

NIOS Class 12 Biology Sample Paper-2

Duration: 180 Minutes

Maximum Marks: 80

Instructions

- This paper contains **43** Questions. The paper is divided into two sections: **Section A – 40** marks, **Section B – 40** marks.
- **Section A** consists of
 - **Q.No. 1 to 16** – Multiple Choice type questions (MCQs) carrying 1 mark each. Select and write the most appropriate option out of the four options given in each of these questions. An internal choice has been provided in some of these questions. You have to attempt only one of the given choices in such questions.
 - **Q. No. 17 to 28** – Objective type questions. Q. No. 17 to 28 carry 02 marks each (with 2 sub- parts of 1 mark each). Attempt these questions as per the instructions given for each of the questions 17 –28.
- **Section B** consists of
 - **Q.No. 29 to 37** – Very Short questions carrying 02 marks each to be answered in the range of 30 to 50 words.
 - **Q.No. 38 to 41** – Short Answer type questions carrying 03 marks each to be answered in the range of 50 to 80 words.
 - **Q.No. 42 and 43** – Long Answer type questions carrying 05 marks each to be answered in the range of 80 to 120 words.
- There is **No Negative marking**.
- Use of mobile phones, smartwatches, calculators, or any electronic gadgets is strictly prohibited.

Section: A

Q1. Which one of the following organisms belongs to the Kingdom Monera? (1)

- (A) Amoeba
- (B) Nostoc

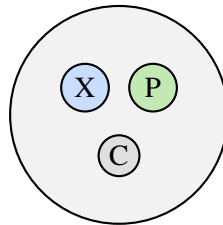


- (C) Yeast
- (D) Chlamydomonas

Q2. Which of the following pairs of animal and its phylum is correctly matched? **(1)**

- (A) Earthworm – Annelida
- (B) Starfish – Mollusca
- (C) Spider – Chordata
- (D) Shark – Arthropoda

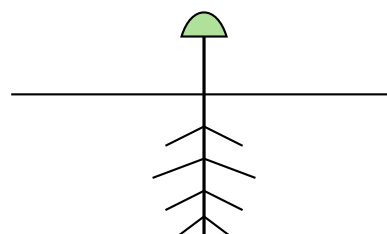
Q3. The tissue that is mainly responsible for the transport of water and minerals in vascular plants is: **(1)**



Vascular bundle (X: xylem, P: phloem, C: cambium)

- (A) Phloem
- (B) Xylem
- (C) Collenchyma
- (D) Parenchyma

Q4. The root system in a mustard plant is best described as: **(1)**



Tap root system

- (A) Fibrous root system
- (B) Adventitious root system



- (C) Tap root system
- (D) Prop root system

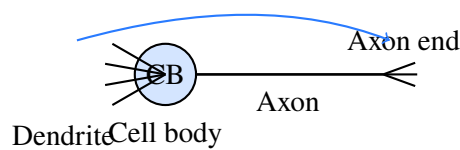
Q5. During glycolysis, one molecule of glucose is broken down in the cytoplasm to give two molecules of pyruvate along with a net gain of: **(1)**

- (A) 2 ATP molecules
- (B) 4 ATP molecules
- (C) 6 ATP molecules
- (D) 8 ATP molecules

Q6. In the light reaction of photosynthesis, water is split to release oxygen. This process is known as: **(1)**

- (A) Glycolysis
- (B) Hydrolysis
- (C) Photorespiration
- (D) Photolysis

Q7. The correct direction of flow of a nerve impulse in a neuron is: **(1)**



- (A) axon → cell body → dendrite → axon end
- (B) dendrite → cell body → axon → axon end
- (C) cell body → dendrite → axon → axon end
- (D) dendrite → axon → axon end → cell body

Q8. The pacemaker of the human heart is: **(1)**

- (A) Sino-Atrial node
- (B) Atrio-Ventricular node

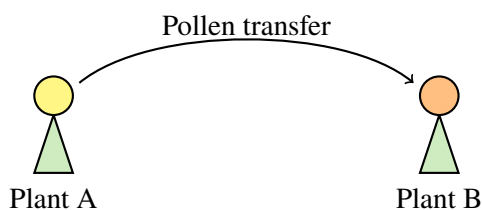


- (C) Bundle of His
- (D) Purkinje fibres

Q9. The enzyme responsible for the fixation of atmospheric nitrogen in root nodules of leguminous plants is: (1)

- (A) Amylase
- (B) Nitrate reductase
- (C) Catalase
- (D) Nitrogenase

Q10. The type of pollination in which pollen grains from the anther of a flower are transferred to the stigma of another flower on a different plant is called: (1)



- (A) Autogamy
- (B) Xenogamy
- (C) Geitonogamy
- (D) Cleistogamy

Q11. The Leydig cells of the human testis are known to secrete: (1)

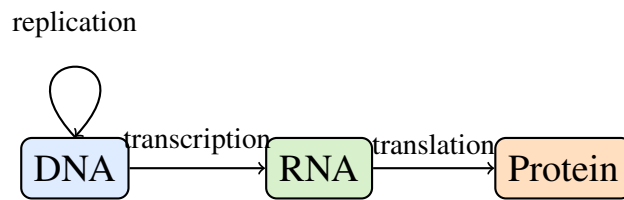
- (A) Seminal fluid
- (B) Sperms
- (C) Testosterone
- (D) Prostatic fluid

Q12. In a monohybrid cross between a pure tall and a pure dwarf pea plant, the phenotypic ratio in the F₂ generation is: (1)



- (A) 3 : 1
- (B) 1 : 1
- (C) 9 : 3 : 3 : 1
- (D) 2 : 1

Q13. Which one of the following is the correct sequence of steps in the central dogma of molecular biology? (1)



- (A) DNA → Protein → RNA
- (B) RNA → DNA → Protein
- (C) DNA → RNA → Protein
- (D) Protein → DNA → RNA

Q14. Which of the following is a permanent method of family planning suitable for a male? (1)

- (A) Copper-T
- (B) Condom
- (C) Oral contraceptive pill
- (D) Vasectomy

Q15. The deficiency of vitamin A in the diet mainly causes: (1)

- (A) Beri-beri
- (B) Scurvy
- (C) Rickets
- (D) Night blindness



Q16. Which of the following cells of the immune system is directly involved in cell-mediated immunity? (1)

- (A) Erythrocytes
- (B) Mast cells
- (C) T-lymphocytes
- (D) Platelets

Note: Q. No. 17 to 28 are the objective type questions of 2 marks each.

Q17. Identify the two **wrong** statements about parenchyma tissue in plants: (2)

- (i) Cells are thin-walled and living with large intercellular spaces.
- (ii) Cells always contain heavily lignified secondary walls.
- (iii) Parenchyma stores food and helps in gaseous exchange.
- (iv) Parenchyma cells are dead at maturity and have no cytoplasm.

