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PREVIOUS YEAR PAPER · 2025

OLYMPIAD · STAGE I

NSEJS

National Standard Examination in Junior Science

2025

Question paper, answer key and Zigyan solutions

60	216	120 min	51
Questions	Maximum marks	Time	Paper code

Question paper and official answer key: Indian Association of Physics Teachers (IAPT), NSEJS 2025, paper code 51.
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

JEE ADVANCED 2026	JEE MAIN 2026
AIR 1,315	AIR 1,095
	99.94 percentile

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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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Given in the question paper

Physical constants you may need….

Mass of electron $m_e = 9.11\times10^{-31}\,kg = 0.511 MeV$	Magnitude of charge on electron $e = 1.60\times10^{-19}\,C$
Mass of proton $m_p = 1.67\times10^{-27}\,kg$	Planck's constant $h = 6.625\times10^{-34}\,Js$
Acceleration due to gravity $g = 9.80\ ms^{-2}$	Density of water is $\rho = 1.0\times10^{3}\,kg\,m^{-3}$
Universal gravitational constant $G = 6.67\times10^{-11}\,Nm^2\,kg^{-2}$	$(1+x)^n \approx 1+nx,\ \text{if}\ \lvert x\rvert << 1$
Universal gas constant $R = 8.31\ J\,mol^{-1}\,K^{-1}$	$1\ eV = 1.6\times10^{-19}\ J$
Boltzmann constant $k = 1.38\times10^{-23}\,JK^{-1}$	$\sin(A\pm B) = \sin A\cos B \pm \cos A\sin B$
Avogadro's constant $A = 6.02\times10^{23}\ mol^{-1}$	$E = mc^2$ gives mass and energy equivalence.
Atmospheric pressure (at STP) $= 1.013\times10^{5}\ Nm^{-2}$	One amu = 1 u = 931.5 MeV
Speed of light in free space $c = 3.0\times10^{8}\ ms^{-1}$	One unit of electric power = 1kWh

PART A-1 · ONE CORRECT OPTION

Q. 1 – 48 · +3 for a correct answer, –1 for a wrong one

1. Which National Park derives its name from the abundance of Red Silk Cotton Trees?

(A) Keoladeo (B) Simlipal (C) Sunderban (D) Kaziranga

Solution · Q1 **Answer: (B)**

Simlipal in Odisha takes its name from the simul, the red silk cotton tree.

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

2. Some algae live as endophytes in sea-weeds. Which of the following alga is endophytic to the aquatic fern, *Azolla*?

(A) *Sarcodia* (B) *Anabaena* (C) *Nostoc* (D) *Chondrus*

Solution · Q2 **Answer: (B)**

Anabaena azollae, a nitrogen-fixing blue-green alga, lives inside the leaf cavities of Azolla.

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

3. St. Anthony's Fire disease is caused by consumption of infected grains of rye. Which of the following is responsible for this disease?

(A) *Candida* (B) *Aspergillus* (C) *Russula* (D) *Claviceps*

Solution · Q3 **Answer: (D)**

St. Anthony's Fire is ergotism.

It is caused by the toxins of Claviceps purpurea, the ergot fungus that infects rye grains.

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

4. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R). Choose the correct option from the codes given below.

Assertion (A): Each of the two strands of the original DNA molecule serves as a template for the synthesis of a new complementary strand. The result is two DNA molecules, each composed of one old (parental) strand and one new (daughter) strand.

Reason (R): During replication, the original DNA molecule is broken into fragments and each fragment is replicated. The newly synthesized DNA fragments and the original fragments are then interspersed, resulting in both strands of the daughter DNA containing a mix of old (parental) and new (daughter) DNA segments.

Code:

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) R is true but A is false

Solution · Q4 **Answer: (C)**

A is true: DNA replication is semiconservative.

Each daughter DNA has one parental strand and one new strand.

R is false: it describes the dispersive model, which does not occur.

∴ A is true but R is false.

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

5. Who among the following is the launching leader of the Human Genome Project?

(A) Alec Jeffreys

(B) Francis Collins

(C) Craig Venter

(D) John Sulston and Bob Waterston

Solution · Q5 **As per Zigyan: (B)**

Francis Collins led the publicly funded international Human Genome Project.

He became director of the US genome research centre in 1993.

The first director, James Watson, is not among the choices.

Reference: National Human Genome Research Institute, USA (genome.gov), Human Genome Project fact sheet: Francis Collins served as the de facto leader of the international sequencing consortium.

Reference: genome.gov, Human Genome Project timeline: James Watson was the first director of the genome research centre (1989), and Francis Collins was appointed its director in April 1993.

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

6. Which of the following is often referred to as the Old Man of the Jungle?

(A) Orangutan (B) Gibbon (C) Gorilla (D) Chimpanzee

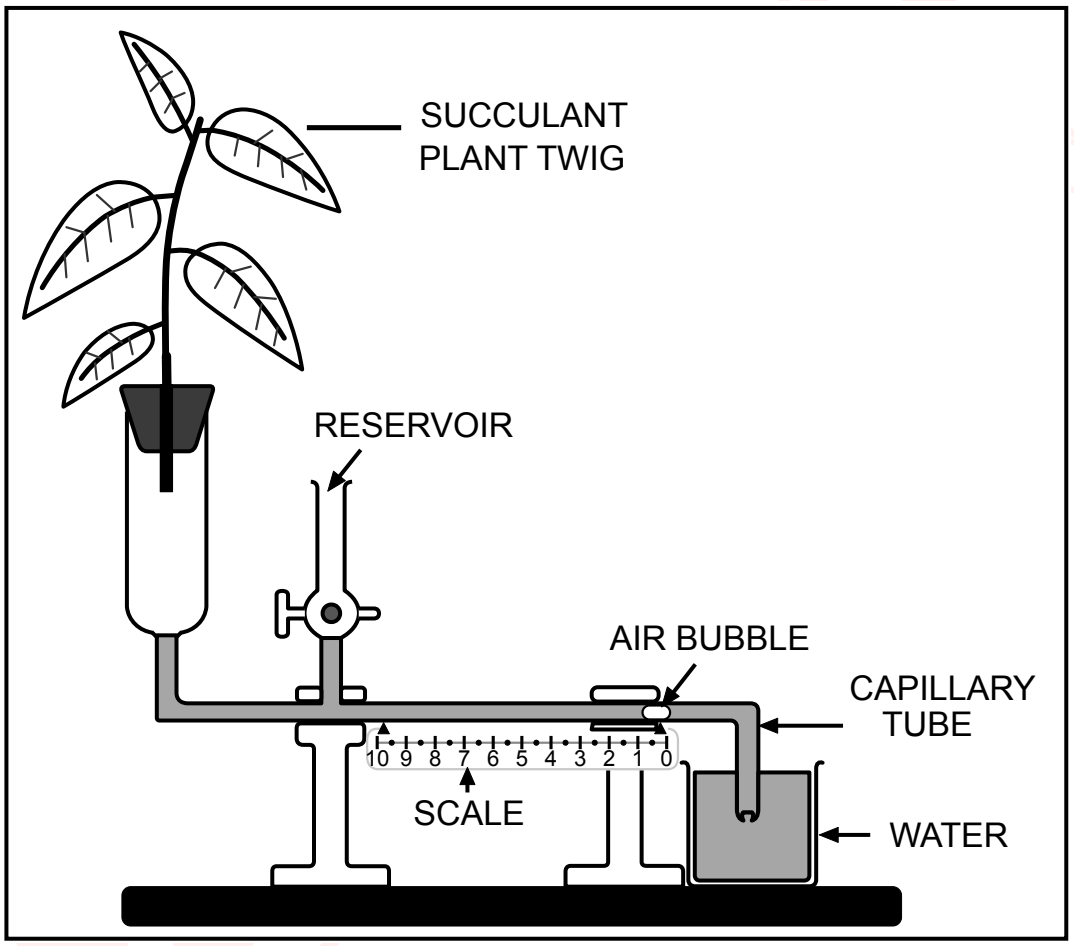
Solution · Q6 **Answer: (A)**

The word orangutan comes from the Malay words for "man of the forest".

Hence the orangutan is called the Old Man of the Jungle.

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

7. In the following experimental set-up, a twig of a succulent plant (*Crassula*) was inserted in the glass tube. The apparatus was kept in sun light for 6 hours. The inserted bubble will:



(A) Move very fast to show high rate of transpiration.

(B) Move slowly to show lower rate of transpiration.

(C) Not move at all.

(D) Move according to temperature of water.

Solution · Q7 **As per Zigyan: (B)**

Crassula is a succulent plant with CAM photosynthesis.

Its stomata stay closed during the day, so transpiration in sunlight is very low.

Closed stomata cannot stop water loss completely, as a little water still escapes through the cuticle.

