RRB Group D Official Paper (Held On: 16 Dec, 2025 Shift 2) (Previous Year Paper)

RRB Group D • 2025 • 100 questions • 90 minutes • Answer key and solutions

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GENERAL SCIENCE

Q1. In the spectrum formed by dispersion of sunlight through a prism, which colour deviates the most?

(a) Red
(b) Green
(c) Yellow
(d) Violet

Q2. Which of the following statements correctly describes the direction of conventional electric current?

(a) From the negative terminal to the positive terminal of a cell
(b) The same as the direction of the electrons' flow
(c) The direction is random and charges flow in a constant way
(d) From the positive terminal to the negative terminal of a cell

Q3. In which part of the neurons, is the first electrical impulse created?

(a) Cell body
(b) Nerve ending
(c) Dendrite
(d) Axon

Q4. Which of the following statements is FALSE regarding cells?

(a) Cells can be round, oval, spindle-shaped or branched.
(b) All cells are of the same size and shape.
(c) Nerve cells are long to help in the conduction of impulses.
(d) Cell shape is often related to its function.

Q5. The blades of a windmill rotate because of which of the following?

(a) Light energy
(b) Wind’s kinetic energy
(c) Elastic energy
(d) Sound energy

Q6. A force of 50 N acts perpendicular to a surface of area 0.1 m^2. What are the values of thrust and pressure exerted on the surface?

(a) Thrust = 50.0 N ; Pressure = 500.0 Pa
(b) Thrust = 25.0 N ; Pressure = 100.0 Pa
(c) Thrust = 50.0 N ; Pressure = 25.0 Pa
(d) Thrust = 100.0 N ; Pressure = 50.0 Pa

Q7. Which of the following glands secretes growth hormones in human beings?

(a) Pituitary gland
(b) Thyroid
(c) Pancreas
(d) Pineal gland

Q8. What is the atomic number of an element that has 17 electrons and 18 neutrons?

(a) 17
(b) 35
(c) 18
(d) 1

Q9. Which of the following best demonstrates that there is a space between particles of matter?

(a) A rubber band stretches
(b) Ice melts into water
(c) A piece of chalk breaks easily
(d) Sugar dissolves in water

Q10. Which among the following covalent compounds will have the least number of shared electron pairs?

(a) O2
(b) N2
(c) CH4
(d) H2

Q11. Which of the following structures is present at the surface of the rough endoplasmic reticulum membrane?

(a) Chromosome
(b) Cell wall
(c) Plasma membrane
(d) Ribosome

Q12. The main purpose of having a curved ceiling in a concert hall is to _____.

(a) Focus sound waves to reach all parts of the hall evenly
(b) Increase the pitch of music
(c) Absorb all sound
(d) Prevent sound from entering the hall

Q13. A man rides a bicycle in a circular track of radius 10 m. He completes one round in 10 minutes. What is his average velocity?

(a) 0.1 m/s
(b) 6.2 m/s
(c) 1 m/s
(d) 0 m/s

Q14. Why does sexual reproduction result in greater variation among offspring?

(a) It involves copying of identical DNA.
(b) It allows combination of genetic material from two individuals.
(c) It occurs only in humans.
(d) It produces exact replicas of the parent.

Q15. Rekha swims in a 40-metre-long pool. She swims from one end to the other and comes back, covering 80 metres in one minute along a straight path. What is her average velocity?

(a) 0 m/min
(b) 20 m/min
(c) 80 m/min
(d) 40 m/min

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Q16. A potential difference of 6 V is applied across the two ends of a conducting wire of resistance R Ω. What will be the value of R if the current flowing through the wire is 2 A?

(a) 1/12
(b) 12
(c) 1/3
(d) 3

Q17. Select the correct statement with respect to 'particles of matter'.

(a) In solids, particles have more space between them.
(b) Particles of matter are stationary.
(c) In liquid, particles have no space between them.
(d) Particles of matter move continuously.

Q18. Calcium hydroxide reacts slowly with the carbon dioxide in air to form a thin layer of which of the following substances that could be used for the purpose of whitewashing?

(a) CaO
(b) CaCO3
(c) CaSO4
(d) Ca(HCO3)2

Q19. Which of the following explains the absence of recessive traits in the F1 generation and their reappearance in the F2 generation in Mendal’s experiment?

(a) Recessive traits are completely destroyed in the F1 generation
(b) Recessive traits skip generations randomly
(c) Recessive traits become dominant in F2 generation.
(d) Recessive alleles are hidden in F1 but reappear in F2 due to segregation.

Q20. In the chlor-alkali process, what is given off at the anode?

(a) Hydrogen gas
(b) Nitrogen gas
(c) Chlorine gas
(d) Sodium Hydroxide

Q21. Tooth enamel made of calcium hydroxyapatite starts decaying when pH in mouth is lower than:

(a) 7.5
(b) 8.5
(c) 6.5
(d) 5.5

Q22. Which of the following statements correctly explains the phenomenon of dispersion?

(a) Dispersion is the bouncing back of light when it strikes a surface.
(b) Dispersion is the scattering of light by colloidal particles.
(c) Dispersion is the bending of light as a light ray of single wavelength goes from one medium to another.
(d) Dispersion is the splitting of white light into its seven constituent colours as it passes through a glass prism.

Q23. What is the primary role of a 'functional group' in an organic compound?

(a) To change the carbon chain from straight to branched
(b) To determine the physical state (solid, liquid, gas) of the compound
(c) To provide the characteristic chemical properties of the compound
(d) To increase the molecular mass of the compound

Q24. Which of the following materials remains unchanged over long periods of time?

(a) Plastic bag
(b) Silk cloth bag
(c) Jute bag

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(d) Cotton cloth bag

Q25. External fertilisation is found in which of the following organisms?

(a) Human
(b) Hen
(c) Cow
(d) Fish

MATHEMATICS

Q26. Simplify $(3x + 2)^2 + (3x - 2)^2$.

(a) 24x
(b) $18x^2 + 8$
(c) $9x^2 + 4$
(d) -24x

Q27. If the third proportional of 9 and 48 is x, then what is the value of x?

(a) 259
(b) 256
(c) 254
(d) 255

Q28. P is two years older than Q who is twice as old as R. If the total of the ages of P, Q and R be 27 years, then how old is Q?

(a) 12 years
(b) 13 years
(c) 10 years
(d) 11 years

Q29. The volume (in m^3) of a cuboidal tank with dimensions 13 m × 4 m × 9 m is:

(a) 453
(b) 468
(c) 483
(d) 484

Q30. A certain sum of money doubles itself in 16 years on simple interest. In how many years it will be six times?

(a) 75
(b) 80
(c) 85
(d) 65

Q31. Nisha buys a mobile phone for her child. The phone is marked at Rs. 24,500 and is offered with two successive discounts of 20% and C%, respectively. After receiving both discounts, she pays Rs. 13,132. Find the value of C.

(a) 32
(b) 31
(c) 33
(d) 34

Q32. When x is added to each of 25, 11, 34 and 13, then the numbers so obtained, in this order, are in proportion. Then, if 9x : y :: y : (8x - 7), and y > 0, what is the value of y?

(a) 59
(b) 72
(c) 70
(d) 63

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Q33. If the profit on selling an article for Rs. 986 is the same as the loss incurred on selling it for Rs. 726, then the cost price of the article is:

(a) Rs. 760
(b) Rs. 856
(c) Rs. 870
(d) Rs. 863

Q34. The cost of a washing machine is 50% less than the cost of a TV. If the cost of the washing machine increases by 53% and that of the TV decreases by 55%, then what is the percentage change in the total cost of 8 washing machines and 2 TVs?

(a) Decrease by 19%
(b) Decrease by 11%
(c) Increase by 17%
(d) Increase by 15%

Q35. If 20% of a number is added to 60, then the result is the same number. 80% of the same number is:

(a) 80
(b) 70
(c) 60
(d) 90

Q36. A girl is standing 15 m away from a vertical flagpole. She observes that the top of the flagpole at an angle of elevation of 30º. Find the height of the flagpole.

(a) 10√3 m
(b) 1/√3 m
(c) 15 √3 m
(d) 5√3 m

Q37. One pipe can fill a tank in 8 minutes, while another pipe can empty the completely filled tank in 16 minutes. If both the pipes are opened together when the tank is empty, how many minutes will it take to fill one-fourth of the tank?

(a) 8
(b) 12
(c) 4
(d) 16

Q38. A solid brass sphere has a diameter of 10.5 cm. Find the cost of tin-plating its surface at a rate of Rs. 4 per 100 cm^2. Use $\pi = 22/7$

(a) Rs. 13.81
(b) Rs. 13.86
(c) Rs. 13.84
(d) Rs. 13.16

Q39. The fraction form of the decimal number 0.595959 is:

(a) 59/99
(b) 59/100
(c) 95/99
(d) 41/100

Q40. In quadrilateral PQRS, the bisectors of angle R and angle S meet at the point T (inside the quadrilateral) and angle STR = 37.5°. If the ratio of angle P to angle Q is 7 : 8, then what is the difference between the measures of angle Q and angle P?

(a) 3°
(b) 5°
(c) 6°
(d) 2°

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Q41. 1/20 is what percentage of 10/50?

(a) 25%
(b) 40%
(c) 35%
(d) 50%

Q42. A can complete a piece of work in 66 days. B is 45% less efficient than A. C is 50% more efficient than B. If B and C work together for 24 days, then A alone will complete the remaining work in:

(a) 31 days
(b) 37 days
(c) 36 days
(d) 33 days

Q43. Which of the following numbers is divisible by 49?

(a) 7311476
(b) 7132979
(c) 7492470
(d) 6697359

Q44. After allowing a discount of 60% on the marked price of an article, it is sold for Rs. 49,834. Find its marked price (in Rs.). 647

(a) 1,24,585
(b) 1,24,593
(c) 1,24,687
(d) 1,24,571

Q45. The arithmetic mean of the observations 21, 23, 38, 99, 64, 35, 48, 52 and 16 is:

(a) 47
(b) 53
(c) 43
(d) 44

Q46. How many seconds will a boy take to run one complete round around a square field of side 20 metres, if he runs at a speed of 9 km/hr?3703

(a) 12
(b) 22
(c) 42
(d) 32

Q47. Simplify: $\sqrt{(5 + \sqrt{25} + 5^2 - 3^2 - 10)} - \sqrt{4}$

(a) 2
(b) $\sqrt{2}$
(c) $\sqrt{8}$
(d) $2\sqrt{3}$

Q48. Walking at 3/4 th of his normal speed from his home, Manish is 8 minutes late in reaching his office. The usual time taken by him to cover the distance between his home and his office is:

(a) 24 minutes
(b) 15 minutes
(c) 27 minutes
(d) 22 minutes

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Q49. If the cost of 13 kg onions is Rs. 273, cost of 21 kg tomatoes is Rs. 462 and the cost of 27 kg potatoes is Rs. 594, then find the total cost of 21 kg onions, 25 kg tomatoes and 32 kg potatoes.

(a) Rs. 1,695
(b) Rs. 1,655
(c) Rs. 1,675
(d) Rs. 1,690

Q50. A class of 38 students took a Physics test. 14 students had an average score of 68. The remaining students had an average score of 73. What is the average score (rounded off to one decimal place) of the whole class?

(a) 65.1
(b) 61.8
(c) 71.2
(d) 78.3

GENERAL INTELLIGENCE & REASONING

Q51. In a certain code language, ‘tooth queen zip’ is coded as ‘hj sx em’ and ‘zip arch ratio’ is coded as ‘pb hj od’. How is ‘zip’ coded in that language?

(a) pb
(b) sx
(c) hj
(d) em

Q52. Refer to the following number and symbol series and answer the question that follows. All numbers are single-digit numbers only. Counting to be done from left to right only.

(Left) 3 @ 2 ^ @ % \ 8 9 \ / ? 8 7 6 # & # + 7 \ (Right)

How many such symbols are there, each of which is immediately preceded by a number and also immediately followed by a number?

(a) One
(b) Three
(c) None
(d) Two

Q53. Seven boxes, B, D, E, P, S, T and W, are kept one over the other but not necessarily in the same order. Only E is kept above D. Only P is kept between D and B. Only W is kept below T. How many boxes are kept between S and W?

(a) Three
(b) One
(c) Two
(d) Four

Q54. What should come in place of the question mark (?) in the given series?

421 423 427 433 441 ?

(a) 455
(b) 451
(c) 453
(d) 449

Q55. What should come in place of the question mark (?) in the given series?

436 438 440 442 444 ?

(a) 448
(b) 447
(c) 445
(d) 446

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Q56. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusion(s) logically follow(s) from the statements.

Statements:

All cows are bulls.

All cows are horses.

Conclusions:

(I) Some bulls are horses.

(II) All horses are cows.

(a) Only conclusion (II) follows.
(b) Only conclusion (I) follows.
(c) Both conclusions (I) and (II) follow.
(d) Neither conclusion (I) nor (II) follows.

Q57. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

MP33 KN41 IL49 GJ57 ?

(a) EH66
(b) EH65
(c) EG66
(d) EG65

Q58. Refer to the given number, symbol series and answer the question that follows. Counting to be done from left to right only. All numbers are single-digit numbers.

(Left) @ 6 1 * # 2 8 $ 7 & £ 3 Ω 9 % 4 + 5 (Right)

How many such numbers are there, each of which is immediately preceded by another number and also immediately followed by a symbol?

(a) 1
(b) 4
(c) 3
(d) 2

Q59. Which letter-cluster will replace the question mark (?) to complete the given series?

LKO OJQ RIS UHU ?

(a) XFV
(b) XGV
(c) YGW
(d) XGW

Q60. RHBA is related to UKHG in a certain way based on the English alphabetical order. In the same way, DTZY is related to GWFE. To which of the given options is MCRQ related, following the same logic?a

(a) PXSO
(b) PXSW
(c) PSWE
(d) PFXW

Q61. Six people, A, B, C, D, E and F, are sitting in a row, facing north. A sits to the immediate left of D. C sits third to the left of E. C is an immediate neighbour of D. F sits to the immediate left of B.

How many people sit between E and F?

(a) Three
(b) One
(c) Two
(d) None

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Q62. What should come in place of the question mark (?) in the given series?

13,22,40,67,103 ?

(a) 149
(b) 148
(c) 150
(d) 147

Q63. If 2 is added to each odd digit and 1 is subtracted from each even digit in the number 7284153, what will be the sum of the digits which are second from the left and second from the right in the new number thus formed?

(a) 12
(b) 14
(c) 10
(d) 8

Q64. Based on the English alphabetical order, three of the following four letter-clusters are alike in a certain way and thus form a group. Which letter-cluster DOES NOT belong to that group?

(Note: The odd one out is not based on the number of consonants/vowels or their position in the letter-cluster.)

(a) BED
(b) RVT
(c) KNM
(d) SVU

Q65. In a certain code language,

A ? B means ‘A is the daughter of B’,

A = B means ‘A is the son of B’,

A @ B means ‘A is the father of B’ and

A √ B means ‘A is the sister of B’.

How is C related to L if 'C √D = E @ F ? L' ?

(a) Sister
(b) Daughter
(c) Mother
(d) Wife

Q66. Refer to the following series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.

(Left) 9 8 2 7 7 1 7 9 9 3 4 1 1 9 4 7 4 9 7 1 6 8 3 1 3 6 8 (Right)

How many such odd numbers are there each of which is immediately preceded by an even number and also immediately followed by an even number?15231

(a) 2
(b) 0
(c) 3
(d) 1

Q67. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which is the letter-cluster pair that DOES NOT belong to that group?

(Note: The odd one out is not based on the number of consonants/vowels or their position in the letter-cluster.)

(a) UP-TW
(b) SN-RV
(c) QL-PS
(d) WR-VY

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Q68. Town B is to the south of Town C. Town D is to the west of Town B. Town E is to the north of Town D. Town F is to the east of Town E. Town C is to the north-east of Town F. What is the position of Town B with respect to Town F?

(a) North-west
(b) South-east
(c) South-west
(d) North-east

Q69. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

(Note: Operations should be performed on the whole numbers, without breaking down the numbers into their constituent digits. E.g. 13 – Operations on 13 such as adding/subtracting/multiplying to 13 can be performed. Breaking down 13 into 1 and 3 and then performing mathematical operations on 1 and 3 is not allowed.)

(15, 5, 3)

(18, 3, 6)

(a) (17, 8, 2)
(b) (14, 7, 4)
(c) (11, 5, 6)
(d) (16, 8, 2)

Q70. Seven boxes, A, B, C, D, E, F and G, are kept one over the other, but not necessarily in the same order. A is kept second from the bottom. Only three boxes are kept between A and D. B is kept at one of the positions below A. Only E is kept between D and G. F is kept at one of the positions above D. How many boxes are kept below C?

(a) Two
(b) Three
(c) None
(d) One

Q71. Each of the digits in the number 8234167 is arranged in ascending order from left to right. What will be the sum of the digits which are second from the left and second from the right in the new number thus formed?

(a) 5
(b) 6
(c) 9
(d) 8

Q72. If '+' means '−', '−' means '×', '×' means '÷' and '÷' means '+', then what will come in place of the question mark (?) in the following equation?

41 - 17 ÷ 133 + 375 × 15 = ?

(a) 805
(b) 799
(c) 765
(d) 825

Q73. RTUR is related to TVWT in a certain way based on the English alphabetical order. In the same way, OQRO is related to QSTQ. To which of the given options is ACDA related, following the same logic?

(a) CEFC
(b) CDEC
(c) CFEN
(d) CEEC

Q74. M, N, O, P, W, X and Y are sitting around a circular table facing the centre of the table. W sits third to the left of O. X sits second to the left of Y. O is the immediate neighbour of both N and X. P is not an immediate neighbour of W. How many people sit between M and X when counted from the right of M?

(a) One
(b) Three
(c) Four
(d) Two

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Q75. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusion(s) logically follow(s) from the statements.

Statements:

All apples are bikes.

All bikes are planes

Conclusion (I): All apples are planes.

Conclusion (II): All bikes are apples.

(a) Only conclusion (I) follows.
(b) Both conclusions (I) and (II) follow.
(c) Only conclusion (II) follows.
(d) Neither conclusion (I) nor (II) follows.

Q76. NU 3 is related to QQ −11 in a certain way. In the same way, EL 7 is related to HH −7. To which of the given options is KP 11 related, following the same logic?

(a) ML −5
(b) NK −5
(c) NL −3
(d) MK −3

Q77. In a certain code language, ‘cup of tea’ is coded as ‘at rh si’ and ‘tea is hot’ is coded as ‘mk cp rh’. How is ‘tea’ coded in that language?

(a) rh
(b) si
(c) at
(d) mk

Q78. Mr. Zzz starts from Point A and drives 9 km towards the west. He then takes a left turn, drives 17 km, turns left and drives 18 km. He then takes a left turn and drives 21 km. He takes a final left turn, drives 9 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90-degree turns only unless specified.)

(a) 4 km to the south
(b) 6 km to the north
(c) 5 km to the east
(d) 3 km to the west

Q79. Seven people B, C, D, I, J, K and L are sitting in a straight line facing north. No one sits to the right of L. Only three people sit between B and L. Only one person sits between L and I. K sits to the immediate left of C. J is not an immediate neighbour of L. How many people sit to the right of D?7074

(a) One
(b) Three
(c) Four
(d) Two

Q80. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only. All numbers are single-digit numbers.

