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PREVIOUS YEAR PAPER · 2024

OLYMPIAD · STAGE I

NSEJS

National Standard Examination in Junior Science

2024

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 2024, 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

OLYMPIAD RESULTS

Above the Minimum Admissible Score - the national band for the subject

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	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 = 9.81 ms^{-2}	Density of water is $\rho = 1.0\times10^{3}$ kg m^{-3}
Universal gravitational constant $G = 6.67\times10^{-11}$ Nm^2kg^{-2}	$(1+x)^n \approx 1+nx$, if $\lvert x\rvert << 1$
Universal gas constant $R = 8.31$ J mol^{-1} K^{-1}	1 eV = 1.6 × 10^{-19} J
Boltzmann constant $k = 1.38\times10^{-23}$ J K^{-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 × 10^5 Nm^{-2}	One unit of electric power = 1kWh
Speed of light in free space $c = 3.0\times10^{8}$ ms^{-1}	

PART A-1 · ONE CORRECT OPTION

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

1. In bilaterally symmetrical animals, segmentation of body into a linear series of similar parts is called metamerism. In which of the following, did it appear for the first time?

(A) Platyhelminthes (B) Arthropoda (C) Vertebrata (D) Annelida

Solution · Q1 **Answer: (D)**

True metamerism appears for the first time in phylum Annelida (e.g. earthworm).

The body is divided outside and inside into similar segments in a row.

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

2. While discussing human evolution generally Hominid stocks, Prehistoric and species of Modern Man are described on the basis of fossil records. Select the correct option showing the pair member of a Hominid stocks and a Prehistoric man:

(A) *Homo erectus pekinensis* & *Homo habilis*

(B) *Homo heidelbergensis* & *Homo sapiens neanderthalensis*

(C) *Australopithecus* & *Homo habilis*

(D) *Ramapithecus* & *Homo sapiens fossilis*

Solution · Q2 **Answer: (C)**

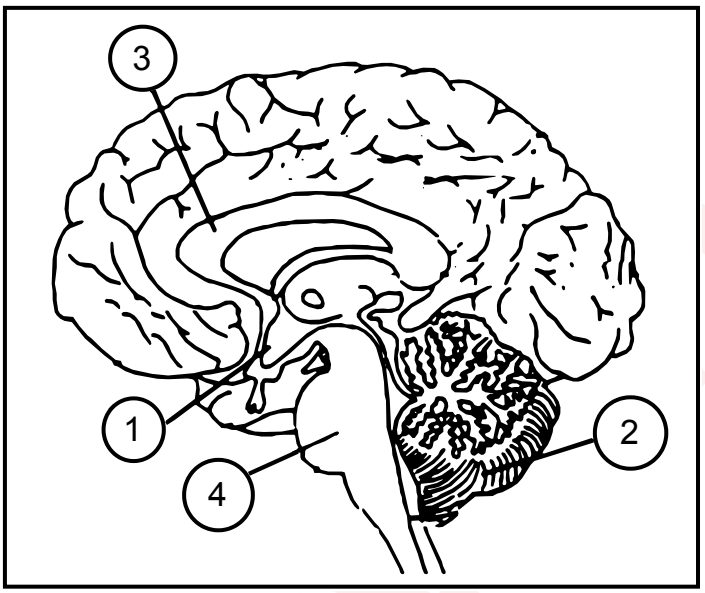
Australopithecus → hominid stock (early ancestor of humans)

Homo habilis → prehistoric man (early member of genus *Homo*)

∴ This pair has one of each.

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

3. The median longitudinal section of human brain given here under is marked with important parts as **1** to **4**.



Following are the functions/disorders related to these parts:

(i) Controls the sleep cycle, manages pain signals and is the pneumotaxic center involved in breathing rhythm regulation. Double vision (diplopia) can be a consequence of damage to this part.

(ii) It maintains homeostasis by directly influencing autonomic nervous system or by managing hormones. Besides controlling hunger and thirst, it senses fullness when eating etc. It secretes feel-good hormone (Dopamine). Malfunctioning causes Prader-Willi Syndrome.

(iii) Plays an important role in controlling emotions and making decisions. Damage to this part can interfere with judging the size of or distance from objects; makes it harder to learn new words or skills; causes trouble in reaching for objects. Responsible for congenital disorder like *Chiari malformation*.

(iv) Largest structure of white matter; allows perception of depth and enables the two sides of brain to communicate. Related with coordination and complex problem-solving. Disfunction may cause Schizophrenia, dementia and other psychiatric disorders.

Correlate the above referred characteristics **(i)** – **(iv)** with the parts labeled (**1** – **4**) in the diagram above and choose the correct option:

(A) (i)-2; (ii)-3; (iii)-1 and (iv)-4
(B) (i)-4; (ii)-1; (iii)-2 and (iv)-3
(C) (i)-3; (ii)-2; (iii)-4 and (iv)-1
(D) (i)-4; (ii)-2; (iii)-1 and (iv)-4

Solution · Q3 **Answer: (B)**

In the figure, 1 is hypothalamus, 2 is cerebellum, 3 is corpus callosum and 4 is pons.

(i) Sleep cycle, pneumotaxic centre → pons, 4

(ii) Hunger, thirst, homeostasis → hypothalamus, 1

(iii) Chiari malformation, reaching for objects → cerebellum, 2

(iv) Largest white matter, joins the two sides → corpus callosum, 3

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

4. Many insects are serious pests of crop plants. Sap-sucking insects can be controlled by spraying systemic insecticides, like:

(A) Chloropyriphos (B) Malathion
(C) Metasystox (D) Chlorantraniliprole

Solution · Q4 **Answer: (C)**

A systemic insecticide is absorbed by the plant and moves in its sap.

Sap-sucking insects take it in while feeding.

Metasystox (oxydemeton-methyl) is such a systemic insecticide.

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

5. What kind of joint is found between the odontoid process of the 2nd vertebra of mammals and the atlas vertebra?

(A) Pivotal Joint (B) Saddle Joint (C) Sliding Joint (D) Hinge Joint

Solution · Q5 **Answer: (A)**

The ring-like atlas turns around the odontoid process of the 2nd vertebra (axis).

Rotation about one axis → pivot joint, which lets the head turn side to side.

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

6. Match the items given under Column-1 with those of Column-2:

Column-1	Column-2
1. Hexacanth	(i) Goose Flesh
2. Renette Cell	(ii) *Ascaris*
3. Respiratory Tree	(iii) Sea Cucumber
4. Piloerectum	(iv) *Taenia*

(A) 1- (i), 2- (iii), 3- (ii) & 4- (iv) (B) 1- (i), 2- (ii), 3- (iv) & 4- (iii)
(C) 1- (iv), 2- (ii), 3- (iii) & 4- (i) (D) 1- (iii), 2- (i), 3- (iv) & 4- (ii)

Solution · Q6 **Answer: (C)**

1. Hexacanth → six-hooked embryo of *Taenia* (iv)
2. Renette cell → excretory cell of roundworms like *Ascaris* (ii)
3. Respiratory tree → breathing organ of sea cucumber (iii)
4. Piloerectum (hairs standing up) → goose flesh (i)

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

7. The tympanic cavity is connected with the auditory capsule through very fine openings. Choose the correct option for such openings:

(A) Fossa ovalis and Fenestra ovalis
(B) Fenestra rotundus and Fossa ovalis
(C) Foramen ovale and Fenestra ovalis
(D) Fenestra ovalis and Fenestra rotundus

Solution · Q7 **Answer: (D)**

The middle ear (tympanic cavity) meets the internal ear at two small windows:
fenestra ovalis (oval window) and fenestra rotunda (round window).

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

8. Currently, all new vehicles sold and registered in India should be compliant with which of the following versions of emission standards?