∴ The twig draws in water very slowly, and the bubble moves slowly.

Why Zigyan differs from IAPT: "Not move at all" needs zero water loss, but a living leafy twig keeps losing a little water even when its stomata are closed.

Reference: OpenStax Biology 2e, section 8.3: cacti take in carbon dioxide at night and keep their stomata closed during the day.

Reference: Tree Physiology (2024), open article on NIH PubMed Central about water loss after stomatal closure in temperate trees: full closure of stomata cannot completely prevent water loss, which can go on through leaky stomata and the cuticle.

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

8. Make the correct matches of the items M,N,O & P with (i) – (iv):

[M] International Day of Forests	(i) 22, May
[N] International Day for Biological Diversity	(ii) 29, July
[O] World Nature Conservation Day	(iii) 21, March
[P] International Tiger Day	(iv) 28, July

Choose the option showing correct matches:

(A) M- (ii), N- (iii), O- (i), P- (iv)
(B) M- (iv), N- (iii), O- (ii), P- (i)
(C) M- (iii), N- (i), O- (iv), P- (ii)
(D) M- (i), N- (iii), O- (ii), P- (iv)

Solution · Q8 **Answer: (C)**

M: International Day of Forests, 21 March (iii)

N: International Day for Biological Diversity, 22 May (i)

O: World Nature Conservation Day, 28 July (iv)

P: International Tiger Day, 29 July (ii)

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

9. Singly or in combination with other nucleotides, which of the following produce co-enzymes for oxidation-reduction reactions?

(A) Vitamin B2 and B5
(B) Vitamin B1 and B3
(C) Vitamin B2 and B6
(D) Vitamin B7 and B9

Solution · Q9 **As per Zigyan: (A)**

Riboflavin (vitamin B2) forms the redox coenzymes FMN and FAD.

FMN is a nucleotide on its own, while FAD is FMN joined to AMP.

Niacin forms the redox coenzymes NAD and NADP.

Here B5 stands for niacin, which current tables number as B3 (they give B5 to pantothenic acid).

∴ The required pair is riboflavin and niacin.

Reference: NCERT Biology Class XI, Chapter 9 'Biomolecules', section 9.8.6: the coenzymes NAD and NADP contain the vitamin niacin.

Reference: OpenStax Anatomy and Physiology 2e, section 24.7, table of water-soluble vitamins: B2 is riboflavin, used to make FAD; B3 is niacin, used to make NAD; B5 is pantothenic acid, used to make

coenzyme A.

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

10. Match the characteristics (V-Z) listed in Column I with the Groups (i-v) listed under Column II:

CHARACTERISTICS	GROUPS
(V) Presence of gelatinous mesogloea.	(i) Nematoda
(W) Presence of syncytial epidermis.	(ii) Platyhelminthes
(X) Presence of parapodia.	(iii) Cnidaria
(Y) Presence of parenchymatous tissue.	(iv) Mollusca
(Z) Presence of Radula.	(v) Annelida

Choose the option showing the correct matches:

(A) V-iii, W-i, X-v, Y-ii & Z-iv
(B) V-iv, W-iii, X-ii, Y-i & Z-v
(C) V-i, W-ii, X-iv, Y-v & Z-iii
(D) V-v, W-iv, X-iii, Y-ii & Z-i

Solution · Q10 **Answer: (A)**

V: gelatinous mesogloea, Cnidaria (iii)

W: syncytial epidermis, Nematoda (i)

X: parapodia, Annelida (v)

Y: parenchymatous tissue, Platyhelminthes (ii)

Z: radula, Mollusca (iv)

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

11. In the animal Kingdom some examples of structures (internal or external) with similar name and function are found in distantly related animals. This is a fascinating example of convergent evolution. Choose the correct option exhibiting such similarity by possessing an organ called 'CROP':

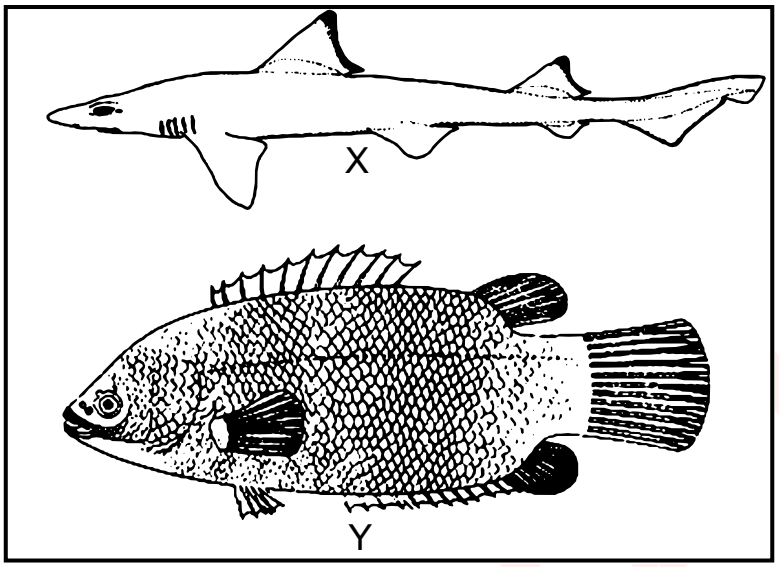
(A) *Taenia*, Prawn and Toad
(B) Earthworm, *Nereis* and *Balanoglossus*
(C) Leech, Cockroach and Bird
(D) *Ascaris*, Crab and Fish

Solution · Q11 **Answer: (C)**

The leech, the cockroach and birds all have a crop, a food-storing part of the food canal.

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

12. Identify the animals X and Y:



Choose the correct option showing their diagnostic characteristic of scales:

(A) X-Ctenoid Scale; Y-Cycloid Scale
(B) X-Placoid Scale; Y-Ctenoid Scale
(C) X-Ganoid Scale; Y-Cosmoid Scale
(D) X-Elasmoid Scale; Y-Placoid Scale

Solution · Q12 **Answer: (B)**

X is a shark, a cartilaginous fish, so it has placoid scales.

Y is a perch-like bony fish with spiny fins, and it has ctenoid scales.

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

13. Which of the following is not only the most abundant biopolymer on earth but a Nitrogenous Polysaccharide, too?

(A) Inulin (B) Hyaluronic Acid (C) Chitin (D) Trehalose

Solution · Q13 **As per Zigyan: (C)**

Chitin is a nitrogen-containing polysaccharide made of N-acetylglucosamine units.

It builds arthropod exoskeletons and fungal cell walls.

Cellulose, the most abundant biopolymer, has no nitrogen. Among the options, chitin is the abundant nitrogenous polysaccharide.

Reference: OpenStax Biology 2e, section 3.2 'Carbohydrates': cellulose is the most abundant natural biopolymer; chitin is a nitrogen-containing polysaccharide made of N-acetylglucosamine units.

Reference: NCERT Biology Class XI, Chapter 9 'Biomolecules', section 9.5: the exoskeleton of arthropods has a complex polysaccharide called chitin.

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

14. The mathematical relationship called 'Fibonacci Series' is commonly observed in the arrangement of:

(A) Stipules on twig (B) Leaves

(C) Stamens (D) Flowers in an inflorescence

Solution · Q14 **Answer: (B)**

The arrangement of leaves on a stem (phyllotaxy) commonly follows the Fibonacci series.

In spiral phyllotaxy, the turn from one leaf to the next is a fraction such as:

1/2, 1/3, 2/5, 3/8

The numbers in these fractions are Fibonacci numbers.

