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PREVIOUS YEAR PAPER · 2021-22

OLYMPIAD · STAGE I

IOQB

Indian Olympiad Qualifier in Biology (Part I)

2021-22

Question paper, answer key and Zigyan solutions

32	120	75 min	21
Questions	Maximum marks	Time	Paper code

Question paper and official answer key: Indian Association of Physics Teachers (IAPT), IOQB 2021-22, paper code 21.
Solutions and notes: Zigyan. This booklet is not an IAPT publication.

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AIR 168	AIR 811
	99.95 percentile



Sulokya Bibhuty

3 YEARS CLASSROOM

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OLYMPIAD RESULTS

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CHEMISTRY

- Sulokya Bibhuty — 3 Years Classroom
- Anay Gupta — 3 Years Classroom
- Akshat Khator — 3 Years Classroom
- Harshit Goyal — 4 Years Classroom
- Hardik Sharma — 3 Years Classroom
- Aarush Kumar — 1 Year Classroom

PHYSICS

- Sulokya Bibhuty — 3 Years Classroom
- Saksham Bishnoi — 4 Years Classroom

ASTRONOMY

- Sulokya Bibhuty — 3 Years Classroom

MATHEMATICS (IOQM)

- Priyanshi — 4 Years Classroom

Saksham Bishnoi qualified the Chemistry Olympiad twice and was selected for the Orientation-cum-Selection Camp at HBCSE, Mumbai.

16 selections	16 of 35	AIR 168
in JEE Advanced 2026	students of the batch selected	best JEE Advanced rank

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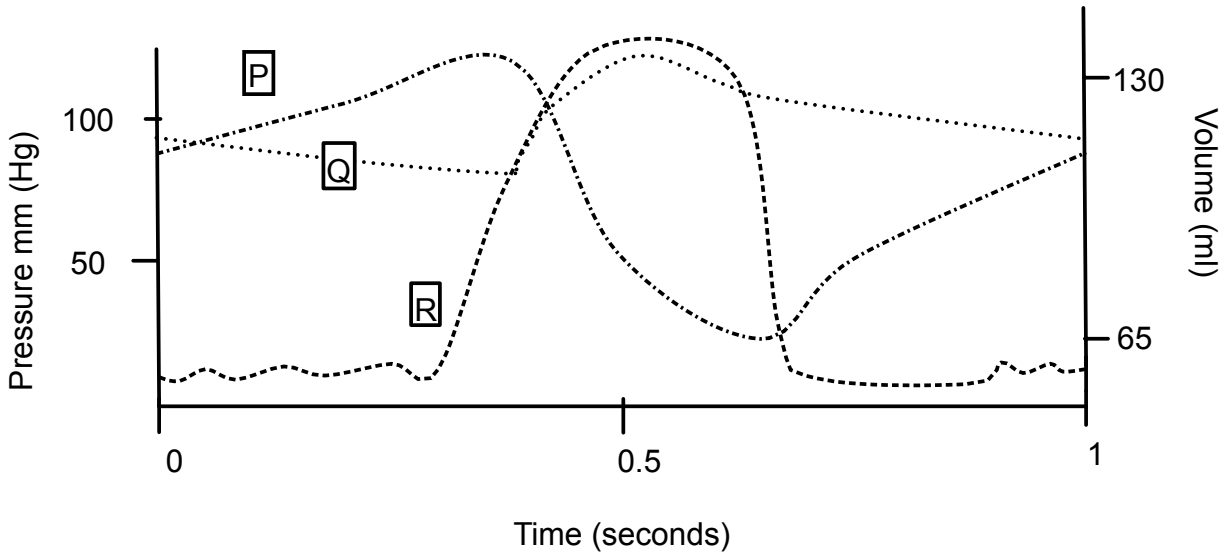
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PART A-1 · ONE CORRECT OPTION

Q. 1 – 24 · +3 for a correct answer, –1 for a wrong one

1. The rhythmic contraction (systole) and relaxation (diastole) of the ventricles constitute the cardiac cycle. The graphical representation below shows the pressure and volume changes during the cardiac cycle (for the left ventricle).



P, Q and R in the graph respectively represent:

(A) Pressure in left ventricle; Pressure in aorta and Volume in left ventricle.

(B) Volume in left ventricle; pressure in left ventricle and pressure in aorta.

(C) Pressure in left ventricle; volume in left ventricle and pressure in aorta.

(D) Volume in left ventricle; pressure in aorta and pressure in left ventricle.

Solution · Q1 **Answer: (D)**

P moves roughly between the 65 ml and 130 ml marks and falls while the ventricle ejects blood.

∴ P is the left ventricular volume.

Q stays high, never going much below 80 mm Hg.

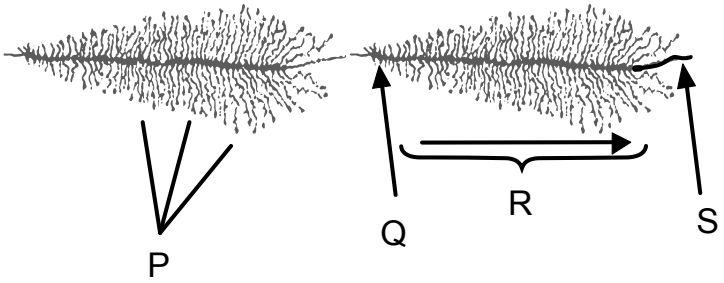
∴ Q is the aortic pressure.

R climbs from near zero to above 120 mm Hg and drops back.

∴ R is the left ventricular pressure.

IAPT answer: (D) | **Zigyan answer:** (D)

2. Transcription of multiple genes of rRNA is represented below. P, Q, R and S in the figure respectively indicate.



(A) DNA; start of transcription; RNA elongation and rRNA strands

(B) mRNA strands; RNA elongation; start of transcription and DNA

(C) rRNA strands; start of transcription; RNA elongation and DNA

(D) Start of transcription; RNA elongation; rRNA and DNA strands

Solution · Q2 **Answer: (C)**

Each feather-like unit is one rRNA gene being transcribed by many RNA polymerases together.

P: side branches, the growing rRNA strands.

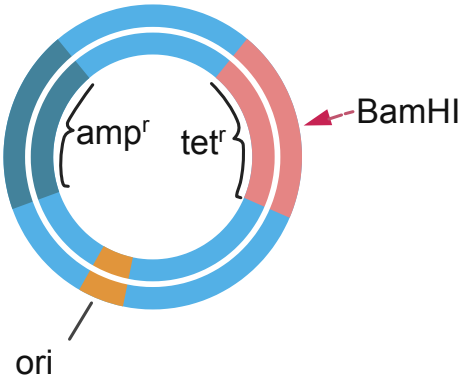
Q: end with the shortest branches, the start of transcription.

R: branches lengthen this way, the direction of RNA elongation.

S: central axis, the DNA.

IAPT answer: (C) | **Zigyan answer:** (C)

3. Reporter genes on plasmids are used in gene cloning experiments to determine the success of foreign DNA insertion. In an experiment, pBR322 plasmid, as shown below, was used as a vector and BamH1 was used as the restriction enzyme to carry out the DNA insertion and cloning. Amp^r and tet^r genes which confer resistance to ampicillin and tetracycline respectively were used as reporter genes.



Which of the following indicates the successful insertion of the foreign DNA?

(A) Cells will grow on medium containing ampicillin and tetracycline.
(B) Cells will grow on media with tetracycline but not with ampicillin.
(C) Cells will only grow on media without any antibiotic.
(D) Cells will show resistance to ampicillin but not to tetracycline.

Solution · Q3 **Answer: (D)**

In pBR322 the BamHI site lies within the tet^r gene.

Foreign DNA inserted there inactivates tet^r, while amp^r stays intact.

∴ Recombinant cells resist ampicillin but not tetracycline.

IAPT answer: (D) | **Zigyan answer:** (D)

4. As part of cloning Dolly, the sheep, biologist Ian Wilmut took differentiated cells from an ewe's udder and starved them of nutrients for a week. One of these cells was then fused with an enucleated egg from a different breed of ewe and nutrients for the further development of the egg were provided. Starvation of the differentiated cells halts the cells in which phase of the cell cycle?

(A) M (B) G1 (C) S (D) G2

Solution · Q4 **Answer: (B)**

Cells starved of nutrients and growth factors do not pass from G1 into S phase.

From G1 they enter the resting (quiescent) stage called G0.

∴ Among the given phases, the arrest is in G1.

IAPT answer: (B) | **Zigyan answer:** (B)

5. During the development of sea urchin embryos, the position of the polar body establishes the animal (upper) pole and the vegetal (lower) pole. After fertilization and cell division upto the 8-cell stage, a developmental biologist used a glass needle to bisect the embryos horizontally (Set 1) and vertically (Set 2). The results of the treatments were as follows:

Set 1: Cells of upper half remained embryonic while cells of lower half developed into small abnormal larvae.

Set 2: Normal but small larvae developed.

Which of the following can be concluded from this experiment?

(A) The right and left half of the embryo differ in their developmental potential.

(B) There is no asymmetry in the early embryos.

(C) The animal and vegetal halves of the embryos differ in the composition of cytoplasmic determinants.

(D) Segregation of nuclear components alone play a role in determining the developmental fate of cells.