Q18. Fill in the blanks (Attempt any **two** sub-parts from (i) to (iv)): (2)

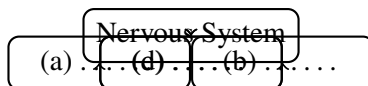
- (i) The lining of the human intestine that shows a “brush border” is made up of epithelial cells.
- (ii) A tissue in which all cells are structurally similar and perform the same function is called a tissue.
- (iii) The type of cell division by which bacteria and *Amoeba* divide is known as
- (iv) muscle fibres, once they start contracting, keep on contracting and relaxing throughout life.

Q19. Match the hormones given in Column I with their functions given in Column II (attempt any **two** matchings): (2)



Column I (Hormone)	Column II (Function)
(i) Testosterone	(a) Causes breasts to develop in females
(ii) Insulin	(b) Regulates the amount of sugar in blood
(iii) Oestrogen	(c) Causes males to start producing sperms
(iv) Adrenaline	(d) Prepares the body for an emergency

Q20. In the flow chart given below, write the basic divisions of the nervous system in the empty boxes (a), (b), (c) and (d). Attempt any **two**. (2)

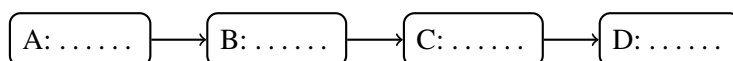


Q21. Match Column I with the correct option of Column II (attempt any **two**): (2)

Column I (Modified plant part)	Column II (Function)
(a) Phylloclade	(i) Protection
(b) Tuber	(ii) Reproduction
(c) Thorn	(iii) Storage of food
(d) Bulbils	(iv) Photosynthesis

Q22. Complete the following flow chart of events in human reproduction from A to D (attempt any **two**):

Sperms are deposited into the female reproductive tract and eggs are released from **A** → Union of sperm and ovum occurs in **B** → Zygote is formed → Zygote divides rapidly to form a spherical mass **C** → Early embryonic stage called blastocyst gets implanted into **D**. (2)

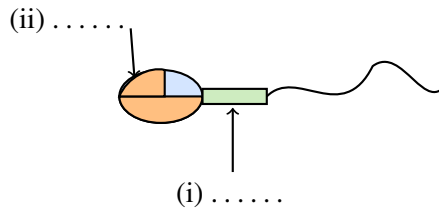


Q23. Identify A and B in the given table: (2)



Secretion	Source	Function
Testosterone	Testis	A
B	Corpus luteum	Maintains endometrium during pregnancy

Q24. Label the parts marked as (i) and (ii) in the given diagram of a human sperm: (2)



Q25. Read the passage and fill in the blanks with appropriate words (Attempt any two):

A hypodermal cell within the **A** of the ovule enlarges and becomes the **B** ; three of the resulting cells degenerate and one remains functional. The functional cell then undergoes three mitotic divisions leading to the formation of **C** . haploid nuclei. This enlarged structure containing all these haploid nuclei is called the **D**

Q26. Read the passage and answer the questions given below:

A large number of children in India suffer from malnutrition. Malnutrition seriously affects the health of growing children as it results in physical and mental retardation. The most common form seen in growing children in the age group of 1–5 years is protein energy malnutrition (PEM). (2)

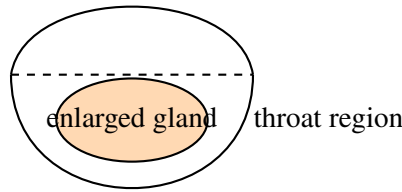
- (i) Define the term “disease”.
- (ii) Name any **two** common protein energy malnutrition diseases seen in India.

Q27. A boy has 47 chromosomes in his karyotype. He shows a thick tongue, mental retardation and drooping facial features throughout his life. (2)

- (i) Name the syndrome he is suffering from.
- (ii) Write his karyotype in terms of the number of autosomes and sex chromosomes.



Q28. The diagram given below shows the enlargement of a gland in the throat region of a person. (Attempt any **two**): (2)



- (1) Name the gland that has enlarged.
- (2) Name the disease that the person is suffering from.
- (3) State the cause of this disease.
- (4) Suggest any one preventive measure so that other people do not suffer from this disease.

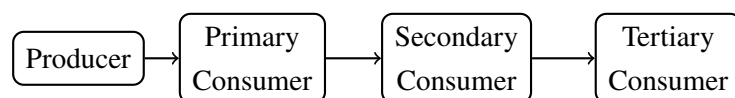
Section: B

Q29. Write the phylum to which each of the following organisms belongs:
 (a) Hydra (b) Cockroach (c) Frog (d) Snail (2)

Q30. Give the technical terms for the following:
 (i) The plant tissue in which all cells are structurally and functionally similar.
 (ii) The plant tissue whose cells have lost the power of division. (2)

Q31. (i) Why are cyanobacteria placed in the Kingdom Monera?
OR
 (ii) State any **four** differences between monocotyledons and dicotyledons. (2)

Q32. Construct a food chain of a grassland ecosystem showing one producer and three consumers. Also state the trophic level of the final consumer of this food chain. (2)



Q33. State any **two** reasons that justify the need for family planning in a country like India. (2)

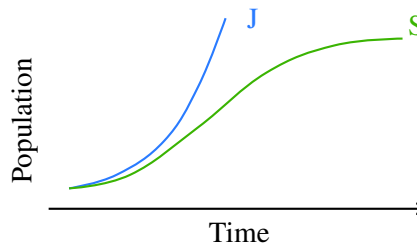


Q34. (i) Under what conditions do populations show a J-shaped and an S-shaped growth curve?

OR

(ii) Arrange the following levels of biological organization in the correct sequence, starting from genes and going up to biosphere:

Genes, cells, organ, organism, population, species, community, ecosystem, biome, biosphere. (2)

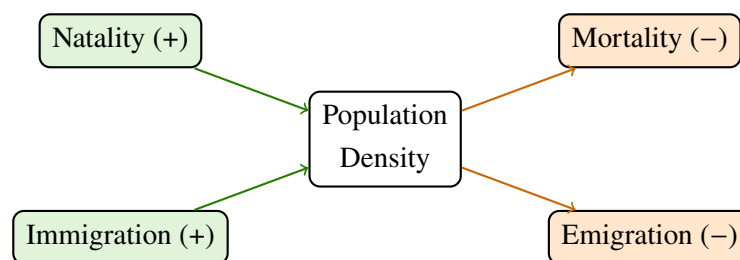


Q35. (i) Name the two specific immune responses that develop in our body when we are infected.