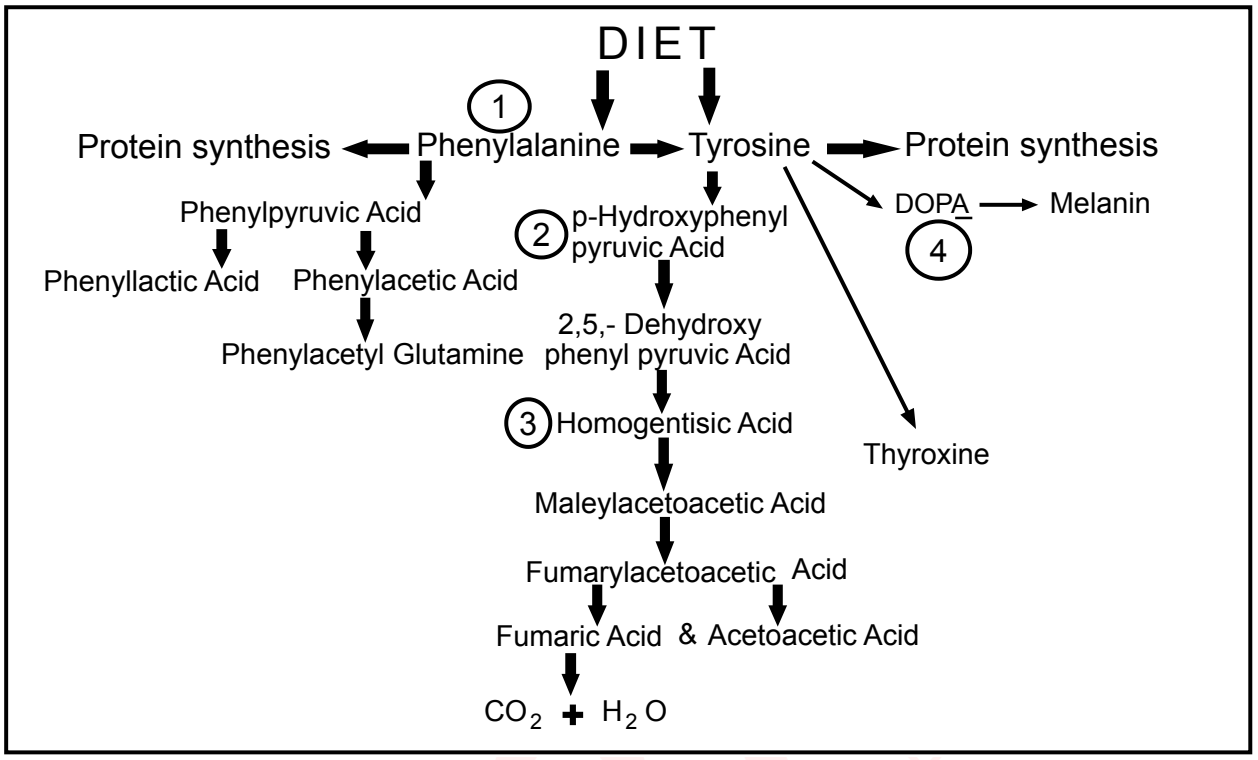
(A) BS-VI (B) BS-IV (C) BS-V (D) BS-VII

Solution · Q8 **Answer: (A)**

India moved straight from BS-IV to BS-VI.
From 1 April 2020, new vehicles sold and registered must follow BS-VI standards.

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

9. In the flow chart given below, accumulation of various products (marked **1** to **4**) results in some inborn diseases in man.



Give the correct sequence of diseases caused by accumulation of products marked as **1** to **4**:

(A) Phenylketonuria, Tyrosinosis, Alkaptonuria & Albinism

(B) Alkaptonuria, Albinism, Tyrosinosis & Phenylketonuria

(C) Tyrosinosis, Alkaptonuria, Phenylketonuria & Albinism

(D) Phenylketonuria, Alkaptonuria, Albinism & Tyrosinosis

Solution · Q9 **As per Zigyan: (A)**

1: phenylalanine piles up → phenylketonuria

2: p-hydroxyphenylpyruvic acid piles up → tyrosinosis

3: homogentisic acid piles up → alkaptonuria

4: this marks the DOPA step towards melanin. When the enzyme tyrosinase fails, melanin is not formed → albinism

So albinism is due to missing melanin, not to a piled-up product.

Reference: MedlinePlus Genetics (US National Library of Medicine), page 'Alkaptonuria': when the enzyme homogentisate 1,2-dioxygenase does not work well, homogentisic acid collects in the body.

Reference: MedlinePlus Genetics, page 'TYR gene': tyrosinase begins melanin formation by changing tyrosine to dopaquinone. In albinism type 1, most changes in this gene stop the enzyme, so no melanin is made.

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

10. Match the Plants mentioned in Column-1 with their characteristics in Column-2:

Column-1	Column-2
1. Wheat	(i) Pseudostem and monocarpy
2. Banyan Tree	(ii) Glumes and lodicules
3. Banana	(iii) Seeds but no fruits
4. Pine Tree	(iv) Prop roots and hypanthia

Choose the correct option:

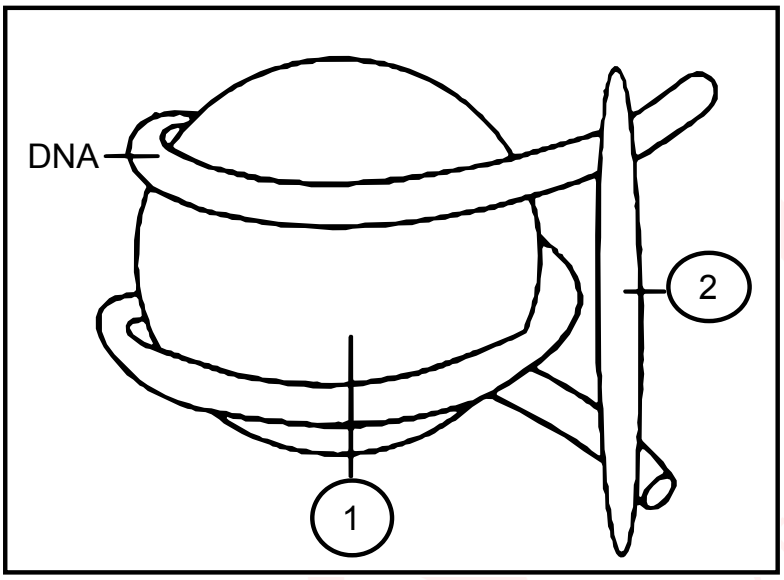
(A) 1-(iv), 2-(i), 3-(ii) & 4-(iii)
(B) 1-(ii), 2-(iii), 3-(i) & 4-(iv)
(C) 1-(ii), 2-(iv), 3-(i) & 4-(iii)
(D) 1-(i), 2-(ii), 3-(iv) & 4-(iii)

Solution · Q10 **Answer: (C)**

1. Wheat → glumes and lodicules (ii)
2. Banyan → prop roots, fig-type inflorescence (iv)
3. Banana → pseudostem, fruits only once in life (i)
4. Pine → gymnosperm, seeds but no fruits (iii)

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

11. Under the electron microscope **'Chromatin'** appears to have a string of bead like structures, as a number of repeating units, called **'Nucleosomes'**. The adjoining diagram shows one such unit. The labeled parts **1** and **2** are its important constituents made up of a total of **5** components. Choose the correct option showing the correct sequence of the 5 component units included in the labeled parts 1 and 2:



(A) H1, H2a, H2b, H3 and H4
(B) H1, H2b, H3a, H3b and H4
(C) H2a, H2b, H3, H4 and H1
(D) H1, H2, H3a, H3b and H4

Solution · Q11 **Answer: (C)**

Part 1 is the histone core (octamer), with two each of H2a, H2b, H3 and H4.

Part 2 is the linker histone H1, which holds DNA where it enters and leaves.

Listing part 1 first and then part 2: H2a, H2b, H3, H4 and H1.

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

12. Two statements marked as ASSERTION (A) and REASON (R) are given below. Choose the correct answer as per the given codes:

ASSERTION (A): The eyes of nocturnal, cave and deep water dwelling animals have only rods in their retina.

REASON (R): Rods provide high sensitivity to light, but with relatively low spatial discrimination and no ability to distinguish different wavelengths of light.

Choose the correct option:

(A) Both assertion **(A)** and reason **(R)** are true and the reason **(R)** is the correct explanation of the assertion **(A).**
(B) Both assertion **(A)** and reason **(R)** are true and the reason **(R)** is not the correct explanation of the assertion**(A).**
(C) Assertion **(A)** is true but reason **(R)** is false.
(D) Both assertion **(A)** and reason **(R)** are false.

Solution · Q12 **As per Zigyan: (A)**

A: As a general rule, animals living in very dim light depend on rods to see. ∴ true.

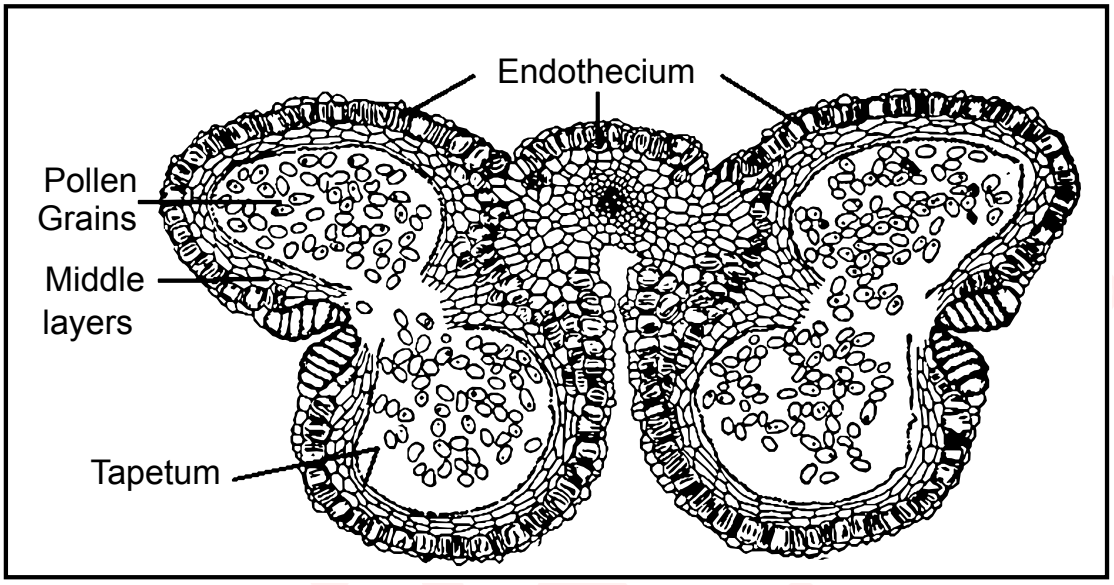
R: Rods are very sensitive to light, but give less sharp vision and no colour. ∴ true.