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

15. Santalin, Red Brasilin and Haematoxylin dyes are naturally found in:

(A) Alburnum (B) Rhytidome (C) Duramen (D) Phelloderm

Solution · Q15 **Answer: (C)**

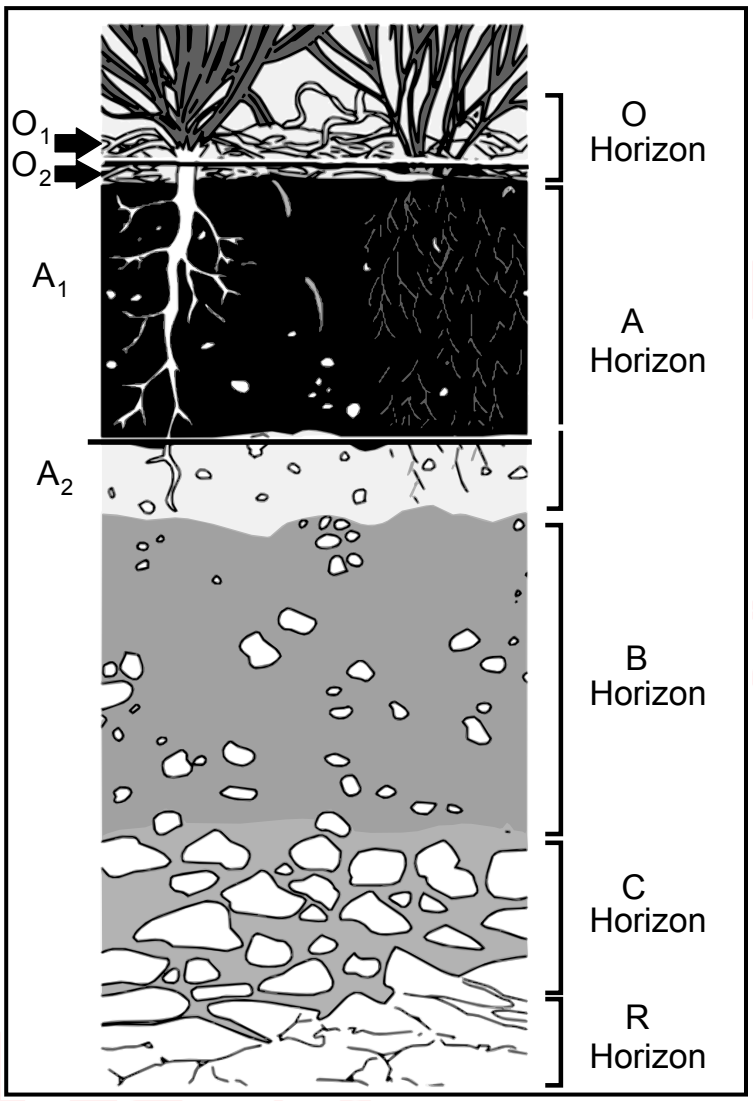
These natural dyes come from heartwood.

Santalin: red sandalwood; brasilin: brazilwood; haematoxylin: logwood.

Heartwood is called duramen. Alburnum is the sapwood.

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

16. Although, profiles of different types of soil differ markedly with respect to their physico-chemical and biological properties; the following diagram shows a typical hypothetical soil profile with its 5 principal horizons [O to R].



Study the given diagram. The characteristics [Q to U] related to various horizons and the names of horizons [i to v] are tabulated below:

CHARACTERISTICS	HORIZONS
(Q) Solum	(i) O2
(R) Podsolic Zone	(ii) A1
(S) Fairly decomposed matter – 'Duff'	(iii) A + B
(T) Melanized Region	(iv) A
(U) Zone of Eluviation	(v) A2

Make the correct matches of the characteristics [Q to U] with the horizons [i to v] and choose the correct option:

(A) Q-i, R-iv, S- v, T-iii, U-ii
(B) Q-v, R-ii, S-iv, T-iii, U-i
(C) Q-iii, R-v, S- i, T-ii, U-iv
(D) Q-ii, R-iv, S-iii, T-i, U-v

Solution · Q16 **Answer: (C)**

Solum (true soil) is A + B: Q-iii

Podsolic zone is the pale, leached A2 layer: R-v

Duff (partly decomposed litter) lies in O2: S-i

Melanized region is the dark, humus-rich A1 layer: T-ii

The zone of eluviation is then the A horizon: U-iv

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

17. A mixture of hydrogen and chlorine kept in a closed flask at a constant temperature was irradiated with scattered light. After a certain time the chlorine content decreased by 20% compared with that of the starting mixture and the resulting mixture had the composition as follows: 60 volume % of chlorine, 10 volume % of hydrogen, and 30 volume % of hydrogen chloride. Determine the composition of the initial gaseous mixture

(A) Cl_2 = 60 %, H_2 = 40 %
(B) H_2 = 60 %, Cl_2 = 40 %
(C) Cl_2 = 45 %, H_2 = 55 %
(D) H_2 = 25 %, Cl_2 = 75 %

Solution · Q17 **Answer: (D)**

$H_2 + C\ell_2 \rightarrow 2HC\ell$

The total volume does not change, so take it as 100.

30 volumes of $HC\ell$ use 15 volumes of H_2 and 15 volumes of $C\ell_2$.

Initial volumes:

$$C\ell_2 = 60 + 15 = 75$$

$$H_2 = 10 + 15 = 25$$

Fall in chlorine:

$$(15/75) \times 100\% = 20\%$$

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

18. A research scholar requires 50 mL aqueous $NaNO_3$ solution containing 70.0 mg Na^+ per mL. The amount of $NaNO_3$ required is

(A) 0.350 g (B) 0.161 g (C) 29.75 g (D) 12.93 g

Solution · Q18 **Answer: (D)**

Mass of Na^+ needed:

$$50 \times 70.0 \text{ mg} = 3500 \text{ mg}$$

$\Rightarrow$ 3.5 g

85 g of $NaNO_3$ contains 23 g of Na^+.

$$m = \frac{3.5 \times 85}{23}$$

$$\Rightarrow m = 12.93\ g$$

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

19. A sample of crystalline soda (A) with a mass of 1.287 g was allowed to react with an excess of hydrochloric acid and 100.8 mL of a gas was liberated (measured at STP). How many molecules of water in relation to one molecule of Na_2CO_3 are contained in the sample of soda?

(Relative atomic masses are: Na = 23; H = 1; C = 12; O = 16)

(A) 5 (B) 6 (C) 4 (D) 10

Solution · Q19 **Answer: (D)**

$Na_2CO_3 \cdot xH_2O + 2HC\ell \rightarrow 2NaC\ell + CO_2 + (x + 1)H_2O$

Moles of soda equal moles of CO_2:

$$n = \frac{100.8}{22400}$$

$$\Rightarrow n = 0.0045\ mol$$

Molar mass of soda:

$$M = \frac{1.287}{0.0045}$$

$$\Rightarrow M = 286\ g\ mol^{-1}$$

$$106 + 18x = 286$$

$$\Rightarrow x = 10$$

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

20. Which of the following ammonium salt, release SO_3 gas on thermal decomposition:

(I) $(NH_4)_2SO_4 \xrightarrow{\Delta}$

(II) $(NH_4)_2S_2O_8 \xrightarrow{\Delta}$

(A) I only (B) II only

(C) Both (I) and (II) (D) None of these

Solution · Q20 **As per Zigyan: (D)**

(I) Gentle heating first drives off ammonia:

$(NH_4)_2SO_4 \rightarrow NH_4HSO_4 + NH_3$

On strong heating, sulphur leaves as SO_2:

$3(NH_4)_2SO_4 \rightarrow 4NH_3 + N_2 + 3SO_2 + 6H_2O$

(II) Ammonium persulphate first loses oxygen:

$2(NH_4)_2S_2O_8 \rightarrow 2(NH_4)_2S_2O_7 + O_2$

The pyrosulphate then breaks up, again giving SO_2:

$3(NH_4)_2S_2O_7 \rightarrow 2NH_3 + 2N_2 + 6SO_2 + 9H_2O$

$\therefore$ Neither salt releases SO_3 gas.

Reference: US Department of Energy project report DE-FG36-07GO17002 (SAIC final report, 2014; OSTI 1130473): on heating pure ammonium sulphate, the main gaseous products found were NH_3, water vapour and SO_2.

Reference: NOAA CAMEO Chemicals, data sheet 'Ammonium persulfate' (June 1999): it decomposes at 120°C; in a fire it decomposes with loss of oxygen.

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

21. Which of the following group contains solid compounds at 10°C?

(A) H_2O, NH_3 CH_4 (B) F_2, Cl_2, Br_2

(C) SO_3, I_2, NaCl (D) Si, S_8, CH_3COCH_3

Solution · Q21 **Answer: (C)**

At 10°C:

(A) H_2O is a liquid; NH_3 and CH_4 are gases.

(B) F_2 and $C\ell_2$ are gases; Br_2 is a liquid.

(C) SO_3 (melts near 17°C), I_2 and $NaC\ell$ are all solids.

(D) CH_3COCH_3 is a liquid.

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

22. How many 1°-amine are possible for $C_5H_{13}N$?

(A) 6 (B) 7 (C) 8 (D) 9

Solution · Q22 **Answer: (C)**

A 1°-amine is $C_5H_{11}NH_2$. Count structural isomers by carbon chain.

Pentane chain (3):

pentan-1-amine, pentan-2-amine, pentan-3-amine

Butane chain with one methyl branch (4):

2-methylbutan-1-amine, 2-methylbutan-2-amine, 3-methylbutan-2-amine, 3-methylbutan-1-amine

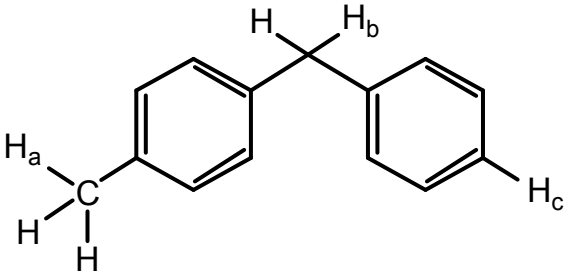
Propane chain with two methyl branches (1):

2,2-dimethylpropan-1-amine

$\therefore 3 + 4 + 1 = 8$

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

23. For the compound given below, the correct increasing order of C–H bond strength is



(A) $C–H_a > C–H_b > C–H_c$ (B) $C–H_a > C–H_c > C–H_b$

(C) $C–H_b > C–H_a > C–H_c$ (D) $C–H_c > C–H_a > C–H_b$

Solution · Q23 **As per Zigyan: (D)**

A more stable radical means a weaker C–H bond.