Solution · Q5 **Answer: (C)**

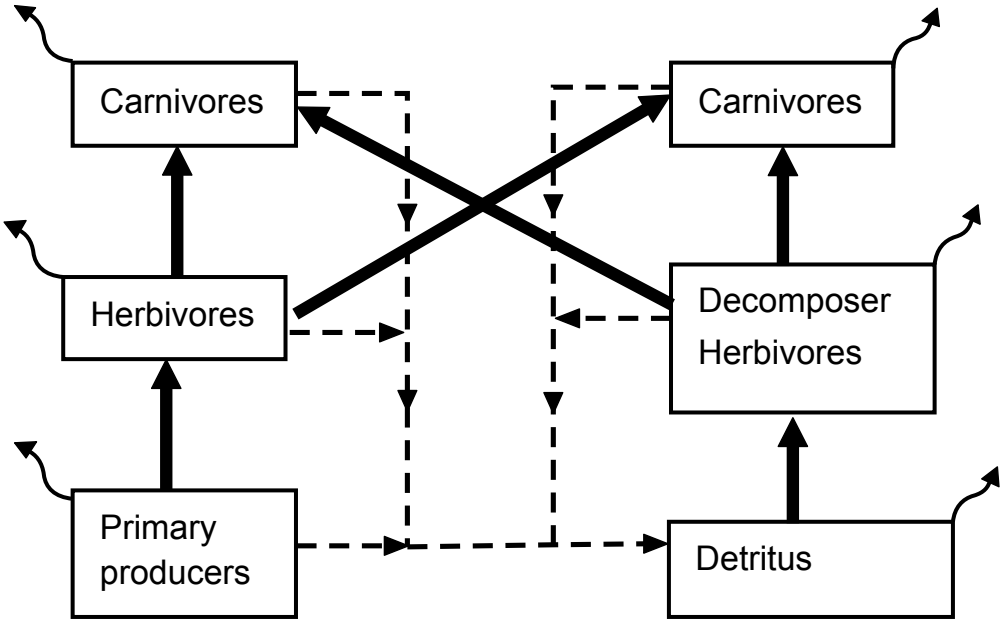
Set 2: each vertical half gets both animal and vegetal cytoplasm, so it forms a normal small larva.

Set 1: each horizontal half gets only one of these regions, so neither develops normally.

∴ The animal and vegetal halves differ in their cytoplasmic determinants.

IAPT answer: (C) | **Zigyan answer:** (C)

6. The figure below depicts two parts of an ecosystem namely the grazing food chain and the detrital food chain.



The solid arrows, curved arrows and dashed arrows respectively represent:

(A) Energy flow; dead organic matter; respiration.

(B) Energy flow; respiration; dead organic matter & waste products.

(C) Total biomass; unconsumed biomass; faeces & urine.

(D) Unconsumed biomass; waste products; energy flow.

Solution · Q6 **Answer: (B)**

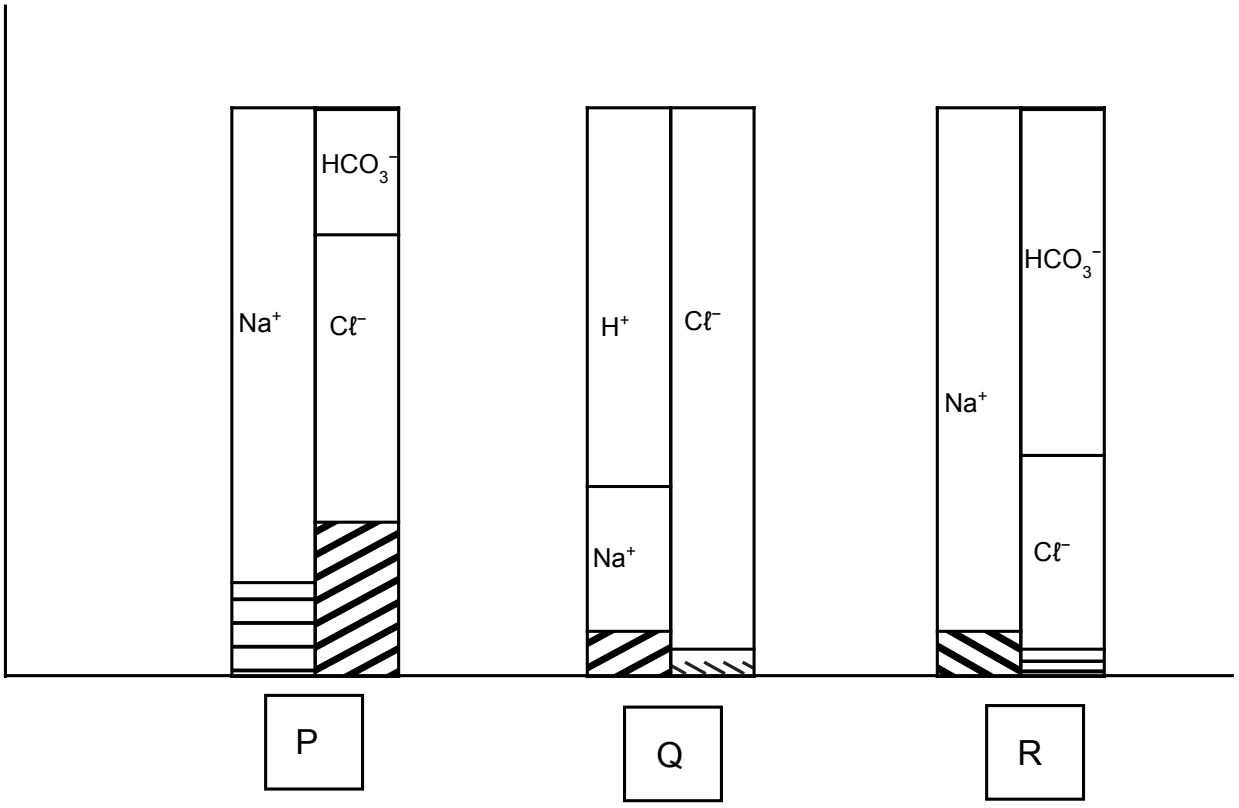
Solid arrows go from food to feeder: energy flow.

Curved arrows leave every compartment: loss through respiration.

Dashed arrows lead to detritus: dead organic matter and waste products.

IAPT answer: (B) | **Zigyan answer:** (B)

7. Relative compositions of major electrolytes in three body secretions in humans are depicted. Shaded regions represent other constituents.



The three secretions P, Q and R most likely represent (respectively):

(A) Blood plasma, gastric juice and gastric mucus.

(B) Blood plasma, gastric juice and pancreatic juice.

(C) Jejunal secretions, gastric mucus and bile.

(D) Gastric juice, hepatic duct secretion and pancreatic juice.

Solution · Q7 **Answer: (B)**

P: mainly Na^+ and $C\ell^-$, a little HCO_3^- and a sizeable share of other anions, as in blood plasma.

Q: H^+ is the chief cation and $C\ell^-$ almost the only anion, as in gastric juice.

R: Na^+ with more HCO_3^- than $C\ell^-$, as in pancreatic juice.

IAPT answer: (B) | **Zigyan answer:** (B)

8. Type I diabetes, if untreated leads to a cascade of events culminating in to coma or death.

Some of these events are listed below. Arrange them in the correct order.

I. Circulatory failure

II. Glucosuria

III. Renal threshold for glucose exceeded

IV. Blood volume and blood pressure drop

V. Hyperglycemia

VI. Osmotic diuresis and polyuria

The correct order is:

(A) II → III → V → VI → IV → I

(B) V → II → I → III → VI → IV

(C) V → III → II → VI → IV → I

(D) III → II → V → I → Vi → IV

Solution · Q8 **Answer: (C)**

Lack of insulin raises blood glucose.

Above the renal threshold, glucose appears in urine and draws water with it (osmotic diuresis, polyuria).

The water loss lowers blood volume and pressure, ending in circulatory failure.

V → III → II → VI → IV → I

IAPT answer: (C) | **Zigyan answer:** (C)

9. Description of a few biomolecules is given below.

I: When oxidized it can give as many as 544 ATP molecules by consuming 26 oxygen molecules.

II: This is the only biomolecule that can generate energy aerobically as well as anaerobically.

I and II respectively refer to:

(A) Fatty acid and amino acid

(B) Glycerol and glucose

(C) Glycerol and fatty acid

(D) Fatty acid and glucose

Solution · Q9 **As per Zigyan: (D)**

I: one molecule of stearic acid, a fatty acid, needs exactly 26 O_2 for complete oxidation.

$C_{18}H_{36}O_2 + 26O_2 \rightarrow 18CO_2 + 18H_2O$

The printed figure of 544 ATP is wrong: this oxidation gives about 146 ATP by the older count (about 120 by the newer one).

II: glucose gives ATP in aerobic respiration, and also without oxygen through glycolysis followed by fermentation.

Reference: NCERT Biology Class XI, Chapter 12 'Respiration in Plants', section 12.3: in fermentation glucose is partly oxidised without oxygen; section 12.6: fatty acids used in respiration are first degraded to acetyl CoA.

Check: older count for stearic acid: 35 NADH, 17 $FADH_2$ and 9 GTP, less 2 ATP for activation; 35 × 3 + 17 × 2 + 9 − 2 gives 146. Reoxidising the 35 NADH and 17 $FADH_2$ needs 26 O_2.