OR

(ii) Which types of cells are involved in each of these two immune responses? Explain briefly with one example of each. (2)

Q36. From the diagram given below, mention (a) any **two** factors which increase population density and (b) any **two** factors which decrease population density. (2)



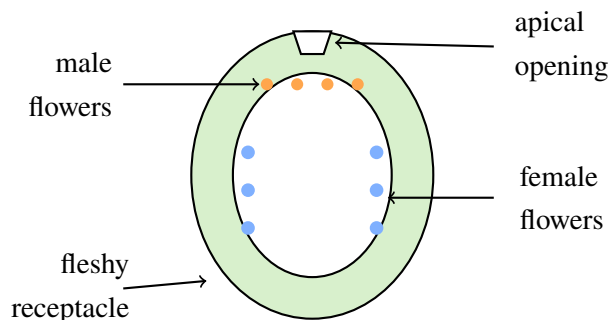
Q37. (i) Which part of the human ear is involved when a gymnast performs balancing feats?

OR

(ii) Suppose you are stuck in a traffic jam and have a strong urge for urination, but you are able to hold on for some time. Which part of the nervous system is responsible for this and what is its role? (2)



Q38. With the help of a neat labelled diagram, explain the hypanthodium type of inflorescence and give one example of a plant showing this inflorescence. (3)



Q39. (i) State any **one** non-surgical method of contraception used in the male and any **one** non-surgical method used in the female. Mention how each works.

OR

(ii) State the function of each of the following organs of the human male reproductive system:

(a) Seminal vesicles (b) Prostate gland (c) Testis (3)

Q40. (i) The population of India is heading towards an explosion. State any **three** reasons which may have contributed to this situation.

OR

(ii) Haemophilia is a sex-linked disease in human beings. A carrier female (heterozygous) marries a normal male. Write the genotypes of both the parents. Predict the phenotype (with respect to haemophilia) of their daughters and sons.

(3)

Q41. (i) The diagram of the Central Dogma given below has an error. Correct it and also state where in a eukaryotic cell each of the three processes – transcription, replication and translation – takes place.

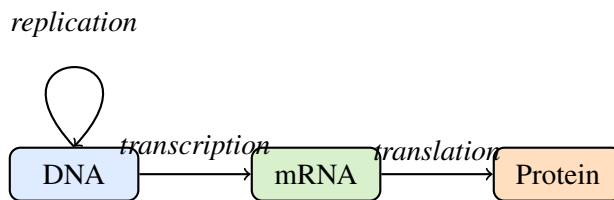
Incorrect diagram: $DNA \xrightarrow{\text{Transcription}} RNA \xrightarrow{\text{Replication}} Protein$

OR

(ii) With the help of a flow chart, show how sex is determined in human beings.

(3)





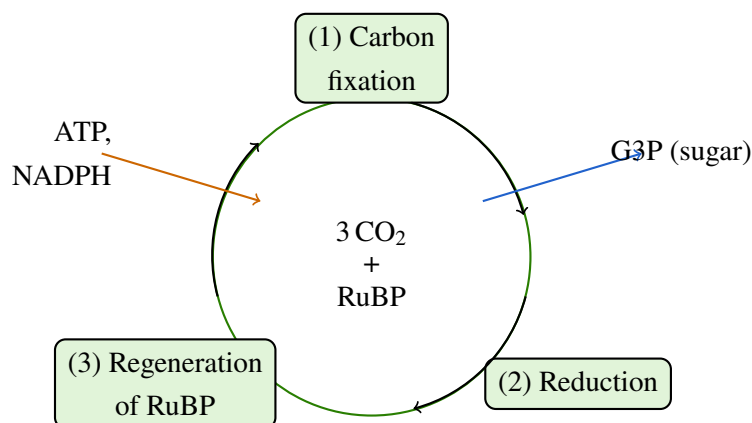
Q42. (i) With the help of a neat labelled diagram only, explain the Calvin cycle (dark reaction) of photosynthesis.

OR

(ii) (a) In photosynthesis, there are two reactions – the light reaction and the dark reaction. Why are they called so? Explain briefly.

(b) What are the products obtained in each of these two reactions?

(c) What are P₆₈₀ and P₇₀₀? **(5)**



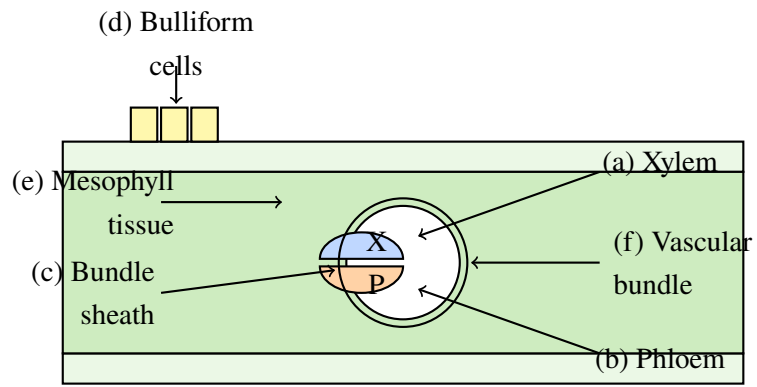
Q43. (i) Draw a neat labelled diagram of the vertical section (V.S.) of a monocot leaf and label the following parts: (a) xylem, (b) phloem, (c) bundle sheath, (d) bulliform cells, (e) mesophyll tissue, (f) vascular bundle.

OR

(ii) The following is a list of hormones produced in the human body. Write their full forms and the names of the endocrine glands that produce them:

(a) STH (b) TSH (c) FSH (d) LH (e) ADH **(5)**





Detailed Solutions

Q1.

Solution

Concept: Kingdom Monera contains prokaryotic organisms which lack a true nucleus and membrane-bound organelles. Cyanobacteria (blue-green algae) such as *Nostoc* and *Anabaena* are classic examples.

Step 1 — *Nostoc* is a filamentous cyanobacterium. Its cells are prokaryotic and possess no membrane-bound nucleus.

Step 2 — It therefore satisfies the defining feature of Kingdom Monera and is placed in it.

Why other options are wrong:

- **Option A:** *Amoeba* is a eukaryotic protozoan and belongs to Kingdom Protocista.
- **Option B:** Yeast is a unicellular eukaryotic fungus and belongs to Kingdom Fungi.
- **Option D:** *Chlamydomonas* is a eukaryotic green alga placed in Kingdom Protocista.

Final Answer: (Option B)

[Go Back to Question 1](#)

Q2.

Solution

Concept: Animals are grouped into phyla on the basis of body plan and symmetry. Earthworm is a segmented worm and belongs to phylum Annelida.

Step 1 — Earthworm has a metamerically segmented, elongated body with a true coelom, so it is placed in phylum Annelida.

Step 2 — The remaining pairs are incorrectly matched, as identified below.

Why other options are wrong:

- **Option A:** Starfish belongs to phylum Echinodermata, not Mollusca.
- **Option C:** Spider belongs to phylum Arthropoda, not Chordata.
- **Option D:** Shark belongs to phylum Chordata, not Arthropoda.

