ASSOCIATION OF TEACHERS IN BIOLOGICAL SCIENCES
National Standard Examination in Biology – 2026
Date of Examination: November 22, 2026

Time: 2:30 PM to 4:30 PM

Question Paper Code: 21

Student's Roll No:											

Write the Question Paper code (mentioned above) on YOUR OMR Answer Sheet (in the space provided), otherwise your Answer Sheet will NOT be evaluated. Note that the same Question Paper Code appears on each page of the Question Paper.

Instructions to Candidates:

1. Use of mobile phone, smart watch, iPad and devices like ear pod etc during exam is STRICTLY PROHIBITED.
2. In addition to this Question Paper, you are given OMR Answer Sheet along with candidate's copy.
3. On the OMR sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.
   Incomplete/ incorrect/ carelessly filled information may disqualify your candidature.
4. On the OMR Answer Sheet, use only **BLUE or BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Your **Eleven-digit roll number and date of birth** entered on the OMR Answer Sheet shall remain your login credentials means login id and password respectively for accessing your performance / result in National Standard Examination in Biology - 2026.
6. Question Paper has two parts. In part A-1 (Q. No.1 to 48) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q.No.12 (a) (●) (c) (d)

In part A-2 (Q. No. 49 to 60) each question has four alternatives out of which any number of alternative (s) (1, 2, 3, or 4) may be correct. You have to choose **all** correct alternative(s) and fill the appropriate bubble(s), as shown

Q.No.52 (a) (●) (c) (●)

7. Attempt all sixty questions. For **Part A-1,** each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In **Part A-2,** you get 6 marks if all the correct alternatives are marked and no incorrect. No negative marks in this part.
8. Rough work may be done in the space provided. There are **18** printed pages in this question paper.
9. Use of **non-programmable scientific** calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting Answer Paper, take away the Question Paper & Candidate's copy of OMR sheet for your future reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the OMR Answer Sheet.

OMR Answer Sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED. Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK SIDE OF THE OMR ANSWER SHEET.

Instructions to Candidates (Continued) :
You may read the following instructions after submitting the Answer Sheet.

12. **Comments/ Inquiries/ Grievances regarding this Question Paper, if any, can be shared on the Inquiry/ Grievance column on www.iapt.org.in on the specified format till Dec 1, 2026.**

13. **The Answers/ Solutions to this Question Paper will be available on the website: www.iapt.org.in by Nov 29, 2026.** The score card may be downloaded after Dec 24, 2026.

14. **CERTIFICATES and AWARDS:**
Following certificates are awarded by IAPT/ATBS to students, successful in the National Standard Examination in Biology – 2026
(i) "CENTRE TOP 10 %" to be downloaded from iapt.org.in after 30.01.27
(ii) "STATE TOP 1 %" will be dispatched to the examinee
(iii) "NATIONAL TOP 1 %" will be dispatched to the examinee
(iv) "GOLD MEDAL & MERIT CERTIFICATE" to all students who attend OCSC – 2027 at HBCSE-TIFR Mumbai
Certificate for centre toppers shall be uploaded on iapt.org.in

15. List of students (with centre number and roll number only) having a score equal and above **Minimum Admissible Score (**MAS) will be displayed on the website: **www.iapt.org.in** by **Dec 25, 2026. See the MAS clause** on the student's brochure on the web.

16. List of students eligible to appear for Indian National Biology Olympiad (INBO – 2027) shall be displayed on **www.iapt.org.in** by Dec 30, 2026.

ASSOCIATION OF TEACHERS IN BIOLOGICAL SCIENCES

NATIONAL STANDARD EXAMINATION IN BIOLOGY

(NSEB - 2026)

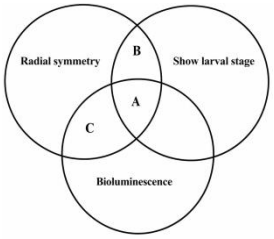
Time: 120 minute **Max. Marks: 216**

Attempt All Sixty Questions

A – 1

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION.

1. The Venn diagram below depicts three features observed in animal phyla. The major phyla that are characteristically attributed to Groups A and B are:



(a) A: Cnidaria, Ctenophora B: Echinodermata
(b) A: Arthropoda, Ctenophora B: Echinodermata
(c) A: Annelida, Cnidaria B: Mollusca
(d) A: Mollusca, Ctenophora B: Annelida

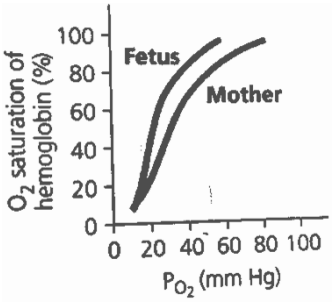
2. In a hypothetical situation, if the cells of the proximal convoluted tubules of the human nephrons are replaced by squamous epithelium, what would be the mostly likely outcome?
   (a) Creatinine will be detected in urine.
   (b) Urine will be highly acidic.
   (c) The person will show symptoms of diabetes like diuresis & glucosuria.
   (d) Plasma proteins will be detected in the urine.

3. A virus consists of nucleic acid enclosed in a protein coat. Researchers often describe viruses as leading a "borrowed life". Which of the following statement best support this phrase?
   i. Viruses are extremely small and structurally simple.
   ii. Viruses lack their own metabolic enzymes for protein synthesis.
   iii. Viruses are facultative intracellular parasites.
   iv. Viruses can replicate only within a living host cell.