IAPT answer: (D) | **Zigyan answer:** (D)

10. Researchers were studying the effect of mineral Z on plant growth. They were also looking for its effect on seed germination. They grew barley plants for three generations in 0.0, 0.6 and 1.0 μM solutions of mineral Z. They harvested seeds from the third-generation plants of each group. After estimating the mineral concentration using a few seeds from every group, they remaining seeds were sown on 'mineral Z free' medium to check the germination success. Which of the following plots will help drawing appropriate conclusion?

(A) X: Mineral Z concentration in nutrient solution, Y: Mineral Z concentration in seeds.

(B) X: Mineral Z concentration in seeds, Y: Percentage germination

(C) X: Mineral Z concentration in nutrient solution, Y: Length of coleoptile

(D) X: Mineral Z concentration in seeds, Y: Rate of germination

Solution · Q10 **Answer: (B)**

On the Z-free medium a seed can depend only on its own store of Z.

Germination success is the percentage of seeds that germinate.

∴ Plot percentage germination against the concentration of Z in the seeds.

IAPT answer: (B) | **Zigyan answer:** (B)

11. When two frog species *Hyla ewingi* and *Hyla verreauxi* were studied on three distant islands, following patterns of oscillograms (songs) were obtained.

Hyla ewingi

I

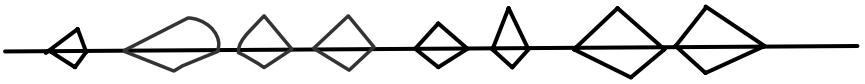


II



Hyla verreauxi

III



IV



Mark the correct statement.

(A) *H. ewingi* with song pattern I and *H. verreauxi* with song pattern III are likely to co-exist on the same island.

(B) *H. ewingi* with song pattern II and *H. verreauxi* with song pattern IV are likely to be staying on the same island.

(C) *H. ewingi* with song pattern I and *H. verreauxi* with song pattern III are likely to be freely interbreeding on one of the islands.

(D) Species *H. verreauxi* shows greater genetic variability than *H. ewingi*.

Solution · Q11 **Answer: (B)**

Where related species live together, their mating calls diverge so that wrong matings are avoided (reproductive character displacement).

Pattern III of *H. verreauxi* is a set of separate pulses, much like *H. ewingi*; pattern IV is strikingly different.

∴ *H. ewingi* with pattern II and *H. verreauxi* with pattern IV are likely to share an island.

IAPT answer: (B) | **Zigyan answer:** (B)

12. A vast country has a time difference of 3 hrs between the east and west coasts. Regular football matches are played between the East Coast Team (ECT) and the West Coast Team (WCT) of this country. The venue is always a West Coast or East Coast. Considering the effect of day-night cycle on athletic performance, which of the following statements about the outcome of the matches?

(A) Night matches will always be advantageous for West Coast players as their training time and match time overlap.

(B) Matches played during day hours in summer will yield better performance of East Coast players.

(C) The outcome of the matches will depend on which team has to travel to the venue.

(D) Variation in the day-night temperature can affect the overall performance of athletes, thus favoring one team over the other.

Solution · Q12 **As per Zigyan: (A)**

Athletic performance changes with the time shown by the body clock and is better around late afternoon than late at night.

A visiting team on a short trip keeps its home clock, 3 hrs apart from the other team's clock. In a night match at either venue, the West Coast clock reads 3 hrs earlier, nearer to the better time.

So the West Coast edge at night does not shift with the travelling team, and it comes from the body clock, not from air temperature.

Reference: Smith RS, Guilleminault C and Efron B, 'Circadian rhythms and enhanced athletic performance in the National Football League', Sleep, 1997, 20(5), 362–365 (abstract, Stanford Health Care publications page): in Monday night professional football games starting at 9 p.m. Eastern time, West Coast teams won more often, and by more points per game, than East Coast teams.

IAPT answer: (A) | **Zigyan answer:** (A)

13. A group of scientists was working on the effect of different wavelengths of light on seed germination. They placed hundred *Vigna unguiculata* (Cowpea) seeds in different petridishes containing sand soaked with nutrient solution. Each Petridish was exposed to a different wavelength of light up to 96 hrs. If we arrange the plates in descending order of the percentage germination found at different wavelength of light, the most accurate sequence will be:

(A) Green> Yellow > Blue > Red

(B) Blue > Red > Green > Yellow

(C) Yellow > Green > Red > Blue

(D) Red > Blue > Yellow > Green

Solution · Q13 **Answer: (D)**

Red light converts phytochrome Pr into Pfr, the active form that promotes germination.

So germination is highest in red light, while green light is the least effective. Only (D) begins with red and ends with green.

IAPT answer: (D) | **Zigyan answer:** (D)

14. *Salvia* has commercial value for its bright beautiful inflorescence. Consider a situation where this short day plant is cultivated under controlled environment of greenhouse. It is subjected to only 9 hours of light condition every day to get the best yield. One day the worker accidentally flashed *Far red* light night over a new batch of plants which were yet to bear flowers. What should be done to make the plant flower normally?

(A) A flash of red light need to be given during the same night.

(B) The whole batch should be kept in 24 hr darkness for the next day.

(C) The day time needs to be interrupted by momentary dark period.

(D) There is no need to do anything as it will not affect flowering.

Solution · Q14 **Answer: (D)**

Salvia, a short day plant, needs a long, unbroken night to flower.

A red flash forms Pfr, which breaks the night and stops flowering.

A far-red flash only turns phytochrome to the Pr form, so the night is not broken. No correction is needed.

IAPT answer: (D) | **Zigyan answer:** (D)

15. Meena bought new bird feeder. She filled it with bird food and hung it over a window near her study table. After a few days, sparrows started approaching the feeder but they continued to fly away as soon as they felt Meena's presence. Meena's mother advised her to avoid approaching the window when sparrows were picking food. She also told her to ignore them and not to show any sudden movements when they were nearby. In a couple of weeks, the sparrows started visiting the feeder even when Meena was sitting at her table near the window. This is an example of:

(A) associative learning (B) habituation

(C) imprinting (D) altruism

Solution · Q15 **Answer: (B)**

Habituation is the gradual loss of response to a repeated stimulus that brings neither harm nor reward.

Meena stayed harmless and ignored the sparrows, so they stopped flying away.

IAPT answer: (B) | **Zigyan answer:** (B)

16. A team of researchers in an agricultural research institute was working on two varieties of commercially important crop having genotypes PpQQRr and PPQqrr respectively. They were trying to get PpQqRr hybrid by crossing the above two types. What is the probability of getting the expected genotype?

(A) 1/6 (B) 1/8 (C) 1/2 (D) 1/4

Solution · Q16 **Answer: (B)**

The three genes assort independently.

For Pp × PP:

Pp = 1/2

For QQ × Qq:

Qq = 1/2

For Rr × rr:

$$Rr = 1/2$$

$$\Rightarrow PpQqRr = 1/2 \times 1/2 \times 1/2$$

$$\therefore PpQqRr = 1/8$$

IAPT answer: (B) | **Zigyan answer:** (B)

17. The following table indicates the different effects imposed by two species P and Q on each other. The '+' sign indicates growth of the population while '–' is for decrease in the same. The'0' sign is given for 'no effect'.

Types of interaction	Effect on growth and survival of Population P and Q			
	When not interacting		When Interacting	
	P	Q	P	Q
i	0	0	–	0
ii	–	0	+	0
iii	0	0	+	+
iv	–	–	+	+

The types of interaction i, ii, iii and iv respectively are:

(A) Ammensalism, Parasitism, Mutualism, Neutralism

(B) Ammensalism, Commensalism, Protocooperation, Mutualism

(C) Commensalism, Competition, Neutralism, Protocooperation

(D) Commensalism, Neutralism, Parasitism, Competition

Solution · Q17 **Answer: (B)**

i: P is harmed and Q is unaffected, so it is amensalism.

ii: P, which suffers alone, gains and Q is unaffected, so it is commensalism.

iii: Both gain but neither suffers alone, so it is protocooperation.

iv: Both suffer alone and both gain together, so it is obligatory mutualism.

IAPT answer: (B) | **Zigyan answer:** (B)

18. Carbon dating is a process where age of certain fossils or old artifacts is determined with the help of its C^{14} content. All the living organisms have C^{12} and C^{14} in a certain proportion as it is continuously maintained in equilibrium with the surrounding environment. As the organism dies, C^{14} being unstable, starts decreasing in amount. Its half life is around 5700 years.

One such fossil sample obtained by archaeologists had 0.185 mg of C^{14} content. If the C^{14} was 0.26 mg at the time of death of the organism. How old is the fossil?

(A) 1000-1500 years
(B) Around 3000 years
(C) 6000 years approximately
(D) 10,000-12,000 years old.

