes, thus they have the ability to perceive stimulus and enter into a state of activity.

ii. **Conductivity:** It is the ability of the nerve to transmit impulses along the whole length of the axon.

iii. **Stimulus:** It is any detectable, physical, chemical, electrical change in the external or internal environment which brings about excitation in a nerve/muscle/organ/ organism. A stimulus must have a minimum intensity called threshold stimulus, in order to be effective. The subliminal (weak) stimulus will have no effect while the

supraliminal (strong) stimulus will produce the same degree of impulse as the threshold stimulus.

iv. **Summation effect**: A single subliminal stimulus will have no effect but when many such weak stimuli are given again and again, they may produce an impulse due to summation of effects.

v. **All or none law**: The nerve will either conduct the impulse along its entire length or will not conduct the impulse at all. This occurs in the case of a subliminal or weak stimulus.

vi. **Refractory period**: It is the time interval (about a millisecond) during which a nerve fails to respond to a second stimulus even if it is strong.

vii. **Synaptic delay:** The impulse takes about 0.3 to 0.5 milliseconds to cross a synapse. It is required for the release of neurotransmitters from the axon terminal and excitation in the dendron of the next neuron.

viii. **Synaptic fatigue**: The transmission of nerve impulses across the synapse stops temporarily due to the depletion of the neurotransmitter.

ix. **Velocity**: The rate of transmission of impulse is higher in long and thick nerves. It is higher in homeotherms than in poikilotherms. The velocity of transmission is higher in voluntary fibres (100 - 120 m/s in man) as compared to autonomic or involuntary nerves (10-20 m/s). In medullated nerve fibre, the velocity of transmission is higher as an impulse has to jump from one node of Ranvier to the next.

Q18. A normal visioned woman whose father is colourblind married a normal visioned man. What are the probabilities of her sons or daughters to be colourblind? Explain with the help of Punnett square.

Solution

The genotype of woman - X^CX (Carrier)

The genotype of man - X^CY (Normal)

Parents	Carrier woman	×	Normal man
Genotype	X^CX	×	X^CY
Gametes	X^CX		X^CY

By Punnett's square :

♂ / ♀	X^C	Y
X^C	X^CX^C colourblind female	X^CY normal male
X	X^CX carrier female	X^CY colourblind male

Q19. State properties of hormones.

Solution

i. They act as chemical messengers and are effective in very low concentration.

ii. Hormones can function as regulators that inhibit or stimulate or modify specific processess.

iii. Some hormones interact with receptors present on plasma membrane of target cells where as some enter the nucleus to interact with genes.

iv. Hypersecretion or Hyposecretion of hormones leads to various disorders.

v. These are metabolised after their function. Thus, cannot be reused.

vi. Hormone secretion is regulated by positive or negative feedback mechanism.

Q20.

20.1. What is nitrification?

Solution

Nitrification is the process of conversion of ammonia into nitrites.

20.2. Name any two nitrifying bacteria in soil.

Solution

First, a soil bacteria convert ammonia into nitrogen-di-oxide (nitrite) eg. Nitrosomonas, Nitrosococcus, etc.

$$2\,NH_3 + 3\,O_2 \xrightarrow[\text{Nitrosococcus}]{\text{Nitrosomonas}} 2\,HNO_2 + 2\,H_2O$$

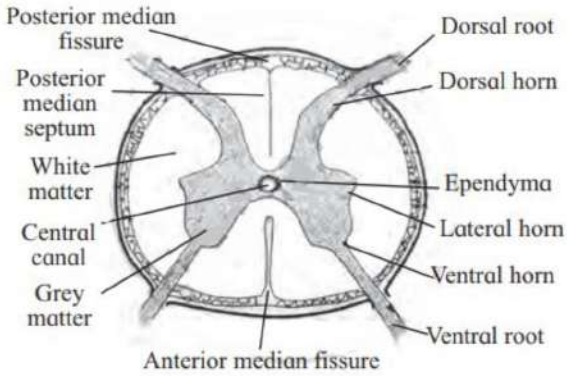
Then another type of soil bacterium called Nitrobacter adds a third oxygen atom to create nitrate.

$$2\,HNO_2 + O_2 \xrightarrow{\text{Nitrobacter}} 2\,HNO_3$$

Q21. Sketch and label T. S. of Spinal cord.