   Select the most suitable combination.

   (a) i & iv (b) ii & iv (c) ii & iii (d) iii & iv

4. The haemoglobin of human foetus differs from that of adult haemoglobin. Compare the oxygen dissociation curves of these two types of haemoglobins given in the graph below.



   Based on the graph, four students gave the following interpretations. Select the one which is best supported by graph.
   (a) Maternal haemoglobin has a higher affinity for oxygen than foetal haemoglobin at high partial pressures of oxygen.
   (b) At any given partial pressure of oxygen, the oxygen saturation of foetal haemoglobin is lower than that of maternal haemoglobin.
   (c) A higher partial pressure of oxygen is required for foetal haemoglobin to achieve the same saturation as maternal haemoglobin.
   (d) The observed difference in oxygen dissociation curves likely facilitates oxygen uptake by the foetus in the placental environment.

5. In an *E. coli* mutant, the lac operator is altered so that the repressor cannot bind. How will this mutation affect β-galactosidase production when the cells are grown in different sugar conditions (with respect to glucose and lactose)?
   (a) Produced under all conditions.
   (b) Produced only when lactose is present.
   (c) Not produced when glucose is present.
   (d) Absent if lactose is absent.

6. The sickle cell allele (S) persists at a relatively high frequency in malaria-endemic regions. Individuals with genotype AS (heterozygotes) are less likely to suffer severe malaria compared to AA individuals, while SS individuals develop sickle cell disease.
   Which evolutionary mechanism best explains this persistence of the S allele?
   (a) Directional selection favouring the sickle allele (S).
   (b) Balancing selection due to heterozygote advantage.
   (c) Stabilizing selection eliminating both extremes (AA and SS).
   (d) Genetic drift maintaining a deleterious allele at high frequency.

7. The level of carbon monoxide (CO) in a room was found to be gradually increasing. The oxygen saturation (SpO_2) of a group of humans who were present in the room was measured periodically. The results are tabulated below.

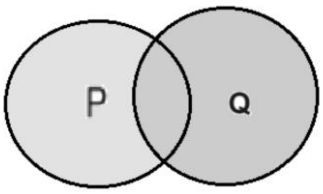
CO concentration in air (ppm)	**Average SpO_2 (%)**
0	98
50	94
100	89
200	78

   Which explanation best accounts for the observed decrease in oxygen saturation?

   (a) CO, having nearly 200–250 times higher affinity for haemoglobin than O_2, displaces O_2 from haemoglobin binding sites and reduces oxygen transport.
   (b) CO enhances the solubility of O_2 in plasma, decreasing its dependence on haemoglobin and thus lowering measured SpO_2.
   (c) CO binding shifts haemoglobin into a relaxed conformation, causing premature release of O_2 in tissues and lowering arterial oxygen levels.
   (d) High CO levels stimulate chemoreceptors, increasing respiratory rate and paradoxically lowering oxygen saturation.

8. In the laboratory, an isolated segment of an axon can conduct nerve impulses in both directions. However, in living organisms, nerve impulses travel predominantly in one direction only. Which of the following best explains the unidirectional propagation of nerve impulses in the body?
   (a) The presence of voltage-gated ion channels only at one end of the axon prevents backward transmission.
   (b) Neurotransmitters are released exclusively at axon terminals, ensuring signals propagate forward across synapses.
   (c) The refractory period temporarily inactivates recently depolarized membrane segments, preventing backward impulse conduction.
   (d) Myelin sheath insulation on axons physically blocks impulses from traveling backward.

9. Refer to the Venn diagram given below, where:



- Circle P = parts of the female reproductive system that support conception
- Circle Q = parts of the female reproductive system that support pregnancy (fetal growth upto delivery)
- Overlap = parts of the female reproductive system that support both conception and pregnancy

Identify which of the following parts belong to P, Q, or the overlapping region:

i. Ovary
ii. Oviduct (Fallopian tube)
iii. Uterus
iv. Placenta
v. Cervix

Which classification is most appropriate?

(a) P → (i, ii); Q → (iv, v); Overlap → (iii)
(b) P → (i, iii, v); Q → (iv); Overlap → (ii)
(c) P → (ii, iv); Q → (iii, v); Overlap → (i)
(d) P → (i, ii, v); Q → (iii, iv); Overlap → none

10. A social insect colony under predator attack would benefit most from which combination of pheromone characteristics?
    (a) Long duration with moderate range for sustained group coordination.
    (b) Short duration with wide range for rapid information spread.
    (c) Long duration with narrow range for precise location marking.
    (d) Moderate duration with wide range for territorial establishment.

11. During spring migration, researchers observe that young birds initially follow innate directional preferences but gradually modify their routes. This behavioural transition demonstrates:
    (a) Overriding of genetic programming with learned navigation.
    (b) Integration of innate orientation with experiential route optimisation.
    (c) Dominance of environmental cues over biological compass systems.
    (d) Evolution of navigation abilities within a single generation.

12. A researcher studies the temporal organisation of behaviours in a nocturnal primate species. The animals show:
    i. Peak foraging activity: 2 - 4 AM
    ii. Social grooming: 6 - 8 PM
    iii. Territorial calls: 10 - 11 PM
    iv. Rest period: 8 AM - 4 PM

    This behavioural rhythm is primarily regulated by which biological mechanism?