Solution · Q18 **Answer: (B)**

Radioactive decay of C^{14}:

$$0.185 = 0.26 \times (1/2)^{t/5700}$$

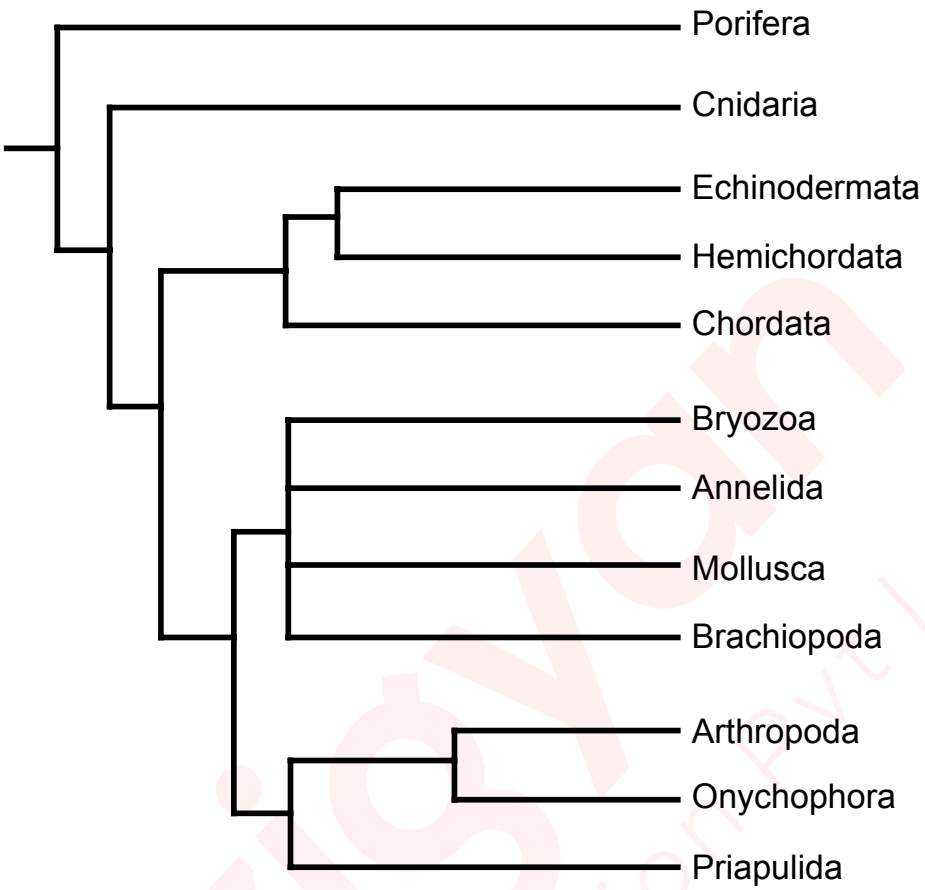
$$\Rightarrow t = 5700 \times \log_2(0.26/0.185)$$

$\Rightarrow t \approx 2800$ years

So the fossil is around 3000 years old.

IAPT answer: (B) | **Zigyan answer:** (B)

19. Observe the following cladogram and determine which one is the ***false*** statement from the given options:



(A) Bryozoa, Annelida, Mollusca and Brachiopoda are monophyletic taxa.

(B) Chordata is as distantly related to Echinodermata as Hemichordata.

(C) Cnidaria is the earliest evolved class after Porifera.

(D) Arthropoda, Onychophora and Priapulida form paraphyletic group.

Solution · Q19 **Answer: (D)**

A paraphyletic group has a common ancestor and only some of its descendants.

Arthropoda, Onychophora and Priapulida are all the descendants of one node, so they are monophyletic. Hence (D) is false.

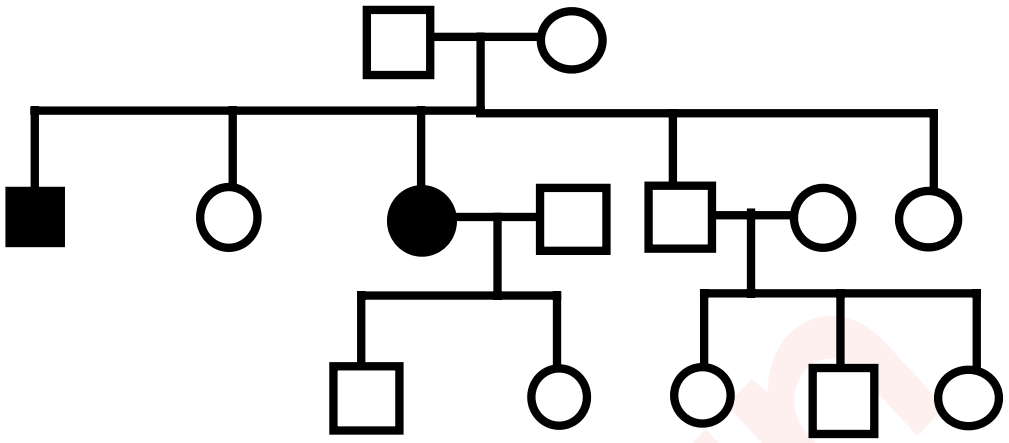
(A): the four phyla arise from one node.

(B): Chordata is the sister group of Echinodermata and Hemichordata together.

(C): Cnidaria branches off next after Porifera.

IAPT answer: (D) | **Zigyan answer:** (D)

20. The inheritance in the following pedigree chart is of:



(A) Autosomal Dominant
(B) Autosomal Recessive
(C) X-lined Dominant
(D) X-linked Recessive

Solution · Q20 **Answer: (B)**

Unaffected parents have affected children, so the trait is recessive.

An affected daughter has an unaffected father. In X-linked recessive inheritance her father would have to be affected.

∴ The inheritance is autosomal recessive.

IAPT answer: (B) | **Zigyan answer:** (B)

21. Photoconversion of phytochrome Pr to Pfr leads to regulation of gene expressions related to which of the following?

I. Opening and greening of cotyledons
II. Shade avoidance
III. Etiolation
IV. Hydrotropism
V. Geotropism
VI. Flowering

(A) I, II, III & VI
(B) II, IV, V & VI
(C) Only I, II & VI
(D) Only II, IV & V

Solution · Q21 **As per Zigyan: (C)**

Light turns Pr into the active form Pfr, which changes gene expression.

I: cotyledons open and turn green.

II: shade avoidance is controlled by the Pr–Pfr balance, set by the red to far-red ratio.

VI: phytochrome regulates flowering.

III is the growth pattern of dark-grown seedlings, seen without Pfr. IV and V are tropisms related to water and gravity.

Reference: Franklin KA and Quail PH, 'Phytochrome functions in *Arabidopsis* development', Journal of Experimental Botany, 2010, 61, 11–24: Pfr is the biologically active form; phytochromes act in de-etiolation, including cotyledon expansion and chlorophyll formation, in shade avoidance and in flowering; dark-grown seedlings keep a long hypocotyl and unexpanded cotyledons.

IAPT answer: (C) | **Zigyan answer:** (C)

22. A statement and two assumptions, I and II are provided below. Choose the correct option from the options given below-

Statement- Tropical plants develop adaptations to maintain the rate of photosynthesis to overcome the limitation of CO_2 concentration.

Assumption I- Intense light and high temperature induce partial to total closure of stomata.

Assumption II- In C_3 plants RBPCase behaves as oxidase while in C_4 plants PEPCase fixes CO_2 at low concentrations.

(A) If only assumption I is implicit.
(B) If only assumption II is implicit.
(C) If neither I nor II is implicit.
(D) If both I and II are implicit

Solution · Q22 **Answer: (D)**

In the tropics, intense light and high temperature make stomata close partly or fully, which cuts the supply of CO_2. This is why CO_2 becomes limiting (I).

At low CO_2, RuBisCO of C_3 plants acts as an oxygenase, but PEPCase of C_4 plants still fixes CO_2. This is why such an adaptation keeps up the rate (II).

∴ Both I and II are implicit.

IAPT answer: (D) | **Zigyan answer:** (D)

23. The loading of photosynthates from mesophyll cells into sieve tubes is sensitive to oxygen shortage and metabolic inhibitors suggesting that the process is:

(A) Concentration dependent
(B) Spontaneous
(C) Facilitated diffusion
(D) Active- ATP dependent

Solution · Q23 **Answer: (D)**

Oxygen shortage and metabolic inhibitors cut the ATP supply, and loading is affected by both.

∴ phloem loading is active, ATP-dependent transport.

IAPT answer: (D) | **Zigyan answer:** (D)

24. Evaluate following statements and choose the correct option;

I. Statement: In a person having hyperthyroidism, there are high chances of infection of *Helicobacter pylori*.

II. Reason: One of the symptoms of the infection by *H. pylori* is bloody/ black vomit.

(A) Both I and II are correct but II cannot explain I
(B) Both I and II are correct and II explains I
(C) Only I is true and II false
(D) Both I and II are false

Solution · Q24 **Answer: (A)**

I is correct: *H. pylori* infection is reported more often in hyperthyroidism due to Graves' disease.

II is correct: *H. pylori* causes peptic ulcer, and a bleeding ulcer gives bloody or black vomit.

A symptom of the infection cannot be the cause of its higher chance.