H_c is on an sp^2 ring carbon. Its radical has no resonance, so this bond is the strongest.

Removing H_a gives a benzylic radical, stabilised by one ring.

Removing H_b gives a radical stabilised by two rings, so this bond is the weakest.

$$\therefore C–H_c > C–H_a > C–H_b$$

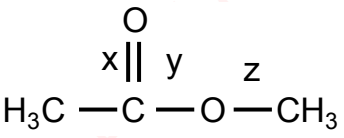
Option (D) shows this order with > signs: strength increases from $C–H_b$ to $C–H_c$.

Reference: OpenStax Organic Chemistry, section 6.8, Table 6.3: bond dissociation energy is 472 kJ/mol for the aromatic $C_6H_5–H$ bond and 375 kJ/mol for the benzylic $C_6H_5CH_2–H$ bond.

Check: the radical left by H_b can spread its odd electron over two benzene rings, one more than the radical left by H_a.

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

24. Consider the C–O bonds x, y and z present in the compound given below



The increasing order of C–O bond length is

(A) x = y = z (B) x < y < z (C) x < z < y (D) y < x < z

Solution · Q24 **Answer: (B)**

x is a C=O double bond, so it is the shortest.

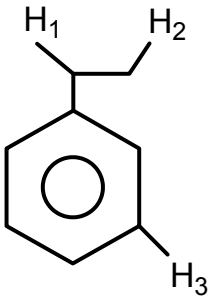
y has partial double-bond character, as the lone pair of this oxygen is in resonance with C=O.

z is a pure single bond, so it is the longest.

$$\therefore x < y < z$$

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

25. The correct order of the bond energy of different C–H bonds in the given compound is



(A) $C–H_1 > C–H_2 > C–H_3$

(B) $C–H_2 > C–H_1 > C–H_3$

(C) $C–H_3 > C–H_2 > C–H_1$

(D) $C–H_3 > C–H_1 > C–H_2$

Solution · Q25 **Answer: (C)**

The bond whose removal gives the more stable radical needs less energy.

Removing H_1 gives a benzylic radical, stabilised by resonance, so this bond is the weakest.

Removing H_2 gives a primary radical with no such resonance.

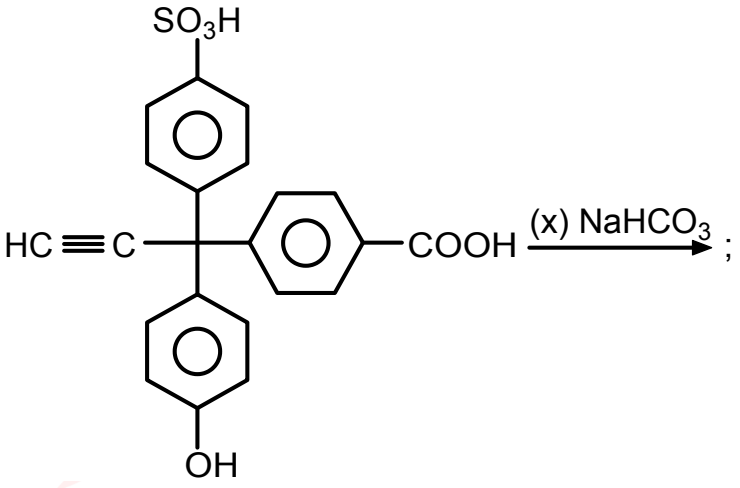
H_3 is on an sp^2 carbon of the ring, so this bond is the strongest.

∴ order of bond energy:

$$C–H_3 > C–H_2 > C–H_1$$

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

26. The total number of moles of $NaHCO_3$ consumed during the given reaction is x.



The value of x is

(A) 1 (B) 2 (C) 3 (D) 4

Solution · Q26 **Answer: (B)**

$NaHCO_3$ reacts only with acids stronger than carbonic acid.

$R–SO_3H + NaHCO_3 \rightarrow R–SO_3Na + H_2O + CO_2$

$R–COOH + NaHCO_3 \rightarrow R–COONa + H_2O + CO_2$

The phenolic –OH and the H on the triple-bonded carbon are much weaker acids, so they do not react.

$\therefore x = 2$

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

27. If 1 mL of water contains 20 drops, the number of water molecules, in each drop of water, is (A is Avogadro number)

(A) $\frac{0.5}{18}A$

(B) 0.05 A

(C) 0.5 A

(D) $\frac{0.05}{18}A$

Solution · Q27 **Answer: (D)**

Density of water is 1 g per mL, so 1 mL weighs 1 g.

Mass of one drop:

$$m = \frac{1}{20}\ g$$

$$\Rightarrow m = 0.05\ g$$

Molar mass of water is 18 g mol^{-1}.

Number of molecules in one drop:

$$N = \frac{0.05}{18}A$$

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

28. In which of the below given sets, all types of bonds (ionic, covalent and coordinate) are present in all the molecules?

(A) HCN, HNO_3, O_3

(B) KNO_3, HNO_3, $CuSO_4 . 5H_2O$

(C) NH_4Cl, KNO_3, $CuSO_4 . 5H_2O$

(D) Both (B) and (C)

Solution · Q28 **Answer: (C)**

HCN has only covalent bonds.

HNO_3 has covalent and coordinate bonds but no ionic bond.

So (A), (B) and (D) are not correct.

$NH_4Cℓ$: ionic between NH_4^+ and $Cℓ^-$, covalent N–H bonds, one coordinate N→H bond.

KNO_3: ionic between K^+ and NO_3^-, covalent N–O bonds, one coordinate N→O bond.

$CuSO_4 . 5H_2O$: ionic between the hydrated copper ion and SO_4^{2-}, covalent S–O and O–H bonds, coordinate bonds from water to Cu^{2+}.

$\therefore$ every compound in (C) has all three types.

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

29. Which of the following C–H bonds has lowest bond dissociation energy?

(A) 3° C–H bond (B) 2° C–H bond

(C) 1° C–H bond (D) All have same bond dissociation energy

Solution · Q29 **Answer: (A)**

A C–H bond breaks more easily when the radical formed is more stable.

Order of radical stability:

$$3° > 2° > 1°$$

∴ the 3° C–H bond has the lowest bond dissociation energy.

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

30. The total number of loan pair of electron in I_3^- is

(A) 2 (B) 3 (C) 6 (D) 9

Solution · Q30 **Answer: (D)**

Valence electrons in I_3^-:

$$3 \times 7 + 1 = 22$$

The two I–I bonds use 4 electrons. Electrons left:

$$22 - 4 = 18$$

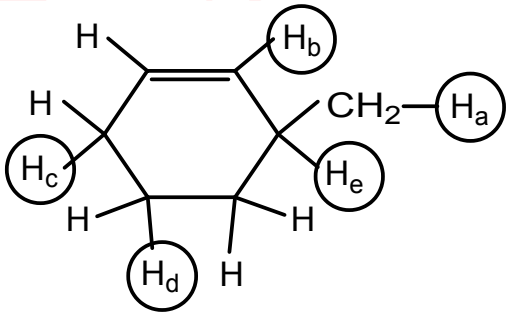
Number of lone pairs:

$$18 \div 2 = 9$$

These are 3 lone pairs on each I atom.

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

31. The correct order of abstraction of hydrogen from the below given compound when treated with halogen is



(A) e > b > c > a > d (B) b > e = c > a > d

(C) e > c > d > a > b (D) b > c > e > d > a

Solution · Q31 **Answer: (C)**

The more stable the radical formed, the more easily that H is removed.

e: tertiary allylic radical.

c: secondary allylic radical.

d: secondary alkyl radical.

a: primary alkyl radical.

b: vinylic radical, the least stable.

∴ ease of removal:

$$e > c > d > a > b$$

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

32. Which of the following will form foam in water containing Ca^{2+} and Mg^{2+} ions?

(A) Ba-stearate (B) Na-palmitate

(C) Potassium *n*-dodecyl benzene sulphonate (D) All of these

Solution · Q32 **Answer: (C)**

A soap such as sodium palmitate forms an insoluble scum in hard water.

$$2C_{15}H_{31}COONa + Ca^{2+} \rightarrow (C_{15}H_{31}COO)_2Ca\downarrow + 2Na^{+}$$

Mg^{2+} reacts in the same way.