Seeing in the dark needs this high sensitivity, so R explains A.

Reference: NCERT Science Class VIII (2024-25), Chapter 13 'Light', pages 172 and 174: rods are sensitive to dim light, cones to bright light and colour. The owl, a night bird, has many rods and only a few cones.

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

13. In the diagram given below, what are the maximum kinds of ploidy levels of the various parts labeled?



(A) Only Haploid
(B) Only Diploid
(C) Haploid and Diploid
(D) Haploid, Diploid and Polyploid

Solution · Q13 **Answer: (D)**

Pollen grains are haploid.

Endothecium and middle layers are diploid.

Tapetum cells commonly become polyploid.

∴ haploid, diploid and polyploid cells are all possible.

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

14. According to Cohesion Theory for the ascent of sap in tall trees, all the forces together which create obstacle in the ascent of sap are about 50 atm. What is the cohesive force of water which helps continuous rise of sap in tallest trees?

(A) 350 atm.
(B) 200 atm.
(C) 140 atm.
(D) 600 atm.

Solution · Q14 **As per Zigyan: (A)**

Hydrogen bonds hold the water molecules together, so the sap column stays unbroken.

In the cohesion theory, the cohesive force of water is taken as up to about 350 atm.

This is far more than the 50 atm that opposes the rise of sap.

Check: 350 atm is seven times the 50 atm resistance, so the water column can be pulled up without breaking.

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

15. Some human males show hypertrichosis of ear pinna. Which of the following is the cause of this genetic characteristic?

(A) A dominant gene in male and a recessive allele in female

(B) Aneuploidy

(C) Holandric gene

(D) Trisomy of an autosome

Solution · Q15 **Answer: (C)**

Hypertrichosis of the ear pinna is taken as a Y-linked trait.

Genes on the non-homologous part of the Y chromosome are holandric genes, passed only from father to son.

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

16. Which of the following is the agreement to protect the stratospheric ozone layer by phasing-out the production and consumption of ozone-depleting substances?

(A) Kyoto Protocol (B) Montreal Protocol

(C) Rio Summit (D) Stockholm Convention

Solution · Q16 **Answer: (B)**

The Montreal Protocol (1987) phases out the production and consumption of ozone-depleting substances.

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

17. A sample of 1.0 liter milk weighs 1.032 kg. The milk contains 4% milk fat by volume having density 865 kg/m^3. The density of fat free (skimmed) milk in kg/m^3 is

(A) 1036.95 (B) 1037.95 (C) 1038.95 (D) 1040.95

Solution · Q17 **Answer: (C)**

Volume of fat in 1.0 L of milk:

$$V_f = 4\% \text{ of } 1.0 \text{ L} = 0.040 \text{ L}$$

Mass of fat:

$$m_f = 865 \times 0.040 \times 10^{-3} = 0.0346 \text{ kg}$$

Density of skimmed milk:

$$\rho = \frac{1.032 - 0.0346}{0.960 \times 10^{-3}}$$

$$\Rightarrow \rho \approx 1038.96 \text{ kg/m}^3$$

The matching option is 1038.95.

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

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

(A) 0.350 g (B) 0.161 g (C) 29.75 g (D) 12.94 g

Solution · Q18 **Answer: (D)**

Mass of Na^+ needed:

$$m(Na^+) = 50 \times 70.0 \text{ mg} = 3.50 \text{ g}$$

Molar masses (g/mol):

$$Na = 22.99, NaNO_3 = 84.99$$

Mass of $NaNO_3$ required:

$$m = 3.50 \times \frac{84.99}{22.99}$$

$$\Rightarrow m \approx 12.94 \text{ g}$$

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

19. One structural isomer of $C_2H_4I_2$ contains both the Iodine (I) atoms attached to same carbon atom. The bond length of C – I bond is 2.10 Å. Assuming tetrahedral angles and additivity of covalent bond radii, the distance between two Iodine (I) atoms is (given that sin 54.75° = 0.815 and sin 109.5° = 0.94)

(A) 2.10 Å (B) 2.47 Å (C) 4.20 Å (D) 3.42 Å

Solution · Q19 **Answer: (D)**

The two C–I bonds make the tetrahedral angle, 109.5°, at carbon.

A perpendicular from C to the line joining the I atoms bisects both the angle and that line.

$$d = 2 \times 2.10 \times \sin 54.75°$$

$$\Rightarrow d = 4.20 \times 0.815$$

$$\Rightarrow d \approx 3.42 \text{ Å}$$

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

20. Amongst the following, select the option in which all the oxides express acidic nature.

(A) F-oxide, S-oxide, C-oxide, In-oxide
(B) Cl-oxide, P-oxide, Ga-oxide, Be-oxide
(C) At-oxide, Xe-oxide, Se-oxide, As-oxide
(D) Br-oxide, Xe-oxide, Te-oxide, Sn-oxide

Solution · Q20 **As per Zigyan: (C)**

(A): CO is a neutral oxide and In_2O_3 is weakly basic.

(B): BeO and Ga_2O_3 are amphoteric.

(D): SnO and SnO_2 are amphoteric.

(C): At, Xe, Se and As are non-metals or metalloids, and their oxides are taken as acidic.

As_2O_3 reacts with bases as an acid.

Reference: NCERT Chemistry Class XI (Part I), Unit 3 'Classification of Elements and Periodicity in Properties', section 3.7.3: CO is a neutral oxide; As_2O_3 is amphoteric, and amphoteric oxides behave as acids with bases.

Reference: LibreTexts, Barron, Chemistry of the Main Group Elements, section 6.6 'Trends for the Oxides of the Group 13 Elements': Ga_2O_3 is amphoteric and In_2O_3 is weakly basic.

Reference: LibreTexts Inorganic Chemistry, 'Oxides of Group 4 Elements' (the carbon family): SnO and SnO_2 are amphoteric.

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

21. How many moles of the so called 'electron gas' weighs one kilogram?

(A) $\frac{6.02}{9.11} \times 10^{54}$ (B) $\frac{100}{6.02 \times 9.11} \times 10^{6}$

(C) 6.02×10^{23} (D) $\frac{10}{9.11} \times 10^{30}$

Solution · Q21 **Answer: (B)**

Mass of one mole of electrons:

$$M = 9.11 \times 10^{-31} \times 6.02 \times 10^{23} \text{ kg}$$

Number of moles in 1 kg:

$$n = \frac{1}{9.11 \times 10^{-31} \times 6.02 \times 10^{23}}$$

$$\Rightarrow n = \frac{10^8}{6.02 \times 9.11}$$

$$\Rightarrow n = \frac{100}{6.02 \times 9.11} \times 10^{6}$$

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

22. The magnitude of electrostatic force between two tiny spherical balls carrying charge q_1 and q_2 separated by a distance r in free space is given by $F = K\frac{q_1 q_2}{r^2}$ where the constant $K = 9 \times 10^9$ in SI units

Two tiny spherical balls of carbon ($^{12}_{6}C$) weighing 1 g each are kept 1 cm apart in free space. The two spheres carry equal and opposite charges. The magnitude of electrostatic force of attraction between the two charged spheres is $F = 1.0 \times 10^{-5}$ N. The ratio of the number of excess electrons to total number of atoms in the negatively charged sphere is

(A) 4.15×10^{-14} (B) 2.08×10^{9} (C) 5.02×10^{-22} (D) 6.02×10^{-23}

Solution · Q22 **Answer: (A)**

Each sphere carries charge of magnitude q:

$$q = r\sqrt{\frac{F}{K}}$$

$$\Rightarrow q = 10^{-2}\sqrt{\frac{1.0 \times 10^{-5}}{9 \times 10^{9}}}$$

$$\Rightarrow q \approx 3.33 \times 10^{-10} \text{ C}$$

Number of excess electrons:

$$N_e = \frac{3.33 \times 10^{-10}}{1.6 \times 10^{-19}} \approx 2.08 \times 10^{9}$$

Atoms in 1 g of carbon-12:

$$N = \frac{6.02 \times 10^{23}}{12} \approx 5.02 \times 10^{22}$$

Required ratio:

$$\frac{N_e}{N} \approx 4.15 \times 10^{-14}$$

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

23. The correct choice for the properties of the atomic species shown in the following table is

Properties	A	B	C	D	E
Smallest ionic radius	Li^+	Na^+	K^+	Be^{2+}	Mg^{2+}
Highest electronegativity	Cl	S	O	He	N
Highest electron affinity	N	Cl	F	Be	O
Highest magnetic moment	Cr^+	Fe^{2+}	Cu^{2+}	Ni^{4+}	Sc^{3+}

(A) D, D, B, A (B) A, D, B, D (C) D, C, B, E (D) D, C, E, A

Solution · Q23 **As per Zigyan: (A)**

Smallest ionic radius: Be^{2+}, so D.