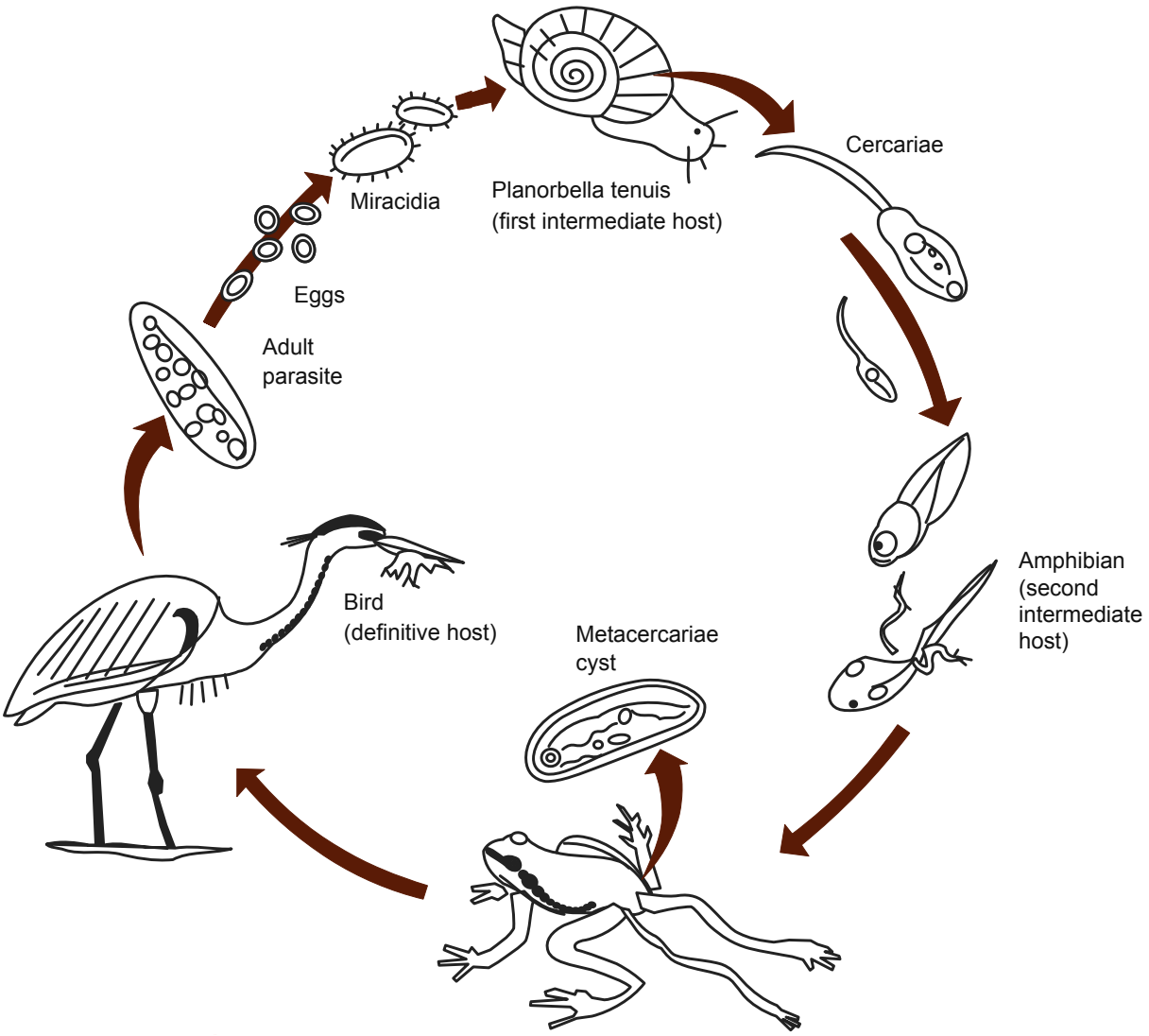
∴ II does not explain I.

IAPT answer: (A) | **Zigyan answer:** (A)

PART A-2 · ONE OR MORE CORRECT OPTIONS

Q. 25 – 32 · 6 marks only if all correct options are marked · no negative marking

25. Trematode lifecycle in shown alongside. What could be the explanation for the lifecycle ?: (Choose the correct answers)



(A) The final host of the parasite is snail and uses the bird dropping to gain access to soil.

(B) The parasitic infection causes supernumerary limbs to develop in tadpoles.

(C) The final host of parasite is bird, so by ensuring food, the parasite gains entry into the final host.

(D) The parasite enters the tadpoles of frogs and accelerates their metamorphosis into frogs.

Solution · Q25 **Answer: (B), (C)**

(A) The bird is the definitive host and the snail is the first intermediate host ∴ false.

(B) The frog in the cycle has extra limbs, as infection disturbs limb development in the tadpole ∴ true.

(C) A deformed frog escapes poorly, so the bird gets easy food and the parasite reaches its final host ∴ true.

(D) The cycle gives no sign of faster metamorphosis ∴ false.

IAPT answer: (B), (C) | **Zigyan answer:** (B), (C)

26. Consider two populations each with 200 diploid individuals. The genotypic distribution of people for a gene with dominant allele 'A' and recessive allele 'a' for population I is 90AA, 40Aa and 70aa while for population II the distribution is 45AA, 130Aa and 25aa. Which of the following statements are true?

(A) Population I is in Hardy Weinberg equilibrium while population II is not.

(B) Both the populations have the same allele frequencies for 'A' and 'a'.

(C) Genetic variation of the two populations is the same.

(D) Allele frequency of the recessive allele for population II is 0.55.

Solution · Q26 **As per Zigyan: (B), (C)**

For population I:

$$p = \frac{2 \times 90 + 40}{400}$$

$$\Rightarrow p = 0.55,\ q = 0.45$$

For population II:

$$p = \frac{2 \times 45 + 130}{400}$$

$$\Rightarrow p = 0.55,\ q = 0.45$$

Hardy–Weinberg numbers expected in each:

$$200p^2 = 60.5$$

$$200 \times 2pq = 99$$

$$200q^2 = 40.5$$

(A) Neither population has these counts, so neither is in equilibrium ∴ false.

(B) The allele frequencies match ∴ true.

(D) The recessive allele frequency is 0.45 ∴ false.

(C) Gene diversity, a measure of genetic variation, uses allele frequencies. For each population:

$$H = 1 - (0.55^2 + 0.45^2)$$

$$\Rightarrow H = 0.495$$

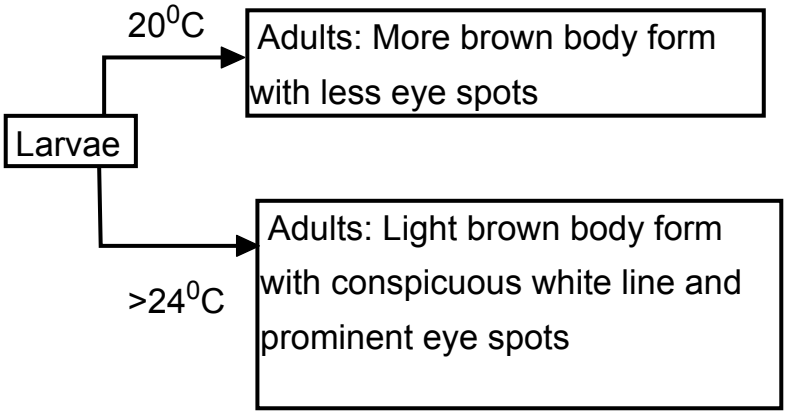
∴ (C) is true.

Reference: DeGiorgio and Rosenberg, 'An unbiased estimator of gene diversity in samples containing related individuals', Molecular Biology and Evolution (2009), Introduction and Simulations: gene diversity (expected heterozygosity) is a frequently used measure of genetic variation; it is one minus the sum of the squared allele frequencies.

IAPT answer: (B), (C) | **Zigyan answer:** (B), (C)

27. The West African butterfly *Bicyclus anynana* has two colour forms. During the dry season most butterflies rest on the dry forest floor much of the time while the wet-season form is the more active form. The distal-less gene in this organism is responsible for the eye- spot formation which helps the butterflies to adapt to different seasons.

Larvae that develop at temperatures <20^{0}C give rise to adult butterflies that have a more brown body form with less eye spots while the larvae developing at >24^{0}C give rise to adults with lighter body form with conspicuous white line and prominent eye spots.



Which of the following statement/s is/ are correct?

(A) Pupae developing under temperatures <20^{0}C produce the dry season form.

(B) During pupal development, the area over which distal-less is expressed decreases with risein temperature.

(C) The wet-season form possesses more prominent eye spots that helps in escaping predation by birds.

(D) The expression of distal-less gene is subdued in the wet-season form.

Solution · Q27 **Answer: (A), (C)**

Development below 20 °C gives the brown dry-season form, and above 24 °C the wet-season form with prominent eyespots.

(A) Pupae from the cool conditions emerge as the dry-season form ∴ true.

(B) Eyespots made under distal-less control are larger when warmer, so its area does not decrease ∴ false.

(C) Prominent eyespots draw a bird's attack away from the vital body parts ∴ true.

(D) Prominent eyespots go with strong distal-less expression ∴ false.

IAPT answer: (A), (C) | **Zigyan answer:** (A), (C)

28. Woodlice show the following behavioral patterns:

I. They show negative phototactic response during the day and positive response to humidity.

II. During night, they show negative phototaxis and less pronounced positive response tohumidity.

III. Under extreme low humidity, they show weakly positive phototactic response.

Which of the following statements are true?

(A) The possibility of woodlice moving through dry places is higher at night.

(B) Light is always a stronger cue for woodlice as compared to humidity.

(C) The behavioral traits show that photoperiod has a direct influence on its survival.

(D) All the three behavioral traits have adaptive significance.

Solution · Q28 **Answer: (A), (D)**

(A) At night the response to humidity is weaker, so they can cross drier places ∴ true.