    (a) Circannual cycles synchronized with seasonal food availability.
    (b) Circadian oscillators entrained by photoperiod changes.
    (c) Social synchronization with other community members.
    (d) Thermoregulatory responses to ambient temperature cycles.

13. Cheetahs (*Acinonyx jubatus*) are known for extremely low genetic diversity. Studies show that skin grafts between unrelated individuals are often accepted without rejection, a phenomenon unusual for most mammals. Which statement best explains why cheetahs exhibit this unusual genetic similarity?
    (a) The bottleneck effect reduced population size drastically, and genetic drift led to loss of many alleles, leaving descendants genetically uniform.
    (b) Natural selection eliminated all harmful alleles, ensuring cheetahs became genetically identical over time.
    (c) The bottleneck effect increased mutation rates, causing all individuals to converge on the same genetic variants.
    (d) Hybridization with other species of cat family introduced uniformity across the population.

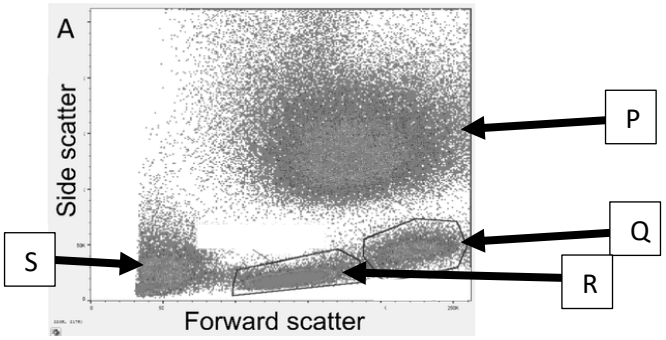
14. During a wildlife study in the Serengeti, researchers observed a group of Thomson's gazelles. When a lion appeared within 30 meters, about 60% of the gazelles displayed stotting (high vertical leaps with stiff legs). Interestingly, when the lion was farther away (about 80 meters), the frequency of stotting was much lower, at only 20%.
    Based on this behavioural pattern, what is the most logical evolutionary explanation for stotting in gazelles?
    (a) Stotting mainly functions as an alarm signal to warn conspecifics; higher stotting when predators are very close is because more individuals detect the predator.
    (b) Stotting specifically primes the muscles for an immediate escape; it increases as the predator gets closer to prepare for rapid flight.
    (c) Stotting is a pursuit-deterrent honest signal to predators showing fitness of the prey because higher stotting is associated with a lower probability that a lion will chase.
    (d) Stotting serves chiefly to confuse or startle the predator, so the frequency of stotting should be highest when group is using scatter tactics.

15. The Giant panda *(Ailuropoda melanoleuca)* and the Lesser red panda *(Ailurus fulgens)* are mammals from Asia that primarily eat bamboo. Despite their dietary similarity and similar name, the giant panda is phylogenetically related to bears (family Ursidae), while the red panda is the sister group to all canoid carnivores (dogs, raccoons, weasels, etc.). Given this information, what does this imply about the evolutionary grouping of 'Pandas'*?*
    (a) 'Pandas' form a monophyletic group since they share a similar diet and ecological niche.
    (b) 'Pandas' represent a paraphyletic group because the 'Giant panda group' excludes its closest relatives (other bears) from the group.
    (c) 'Pandas' represent a polyphyletic group because their similarities are due to convergent evolution, and not due to common ancestry.
    (d) 'Pandas' are an artificial group but still reflect evolutionary history since both belong to the order Carnivora.

16. Clinical tests were conducted on a family who slept in a poorly ventilated room, during winter using a charcoal heater. The test results showed:
    - Mean SpO_2 (by pulse oximeter) of 98%
    - Arterial O_2 content was severely reduced
    - Symptoms of headache, dizziness, cherry-red skin
    - Some members complained of disorientation.

    Which explanation best accounts for the clinical observations?
    (a) CO_2 decreases the amount of dissolved O_2 in plasma, resulting in inadequate oxygen transport despite normal SpO_2 values.
    (b) CO_2 increases the partial pressure of O_2 in blood, leading to falsely high SpO_2 readings and hypoxia in tissues.
    (c) CO binds to Hb with much higher affinity than O_2, forming carboxyhemoglobin, which falsely maintains SpO_2 readings but severely reduces oxygen delivery to tissues.
    (d) CO causes rapid hyperventilation, raising SpO_2 but paradoxically lowering oxygen content in the arterial blood.

17. In a flow cytometer, cells are analyzed for their size and internal density or granularity. The forward scatter is a measure of cell size, while the side scatter is a measure of intracellular density/granularity. Given below is the result of flow cytometry for blood cells. P, Q, R and S respectively indicate:



(a) P - Basophils, Q - Neutrophils, R - Monocytes, S - Platelets
(b) P - Neutrophils, Q - Monocytes, R - Lymphocytes, S - Erythrocytes
(c) P - Erythrocytes, Q - Lymphocytes, R - Monocytes, S - Platelets
(d) P - Eosinophils, Q - Basophils, R - Neutrophils, S - Lymphocytes.

18. Researchers measured SAP2 gene expression in clinical *C. albicans* isolates using qPCR, normalized to the housekeeping gene ACT1. Lower Ct values indicate higher expression.

Isolate ID	Source	Ct (SAP2)	Ct (ACT1)	ΔCt (SAP2–ACT1)
Pt1	Blood	26	19	7
	Vaginal swab	23	19	4
	Oral swab	28	20	8
Pt2	Blood	21	20	1
	Oral swab	25	20	5

Which of the following statements is true?