(Left) # 9 & 5 1 © * * * @ # & 7 & # $ 8 & 3 1 @ € (Right)

How many such symbols are there, each of which is immediately preceded by a number and also immediately followed by a number?

(a) 1
(b) 4
(c) 3
(d) 2

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GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. On 29 April 2025, which new facility was launched by the National Center for Sports Science and Research (NCSSR) to revolutionise athlete rehabilitation in India?

(a) Sports Wellness Lab
(b) Fit India Movement Hub
(c) Khelo India Data Centre
(d) Return to Play Facility

Q82. The municipal corporation of which city launched India's first QR-Based Digital House Address System in July 2025?

(a) Indore
(b) Hyderabad
(c) Shimla
(d) Jaipur

Q83. Swachh Vayu Sarvekshan 2025, conducted under the National Clean Air Programme (NCAP), evaluated how many cities across India?

(a) 130 cities
(b) 100 cities
(c) 120 cities
(d) 150 cities

Q84. Recognised for excellence in chess, which individual was honoured with the Major Dhyan Chand Khel Ratna Award in 2025?

(a) Gukesh Dommaraju
(b) Praveen Kumar
(c) Harmanpreet Singh
(d) Anish Sarkar

Q85. The Constitution (Scheduled Castes) Order (Amendment) Bill, 2023 amends the Constitution (Scheduled Caste) Order 1950 with respect to which state?

(a) West Bengal
(b) Kerala
(c) Karnataka
(d) Chhattisgarh

Q86. Which of the following schemes aims at fostering innovation & technology development in defence and aerospace by engaging start-ups, MSMEs, academic institutes under the management of the Defence Innovation Organisation (DIO)?

(a) Acing Development of Innovative Technologies with iDEX
(b) Technology Development Fund
(c) Systematic Deposit Plan
(d) Innovations for Defence Excellence

Q87. Which of the following countries celebrated Poson Poya Honoring 2000 Years of Buddhism in June 2025?

(a) China
(b) Japan
(c) India
(d) Sri Lanka

Q88. Which Gram Panchayat received the Gold Award in the new category of the National e-Governance Awards 2025?

(a) West Malsipur, Tripura
(b) Palsana, Gujarat
(c) Rohini, Maharashtra
(d) Kothur, Andhra Pradesh

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Q89. Which of the following countries won the Presidency of International Institute of Administrative Sciences for the term 2025-28?

(a) India
(b) Austria
(c) France
(d) Germany

Q90. The All India Chess Federation (AICF) launched which scheme to support young chess players from U-7 to U-19 age groups in 2025?

(a) National Chess Talent Initiative
(b) Top National Players Stipend Scheme
(c) Youth Chess Empowerment Scheme
(d) Chess Development Program

Q91. The Air India plane that crashed in Ahmedabad in June 2025 was flying to which city?

(a) Tokyo
(b) London
(c) New York
(d) Paris

Q92. Who became the youngest player ever to win a WTA 1000 title on 22 February 2025?

(a) Iga Świątek
(b) Clara Tauson
(c) Mirra Andreeva
(d) Coco Gauff

Q93. In May 2025, the Defence Research and Development Organisation (DRDO) conducted combat firing (with reduced explosives) of the indigenous Multi-Influence Ground Mine with the _____.

(a) Border Security Force
(b) Indian Air Force
(c) Indian Army
(d) Indian Navy

Q94. Which of the following organisations released the 8^(th) issue of the publication titled 'EnviStats India 2025: Environment Statistics' in June 2025?

(a) Forest Institute of India
(b) Ministry of Environment and Climate Change
(c) National Green Tribunal
(d) Ministry of Statistics and Programme Implementation

Q95. According to Union Budget 2025–26, which state will get a new Greenfield Airports as part of infrastructure development?

(a) Gujarat
(b) Bihar
(c) Odisha
(d) Jharkhand

Q96. In June 2025, which regulatory authority approved Lenacapavir for HIV prevention?

(a) United States Food and Drug Administration
(b) Central Drugs Standard Control Organization
(c) European Medicines Agency
(d) World Health Organization

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Q97. Who became the first female and first African President of the IOC in March 2025?

(a) Thomas Bach
(b) Seb Coe
(c) Juan Antonio Samaranch Jr.
(d) Kirsty Coventry

Q98. What is the real Gross Domestic Product (GDP) growth for the year 2025–26 projected by the Reserve Bank of India (RBI)?

(a) 7.5%
(b) 8.5%
(c) 7%
(d) 6.5%

Q99. The AI Action Summit, co-chaired by France and India, was held in February 2025 at which iconic venue?

(a) Grand Palais, Paris
(b) Bletchley Park, UK
(c) Palais des Festivals, Cannes
(d) India Habitat Centre, Delhi

Q100. What was the unemployment rate for youth aged 15–29 in April 2025, as per Periodic Labour Force Survey (PLFS)?

(a) 12.3%
(b) 17.2%
(c) 10.7%
(d) 13.8%

ANSWER KEY

1	d	2	d	3	c	4	b	5	b	6	a	7	a	8	a	9	d	10	d
11	d	12	a	13	d	14	b	15	a	16	d	17	d	18	b	19	d	20	c
21	d	22	d	23	c	24	a	25	d	26	b	27	b	28	c	29	b	30	b
31	c	32	d	33	b	34	c	35	c	36	d	37	c	38	b	39	a	40	b
41	a	42	d	43	b	44	a	45	d	46	d	47	a	48	a	49	a	50	c
51	c	52	a	53	b	54	b	55	d	56	b	57	b	58	d	59	d	60	d
61	b	62	b	63	d	64	b	65	b	66	d	67	b	68	b	69	d	70	a
71	c	72	a	73	a	74	d	75	a	76	c	77	a	78	a	79	a	80	d
81	d	82	a	83	a	84	a	85	d	86	d	87	d	88	c	89	a	90	b
91	b	92	c	93	d	94	d	95	b	96	a	97	d	98	d	99	a	100	a

SOLUTIONS

Q1. Answer: (d) Violet

The correct answer is Violet.

Key Points

• When sunlight passes through a prism, it undergoes dispersion, splitting into its constituent colors, forming a spectrum known as VIBGYOR (Violet, Indigo, Blue, Green, Yellow, Orange, Red).

• The degree of bending or deviation of light depends on its wavelength. Shorter wavelengths deviate more, while longer wavelengths deviate less.

• Violet light, having the shortest wavelength (around 400 nm), deviates the most when passing through a prism.

• Red light, having the longest wavelength (around 700 nm), deviates the least in the spectrum.

• This phenomenon is a result of the refractive index of the prism material being inversely proportional to the wavelength of light.

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• Thus, in the spectrum of dispersed sunlight, violet appears at the bottom (most deviated), while red appears at the top (least deviated).

Additional Information

• Dispersion of Light:

• Dispersion is the phenomenon where white light splits into its constituent colors when passing through a medium like a glass prism.

• The colors are ordered based on their wavelength, with violet having the shortest wavelength and red the longest.

• This is governed by the refractive index of the medium, which varies for different wavelengths.

• Refractive Index:

• The refractive index of a material determines how much light bends when entering the material.

• It is inversely related to the wavelength of light—shorter wavelengths experience a higher refractive index and bend more.

• For example, the refractive index for violet light in glass is higher than that for red light, causing greater deviation for violet.

• Applications of Dispersion:

• Rainbows are natural examples of dispersion, where sunlight is dispersed by raindrops, creating a spectrum of colors.

• Prisms are used in scientific instruments like spectrometers to analyze light spectra.

• Understanding dispersion helps in designing optical devices like cameras, telescopes, and microscopes.

• Wavelengths of Visible Light:

• Violet: ~380-450 nm

• Blue: ~450-495 nm

• Green: ~495-570 nm

• Yellow: ~570-590 nm

• Orange: ~590-620 nm

• Red: ~620-750 nm

Important Points

• Isaac Newton demonstrated the dispersion of light using a glass prism in the 17th century.

• The angle of deviation for a particular color depends on the shape and material of the prism, as well as the wavelength of the light.

• In practical applications, dispersion is minimized in lenses using achromatic lenses, which combine materials with different refractive indices to reduce chromatic aberration.

• The order of colors in the spectrum remains consistent in all dispersion phenomena: Violet, Indigo, Blue, Green, Yellow, Orange, Red (VIBGYOR).

Q2. Answer: (d) From the positive terminal to the negative terminal of a cell

The correct answer is From the positive terminal to the negative terminal of a cell.

Key Points

• Conventional current flows from the positive terminal to the negative terminal of a cell. This direction was historically defined before the discovery of electrons.

• The electrons' flow, or the actual flow of charge carriers in most metallic conductors, is in the opposite direction of the conventional current.

• The direction of conventional current is based on the assumption that positive charges move, even though in most cases (like in metals), negative electrons are the actual charge carriers.

• The statement "From the negative terminal to the positive terminal of a cell" is incorrect because it describes the electron flow, not the conventional current.

• The conventional direction of current is used in circuit diagrams and analysis, regardless of the type of charge carriers in the material. Hence, the correct answer is "From the positive terminal to the negative terminal of a cell."

Additional Information

• Electron Flow vs Conventional Current:

• Electrons flow from the negative terminal to the positive terminal of a cell because they are negatively charged and are attracted to the positive terminal.

• Conventional current assumes that positive charges flow from the positive terminal to the negative terminal. This convention was established before the discovery of the electron.

• Electric Current:

• Electric current is defined as the rate of flow of electric charge. In metals, this charge is carried by electrons.

• The unit of current is the ampere (A), and it is measured using an ammeter.

• Real-world Applications:

• In electronic circuits, the conventional current direction is used for designing and analyzing circuits, regardless of the type of charge carriers (positive ions, electrons, etc.).

• In electrolytes, both positive and negative ions contribute to the current, but the conventional current direction is still from positive to negative.

• Historical Context:

• The concept of conventional current was introduced by Benjamin Franklin in the 18th century, long before the discovery of the electron in 1897 by J.J. Thomson.

• Franklin assumed that the charge carriers were positive, leading to the convention of current flowing from positive to negative.

Important Points

• Direction of Current in Different Materials:

• In metallic conductors, current is due to the movement of free electrons.

• In semiconductors, both electrons and holes contribute to current flow.

• In electrolytic solutions, current is carried by the movement of positive and negative ions.

• Practical Relevance:

• Although the electron flow is opposite to the conventional current, the latter is universally used in circuit analysis for simplicity and consistency.

Q3. Answer: (c) Dendrite

The correct answer is Dendrite.

Key Points

• Dendrites are the branch-like extensions of a neuron that receive signals from other neurons or external stimuli. The first electrical impulse is generated here when the dendrites detect a stimulus.

• These impulses are the result of the movement of ions across the neuronal membrane, which creates an electrical signal known as an action potential.

• The dendrites play a crucial role in the initial phase of signal transmission, where they collect and process incoming signals before relaying them to the cell body.

• The electrical signals collected by the dendrites are transmitted to the axon hillock, where the decision to generate a full-fledged action potential is made.

• The dendritic structure ensures that neurons can process multiple incoming signals simultaneously, enabling complex neurological functions.

Additional Information

• Structure of a Neuron:

• A neuron consists of three main parts: dendrites, a cell body, and an axon.

• The dendrites receive signals, the cell body processes them, and the axon transmits the signals to the next neuron or target tissue.

• Role of Dendrites in Signal Transmission:

• Dendrites primarily function as receivers of chemical or electrical signals from other neurons or sensory organs.

• The signals received are converted into small electrical changes called graded potentials, which travel toward the cell body.

• Action Potential:

• The electrical impulse in a neuron is called an action potential, a rapid change in electrical charge across the membrane that allows signals to travel along the neuron.

• Action potentials are initiated only if the signals received by the dendrites and cell body reach a certain threshold at the axon hillock.

• Functions of Neuronal Components:

• Cell Body (Soma): Contains the nucleus and organelles; integrates incoming signals.

• Axon: Conducts electrical impulses away from the cell body to other neurons or muscles.

• Nerve Endings: Release neurotransmitters to communicate with other cells.

• Examples of Neuron Types:

• Motor Neurons: Carry signals from the central nervous system to muscles.

• Sensory Neurons: Transmit sensory information like touch, heat, and pain to the brain.

• Interneurons: Facilitate communication between sensory and motor neurons.

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Q4. Answer: (b) All cells are of the same size and shape.

The correct answer is All cells are of the same size and shape..

Key Points

• Cells can be round, oval, spindle-shaped, or branched: The shape of cells varies significantly depending on their type and function. For instance, red blood cells are biconcave, while nerve cells are elongated. This statement is correct.

• All cells are of the same size and shape: This is a false statement. Cells vary greatly in size and shape based on their role in the body. For example, a human egg cell is much larger than a red blood cell, and nerve cells are elongated to transmit signals efficiently. This statement is incorrect.

• Nerve cells are long to help in the conduction of impulses: Nerve cells (neurons) have long extensions called axons that are adapted for transmitting electrical impulses over long distances. This structural adaptation supports their function. This statement is correct.

• Cell shape is often related to its function: The shape of a cell is closely linked to its function. For example, muscle cells are elongated to facilitate contraction, and epithelial cells are flat to form protective layers. This statement is correct.

Additional Information

• Variation in cell size:

• The size of cells varies greatly. For example, bacterial cells are typically 1-10 micrometers in size, while human egg cells can reach up to 100 micrometers.

• Some specialized cells, like neurons, can extend over a meter in length in large organisms.

• Variation in cell shape:

• Cell shapes are highly diverse and adapted to their functions. For instance:

• Red blood cells are disc-shaped to maximize surface area for oxygen exchange.

• Guard cells in plants are kidney-shaped to facilitate opening and closing of stomata.

• Nerve cells have branching structures for communication with other cells.

• Structure and function correlation:

• The relationship between structure and function is a fundamental principle in biology. For example:

• Muscle cells contain actin and myosin proteins for contraction.

• Leaf cells have chloroplasts to perform photosynthesis.

• Cell diversity in organisms:

• Multicellular organisms have specialized cells for different functions, such as blood cells for oxygen transport, immune cells for defense, and skin cells for protection.

• Unicellular organisms like amoebas perform all life processes within a single cell.

Important Points

• Examples of cell specialization:

• Red blood cells lack nuclei to maximize space for hemoglobin, which transports oxygen.

• Root hair cells in plants have long extensions to increase surface area for water absorption.

• Discovery of cells:

• Cells were first discovered by Robert Hooke in 1665 when he observed cork under a microscope.

• The cell theory, proposed by Schleiden and Schwann, states that all living organisms are composed of cells, which are the basic unit of life.

• Cell types:

• Prokaryotic cells lack a nucleus and membrane-bound organelles (e.g., bacteria).

• Eukaryotic cells have a nucleus and specialized organelles (e.g., animal and plant cells).

Q5. Answer: (b) Wind’s kinetic energy

The correct answer is Wind’s kinetic energy.

Key Points

• The blades of a windmill rotate due to the kinetic energy of the wind. When the wind blows, it transfers its kinetic energy to the blades, causing them to move.

• As the wind strikes the blades, it exerts a force on them. The design of the blades, often curved or tilted, ensures that this force causes rotation.

• The rotation of the windmill blades is then converted into other forms of energy, typically mechanical energy, which is used for tasks such as pumping water or grinding grains.

• In modern wind turbines, the mechanical energy is further converted into electrical energy via a generator, contributing to sustainable energy production.

• This process exemplifies the principle of energy conversion, where the wind's kinetic energy is transformed into usable forms of energy, reducing dependency on fossil fuels.

Additional Information

• Kinetic Energy:

• Kinetic energy is the energy possessed by an object due to its motion.

• The formula for kinetic energy is given by KE = 1/2 mv^2, where m is the mass of the object and v is its velocity.

• In the case of wind, the moving air molecules possess kinetic energy that can be harnessed for various purposes.

• Wind Energy:

• Wind energy is a form of renewable energy derived from the movement of air in the Earth's atmosphere.

• It is a clean and sustainable source of energy, widely used in generating electricity through wind turbines.

• Countries like China, the United States, and Germany are global leaders in wind energy production.

• Wind energy contributes significantly to reducing greenhouse gas emissions and combating climate change.

• Windmill Design:

• Windmill blades are designed aerodynamically to optimize the capture of wind energy.

• The shape and angle of the blades ensure that they catch maximum wind, creating a lift force that causes rotation.

• Modern wind turbines can adjust the angle of their blades (pitch control) to regulate energy production based on wind speed.

• Other Forms of Energy:

• While the question mentions other forms of energy like light, elastic, and sound energy, they are not responsible for the rotation of windmill blades.

• Light energy is typically associated with solar power, while elastic energy relates to materials under tension or compression.

• Sound energy refers to the energy carried by sound waves and does not have the capacity to rotate windmill blades.

Important Points

• Global Wind Energy Statistics:

• As of 2022, global wind power capacity exceeded 800 GW, according to the Global Wind Energy Council.

• India ranks among the top countries for wind energy production, with states like Tamil Nadu, Gujarat, and Maharashtra leading in installations.

• Advantages of Wind Energy:

• It is a renewable and eco-friendly source of energy.

• Wind turbines have a low operational cost once installed.

• They reduce reliance on fossil fuels and help in achieving energy security.

• Challenges in Wind Energy:

• Wind energy production is location-dependent, requiring areas with consistent wind speeds.

• High initial investment costs can be a barrier to widespread adoption.

• The intermittent nature of wind can pose challenges to grid stability without energy storage systems.

Q6. Answer: (a) Thrust = 50.0 N ; Pressure = 500.0 Pa

The correct answer is Thrust = 50.0 N; Pressure = 500.0 Pa.

Key Points

• Thrust: Thrust is the force acting perpendicular to a surface. In this case, a force of 50 N acts perpendicular to the surface. This means the thrust is 50 N. Hence, the value of thrust is correct.

• Pressure: Pressure is defined as force per unit area. The formula is:

• Pressure = Force ÷ Area

• Given force = 50 N, Area = 0.1 m^2

• Pressure = 50 ÷ 0.1 = 500 Pa

• The provided values for thrust (50 N) and pressure (500 Pa) are consistent with the given conditions and calculations.

• Thus, the correct option is Thrust = 50.0 N; Pressure = 500.0 Pa.

Additional Information

• Thrust:

• Thrust is a vector quantity that acts perpendicular to the surface it is applied to.

• In this problem, thrust is equal to the given force, as the force is applied perpendicular to the surface.

• Unit: The SI unit of thrust is the Newton (N).

• Applications: Thrust plays a crucial role in various fields, such as fluid dynamics, aerodynamics, and engineering.

• Pressure:
• Pressure is a scalar quantity and is defined as force applied per unit area.
• Formula: Pressure = Force ÷ Area
• Unit: The SI unit of pressure is the Pascals (Pa). 1 Pa = 1 N/m².
• Applications: Pressure is widely used in fluid mechanics, hydraulics, and meteorology.
• Examples: Atmospheric pressure, blood pressure, and pressure in hydraulic systems.
• Relationship between force, area, and pressure:
• As the area decreases for a given force, the pressure increases.
• Conversely, as the area increases for a given force, the pressure decreases.
• Units and Conversion:
• Pressure in Pascals can be converted into other units like bar, atmosphere, and mmHg (millimeter of mercury).
• 1 bar = 10^5 Pa, 1 atm = 101325 Pa, and 1 mmHg = 133.322 Pa.