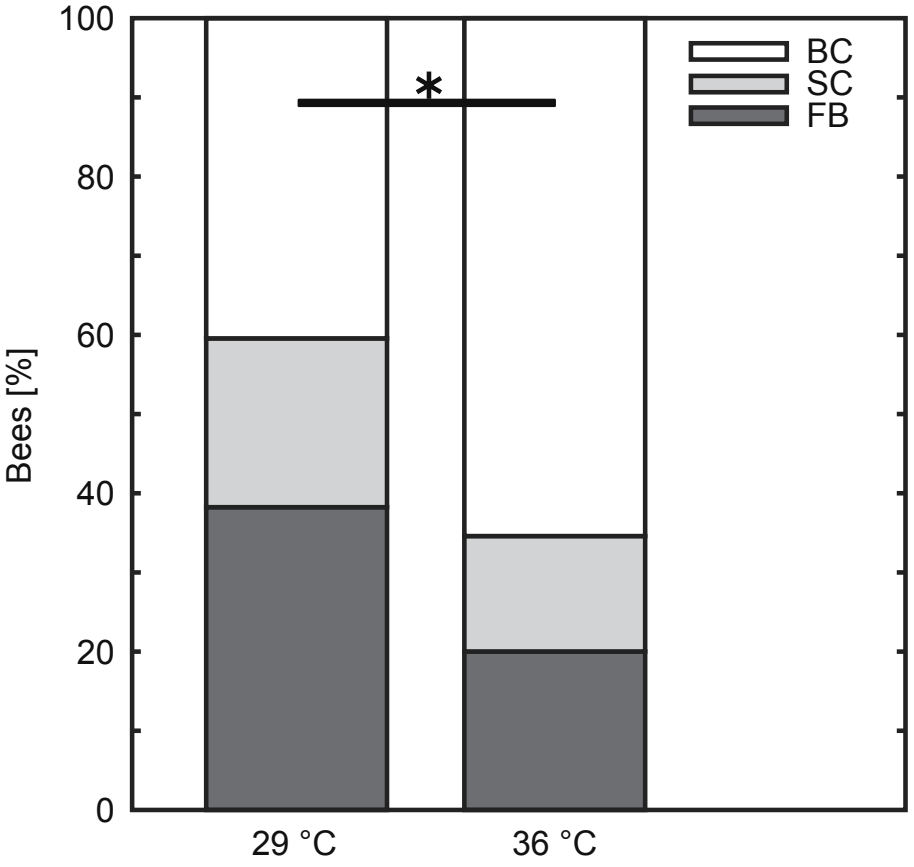
(B) In very dry air they become weakly attracted to light, so humidity can override the light cue ∴ false.

(C) A day–night difference does not show a direct effect of photoperiod on survival ∴ false.

(D) Dark, damp shelter by day limits drying and predation; night activity allows movement; going towards light in very dry places helps them leave ∴ true.

IAPT answer: (A), (D) | **Zigyan answer:** (A), (D)

29. In an experiment, a cluster of bees was exposed to uniform temperature. The figure alongside, shows the percentage of bees not in clusters (free bees, FB), bees in small clusters (2–3 bees, SC) and the bees in big clusters (>3 bees, BC) at 29±1°C compared to the free bees, bees in small clusters and bees in big clusters at 36±1°C. (* indicates significant difference.)



Which of the following statements are correct ?

(A) Bees form more smaller clusters at 29°C, where the waiting time is short and form bigger clusters at 36°C.

(B) Clustering of the bees in the optimal temperature spot is an occasional event and with homogeneous temperatures in a given area, the bees tend to form several small clusters scattered across the area.

(C) The bees forming several big clusters in an area of homogeneous temperature in a hive, has the advantage to bees of wandering from one small cluster to the other, increasing the probability of reaching all cells that require cleaning.

(D) Bigger clusters form slowly than smaller ones, but in smaller clusters a higher percentage of bees may be at sub-optimum temperature due to crowding effects.

Solution · Q29 **As per Zigyan: (A)**

From the graph:

29 °C: FB ≈ 38%, SC ≈ 21%, BC ≈ 40%

36 °C: FB ≈ 20%, SC ≈ 15%, BC ≈ 65%

(A) Waiting after a meeting is short at 29 °C and long at 36 °C. So small clusters are commoner at 29 °C and big ones at 36 °C ∴ true.

(B) Gathering at the optimal spot is a regular response, and big clusters hold more bees than small ones at both temperatures ∴ false.

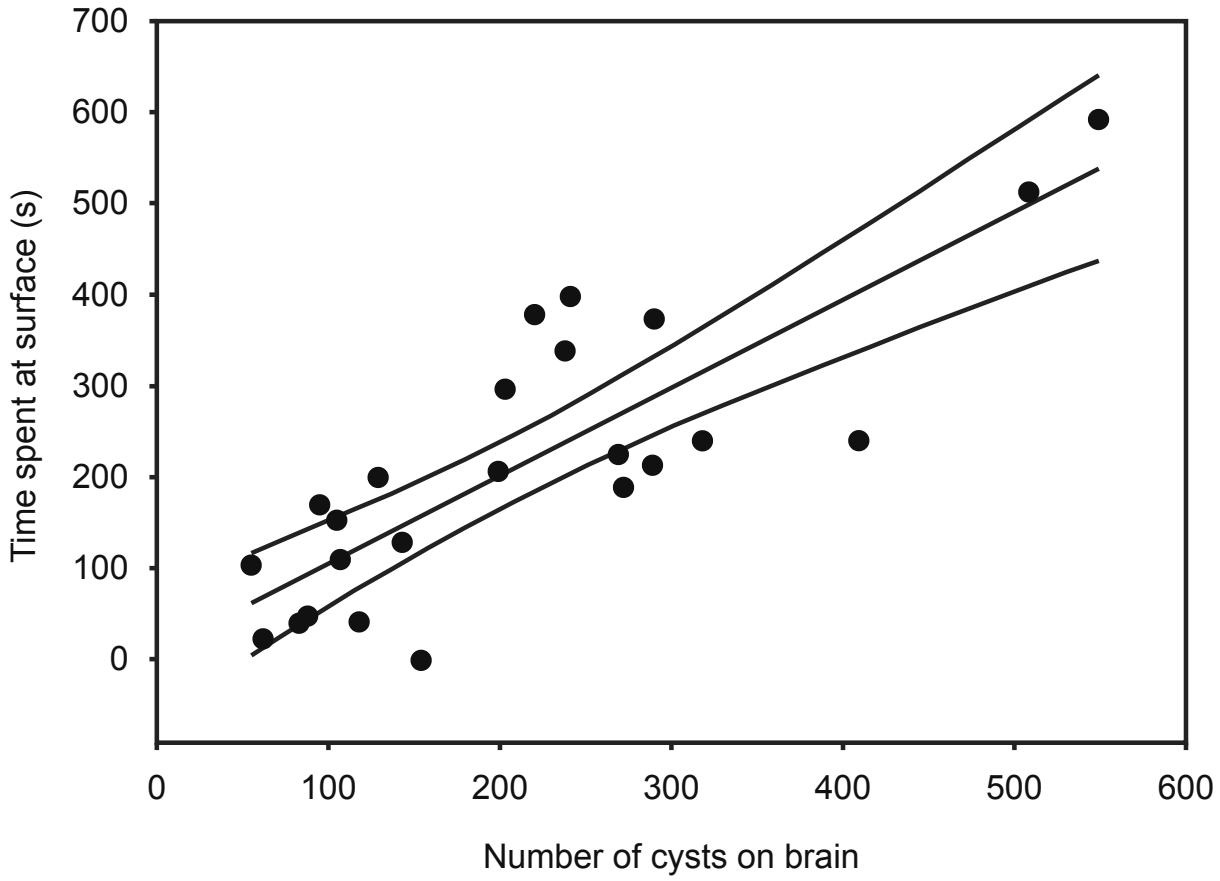
(C) It names several big clusters but then bees moving between small clusters, contradicting itself ∴ false.

(D) Crowding belongs to bigger clusters, and the graph gives no formation time ∴ false.

Reference: Szopek, Stokanic, Radspieler and Schmickl, 'Simple physical interactions yield social self-organization in honeybees', Frontiers in Physics 9:670317 (2021), section 2.2.1: bees often wait after meeting another bee; the waiting-time curve used there, derived from observations of young honeybees, gives 1 s at 28 °C and 25 s at 36 °C.

IAPT answer: question dropped by IAPT | **Zigyan answer:** (A)

30. Longnose killifish, *Fundulus similis*, are found in estuarian habitats of South Texas. They are naturally infected with metacercariae of the trematode, *Euhaplorchis sp*. Relationship between the number of cysts of *Euhaplorchis sp.* in the brain of *Fundulus similis*, and the time spent in the top 5 cm of the water column in an experimental tank during 15 min of observations is depicted in the figure below;



Which of the following statements are correct?

(A) Changes in the surfacing behavior could make the infected fish survive longer in the murky estuarine water by gulping air.

(B) It is possible that larger and, hence, heavily infected fish are removed from the population by predation.

(C) The infection of trematode parasite and its effect on the behavior of Killifish host, provides an adaptive advantage to the host in the estuarine ecosystem.

(D) Time spent in the top 5 cm of the tank is significantly and positively related to the number of metacercariae on the brain of the killifish.