(a) Patient 1 is suffering from a very serious infection and needs medical intervention immediately as compared to Pt2.
(b) Pt2 has recovered from the infection with few lesions in oral cavity.
(c) Pt1 has moderate form of infection and oral gargling and topical ointments can help reduce the infection.
(d) Pt2 shows well spread infection and persistent colonisation in the oral cavity.

19. Abundance of specific intracellular organelles is closely associated with the metabolic and physiological demands of the cell. A few cell types/tissues are listed below.

I. Macrophages
II. Salivary glands
III. Ovary cells
IV. Pancreatic cells

The organelles that are especially abundant in them are respectively:

(a) Rough ER, Smooth ER, Mitochondria, Golgi bodies.
(b) Lysosomes, Smooth ER, Golgi bodies, Rough ER.
(c) Mitochondria, Rough ER, Nuclei, Smooth ER.
(d) Lysosomes, Golgi bodies, Smooth ER, Rough ER.

20. Few bacteria can produce enzyme lysine decarboxylase (LC) to utilize lysine as a carbon source when sugar is depleted. LC decarboxylates lysine to produce an amine. In order to know if the given bacterial species X contains this enzyme, the following experiment was done. A growth medium containing a pH indicator that turns yellow in acidic pH and purple in alkaline pH was prepared. The medium was divided into two tubes; to one tube only glucose was added and to the other tube glucose and lysine were added. The glucose concentration was adjusted to last 12 hours in both tubes. The media in both the tubes were yellow, and the tubes were inoculated with LC positive bacteria. What would be the expected color in the two tubes after incubation for 24 hours?

Option	Colour of tube containing glucose	Colour of the tube containing glucose + lysine
(a)	Purple	Purple
(b)	Yellow	Yellow
(c)	Purple	Yellow
(d)	Yellow	Purple

21. One can predict if an antibiotic is bactericidal or bacteriostatic based on the mechanism of action. Some statements with examples of different antibiotics and their respective modes of action are listed below:
    I. Penicillin that targets cell walls can be effectively used against mycoplasma infections.
    II. Erythromycin that acts as a 50S ribosomal subunit inhibitor can be used as an antibacterial against *B. subtilis*.
    III. Daptomycin that causes leakage of cellular contents and rapid death can be used as a bactericidal agent for Streptococci.
    IV. Ciprofloxacin that inhibits DNA gyrase and topoisomerase can be used as a bactericidal agent for *E. coli*.

    Which of the statements are correct?

    (a) III and IV only (b) II and III only (c) II, III and IV only (d) I and IV only

22. A surgical instrument was subjected to following two methods of sterilization:
    I. Treated with a chemical that kills 99.99% of the bacteria followed by two steps that each reduce the load by 1 log order
    II. Initial treatment that reduced bacterial load by 2 log orders and then treated with a disinfectant that kills 99.9% of live bacteria.

    Assuming the initial load on the instrument was 1×10^6 bacteria, which of the following statements is true?
    (a) Method I is preferred as it results in zero colony forming units.
    (b) Method II is preferred as it requires less number of steps hence, less chance of additional source of contamination.
    (c) Both methods are equally effective as both leave same number of colony forming units on the instrument.
    (d) Method I is preferred over II as it leaves less number of bacteria on the instrument.

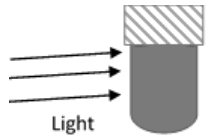
23. A few animals are listed below. Which of these are correctly described?
    i. Beetles: acoelomates with a chitinous exoskeleton
    ii. Snails: soft-bodied coelomates
    iii. Dinosaurs: segmented coelomates
    iv. Liver flukes: unsegmented coelomates
    v. Earthworms: segmented pseudo-coelomates

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

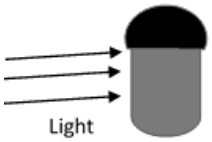
24. A patient's pancreatic duct is completely blocked, but the liver and salivary glands are functioning normally. Which of the following is **NOT** likely to happen?
    (a) Reduction in carbohydrate absorption. (b) Presence of oily stools.
    (c) Reduced protein absorption. (d) Pale coloured stools and itchy skin.

25. Naked mole rats live in large subterranean colonies in the dry hot regions where the temperature underground is generally warm and stable. They are nearly hairless and their skin lacks insulating layers of fat. When it is too cold, they huddle in large numbers, and body temperature can be as low as 15ºC. Their body metabolism is much lower than other rodents of their size. They can be most appropriately described as;
    (a) Endothermic homeotherms (b) Ectothermic poikilotherms
    (c) Ectothermic homeotherms (d) Endothermic poikilotherms

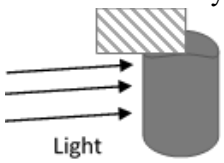
26. In which of the following conditions, negative phototropism will be observed in plant shoots?
    (a) Plant shoot tip is cut and placed on an agar block. The block is then placed on plant tip and light allowed only from one side.



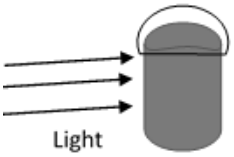
    (b) Plant shoot tip covered with non-transparent cap and light allowed to fall only from one side on the plant.



    (c) Plant grown in the dark for a few days. Then shoot tip cut. An agar block containing auxin is kept on one side of the cut tip and light allowed to fall only on the same side.