Important Points

• Factors affecting pressure:
• Force: Higher force leads to greater pressure if the area remains constant.
• Area: Smaller area leads to greater pressure if the force remains constant.
• Real-life applications of pressure:
• In tire design: Pressure is critical for maintaining proper traction and safety.
• In hydraulics: Hydraulic systems use pressure to lift heavy objects.
• In weather prediction: Atmospheric pressure variations help predict weather conditions.
• Thrust in fluid mechanics:
• Thrust is used in propulsion systems of rockets, planes, and submarines.
• It is also used to measure aerodynamic forces in wind tunnels.

Q7. Answer: (a) Pituitary gland

The correct answer is Pituitary gland.

Key Points

• The Pituitary gland is often referred to as the "master gland" of the human body because it controls several other hormone-secreting glands such as the thyroid, adrenal glands, and reproductive organs.
• The pituitary gland secretes growth hormone (GH), also known as somatotropin, which is crucial for the growth and development of tissues and organs in the body.
• Growth hormone is responsible for stimulating the growth of bones, muscles, and other tissues during childhood and adolescence. It plays a critical role in metabolism throughout life.
• The secretion of growth hormone is regulated by the hypothalamus through the release of growth hormone-releasing hormone (GHRH) and somatostatin, which either stimulate or inhibit GH production.
• Disorders of the pituitary gland can lead to conditions such as gigantism (excess GH secretion during childhood) or dwarfism (deficient GH secretion during childhood).

Additional Information

• Thyroid gland:
• The thyroid gland primarily produces thyroxine (T4) and triiodothyronine (T3), which regulate metabolism, energy levels, and growth in the body.
• It is located in the neck and plays a vital role in controlling the body's energy expenditure.
• Unlike the pituitary gland, the thyroid gland does not secrete growth hormones.
• Pancreas:
• The pancreas is responsible for producing insulin, a hormone that regulates blood sugar levels, and glucagon, which raises blood sugar levels.
• It plays a key role in digestion and endocrine functions but does not produce growth hormones.
• Pineal gland:
• The pineal gland is located in the brain and is responsible for producing melatonin, a hormone that regulates sleep-wake cycles.
• It does not contribute to growth hormone production or growth-related functions.
• Key Disorders Associated with Growth Hormone:
• Acromegaly: Excessive growth hormone secretion in adulthood, leading to enlarged bones in the face, hands, and feet.
• Pituitary dwarfism: Deficiency of growth hormone during childhood, resulting in stunted growth.

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• Laron syndrome: A rare genetic disorder where the body is insensitive to growth hormone due to a receptor defect.

Important Points

• The pituitary gland is located at the base of the brain in a bony structure called the sella turcica.

• It consists of two main parts: the anterior pituitary (adenohypophysis), which secretes growth hormone, and the posterior pituitary (neurohypophysis), which stores and releases hormones such as oxytocin and vasopressin.

• Growth hormone levels are highest during childhood and adolescence, gradually declining with age.

• Artificial growth hormones are sometimes used in medicine to treat growth hormone deficiencies but must be administered under strict medical supervision.

• Modern diagnostic tools like MRI scans and blood tests are used to detect abnormalities in the pituitary gland or growth hormone levels.

Q8. Answer: (a) 17

The correct answer is 17.

Key Points

• Atomic Number: The atomic number of an element is determined by the number of protons in its nucleus. Since the number of protons equals the number of electrons in a neutral atom, an element with 17 electrons has an atomic number of 17. This is correct.

• Chlorine: The element with an atomic number of 17 is chlorine (Cl). It is a halogen and is known for its high reactivity.

• Neutrons: The number of neutrons in an atom can be calculated using the formula: Mass Number = Protons + Neutrons. If the atom has 17 protons and 18 neutrons, its mass number is 35. This matches the most common isotope of chlorine, chlorine-35. This is correct.

• Electron Configuration: Chlorine's electron configuration is 2, 8, 7, indicating it belongs to Group 17 of the periodic table (halogens).

• Periodic Table Position: With an atomic number of 17, chlorine is positioned in the third period and the p-block of the periodic table.

Additional Information

• Chlorine in Nature: Chlorine is commonly found in compounds such as sodium chloride (table salt). It is abundant in seawater and is also found in minerals such as halite.

• Uses of Chlorine: Chlorine is widely used in water purification, bleaching agents, and in the production of plastics like PVC (polyvinyl chloride).

• Isotopes: Chlorine has two stable isotopes: chlorine-35 (about 76% abundance) and chlorine-37 (about 24% abundance). The average atomic mass of chlorine is approximately 35.5 u due to these isotopes.

• Halogen Properties: As a halogen, chlorine is highly reactive and forms compounds readily. It often forms ionic bonds with metals and covalent bonds with nonmetals.

• Safety Considerations: Chlorine gas is highly toxic and was historically used as a chemical weapon. Proper safety measures are essential when handling chlorine.

Q9. Answer: (d) Sugar dissolves in water

The correct answer is Sugar dissolves in water.

Key Points

• Sugar dissolving in water demonstrates that there are spaces between particles of matter. When sugar is added to water, it breaks down into smaller particles that occupy the spaces between the water molecules.

• This phenomenon is possible because particles of matter are not tightly packed and have spaces between them, allowing other particles to fit in.

• During dissolution, the sugar particles interact with water molecules through intermolecular forces, dispersing evenly in the liquid.

• The process of sugar dissolving also illustrates the concept of solubility, which is determined by the nature of both the solute (sugar) and solvent (water).

• It serves as evidence for the kinetic theory of matter, which states that particles are in constant motion and have spaces between them. Hence, this option is correct.

Additional Information

• Intermolecular Space:

• All matter is made of particles, and these particles have spaces between them.

• The magnitude of these spaces varies depending on the state of matter (solid, liquid, or gas).

• Solids: Particles are tightly packed with minimal intermolecular space.

• Liquids: Particles have moderate space, allowing them to flow.

• Gases: Particles have maximum space and move freely.

• Solubility:
• Solubility is the ability of a substance to dissolve in a solvent, forming a solution.
• Sugar dissolves in water due to its polar nature, which matches the polarity of water.
• Temperature and pressure are factors that can affect the solubility of substances.
• Kinetic Theory of Matter:
• According to this theory, particles are in constant motion, and their movement depends on the state of matter.
• In liquids, the movement of particles allows substances like sugar to dissolve by filling the spaces between water molecules.
• Other Observations:
• A rubber band stretches: It demonstrates elasticity, not spaces between particles.
• Ice melts into water: This indicates a change of state due to heat, not the concept of spaces between particles.
• A piece of chalk breaks easily: It illustrates brittleness, which is unrelated to intermolecular spaces.

Important Points

• Experimental Evidence: The dissolution of sugar in water can be observed during practical experiments, providing a clear understanding of intermolecular spaces.
• Applications: The concept of spaces between particles is crucial in understanding various phenomena, such as diffusion, solubility, and state changes.
• Daily Life Examples: Dissolving salt, mixing drinks, and diffusion of perfume are instances where intermolecular spaces play a significant role.
• Scientific Basis: Studies on molecular structure, forces, and behavior have provided detailed insights into the nature of matter and particle interaction.

Q10. Answer: (d) H2

The correct answer is H2.

Key Points

• Covalent compounds are formed when atoms share electrons to achieve a full outer shell and attain stability. Each shared pair of electrons forms a covalent bond.
• O2 (Oxygen molecule): Consists of a double bond between two oxygen atoms, which means it involves two shared pairs of electrons (4 electrons in total).
• N2 (Nitrogen molecule): Consists of a triple bond between two nitrogen atoms, meaning it involves three shared pairs of electrons (6 electrons in total).
• CH4 (Methane): Each hydrogen atom shares one electron with the carbon atom, forming four single covalent bonds. Therefore, methane has 4 shared electron pairs.
• H2 (Hydrogen molecule): Consists of a single covalent bond between two hydrogen atoms, involving only one shared pair of electrons (2 electrons in total). This is the least number of shared electron pairs.

Additional Information

• Covalent Bonding:
• Occurs between non-metallic elements where atoms share electrons to achieve a stable electronic configuration (similar to a noble gas).
• Examples include molecules like H2, O2, N2, and CH4.
• Depending on the number of shared electron pairs, covalent bonds can be classified as single, double, or triple bonds.
• Types of Covalent Bonds:
• Single Bond: Involves one shared pair of electrons (e.g., H2, Cl2).
• Double Bond: Involves two shared pairs of electrons (e.g., O2, CO2).
• Triple Bond: Involves three shared pairs of electrons (e.g., N2, C2H2).
• Electron Pair Sharing:
• Each shared electron pair corresponds to a covalent bond.
• In molecules with multiple bonds (double or triple), more electron pairs are shared compared to single bonds.
• Stability of Covalent Compounds:
• The stability of a covalent compound depends on the strength of its bonds. Triple bonds (e.g., in N2) are stronger than double or single bonds.
• Hydrogen (H2), having a single bond, is less complex in terms of shared electron pairs.

Important Points

• H2: The simplest molecule, involving only one shared pair of electrons, making it the molecule with the least number of shared electron pairs in the given options.

• Bond Order: The number of shared pairs of electrons correlates directly with the bond order (e.g., single bond = bond order 1, double bond = bond order 2).

• Applications: Hydrogen (H2) is widely used in industries (e.g., ammonia production, hydrogen fuel cells) due to its simple molecular structure and chemical properties.

Q11. Answer: (d) Ribosome

The correct answer is Ribosome.

Key Points

• Ribosomes are present on the surface of the rough endoplasmic reticulum (RER), giving it its "rough" appearance.

• The rough endoplasmic reticulum is involved in the synthesis of proteins that are destined for secretion, membrane incorporation, or lysosomal use.

• Ribosomes bind to the membrane of the RER through specific receptors during the process of protein translation.

• Proteins synthesized by ribosomes on the RER are transported into the lumen of the RER for post-translational modification.

• The presence of ribosomes distinguishes the rough endoplasmic reticulum from the smooth endoplasmic reticulum, which is involved in lipid synthesis and lacks ribosomes.

Additional Information

• Endoplasmic Reticulum (ER):

• The endoplasmic reticulum is a membranous network within eukaryotic cells that plays a critical role in protein and lipid synthesis.

• It is divided into two types: rough ER (with ribosomes) and smooth ER (without ribosomes).

• The ER also assists in the transportation of substances within the cell and provides a site for biochemical reactions.

• Ribosomes:

• Ribosomes are molecular machines responsible for protein synthesis by translating messenger RNA (mRNA).

• They are found either freely floating in the cytoplasm or attached to the rough endoplasmic reticulum.

• Ribosomes are composed of ribosomal RNA (rRNA) and proteins and exist as two subunits (small and large).

• Protein Synthesis:

• The process of protein synthesis involves transcription (DNA to mRNA) and translation (mRNA to protein).

• Ribosomes play a critical role in translation, where they assemble amino acids into polypeptide chains based on the mRNA sequence.

• Other Cellular Structures:

• Chromosome: Chromosomes are structures within the nucleus containing DNA and are not located on the ER.

• Cell Wall: The cell wall is a rigid structure found in plant cells and is unrelated to the ER.

• Plasma Membrane: The plasma membrane surrounds the cell and regulates the movement of substances in and out of the cell, but it is not part of the ER.

Important Points

• The rough endoplasmic reticulum is abundant in cells that produce and secrete large amounts of proteins, such as pancreatic cells and plasma cells.

• The smooth endoplasmic reticulum is prominent in cells involved in lipid metabolism, such as those in the liver and adrenal glands.

• Ribosomes are not membrane-bound organelles; they are composed of RNA and protein and function independently or attached to the RER.

• Proteins synthesized on the RER may undergo additional modifications in the Golgi apparatus before being transported to their final destinations.

Q12. Answer: (a) Focus sound waves to reach all parts of the hall evenly

The correct answer is Focus sound waves to reach all parts of the hall evenly.

Key Points

• The primary purpose of having a curved ceiling in a concert hall is to enhance sound distribution by focusing sound waves and ensuring that they reach all parts of the hall uniformly.

• Curved surfaces, including ceilings, act as acoustic reflectors, helping to evenly distribute sound waves throughout the auditorium, minimizing dead zones or areas where sound may be muffled.

• This design feature helps create a balanced acoustic experience, ensuring that each audience member, regardless of their seat, hears the sound clearly and at a similar volume.

• Unlike flat ceilings, curved ceilings prevent sound waves from being trapped or concentrated in one area, reducing issues such as echoes or sound distortion.

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• Concert halls are engineered with these design principles to support optimal acoustics for performances such as music concerts, plays, and speeches.

Additional Information

• Acoustics in Architecture:

• Acoustics refers to the science of sound, including its production, transmission, and effects. In architecture, it focuses on enhancing sound quality within a space.

• Architectural elements such as curved ceilings, angled walls, and sound-absorbing materials are used to optimize acoustics in buildings like concert halls, theaters, and auditoriums.

• Function of Curved Ceilings:

• Curved ceilings are specifically designed to reflect sound waves in a manner that avoids concentration or absorption in specific areas.

• They help prevent issues such as sound dead zones (areas where sound is inaudible) or excessive reverberation (prolonged sound echo).

• Examples of Acoustically Advanced Structures:

• Famous concert halls such as the Sydney Opera House and the Vienna Musikverein employ curved architectural designs for superior acoustics.

• These structures incorporate advanced engineering principles to maximize sound clarity and distribution.

• Alternative Acoustic Solutions:

• While curved ceilings are effective, other solutions like sound panels, diffusers, and absorbers are also used to enhance the acoustic quality of spaces.

• These solutions are often used in conjunction with architectural designs to achieve the desired sound performance.

Important Points

• Incorrect Options:

• Increase the pitch of music: A concert hall design does not alter the pitch of music, as pitch is determined by the frequency of sound waves, not the architectural structure.

• Absorb all sound: Concert halls are designed to reflect sound, not absorb all of it. Excessive absorption would lead to poor acoustics.

• Prevent sound from entering the hall: While soundproofing is important, the primary focus of a concert hall's design is to enhance internal acoustics, not just block external noise.

• Key Acoustic Terms:

• Reverberation: The persistence of sound in a space after the original sound is produced.

• Echo: A reflected sound wave that is heard as a distinct repetition of the original sound.

• Diffusion: The spreading of sound waves to avoid concentration in one area.

Q13. Answer: (d) 0 m/s

The correct answer is 0 m/s.

Key Points

• Average velocity is defined as the displacement divided by the total time taken. Displacement is the shortest distance between the initial and final points.

• In the given scenario, the man is riding a bicycle on a circular track of radius 10 m. The circumference of the track can be calculated using the formula $2\pi r$, where r = 10 m. This gives the circumference as 62.8 m.

• Since the man completes one full round of the circular track, his initial and final positions are the same. Thus, the displacement is 0 m.

• As displacement is zero, the average velocity, which is displacement divided by time, also becomes 0 m/s.

• The time taken for one complete round is given as 10 minutes (600 seconds), but since the displacement is zero, the time becomes irrelevant in this calculation for average velocity.

• Hence, the correct answer is 0 m/s.

Additional Information

• Difference between velocity and speed:

• Velocity is a vector quantity that considers both magnitude and direction. It depends on displacement.

• Speed is a scalar quantity and is based on the total distance traveled, irrespective of direction.

• In this case, the speed of the cyclist would be distance/time = 62.8 m / 600 s ≈ 0.1 m/s, while the average velocity is 0 m/s due to zero displacement.

• Displacement in a circular motion:

• For a complete circular motion, the initial and final positions of the object are the same, resulting in a displacement of 0 m.

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• For partial circular motion (e.g., half a circle), the displacement would be equal to the diameter of the circle, which is 2r.

• Formula for circular track circumference:

• The circumference of a circle is calculated using the formula 2πr, where π ≈ 3.14159 and r is the radius.

• For a radius of 10 m, the circumference is 62.8 m.

• Practical examples of average velocity:

• In real-world scenarios, average velocity is often zero for objects moving in closed loops, such as vehicles on a circular race track completing full laps.

• It is important to differentiate between velocity and speed to avoid confusion in such cases.

Important Points

• Displacement: It is the shortest path between two points in a straight line, along with the direction. It is a vector quantity.

• Time: In average velocity calculations, only displacement and time are considered, not the total distance covered.

• Zero displacement: If the starting and ending positions are the same, the displacement is always zero, resulting in an average velocity of zero.

• Applications: Understanding displacement and average velocity is critical in physics, especially in motion-related problems and engineering applications.

Q14. Answer: (b) It allows combination of genetic material from two individuals.

The correct answer is It allows combination of genetic material from two individuals..

Key Points

• Sexual reproduction results in greater variation among offspring because it involves the combination of genetic material from two individuals. This process ensures the mixing of genes, leading to unique genetic combinations in the offspring.

• Each parent contributes half of their genetic material to the offspring through specialized reproductive cells called gametes (sperm and egg). This recombination during fertilization is the basis for genetic diversity.

• Meiosis, a special type of cell division, plays a crucial role in sexual reproduction by producing gametes with a unique set of genetic material. This includes processes like crossing over and independent assortment of chromosomes, which further enhance variation.

• Genetic variation is important for the adaptation and survival of species in changing environments. It allows populations to evolve and develop resistance to diseases, environmental changes, and other challenges.

• Unlike asexual reproduction, which produces genetically identical offspring, sexual reproduction introduces new traits and characteristics in each generation, enhancing the species' genetic diversity.

Additional Information

• Characteristics of Sexual Reproduction:

• Involves the fusion of male and female gametes (sperm and egg).

• Promotes genetic diversity within a population.

• Occurs in most animals, plants, and some microorganisms.

• Requires two parents, unlike asexual reproduction, which involves only one parent.

• Role of Meiosis in Genetic Variation:

• During meiosis, homologous chromosomes exchange genetic material in a process called crossing over.

• Independent assortment of chromosomes during meiosis ensures that each gamete receives a unique combination of genetic material.

• These processes create a wide range of genetic combinations, contributing to the diversity seen in sexually reproducing populations.

• Importance of Genetic Variation:

• Genetic diversity enhances a species' ability to survive environmental changes and adapt to new conditions.

• Populations with greater variation are more likely to withstand diseases, predators, and climate changes.

• It drives the process of natural selection, where individuals with advantageous traits are more likely to survive and reproduce.

• Comparison with Asexual Reproduction:

• Asexual reproduction involves a single parent and produces offspring that are genetically identical to the parent.

• While it is faster and requires less energy, it does not contribute to genetic diversity.

• Examples include binary fission, budding, and vegetative propagation.

Important Points

• Key Features of Sexual Reproduction:

• Generates offspring with unique genetic identities.

• Ensures the survival and adaptability of species over time.

• Crucial for the process of evolution and the development of new species.

• Examples of Genetic Variation:

• In humans, traits such as eye color, hair type, and blood group vary due to genetic diversity.

• In agriculture, crossbreeding of plants is used to develop new crop varieties with desirable traits like disease resistance and higher yield.

Q15. Answer: (a) 0 m/min

The correct answer is 0 m/min.