Solution · Q30 **Answer: (B), (D)**

(A) Time at the surface exposes fish to birds; no gain from gulping air is shown ∴ false.

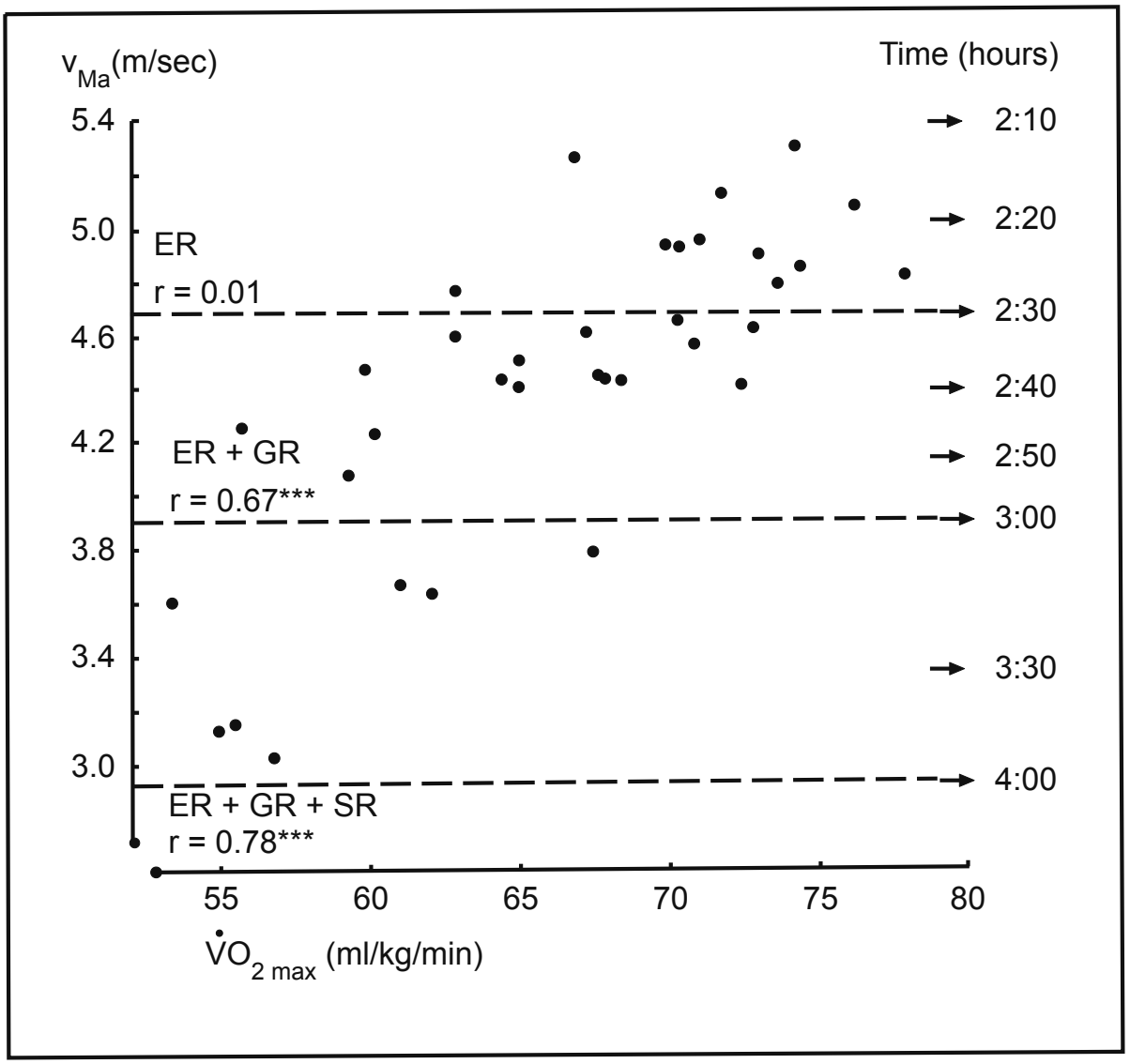
(B) Larger fish can carry more cysts, surface more and be eaten by birds ∴ possible, true.

(C) The changed behaviour helps the parasite reach its bird host, not the fish ∴ false.

(D) The fitted line and its confidence band rise with the number of cysts, a significant positive relation ∴ true.

IAPT answer: (B), (D) | **Zigyan answer:** (B), (D)

31. Maximal oxygen output (VO_{2max}) is high in endurance event athletes like marathon runners. Mean Marathon velocity (V_{Ma}) and the VO_{2max} in different groups of Elite marathon runners (ER) are shown in the figure with their different styles of running i.e. Good runners (GR) and slow runners (SR). "r" is the correlation coefficient.



Which of the following statements are correct ?

(A) There is a large variation in performance between runners of equal $VO_{2\ max}$ and vice versa.

(B) Marathon runners with a good performance timing (< 2h 30min) have VO_{2max} above 70 ml/Kg/min.

(C) Elite Marathon runners with personal best of less than 2h 30min show a $VO_{2\ max}$ more than 65 ml/Kg/min.

(D) From the figure, it is evident that, when a subgroup of marathon runners is studied, there is a high correlation between marathon performance and VO_{2max}.

Solution · Q31 **As per Zigyan: (A)**

(A) Near 67 ml/kg/min, speeds run from about 3.8 to 5.3 m/s. Near 4.45 m/s, VO_{2max} runs from about 60 to 72 ∴ true.

(B), (C) Runners above the 2:30 line include one near 63 ml/kg/min ∴ both false.

(D) For the ER subgroup alone:

$$r = 0.01$$

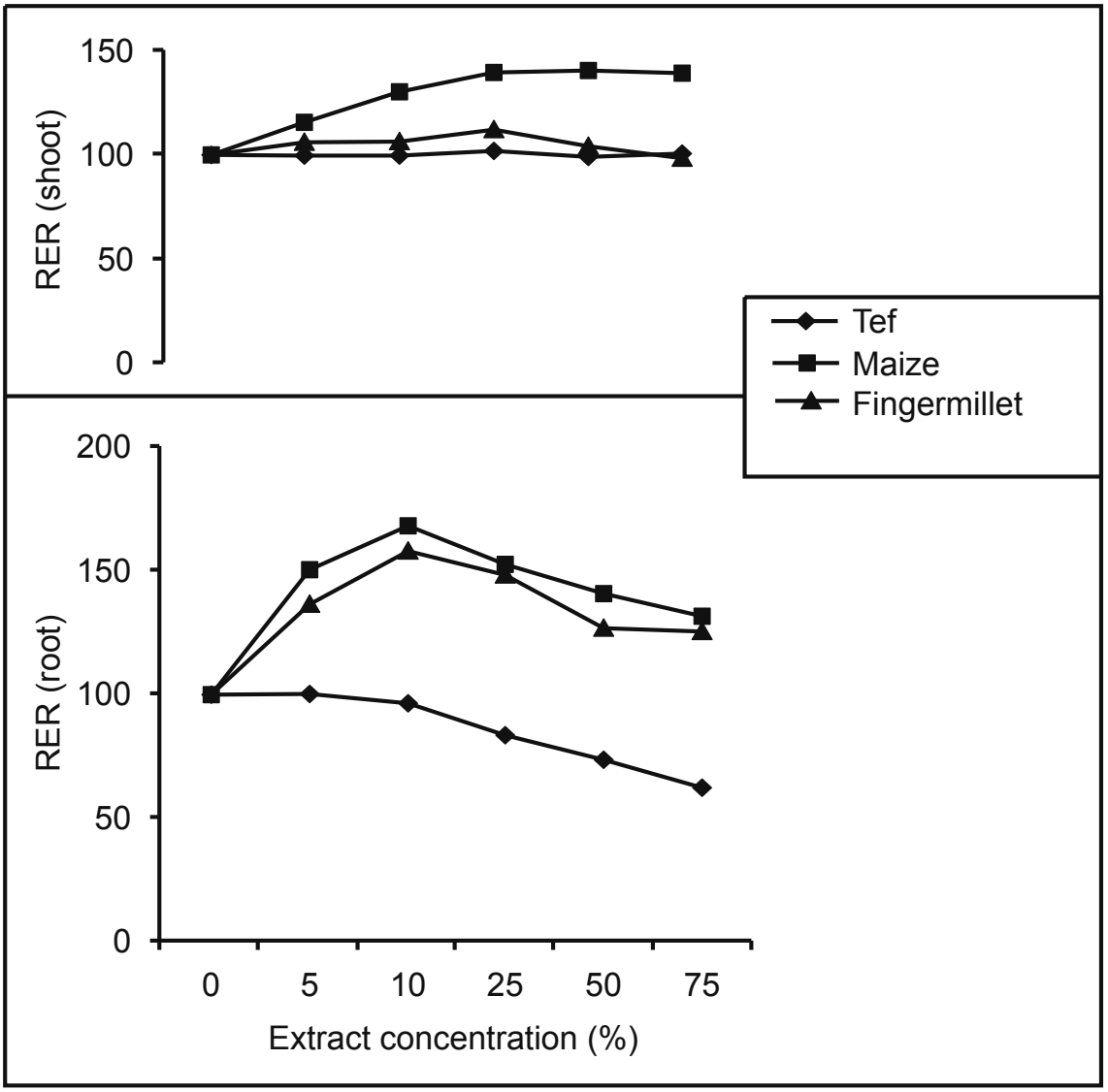
So it shows practically no correlation ∴ false.