Barium stearate is itself an insoluble soap.

The sulphonate is a detergent. It forms no such scum with these ions, so it still gives foam.

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

33. A student, intending to catch a bus on the bus stand, finds that the bus starts and accelerates away from him/her with uniform acceleration a = 2 ms^{-2} when he is 16 m far from the bus. He runs fast enough with a uniform speed so as just to catch the bus. The minimum speed with which the student must run, is

(A) 2.0 ms^{-1} (B) 4.0 ms^{-1} (C) 8.0 ms^{-1} (D) 16.0 ms^{-1}

Solution · Q33 **Answer: (C)**

Let the student run with speed v and reach the bus after time t.

The bus starts from rest, 16 m ahead of him.

$$vt = 16 + \frac{1}{2} \times 2 \times t^2$$

$$\Rightarrow t^2 - vt + 16 = 0$$

For t to be real:

$$v^2 - 4 \times 16 \geq 0$$

$$\Rightarrow v \geq 8 \text{ m s}^{-1}$$

∴ the minimum speed is 8.0 m s^{-1}.

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

34. A block of mass 2.0 kg is suspended from the ceiling by a massless string. The string is taut bearing a definite tension when the block is stationary. Suddenly, the string breaks and the block start falling freely. The difference in the tension in string just before and after it breaks is

(A) 9.8 N (B) 19.6 N (C) 4.9 N (D) zero

Solution · Q34 **Answer: (B)**

Before the string breaks, the block is at rest.

$$T_1 = mg$$

$$\Rightarrow T_1 = 2.0 \times 9.8$$

$$\Rightarrow T_1 = 19.6 \text{ N}$$

After it breaks, the block falls freely and the tension is zero.

$$T_2 = 0$$

$$\therefore T_1 - T_2 = 19.6 \text{ N}$$

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

35. Having been paddled continuously on a horizontal road, the speed of a bicycle is increasing, the force of friction exerted by the ground on the wheels is

(A) in the backward direction on both the wheels

(B) in the forward direction on both the wheels

(C) in the forward direction on the front wheel and in backward direction on the rear wheel

(D) in the backward direction on the front wheel and in forward direction on the rear wheel

Solution · Q35 **Answer: (D)**

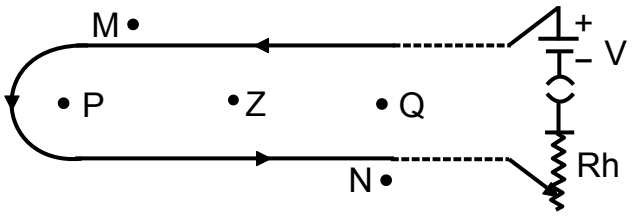
Pedalling turns the rear wheel. Its point of contact tends to slip backward, so friction on it acts forward.

The front wheel is not driven; the frame pushes it forward. Its point of contact tends to slip forward, so friction on it acts backward.

The speed increases because the forward friction is the larger one.

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

36. A current i = 2 amp is established through the long straight conductors which are the arms of a hairpin like structure placed in the plane of paper as shown in the figure. Knowing that a current carrying conductor produces magnetic field represented by the lines of force, analyze the situations described



The correct option is

(A) The magnetic field at point P is directed outward, normal to the plane of paper

(B) The magnetic field at point Q is directed inward, normal to the plane of paper

(C) The magnetic field at point Z is directed normal to the line PQ in the plane of paper

(D) No magnetic field is produced outside the hair pin that is at points M & N

Solution · Q36 **Answer: (A)**

In the figure, current goes left in the upper arm, down at the bend and right in the lower arm.

By the right hand thumb rule, the field at P, Z and Q is out of the paper.

(A) is true.

(B) is false, as the field at Q is outward.

(C) is false, as the field at Z is normal to the paper, not in its plane.

(D) is false. At M and N the nearer arm has the stronger effect, so there is a field into the paper.

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

37. A certain water pump rated 500 watt lifts water from ground level to a height h = 10 meter at a rate of 240 kg/minute. Ignoring the kinetic energy gained by water, the efficiency of water pump is

(A) 74.8 % (B) 78.4 % (C) 84.7 % (D) 87.4 %

Solution · Q37 **Answer: (B)**

Water lifted in 1 s:

$$m = 240\ \text{kg} \div 60$$

$$\Rightarrow m = 4\ \text{kg}$$

Useful power output:

$$P_{out} = 4 \times 9.8 \times 10$$

$$\Rightarrow P_{out} = 392\ \text{W}$$

Efficiency of the pump:

$$\eta = \frac{392}{500} \times 100\%$$

$$\Rightarrow \eta = 78.4\ \%$$

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

38. An electric kettle consists of two filaments F_1 and F_2 of different resistances R_1 and R_2 respectively, connected in parallel with separate switches. With a certain fixed amount of water in the kettle pot to prepare the tea, when only F_1 is switched on, it takes 4 minute to boil the water. When F_1 and F_2 both are switched on simultaneously, it takes 3 minute to boil the same amount of water up to the same temperature. The time taken to boil the same amount of water when only F_2 is switched on (assume that entire heat radiated by filaments is used in boiling the water starting from the same room temperature in each case) is

(A) 7.0 min (B) 8.4 min (C) 9.6 min (D) 12.0 min

Solution · Q38 **Answer: (D)**

In parallel both filaments get the same voltage, so their powers add. The heat H needed is the same each time.

$$H = P_1 \times 4$$

$$H = (P_1 + P_2) \times 3$$

$$\Rightarrow 4P_1 = 3P_1 + 3P_2$$

$$\Rightarrow P_1 = 3P_2$$

With only F_2 on for time t:

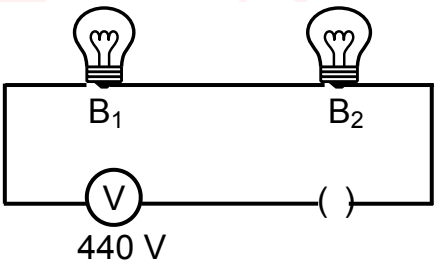
$$P_2 \times t = P_1 \times 4$$

$$\Rightarrow t = 3 \times 4$$

$$\Rightarrow t = 12 \text{ min}$$

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

39. Two filament bulbs B_1 (100 W, 220 V) and B_2 (60W, 220 V) are connected in series with a 440 V supply voltage source as shown. When switched on, the bulb



(A) B_1 will fuse: B_2 will not fuse

(B) B_1 will not fuse: B_2 will fuse

(C) B_1 and B_2 both will fuse at the same instant

(D) B_1 and B_2 both will not fuse

Solution · Q39 **Answer: (B)**

Take each filament resistance as constant.

$$R_1 = \frac{220^2}{100}$$

$$\Rightarrow R_1 = 484\ \Omega$$

$$R_2 = \frac{220^2}{60}$$

$$\Rightarrow R_2 \approx 806.7\ \Omega$$

In series, voltage divides in the ratio of resistances.

$$V_1 : V_2 = 3 : 5$$

$$V_1 = \frac{3}{8} \times 440$$

$$\Rightarrow V_1 = 165\ V$$

$$V_2 = \frac{5}{8} \times 440$$

$$\Rightarrow V_2 = 275\ V$$

B_2 gets more than its rated 220 V, so it fuses.

The circuit then breaks. B_1 was below 220 V, so it does not fuse.

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

40. The volume of water, spilled out of a completely filled cubic container of side 4 m when the container has been accelerated horizontally with 1.96 m/s^2, is

(A) 0 (B) 12.8 m^3 (C) 6.4 m^3 (D) 3.2 m^3

Solution · Q40 **Answer: (C)**

With the container open at the top, the water surface tilts through an angle θ.

$$\tan\theta = \frac{a}{g}$$

$$\Rightarrow \tan\theta = \frac{1.96}{9.8}$$

$$\Rightarrow \tan\theta = 0.2$$

One edge stays at the brim. The opposite edge drops by y.

$$y = 4 \times 0.2$$

$$\Rightarrow y = 0.8\ m$$

The spilled water is a wedge.

$$V = \frac{1}{2} \times 4 \times 0.8 \times 4$$

$$\Rightarrow V = 6.4\ m^3$$

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

41. Two athletes, A and B, run in the ground on an oval track of length L (say) at 8.0 m/s and 6.0 m/s respectively in the same direction starting from same initial point. How many laps (rounds) will the athlete A complete on the track before overtaking athlete B for the first time?