Key Points

• Average velocity is defined as the total displacement divided by the total time taken. It is a vector quantity and depends on the net change in position (displacement).

• In the given scenario, Rekha swims in a straight path in a 40-meter-long pool. She swims from one end of the pool to the other and comes back to the starting point.

• The total displacement in this case is 0 meters because Rekha starts and ends at the same point. Displacement is the shortest distance between the initial and final positions, which is zero.

• The total time taken for the swim is 1 minute.

• Using the formula for average velocity:

Average Velocity = Total Displacement / Total Time, we get:

Average Velocity = 0 meters / 1 minute = 0 m/min.

• Hence, the average velocity of Rekha is 0 m/min.

Additional Information

• Velocity vs. Speed:

• Velocity is a vector quantity that considers both magnitude and direction, whereas speed is a scalar quantity and only takes magnitude into account.

• In this scenario, while the total distance covered by Rekha is 80 meters, her displacement is 0 meters, resulting in a velocity of 0 m/min.

• Displacement:

• Displacement is defined as the shortest distance between the initial and final position of an object.

• In the given scenario, since Rekha returns to her starting point, the displacement is 0 meters.

• Average Speed:

• Average speed is calculated as Total Distance / Total Time.

• In this case, Rekha's total distance is 80 meters, and the total time is 1 minute. Thus, her average speed is 80 m/min.

• Practical Examples:

• Scenarios where displacement is zero often occur in closed-loop movements, such as running on a circular track or swimming back and forth in a straight pool.

• In such cases, the average velocity will always be 0 if the starting and ending points are the same.

Important Points

• Key Formulae:

• Average Velocity = Displacement / Time

• Average Speed = Total Distance / Time

• Difference Between Displacement and Distance:

• Distance is the total path covered, while displacement is the shortest path between two points.

• In this question, Rekha's total distance is 80 meters, but her displacement is 0 meters.

• Nature of Scalar and Vector Quantities:

• Speed is a scalar quantity because it only considers magnitude.

• Velocity is a vector quantity because it considers both magnitude and direction.

Q16. Answer: (d) 3

The correct answer is Option 3.

Key Points

• The problem is based on Ohm's Law, which states that the current (I) through a conductor between two points is directly proportional to the voltage (V) across the two points and inversely proportional to the resistance (R) of the conductor.

• The mathematical representation of Ohm's Law is: $V = I \times R$, where:

• V is the voltage in volts (V).

• I is the current in amperes (A).
• R is the resistance in ohms (Ω).
• In the given problem:
• Voltage (V) = 6 V.
• Current (I) = 2 A.
• To calculate resistance (R):
• Rearranging the formula: R = V / I.
• Substituting the given values: R = 6 / 2 = 3 Ω.
• Therefore, the resistance of the wire is 3 Ω, which corresponds to Option 3.

Additional Information

• Ohm's Law:
• It was formulated by Georg Simon Ohm in 1827.
• The law is fundamental in electrical engineering and circuit theory.
• It applies to linear resistive circuits where the relationship between voltage, current, and resistance is constant.
• Non-linear components like diodes or transistors do not follow Ohm’s Law.
• Resistance:
• Resistance is the measure of the opposition to the flow of electric current in a conductor.
• It is measured in ohms (Ω), named after Georg Simon Ohm.
• Factors affecting resistance:
• Material: Conductors (e.g., copper) have low resistance, while insulators (e.g., rubber) have high resistance.
• Length: Resistance increases with the length of the conductor.
• Cross-sectional area: Resistance decreases with an increase in the area of the conductor.
• Temperature: For most conductors, resistance increases with temperature.
• Applications of Ohm's Law:
• Used in designing electrical and electronic circuits.
• Helps in calculating the required resistance, current, or voltage for circuit components.
• Essential for determining power consumption using the formula: P = V × I.
• Real-life Example:
• Consider a household electric bulb. If the bulb operates at 220 V and draws a current of 0.5 A, its resistance can be calculated using Ohm's Law:
• R = V / I = 220 / 0.5 = 440 Ω.

Important Points

• Power formula:
• Electrical power (P) is calculated as: P = V × I or P = I^2 × R or P = V^2 / R.
• Kirchhoff's Laws:
• Kirchhoff's Current Law (KCL): The total current entering a junction equals the total current leaving the junction.
• Kirchhoff's Voltage Law (KVL): The sum of all voltages around a closed loop equals zero.
• Ohm's Law is often used alongside Kirchhoff’s Laws in circuit analysis.
• Practical Limitations:
• Ohm's Law does not apply to non-linear and time-variant components like diodes, transistors, and thermistors.
• For alternating current (AC) circuits, impedance (Z) replaces resistance (R), and the relationship becomes V = I × Z.

Q17. Answer: (d) Particles of matter move continuously.

The correct answer is Particles of matter move continuously..

Key Points

• Particles of matter move continuously: The particles in all states of matter (solid, liquid, gas) exhibit random motion. This is due to the kinetic energy they possess, which allows them to vibrate, rotate, or translate freely. Hence, this statement is correct.
• In solids, particles have more space between them: This statement is incorrect. In solids, particles are closely packed with very little space between them due to strong intermolecular forces. This arrangement gives solids their definite shape and volume.
• Particles of matter are stationary: This statement is incorrect. Particles of matter are never stationary; they are always in motion, as evidenced by phenomena like diffusion and Brownian motion.
• In liquids, particles have no space between them: This statement is incorrect. Liquids have particles that are less tightly packed compared to solids, leaving some space between them. This allows liquids to flow and take the shape of their container.

Additional Information

• Properties of particles of matter:

• Continuous motion: Particles of matter are always in random motion due to the presence of kinetic energy. Their speed increases with an increase in temperature.

• Interparticle spaces: Particles of matter have spaces between them. The extent of these spaces varies in solids, liquids, and gases.

• Forces of attraction: There are intermolecular forces of attraction between the particles, which are strongest in solids, moderate in liquids, and weakest in gases.

• Examples of particle motion:

• Diffusion: The movement of particles from a region of higher concentration to lower concentration, such as the spreading of a drop of ink in water.

• Brownian motion: The random movement of particles in a fluid (liquid or gas) due to collisions with other particles.

• State-specific characteristics:

• Solids: Particles are tightly packed, with minimal motion (vibration in fixed positions).

• Liquids: Particles can slide past each other, allowing liquids to flow.

• Gases: Particles move freely and occupy the entire volume of their container.

Important Points

• Brownian motion: This phenomenon, discovered by Robert Brown in 1827, provides direct evidence of the continuous motion of particles in fluids.

• Diffusion examples: The fragrance of perfume spreading in a room or sugar dissolving in water demonstrates the movement of particles.

• Temperature effect: The kinetic energy of particles increases with temperature, leading to faster movement and greater diffusion rates.

• Applications: The concept of particle motion is applied in various scientific fields, including thermodynamics, fluid mechanics, and material science.

Q18. Answer: (b) CaCO3

The correct answer is CaCO3.

Key Points

• Calcium hydroxide (Ca(OH)2), commonly known as slaked lime, is used in the process of whitewashing walls. It reacts with carbon dioxide (CO2) in the air.

• The reaction between calcium hydroxide and carbon dioxide forms calcium carbonate (CaCO3), which is responsible for the white layer that appears on walls after whitewashing.

• The chemical reaction is as follows:

• Ca(OH)2 + CO2 → CaCO3 + H2O

• Calcium carbonate is a solid, white-colored compound that provides a durable, smooth, and bright finish to the walls.

• The process is slow because it depends on the availability of carbon dioxide in the air, which reacts with the surface layer of slaked lime.

• This transformation makes calcium carbonate an effective and economical material for whitewashing.

Additional Information

• Properties of Calcium Hydroxide:

• It is a white, crystalline substance that is sparingly soluble in water.

• Its aqueous solution is called lime water, which turns milky when carbon dioxide is passed through it due to the formation of calcium carbonate.

• Calcium Carbonate (CaCO3):

• It is a naturally occurring compound found in rocks like limestone, chalk, and marble.

• It is insoluble in water and has a bright white appearance, making it suitable for whitewashing and as a pigment in paints.

• Applications of Whitewashing:

• Whitewashing is used for aesthetic purposes and to protect walls from pests, moisture, and fungal growth.

• It is widely used in rural areas due to its cost-effectiveness and ease of application.

• Other By-products of Reaction:

• Water (H2O) is also formed in this reaction, which evaporates over time, leaving a solid layer of calcium carbonate.

• Incorrect Options:

• Calcium oxide (CaO): It is quicklime and does not form a white layer in the process of whitewashing.

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• Calcium sulfate (CaSO4): It is commonly found as gypsum and is not formed during the whitewashing process.

• Calcium bicarbonate (Ca(HCO3)2): It is a soluble compound and does not form a solid layer suitable for whitewashing.

Q19. Answer: (d) Recessive alleles are hidden in F1 but reappear in F2 due to segregation.

The correct answer is Recessive alleles are hidden in F1 but reappear in F2 due to segregation.

Key Points

• In Mendel's experiments, recessive traits were not observed in the F1 generation because dominant alleles mask the expression of recessive alleles.

• Mendel proposed the Law of Segregation, which states that allele pairs separate during gamete formation, ensuring that each gamete carries only one allele for each gene.

• In the F1 generation, individuals are heterozygous (carry one dominant and one recessive allele), but the recessive trait remains hidden because the dominant allele determines the phenotype.

• When F1 individuals are self-crossed, the alleles segregate independently, resulting in the reappearance of the recessive trait in the F2 generation in a phenotypic ratio of 3:1 (dominant:recessive).

• This reappearance of recessive traits in F2 demonstrates the inheritance of alleles as discrete units, as explained by Mendel's principles.

Additional Information

• Dominant and Recessive Alleles:

• Dominant alleles are expressed in the phenotype even if only one copy is present (e.g., T for tall plants).

• Recessive alleles are only expressed when two copies are present (e.g., t for short plants).

• Mendel used symbols like T (dominant) and t (recessive) to represent alleles.

• F1 and F2 Generations:

• F1 generation results from the crossing of two pure-breeding (homozygous) parents (e.g., TT x tt).

• F2 generation results from self-pollination of F1 plants, showing a 3:1 phenotypic ratio.

• Mendel's Laws:

• Law of Segregation: Each individual carries two alleles for a trait, which segregate during gamete formation.

• Law of Independent Assortment: Genes for different traits assort independently of one another during gamete formation (applies when genes are on different chromosomes).

• Significance of Mendel's Work:

• Mendel's experiments laid the foundation for the modern field of genetics.

• He demonstrated that inheritance follows specific, predictable patterns, which led to the development of Punnett squares and other genetic tools.

Important Points

• Mendel's Pea Plant Experiment:

• Mendel chose pea plants (Pisum sativum) for his experiments because they had easily observable traits like flower color and seed shape.

• He conducted cross-pollination and self-pollination experiments to study inheritance patterns.

• He studied seven contrasting traits, such as tall vs. short plants and yellow vs. green seeds.

• Significance of Recessive Traits:

• Recessive traits provide evidence that genetic information is passed down in pairs of alleles.

• Their reappearance in F2 supports the concept of genetic segregation and recombination.

• Modern Genetic Insights:

• Mendel's principles were later supported by the discovery of DNA and the molecular basis of genetics.

• The understanding of gene expression and dominance has expanded with modern tools like CRISPR and genomics.

Q20. Answer: (c) Chlorine gas

The correct answer is Chlorine gas.

Key Points

• The chlor-alkali process is an industrial process used for the production of chlorine, hydrogen, and sodium hydroxide (caustic soda) by the electrolysis of brine (concentrated sodium chloride solution).

• In this process, chlorine gas is released at the anode as a result of the oxidation of chloride ions (Cl^-) into chlorine (Cl2).

• The chemical reaction occurring at the anode is: 2Cl^- → Cl2 + 2e^-.

• Hydrogen gas is produced at the cathode as a result of the reduction of water: 2H2O + 2e^- → H2 + 2OH^-.

• Sodium hydroxide (NaOH) is formed in the solution as a by-product.

• The entire process is conducted in electrolytic cells, such as the mercury cell, diaphragm cell, or membrane cell, depending on the specific setup.

Additional Information

• Electrolytic Cell Setup:

• The electrolytic cell used in the chlor-alkali process has two electrodes: anode (positively charged) and cathode (negatively charged).

• Brine solution (NaCl) is used as the electrolyte, which dissociates into Na^+ and Cl^- ions in water.

• Products of the Chlor-Alkali Process:

• Chlorine gas (Cl2): Released at the anode and used in industries for making PVC, disinfectants, and bleaches.

• Hydrogen gas (H2): Released at the cathode and used in fuel cells, ammonia production, and hydrogenation of fats and oils.

• Sodium hydroxide (NaOH): Remains in the solution and is used in paper manufacturing, soap making, and water treatment.

• Electrochemical Reactions:

• At the anode (oxidation): 2Cl^- → Cl2 + 2e^- (Chlorine gas is released).

• At the cathode (reduction): 2H2O + 2e^- → H2 + 2OH^- (Hydrogen gas and hydroxide ions are formed).

• Applications of Chlorine Gas:

• Used in the production of polyvinyl chloride (PVC), which is used in pipes, cables, and packaging materials.

• Essential in the manufacture of bleaches like sodium hypochlorite and calcium hypochlorite.

• Used as a disinfectant in water treatment plants to kill bacteria and viruses.

• Environmental Concerns:

• The chlor-alkali process can lead to the release of harmful by-products if not properly managed, such as mercury and chlorine gas leaks.

• Modern methods like the membrane cell process are designed to minimize environmental impact and improve efficiency.

Important Points

• Mercury Cell Process:

• In this method, mercury acts as the cathode, and chlorine gas is released at the anode.

• However, it poses environmental risks due to mercury contamination.

• Diaphragm Cell Process:

• It uses a porous diaphragm to separate the anode and cathode compartments, preventing the mixing of chlorine and hydroxide ions.

• This ensures the purity of sodium hydroxide produced.

• Membrane Cell Process:

• A modern and environmentally friendly method that uses a selective ion-exchange membrane to separate the compartments.

• This process achieves high efficiency and eliminates the need for mercury or asbestos diaphragms.

• Industrial Use of By-products:

• Hydrogen gas: Used as a clean energy source in various industrial applications.

• Sodium hydroxide: Widely used in textiles, detergents, and paper manufacturing industries.

Q21. Answer: (d) 5.5

The correct answer is 5.5.

Key Points

• Tooth enamel is primarily made of calcium hydroxyapatite, a crystalline calcium phosphate mineral, which is highly susceptible to acidic environments.

• When the pH level in the mouth drops below 5.5, the enamel begins to dissolve, leading to the process of dental decay. This is known as the critical pH threshold for enamel demineralization.

• The acidic environment in the mouth is typically caused by the metabolic activity of oral bacteria, which break down sugars and starches to produce lactic acid and other acids.

• At a pH of 5.5 or lower, the minerals in the enamel start to leach out, resulting in the weakening of the tooth structure and the formation of cavities. Hence, maintaining oral pH above 5.5 is crucial for dental health.

• Factors such as poor oral hygiene, frequent consumption of acidic foods and drinks, and dry mouth can exacerbate the drop in pH, leading to faster enamel erosion.

Additional Information

• pH Scale and Oral Health:

• The pH scale ranges from 0 to 14, where a pH of 7 is neutral, values below 7 are acidic, and values above 7 are alkaline.

• Saliva typically has a pH range of 6.5 to 7.5, which helps neutralize acids and protect enamel.

• When the pH drops below the critical level of 5.5, enamel demineralization begins, increasing the risk of cavities.

• Role of Saliva:

• Saliva plays a vital role in maintaining oral pH by buffering acids and replenishing minerals like calcium and phosphate, which strengthen enamel.

• Conditions like xerostomia (dry mouth) reduce saliva production, increasing the risk of enamel erosion and dental decay.

• Acidic Foods and Drinks:

• Foods and beverages with low pH, such as soda, citrus fruits, and vinegar, can lower the oral pH and contribute to enamel erosion.

• Frequent consumption of sugary and starchy foods fuels bacterial activity, leading to increased acid production and a drop in pH.

• Preventive Measures:

• Fluoride in toothpaste and mouthwash strengthens enamel and makes it more resistant to acid attacks.

• Maintaining good oral hygiene, reducing sugar intake, and rinsing the mouth after meals help prevent pH drops and enamel erosion.

• Chewing sugar-free gum stimulates saliva production, which aids in neutralizing acids and protecting enamel.

• Dental Decay Statistics:

• According to the World Health Organization (WHO), dental caries affects an estimated 60–90% of schoolchildren and nearly 100% of adults worldwide.

• Preventive interventions like fluoride treatments and dental sealants are highly effective in reducing dental decay rates.

Important Points

• Critical pH Threshold: Enamel demineralization begins at a pH of 5.5. Below this level, enamel loses its protective minerals.

• Fluoride Benefits: Fluoride enhances remineralization and creates a barrier against acid attacks, protecting enamel from decay.

• Saliva's Role: Saliva acts as a natural buffer, neutralizing acids and maintaining a healthy oral environment.

• Diet and Oral Health: Avoiding sugary foods and acidic drinks can help maintain oral pH above the critical threshold, protecting teeth from decay.

Q22. Answer: (d) Dispersion is the splitting of white light into its seven constituent colours as it passes through a glass...

The correct answer is Dispersion is the splitting of white light into its seven constituent colours as it passes through a glass prism..

Key Points

• Dispersion refers to the phenomenon where white light splits into its seven constituent colours (Violet, Indigo, Blue, Green, Yellow, Orange, Red) when it passes through a medium such as a prism.

• This occurs because different colours of light have different wavelengths, and each wavelength bends by a different amount when passing through the prism, causing the light to spread out into a spectrum.

• The index of refraction of a material (e.g., glass) depends on the wavelength of the light, leading to varying degrees of bending for each colour. For instance, violet light bends the most, while red light bends the least.

• This principle is why we observe natural phenomena like rainbows, where sunlight is dispersed by water droplets in the atmosphere.

• The splitting of white light into its constituent colours is an example of refraction, but it specifically highlights the wavelength dependence of the refractive index, which is the essence of dispersion.

Additional Information

• Incorrect Options Explained:

• Option 1: Dispersion is not the bouncing back of light when it strikes a surface. This phenomenon is called reflection. Hence, this option is incorrect.

• Option 2: Dispersion is not the scattering of light by colloidal particles. This is known as scattering of light, which explains phenomena like the blue colour of the sky. Hence, this option is incorrect.

• Option 3: Dispersion is not simply the bending of light as a single wavelength passes from one medium to another. This is called refraction. Dispersion specifically involves the splitting of light into its spectrum. Hence, this option is also incorrect.

• Option 5: This option is left blank in the question and does not provide any explanation or statement to consider. Hence, it is not applicable.

• Applications of Dispersion:

• Rainbows: Formed when sunlight undergoes dispersion through water droplets in the atmosphere.

• Spectroscopy: Used in scientific instruments to analyze light spectra, helping in the identification of materials.

• Prism Experiments: Commonly used in physics to demonstrate the splitting of light into its constituent colours.

• Important Properties Related to Dispersion:

• Refractive Index Dependence: The refractive index varies for different wavelengths of light, which is the primary cause of dispersion.

• Angular Separation: The angular separation of colours depends on the material of the prism and the angle of incidence of light.