    (d) Plant kept in dark for a couple of days and then shoot tip covered with transparent cap and light allowed to fall only on one side.



27. Most carbon atoms found in the atmosphere are of atomic weight 12 (^{12}C). However, a few exist as radioactive isotope ^{14}C as a result of bombardment of particles from space. Thus, at any given time, there is a proportion of ^{14}C:^{12}C in the air.
    Consider samples tested for this ratio:

    (i) Grass → (ii) Grass moth → (iii) Mouse → (iv) Hawk

    From members i, ii, and iii in the above food chain and iv-a fossil skeleton of a hawk, what relationship is expected to be observed for ^{14}C:^{12}C ratio?
    (a) i > ii > iii > iv (b) i = ii > iii > iv (c) i > ii > iii < iv (d) i = ii = iii > iv

28. There are several factors that bring about evolutionary change. Select the factor along with its correct consequences:
    (a) Mutation: The sole source of adaptive evolutionary change.
    (b) Non-random mating: It alters allelic frequency and stabilises heterozygotes.
    (c) Migration: Results from movement of individuals or gene flow.
    (d) Genetic Drift: Non-random changes in allele frequencies occurring in small populations.

29. Which of the following factors can affect Tm (melting temperature) of a DNA strand?
    i. Salt concentration of reaction mixture
    ii. Total length of DNA strand
    iii. % GC content
    iv. Concentration of DNA in the reaction mixture.

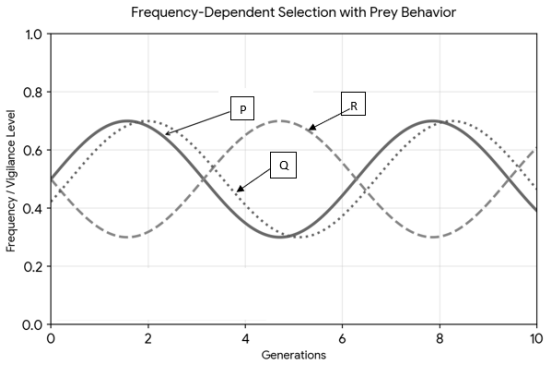
    (a) ii and iii only (b) only iii (c) i, and ii only (d) i, ii, iii and iv

30. Facultative anaerobe such as *E. coli* was grown under three different conditions as follows:
    I. Grown in media which contains optimum concentration of glucose (media X) with high aeration facility
    II. Grown in sealed container containing media X
    III. Grown in sealed container containing media X along with alternative electron acceptors like nitrates (NO_3^-)

    What is the correct order of doubling time (DT) of *E. coli* grown in the above three media?

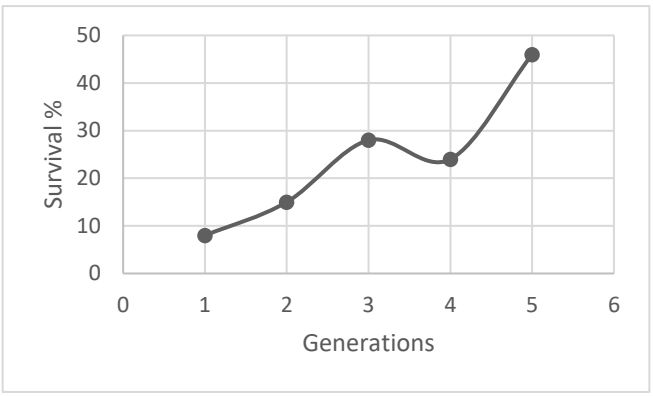
    (a) (DT) I > (DT) II > (DT) III (b) (DT) III > (DT) II > (DT) I
    (c) (DT) II > (DT) III > (DT) I (d) (DT) I > (DT) III > (DT) II

31. In the scale-eating cichlid fish, individuals have asymmetrical mouth openings where left-mouthed fish snatch scales from the right flank of prey, and right-mouthed fish attack the left flank. Scientists observed that the frequencies of left-mouthed and right-mouthed morphs oscillate across generations rather than one type dominating permanently.
    In the following graph P, Q and R indicate:



    (a) P: Prey vigilance defending right flank, Q: left-mouthed fish, R: Right-mouthed fish
    (b) P: Prey vigilance defending left flank, Q: right-mouthed fish, R: left-mouthed fish
    (c) P: left-mouthed fish, Q: Prey vigilance defending right flank, R: Right-mouthed fish
    (d) P: Right-mouthed fish, Q: left-mouthed fish, R: Prey vigilance defending right flank

32. The graph below shows the percentage survival of an insect population after pesticide treatment across six consecutive generations.



Which explanation best accounts for the observed pattern?

(a) The pesticide lost effectiveness because environmental factors like rainfall and sunlight reduced its concentration, creating apparent increases in survival with each new generation.
(b) Although some random fluctuations occur, resistant individuals survive pesticide exposure and reproduce, causing the frequency of resistant alleles to show an overall rise in the population.
(c) Each generation of insects gradually learns to avoid sprayed surfaces and passes this avoidance behaviour genetically to offspring, increasing survival percentages.
(d) The pesticide stimulated insects to develop stronger resistance mechanisms during their lifetime, and these traits were inherited by the next generation.