He has no Pauling value, so electronegativity is compared on the Mulliken scale.

Ionisation energy and electron affinity (electron gain enthalpy with sign reversed) are added, in eV:

He: 24.59 − 0.50 = 24.09

Cl: 12.97 + 3.62 = 16.59

O: 13.62 + 1.46 = 15.08

S and N also give smaller sums, so He is highest: D.

Highest electron affinity: Cl, so B.

Unpaired electrons: Cr^+ 5, Fe^{2+} 4, Cu^{2+} 1, Ni^{4+} 4, Sc^{3+} 0.

∴ highest magnetic moment: Cr^+, so A.

Correct order: D, D, B, A.

Reference: NCERT Chemistry Class XI (Part I), Unit 3 'Classification of Elements and Periodicity in Properties', section 3.7.1: electronegativity is not a measurable quantity and has several scales, such as Pauling and Mulliken-Jaffe; Table 3.7 gives electron gain enthalpies (He +48, O −141, S −200, Cl −349 kJ/mol).

Reference: LibreTexts, Ursinus College CHEM322, section 2.1.2 'Electronegativity and the Bonding Continuum': the Mulliken scale relates electronegativity to the sum of first ionisation energy and first electron affinity.

Reference: NIST Atomic Spectra Database, ionisation energies: He 24.59 eV, N 14.53 eV, O 13.62 eV, S 10.36 eV and Cl 12.97 eV.

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

24. On Fahrenheit scale of temperature, the freezing point of water is marked as 32°F and the boiling point of water is marked as 212°F. While the freezing point and boiling point of water on the Celsius scale are marked as 0°C and 100°C respectively.

During the routine checkup of some patient, a doctor measures the temperature of the patient as 102.6°F. The temperature of patient on Celsius scale is

(A) 37.0 °C (B) 39.0 °C (C) 39.2 °C (D) 39.4 °C

Solution · Q24 **Answer: (C)**

Both scales are linear, so:

$$\frac{C}{100} = \frac{F - 32}{180}$$

$$\Rightarrow C = \frac{5}{9}(102.6 - 32)$$

$$\Rightarrow C \approx 39.2\ °C$$

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

25. The pH of neutral pure water at 25 °C is 7. When water is heated to 70 °C the pH value

(A) decreases and its nature turns acidic (B) increases and its nature turns basic

(C) remain constant as 7 (D) decreases but its nature remains neutral

Solution · Q25 **Answer: (D)**

Ionisation of water is endothermic, so heating increases it.

K_w and $[H^+]$ rise, so the pH falls below 7.

H^+ and OH^- are still formed in equal numbers.

$$[H^+] = [OH^-]$$

$\therefore$ The water remains neutral.

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

26. The concentration (mole/liter) of hydronium ion $[H_3O^+]$ for a solution having pH 8.26 is

(A) 10^{-7} (B) 1×10^{-9} (C) 5.5×10^{-9} (D) 3.2×10^{-3}

Solution · Q26 **Answer: (C)**

$$[H_3O^+] = 10^{-pH}$$

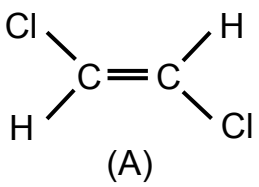
$$\Rightarrow [H_3O^+] = 10^{-8.26}$$

$$\Rightarrow [H_3O^+] = 10^{0.74} \times 10^{-9}$$

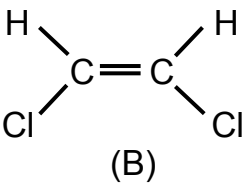
$$\Rightarrow [H_3O^+] \approx 5.5 \times 10^{-9}\ \text{mol L}^{-1}$$

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

27. The expected values of the normal boiling point of the two compounds A and B given below are T_A and T_B respectively. Then



(A)



(B)

(A) $T_A < T_B$ (B) $T_A = T_B$

(C) $T_A > T_B$ (D) Can't be predicted

Solution · Q27 **Answer: (A)**

A is trans-1,2-dichloroethene and B is cis-1,2-dichloroethene.

In A, the two C–Cℓ bond dipoles cancel.

In B, they do not cancel, so B is polar.

Stronger dipole–dipole attraction gives B the higher boiling point.

$\therefore T_A < T_B$

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

28. Which of the following is the strongest material (in terms of tensile strength)?

(A) Diamond (B) Tungsten (C) Graphene (D) Steel

Solution · Q28 **Answer: (C)**

Graphene is a single layer of carbon atoms joined by strong covalent bonds.

Its tensile strength is about 130 GPa, the highest of the four materials.

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

29. Which pair of the following group 13 elements represents the pair of the most stable oxidation state of the pair?

(A) $B^+, T\ell^+$ (B) $B^{3+}, T\ell^{3+}$ (C) $B^{3+}, T\ell^+$ (D) $B^+, T\ell^{3+}$

Solution · Q29 **Answer: (C)**

Boron shows the +3 state, as it has no inert pair effect.

In Tℓ, the $6s^2$ pair tends to stay unused (inert pair effect).

So the most stable state of Tℓ is +1.

$\therefore$ The pair is $B^{3+}, T\ell^+$.

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

30. To have a secured and safe travel, air bags are being used in modern vehicles/automobiles for road journey. The substance most often used in the air bags in automobiles is

(A) NaN_3 (B) Na_3N (C) KO_2 (D) Acurite

Solution · Q30 **Answer: (A)**

Of these, sodium azide is the gas-producing chemical of air bags.

In a crash it decomposes very fast, and nitrogen gas fills the bag.

$2NaN_3 \rightarrow 2Na + 3N_2$

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

31. Most predominantly used metal in magnetic resonance imaging (MRI) contrast solutions is

(A) Lr (B) Gd (C) Pm (D) Sm

Solution · Q31 **Answer: (B)**

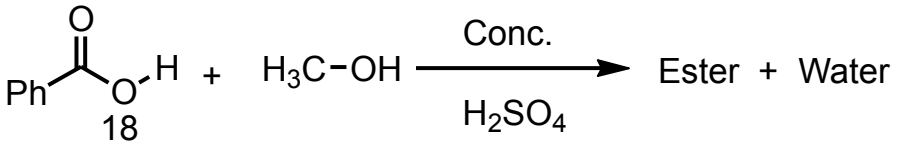
Most MRI contrast agents are complexes of gadolinium(III).

Gd^{3+} has seven unpaired electrons, so it is strongly paramagnetic.

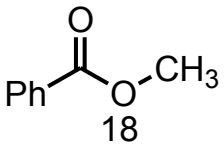
It makes nearby water protons relax faster, which improves image contrast.

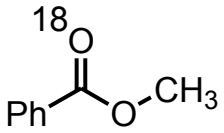
IAPT answer: (B) | **Zigyan answer:** (B)

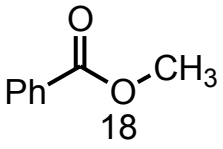
32. An esterification process has been represented by the following chemical reaction

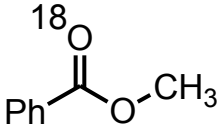


The fate of the labelled oxygen (O^{18}) atom in the product is:

(A)


(B)


(C) Mixture of


and


(D) H_2O^{18}

Solution · Q32 **As per Zigyan: (D)**

In Fischer esterification, the C–OH bond of the acid breaks.

The oxygen of the $-OCH_3$ group in the ester comes from methanol.

Here ^{18}O is in the –OH group of the acid, so it leaves in water.

$Ph–CO–{}^{18}OH + CH_3OH \rightleftharpoons Ph–CO–OCH_3 + H_2{}^{18}O$

Why Zigyan differs from IAPT: option (B) would need the old C=O oxygen to leave in water. Esterification replaces the acid's –OH group by $–OCH_3$, so the ^{18}O of that group goes into water.

Reference: NCERT Chemistry Class XII (Part II), Unit 8 'Aldehydes, Ketones and Carboxylic Acids', section 8.9.2, Esterification: it is a reaction involving C–OH bond cleavage; a hydroxyl group of the intermediate leaves as water, and the alcohol's OR′ group stays in the ester.