• Historical Context:

• Isaac Newton: First demonstrated dispersion using a glass prism in the 17th century, showing that white light is composed of different colours.

Important Points

• Order of Colours in Dispersion: The colours always appear in the order: Violet, Indigo, Blue, Green, Yellow, Orange, Red (VIBGYOR).

• Angle of Deviation: Violet light experiences the greatest angle of deviation because it has the shortest wavelength, while red light has the smallest deviation.

• Natural Examples: Dispersion is responsible for phenomena like fireworks, where different chemicals produce different colours due to the dispersion of light.

• Relation to Wavelength: Shorter wavelengths (e.g., violet) are refracted more than longer wavelengths (e.g., red), highlighting the dependence of dispersion on wavelength.

Q23. Answer: (c) To provide the characteristic chemical properties of the compound

The correct answer is To provide the characteristic chemical properties of the compound.

Key Points

• Functional groups are specific groups of atoms within molecules that are responsible for the characteristic chemical reactions of those molecules.

• The presence of a functional group determines the chemical properties and reactivity of the compound, such as its ability to undergo specific chemical reactions.

• Common examples of functional groups include hydroxyl (-OH), carbonyl (C=O), carboxyl (-COOH), amine (-NH2), and alkene (-C=C-).

• Functional groups influence the behavior of organic compounds in chemical reactions, such as nucleophilic substitution, elimination, or addition reactions.

• For instance, the hydroxyl group (-OH) in alcohols makes them polar and capable of forming hydrogen bonds, which directly affects their solubility and boiling points.

Additional Information

• Key Features of Functional Groups:

• Functional groups determine the chemical reactivity and physical properties of a molecule.

• They often participate in specific types of chemical reactions, such as acid-base reactions, oxidation-reduction, and polymerization.

• Examples of functional group reactions include the esterification of carboxylic acids and the hydration of alkenes.

• Examples of Functional Groups:

• Alcohol (-OH): Found in ethanol, responsible for its polar nature and hydrogen bonding.

• Carbonyl (C=O): Found in aldehydes and ketones, influencing their reactivity in nucleophilic addition reactions.

• Carboxyl (-COOH): Present in carboxylic acids, contributing to their acidic properties.

• Amine (-NH2): Found in amino acids, playing a role in their basicity and nucleophilicity.

• Role in Organic Chemistry:

• Functional groups are used to classify and name organic compounds under the IUPAC nomenclature system.

• They are essential in determining the reactivity patterns of molecules in synthetic organic chemistry.

• Understanding functional groups is crucial in fields such as pharmaceutical chemistry, biochemistry, and material science.

• Applications of Functional Groups:

• Functional groups are used in designing drugs, as their interactions with biological targets depend on specific groups.

• They play a vital role in polymer chemistry, such as the formation of polyethylene or nylon.

• Functional groups are critical in determining the spectroscopic properties of molecules, aiding in their identification through IR, NMR, and UV-Vis spectroscopy.

Important Points

• Option 1: Changing the carbon chain from straight to branched affects the molecule's structure but is not the primary role of functional groups. Hence, this option is incorrect.

• Option 2: Physical state (solid, liquid, gas) is influenced by intermolecular forces like hydrogen bonding or van der Waals forces, not directly by functional groups. Hence, this option is incorrect.

• Option 4: Increasing molecular mass depends on the number of atoms, not solely on functional groups. Hence, this option is

incorrect.

• Option 5: This option does not exist in the question and is irrelevant. Hence, it is not applicable.

Q24. Answer: (a) Plastic bag

The correct answer is Plastic Bag.

Key Points

• Plastic bags are made from synthetic polymers derived from petroleum, such as polyethylene, which are non-biodegradable in nature.

• They do not decompose easily and can persist in the environment for hundreds of years, contributing significantly to pollution.

• Unlike organic materials such as silk, jute, or cotton, plastic bags are resistant to biological degradation, making them a major environmental hazard.

• Plastic bags often break down into microplastics under sunlight, which further contaminates soil and water systems.

• The durability and resistance of plastic bags to natural decomposition make them unsuitable for sustainable environmental practices.

Additional Information

• Silk Cloth Bag:

• Silk is a natural protein fiber obtained from silkworms and is biodegradable.

• Silk cloth bags decompose easily in the environment within a few months under favorable conditions.

• They are a sustainable alternative to plastic bags and are widely used for premium packaging.

• Jute Bag:

• Jute is a natural fiber grown in countries like India and Bangladesh, known for its biodegradable properties.

• Jute bags decompose within a few weeks to months and do not harm the environment.

• Due to its eco-friendly nature, jute is often promoted as a sustainable option for daily use.

• Cotton Cloth Bag:

• Cotton is a natural fiber derived from the cotton plant and is biodegradable.

• Cotton cloth bags take a few months to decompose and are considered environmentally friendly.

• They are reusable and widely used as alternatives to plastic bags for grocery shopping and storage.

• Environmental Impact of Plastic Bags:

• Plastic bags contribute to soil, water, and air pollution and are one of the major causes of clogged drainage systems.

• They pose threats to wildlife as animals often ingest plastic, mistaking it for food, leading to fatal consequences.

• Globally, efforts are being made to ban or limit the use of plastic bags to promote sustainable alternatives.

• Examples include bans on single-use plastics in countries like India (2019) and the European Union's initiatives to reduce plastic waste.

Important Points

• Biodegradable vs. Non-Biodegradable:

• Biodegradable materials like jute, cotton, and silk break down naturally through microbial activity, causing minimal environmental harm.

• Non-biodegradable materials like plastic persist for decades to centuries, leading to long-term environmental damage.

• Government Initiatives:

• Many governments globally have introduced bans on plastic bags to combat pollution. For example, India imposed a ban on single-use plastic items from July 1, 2022.

• Awareness campaigns and subsidies are being provided to promote eco-friendly alternatives like jute and cloth bags.

• Global Plastic Waste Statistics:

• According to the United Nations Environment Programme (UNEP), around 300 million tons of plastic waste is generated every year globally.

• Less than 10% of plastic waste is recycled, with the majority ending up in landfills or oceans.

Q25. Answer: (d) Fish

The correct answer is Fish.

Key Points

• External fertilization is a reproductive process where the fertilization of the egg occurs outside the body of the organism. It typically happens in an aquatic environment.

• Among the options provided, Fish exhibit external fertilization. Female fish release eggs into the water, and male fish release sperm over the eggs to fertilize them externally. This process ensures a higher chance of fertilization in aquatic conditions.

• Other organisms listed, such as Humans, Hens, and Cows, exhibit internal fertilization, where the fusion of sperm and egg occurs inside the body of the female.

• External fertilization is common in aquatic organisms like fish, amphibians, and some invertebrates because water facilitates the movement of gametes and prevents them from drying out.

• The process of external fertilization has both advantages, such as producing a large number of offspring, and disadvantages, including the vulnerability of gametes and embryos to environmental hazards and predators.

Additional Information

• External Fertilization:

• External fertilization occurs in water or moist environments to protect gametes from desiccation and to allow sperm to swim to eggs.

• The process is less energy-intensive for the parents compared to internal fertilization, but it often results in lower survival rates due to environmental threats.

• Examples of organisms exhibiting external fertilization include fish (like salmon and cod), amphibians (like frogs), and certain invertebrates (like sea urchins).

• The fertilized eggs or embryos are often left to develop independently, with limited or no parental care.

• Internal Fertilization:

• In internal fertilization, fertilization occurs inside the female's body. This method is more common in terrestrial animals to prevent gametes from drying out.

• Organisms such as Humans, Cows, and Hens exhibit internal fertilization.

• Internal fertilization provides better protection to the developing embryo and often involves significant parental investment.

• Examples of internal fertilization include mammals (like humans and cows), birds (like hens), and reptiles.

• Comparison:

• External fertilization often produces a large number of offspring, but survival rates can be low due to environmental threats and lack of parental care.

• Internal fertilization produces fewer offspring, but survival rates are higher due to better protection and care provided to the embryos.

• Fish Reproduction:

• Most fish exhibit external fertilization, though some species (like guppies and sharks) perform internal fertilization.

• Fish that use external fertilization typically release eggs and sperm simultaneously into the water during spawning.

• Environmental factors such as temperature, salinity, and water currents can significantly affect the success of external fertilization in fish.

Important Points

• Examples of External Fertilization in Fish:

• Species like salmon, cod, and carp are known for external fertilization.

• These species often migrate to specific spawning grounds to maximize the chances of successful fertilization.

• Adaptations for External Fertilization:

• Many aquatic species produce a large number of gametes to increase the likelihood of successful fertilization.

• The timing of gamete release is often synchronized to ensure that eggs and sperm meet.

• Disadvantages of External Fertilization:

• Gametes and embryos are exposed to predators and environmental hazards.

• There is limited parental care, which reduces the survival rate of offspring.

Q26. Answer: (b) $18x^2 + 8$

Shortcut Trick

Using the algebraic identity: $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$.

Identify the values: $a = 3x$ and $b = 2$.

Substitute into the formula: $2 \times [(3x)^2 + (2)^2]$

$\Rightarrow 2 \times [9x^2 + 4] = 18x^2 + 8$.

Therefore The correct answer is $18x^2 + 8$.

Alternate Method

Given: The expression to simplify is $(3x + 2)^2 + (3x - 2)^2$.

Formula Used:

1. $(a + b)^2 = a^2 + 2ab + b^2$

2. $(a - b)^2 = a^2 - 2ab + b^2$

Calculations:

=> Expand the first term: $(3x + 2)^2 = (3x)^2 + 2(3x)(2) + 2^2 = 9x^2 + 12x + 4$

=> Expand the second term: $(3x - 2)^2 = (3x)^2 - 2(3x)(2) + 2^2 = 9x^2 - 12x + 4$

=> Add both expanded expressions: $(9x^2 + 12x + 4) + (9x^2 - 12x + 4)$

=> Combine like terms: $(9x^2 + 9x^2) + (12x - 12x) + (4 + 4)$

=> $18x^2 + 0 + 8$

=> $18x^2 + 8$

Therefore The correct answer is $18x^2 + 8$.

Additional Information

Sum of Squares Identity

The sum of the squares of two binomials differing only in sign is given by $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$.

Difference of Squares of Binomials

Subtracting the square of a difference from the square of a sum yields $(a + b)^2 - (a - b)^2 = 4ab$.

BODMAS in Algebra

Always expand exponents first before performing addition or subtraction of algebraic terms.

Q27. Answer: (b) 256

Shortcut Trick

For two numbers a and b, the third proportional x is calculated as $b^2 \div a$.

Here, a = 9 and b = 48.

$x = (48 \times 48) \div 9 = (16 \times 3 \times 16 \times 3) \div 9 = 16 \times 16 = 256$.

Therefore The correct answer is 256.

Alternate Method

Given:

First number (a) = 9

Second number (b) = 48

Third proportional = x

Formula Used:

If a, b, and x are in continued proportion, then a : b :: b : x, which implies $x = b^2/a$.

Calculations:

=> 9 / 48 = 48 / x

=> $9 \times x = 48 \times 48$

=> $x = (48 \times 48) / 9$

=> x = 2304 / 9

=> x = 256

Therefore The correct answer is 256.

Additional Information

Mean Proportional

The mean proportional between two numbers a and b is given by $\sqrt{(a \times b)}$.

Fourth Proportional

If a : b :: c : d, then d is the fourth proportional, calculated as $d = (b \times c) / a$.

Continued Proportion

Three numbers a, b, c are in continued proportion if a/b = b/c, meaning $b^2 = ac$.

Q28. Answer: (c) 10 years

Shortcut Trick

Let the age of R be 1 unit.

Then Q = 2 units and P = 2 units + 2 years.

Total age = 1 + 2 + 2 units + 2 years = 5 units + 2 = 27 years.

5 units = 25 => 1 unit = 5 years.

Q = 2 units = 10 years.

Therefore The correct answer is 10 years.

Alternate Method
Given: Total age of P, Q, and R = 27 years.
Formula Used: Sum of individual ages = Total Age.
Let R age = x years.
=> Q age = 2x years.
=> P age = (2x + 2) years.
=> x + 2x + 2x + 2 = 27
=> 5x + 2 = 27
=> 5x = 25
=> x = 5 years.
=> Q = 2 × 5 = 10 years.
Therefore The correct answer is 10 years.
Additional Information
Ratio of Ages
If the ratio of ages of A and B is a:b, their ages are taken as ax and bx.
Age after 'n' years
If current age is x, then age after n years = x + n and age n years ago = x − n.
Average Age
Average Age = (Sum of ages of all persons) ÷ (Number of persons).

Q29. Answer: (b) 468

Shortcut Trick
For a cuboid, the volume is the product of its three dimensions.
Volume = 13 × 4 × 9
=> 52 × 9 = 468 m^3
Therefore The correct answer is 468 m^3.
Alternate Method
Given:
Length (L) of the cuboidal tank = 13 m
Breadth (B) of the cuboidal tank = 4 m
Height (H) of the cuboidal tank = 9 m
Formula Used:
Volume of a Cuboid = Length × Breadth × Height
Calculations:
=> Volume = 13 × 4 × 9
=> Volume = (13 × 4) × 9
=> Volume = 52 × 9
=> Volume = 468 m^3
Therefore The correct answer is 468 m^3.
Additional Information
Total Surface Area of a Cuboid
The total surface area is the sum of the areas of all six faces: 2 × (LB + BH + HL).
Diagonal of a Cuboid
The longest rod that can be placed inside a cuboid is its diagonal, given by $\sqrt{(L^2 + B^2 + H^2)}$.
Lateral Surface Area of a Cuboid
The area of the four side walls (excluding top and bottom) is calculated as 2 × H × (L + B).

Q30. Answer: (b) 80

Shortcut Trick
In simple interest, interest earned = (Multiple − 1) × Principal.
To double (2 times), Interest = 2 − 1 = 1 unit. Time taken = 16 years.
To become 6 times, Interest = 6 − 1 = 5 units.

Since Interest prop. to Time, Time = 16 × 5 = 80 years.
Therefore The correct answer is 80 years.
Alternate Method
Given: Principal (P) becomes 2P in 16 years.
Formula Used: Simple Interest (S.I.) = (P × R × T) / 100 | Amount = P + S.I.
=> Case 1: S.I.1 = 2P − P = P
=> P = (P × R × 16) / 100
=> R = 100 / 16 = 6.25%
=> Case 2: New Amount = 6P
=> S.I.2 = 6P − P = 5P
=> 5P = (P × 6.25 × T2) / 100
=> 5 = (6.25 × T2) / 100
=> T2 = (5 × 100) / 6.25 = 500 / 6.25
=> T2 = 80 years
Therefore The correct answer is 80 years.
Additional Information
Simple Interest vs Time Relation
For a constant Principal and Rate, the time (T) required for a sum to become n times itself is given by T = (n − 1) × 100 / R.
Ratio Formula for S.I.
When the same sum is invested, the relationship between time periods is T1 / (n1 − 1) = T2 / (n2 − 1).
Rate of Interest Shortcut
If a sum doubles in T years at Simple Interest, the Rate of interest (R) is always 100 / T%.

Q31. Answer: (c) 33

Shortcut Trick
First Discounted Price = 24,500 × (100 − 20)% = 24,500 × 0.8 = 19,600.
Total Discount Remaining = 19,600 − 13,132 = 6,468.
Value of C = (Remaining Discount ÷ First Discounted Price) × 100.
C = (6,468 ÷ 19,600) × 100 = 33.
Therefore The correct answer is 33.
Alternate Method
Given → Marked Price (MP) = Rs. 24,500, Selling Price (SP) = Rs. 13,132, D1 = 20%, D2 = C%.
Formulas: SP = MP × (100 − D1)% × (100 − D2)%
=> Step 1: Calculate price after first discount: 24,500 × (80/100) = 19,600.
=> Step 2: Use SP formula for second discount: 13,132 = 19,600 × (100 − C)/100.
=> Step 3: (13,132 ÷ 19,600) = (100 − C)/100.
=> Step 4: 0.67 = (100 − C)/100.
=> Step 5: 67 = 100 − C.
=> Step 6: C = 100 − 67 = 33.
Therefore The correct answer is 33.
Additional Information
Successive Discounts
When two discounts a% and b% are given, the Equivalent Single Discount is (a + b − ab/100)%.
Marked Price & Selling Price
Selling Price (SP) is the price paid after applying all discounts to the Marked Price (MP).

Q32. Answer: (d) 63

Shortcut TrickTo find x when added to 25, 11, 34, 13 to make them proportional:Using the cross-difference ratio shortcut: (25 − 11) = 14 and (34 − 13) = 21.Ratio of differences = 14 : 21 = 2 : 3.Equating the scaled terms: 3 × (25 + x) = 2 × (34 + x) => 75 + 3x = 68 + 2x => x = −7.Substitute x = −7 into $y^2 = 9x(8x - 7)$ => $y^2 = 9(-7)(-56 - 7) = -63 \times -63 = 63^2$ => y = 63.Therefore The correct answer is 63.Alternate MethodGiven: Numbers are 25, 11, 34, 13 and 9x : y :: y : (8x - 7) with y > 0 .Formula Used: If a, b, c, d are in proportion, then a/b = c/d. Also, if p : q :: q : r, then $q^2 = p \times r$ .Calculations:=> (25 + x)/(11 + x) = (34 + x)/(13 + x) => (25 + x)(13 + x) = (34 + x)(11 + x) => 325 + 38x + x^2 = 374 + 45x + x^2 => 38x - 45x = 374 - 325 => -7x = 49 => x = −7Now, substituting the

value of x in the mean proportion relation:=> $y^2 = 9x(8x - 7)$ => $y^2 = 9(-7)[8(-7) - 7]$ => $y^2 = -63 \times (-56 - 7)$ => $y^2 = -63 \times -63$ => $y^2 = 63^2$ => y = 63 (since y > 0)Therefore The correct answer is 63.Additional InformationMean ProportionalIf three quantities a, b, and c are in continued proportion, then b is called the mean proportional between a and c, where b2 = ac.Proportionality PropertiesIf four terms a, b, c, d are in proportion, then product of extremes equals product of means: ad = bc.

Q33. Answer: (b) Rs. 856

Shortcut Trick

When the Profit earned at one price equals the Loss incurred at another, the Cost Price (CP) is simply the average of the two selling prices.

CP = (SP1 + SP2) ÷ 2

CP = (986 + 726) ÷ 2 = 1712 ÷ 2

CP = 856

Therefore The correct answer is Rs. 856.

Alternate Method

Given: SP1 = Rs. 986 (Profit), SP2 = Rs. 726 (Loss). Formulas: Profit = SP − CP | Loss = CP − SP.

=> Let the Profit and Loss be x.

=> Case 1: CP = SP1 − Profit = 986 − x

=> Case 2: CP = SP2 + Loss = 726 + x

=> Equating CP: 986 − x = 726 + x

=> 2x = 986 − 726 = 260 => x = 130

=> CP = 726 + 130 = 856

Therefore The correct answer is Rs. 856.

Additional Information

Profit and Loss Basics

Profit occurs when SP > CP, and Loss occurs when CP > SP. If Profit = Loss, the CP is the arithmetic mean of the two Selling Prices.

Linear Relationship

If the profit is 'n' times the loss, then CP = (SP1 + n × SP2) ÷ (n + 1).