Why Zigyan differs from IAPT: (C) requires more than 65 ml/kg/min for times under 2h 30min, but one plotted runner above that line has only about 63.

Check: that dot lies at about 4.77 m/s; at this speed a 42195 m marathon takes about 2 h 27 min, which is under 2 h 30 min.

IAPT answer: (A), (C) | **Zigyan answer:** (A)

32. *Lantana camara* leaf extracts were prepared in different concentrations. Germinating seeds of maize (*Zea mays*), finger millet (*Eleusine coracana*) and tef grass (*Eragrostis tef*) were exposed to soil treated with various concentrations of the leaf extract. The relative elongation ratio (RER) was estimated for the root and shoot lengths. The observations as compared to control plants treated with water are shown in the figure alongside.



Which of the following statements are correct ?

(A) The leaf extract has differential allelopathic effect on the germination and growth of different seeds used in the experiment.

(B) Shoot growth is less affected by the leaf extract treatment than root growth.

(C) The results indicate the possibility to cultivate maize and finger millet in agricultural lands invaded by lantana after its removal.

(D) Growing tef grass may be promising in areas where lantana invasion occurs due to positive allelopathic interference.

Solution · Q32 **As per Zigyan: (A), (B), (C)**

(A) Maize and finger millet roots are stimulated but tef roots are inhibited ∴ true.

(B) Average change from the control RER of 100, over 5–75% extract:

Roots: maize ≈ 48, finger millet ≈ 39, tef ≈ 17

Shoots: maize ≈ 33, finger millet ≈ 6, tef ≈ 1

∴ shoots are less affected, true.

(C) Maize and finger millet keep RER about 100 or more, so growing them after removing lantana is possible ∴ true.

(D) Tef root growth falls at higher concentrations, which is negative allelopathy ∴ false.

Why Zigyan differs from IAPT: in all three crops the shoot values move less, on average, from the control value than the root values do.

Check: read from the graph, root RER spreads from about 62 to 168, but shoot RER only from about 98 to 140.

IAPT answer: (A), (C) | **Zigyan answer:** (A), (B), (C)

ANSWER KEY

IOQB 2021-22 · PAPER CODE 21

32
QUESTIONS · 120 MARKS

IAPT final answer key for paper code 21. ★ marks an answer given as per Zigyan.

1	(D)	2	(C)	3	(D)	4	(B)	5	(C)
6	(B)	7	(B)	8	(C)	9	(D)★	10	(B)
11	(B)	12	(A)★	13	(D)	14	(D)	15	(B)
16	(B)	17	(B)	18	(B)	19	(D)	20	(B)
21	(C)★	22	(D)	23	(D)	24	(A)	25	(B), (C)
26	(B), (C)★	27	(A), (C)	28	(A), (D)	29	(A)★	30	(B), (D)
31	(A)★	32	(A), (B), (C)★						

★ Answers as per Zigyan

- **Q9** — As per Zigyan: (D); IAPT key (D).
- **Q12** — As per Zigyan: (A); IAPT key (A).
- **Q21** — As per Zigyan: (C); IAPT key (C).
- **Q26** — As per Zigyan: (B), (C); IAPT key (B), (C).
- **Q29** — As per Zigyan: (A); dropped by IAPT.
- **Q31** — As per Zigyan: (A); IAPT key (A), (C).
- **Q32** — As per Zigyan: (A), (B), (C); IAPT key (A), (C).

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OLYMPIADS · 2026

Olympiad results



TOP ACHIEVEMENT · CHEMISTRY

Qualified the Chemistry Olympiad twice, and selected for the HBCSE camp.

Saksham Bishnoi reached the national stage of the Chemistry Olympiad in two consecutive years and was selected for the Orientation-cum-Selection Camp at HBCSE, Mumbai. 4 Years Classroom - the same student who took AIR 168 in JEE Advanced 2026.

Qualified twice | HBCSE selection camp | Only student from Faridabad

Above MAS means above the **Minimum Admissible Score**: clearing it puts a student in the national band for their subject. It is a real threshold, not a participation marker.

CHEMISTRY · ABOVE MAS



Sulokya Bibhuty
Class XII
3 Years Classroom
Above MAS



Anay Gupta
Class XI
3 Years Classroom
Above MAS



Akshat Khator
Class XI
3 Years Classroom
Above MAS



Harshit Goyal
Class XII
4 Years Classroom
Above MAS



Hardik Sharma
Class XI
3 Years Classroom
Above MAS



Aarush Kumar
Class XII
1 Year Classroom
Above MAS

PHYSICS · ASTRONOMY · MATHEMATICS

PHYSICS



Sulokya Bibhuty
Class XII
3 Years Classroom
Above MAS

PHYSICS



Saksham Bishnoi
Class XII
4 Years Classroom
Above MAS

ASTRONOMY



Sulokya Bibhuty
Class XI
3 Years Classroom
Above MAS

MATHEMATICS · IOQM



Priyanshi
Class XI
4 Years Classroom
IOQM Qualifier

OLYMPIADS WE PREPARE STUDENTS FOR

NSEP	NSEC	NSEB	NSEA	IOQM	NSEJS
Physics	Chemistry	Biology	Astronomy	Mathematics	Class X and below

The olympiad pathway starts in Class 8.

NSEJS is open to Class 10 and below - the habit of staying with one hard problem is the one JEE Advanced rewards.

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RESULTS · 2021 – 2026

Our toppers, year by year

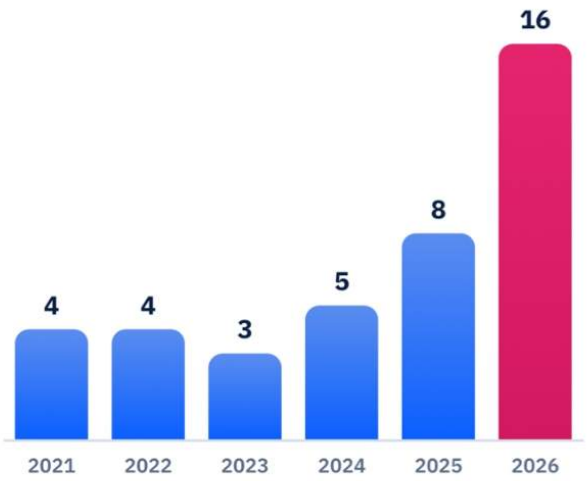
40
JEE Advanced selections in 6 years

AIR 168
best rank — Saksham Bishnoi, 2026

16 of 35
students selected, JEE Advanced 2026

14 of 35
above 98 percentile, JEE Main 2026

JEE ADVANCED SELECTIONS PER YEAR



BEST RANK EACH YEAR

YEAR	JEE ADVANCED	JEE MAIN
2026	**Saksham Bishnoi** AIR 168 · 4 Years Classroom	**Saksham Bishnoi** AIR 811 · 99.95 %ile
2025	**Chakshu** AIR 4,233 · 2 Years Classroom	**Chakshu** AIR 8,538 · 99.44 %ile
2024	**Harshit** AIR 777 · 2 Years Classroom	**Harshit** AIR 1,473 · 99.91 %ile
2023	**Aditya Jain** AIR 2,373 · 2 Years Classroom	**Aditya Jain** AIR 2,503 · 99.79 %ile
2022	**Rachit Sharma** AIR 698 · 1 Year Classroom	**Rachit Sharma** AIR 1,016 · 99.90 %ile
2021	**Sparsh Mittal** AIR 2,237 · 1 Year Classroom	**Sparsh Mittal** AIR 1,562

JEE ADVANCED 2026 — THIRTEEN NAMED SELECTIONS



Saksham Bishnoi
AIR 168
4 Years Classroom



Sulokya Bibhuty
AIR 1,315
3 Years Classroom



Aarush
AIR 2,699
1 Year Classroom



Manishka
AIR 2,869
4 Years Classroom



Oojit Kumar
AIR 5,765
4 Years Classroom



Harshit Goyal
AIR 6,407
4 Years Classroom



Pranab Sharma
AIR 6,750
3 Years Classroom



Aditya Dhar
AIR 15,183
3 Years Classroom



Arpit Anshuman
AIR 19,308
4 Years Classroom



Lokesh
AIR 22,857
3 Years Classroom



Arjun
AIR 24,674
3 Years Classroom



Sanyam Gulyani
AIR 25,123
1 Year Classroom



Saket
AIR 27,628
3 Years Classroom

Sixteen students of the 2026 batch were selected in JEE Advanced; the thirteen above are named with their All India Rank.

JEE MAIN 2026 — TOP SIX, WITH PERCENTILE



Saksham Bishnoi
AIR 811
99.95 %ile
4 Years Classroom



Sulokya Bibhuty
AIR 1,095
99.94 %ile
3 Years Classroom



Harshit Goyal
AIR 2,662
99.83 %ile
4 Years Classroom



Manishka
AIR 4,817
99.70 %ile
4 Years Classroom



Oojit Kumar
AIR 5,040
99.69 %ile
4 Years Classroom



Aarush
AIR 5,276
99.67 %ile
1 Year Classroom

14 of the 35 students in the 2026 batch scored above the 98th percentile in JEE Main.

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