Solution

T. S. of Spinal cord -



Q22. Observe the given sequence of nitrogenous bases on a DNA fragments and answer the following questions:

5' - CAGAATTCTTA - 3'
3' - GTCTTAAGAAT - 5'

i. **Name a restriction enzyme which can recognise this DNA sequence.**

ii. **Write the sequence after digestion.**

iii. **Why are the ends generated after digestion called sticky ends?**

Solution

(i) EcoRI

(ii)

5'CAG3'	5'AATTCTTA3'
3'GTCTTAA 5'	3'GAAT5'

(iii) Because they create hydrogen connections with their complementary cut sections, these are known as sticky ends.

Q23. Explain the process of blood clotting.

Solution

Blood clotting is also known as blood coagulation. It is a process in which the Liquid blood changes into a semi-solid form known as a clot.

The process of blood clotting prevents the excessive loss of blood.

The process of blood clotting occurs in a series of following steps:

1. The injured tissue cells and the platelets (thrombocytes) release thromboplastin.
2. Thromboplastin helps in the formation of the enzyme prothrombinase in the presence of Ca^{2+} ions.
3. Prothombinose inactivates heparin (anticoagulant) and also converts inactive prothrombin into active thrombin.
4. Thrombin converts soluble fibrinogen into insoluble fibrin in the presence of Ca^{2+} ions.
5. Fibrin forms a mesh or network in which platelets (thrombocytes) and other blood cells get trapped to form the clot.

Q24. How the resistance in crops can be developed?

Solution

i. Development of morphological characters like hairy leaves in cotton and wheat develop vector resistance from jassids and cereal leaf beetle, respectively.

ii. Solid stem in wheat leads to resistance to stem borers.

iii. Biochemical characters provide resistance to insects and pests. For example, the high aspartic acid, and low nitrogen and sugar content in maize, lead to resistance against stem borers.

iv. The nectar-less cotton having smooth leaves develop resistance against bollworms.

Q25. What are long-day plants (LDP)? Give two examples.

Solution

i. Plants that flower usually during summer are called long-day plants. They require a longer duration of light than the critical photoperiod, for flowering.

ii. They are called short-night plants as they require a short dark period.

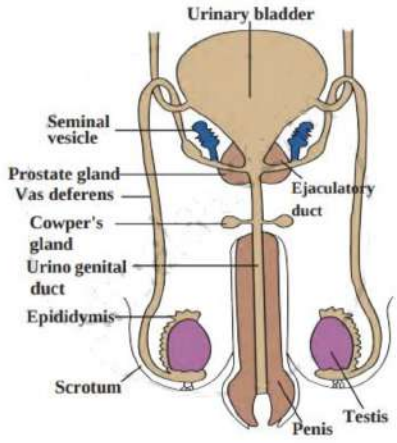
iii. When the long dark period is interrupted by a brief flash of light, LD plants can flower e.g. pea, radish, sugar beat,

iv. Example: cabbage, spinach, wheat, poppy, etc.

Q26.

26.1. Sketch and label Human Male Reproductive System.

Solution



Human Male Reproductive System

26.2. Write briefly about the Testis.

Solution

The testis is externally covered by a collagenous connective tissue layer called the tunica albuginea. Outer to it is an incomplete peritoneal covering called tunica vaginalis, and inner to it is tunica vasculosa, a thin membranous and vascular layer. Fibers from tunica albuginea divide each testis into about 200-300 testicular lobules. Each with 1-4 highly coiled seminiferous tubules. Each seminiferous tubule is internally lined by cuboidal germinal epithelial cells (spermatogonia) and few large pyramidal cells called Sertoli or sustentacular cells. The germinal epithelial cells undergo gametogenesis to form spermatozoa. Sertoli cells provide nutrition to the developing sperms. Various stages of spermatogenesis can be seen in the

seminiferous tubules. The inner most spermatogonial cell (2n), primary spermatocyte (2n), secondary spermatocyte (n), spermatids (n) and sperms (n). The Interstitial or Leydig's cells lie in between the seminiferous tubules. They secrete the male hormone androgen or testosterone.