Final Answer: (Option A)

[Go Back to Question 2](#)



Q3.

Solution

Concept: In vascular plants, xylem is the tissue specialised for the upward conduction of water and dissolved minerals from the roots to other parts of the plant. Phloem, in contrast, transports food.

Step 1 — Xylem is composed of tracheids and vessels which are dead, lignified and tubular. This structural arrangement forms a continuous conducting channel.

Step 2 — Water is pulled up through the xylem mainly by the transpiration pull generated at the leaf surface.

Why other options are wrong:

- **Option A:** Phloem transports food (mainly sucrose), not water.
- **Option C:** Collenchyma is a mechanical tissue that provides flexible support.
- **Option D:** Parenchyma is a general packing/storage tissue and is not the main conducting tissue for water.

Final Answer: (Option B)

Answer: (B) [Go Back to Question 3](#)

Q4.

Solution

Concept: In dicots such as mustard, the primary root persists as a strong main root called the tap root, which gives rise to lateral (secondary) roots.

Step 1 — Mustard is a dicot plant. Its radicle grows directly into the soil to form a well-developed main root.

Step 2 — Numerous lateral roots arise from this main root, producing a tap root system as shown in the figure.

Why other options are wrong:

- **Option A:** Fibrous root systems are typical of monocots such as grasses and wheat.
- **Option B:** Adventitious roots arise from parts other than the radicle, e.g., stem or leaves.
- **Option D:** Prop roots are aerial supporting roots as seen in banyan.

Final Answer: (Option C)

Answer: (C) [Go Back to Question 4](#)



Q5.

Solution

Concept: Glycolysis is the anaerobic breakdown of one molecule of glucose (a six-carbon sugar) into two molecules of pyruvate (a three-carbon compound) in the cytoplasm.

Step 1 — During glycolysis, 4 ATP molecules are produced but 2 ATP molecules are consumed in the initial phosphorylation steps.

Step 2 — The net gain of ATP molecules per molecule of glucose is therefore:

$$4 - 2 = 2$$

Why other options are wrong:

- **Option B:** 4 ATP is the gross production, not the net gain.
- **Option C:** 6 ATP is not associated with glycolysis; part of it appears when NADH is oxidised in mitochondria.
- **Option D:** 8 ATP is far greater than the net gain of glycolysis.

Final Answer: (Option A)

Answer: (A)

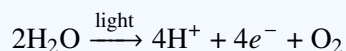
[Go Back to Question 5](#)

Q6.

Solution

Concept: The splitting of a water molecule using light energy in the thylakoid membranes of the chloroplast is called photolysis. It releases O₂, protons and electrons.

Step 1 — The overall reaction of photolysis of water can be written as:



Step 2 — The oxygen released by green plants during photosynthesis comes from this photolysis and not from CO₂.

Why other options are wrong:

- **Option A:** Glycolysis is the breakdown of glucose during respiration.
- **Option C:** Hydrolysis involves splitting of a molecule using water.
- **Option D:** Photorespiration is the light-dependent uptake of oxygen and release of CO₂ by plants, not water splitting.

Final Answer: (Option D)

Answer: (D)

[Go Back to Question 6](#)



Q7.

Solution

Concept: A nerve impulse in a neuron travels in one direction only: it is picked up by the dendrites, transmitted through the cell body and the axon, and finally passed to the next neuron at the axon terminal.

Step 1 — The dendrites receive the stimulus from a receptor or another neuron.

Step 2 — The impulse then passes through the cell body, travels along the axon, and reaches the axon end (synaptic knob), from where it can be transmitted to the next cell.

Why other options are wrong:

- **Option A:** Direction is reversed; impulses do not flow from axon end back to the dendrite.
- **Option C:** The cell body cannot come before the dendrite in the pathway.
- **Option D:** The impulse never returns to the cell body after leaving the axon.

Final Answer: dendrite → cell body → axon → axon end (Option B)

Answer: (B) [Go Back to Question 7](#)

Q8.

Solution

Concept: The sino-atrial (SA) node is a specialised patch of tissue located in the wall of the right atrium. It initiates the wave of contraction of the heart and hence acts as the natural pacemaker.

Step 1 — The SA node generates electrical impulses at regular intervals without any external stimulation.

Step 2 — These impulses spread through the atria and then reach the atrio-ventricular (AV) node, which relays them further through the bundle of His and Purkinje fibres.

Why other options are wrong:

- **Option A:** The AV node is a relay station, not the primary pacemaker.
- **Option B:** The Bundle of His transmits impulses from the AV node to the ventricles.
- **Option D:** Purkinje fibres carry the impulse into the ventricular muscle but do not originate it.

Final Answer: Sino-Atrial node (Option A)

Answer: (A) [Go Back to Question 8](#)

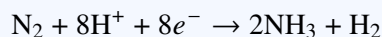


Q9.

Solution

Concept: Biological nitrogen fixation is carried out by the enzyme *nitrogenase*, which is present in the bacteroids of *Rhizobium* inside root nodules of leguminous plants.

Step 1 — Nitrogenase catalyses the reduction of atmospheric N₂ to ammonia (NH₃):



Step 2 — The ammonia formed is then assimilated by the plant into amino acids and other nitrogenous compounds.

Why other options are wrong:

- **Option A:** Amylase hydrolyses starch, not nitrogen.
- **Option C:** Nitrate reductase reduces nitrate to nitrite, it does not fix atmospheric N₂.
- **Option D:** Catalase breaks down hydrogen peroxide.

Final Answer: Nitrogenase (Option D)

Answer: (D) [Go Back to Question 9](#)

Q10.

Solution

Concept: When pollen is transferred from the anther of a flower on one plant to the stigma of a flower on a genetically different plant of the same species, the process is called xenogamy (cross-pollination between different plants).

Step 1 — Autogamy involves transfer of pollen within the same flower, and geitonogamy involves transfer between two flowers of the same plant.

Step 2 — Since the transfer here is between two different plants (as shown in the figure), the correct term is xenogamy.

Why other options are wrong:

- **Option A:** Autogamy is self-pollination within a single flower.
- **Option C:** Geitonogamy is genetically similar to autogamy as it occurs between flowers of the same plant.
- **Option D:** Cleistogamy is self-pollination inside a flower that never opens.

Final Answer: Xenogamy (Option B)

Answer: (B) [Go Back to Question 10](#)



Q11.

Solution

Concept: Leydig cells (interstitial cells) are situated in the connective tissue between the seminiferous tubules of the testis. They secrete the male sex hormone testosterone.

Step 1 — Testosterone is responsible for the development of secondary sexual characters in males and also supports spermatogenesis.

Step 2 — Sperms are produced inside the seminiferous tubules by spermatogenic cells, not by Leydig cells.