Q34. Answer: (c) Increase by 17%

Shortcut Trick

Let cost of TV = 100, then Washing Machine (WM) = 50.

Initial total cost of 8 WM and 2 TV = (8 × 50) + (2 × 100) = 400 + 200 = 600.

New WM cost = 50 × 1.53 = 76.5 | New TV cost = 100 × 0.45 = 45.

New total cost = (8 × 76.5) + (2 × 45) = 612 + 90 = 702.

Percentage change = (702 − 600) ÷ 600 × 100 = 102 ÷ 600 × 100 = 17% increase.

Therefore The correct answer is Increase by 17%.

Alternate Method

Given: Cost of WM is 50% less than TV. WM cost increase = 53%, TV cost decrease = 55%.

Formulas: Total Cost = (Quantity1 × Price1) + (Quantity2 × Price2) | % Change = (New − Old) ÷ Old × 100

=> Initial Cost = (8 × 50) + (2 × 100) = 600

=> Final Cost = 8 × (50 + 53% of 50) + 2 × (100 − 55% of 100)

=> Final Cost = 8 × (50 + 26.5) + 2 × (45) = 8 × 76.5 + 90 = 612 + 90 = 702

=> % Change = [(702 − 600) ÷ 600] × 100 = (102 ÷ 600) × 100 = 17%

Therefore The correct answer is Increase by 17%.

Additional Information

Percentage Increase/Decrease

To increase a value by x%, multiply by (100 + x) ÷ 100. To decrease by x%, multiply by (100 − x) ÷ 100.

Weighted Average Method

The net percentage change can also be found using the formula: % Change = (n1c1 + n2c2) ÷ (n1w1 + n2w2) where n is quantity and c is cost change.

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Q35. Answer: (c) 60

Shortcut Trick

Let the complete number be 100%.

According to the question: 20% of the number + 60 = 100% of the number.

=> 100% − 20% = 60

=> 80% of the number = 60

The question directly asks for 80% of the same number, which is exactly 60.

Therefore The correct answer is 60.

Alternate Method

Given:

20% of a number + 60 = the number

Concept Used:

Any complete quantity is always considered as 100% of itself.

20% 80% = 60 100% (The Complete Number) Added Value = 60

Calculations:

Let the unknown number be x.

=> 20% of x + 60 = x

=> (20 ÷ 100) × x + 60 = x

=> x − 0.20x = 60

=> x(1 − 0.20) = 60

=> 0.80x = 60

=> 80% of x = 60

Since the question asks us to find 80% of the same number, we already have the required value.

Therefore The correct answer is 60.

Additional Information

Base Value in Percentages

Every quantity in its original or complete state is always considered as 100%. When a part is given as p%, the remaining part is simply (100 − p)%.

Fraction to Percentage Conversion

Fractions can be easily converted to percentages by multiplying by 100. For example, 1/5 × 100 = 20%, and 4/5 × 100 = 80%.

Q36. Answer: (d) 5√3 m

Shortcut Trick

In a 30º–60º–90º right-angled triangle, the ratio of sides is 1 : √3 : 2.

Side opposite to 60º (Base) = 15 m = √3 units.

Side opposite to 30º (Height) = 1 unit = 15 ÷ √3.

Rationalizing: (15 × √3) ÷ 3 = 5√3 m.

Therefore The correct answer is 5√3 m.

Alternate Method

Given:

Distance from flagpole (Base) = 15 m

Angle of elevation (θ) = 30º

Formula Used:

tan θ = Perpendicular (Height) ÷ Base

Calculations:

=> tan 30º = Height ÷ 15

=> 1/√3 = Height ÷ 15

=> Height = 15 / √3

=> Height = (15 × √3) / (√3 × √3)

=> Height = 15√3 / 3

=> Height = 5√3 m

Therefore The correct answer is 5√3 m.

Additional Information

Trigonometric Ratios

Standard values: tan 30º = 1/√3, tan 45º = 1, and tan 60º = √3.

Angle of Elevation and Depression

The angle of elevation from an observer's eye to an object is equal to the angle of depression from the object to the observer due to alternate interior angles.

Pythagoras Theorem

In any right-angled triangle, Hypotenuse² = Base² + Perpendicular².

Q37. Answer: (c) 4

Shortcut Trick

Net filling efficiency of both pipes = (1 ÷ 8) − (1 ÷ 16) = 1 ÷ 16 of the tank per minute.

Time required to fill the entire tank = 16 minutes.

Time required to fill 1/4th of the tank = 16 × (1 ÷ 4) = 4 minutes.

Therefore The correct answer is 4 minutes.

Alternate Method

Given:

Time taken by filling pipe (A) = 8 minutes

Time taken by emptying pipe (B) = 16 minutes

Formula/LCM Table:

Pipe	Time (minutes)	Total Capacity (LCM)	Efficiency
Pipe A (Filling)	8	16 units	+2 units/min
Pipe B (Emptying)	16	−1 unit/min	

Calculations:

=> Total capacity of the tank = LCM(8, 16) = 16 units

=> Combined efficiency of both pipes when opened together = 2 − 1 = 1 unit/minute

=> Target volume to be filled = 1/4th of total capacity = 16 ÷ 4 = 4 units

=> Time required to fill the target volume = 4 units ÷ 1 unit/minute = 4 minutes

Therefore The correct answer is 4 minutes.

Additional Information

Pipes and Cisterns Net Efficiency

Filling pipes are considered as positive work (+ efficiency) and emptying pipes (leaks) are considered as negative work (− efficiency).

LCM Method for Work

Total capacity is assumed as the Least Common Multiple (LCM) of individual times, which simplifies the calculations of individual flow rates as integers.

Q38. Answer: (b) Rs. 13.86

Shortcut Trick

Radius (r) = 10.5 ÷ 2 = 5.25 cm.

Surface Area = 4 × π × r² = 4 × (22/7) × 5.25 × 5.25 = 346.5 cm².

Cost = (Total Area ÷ 100) × Rate = (346.5 ÷ 100) × 4 = 3.465 × 4 = Rs. 13.86.

Therefore The correct answer is Rs. 13.86.

Alternate Method

Given:

Diameter of the solid brass sphere (d) = 10.5 cm.

Rate of tin-plating = Rs. 4 per 100 cm².

Formula Used:

Surface Area of Sphere = 4πr²

Total Cost = (Surface Area × Rate) ÷ Unit Area

Calculations:

=> Radius (r) = d ÷ 2 = 10.5 ÷ 2 = 5.25 cm = 21/4 cm

=> Surface Area = 4 × (22/7) × (21/4) × (21/4)

=> Surface Area = 4 × (22/7) × (441/16)

=> Surface Area = (22 × 63) ÷ 4 = 1386 ÷ 4 = 346.5 cm^2

=> Cost for 100 cm^2 = Rs. 4

=> Total Cost = (346.5 ÷ 100) × 4

=> Total Cost = 3.465 × 4 = Rs. 13.86

Therefore The correct answer is Rs. 13.86.

Additional Information

Volume of a Sphere

The volume of a sphere is given by $V = (4/3)\pi r^3$, where r is the radius.

Hemisphere Properties

For a hemisphere: Curved Surface Area (CSA) = $2\pi r^2$ and Total Surface Area (TSA) = $3\pi r^2$.

Unit Conversions

1 m^2 = 10,000 cm^2. Always ensure units of area and rate are consistent before multiplication.

Q39. Answer: (a) 59/99

Shortcut Trick

For a pure recurring decimal in the form 0.XYXYXY..., the fraction is simply the repeating digits divided by the same number of 9s.

Here, the decimal is 0.595959... where the repeating block is 59.

Since there are exactly 2 repeating digits, we place 59 over two 9s.

Fraction = 59 ÷ 99

Therefore The correct answer is 59/99.

Alternate Method

Given:

The recurring decimal number is 0.595959...

Method Used:

Algebraic multiplication method to eliminate the infinite recurring decimal portion.

Calculations:

=> Let x = 0.595959... (Equation 1)

=> Since there are 2 digits repeating, we multiply both sides by 10^2 (which is 100).

=> 100x = 59.595959... (Equation 2)

=> Subtract Equation 1 from Equation 2:

=> 100x − x = 59.595959... − 0.595959...

=> 99x = 59

=> x = 59 ÷ 99

Therefore The correct answer is 59/99.

Additional Information

Pure Recurring Decimals

A decimal number where all digits immediately after the decimal point repeat continuously. To convert into a fraction, write the repeating block as the numerator and put as many 9s in the denominator as there are repeating digits. Example: 0.777... = 7/9.

Mixed Recurring Decimals

A decimal where some digits do not repeat before the repeating sequence begins. The formula is (Total number formed by all digits − Non-repeating part) ÷ (As many 9s as repeating digits followed by as many 0s as non-repeating digits). Example: 0.12555... = (125 − 12) ÷ 900 = 113/900.

Q40. Answer: (b) 5°

Shortcut Trick

In any quadrilateral PQRS, the sum of the angles angle P and angle Q is always equal to twice the angle formed by the bisectors of the other two angles angle R and angle S.

=> angle P + angle Q = 2 × angle STR

=> angle P + angle Q = 2 × 37.5° = 75°

Since the ratio of angle P : angle Q is 7 : 8, the difference between angle Q and angle P is:

=> Difference = (8 − 7) ÷ (7 + 8) × 75° = 1/15 × 75° = 5°

Therefore The correct answer is 5°.

Alternate Method

Given:

• In quadrilateral PQRS, the bisectors of angle R and angle S meet at T.

• angle STR = 37.5°

• Ratio of angle P to angle Q = 7 : 8

Formula Used:

• Sum of interior angles of a quadrilateral = 360°

• Sum of angles in a triangle = 180°

Calculations:

In triangle STR:

=> angle STR + angle TSR + angle TRS = 180°

Since ST and RT are the angle bisectors of angle S and angle R respectively:

=> angle TSR = angle S ÷ 2

=> angle TRS = angle R ÷ 2

Substituting these values in the triangle angle sum equation:

=> 37.5° + (angle S ÷ 2) + (angle R ÷ 2) = 180°

=> (angle S + angle R) ÷ 2 = 180° − 37.5°

=> (angle S + angle R) ÷ 2 = 142.5°

=> angle S + angle R = 285°

In quadrilateral PQRS, the sum of all four interior angles is 360°:

=> angle P + angle Q + angle R + angle S = 360°

=> angle P + angle Q + 285° = 360°

=> angle P + angle Q = 360° − 285° = 75°

Let angle P = 7x and angle Q = 8x (since angle P : angle Q = 7 : 8):

=> 7x + 8x = 75°

=> 15x = 75°

=> x = 5°

The difference between the measures of angle Q and angle P is:

=> angle Q − angle P = 8x − 7x = x = 5°

Therefore The correct answer is 5°.

Additional Information

Angle Bisector Theorem in Quadrilaterals

The angle formed by the bisectors of two adjacent angles of a quadrilateral is equal to half the sum of the remaining two angles. That is, angle STR = (angle P + angle Q) ÷ 2.

Sum of Interior Angles of a Polygon

For any n-sided polygon, the sum of interior angles is given by (n − 2) × 180°. For a quadrilateral (n = 4), the sum is always 360°.

Opposite Angle Bisectors

If the bisectors of opposite angles of a quadrilateral (say angle P and angle R) meet, the angle between them is equal to half the difference of the other two angles, i.e., |angle Q − angle S| ÷ 2.

Q41. Answer: (a) 25%

Shortcut Trick

Target value = 1/20 and Base value = 10/50 = 1/5

Required Percentage = (Target ÷ Base) × 100

Required Percentage = (1/20 ÷ 1/5) × 100

Required Percentage = (1/20 × 5) × 100

Required Percentage = 1/4 × 100 = 25%

Therefore The correct answer is 25%.

Alternate Method

Given:

Target value = 1/20
Base value = 10/50
Formula Used:
Percentage = (Target ÷ Base) × 100
Base Value = 10/50 = 1/5 Target Value = 1/20 1/4 of Base = 25% Percentage = (1/20 ÷ 1/5) × 100 = 25%
Calculations:
=> Base value = 10/50 = 1/5
=> Percentage = (1/20 ÷ 1/5) × 100
=> Percentage = (1/20 × 5/1) × 100
=> Percentage = (5/20) × 100
=> Percentage = (1/4) × 100
=> Percentage = 25%
Therefore The correct answer is 25%.
Additional Information
Percentage Formula
To find what percentage X is of Y, use the formula (X ÷ Y) × 100.
Fraction to Percentage Conversion
To convert any fraction to a percentage, multiply it by 100. For example, 1/4 = 1/4 × 100 = 25%.
Percentage of a Quantity
To find a given percentage P of a quantity Q, calculate (P ÷ 100) × Q.
Reciprocal Percentages
Knowing basic fraction to percentage conversions (like 1/2 = 50%, 1/4 = 25%, 1/5 = 20%) speeds up calculation significantly in competitive exams.

Q42. Answer: (d) 33 days

Shortcut Trick
Efficiency ratio A : B : C = 100 : (100 − 45) : 55 × 1.5 = 100 : 55 : 82.5 = 200 : 110 : 165 = 40 : 22 : 33.
Total Work = Efficiency of A × Time of A = 40 × 66 = 2640 units.
Work done by B + C in 24 days = (22 + 33) × 24 = 55 × 24 = 1320 units.
Remaining Work = 2640 − 1320 = 1320 units.
Time taken by A for remaining work = 1320 ÷ 40 = 33 days.
Therefore The correct answer is 33 days.
Alternate Method
Given: Time taken by A = 66 days. B is 45% less efficient than A. C is 50% more efficient than B.
Formula Used: Total Work = Efficiency × Time; Time = Work ÷ Efficiency

Person	Days	Total Work	Efficiency
A	66	2640	40
B	•	40 × 0.55 = 22	
C	•	22 × 1.5 = 33	

=> Efficiency of A = 40 units/day (Assumed for calculation ease based on percentage).
=> Total Work = 40 × 66 = 2640 units.
=> Efficiency of B = 40 − 45% of 40 = 40 − 18 = 22 units/day.
=> Efficiency of C = 22 + 50% of 22 = 22 + 11 = 33 units/day.
=> Work completed by B and C in 24 days = (22 + 33) × 24 = 55 × 24 = 1320 units.
=> Remaining Work = 2640 − 1320 = 1320 units.
=> Time taken by A alone = 1320 ÷ 40 = 33 days.
Therefore The correct answer is 33 days.
Additional Information
Efficiency and Time Relation
Efficiency is inversely proportional to the time taken to complete a work. If the ratio of efficiencies is x : y, the ratio of time taken is

y : x.

Work and Wages

Wages are generally distributed in the ratio of the work done by each person, which is equivalent to the ratio of their efficiencies if they work for the same duration.

Q43. Answer: (b) 7132979

Shortcut Trick

To check divisibility by 49, we can use the osculator method for 7^2 or simpler division.

A number is divisible by 49 if (Remaining digits + 5 × Last digit) is divisible by 49.

Checking 7132979: 713297 + 5(9) = 713342; 71334 + 5(2) = 71344; 7134 + 5(4) = 7154; 715 + 5(4) = 735.

Since 735 ÷ 49 = 15, the number is divisible.

Therefore The correct answer is 7132979.

Alternate Method

Given: Numbers to check for divisibility by 49.

Method: Since 49 = 7 × 7, a number divisible by 49 must be divisible by 7 twice or simply perform long division for the target values.

=> Option 1: 7311476 ÷ 49 ≈ 149213.79 (Not divisible)

=> Option 2: 7132979 ÷ 49 = 145571 (Divisible)

=> Option 3: 7492470 ÷ 49 ≈ 152907.55 (Not divisible)

=> Option 4: 6697359 ÷ 49 ≈ 136680.79 (Not divisible)

Therefore The correct answer is 7132979.

Additional Information

Divisibility by 7

Double the last digit and subtract it from the remaining number. If the result is divisible by 7, the original number is also divisible by 7.

Osculator for 49

For a number ending in 9 like 49, the positive osculator is (4 + 1) = 5. Multiply the last digit by 5 and add to the remaining part.

Divisibility by 7^n

For higher powers of 7, it is often faster in exams to use long division or digital sum combined with prime factorization checks.

Q44. Answer: (a) 1,24,585

Shortcut Trick

The Selling Price (SP) is what remains after subtracting the Discount% from the Marked Price (MP).

MP × (100 − Discount)% = SP

MP × 40% = 49,834

MP = 49,834 ÷ 0.4 = 1,24,585.

Therefore The correct answer is Rs. 1,24,585.

Alternate Method

Given: Discount = 60%, Selling Price (SP) = Rs. 49,834.

Formulas: SP = MP × (100 − Discount%) ÷ 100 | MP = (SP × 100) ÷ (100 − Discount%)

=> Let the Marked Price be MP.

=> SP = MP − 60% of MP = 40% of MP.

=> 40 ÷ 100 × MP = 49,834.

=> MP = (49,834 × 100) ÷ 40.

=> MP = 49,834 × 2.5 = 1,24,585.

Therefore The correct answer is Rs. 1,24,585.

Additional Information

Marked Price & Discount

The Marked Price is the price printed on the label. Discount is always calculated on the Marked Price: SP = MP − Discount.

Ratio Method

60% discount means a ratio of 3:5. If MP is 5 units, Discount is 3 units, then SP is 2 units. Here, 2 units = 49,834, so 1 unit = 24,917. Therefore, 5 units = 1,24,585.

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Q45. Answer: (d) 44

Shortcut Trick

Assume a base value for the Mean as 40.

Calculate deviations from 40: −19, −17, −2, +59, +24, −5, +8, +12, −24.

Net Deviation = (−19 − 17 − 2 − 5 − 24) + (59 + 24 + 8 + 12) = −67 + 103 = 36.

Average Deviation = 36 ÷ 9 = +4.

Correct Arithmetic Mean = 40 + 4 = 44.

Therefore The correct answer is 44.

Alternate Method

Given:

Observations = 21, 23, 38, 99, 64, 35, 48, 52, 16

Total number of observations (n) = 9

Formula Used:

Arithmetic Mean = (Sum of all observations) ÷ (Total number of observations)

Calculations:

=> Sum = 21 + 23 + 38 + 99 + 64 + 35 + 48 + 52 + 16

=> Sum = 396

=> Arithmetic Mean = 396 ÷ 9

=> Arithmetic Mean = 44

Therefore The correct answer is 44.

Additional Information

Combined Mean

If two groups have means x1 and x2 with sizes n1 and n2, the combined mean is (n1x1 + n2x2) ÷ (n1 + n2).

Effect of Change

If every observation is increased or decreased by a constant value 'k', the mean also increases or decreases by 'k'.

Sum of Deviations

The sum of the deviations of all observations from their arithmetic mean is always equal to zero (∑(x_i − Mean) = 0).

Q46. Answer: (d) 32

Shortcut Trick

Distance = 4 × Side = 4 × 20 = 80 m

Speed in m/s = 9 × (5/18) = 2.5 m/s

Time = Distance ÷ Speed = 80 ÷ 2.5 = 32 seconds

Therefore The correct answer is 32 seconds.