Reference: OpenStax Organic Chemistry, section 21.3 'Reactions of Carboxylic Acids': with ^{18}O-labelled methanol, the label is found in methyl benzoate and the water is unlabelled, so the acid's C–OH bond is the one broken.

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

33. Which of the following motions has largest magnitude of acceleration? Assume that all objects are moving in straight line with constant acceleration.

(A) A bus moving with an initial velocity 72 km/hr comes to rest in 2.50 s

(B) A rock during its free fall near the earth surface

(C) A car accelerates from rest to a velocity v = 108 km/hr in 4.00 s

(D) A train, starting from rest, takes 6.00 s to cover a distance of 216 m

Solution · Q33 **Answer: (D)**

For the bus:

$$72 \text{ km/h} = 20 \text{ m/s}$$

$$\Rightarrow |a| = 20/2.50 = 8 \text{ m/s}^2$$

For the rock:

$$a = g = 9.8 \text{ m/s}^2$$

For the car:

$$108 \text{ km/h} = 30 \text{ m/s}$$

$$\Rightarrow a = 30/4.00 = 7.5 \text{ m/s}^2$$

For the train:

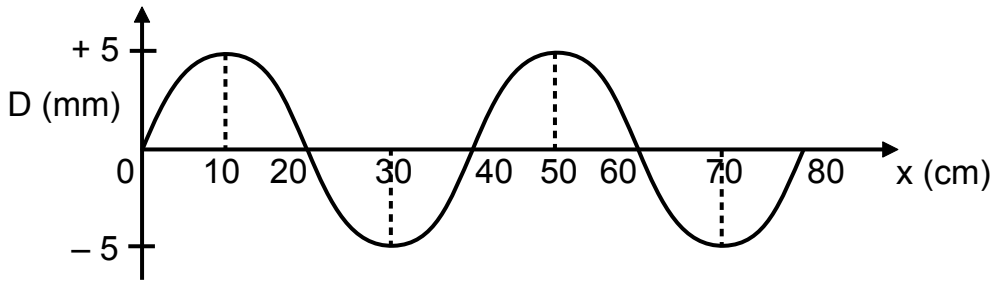
$$216 = (1/2) \times a \times (6.00)^2$$

$$\Rightarrow a = 12 \text{ m/s}^2$$

$\therefore$ The train has the largest acceleration.

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

34. A sound wave is propagating in a medium in the + x direction at a speed of 360 m/s. At a given instant, a snap shot of the plot of displacement (D) of various particles of medium from their equilibrium position (taken along y axis) vs the position (x) of particle on x axis, is shown in figure below. The incorrect option is



(A) the amplitude of wave is 5 mm

(B) the frequency of wave is 900 Hz

(C) after 0.01 sec the trough of the wave will occur at x = 20 cm and x = 40 cm

(D) this wave will travel a distance of 1.62 km along + x axis in 4.5 s

Solution · Q34 **Answer: (C)**

From the graph:

$$A = 5 \text{ mm}, \lambda = 40 \text{ cm} = 0.4 \text{ m}$$

$$f = v/\lambda$$

$$\Rightarrow f = 360/0.4 = 900 \text{ Hz}$$

For 4.5 s:

$$d = 360 \times 4.5$$

$$\Rightarrow d = 1620 \text{ m} = 1.62 \text{ km}$$

Number of time periods in 0.01 s:

$$n = f\,t = 900 \times 0.01 = 9$$

After a whole number of periods the graph is unchanged, so the troughs are again at:

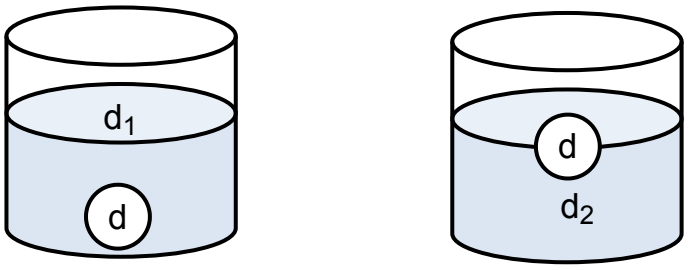
$$x = 30 \text{ cm and } 70 \text{ cm}$$

At 20 cm and 40 cm the displacement is zero.

$\therefore$ Statement (C) is incorrect.

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

35. When placed inside a liquid of density d_1, a sphere sinks, as shown in figure (i). When placed inside a liquid of density d_2, the same sphere floats with half of its volume appearing above the liquid surface, as shown in figure (ii). Given that the density of the sphere is d



(i) (ii)

If F_1 and F_2 are buoyant forces acting on the sphere in the two situations (i) and (ii) respectively due to the two liquids, then the ratio $\frac{F_1}{F_2}$ equals

(A) $\frac{d_1}{d_2}$ (B) $\frac{d_1}{2d_2}$

(C) $\frac{d_1}{d}$ (D) $\frac{d}{d_2}$

Solution · Q35 **Answer: (C)**

In (ii), the sphere floats, so the buoyant force equals its weight.

$$F_2 = Vdg$$

In (i), the whole volume V is inside the liquid.

$$F_1 = Vd_1g$$

$$\Rightarrow \frac{F_1}{F_2} = \frac{d_1}{d}$$

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

36. A car is moving on a horizontal cement road with uniform velocity 90 km/hr. Read the following statements regarding motion of car.

S_1: The acceleration of car is zero

S_2: No force is acting on the car

S_3: Kinetic energy and linear momentum of car are constant during this motion

S_4: Engine of car is doing no work

Now choose the correct option

(A) Only the statements S_1 and S_2 are true

(B) Only the statements S_1 and S_3 are true

(C) Only the statements S_1, S_2 and S_3 are true

(D) All the statements S_1, S_2, S_3 and S_4 are true

Solution · Q36 **Answer: (B)**

S_1 is true: uniform velocity means zero acceleration.

S_2 is false: weight, normal reaction, friction and air drag act; only their resultant is zero.

S_3 is true: speed and direction do not change, so kinetic energy and momentum stay constant.

S_4 is false: the engine does work against friction and air drag.

$\therefore$ Only S_1 and S_3 are true.

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

37. A particle is moving along circular path of diameter D = 14 cm with constant speed v. It takes 0.02 second to complete an arc which subtends an angle of 45° at the center. If f is its frequency of revolution, then the correct option is

(A) $v = 5.5\ m\ sec^{-1}$, $f = 6.25\ Hz$

(B) $v = 5.5\ m\ sec^{-1}$, $f = 12.5\ Hz$

(C) $v = 2.75\ m\ sec^{-1}$, $f = 6.25\ Hz$

(D) $v = 2.75\ m\ sec^{-1}$, $f = 12.5\ Hz$

Solution · Q37 **Answer: (C)**

An arc of 45° is one-eighth of the circle.

Time period:

$$T = 8 \times 0.02 = 0.16\ s$$

$$f = \frac{1}{T} = \frac{1}{0.16}$$

$$\Rightarrow f = 6.25\ Hz$$

Speed:

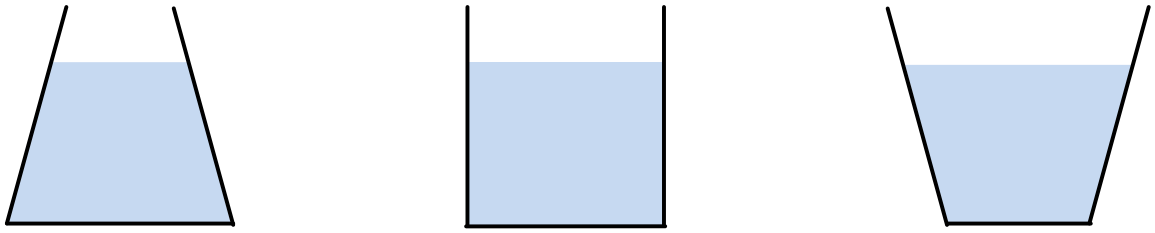
$$v = \pi D f$$

$$v = \frac{22}{7} \times 0.14 \times 6.25$$

$$\Rightarrow v = 2.75\ m\ s^{-1}$$

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

38. The same liquid is filled in vessels of three different shapes up to the same height, as shown in figures (a), (b) and (c). Each vessel has equal base area.



(a) (b) (c)

Let P_a, P_b and P_c are the values of liquid pressure on the base of vessels in figure (a), (b) and (c) respectively. W_a, W_b and W_c are the weights of liquid contained in vessels in figure (a), (b) and (c) respectively. Choose the correct option

(A) $P_a < P_b < P_c$ and $W_a < W_b < W_c$

(B) $P_a = P_b = P_c$ and $W_a = W_b = W_c$

(C) $P_a < P_b < P_c$ and $W_a = W_b = W_c$

(D) $P_a = P_b = P_c$ and $W_a < W_b < W_c$

Solution · Q38 **Answer: (D)**

Liquid pressure at depth h:

$$P = h\rho g$$

The liquid and the height are the same in all three vessels.

$$\therefore P_a = P_b = P_c$$

The base areas are equal. Vessel (a) narrows upwards, (b) has vertical walls and (c) widens upwards.