(A) 2 (B) 3 (C) 4 (D) 5

Solution · Q41 **Answer: (C)**

For the first overtaking, A must run one full lap L more than B.

$$8t - 6t = L$$

$$\Rightarrow t = \frac{L}{2}$$

Distance run by A:

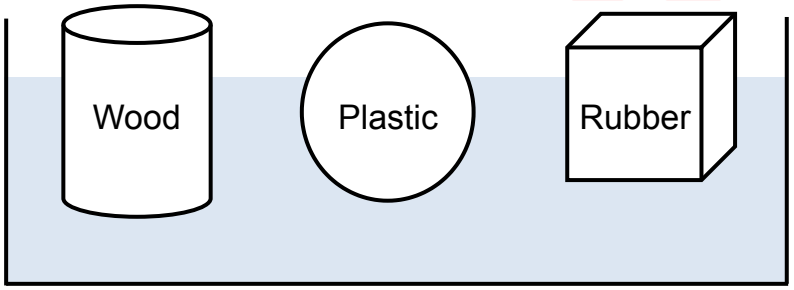
$$d_A = 8t$$

$$\Rightarrow d_A = 4L$$

$\therefore$ A completes 4 laps.

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

42. A wooden solid cylinder (density 0.80 kg/m^3), a plastic ball (density 0.90 kg/m^3) and a rubber cube (density 0.95 kg/m^3) all of equal mass M float partly immersed in a trough containing water (density 1.00 kg/m^3) as shown below (ignore any tilt during floatation)



You may conclude that

(A) The buoyant force is largest on the wooden cylinder

(B) The buoyant force is largest on the Plastic ball

(C) The buoyant force is largest on the rubber cube

(D) The buoyant force is equal on all the three

Solution · Q42 **As per Zigyan: (D)**

The densities are to be read in g/cm^3 (water 1.00 g/cm^3). Each body is less dense than water and floats.

For a floating body, buoyant force balances weight.

$$F_B = Mg$$

The mass M is the same for all three, so the buoyant force is equal on all three.

Reference: NCERT Science Class VIII (Curiosity), Chapter 5 'Exploring Forces', section 5.6: an object floats when the buoyant force on it equals the gravitational force on it.

Reference: NCERT Physics Class XI (Part II), Chapter 9 'Mechanical Properties of Fluids', section 9.2: water at 4 °C has a density of 1.0×10^3 kg m^{-3}.

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

43. A stone is thrown vertically down into a well, the splash is heard after a time t_1. If the stone is thrown vertically up with the same speed from the same point, the splash is heard after a time t_2. The common initial speed (u) of the stone in both the cases is given by (the time taken by the splash sound to reach the observer is ignored)

(A) $u = g(t_2 - t_1)$ (B) $u = g(t_2 + t_1)$

(C) $u = \frac{1}{2}g(t_2 + t_1)$ (D) $u = \frac{1}{2}g(t_2 - t_1)$

Solution · Q43 **Answer: (D)**

Take downward as positive and h as the depth of the water surface.

Thrown down:

$$h = ut_1 + \frac{1}{2}gt_1^2$$

Thrown up:

$$h = -ut_2 + \frac{1}{2}gt_2^2$$

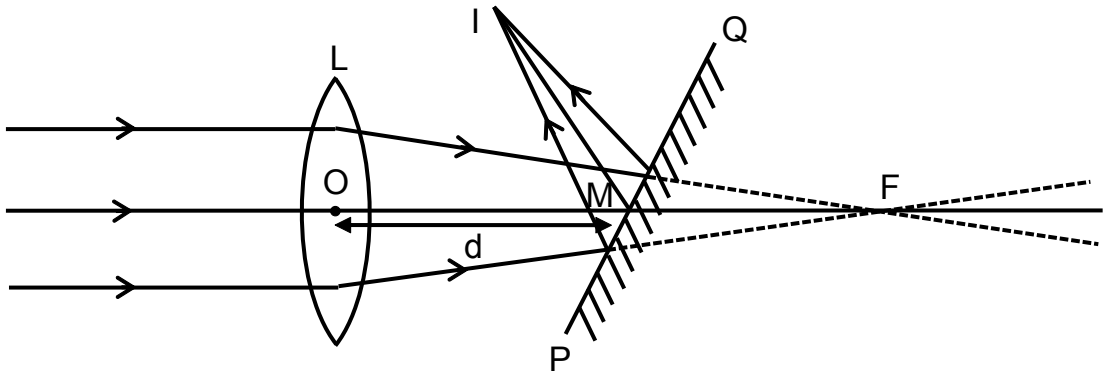
Equating the two,

$$u(t_1 + t_2) = \frac{1}{2}g(t_2^2 - t_1^2)$$

$$\Rightarrow u = \frac{1}{2}g(t_2 - t_1)$$

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

44. A beam of light is incident parallel to principal axis on a convex lens (L) of focal length f = 20 cm. A plane mirror PQ (See figure), inclined at 60° with the principal axis, is placed a distance 'd' behind the lens so as to form a real image I of the distant object at a distance 'd' from the optical center of the lens as shown in the figure. The value of 'd' is



(A) 5 cm (B) 10 cm (C) 15 cm (D) 20 cm

Solution · Q44 **Answer: (B)**

Without the mirror, the rays would meet at the focus F. So F is a virtual object for the mirror.

$$MF = 20 - d$$

I is the mirror image of F.

$$MI = MF$$

MF makes 60° with the mirror, so MI also makes 60° with it.

$$\angle OMI = 180° - 60° - 60°$$

$$\Rightarrow \angle OMI = 60°$$

Since OM and OI are both d, triangle OMI is equilateral.

$$\therefore MI = d$$

$$\Rightarrow 20 - d = d$$

$$\Rightarrow d = 10 \text{ cm}$$

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

45. A 80 kg man skating with a speed of 10 m/s on a smooth horizontal surface collides with a 20 kg skater at rest, as a result the two cling to each other. What percentage of initial kinetic energy of skaters is lost during the collision? (Ignore any friction)

(A) 12 % (B) 18 % (C) 20 % (D) 25 %

Solution · Q45 **Answer: (C)**

By conservation of momentum,

$$80 \times 10 = (80 + 20) \times v$$

$$\Rightarrow v = 8 \text{ m/s}$$

Kinetic energy before collision:

$$K_1 = \frac{1}{2} \times 80 \times 10^2$$

$$\Rightarrow K_1 = 4000 \text{ J}$$

Kinetic energy after collision:

$$K_2 = \frac{1}{2} \times 100 \times 8^2$$

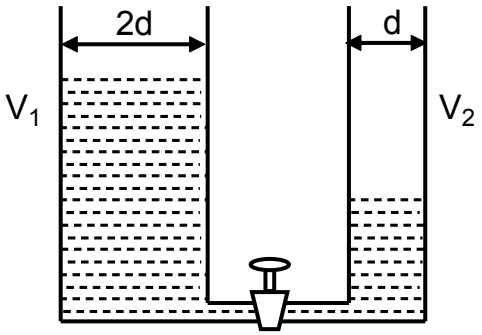
$$\Rightarrow K_2 = 3200 \text{ J}$$

Percentage loss:

$$\frac{4000 - 3200}{4000} \times 100 = 20\%$$

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

46. Two cylindrical vessels V_1 and V_2 are placed on the same horizontal level. Each vessel contains the same liquid of density ρ. Initially the vessels are not connected (valve closed). The height of liquid in vessel V_1 is h_1 and that in vessel V_2 is h_2. The diameter of vessels V_1 and V_2 are 2d and d respectively. When vessels are interconnected (valve opened) at the bottom, the height h of liquid in each vessel (neglecting the volume of liquid in connecting tube) will be



(A) $\frac{2h_1 + h_2}{3}$ (B) $\frac{4h_1 + h_2}{5}$

(C) $\frac{h_1 + h_2}{2}$ (D) $\frac{h_1 + 2h_2}{4}$

Solution · Q46 **Answer: (B)**

Area varies as the square of diameter, so the areas are 4A and A.

The volume of liquid does not change.

$$4Ah_1 + Ah_2 = (4A + A)\, h$$

$$\Rightarrow h = \frac{4h_1 + h_2}{5}$$

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

47. Two vertical object pins are located on the principal axis of a thin lens at distances of x_1 = 9.0 cm and x_2 = 18.0 cm from the lens on the two sides of the lens. The images of the two pins formed by the lens are at the same position (overlap). The focal length and the nature of the lens are

(A) 15 cm, convex (B) 12 cm, convex (C) 15 cm, concave (D) 12 cm, concave

Solution · Q47 **Answer: (B)**

For the images to overlap, one is real and the other virtual. Let both be at distance y from the lens. Apply the lens formula, with signs, to each pin.

Pin at 18 cm (real image):

$$\frac{1}{f} = \frac{1}{y} + \frac{1}{18}$$

Pin at 9 cm (virtual image):

$$\frac{1}{f} = \frac{1}{9} - \frac{1}{y}$$

Adding the two,

$$\frac{2}{f} = \frac{1}{18} + \frac{1}{9}$$

$$\Rightarrow f = 12 \text{ cm}$$

f is positive, so the lens is convex.