33. Speciation is a process by which genetically independent group of organisms are formed through the process of evolution. Steps that lead to allopatric speciation are given below. Their correct order is:

I II III IV



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

34. Proteins are large, complex macromolecules made of long chains of amino acids. Based on their structures, they can be broadly classified as fibrous or globular. The examples of globular and fibrous proteins respectively are:

(a) Immunoglobulins and aquaporins. (b) Myosin and actin.
(c) Collagen and pepsin. (d) Hemoglobin and collagen.

35. A life process P shows the following characteristics:

i. genetically regulated.
ii. involve chromatin condensation.
iii. require ATP
iv. absent in prokaryotes.
v. are important part of homeostasis.

P refers to:

(a) Mitosis (b) Meiosis
(c) Programmed cell death (d) Necrosis

36. When a green plant is kept in dark or very low light condition for a prolonged period, it shows morphological difference during growth. Which one of the following options correctly describe such a plant?
    (a) Thick stem, red leaves, short internodes
    (b) Profusely branched stem, green leaves, short internodes
    (c) Thin stem, yellow leaves, long internodes
    (d) Thick stem, large yellow leaves, long internodes

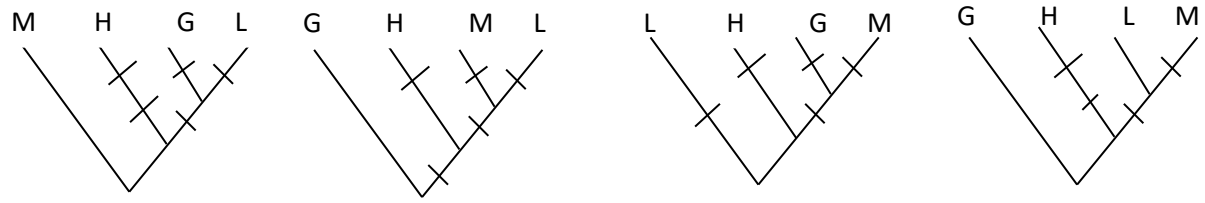
37. If a man with X-linked dominant disorder marries an unaffected woman, the phenotype of their children would be:
    (a) 50% of sons and 50% of daughters will be affected.
    (b) All daughters and sons will be affected.
    (c) Only sons will show the symptoms while all daughters will be carriers.
    (d) All daughters will show the symptoms and sons will be unaffected.

38. Thick waxy cuticles, reduced leaf surface area and widespread root systems are adaptations found in:
    (a) Hydrophytes and hygrophytes.
    (b) Halophytes and xerophytes.
    (c) Hydrophytes and mesophytes.
    (d) Halophytes and hygrophytes.

39. A few characteristics of cryptogams are tabulated.

	C1 Protected multicellular embryo	**C2** Peristome teeth	**C3** Oil bodies	**C4** Dominant gametophyte	**C5** Basal meristem in sporophyte
Moss (**M**)	1	1	0	1	0
Hornwort (**H**)	1	0	0	0	1
Green alga (**G**)	0	0	0	0	0
Liverwort (**L**)	1	0	1	1	0

Note: "1" indicates Prescence and "0" indicates absence of a particular characteristic.
Based on the data, the most appropriate cladogram is:



(a) (b) (c) (d)

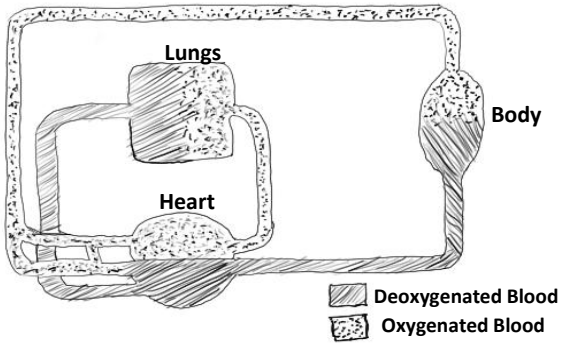
40. In a population of Superb fairywren, a socially monogamous male feeds chicks in a nest. Genetic analysis later reveals that due to extra-pair copulation, only 3 out of the 5 chicks in the nest are actually its biological offspring. If the male feeds all 5 chicks equally, what is the average genetic relatedness of the male to the chicks it is investing in?
    (a) 0.50 (b) 0.30 (c) 0.25 (d) 0.60

41. Different animals show different sensitivities to wavelengths of light depending on their sensory receptor cells, organ structures, and ecological needs. Few statements regarding three animals: X, Y and Z are made.
    I. Animal X shows peak sensitivity in infrared region.
    II. Animal Y has retina dominated almost entirely by rods that are highly specialized to detect the blue wavelengths of light.
    III. Animal Z shows sensitivity shift towards blue-green spectrum with rod dominance in retina.

    X, Y and Z most likely, respectively, are:

    (a) bee, bird, and primate.
    (b) mammal, shallow water fish, and bird.
    (c) snake, deep sea fish, and owl.
    (d) bird, mammal, and bee.

42. The circulatory system in crocodile is represented in the drawing below;



    Mark the correct statement.
    (a) The body always receives fully oxygenated blood.
    (b) When underwater for long hours, the blood is shunted to lungs from right ventricle.
    (c) When diving deep in water bodies, diverting the blood to brain is more advantageous.
    (d) The system is less efficient than that of an amphibian as the oxygenated and de-oxygenated blood gets mixed.