Why other options are wrong:

- **Option A:** Seminal fluid is contributed mainly by the seminal vesicles and prostate.
- **Option C:** Sperms are produced by germ cells inside the seminiferous tubules.
- **Option D:** The prostatic (alkaline) secretion is produced by the prostate gland.

Final Answer: Testosterone (Option C)

Answer: (C) [Go Back to Question 11](#)

Q12.

Solution

Concept: In Mendel’s monohybrid cross between a pure tall (TT) and a pure dwarf (tt) pea plant, the F_1 generation is all tall (Tt). Self-pollination of the F_1 gives an F_2 phenotypic ratio of 3 tall : 1 dwarf.

Step 1 — F_2 genotypes: $1 TT : 2 Tt : 1 tt$.

Step 2 — Since TT and Tt are both phenotypically tall, the phenotypic ratio becomes:

3 tall : 1 dwarf

Why other options are wrong:

- **Option A:** 1:1 is the ratio of a test cross, not the F_2 of a monohybrid.
- **Option C:** 9:3:3:1 is the phenotypic ratio of a dihybrid F_2 .
- **Option D:** 2:1 is not a Mendelian monohybrid ratio.

Final Answer: 3 : 1 (Option A)

Answer: (A) [Go Back to Question 12](#)



Q13.

Solution

Concept: The central dogma of molecular biology describes the general flow of genetic information: DNA is transcribed into RNA, and RNA is translated into protein. DNA also replicates itself for inheritance.

Step 1 — DNA $\xrightarrow{\text{transcription}}$ mRNA.

Step 2 — mRNA $\xrightarrow{\text{translation}}$ Protein.

Why other options are wrong:

- **Option A:** DNA does not directly form protein without an RNA intermediate.
- **Option B:** RNA is not the primary source of DNA in normal cells (this occurs only in reverse transcription in some viruses).
- **Option D:** Proteins do not template DNA in normal biology.

Final Answer: DNA → RNA → Protein (Option C)

Answer: (C) [Go Back to Question 13](#)

Q14.

Solution

Concept: Vasectomy is a permanent surgical method of contraception in males in which a small segment of each vas deferens is cut and ligated, preventing sperms from entering the semen.

Step 1 — After vasectomy, semen is produced but does not contain sperms, hence fertilisation cannot occur.

Step 2 — The procedure is highly effective and is used as a permanent method of family planning.

Why other options are wrong:

- **Option A:** Copper-T is an intra-uterine device used in females and is reversible.
- **Option C:** Condom is a barrier method that is temporary.
- **Option D:** Oral contraceptive pills are temporary hormonal contraceptives used by females.

Final Answer: Vasectomy (Option D)

Answer: (D) [Go Back to Question 14](#)



Q15.

Solution

Concept: Vitamin A (retinol) is essential for the formation of the visual pigment rhodopsin in the rod cells of the retina, which is required for vision in dim light. Its deficiency mainly leads to night blindness (nyctalopia).

Step 1 — In the absence of vitamin A, rhodopsin cannot be regenerated efficiently, so the eye is unable to adapt to low light.

Step 2 — Prolonged deficiency may also cause xerophthalmia (dryness of the cornea).

Why other options are wrong:

- **Option A:** Beri-beri is caused by deficiency of vitamin B₁ (thiamine).
- **Option C:** Scurvy is caused by deficiency of vitamin C.
- **Option D:** Rickets is caused by deficiency of vitamin D.

Final Answer: Night blindness (Option D)

Answer: (D) [Go Back to Question 15](#)

Q16.

Solution

Concept: Cell-mediated immunity (CMI) is a specific immune response mediated by T-lymphocytes (T-cells). It protects against intracellular pathogens, cancer cells and transplanted foreign tissues.

Step 1 — T-cells mature in the thymus. Cytotoxic T-cells and helper T-cells are the main effectors of the cell-mediated response.

Step 2 — Antibody-mediated (humoral) immunity is carried out by B-lymphocytes, not by T-cells.

Why other options are wrong:

- **Option A:** Erythrocytes are red blood cells that transport gases; they do not participate in immunity.
- **Option C:** Mast cells are involved in allergic and inflammatory reactions, not directly in CMI.
- **Option D:** Platelets are involved in blood clotting.

Final Answer: T-lymphocytes (Option C)

Answer: (C) [Go Back to Question 16](#)



Q17.

Solution

Concept: Parenchyma is a simple, living plant tissue with thin cellulose walls, prominent nucleus, dense cytoplasm and large intercellular spaces. It functions in storage, photosynthesis and gaseous exchange.

Step 1 — Statement (i) is correct – parenchyma cells are indeed thin-walled, living, with intercellular spaces.

Step 2 — Statement (iii) is correct – parenchyma stores food and takes part in gaseous exchange.

Step 3 — The **wrong** statements are:

- Statement (ii): Heavy lignification of secondary walls is characteristic of sclerenchyma, not parenchyma.
- Statement (iv): Parenchyma cells are living at maturity and have cytoplasm; only sclerenchyma and mature xylem elements are dead.

Final Answer: Wrong statements: (ii) and (iv)

Answer: ((ii) & (iv))

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Q18.

Solution

Concept: Attempt any two of the four sub-parts. The blanks test the basic structural and functional terms of tissues in animals and lower organisms.

Step 1 — (i) The “brush border” in the intestinal lining is due to microvilli on **columnar (ciliated columnar) epithelial cells**.

Step 2 — (ii) A tissue in which all cells are structurally similar and perform the same function is called a **simple tissue**.

Step 3 — (iii) The type of cell division in bacteria and *Amoeba* is **binary fission**.

Step 4 — (iv) **Cardiac** muscle fibres, once they begin to contract, keep on contracting and relaxing throughout life.

Final Answer: (i) columnar epithelial cells; (ii) simple tissue; (iii) binary fission; (iv) cardiac muscle

Answer: (See above)

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Q19.

Solution

Concept: Endocrine hormones exert highly specific effects on particular target organs. The correct matching is done by recalling the function of each hormone.

Step 1 — (i) Testosterone – Causes males to start producing sperms → matches with (c).

Step 2 — (ii) Insulin – Regulates the amount of sugar in the blood → matches with (b).

Step 3 — (iii) Oestrogen – Causes breasts to develop in females → matches with (a). (iv) Adrenaline – Prepares the body for an emergency → matches with (d).

Final Answer: (i)-c, (ii)-b, (iii)-a, (iv)-d

Answer: (See above)

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Q20.

Solution

Concept: The nervous system in humans is broadly classified into the Central Nervous System (CNS) and the Peripheral Nervous System (PNS). CNS consists of the brain and the spinal cord; PNS is subdivided into somatic and autonomic pathways.

Step 1 — (a) The first branch of the nervous system is the **Central Nervous System (CNS)**.