SECTION – D

Attempt any THREE of the following questions:

Q27. Describe hormonal control in various phases of the menstrual cycle.

Describe menstrual cycle in human female.

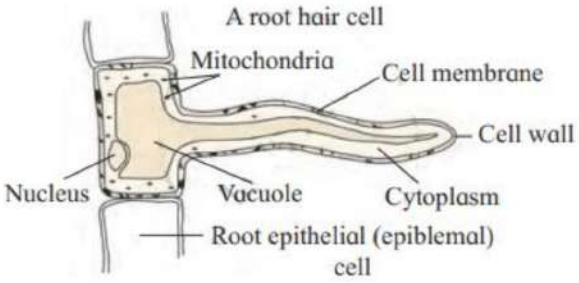
Solution

1. **Menstrual phase:** Day 1st - 5th day.
   The endometrium of the uterus breaks down under the effect of prostaglandins released due to decreased levels of progesterone and estrogen.
2. **Proliferative phase/Follicular phase/Post menstrual phase:** Day 6th - 13th day.
   A few secondary follicles proceed to develop but usually one of them develops into a Graafian follicle (mature follicle). The other secondary follicles degenerate. This process of degeneration is called atresia.
   Developing secondary follicles secrete the hormone estrogen. The stimulation for the proliferation of new follicles is influenced by GnRH which stimulates the release of FSH.
3. **Ovulatory phase:** It is the shortest phase of the menstrual cycle. It involves rupturing of the mature Graafian follicle and the release of an ovum (secondary oocyte) into the pelvic cavity; usually on the 14th day of the menstrual cycle. Rapid secretion of LH by a positive feedback mechanism causes the mature follicle to rupture.
4. **Secretory phase/Luteal phase:** Day 15th to 28th day.
   After the release of the secondary oocyte, the remaining tissue of the Graafian follicle transforms into corpus luteum under the effect of LH. The Corpus luteum begins to secrete progesterone and estrogens. The ovulated egg may get fertilized within 24 hours. However, in the absence of fertilization, the corpus luteum can survive for only two weeks and then degenerate into a white scar called corpus Albicans.

The corpus luteum releases progesterone, a small amount of estrogens and inhibin. Under the influence of these hormones, the endometrial glands grow, become coiled and start uterine secretions. The endometrium becomes more vascularized and thickens up to 8-10 mm. Inhibin stops the secretion of FSH.

Q28. Describe structure of root hair.

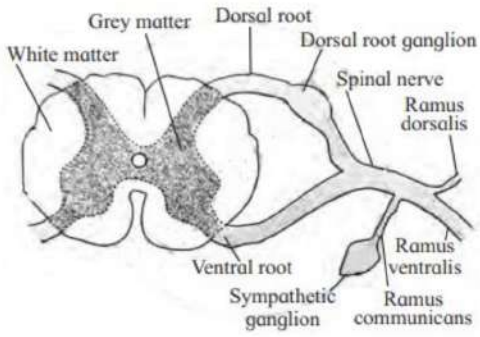
Solution



1. Root hair is a cytoplasmic extension (prolongation) of epiblema cell.
2. Each root hair may be approximately 1 to 10 mm long and tube-like structure.
3. It is colourless, unbranched, short-lived (ephemeral), and very delicate.
4. It has a large central vacuole surrounded by a thin film of cytoplasm, plasma membrane, and thin cell wall, which is two-layered.
5. Outer layer is composed of pectin and the inner layer is made up of cellulose.
6. Cell wall of a root hair is freely permeable but the plasma membrane is selectively permeable.

Q29. Explain the formation of a typical spinal nerve with the help of a neat labelled diagram.