So (a) holds the least liquid and (c) the most.

$$\therefore W_a < W_b < W_c$$

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

39. An ant moves at constant speed on the principal axis of concave mirror of focal length f, from a point at distance 5f from the pole of the mirror to the focus F of the mirror. During the motion of the ant (consider the ant as a point), its image formed by the mirror

Statement S_1: moves with constant speed

Statement S_2: has same velocity as that of the ant when the ant is at center of curvature C of the mirror

Statement S_3: moves slower in the beginning and faster towards the end

Statement S_4: moves faster in the beginning and slower towards the end

Now, choose the correct option:

(A) Only the statement S_1 is correct

(B) Statements S_2 and S_3 are correct

(C) Only the statement S_3 is correct

(D) The statements S_2 and S_4 are correct

Solution · Q39 **Answer: (C)**

For motion along the principal axis, speeds are related by

$$v_{image} = m^2 v_{ant}$$

For a real image, the size of the magnification at object distance x from the pole is

$$|m| = \frac{f}{x - f}$$

At the starting point:

$$m^2 = \frac{1}{16}$$

At C:

$$m^2 = 1$$

Near F, m becomes very large.

So the image moves slowly at first and fast towards the end: S_3 is true; S_1 and S_4 are false.

At C the two speeds are equal, but the ant moves towards the mirror while the image moves away. The velocities are opposite, so S_2 is false.

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

40. Which of the following cannot be used as a unit of electric current (i)?

(A) $\frac{\text{coulomb}}{\text{second}}$ (B) $\frac{\text{joule}}{\text{coulomb - ohm}}$

(C) $\frac{\text{watt}}{\text{volt}}$ (D) $\frac{\text{volt}}{\text{coulomb - meter}}$

Solution · Q40 **Answer: (D)**

(A) is charge per unit time:

$$I = \frac{Q}{t}$$

(B) Joule per coulomb is volt, and volt per ohm is ampere.

(C) From electric power:

$$I = \frac{P}{V}$$

(D) A volt per metre is the same as a newton per coulomb.

$$\frac{V}{C \times m} = \frac{N}{C^2}$$

This is not the ampere, so (D) cannot be used for current.

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

41. From the famous Einstein mass-energy equivalence relation, energy equivalent to one atomic mass unit (u) (given that $1u = 1.6605 \times 10^{-27}$ kg and the speed of light in vacuum $c = 2.9979 \times 10^8$ m/s) is close to

(A) 931 J (B) 931 eV (C) 931 MeV (D) 931 keV

Solution · Q41 **Answer: (C)**

$$E = mc^2$$

$$E = 1.6605 \times 10^{-27} \times (2.9979 \times 10^8)^2$$

$$\Rightarrow E = 1.4924 \times 10^{-10} \text{ J}$$

Change to electron volt, using the charge of an electron:

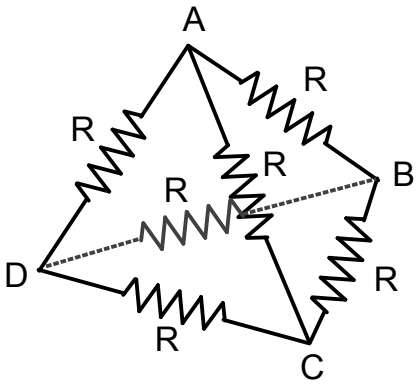
$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

$$E = \frac{1.4924 \times 10^{-10}}{1.602 \times 10^{-19}} \text{ eV}$$

$$\Rightarrow E \approx 931.6 \times 10^6 \text{ eV} \approx 931 \text{ MeV}$$

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

42. Each resistance in the electrical network shown as a tetrahedron in the adjacent figure is R = 12 Ω. The electrical resistance between any two vertices of tetrahedron must be



(A) 2 Ω (B) 3 Ω (C) 4 Ω (D) 6 Ω

Solution · Q42 **Answer: (D)**

Take the vertices A and B.

They are joined directly by R, and by two more paths, through C and through D, each of resistance 2R.

By symmetry, C and D are at the same potential, so no current flows in CD.

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{2R} + \frac{1}{2R}$$

$$\Rightarrow R_{eq} = \frac{R}{2}$$

$$\Rightarrow R_{eq} = 6\ \Omega$$

The same is true for every pair of vertices.

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

43. Two particles of mass 1 kg and 4 kg are moving with equal kinetic energy. Ratio of magnitudes of their linear momenta is (Assume nonrelativistic velocity)

(A) 1 : 4 (B) 1 : 2 (C) 2 : 1 (D) 1 : 16

Solution · Q43 **Answer: (B)**

$$K = \frac{p^2}{2m}$$

$$\Rightarrow p = \sqrt{2mK}$$

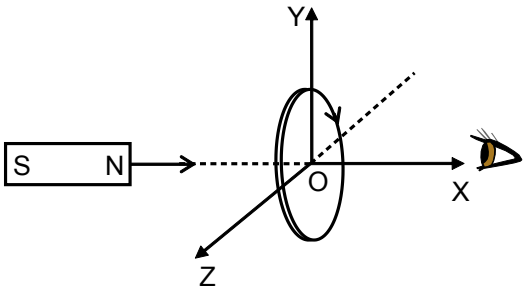
For equal kinetic energy:

$$\frac{p_1}{p_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{1}{4}}$$

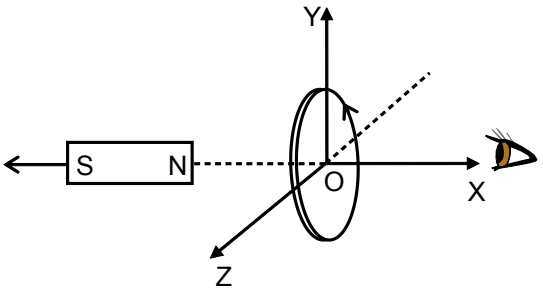
$$\Rightarrow p_1 : p_2 = 1 : 2$$

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

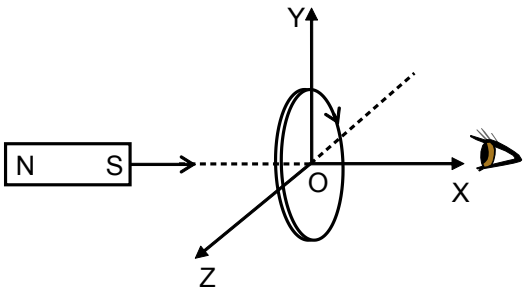
44. In the following figures, all the conducting coils are in Y-Z plane. The magnet is moved along +X axis or – X axis with a constant speed v. The direction of induced current in the coils has been shown, as viewed from +X axis. Identify the diagram/diagrams which show correct direction of induced current.



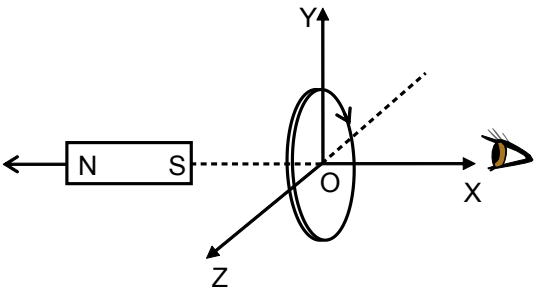
(i)



(ii)



(iii)



(iv)

(A) only (i), (ii) and (iii)
(B) only (iii)
(C) only (ii), (iii) and (iv)
(D) only (i), (ii) and (iv)

Solution · Q44 **Answer: (D)**

Seen from +X, a clockwise current makes the coil face towards the magnet a north pole. An anticlockwise current makes it a south pole.

By Lenz's law, this face repels an approaching magnet and attracts a receding one.

(i) N approaches, face must be N: clockwise. Shown correctly.

(ii) N moves away, face must be S: anticlockwise. Shown correctly.

(iii) S approaches, face must be S: anticlockwise. Shown clockwise, so wrong.

(iv) S moves away, face must be N: clockwise. Shown correctly.

∴ Only (i), (ii) and (iv) are correct.