43. Coyotes and badgers hunt small mammals such as prairie dogs, ground squirrels, and rabbits. Coyotes are fast runners while badgers have powerful claws. They are often seen together in open grasslands. The relationship between them can be best described as:
    (a) Proto-cooperation (b) Mutualism (c) Commensalism (d) Amensalism

44. Biological membranes are selectively permeable, meaning they only let specific molecules pass through. This selective control allows cells to manage energy, communicate, and stay alive. However, membrane permeability can vary across different organs depending on the functions of the organs. The correct decreasing order of permeability in the human body is:
    (a) Brain > Liver > Kidney
    (b) Liver > Kidneys > brain
    (c) Skeletal muscles > Kidney > Liver
    (d) Brain > Intestine > Liver

45. Arabian babblers are social birds. Individual birds are seen feeding chicks and guarding the flock. A bird perched on a high branch as a guard; risks being seen by predators. While feeding, they are also known to feed chicks of unrelated birds.
    Which of the following is the correct interpretation?
    (a) This is a selfless act to protect their family and benefit the species.
    (b) Being social birds, they are hardwired to help members surrounding them.
    (c) By doing these chores, they showcase their fitness and thus increase their chances of getting a future mate.
    (d) Guarding and feeding of birds is not an energy demanding task and is a good strategy to survive in harsh environments by receiving benefits.

46. Stomata are microscopic pores found on the epidermis of leaves. Which of the following will lead to stomatal closure?
    i. High vapour pressure deficit
    ii. High soil moisture
    iii. Pathogen attack
    iv. Extremely low temperatur

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

47. Insect legs can show modifications based on the habitats they live in and the predominant functions such as moving, hunting, and gathering food. Four such modifications are listed below. Match them sequentially, against the correct insect.
    i. Long, slim legs
    ii. Hind legs with broad thighs
    iii. Broad fore legs shaped like shovels
    iv. Fore legs with spines

    (a) i: cockroach, ii: grasshopper, iii: mole cricket, iv: praying mantis
    (b) i: praying mantis, ii: grasshopper, iii: mole cricket, iv: cockroach
    (c) i: mole cricket, ii: grasshopper, iii: cockroach, iv: praying mantis
    (d) i: cockroach, ii: mole cricket, iii: grasshopper, iv: praying mantis

48. Three antibiotics are being considered for treating an infection caused by an antibiotic- resistant *E.coli* strain. Therapeutic index is the ratio of toxic dose to the effective dose of the antibiotic.

Antibiotic	**Toxic dose**	**Effective dose**	**Cost**
X	100mg	2mg	Inexpensive
Y	100µg	40µg	Inexpensive
Z	1mg	50 µg	Expensive

    Which of the following statements is true?
    (a) Drug Z should be the drug of choice as it is most effective although expensive.
    (b) Drug X should be the drug of choice as it is safer than drug Z and also inexpensive.
    (c) Y and Z should be preferred over X as they are more potent than X.
    (d) Y is a preferred drug as it is most effective and also least expensive.

A – 2
ANY NUMBER OF OPTIONS (4, 3, 2 or 1) MAY BE CORRECT
MARKS WILL BE AWARDED ONLY IF ALL THE CORRECT OPTIONS ARE BUBBLED AND NO INCORRECT.

49. Electrocardiograms of two individuals (1) and (2) are given below. ECG (2) shows a variation from the normal ECG(1).


(1)


(2)

In which of the following cases would you expect ECG (2)?

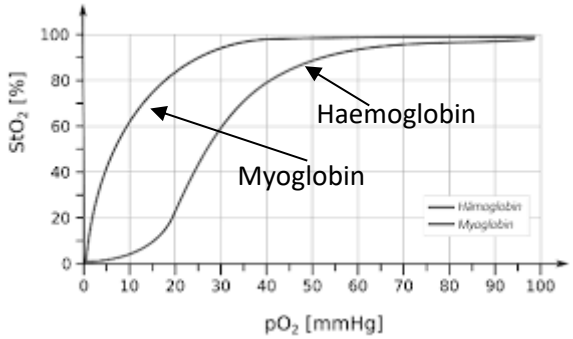
(a) An aged man
(b) A pregnant woman in her third trimester
(c) Person running on a treadmill
(d) Person showing persistent low levels of T3 & T4

50. In hospitals, medicines are administered intravenously to patients instead of intra-arterial route. Which of the following statements correctly justify the practice?
    (a) Veins carry deoxygenated blood so its overall chemical reactivity is very low.
    (b) Intravenous administration helps in even distribution of medicine throughout the body since veins drain blood into the heart.
    (c) Valves present in veins slow down the flow of medicine which helps in retaining it in vicinity of affected organ.
    (d) Intra-arterial injections have the risk of large dosage reaching under high pressure to the target organ.

51. In a population of 2,820 Shorthorn cattle, 260 are white, 1,430 are red, and 1,130 are roan. Which of the following assumptions are justified by the data?
    (a) The coat-colour trait is controlled by a single autosomal locus with two alleles showing codominance.
    (b) Mating with respect to this locus has been random in the population.
    (c) There is strong heterozygote advantage favouring roan individuals.
    (d) The data implies that there is no significant deviation from the Hardy–Weinberg law.

52. When two freshwater algae, spirogyra (cell diameter 5 μm and length 75 μm) and chlorella (cell diameter 14 μm) were grown in stagnant nutrient poor water, spirogyra was found to grow at a faster rate than chlorella. The most likely reasons are:
    (a) Spirogyra being a buoyant alga can remain on surface to capture light as compared to chlorella.
    (b) The elongated shape of spirogyra reduces total volume compared to sphere reducing its metabolic demand.
    (c) Loss of nutrients by diffusion is greater in chlorella due to shorter diffusion distance.
    (d) Spirogyra has greater surface area per unit volume enabling efficient nutrient absorption.