Step 2 — (b) The second branch is the **Peripheral Nervous System (PNS)**.

Step 3 — (c) A key component of the CNS (besides the brain) is the **spinal cord**. (d) The involuntary component of PNS is the **autonomic nervous system (autonomic pathway)**.

Final Answer: (a) Central Nervous System; (b) Peripheral Nervous System; (c) Spinal cord; (d) Autonomic pathway

Answer: (See above)

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Q21.

Solution

Concept: A phylloclade is a green flattened stem that carries out photosynthesis, while a tuber is a swollen underground stem specialised for storage of food. Thorns are modified stems that protect the plant, and bulbils are modified buds used for vegetative reproduction.

Step 1 — (a) Phylloclade → (iv) Photosynthesis.

Step 2 — (b) Tuber → (iii) Storage of food.

Step 3 — (c) Thorn → (i) Protection. (d) Bulbils → (ii) Reproduction.

Final Answer: (a)-iv, (b)-iii, (c)-i, (d)-ii

Answer: (See above)

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Q22.

Solution

Concept: In humans, ovulation occurs from the ovary, fertilisation takes place in the fallopian tube, the zygote undergoes rapid cleavage to form a morula, and the resulting blastocyst becomes implanted in the wall of the uterus.

Step 1 — A: The eggs are released from the **ovary**. B: Fertilisation occurs in the **fallopian tube (oviduct)**.

Step 2 — C: Rapid divisions of the zygote produce a solid ball of cells called the **morula**. D: The blastocyst is implanted in the **uterus (endometrium)**.

Final Answer:

Answer: (See above)

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Q23.

Solution

Concept: Testosterone secreted by the testis is responsible for the development of male secondary sexual characters and the production of sperms. Progesterone is secreted by the corpus luteum and maintains the endometrium during pregnancy.

Step 1 — A: Function of testosterone is to **initiate sperm production and develop male secondary sexual characters**.

Step 2 — B: The secretion of the corpus luteum that maintains the endometrium is **progesterone**.

Final Answer:

Answer: (See above)

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Q24.

Solution

Concept: A human sperm consists of a head (with the acrosome and nucleus), a middle piece (rich in mitochondria that provide energy) and a long tail (flagellum for motility).

Step 1 — In the given diagram, part (i) is the middle piece, which is packed with **mitochondria** to supply ATP for the beating of the tail.

Step 2 — Part (ii) is the cap-like structure at the front of the head, which is called the **acrosome**. It contains enzymes that help the sperm penetrate the egg.

Final Answer:

Answer: (See above)

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Q25.

Solution

Concept: In an angiosperm ovule, the development of the female gametophyte (embryo sac) starts with a hypodermal cell of the nucellus, which enlarges to form the megaspore mother cell. It undergoes meiosis to give four megaspores, of which three degenerate and one becomes functional and undergoes three mitotic divisions.

Step 1 — A: The hypodermal cell lies within the **nucellus** of the ovule.

Step 2 — B: The enlarged hypodermal cell becomes the **megaspore mother cell (MMC)**.

Step 3 — C: Three mitotic divisions of the functional megaspore produce **eight** haploid nuclei. D: The enlarged structure containing these eight haploid nuclei is called the **embryo sac**.

Final Answer:

A – Nucellus; B – Megaspore mother cell; C – Eight haploid nuclei; D – Embryo sac

Answer: (See above)

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Q26.

Solution

Concept: Disease is a state in which the normal functioning of the body or its part is disturbed. Protein Energy Malnutrition (PEM) mainly gives rise to marasmus and kwashiorkor in young children.

Step 1 — (i) Disease: Disease may be defined as a malfunctioning of a part or the whole of the body in which normal functions are disturbed or damaged. The word literally means “not at ease” (*dis* = not, *ease* = comfort).

Step 2 — (ii) Two common protein energy malnutrition diseases seen in India are **Marasmus** and **Kwashiorkor**.

Final Answer:

(i) Disease – disturbance of normal body function; (ii) Marasmus and Kwashiorkor

Answer: (See above)

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Q27.

Solution

Concept: A karyotype with 47 chromosomes indicates the presence of an extra chromosome. The symptoms of thick tongue, mental retardation and typical facial features point to Down's syndrome, which is caused by trisomy of chromosome 21.

Step 1 — (i) The syndrome is **Down's syndrome (Mongolism)**, caused by **trisomy of chromosome 21**.

Step 2 — (ii) The karyotype in males can be written as: 44 **autosomes +XY sex chromosomes with an extra 21st chromosome**, i.e., 45 autosomes +XY, giving a total of 47 chromosomes.

Final Answer: (i) Down's syndrome (trisomy 21); (ii) 45 autosomes +XY sex chromosomes (47 chromosomes)

Answer: (See above)

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Q28.

Solution

Concept: Enlargement of the thyroid gland in the throat region is called goitre. It is commonly caused by dietary deficiency of iodine, which is required by the thyroid to synthesise the hormone thyroxine.

Step 1 — (1) The gland that has enlarged is the **thyroid gland**.

Step 2 — (2) The disease is called **simple goitre**. (3) It is caused by **deficiency of iodine** in the diet.

Step 3 — (4) One preventive measure is the **regular use of iodised salt** and inclusion of iodine-rich foods (sea food, fish, green leafy vegetables) in the diet.

Final Answer: (1) Thyroid gland; (2) Goitre; (3) Iodine deficiency; (4) Use iodised salt

Answer: (See above)

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Q29.

Solution

Concept: Every animal is placed in a phylum on the basis of its body plan, symmetry, level of organisation and presence or absence of a coelom.

Step 1 — (a) *Hydra* – Phylum **Coelenterata (Cnidaria)**.

Step 2 — (b) Cockroach – Phylum **Arthropoda**.

Step 3 — (c) Frog – Phylum **Chordata**. (d) Snail – Phylum **Mollusca**.

Final Answer: Hydra – Coelenterata; Cockroach – Arthropoda; Frog – Chordata; Snail – Mollusca

Answer: (See above)

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Q30.

Solution

Concept: Plant tissues are classified into simple and complex tissues. Cells that have permanently lost the power of division are said to be permanent tissues.

Step 1 — (i) A plant tissue in which all cells are structurally and functionally similar is called a **simple tissue**. Parenchyma, collenchyma and sclerenchyma are simple tissues.

Step 2 — (ii) A plant tissue whose cells have lost the power of division is called a **permanent tissue**.

Final Answer: (i) Simple tissue; (ii) Permanent tissue

Answer: (See above)

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Q31.

Solution

Concept: Cyanobacteria are placed in Kingdom Monera because they are prokaryotic. Monocots and dicots are the two classes of angiosperms and differ in several structural features.