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

45. The heater filament of an electric kettle is made up of a conducting wire of length L and diameter D. When connected to a line voltage source, it takes 6 minute to raise the temperature of 500 ml of water by 40°C. If the heater filament is replaced by a new one of same material but length 2L and diameter 2D, the time taken for heating the same quantity of water through the same temperature difference will be

(Assume that entire system is thermally insulated)

(A) 12 minute (B) 6 minute (C) 3 minute (D) 1.5 minute

Solution · Q45 **Answer: (C)**

Resistance of the filament:

$$R = \frac{4\rho L}{\pi D^2}$$

Let the old values have suffix 1 and the new values suffix 2. Now the length is 2L and the diameter is 2D.

$$R_2 = \frac{2}{4}R_1 = \frac{R_1}{2}$$

The heat needed H and the line voltage V are unchanged:

$$H = \frac{V^2 t}{R}$$

$$\Rightarrow t \propto R$$

$$\Rightarrow t_2 = \frac{t_1}{2} = \frac{6}{2} = 3 \text{ min}$$

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

46. On straight rails a train is moving with constant velocity v. Suddenly a wagon breaks away from train. The train continues to move with same velocity while the wagon moves with constant retardation. After breaking away from train, the wagon covers distance d_1 before coming to rest and the train covers distance d_2 in the same duration, $\frac{d_1}{d_2}$ is

(A) $\frac{1}{3}$ (B) $\frac{1}{2}$
(C) $\frac{2}{3}$ (D) 1

Solution · Q46 **Answer: (B)**

Let the wagon come to rest after time t.

Wagon, with uniform retardation:

$$d_1 = \frac{v + 0}{2}t = \frac{vt}{2}$$

Train, with constant velocity:

$$d_2 = vt$$

$$\therefore \frac{d_1}{d_2} = \frac{1}{2}$$

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

47. A person with short-sightedness (myopia) cannot see objects clearly, beyond 2.5 meter. The power of lens required to correct his vision is

(A) + 2.5 D (B) + 0.4 D (C) − 2.5 D (D) − 0.4 D

Solution · Q47 **Answer: (D)**

The lens must form the image of a very distant object at the far point, 2.5 m in front of the eye.

$$u = -\infty,\ v = -2.5 \text{ m}$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow f = -2.5 \text{ m}$$

With f in metre,

$$P = \frac{1}{f} = \frac{1}{-2.5}$$

$$\Rightarrow P = -0.4 \text{ D}$$

So a concave lens is needed.

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

48. The mass and radius of the planet-one are M and R respectively. The mass and radius of planet-two are 2M and 2R respectively. Assume that both the planets have spherical shape. Acceleration due to gravity on the surface of planet-one and planet-two are g_1 and g_2 respectively. $\frac{g_1}{g_2}$ must be

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

Solution · Q48 **Answer: (B)**

$$g = \frac{GM}{R^2}$$

$$\frac{g_1}{g_2} = \frac{M}{2M} \times \left(\frac{2R}{R}\right)^2$$

$$\Rightarrow \frac{g_1}{g_2} = \frac{2}{1}$$

$$\Rightarrow g_1 : g_2 = 2 : 1$$

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

PART A-2 · ONE OR MORE CORRECT OPTIONS

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

49. Which of the following plant(s) has/have edible **aril**?

(A) Litchi (*Litchi chinensis*)
(B) Rambutan (*Nephelium lappaceum*)
(C) Cashew (*Anacardium occidentale*)
(D) Nutmeg (*Myristica fragrans*)

Solution · Q49 **Answer: (A), (B), (D)**

(A), (B) Litchi and rambutan: the juicy aril around the seed is eaten. ∴ true.

(C) Cashew: the swollen stalk (cashew apple) and the kernel are eaten, not an aril. ∴ false.

(D) Nutmeg: its aril, mace, is eaten as a spice. ∴ true.

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

50. Which of the following statement(s) regarding Viruses is/are **incorrect**?

(A) Usually potentially infectious
(B) Reproduction by genetic material only
(C) Envelope made of Glycolipids
(D) Presence of Ribosomes

Solution · Q50 **Answer: (C), (D)**

(A) Viruses can usually infect suitable host cells. ∴ correct statement.

(B) A virus is reproduced from its genetic material alone; it does not grow or divide. ∴ correct statement.

(C) A viral envelope is mainly a phospholipid bilayer from a host membrane, carrying glycoproteins. ∴ incorrect statement.

(D) Viruses have no ribosomes of their own; they use those of the host. ∴ incorrect statement.

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

51. Which of the following major Division(s) of Algae is/are characterised by **two** flagella?

(A) Rhodophyta (B) Phaeophyta (C) Chlorophyta (D) Cyanophyta

Solution · Q51 **Answer: (B), (C)**

(B) Phaeophyta (brown algae): zoospores have two unequal, lateral flagella. ∴ true.

(C) Chlorophyta (green algae): motile cells commonly have two equal, apical flagella, as in *Chlamydomonas*. ∴ true.

(A), (D) Red algae and blue-green algae have no flagella. ∴ false.

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

52. Which of the following statement(s) is/are true?

(A) All immunoglobulins are glycoproteins
(B) Eosinophils are not polymorphonuclear phagocytes
(C) Cilia in the windpipe are mechanical barriers
(D) Human **β** cells bear IgM and IgD immunoglobulins on their surface

Solution · Q52 **As per Zigyan: (A), (C), (D)**

(A) Antibodies are proteins with sugar chains attached. ∴ true.

(B) Eosinophils have a lobed nucleus and are phagocytic, so they are polymorphonuclear phagocytes. ∴ false.

(C) Windpipe cilia physically push out mucus carrying trapped germs. ∴ true.

(D) Here β cells means B cells (B lymphocytes).

Mature B cells that have not yet met an antigen carry IgM and IgD on their surface. ∴ true.

Reference: OpenStax Microbiology, section 18.4 'B Lymphocytes and Humoral Immunity': the surface receptors of naive mature B cells are membrane-bound IgD and IgM.

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

53. Which of the following colloids is/are medicines?

(A) Argyrol
(B) S-sol
(C) Milk of Magnesia
(D) Purple of Cassius

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

(A) Argyrol: a silver colloid used as an eye lotion. ∴ medicine.

(B) S-sol: colloidal sulphur, used as a germicide for skin troubles. ∴ medicine.

(C) Milk of magnesia: $Mg(OH)_2$ in water, used as an antacid and laxative. ∴ medicine.

(D) Purple of Cassius: a gold colloid used as a red-purple colour for glass and pottery. ∴ not a medicine.

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

54. In which of the following process, the N-atom is reduced

(A) $NH_4^+ \rightarrow N_2$
(B) $NH_2^- \rightarrow NO$
(C) $NO_2 \rightarrow NO_2^-$
(D) $NO_3^- \rightarrow NH_4^+$

Solution · Q54 **Answer: (C), (D)**

Change in oxidation number of N:

(A) $-3 \rightarrow 0$, increases

(B) $-3 \rightarrow +2$, increases

(C) $+4 \rightarrow +3$, decreases

(D) $+5 \rightarrow -3$, decreases

A decrease means reduction.

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

55. Which of the following statement(s) is/are true, if one mole of H_3PO_x is completely neutralized by 40 g NaOH?

(A) x = 2 and acid is monobasic
(B) x = 3 and acid is dibasic
(C) x = 4 and acid is tribasic
(D) x = 2 and acid does not form an acid salt

Solution · Q55 **Answer: (A), (D)**

Moles of NaOH used:

$$n = \frac{40}{40} = 1 \text{ mol}$$

One mole of acid needs only one mole of NaOH, so the acid is monobasic.

This is hypophosphorous acid, H_3PO_2.

$$x = 2$$

It has only one replaceable H, so it cannot form an acid salt. ∴ (A), (D) true.

H_3PO_3 is dibasic and H_3PO_4 is tribasic; they would need 2 and 3 moles of NaOH. ∴ (B), (C) false.

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

56. Select the correct statement(s) regarding an element having 2K, 8L, 9M and 2N electrons.

(A) It contains 1 unpaired electron
(B) It contains 1 d-electron
(C) It contains 12-p electron
(D) It is a non-metal

Solution · Q56 **Answer: (A), (B), (C)**

Total number of electrons:

$$2 + 8 + 9 + 2 = 21 \text{ (Sc)}$$

Electronic configuration:

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1\ 4s^2$

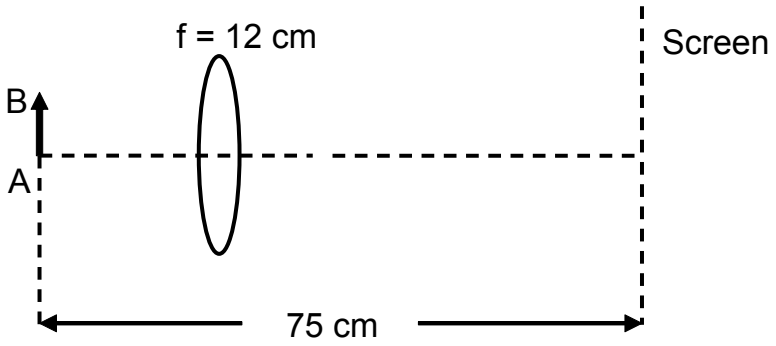
(A), (B) There is one 3d electron, and it is the only unpaired electron. ∴ true.

(C) The 2p and 3p subshells hold six electrons each, twelve in all. ∴ true.

(D) Scandium is a metal. ∴ false.