Alternate Method

Given:

Side of square field (a) = 20 m

Speed of the boy (v) = 9 km/hr

Formula Used:

Distance (Perimeter) = 4 × Side

Time = Distance ÷ Speed

To convert km/hr to m/s, multiply by 5/18

Calculations:

=> Total distance for one complete round = 4 × 20 m = 80 m

=> Speed in m/s = 9 × (5/18) = 5/2 = 2.5 m/s

=> Time taken = 80 ÷ 2.5

=> Time taken = 32 seconds

Therefore The correct answer is 32 seconds.

Additional Information

Unit Conversion

1 km/hr = 5/18 m/s and 1 m/s = 18/5 km/hr. Always ensure distance and speed units are compatible.

Perimeter of Polygons

For a complete round, the distance covered is equal to the perimeter. For a rectangle, it is 2 × (length + breadth).

Average Speed

Average Speed = Total Distance ÷ Total Time. In uniform motion, speed remains constant throughout the journey.

Q47. Answer: (a) 2

Shortcut Trick

Apply BODMAS and solve orders (powers and roots) directly in one step.

Expression: $\sqrt{(5 + \sqrt{25} + 5^2 - 3^2 - 10)} - \sqrt{4}$

=> $\sqrt{(5 + 5 + 25 - 9 - 10)} - 2$

=> $\sqrt{(35 - 19)} - 2$

=> $\sqrt{(16)} - 2 = 4 - 2 = 2$

Therefore The correct answer is 2.

Alternate Method

Given:

Expression = $\sqrt{(5 + \sqrt{25} + 5^2 - 3^2 - 10)} - \sqrt{4}$

Concept Used:

Follow the BODMAS rule (Brackets, Orders, Division, Multiplication, Addition, Subtraction).

Calculation:

First, resolve the squares and square roots (Orders) inside the main square root.

=> $\sqrt{25} = 5$

=> $5^2 = 25$

=> $3^2 = 9$

=> $\sqrt{4} = 2$

Substitute these values back into the expression:

=> $\sqrt{(5 + 5 + 25 - 9 - 10)} - 2$

Perform the addition inside the bracket:

=> $\sqrt{(10 + 25 - 9 - 10)} - 2$

=> $\sqrt{(35 - 9 - 10)} - 2$

Perform the subtraction inside the bracket:

=> $\sqrt{(26 - 10)} - 2$

=> $\sqrt{16} - 2$

Resolve the final square root:

=> 4 − 2

=> 2

Therefore The correct answer is 2.

Additional Information

BODMAS Rule

An acronym to remember the order of operations in arithmetic: Brackets, Orders (powers and roots), Division, Multiplication, Addition, and Subtraction.

Perfect Squares and Roots

Squaring a number means multiplying it by itself (e.g., 5 × 5 = 25). The square root operation is its inverse, finding the value that was squared to yield the number (e.g., $\sqrt{25} = 5$). For pure simplification, the principal (positive) square root is always considered.

Q48. Answer: (a) 24 minutes

Shortcut Trick

When speed becomes 3/4, the time becomes 4/3 of the usual time.

Difference in time ratio = 4 − 3 = 1 unit.

Given 1 unit = 8 minutes.

Usual time = 3 units = 3 × 8 = 24 minutes.

Therefore The correct answer is 24 min.

Alternate Method

Given: New speed = 3/4 of Usual speed, Delay = 8 minutes.

Formula: Since Distance is constant, Speed prop. to 1/Time. (Ratio of speed = a : b → Ratio of time = b : a)

=> Ratio of Speed (Usual : New) = 1 : 3/4 = 4 : 3

=> Ratio of Time (Usual : New) = 3 : 4

=> Difference in time parts = 4 − 3 = 1 unit

=> 1 unit = 8 minutes

=> Usual time = 3 units = 3 × 8 = 24 minutes

Therefore The correct answer is 24 min.

Additional Information

Inverse Proportion Rule

When distance is constant, speed and time are inversely proportional. If speed is multiplied by a/b, time is multiplied by b/a.

Direct Formula for Usual Time

If a person travels at a/b of his usual speed and is 't' minutes late, Usual Time = (a × t) / |b − a|.

Average Speed

For two equal distances covered at speeds x and y, Average Speed = 2xy / (x + y).

Q49. Answer: (a) Rs. 1,695

Shortcut Trick

Find the unit price of each item: Onions = 273 ÷ 13 = 21, Tomatoes = 462 ÷ 21 = 22, Potatoes = 594 ÷ 27 = 22.

Total cost = (21 × 21) + (25 × 22) + (32 × 22).

Total cost = 441 + 550 + 704 = 1,695.

Therefore The correct answer is Rs. 1,695.

Alternate Method

Given → Cost of 13 kg onions = Rs. 273, 21 kg tomatoes = Rs. 462, 27 kg potatoes = Rs. 594.

Formulas → Unit Cost = Total Cost ÷ Quantity | Total Cost = Σ(Unit Cost × New Quantity)

=> Cost per kg of Onion = 273 ÷ 13 = Rs. 21.

=> Cost per kg of Tomato = 462 ÷ 21 = Rs. 22.

=> Cost per kg of Potato = 594 ÷ 27 = Rs. 22.

=> Cost of 21 kg Onions = 21 × 21 = Rs. 441.

=> Cost of 25 kg Tomatoes = 25 × 22 = Rs. 550.

=> Cost of 32 kg Potatoes = 32 × 22 = Rs. 704.

=> Total Cost = 441 + 550 + 704 = Rs. 1,695.

Therefore The correct answer is Rs. 1,695.

Additional Information

Unitary Method

This method involves finding the value of a single unit first and then multiplying it by the required number of units to find the total value.

Calculation Tip

When multiplying by 22, you can multiply by 2 and then by 11. For example, 32 × 22 = 64 × 11 = 704.

Q50. Answer: (c) 71.2

Shortcut Trick

Ratio of students in the two groups = 14 : (38 − 14) = 14 : 24 = 7 : 12.

Assume the base average is 73. Deviation for the first group = 68 − 73 = −5.

Total deviation = 7 × (−5) = −35. This is distributed over the total ratio parts (7 + 12 = 19).

Net deviation per student = −35 ÷ 19 ≈ −1.84.

Actual Average = 73 − 1.84 = 71.16 ≈ 71.2.

Therefore The correct answer is 71.2.

Alternate Method

Given:

Total number of students = 38

Number of students in Group 1 (n1) = 14 | Average score (A1) = 68

Number of students in Group 2 (n2) = 38 − 14 = 24 | Average score (A2) = 73

Formula Used:

Combined Average = (n1 × A1 + n2 × A2) ÷ (n1 + n2)
Calculations:
=> Total score of Group 1 = 14 × 68 = 952
=> Total score of Group 2 = 24 × 73 = 1752
=> Total score of the whole class = 952 + 1752 = 2704
=> Average score of the whole class = 2704 ÷ 38
=> Average score = 1352 ÷ 19
=> Average score ≈ 71.1578...
=> Average score (rounded to one decimal place) = 71.2
Therefore The correct answer is 71.2.
Additional Information
Weighted Average Concept
When groups of different sizes are combined, the weighted average is pulled closer to the average of the larger group.
Assumed Mean Method
New Average = Assumed Average + (Sum of Deviations ÷ Total Number of items). This simplifies large multiplications.
Rounding Rules
To round to one decimal place, look at the second decimal digit; if it is 5 or more, round up the first decimal digit.

Q51. Answer: (c) hj

Given: In a certain code language, ‘tooth queen zip’ is coded as ‘hj sx em’ and ‘zip arch ratio’ is coded as ‘pb hj od’.
Thus, ‘zip’ is coded as 'hj' in that language.
Hence, the correct answer is "Option 3".

Q52. Answer: (a) One

Given: (Left) 3 @ 2 ^ @ % \ 8 9 \ / ? 8 7 6 # & # + 7 \ (Right)
Now,
Symbols, each of which is immediately preceded by a number and also immediately followed by a number.
So, the needed pattern is: Number — Symbol — Number
Thus, there is one such symbol, which is immediately preceded by a number and also immediately followed by a number.
Hence, the correct answer is "Option 1".

Q53. Answer: (b) One

Given: Seven boxes, B, D, E, P, S, T and W, are kept one over the other but not necessarily in the same order.
1. Only E is kept above D.
2. Only P is kept between D and B.
3. Only W is kept below T.

E
D
P
B
T
W

S, the only box left will occupy the vacant position.

E
D
P
B

S
T
W

Thus, one box is kept between S and W.

Hence, the correct answer is "Option 2".

Q54. Answer: (b) 451

Given: 421 423 427 433 441 ?

The logic followed here is:

Thus, 451 should come in place of the question mark (?) in the given series.

Hence, the correct answer is "Option 2".

Q55. Answer: (d) 446

Given: 436 438 440 442 444 ?

The logic followed here is:

Thus, 446 should come in place of the question mark (?) in the given series.

Hence, the correct answer is "Option 4".

Q56. Answer: (b) Only conclusion (I) follows.

Statements:

All cows are bulls.

All cows are horses.

The least possible Venn diagram for the given statement is:

Conclusions:

(I) Some bulls are horses. - Follow (Because, all cows are bulls and all cows are horses, which means some bulls being cows are horses.)

(II) All horses are cows. - Does not follow (Because, all cows are horses which means some horses are cows.)

Thus, only conclusion (I) follows.

Hence, the correct answer is "Option 2".

Q57. Answer: (b) EH65

The position and positional values or English Alphabets are:

Given: MP33 KN41 IL49 GJ57 ?

The logic followed here is:

Thus, EH65 will replace the question mark (?) in the given series to make it logically complete.

Hence, the correct answer is "Option 2".

Q58. Answer: (d) 2

Given: (Left) @ 6 1 * # 2 8 $ 7 & £ 3 Ω 9 % 4 + 5 (Right)

Now,

Numbers, each of which is immediately preceded by another number and also immediately followed by a symbol.

So, the needed pattern is: Number — Number — Symbol

Thus, there are 2 such numbers, each of which is immediately preceded by another number and also immediately followed by a symbol.

Hence, the correct answer is "Option 4".

Q59. Answer: (d) XGW

The position and positional values or English Alphabets are:

Given: LKO OJQ RIS UHU ?

The logic followed here is:

Thus, XGW will replace the question mark (?) to complete the given series.

Hence, the correct answer is "Option 4".

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Q60. Answer: (d) PFXW

The position and positional values or English Alphabets are:

Given: RHBA is related to UKHG in a certain way based on the English alphabetical order. In the same way, DTZY is related to GWFE.

The logic followed here is:

Similarly,

Thus, MCRQ is related to PFXW, following the same logic.

Hence, the correct answer is "Option 4".

Q61. Answer: (b) One

Given: Six people, A, B, C, D, E and F, are sitting in a row, facing north.

1. A sits to the immediate left of D.

2. C sits third to the left of E.

3. C is an immediate neighbour of D.

4. F sits to the immediate left of B.

Thus, only one person sit between E and F.

Hence, the correct answer is "Option 2".

Q62. Answer: (b) 148

Given: 13,22,40,67,103 ?

The logic followed here is:

Thus, 148 should come in place of the question mark (?) in the given series.

Hence, the correct answer is "Option 2".

Q63. Answer: (d) 8

Given: If 2 is added to each odd digit and 1 is subtracted from each even digit in the number 7284153.

Second digit from the left = 1

Second digit from the right = 7

Sum = 1 + 7 = 8

Thus, 8 will be the sum of the digits which are second from the left and second from the right in the new number thus formed.

Hence, the correct answer is "Option 4".

Q64. Answer: (b) RVT

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster follows the pattern +3, -1.

Let’s check each option:

1. BED

This letter-cluster follows the pattern +3, -1.

2. RVT

This letter-cluster does not follow the pattern +3, -1.

3. KNM

This letter-cluster follows the pattern +3, -1.

4. SVU

This letter-cluster follows the pattern +3, -1.

Thus, RVT is the odd one out.

Hence, the correct answer is "Option 2".

Q65. Answer: (b) Daughter

Family Chart:

Decoding the Symbols:

A is				
Symbol	?	=	@	√

Meaning	daughter	son	father	sister
to B				

Given: C √ D = E @ F ? L

It means: C is the sister of D, D is the son of E, E is the father of F, F is the daughter of L.

Thus, C is daughter of L.

Hence, the correct answer is "Option 2".

Q66. Answer: (d) 1

Given: (Left) 9 8 2 7 7 1 7 9 9 3 4 1 1 9 4 7 4 9 7 1 6 8 3 1 3 6 8 (Right)

Now,

Odd numbers, each of which is immediately preceded by an even number and also immediately followed by an even number.

So, the needed pattern is: Even — Odd — Even

Thus, there is 1 odd number, which is immediately preceded by an even number and also immediately followed by an even number.

Hence, the correct answer is "Option 4".

Q67. Answer: (b) SN-RV

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster pair follows the pattern -1, +7.

Let's check each option:

1. UP-TW

This letter-cluster pair follows the pattern -1, +7.

2. SN-RV

This letter-cluster pair does not follow the pattern -1, +7.

3. QL-PS

This letter-cluster pair follows the pattern -1, +7.

4. WR-VY

This letter-cluster pair follows the pattern -1, +7.

Thus, SN-RV is the odd one out.

Hence, the correct answer is "Option 2".

Q68. Answer: (b) South-east

Given:

1. Town B is to the south of Town C.
2. Town D is to the west of Town B.
3. Town E is to the north of Town D.
4. Town F is to the east of Town E.
5. Town C is to the north-east of Town F.

Thus, Town B is to the South-east of Town F.

Hence, the correct answer is "Option 2".

Q69. Answer: (d) (16, 8, 2)

The logic followed here is:

Logic: (2nd No. × 3rd No.) = 1st No.

(15, 5, 3) → 5 × 3 = 15

(18, 3, 6) → 3 × 6 = 18

Let's check each option:

1. (17, 8, 2) → 8 × 2 = 16 ≠ 17
2. (14, 7, 4) → 7 × 4 = 28 ≠ 14
3. (11, 5, 6) → 5 × 6 = 30 ≠ 11
4. (16, 8, 2) → 8 × 2 = 16

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Thus, (16, 8, 2) is the set in which the numbers are related in the same way as the given sets.

Hence, the correct answer is "Option 4".

Q70. Answer: (a) Two

Given: Seven boxes, A, B, C, D, E, F and G, are kept one over the other, but not necessarily in the same order.

1. A is kept second from the bottom.
2. Only three boxes are kept between A and D.
3. B is kept at one of the positions below A.
4. Only E is kept between D and G.
5. F is kept at one of the positions above D.

F
D
E
G
A
B

C, the only box left will occupy the vacant position.

F
D
E
G
C
A
B

Thus, two boxes are kept below C.

Hence, the correct answer is "Option 1".

Q71. Answer: (c) 9

Given: Each of the digits in the number 8234167 is arranged in ascending order from left to right.

Arranging the digits in ascending order:

8	**2**	**3**	**4**	**1**	**6**	**7**
1	2	3	4	6	7	8

Digit second from the left = 2

Digit second from the right = 7

Sum = 2 + 7 = 9

Thus, 9 will be the sum of the digits which are second from the left and second from the right in the new number thus formed

Hence, the correct answer is "Option 3".

Q72. Answer: (a) 805

BODMAS Rule:

Decoding the given information:

Symbol	•	•	×	÷
Meaning	•	×	÷	•

Given equation: 41 − 17 ÷ 133 + 375 × 15 = ?

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Now replacing the sign from left to right using BODMAS Rule, we get:

=> 41 × 17 + 133 − 375 ÷ 15 = ?

=> 41 × 17 + 133 − 25 = ?

=> 697 + 133 − 25 = ?

=> 830 − 25 = ?

=> 805 = ?

Hence, the correct answer is "Option 1".

Q73. Answer: (a) CEFC

The position and positional values or English Alphabets are:

Given: RTUR is related to TVWT in a certain way based on the English alphabetical order. In the same way, OQRO is related to QSTQ.

The logic followed here is:

Similarly,

Thus, ACDA is related to CEFC, following the same logic.

Hence, the correct answer is "Option 1".

Q74. Answer: (d) Two

Given: M, N, O, P, W, X and Y are sitting around a circular table facing the centre of the table.

1. W sits third to the left of O.
2. X sits second to the left of Y.
3. O is the immediate neighbour of both N and X.
4. P is not an immediate neighbour of W.

M, the only person left will occupy the vacant position.

Thus, two people sit between M and X when counted from the right of M.

Hence, the correct answer is "Option 4".

Q75. Answer: (a) Only conclusion (I) follows.

Statements:

All apples are bikes.

All bikes are planes.

The least possible Venn diagram for the given statement is:

Conclusions:

(I) All apples are planes. - Follow (Because, all apples are bikes and all bikes are planes, which means all apples are planes.)

(II) All bikes are apples. - Does not follow (Because, all apples are bikes which means some bikes are apples.)

Thus, only conclusion (I) follows.

Hence, the correct answer is "Option 1".

Q76. Answer: (c) NL −3

The position and positional values or English Alphabets are:

Given: NU 3 is related to QQ −11 in a certain way. In the same way, EL 7 is related to HH −7.

The logic followed here is:

Similarly,

Thus, KP 11 is related to NL -3, following the same logic.

Hence, the correct answer is "Option 3".

Q77. Answer: (a) rh

Given: In a certain code language, ‘cup of tea’ is coded as ‘at rh si’ and ‘tea is hot’ is coded as ‘mk cp rh’.

Thus, ‘tea’ is coded as 'rh' in that language.

Hence, the correct answer is "Option 1".

Q78. Answer: (a) 4 km to the south

Given: Mr. Zzz starts from Point A and drives 9 km towards the west. He then takes a left turn, drives 17 km, turns left and drives 18 km. He then takes a left turn and drives 21 km. He takes a final left turn, drives 9 km and stops at Point P.

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Thus, he should drive 4 km to the south in order to reach Point A again.

Hence, the correct answer is "Option 1".

Q79. Answer: (a) One

Given: Seven people B, C, D, I, J, K and L are sitting in a straight line facing north.

1. No one sits to the right of L.
2. Only three people sit between B and L.
3. Only one person sits between L and I.
4. K sits to the immediate left of C.
5. J is not an immediate neighbour of L.

D, the only person left will occupy the vacant position.

Thus, only one person sits to the right of D.

Hence, the correct answer is "Option 1".

Q80. Answer: (d) 2

Given: (Left) # 9 & 5 1 © * * * @ # & 7 & # $ 8 & 3 1 @ € (Right)

Now,

Symbols, each of which is immediately preceded by a number and also immediately followed by a number.

So, the needed pattern is: Number — Symbol — Number

Thus, there are 2 such symbols, each of which is immediately preceded by a number and also immediately followed by a number.

Hence, the correct answer is "Option 4".

Q81. Answer: (d) Return to Play Facility

The correct answer is Return to Play Facility.

Key Points

• On 29 April 2025, the National Center for Sports Science and Research (NCSSR) launched the Return to Play Facility to revolutionize the way Indian athletes recover from injuries and transition back to active competition.

• The primary objective of this facility is to provide a scientific and data-driven approach to rehabilitation, ensuring that athletes do not just recover but return to their respective sports at peak performance levels.

• This facility is designed to cater specifically to elite athletes, national campers, and participants in the Khelo India schemes, reducing the dependency on overseas rehabilitation centers.

• The Return to Play Facility utilizes advanced sports science technologies, including biomechanical monitoring and physiological assessment tools, to track an athlete's progress throughout the recovery cycle.