Step 1 — Alternative (i): Cyanobacteria (blue-green algae) are photosynthetic prokaryotes. They are placed in Kingdom Monera because they are unicellular/filamentous, lack a well-defined nucleus and membrane-bound cell organelles, and possess 70S ribosomes – all characters of prokaryotes.

Step 2 — Alternative (ii): Four differences between monocots and dicots:

- Seed has one cotyledon in monocots but two cotyledons in dicots.
- Leaves show parallel venation in monocots and reticulate venation in dicots.
- Vascular bundles are scattered in monocot stems, but arranged in a ring in dicot stems.
- Flowers are trimerous in monocots and pentamerous (or tetramerous) in dicots.

Final Answer: Cyanobacteria are prokaryotic; monocots and dicots differ in cotyledons, venation, vascular bundles and floral symmetry

Answer: (See above)

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Q32.

Solution

Concept: A food chain is a linear sequence of organisms through which food and energy pass from producers to a series of consumers. Green plants are producers (first trophic level).

Step 1 — A grassland food chain with one producer and three consumers:

Grass → Grasshopper → Frog → Snake

Step 2 — Trophic levels are: Grass – T₁; Grasshopper – T₂; Frog – T₃; Snake – T₄.

Step 3 — Therefore the final consumer (snake) belongs to the **fourth trophic level**.

Final Answer: Grass → Grasshopper → Frog → Snake; 4th trophic level

Answer: (See above)

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Q33.

Solution

Concept: Family planning aims at limiting the size of the family so that adequate resources like food, education and health care can be provided to each member and the pressure on natural resources is reduced.

Step 1 — A small family can afford better health care, nutrition and education for the children and puts less pressure on the earning parents.

Step 2 — A controlled population puts less pressure on land, water, food, transport and other natural resources, and reduces environmental degradation.

Final Answer: Better living standards for the family; reduced pressure on natural resources and environment

Answer: (See above)

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Q34.

Solution

Concept: Population growth curves depend on the availability of resources. Unlimited resources give rise to J-shaped exponential growth, whereas limited resources produce S-shaped logistic growth that levels off at the carrying capacity.

Step 1 — Alternative (i):

- Populations show a **J-shaped** curve when food and space are available in plenty and there is no environmental resistance. Growth is exponential.
- Populations show an **S-shaped** curve when resources become limited; growth slows as it approaches the carrying capacity (*K*).

Step 2 — Alternative (ii): Correct sequence of levels of biological organisation from genes to biosphere:

Genes → Cells → Organ → Organism → Population → Species → Community → Ecosystem → Biome → Bi

Final Answer: J-curve: unlimited resources; S-curve: limited resources; hierarchy: genes → ... → biosphere

Answer: (See above)

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Q35.

Solution

Concept: The two specific (acquired) immune responses in the body are the **humoral (antibody-mediated)** response and the **cell-mediated** response.

Step 1 — Alternative (i): The two specific immune responses are (a) **humoral immune response (antibody-mediated)** and (b) **cell-mediated immune response (CMI)**.

Step 2 — Alternative (ii):

- Humoral response is carried out by **B-lymphocytes**, which produce antibodies against extracellular pathogens (e.g., protection against poliovirus after vaccination).
- Cell-mediated response is carried out by **T-lymphocytes**, which act against virus-infected cells, cancer cells and transplants (e.g., rejection of a foreign skin graft).

Final Answer: Humoral – B-cells (antibodies); Cell-mediated – T-cells (against infected/foreign cells)

Answer: (See above)

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Q36.

Solution

Concept: Population density is regulated by four processes: natality, mortality, immigration and emigration. The first two are births and deaths within the population; the latter two involve movement of individuals in and out.

Step 1 — Factors that increase density:

- **Natality** (birth rate) – addition of new individuals through births.
- **Immigration** – entry of individuals from other populations into the given area.

Step 2 — Factors that decrease density:

- **Mortality** (death rate) – loss of individuals through death.
- **Emigration** – movement of individuals out of the given area.

Final Answer: Increase: natality, immigration; Decrease: mortality, emigration

Answer: (See above)

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Q37.

Solution

Concept: Balance and equilibrium of the body are controlled by the vestibular apparatus of the internal ear. Voluntary control over reflex actions like urination is exercised by the autonomic nervous system.

Step 1 — Alternative (i): The part of the ear involved in balancing is the **vestibule (vestibular apparatus)**, which includes the utricle, saccule and the semicircular canals of the internal ear.

Step 2 — Alternative (ii): The urge to urinate is normally controlled by the **sympathetic division of the autonomic nervous system**, which allows the urinary bladder to hold urine by relaxing its wall and contracting its sphincter; the parasympathetic division brings about the actual act of urination when it becomes appropriate.

Final Answer: (i) Vestibule of internal ear; (ii) Sympathetic (autonomic) nervous system holds urine, parasympathetic releases it

Answer: (See above)

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Q38.

Solution

Concept: Hypanthodium is a special type of inflorescence in which the receptacle is fleshy and forms a hollow cavity with a narrow apical opening (ostiole). Male flowers are borne near the opening and female flowers on the inner wall of the cavity.

Step 1 — The fleshy receptacle grows around the flowers and encloses them almost completely; only the apical opening (ostiole) remains through which pollinating insects enter.

Step 2 — Inside the cavity, the male flowers lie near the ostiole while the female flowers are located deeper along the inner wall, along with sterile gall flowers.

Step 3 — A common example of hypanthodium inflorescence is ***Ficus* (fig, banyan, peepal)**. Pollination is carried out mainly by tiny wasps that enter through the ostiole.

Final Answer: Fleshy receptacle with apical opening (ostiole); male flowers near opening, female inside; example: *Ficus*

Answer: (See above)

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Q39.

Solution

Concept: Non-surgical (reversible) methods of contraception include barrier methods, hormonal pills and intra-uterine devices. The male reproductive organs perform distinct roles: sperm production, formation of seminal fluid and secretion of alkaline fluid.

Step 1 — Alternative (i):

- **Male:** Use of a **condom** – a thin rubber sheath worn on the penis that acts as a barrier and prevents sperms from entering the female tract.
- **Female:** Use of **oral contraceptive pills** – hormonal pills that alter the balance of oestrogen and progesterone and prevent ovulation. Intra-uterine devices (IUDs) such as the Copper-T are another non-surgical option that prevents implantation.

Step 2 — Alternative (ii): Functions of male reproductive organs:

- **(a) Seminal vesicles:** Secrete a fructose-rich alkaline fluid that provides nutrition and motility to the sperms.
- **(b) Prostate gland:** Adds a thin, milky alkaline secretion to semen that neutralises the acidity of the female tract and activates sperms.
- **(c) Testis:** Produces **sperms** (spermatogenesis) and secretes the male sex hormone **testosterone**.