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

57. The screen S is placed at a distance of 75 cm in front of an illuminated object AB. A thin convex lens of focal length f = 12 cm is placed somewhere between the object and the screen so as to obtain a real image of the object on the screen. Choose the correct option(s)



(A) Distance between lens and object may be 15 cm
(B) Distance between lens and object may be 60 cm
(C) Image size may be larger than object size
(D) Image size may be smaller than object size

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

Take the distance of the lens from the object as x, in cm.

$$u = -x,\ v = 75 - x$$

By the lens formula,

$$\frac{1}{75 - x} + \frac{1}{x} = \frac{1}{12}$$

$$\Rightarrow x^2 - 75x + 900 = 0$$

$$\Rightarrow (x - 15)(x - 60) = 0$$

$$\therefore x = 15 \text{ cm}, 60 \text{ cm}$$

So (A) and (B) are true.

Size of image compared with object at the first position:

$$\frac{v}{u} = -\frac{60}{15} = -4$$

At the second position:

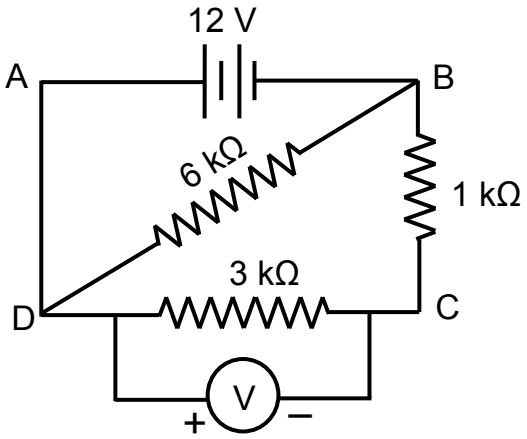
$$\frac{v}{u} = -\frac{15}{60} = -\frac{1}{4}$$

The image can be 4 times the object or one-fourth of it. ∴ (C), (D) true.

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

58. In the circuit shown in adjacent figure, a voltmeter of resistance 6000 Ω has been connected across 3 kΩ resistor. Internal resistance of battery is negligible.

Choose the correct option(s)



(A) Voltmeter reading is 8 volt

(B) Current passing through 1 kΩ resistor is 2 mA

(C) Current drawn from battery is 6 mA

(D) Electrical power dissipated in 6 kΩ resistor is 24 mili-watt

Solution · Q58 **Answer: (A), (C), (D)**

Voltmeter and 3 kΩ in parallel:

$$R = \frac{3 \times 6}{3 + 6} = 2\ \text{k}\Omega$$

This is in series with 1 kΩ, and the whole branch is across 12 V.

$$I = \frac{12}{2 + 1} = 4\ \text{mA}$$

Voltmeter reading:

$$V = 4 \times 2 = 8\ \text{V}$$

Current in the 6 kΩ resistor, also across 12 V:

$$i = \frac{12}{6} = 2\ \text{mA}$$

Battery current:

$$4 + 2 = 6\ \text{mA}$$

Power in the 6 kΩ resistor:

$$P = 12 \times 2 = 24\ \text{mW}$$

∴ (A), (C), (D) true; (B) false.

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

59. A train, moving on a straight horizontal track with constant speed of 108 km/hour, approaches a hill. When the engine of train is at distance 1200 m from hill, it produces a whistle of frequency 550 Hz. Assuming that the speed of sound in air is 330 m/s, the correct option(s) is/are

(A) the echo from hill will be heard by driver after $\frac{1}{9}$ minute

(B) the distance of engine from hill at which echo is heard by driver is 1000 m

(C) the wavelength of sound produced by whistle is 60 cm

(D) the echo from hill will be heard by driver after $\frac{20}{3}$ second

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

Speed of the train:

$$108 \text{ km/h} = 30 \text{ m/s}$$

Till the echo is heard, the paths of sound and train add up to twice the starting distance.

$$330t + 30t = 2 \times 1200$$

$$\Rightarrow t = \frac{20}{3} \text{ s}$$

$$\Rightarrow t = \frac{1}{9} \text{ min}$$

Distance of the engine from the hill then:

$$1200 - 30 \times \frac{20}{3} = 1000 \text{ m}$$

Wavelength of the whistle's own sound, from its frequency:

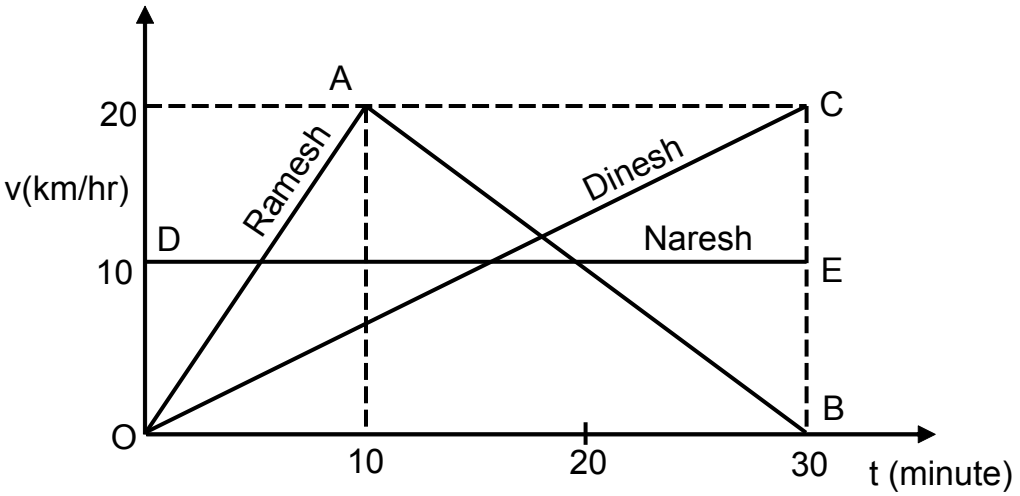
$$\lambda = \frac{330}{550} \text{ m}$$

$$\Rightarrow \lambda = 60 \text{ cm}$$

$\therefore$ all four are true.

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

60. Velocity-time graphs of three athletes Ramesh, Naresh and Dinesh for a given duration (0-30 Minute) are given below.



Graph OAB is v-t graph for athlete Ramesh, graph DE is v-t graph for athlete Naresh and graph OC is v-t graph for athlete Dinesh. The graphs are linear. Which of the following option(s) is/are correct during given interval of time?

(A) Athlete Dinesh has travelled maximum distance

(B) Athletes Ramesh, Naresh and Dinesh each have travelled equal distance

(C) Acceleration of athlete Dinesh is 40 km/hr^2

(D) None of the athletes is in uniform motion

Solution · Q60 **Answer: (B), (C)**

Distance is the area under the v-t graph. The total time is half an hour.

Ramesh (triangle):

$$\frac{1}{2} \times 0.5 \times 20 = 5 \text{ km}$$

Naresh (rectangle):

$$10 \times 0.5 = 5 \text{ km}$$

Dinesh (triangle):

$$\frac{1}{2} \times 0.5 \times 20 = 5 \text{ km}$$

All three distances are equal. ∴ (B) true, (A) false.

Slope of OC gives the acceleration of Dinesh:

$$a = \frac{20}{0.5} = 40 \text{ km/h}^2$$

∴ (C) true.

Naresh has constant velocity, which is uniform motion. ∴ (D) false.

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

ANSWER KEY

NSEJS 2024 · PAPER CODE 51

60
QUESTIONS · 216 MARKS

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

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

★ Answers as per Zigyan

- **Q9** — As per Zigyan: (A); IAPT key (A).
- **Q12** — As per Zigyan: (A); IAPT key (A).
- **Q14** — As per Zigyan: (A); IAPT key (A).
- **Q20** — As per Zigyan: (C); dropped by IAPT.
- **Q23** — As per Zigyan: (A); IAPT key (A).
- **Q32** — As per Zigyan: (D); IAPT key (B).
- **Q52** — As per Zigyan: (A), (C), (D); IAPT key (A), (C), (D).

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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

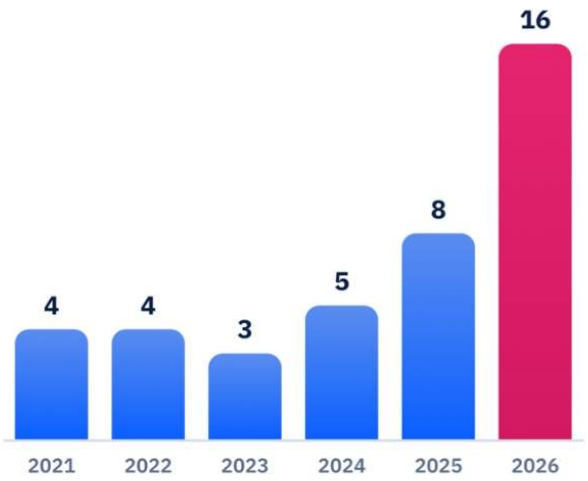
40
JEE Advanced selections in 6 years

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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