Solution



Formation of Spinal Nerve

i. All spinal nerves are of the mixed type i.e. they have some nerve fibre as sensory and some motor.

ii. Each spinal nerve is formed inside the neural canal of vertebral column by two roots - the posterior or dorsal sensory root and anterior or ventral root.

iii. Anterior root receives the sensory nerve from the dorsal root ganglion (cell bodies of sensory neurons are located in the ganglion), while the anterior/ventral root gives out the motor nerve.

iv. The dorsal sensory and the ventral motor nerves together form the mixed spinal nerve.

v. It emerges out from both sides of the spinal cord through the intervertebral foramen.

vi. As soon as it emerges out of vertebral column, it shows three branches viz.

a. **Ramus dorsalis:** From skin and to muscles of dorsal side.

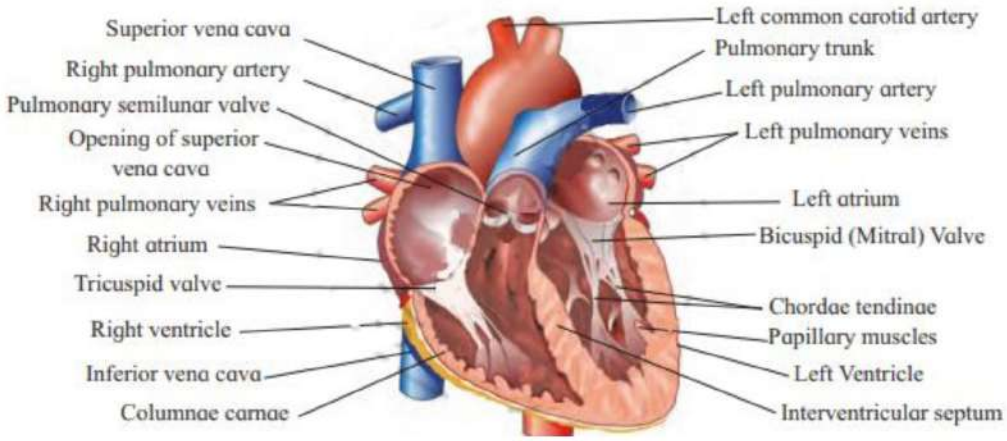
b. **Ramus ventralis:** The largest of the three supplies the organs and muscles on lateral and anterior side.

c. **Ramus communicans:** The smallest of the three and given out from 1st thoracic upto 3rd lumbar (L3) spinal nerve. It joins the sympathetic ganglia.

Q30.

30.1. Draw the neat Labelled diagram of the internal structure of the human heart.

Solution



30.2. What is phosphorylation?

Solution

It involves trapping the heat energy in the form of high energy bond of ATP molecule. ATP is used to carry out vital life processes and so is called as energy currency of the cell.

ADP + iP + 7.3 Kcal ⟶ ATP

Q31. Describe the mechanism for absorption of water.

Solution

1. **A mechanism for absorption of water:** In plants, water is absorbed mainly by two processes: Passive absorption and Active absorption
2. **Passive absorption:**
    a. About 98% of the total water absorbed in plants occurs passively.
    b. In passive absorption, living cells of the root do not play an important role in water absorption.
    c. The driving force is transpiration pull and it thus proceeds through the DPD gradient.
    d. There is no expenditure of energy (ATP) as water moves in accordance with the concentration gradient. Hence, it is passive absorption.
    e. Passive absorption occurs during day time when transpiration is in progress. It stops at night when transpiration stops.
    f. Rapid transpiration creates tension in the xylem vessel due to negative water potential. This tension is transmitted to xylem in the roots. Consequently, water is pulled upwards passively.
    g. During passive absorption, no ATP is utilized. Thus, the rate of respiration is not affected.
3. **Active absorption:**
    a. In this water is absorbed due to the activity of roots.
    b. Root cells play an active role in the absorption of water.

c. The driving force is the root pressure developed, in the living cells of the root.

d. Active absorption occurs usually at night when transpiration stops due to closure of stomata.

e. As water absorption is against the DPD gradient, there is an expenditure of ATP (energy) generated through the respiratory activity of cells.