53. Oxygen saturation curves of haemoglobin and myoglobin are shown below.



What will happen if a mutant haemoglobin is discovered which shows oxygen saturation curve like myoglobin?

(a) The blood would load oxygen less efficiently in the lungs.
(b) It would fail to unload oxygen to working muscles and tissues.
(c) The loading of oxygen in the blood will worsen if such a person travels to higher altitudes.
(d) Body will upregulate synthesis of red blood cells.

54. In a state of metabolic overload such as obesity, the liver becomes packed with excess fat. As a result, specific lipid intermediates called sn-1,2-diacylglycerols (DAGs) accumulate in the cell membrane. DAGs activate a destructive enzyme called Protein Kinase C (PKC)**.** It physically attaches to and disables the insulin receptor. Uncouplers are chemicals which delink the process of electron transport via the respiratory complexes from ATP production. If mice with fatty liver are exposed to uncouplers, it will result in an increase in:

(a) insulin sensitivity.
(b) lipogenesis.
(c) VLDL synthesis by liver cells.
(d) beta oxidation of fatty acids.

55. A person experiences excessive summer heat for long period. Which of the following will be the immediate effects on the body physiology of that person?

(a) Widening of blood vessels near extremities
(b) Reduced brain perfusion
(c) Decrease in blood pressure
(d) Hypoventilation leading to respiratory acidosis

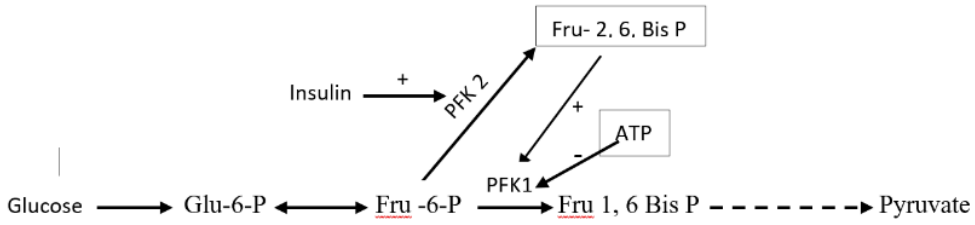
56. Along with light and carbon dioxide, plants require several nutrients for their optimum growth. A plant growing in soil type I showed yellowing of maturing leaves while plant growing in soil type II showed browning of tips of young leaves, yellowing in regions between the veins.
This could be explained as:

(a) Plant in soil I most likely lacked mobile nutrients such as nitrogen.
(b) Plant in soil II most likely lacked immobile nutrients such as calcium.
(c) Yellowing observed in plant in soil I is natural as a result of senescence.
(d) Observed fact in plant in soil II indicates excessive sunlight leading to bleaching of chlorophyll.

57. In yeast cells, mating type *a* secrete 'a factor' and cells of mating type *α* secrete 'α factor.' Each cell type has receptors that specifically detect the pheromone secreted by the opposite type, initiating signal transduction leading to mating. Considering this system, which explanations appropriately describes why yeast rely on chemical signalling for mate recognition instead of direct physical contact?

(a) Chemical signalling ensures that only cells of appropriate mating type recognize each other, preventing waste of energy on fusion attempts.
(b) Chemical signalling lowers the activation energy of membrane fusion, making the mating process energetically favourable.
(c) Direct physical contact relies entirely on random collisions, which is a highly inefficient process.
(d) Pheromones permanently bind to receptors, locking cells together and ensuring fusion occurs without error.

58. Part of the glycolytic pathway is shown below:



'+' indicates activation and '–' indicates inhibition.

Which of the following statements are true?

(a) In a well-fed state, insulin will trigger glycolysis.
(b) If PFK-2 is mutated, in a well-fed state, it will lead to hypoglycemia.
(c) Any mutation in PFK-1 or PFK-2 will lead to complete halt of glycolysis which will be lethal to cell.
(d) If the ATP binding site of enzyme PFK-1is altered, glycolysis will proceed regardless of energy level in the cell.

59. In some fish species, young ones are born as females and later in life, they transition to males. This is termed as protogyny. In others, young ones are born as males and later in life they transition to females. This is termed as protoandry. This type of sequential hermaphroditism evolved because the evolutionary model suggests that it is advantageous for an organism to be of one sex when young and the opposite sex when older.
In which of the following social systems, protoandry and protogyny will be favoured?

(a) Large male defends a territory, or it defends a harem of females → protoandry
(b) A larger female can carry and lay significantly more eggs → protogyny
(c) Mating system involves strict monogamous pairs → protoandry
(d) Polygynous mating system → protogyny.

60. *Vibrio cholerae* is an organism that causes severe intestinal infection through secretion of virulent cholera toxin. It can make biofilms to survive environmental stress. It also uses quorum sensing mechanism to regulate its virulence. Which of the following evolutionary strategies will make this organism's survival and propagation successful?
(a) At low cell density, the toxin genes are repressed.
(b) At high cell density, it reduces toxin production thereby prolonging host's life and optimising transmission.
(c) At low cell density, quorum sensing upregulates toxin production to prepare for dispersal.
(d) At high cell density, it represses the production of the biofilm matrix for effective dispersal.

Rough Work