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

48. A steam boat goes across a lake up to a distance of 1200 meter and comes back. There is a uniform wind blowing with velocity v so as to help the onward journey and to impede the journey back. If the uniform speed of launch of the boat is 5 ms^{-1} and total time taken by the boat in going and coming back is 500 s, the velocity v of the wind blow is

(A) 0.6 ms^{-1} (B) 0.8 ms^{-1} (C) 1.0 ms^{-1} (D) 1.2 ms^{-1}

Solution · Q48 **Answer: (C)**

The wind adds to the boat speed while going and subtracts while returning.

$$\frac{1200}{5+v}+\frac{1200}{5-v}=500$$

$$\Rightarrow \frac{1200\times 10}{25-v^2}=500$$

$$\Rightarrow 25-v^2=24$$

$$\Rightarrow v=1.0\ ms^{-1}$$

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

PART A-2 · ONE OR MORE CORRECT OPTIONS

Q. 49 – 60 · 6 marks only if all correct options are marked · no negative marking

49. Fine structure of striated muscle fibres has been elucidated with the help of electron microscope. Study the following statements and choose the **incorrect** ones:

(A) The dark and light bands of myofibrils have been respectively, named as 'A' [Anisotropic under polarized light] and 'I' [Isotropic under polarized light] bands.

(B) The 'A' bands contain about 120Å thick and 18Å long actin filaments.

(C) Each 'I' band is divided into two equal halves by a thin, fibrous and transverse zig-zag partition called 'Z' band.

(D) The major middle lighter region of 'A' band is called 'M' zone

Solution · Q49 **Answer: (B), (D)**

(A) The dark A band is anisotropic and the light I band is isotropic. ∴ correct.

(B) A band has the thick myosin filaments. Actin filaments are thin and far longer than 18Å. ∴ incorrect.

(C) A zig-zag Z line cuts each I band into two halves. ∴ correct.

(D) The lighter middle part of A band is the H zone. The M line lies at its centre. ∴ incorrect.

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

50. The autonomic nervous system is divided into two parts- [A] Sympathetic and [B] Parasympathetic. Some effects of these systems are given below, respectively. Choose the correct option(s)

(A) Pupil constricts; Glycogen converted into glucose

(B) Salivation decreases; Bladder constricts

(C) Adrenaline released; Glucose converted into glycogen

(D) Bronchii constrict; Gastric activity stimulated

Solution · Q50 **Answer: (B), (C)**

Each option gives a sympathetic effect, then a parasympathetic effect.

(A) The sympathetic system dilates the pupil. ∴ wrong.

(B) Sympathetic: less saliva. Parasympathetic: the urinary bladder contracts. ∴ correct.

(C) Sympathetic: adrenaline is released. Parasympathetic: glucose is stored as glycogen. ∴ correct.

(D) The sympathetic system dilates the bronchi. ∴ wrong.

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

51. Study the following statements regarding Haemophilia and choose the incorrect option(s)

(A) It follows criss-cross pattern of inheritance

(B) It is a Y-linked dominant trait

(C) It is common in women but rare in man

(D) It is also called royal disease

Solution · Q51 **Answer: (B), (C)**

Haemophilia is an X-linked recessive disorder.

(A) It can pass from an affected man, through his carrier daughter, to a grandson. ∴ correct.

(B) It is neither Y-linked nor dominant. ∴ incorrect.

(C) A man has only one X chromosome, so it is much more common in men. ∴ incorrect.

(D) It spread in royal families through Queen Victoria's descendants. ∴ correct.

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

52. Which of the following trees does/do not show cheiropterophily?

(A) Sausage tree (B) Kadamb (C) Coral tree (D) Silk Cotton

Solution · Q52 **Answer: (C), (D)**

Cheiropterophily means pollination by bats.

Sausage tree and Kadamb are standard examples of bat pollination.

Coral tree and Silk Cotton are standard examples of bird pollination (ornithophily).

∴ (C) and (D) do not show cheiropterophily.

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

53. The pair(s) of elements which has/have equal number of electrons in the outer most shell is/are

(A) Na, Sr (B) Se, Te (C) Mn, Fe (D) As, Bi

Solution · Q53 **Answer: (B), (C), (D)**

Electrons in the outermost shell:

(A) Na has 1 and Sr has 2. ∴ not equal.

(B) Se has 6 and Te has 6. ∴ equal.

(C) Mn and Fe both end in $4s^2$, so each has 2. ∴ equal.

(D) As has 5 and Bi has 5. ∴ equal.

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

54. The correct statement(s) is/are

(A) pH of 10^{-8} NaOH is 8

(B) pH of 10^{-8} HCl is < 7

(C) Aqueous solution of $FeCl_3$ is acidic

(D) NaH_2PO_2 will react with NaOH to form Na_2HPO_2

Solution · Q54 **Answer: (B), (C)**

(A) The ions from water must also be counted:

$$[OH^-] \approx 1.05 \times 10^{-7}\ M$$

$$\Rightarrow pH \approx 7.02$$

∴ false.

(B) For the acid, in the same way:

$$pH \approx 6.98$$

∴ true.

(C) $FeC\ell_3$ (strong acid, weak base) hydrolyses to give H^+ ions. ∴ true.

(D) In NaH_2PO_2, both H atoms are bonded to P and are not acidic. So Na_2HPO_2 does not form. ∴ false.

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

55. Considering the H-spectrum series, select the correctly matched pair(s)

(A) Balmer: $n_2 > 2$

(B) Pfund: $\frac{1}{\lambda} = R\left[\frac{1}{3^2} - \frac{1}{n^2}\right]$

(C) Humphery: $n_1 > 6$

(D) Paschen: IR region

Solution · Q55 **Answer: (A), (D)**

(A) For Balmer series:

$$n_1 = 2 \text{ and } n_2 > 2$$

∴ correct.

(B) For Pfund series:

$$n_1 = 5$$

The given formula has 3^2, so it is of Paschen series. ∴ wrong.

(C) For Humphreys series:

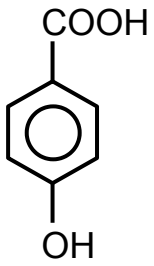
$$n_1 = 6$$

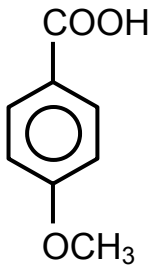
It is the higher level that is greater than 6. ∴ wrong.

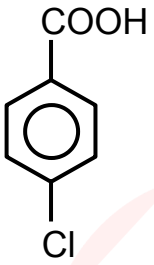
(D) Paschen lines lie in the IR region. ∴ correct.

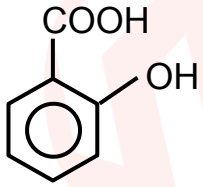
IAPT answer: (A), (D) | **Zigyan answer:** (A), (D)

56. Which of the following acids are stronger than benzoic acid?

(A) 

(B) 

(C) 

(D) 

Solution · Q56 **Answer: (C), (D)**

A more stable carboxylate ion means a stronger acid.

(A), (B) Para –OH and $-OCH_3$ push electrons into the ring (+R effect). ∴ weaker than benzoic acid.

(C) $-C\ell$ pulls electrons, as its –I effect is stronger than its +R effect. ∴ stronger.

(D) The ortho –OH forms a hydrogen bond with $-COO^-$ and stabilises the ion. ∴ stronger.

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

57. A trolley of mass 240 kg is initially at rest on the frictionless horizontal straight rails lying in east-west direction. The length of the trolley is 20 meter. A man of mass 60 kg is standing at the eastern end of the trolley. The man starts moving on the trolley from eastern end towards west with velocity 1.0 m/s relative to the trolley. Assume the displacement and the velocity in eastward direction to be positive.

Choose the correct option.

(A) The velocity of man relative to ground is $-1\ ms^{-1}$

(B) The recoil velocity of the trolley relative to ground is $+ 0.2\ ms^{-1}$

(C) The man reaches from one end of trolley to other end in time t = 20 s

(D) Displacement of trolley over the ground when the man reaches the other end of trolley is + 4.0 m.

Solution · Q57 **Answer: (B), (C), (D)**

East is positive. Let the trolley move with velocity V.

Velocity of the man relative to ground:

$$v = V - 1$$

By conservation of momentum:

$$60(V - 1) + 240V = 0$$

$$\Rightarrow V = +0.2\ m\ s^{-1}$$

$$\Rightarrow v = -0.8\ m\ s^{-1}$$

Time to cross the trolley, using the relative speed:

$$t = 20/1.0$$

$$\Rightarrow t = 20\ s$$

Displacement of the trolley:

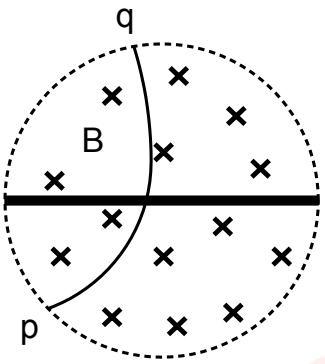
$$s = +0.2 \times 20$$

$$\Rightarrow s = +4.0\ m$$

$\therefore$ (A) is wrong; (B), (C) and (D) are correct.