Final Answer:

(i) Male: condom; Female: pills / IUD. (ii) Seminal vesicles – nutritive fluid; Prostate – alkaline secretion; Testis – sperms and testosterone

Answer: (See above)[Go Back to Question 39](#)

Q40.

Solution

Concept: Rapid population growth in India is due to a combination of social, economic and medical factors. Haemophilia is an X-linked recessive disorder whose inheritance can be worked out by a Punnett square.

Step 1 — Alternative (i): Three reasons for population explosion in India:

- **Illiteracy and lack of awareness** about family planning, leading to large families.
- **Advancement in medicine and health care** has decreased the death rate while the birth rate has not decreased proportionally, so life span has increased.
- **Traditional preference for a male child** makes couples continue producing children until a son is born.

Step 2 — Alternative (ii): Let X^H denote the normal (dominant) allele and X^h the haemophilic (recessive) allele. Then:

- Carrier female: $X^H X^h$
- Normal male: $X^H Y$

Step 3 — Punnett square gives progeny in equal proportions:

	X^H (from father)	Y (from father)
X^H	$X^H X^H$ (normal girl)	$X^H Y$ (normal boy)
X^h	$X^H X^h$ (carrier girl)	$X^h Y$ (haemophilic boy)

So daughters: 50% normal, 50% carrier (all phenotypically normal). Sons: 50% normal, 50% haemophilic.

Final Answer: (i) Illiteracy, better medicine, preference for male child; (ii) Daughters all normal (half carriers); half of sons normal, half haemophilic

Answer: (See above)

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Q41.

Solution

Concept: The correct central dogma involves transcription of DNA into RNA and translation of RNA into protein. Replication of DNA occurs on DNA itself. Sex determination in humans is of the XY type.

Step 1 — Alternative (i): The corrected diagram is:

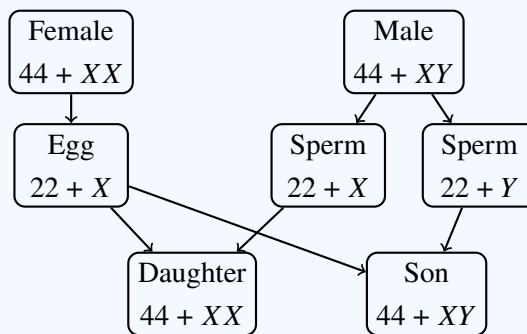


Replication takes place on DNA itself and is shown as a loop on DNA.

Step 2 — Locations in a eukaryotic cell:

- Transcription – **nucleus** (mRNA is synthesised on the DNA template).
- Replication – **nucleus** (during the S phase of the cell cycle).
- Translation – **cytoplasm**, on ribosomes.

Step 3 — Alternative (ii): Human sex determination:



Final Answer:

Corrected dogma: DNA → mRNA → Protein; transcription & replication in nucleus, translation in cytoplasm; sex determined by father’s sperm

Answer: (See above)

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Q42.

Solution

Concept: Photosynthesis has two stages – the light reaction (photochemical, in thylakoids) and the dark reaction (biochemical/Calvin cycle, in stroma). The dark reaction fixes CO₂ using ATP and NADPH generated in the light reaction.

Step 1 — Alternative (i): The Calvin cycle takes place in the stroma of the chloroplast and consists of three main phases:

- **Carbon fixation:** CO₂ combines with the 5-carbon acceptor RuBP to form two molecules of a 3-carbon compound (3-PGA), catalysed by the enzyme RuBisCO.
- **Reduction:** 3-PGA is reduced using ATP and NADPH to form G3P (glyceraldehyde-3-phosphate). Some G3P leaves the cycle to build sugars.
- **Regeneration of RuBP:** The remaining G3P is rearranged, using ATP, back into RuBP so that the cycle can continue.

Step 2 — Alternative (ii)(a): The first stage of photosynthesis is called the **light reaction** because it can occur *only* in the presence of light. The second stage is called the **dark reaction** because it does not directly require light (though it depends on the products of the light reaction) and can proceed as long as ATP and NADPH are available.

Step 3 — (b) Products:

- Light reaction: **ATP, NADPH and O₂** (oxygen released from photolysis of water).
- Dark reaction: **Glucose (carbohydrates)**, with ADP and NADP⁺ recycled back to the light reaction.

Step 4 — (c) P₆₈₀ and P₇₀₀: These are the reaction-centre chlorophyll molecules of the two photosystems. The special pair of **Photosystem II absorbs light most strongly at 680 nm** and is therefore called P₆₈₀, while the special pair of **Photosystem I absorbs best at 700 nm** and is called P₇₀₀.

Final Answer: Calvin cycle: fixation, reduction, regeneration; light reaction gives ATP, NADPH, O₂; dark reaction gives glucose; P₆₈₀ and P₇₀₀ are reaction-centre chlorophylls of PS II and PS I

Answer: (See above)

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Q43.

Solution

Concept: A monocot leaf shows characteristic bulliform cells in the upper epidermis, vascular bundles of similar size surrounded by a bundle sheath, and a mesophyll that is not differentiated into palisade and spongy layers. Alternatively, several pituitary hormones (STH, TSH, FSH, LH, ADH) are important tropic/non-tropic hormones with specific target glands.

Step 1 — Alternative (i): Salient features of a vertical section of a monocot leaf (as labelled in the diagram):

- (a) **Xylem** lies on the upper side of each vascular bundle.
- (b) **Phloem** lies on the lower side of the vascular bundle.
- (c) **Bundle sheath** surrounds each vascular bundle and takes part in transport.
- (d) **Bulliform cells** are large, thin-walled colourless cells on the upper epidermis; they help in rolling/unrolling of the leaf during water stress.
- (e) **Mesophyll tissue** lies between the two epidermal layers and is undifferentiated in monocots.
- (f) **Vascular bundles** are of nearly equal size and are arranged along the entire length of the leaf.

Step 2 — Alternative (ii): Full forms and endocrine sources of the given hormones:

- (a) **STH – Somatotropic Hormone (Growth Hormone).** Source: **anterior pituitary.**
- (b) **TSH – Thyroid Stimulating Hormone.** Source: **anterior pituitary;** target: thyroid gland.
- (c) **FSH – Follicle Stimulating Hormone.** Source: **anterior pituitary;** target: ovaries/testes.
- (d) **LH – Luteinising Hormone.** Source: **anterior pituitary;** target: gonads.
- (e) **ADH – Antidiuretic Hormone (Vasopressin).** Source: **posterior pituitary;** target: kidney tubules.

Final Answer:

Monocot leaf shows bulliform cells, undifferentiated mesophyll and uniform vascular bundles; STH, TSH, FSH, LH from anterior pituitary and ADH from posterior pituitary

Answer: (See above)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	B	4	C	5	A
6	D	7	B	8	A	9	D	10	B
11	C	12	A	13	C	14	D	15	D
16	C								