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

58. In an experiment performed using a cloud chamber (a device that can show the tracks of subatomic particle) the nature of a particle can be analysed. Under the influence of a strong perpendicular magnetic field **B** directed into the plane of paper, a particle track like the one shown beside as p q was obtained. The track shown may depict



(A) a proton (charge + e) moving from point p to q

(B) an alpha particle (charge + 2e) moving from point p to q

(C) an electron (charge – e) moving from point q to p

(D) a neutron (charge zero) moving from point p to q

Solution · Q58 **As per Zigyan: (C)**

The thick line is a plate across the chamber. The track bends much more below it than above it.

In a magnetic field:

$$r = mv/(qB)$$

So the momentum is smaller below the plate.

A particle loses energy in matter and the magnetic field gives it none. So it travels from q to p.

Moving down, it bends towards the left of the figure. For a positive charge, v × B would push it to the right.

∴ the charge is negative: an electron moving from q to p.

A neutron would not bend.

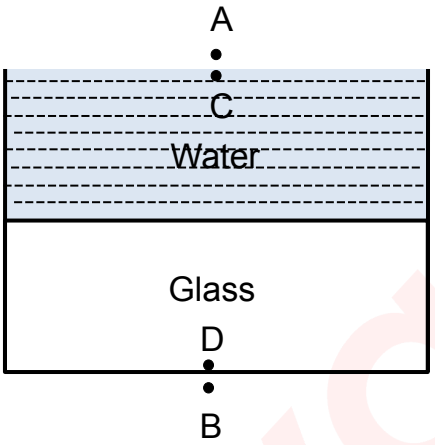
Why Zigyan differs from IAPT: a proton or alpha particle going from p to q would leave the plate with more momentum than it entered with, which cannot happen.

Reference: NCERT Physics Class XII (Part I), Chapter 4 'Moving Charges and Magnetism', section 4.3: a larger momentum gives a larger circle, and the magnetic force does no work.

Reference: American Physical Society, APS News (August 2004), 'August 1932: Discovery of the Positron': a particle leaves a cloud-chamber lead plate with lower energy, which fixes its direction of travel.

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

59. A homogeneous column of water $\left({}_{a}\mu_{w} = \frac{4}{3}\right)$ of height 8.0 cm fills the space above a 9.0 cm thick glass $\left({}_{a}\mu_{g} = \frac{3}{2}\right)$ slab. Observers A and B are in air just outside the top and the bottom whereas the observers C and D are inside just below the top and above the bottom. The total thickness of glass plus water observed by these observers are



(A) Observer A measures it as 12.0 cm
(B) Observer B measures it as 12.0 cm
(C) Observer C measures it as 16.0 cm
(D) Observer D measures it as 18.0 cm

Solution · Q59 **Answer: (A), (B), (C), (D)**

First add each real thickness divided by its refractive index:

$$S = 8 \times 3/4 + 9 \times 2/3$$

$$\Rightarrow S = 12 \text{ cm}$$

An observer in a medium of refractive index μ sees a total thickness of μS.

(A), (B) Observers A and B are in air:

$$1 \times 12 = 12 \text{ cm}$$

(C) Observer C is in water:

$$(4/3) \times 12 = 16 \text{ cm}$$

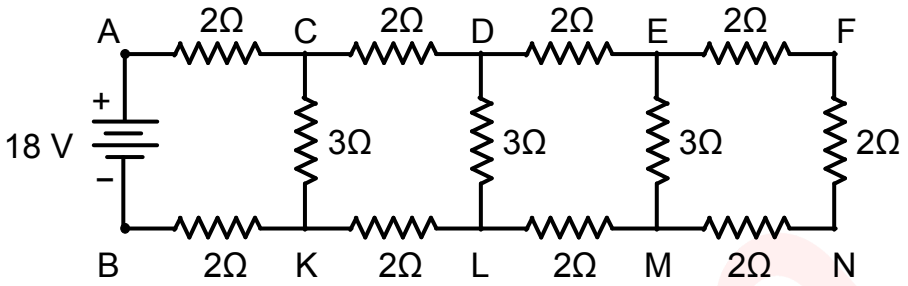
(D) Observer D is in glass:

$$(3/2) \times 12 = 18 \text{ cm}$$

∴ all four statements are correct.

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

60. Several resistances of 2Ω and 3Ω are used to form a typical electric network as shown in the figure below. A dc supply of emf 18 volt and negligible internal resistance has been connected between points A and B.



Choose the correct option(s)

(A) Total resistance between A and B is 6 Ω

(B) The power consumed in the network is 60 W

(C) The current through resistance of 2Ω on the branch AC is 3A

(D) The current through resistance of 3Ω in the branch CK is 2A

Solution · Q60 **Answer: (A), (C), (D)**

Start from the far end. EF, FN and NM are in series:

$$2 + 2 + 2 = 6\ \Omega$$

This is in parallel with the 3 Ω across EM:

$$(6 \times 3)/(6 + 3) = 2\ \Omega$$

The same step repeats at DL and then at CK.

(A) Total resistance:

$$R = 2 + 2 + 2$$

$$\Rightarrow R = 6\ \Omega$$

(C) Current through AC:

$$I = 18/6$$

$$\Rightarrow I = 3\ A$$

(B) Power:

$$P = 18 \times 3$$

$$\Rightarrow P = 54\ W$$

(D) Voltage across CK:

$$V = 18 - 3 \times 2 - 3 \times 2$$

$$\Rightarrow V = 6\ V$$

Current in CK:

$$I = 6/3$$

$$\Rightarrow I = 2\ A$$

$\therefore$ only (B) is wrong.

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

ANSWER KEY

NSEJS 2025 · PAPER CODE 51

60
QUESTIONS · 216 MARKS

IAPT final answer key for paper code 51. ★ marks an answer given as per Zigyan.

1	(B)	2	(B)	3	(D)	4	(C)	5	(B)★
6	(A)	7	(B)★	8	(C)	9	(A)★	10	(A)
11	(C)	12	(B)	13	(C)★	14	(B)	15	(C)
16	(C)	17	(D)	18	(D)	19	(D)	20	(D)★
21	(C)	22	(C)	23	(D)★	24	(B)	25	(C)
26	(B)	27	(D)	28	(C)	29	(A)	30	(D)
31	(C)	32	(C)	33	(C)	34	(B)	35	(D)
36	(A)	37	(B)	38	(D)	39	(B)	40	(C)
41	(C)	42	(D)★	43	(D)	44	(B)	45	(C)
46	(B)	47	(B)	48	(C)	49	(B), (D)	50	(B), (C)
51	(B), (C)	52	(C), (D)	53	(B), (C), (D)	54	(B), (C)	55	(A), (D)
56	(C), (D)	57	(B), (C), (D)	58	(C)★	59	(A), (B), (C), (D)	60	(A), (C), (D)

★ Answers as per Zigyan

- **Q5** — As per Zigyan: (B); IAPT key (B).
- **Q7** — As per Zigyan: (B); IAPT key (C).
- **Q9** — As per Zigyan: (A); IAPT key (A).
- **Q13** — As per Zigyan: (C); IAPT key (C).
- **Q20** — As per Zigyan: (D); IAPT key (D).
- **Q23** — As per Zigyan: (D); IAPT key (D).
- **Q42** — As per Zigyan: (D); IAPT key (D).
- **Q58** — As per Zigyan: (C); IAPT key (A), (B), (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

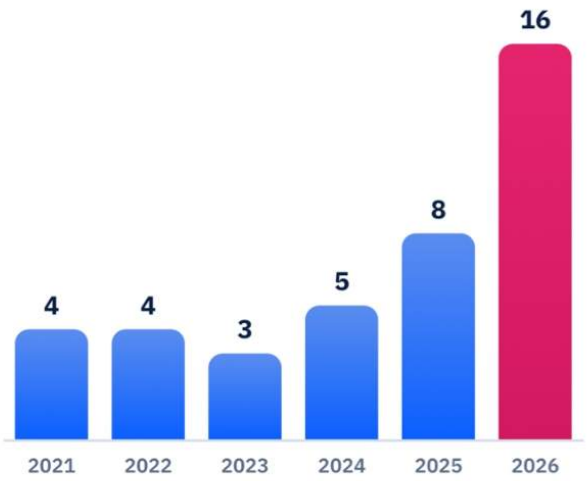
40
JEE Advanced selections in 6 years

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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