• It bridges the critical gap between medical clearance after an injury and the athlete's ability to withstand the high-intensity physical demands of professional sports.

Additional Information

• National Center for Sports Science and Research (NCSSR):

• The NCSSR is a key initiative under the Ministry of Youth Affairs and Sports, Government of India, aimed at providing high-level scientific support to athletes.

• It functions as a hub for sports medicine, sports nutrition, and sports psychology, working in close coordination with the Sports Authority of India (SAI).

• Athlete Rehabilitation Process:

• Modern rehabilitation involves more than just physiotherapy; it includes strength and conditioning, load management, and mental health support to ensure holistic recovery.

• The Return to Play protocol is a standardized phase-wise progression that ensures an athlete meets specific functional criteria before returning to the field.

• Significance in the Indian Context:

• By establishing world-class facilities like this, India aims to improve its medal prospects in the Olympic Games, Asian Games, and Commonwealth Games.

• The facility helps in the early identification of injury-prone movements, thereby acting as a preventive tool to prolong the careers of Indian sportspersons.

• It represents a shift toward a professionalized sports ecosystem where every aspect of an athlete's health is managed by certified specialists and modern equipment.

Important Points

• The launch of this facility coincides with India's increasing focus on sports technology and the integration of Artificial Intelligence

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(AI) in performance tracking.

• The Return to Play Facility is expected to operate in collaboration with various High-Performance Centers (HPCs) across the country to create a unified athlete management system.

• Key technologies deployed include anti-gravity treadmills, isokinetic dynamometers, and cryotherapy chambers to speed up the healing and strengthening processes.

Q82. Answer: (a) Indore

The correct answer is Indore.

Key Points

• The Indore Municipal Corporation (IMC) achieved a significant milestone by launching India's first QR-Based Digital House Address System in July 2025.

• This innovative system assigns a unique Digital Address to every household in the city, which is accessible through a QR code plate installed at the entrance of the property.

• The primary objective of this project is to simplify urban navigation and improve the efficiency of municipal service delivery, such as waste management and emergency response.

• The Digital Address system integrates various datasets, including Property Tax records, water connection details, and Geospatial coordinates, into a single scannable interface.

• By implementing this system, Indore has become the first city in India to transition from traditional, often confusing physical addresses to a precise, digitized location framework.

Additional Information

• Smart Cities Mission:

• The Smart Cities Mission was launched by the Government of India in June 2015 to promote sustainable and inclusive cities.

• Indore has consistently been a frontrunner in this mission, utilizing Information and Communication Technology (ICT) to enhance the quality of government services.

• Indore's Cleanliness Legacy:

• Indore, located in Madhya Pradesh, is widely recognized for its cleanliness and has been ranked as India's cleanest city for multiple consecutive years in the Swachh Survekshan survey.

• The introduction of the QR-based system further strengthens its Solid Waste Management tracking by ensuring that every house is covered during collection rounds.

• Digital India Initiative:

• The Digital India campaign, launched in 2015, aims to ensure that government services are available to citizens electronically by improving online infrastructure and internet connectivity.

• Digital addressing is a subset of this vision, facilitating easier E-commerce deliveries, postal services, and Logistics management.

• Technological Integration:

• The system utilizes GIS (Geographic Information System) mapping to provide exact locations, which is particularly useful for Ambulance and Fire Services in navigating narrow urban lanes.

• It also helps the Municipal Corporation in identifying unauthorized constructions and ensuring accurate Property Valuation and revenue collection.

Important Points

• Key Benefits of the System:

• Ease of Navigation: Visitors and service providers can find exact locations using a simple Unique Digital Code or scanning the QR code.

• Emergency Efficiency: Reduces response time for Emergency Services like the Police or Disaster Management teams by eliminating address ambiguity.

• Data Centralization: All civic amenities linked to a property are unified under one Digital ID, promoting transparency in Governance.

• Future Scope:

• Following Indore's success, other major cities like Hyderabad, Jaipur, and Bengaluru are expected to adopt similar Digital Addressing frameworks under the National Urban Digital Mission.

Q83. Answer: (a) 130 cities

The correct answer is 130 cities.

Key Points

• The Swachh Vayu Sarvekshan is an initiative by the Ministry of Environment, Forest and Climate Change (MoEFCC) to rank cities on the basis of implementation of activities approved under the City Action Plan and air quality improvement.

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• Under the National Clean Air Programme (NCAP), the survey for 2025 evaluated 130 cities across India to measure their progress in reducing air pollution levels.

• The assessment is based on various parameters including solid waste management, road dust management, management of construction and demolition waste, control of vehicular emissions, and industrial pollution.

• Cities are ranked based on the self-assessment reports submitted on the PRANA portal, which are further vetted by a technical team and third-party agencies.

• The Swachh Vayu Sarvekshan aims to promote healthy competition among cities and encourage them to take proactive steps toward achieving the targets of the NCAP.

Additional Information

• National Clean Air Programme (NCAP):

• Launched in January 2019, the NCAP is a long-term, time-bound, national-level strategy to tackle the air pollution problem across the country in a comprehensive manner.

• The initial target was to achieve a 20% to 30% reduction in Particulate Matter (PM10 and PM2.5) concentrations by 2024, keeping 2017 as the base year for comparison.

• The Government of India later updated the target to achieve a 40% reduction in particulate matter levels in targeted cities by the year 2026.

• Categorization of Cities:

• For the purpose of ranking, cities are divided into three categories based on their 2011 Census population.

• Category 1: Cities with a population of more than 10 lakhs (Million-plus cities).

• Category 2: Cities with a population between 3 lakhs and 10 lakhs.

• Category 3: Cities with a population of less than 3 lakhs.

• PRANA Portal:

• PRANA stands for Portal for Regulation of Air-pollution in Non-Attainment cities.

• It serves as a platform to monitor the implementation of the NCAP and provides real-time information on air quality and the status of various city-level action plans.

• It facilitates transparency and accountability by allowing the MoEFCC and the public to track the progress of 131 non-attainment cities.

Important Points

• Non-Attainment Cities: These are cities that have consistently failed to meet the National Ambient Air Quality Standards (NAAQS) for PM10 or Nitrogen Dioxide (NO2) over a period of five years.

• Funding: The NCAP provides dedicated funds to these cities to implement measures like installing Electric Vehicle (EV) charging stations, increasing green cover, and upgrading mechanical street sweeping machines.

• Incentives: Cities performing well in the Swachh Vayu Sarvekshan are awarded cash prizes and trophies to further motivate local urban bodies to prioritize environmental health.

• Air Quality Index (AQI): While the Sarvekshan looks at action taken, the AQI remains the standard daily tool for communicating the health of the air to the public, ranging from 'Good' (0-50) to 'Severe' (above 400).

Q84. Answer: (a) Gukesh Dommaraju

The correct answer is Gukesh Dommaraju.

Key Points

• Gukesh Dommaraju, popularly known as Gukesh D, was selected for the prestigious Major Dhyan Chand Khel Ratna Award in 2025 in recognition of his extraordinary achievements in the field of Chess.

• He created history by becoming the youngest-ever challenger for the World Chess Championship title after winning the FIDE Candidates Tournament held in Toronto, Canada, in April 2024.

• He played a instrumental role in India winning its first-ever Gold Medal in the Open Category at the 45th Chess Olympiad held in Budapest, Hungary, in September 2024, where he also won an individual Gold Medal on the first board.

• The Major Dhyan Chand Khel Ratna is the highest sporting honor in India, awarded annually by the Ministry of Youth Affairs and Sports for spectacular and most outstanding performance in the field of sports over a period of four years.

• Gukesh became a Grandmaster at the age of 12 years, 7 months, and 17 days, making him the third-youngest person in history to achieve this title at that time.

Additional Information

• Harmanpreet Singh:

• He is the captain of the Indian Men's National Hockey Team.

• Under his leadership, India won the Bronze Medal at the Paris 2024 Olympics.

• He was the top scorer of the Paris Olympics hockey tournament with 10 goals and is widely regarded as one of the best

drag-flickers in the world.

• Praveen Kumar:

• He is a celebrated Indian Para-athlete specializing in the High Jump.

• He clinched the Gold Medal in the Men's High Jump T64 event at the Paris 2024 Paralympics with an Asian Record jump of 2.08 meters.

• Anish Sarkar:

• He is a chess prodigy from West Bengal who made headlines in late 2024.

• At the age of 3 years, 8 months, and 19 days, he became the youngest-ever FIDE-rated player in history, surpassing the previous record.

• Major Dhyan Chand Khel Ratna Award:

• The award was formerly known as the Rajiv Gandhi Khel Ratna Award and was renamed in August 2021.

• The first recipient of this award was the chess legend Viswanathan Anand in the year 1991-92.

Important Points

• The Major Dhyan Chand Khel Ratna Award carries a cash prize of Rs. 25 lakh, a medallion, and a certificate.

• Gukesh D reached a peak FIDE live rating of over 2790 in 2024, solidifying his position among the top 5 chess players globally.

• In 2023, he surpassed Viswanathan Anand to become the top-ranked Indian player in the FIDE rating list, ending Anand's 37-year reign as India's number one.

• The award ceremony usually takes place at the Rashtrapati Bhavan, where the President of India confers the honors upon the athletes.

Q85. Answer: (d) Chhattisgarh

The correct answer is Chhattisgarh.

Key Points

• The Constitution (Scheduled Castes) Order (Amendment) Bill, 2023 was introduced and passed by the Parliament of India to amend the Constitution (Scheduled Castes) Order, 1950, specifically in its application to the state of Chhattisgarh.

• The primary objective of the bill is to include the Mahara and Mahra communities as synonyms for the Mehra, Mahar, and Ganda communities in the Scheduled Castes list of Chhattisgarh.

• The Lok Sabha passed the bill on July 24, 2023, and the Rajya Sabha gave its approval on August 9, 2023, during the Monsoon Session.

• This amendment ensures that members of these communities can avail of the benefits meant for Scheduled Castes in the state, including reservation in educational institutions and government jobs.

• The bill was moved by the Union Minister for Social Justice and Empowerment, Shri Virendra Kumar, to rectify discrepancies in the existing list. Hence, the correct answer is Chhattisgarh.

Additional Information

• Article 341 of the Constitution:

• This article empowers the President to specify the castes, races, or tribes which shall be deemed to be Scheduled Castes in relation to a particular State or Union Territory.

• Once the initial list is notified by the President, any inclusion or exclusion from the list can only be done by an Act of Parliament.

• The Constitution (Scheduled Castes) Order, 1950:

• This is the foundational Presidential Order that lists the various castes eligible for affirmative action in India.

• It has been amended several times over the decades (e.g., 1956, 1976, and 2002) to reflect changing social dynamics and administrative corrections.

• The Process of Inclusion:

• The process begins with a recommendation from the concerned State Government.

• It is then vetted by the Registrar General of India (RGI) and the National Commission for Scheduled Castes (NCSC).

• After their concurrence, the proposal is placed before the Union Cabinet and finally introduced as a Bill in Parliament.

• Chhattisgarh State Context:

• The state of Chhattisgarh was carved out of Madhya Pradesh on November 1, 2000.

• Since its formation, there have been several demands to include phonetic variations of existing Scheduled Castes and Scheduled Tribes to ensure legitimate beneficiaries are not excluded due to spelling errors or local nomenclature.

Important Points

• Ministry of Social Justice and Empowerment: This ministry is the nodal agency at the Central Government level for the welfare of Scheduled Castes.

• Impact of the 2023 Bill: By adding the Mahara and Mahra communities, the government addressed a long-standing demand for

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social justice, as these groups were historically denied benefits despite sharing the same socio-economic status as the Mahar or Ganda communities.

• National Commission for Scheduled Castes (NCSC): Established under Article 338, this constitutional body monitors safeguards provided for Scheduled Castes and participated in the consultative process for this 2023 Amendment.

Q86. Answer: (d) Innovations for Defence Excellence

The correct answer is Innovations for Defence Excellence.

Key Points

• The Innovations for Defence Excellence (iDEX) was launched by the Prime Minister of India in April 2018 during the DefExpo.

• It serves as the flagship initiative of the Ministry of Defence to encourage innovation and technology development specifically for the Defence and Aerospace sectors.

• The scheme is managed and funded by the Defence Innovation Organisation (DIO), which was formed as a not-for-profit company under Section 8 of the Companies Act 2013.

• The primary objective of iDEX is to engage various stakeholders, including start-ups, MSMEs, individual innovators, and academic institutions, to develop cutting-edge technologies for the Indian Armed Forces.

• It provides grants and funding to carry out Research and Development (R&D) projects that have a high potential for future adoption by the Indian Army, Navy, and Air Force.

Additional Information

• Defence Innovation Organisation (DIO):

• The DIO was founded by two major Defence Public Sector Undertakings (DPSUs), namely Hindustan Aeronautics Limited (HAL) and Bharat Electronics Limited (BEL).

• It acts as the executive body that oversees the implementation of the iDEX framework and ensures the efficient utilization of the Defence Innovation Fund.

• Technology Development Fund (TDF):

• The Technology Development Fund (TDF) is a program executed by the Defence Research and Development Organisation (DRDO).

• It aims to support MSMEs and start-ups in developing components, products, and systems that are currently not available in the Indian defence industry.

• Unlike iDEX, which focuses on broader innovation, TDF is more specifically aligned with DRDO's mission of indigenization.

• Acing Development of Innovative Technologies with iDEX (ADITI):

• The ADITI scheme was launched in March 2024 during the DefConnect 4.0 event to promote innovations in critical and strategic defence technologies.

• It offers a much higher grant-in-aid of up to Rs 25 crore to start-ups for research and development in areas like space technology and cybersecurity.

Important Points

• Defence India Startup Challenge (DISC): Under the iDEX initiative, the DISC is periodically launched to present specific problem statements from the Armed Forces to the start-up ecosystem.

• Self-Reliance: The core vision of these schemes is to achieve Atmanirbharta (self-reliance) in defence production and reduce India's dependency on foreign imports.

• iDEX Prime: This is an extension of iDEX meant to support projects requiring higher funding, offering grants up to Rs 10 crore for more complex technological challenges.

• Financial Support: Since its inception, iDEX has supported hundreds of start-ups and led to the procurement of various indigenous technologies by the Indian military.

Q87. Answer: (d) Sri Lanka

The correct answer is Sri Lanka.

Key Points

• Poson Poya is a major religious and cultural festival celebrated by Buddhists in Sri Lanka to commemorate the arrival of Buddhism in the country.

• The festival takes place annually on the Full Moon day of June, which is known as Poson in the Sinhala calendar. In June 2025, the nation marks this significant milestone with island-wide celebrations.

• It commemorates the arrival of Arahat Mahinda, the son of the Indian Emperor Ashoka, who brought the teachings of the Buddha to Sri Lanka in the 3rd Century BC.

• The historic introduction of Buddhism occurred at Mihintale, where Arahat Mahinda met and converted King Devanampiyatissa, the reigning monarch of the time.

• The celebrations in June 2025 honor the enduring legacy of over 2000 years of Buddhist tradition, which has fundamentally

shaped the culture, social structure, and governance of Sri Lanka.

Additional Information

• Geographical Significance:

• Mihintale, located near the ancient city of Anuradhapura, is regarded as the cradle of Buddhism in Sri Lanka. During Poson Poya, thousands of pilgrims climb the 1,840 steps to reach the summit of the sacred mountain.

• Anuradhapura, a UNESCO World Heritage Site, serves as the primary hub for religious observances, including Sil campaigns and meditation sessions.

• Cultural Traditions:

• Devotees engage in Amisa-puja (offerings of food and flowers) and Pratipatti-puja (following the path of Dhamma). Many laypersons observe Atthasila (the eight precepts) while wearing white attire.

• A unique feature of the festival is the Dansala, where local communities provide free food, drinks, and snacks to pilgrims and travelers as an act of generosity (Dana).

• The streets are decorated with Buddhist flags and illuminated lanterns. Large structures called Pandols (Thoranas), depicting stories from the Jataka tales (previous lives of the Buddha), are erected with colorful electric lights.

• Historical Context:

• Following the meeting at Mihintale, Buddhism became the state religion of Sri Lanka. This led to the establishment of the Mahavihara monastery and the flourishing of Pali literature and Sinhalese architecture.

• The Government of Sri Lanka typically declares a Poson Week to facilitate religious activities and ensures the protection of sacred sites during the influx of pilgrims.

Important Points

• Comparison with Vesak: While Vesak (celebrated in May) commemorates the birth, enlightenment, and passing away (Parinirvana) of the Buddha, Poson is specific to the Sri Lankan context, celebrating the localized birth of the Dhamma on the island.

• National Importance: Poson Poya is a Public Holiday in Sri Lanka. In 2025, special focus is placed on interfaith harmony and the preservation of ancient monuments that date back to the initial conversion period.

• Modern Observance: Modern celebrations often include Poson Bhakthi Gee (devotional songs) and processions (Peraheras) involving traditional dancers and drummers.

Q88. Answer: (c) Rohini, Maharashtra

The correct answer is Rohini, Maharashtra.

Key Points

• Rohini Gram Panchayat, located in the Wardha district of Maharashtra, achieved the prestigious Gold Award at the National e-Governance Awards 2025 (officially presented during the 27th National Conference on e-Governance).

• The award was conferred under the newly instituted Category IX, which focuses on Excellence in District level initiative in e-Governance specifically highlighting the role of Gram Panchayats in digital transformation.

• The initiative was recognized for its exemplary use of technology to streamline administrative processes, improve transparency, and provide citizen-centric services directly at the doorstep of rural residents.

• This recognition was part of the awards organized by the Department of Administrative Reforms and Public Grievances (DARPG) in collaboration with the Ministry of Electronics and Information Technology (MeitY) and the Government of Maharashtra.

• As a recipient of the Gold Award, the Rohini Gram Panchayat received a trophy, a certificate, and a substantial cash incentive of Rs. 10 Lakhs to further enhance its digital infrastructure.

Additional Information

• National e-Governance Awards (NAeG):

• These awards are presented annually to recognize and promote excellence in the implementation of e-Governance initiatives that improve the ease of living for citizens.

• The 2025 cycle awards were showcased during the conference held in Mumbai in September 2024, reflecting the progress made during the 2024-2025 administrative year.

• Category-specific Details:

• The introduction of a specific category for Gram Panchayats underlines the Government of India's commitment to the Digital India mission at the grassroots level.

• While Rohini, Maharashtra secured the Gold, West Malsipur Gram Panchayat from Tripura was honored with the Silver Award in the same category.

• Role of Technology in Rural Governance:

• The e-GramSwaraj portal, launched by the Ministry of Panchayati Raj, serves as a primary tool for digital accounting and planning for these local bodies.

• Successful panchayats like Rohini utilize these platforms to ensure 100% digital payments and real-time monitoring of development projects.

Important Points

• Evaluation Parameters: The selection process involves rigorous vetting based on innovation, sustainability, scalability, and the extent of citizen engagement.

• Geographic Significance: Maharashtra has consistently performed well in the e-Governance index, and the success of a village in Wardha signifies the penetration of digital literacy in the Vidarbha region.

• Historical Context: The National Conference on e-Governance has been held since 1997, evolving from simple discussions on computerization to complex dialogues on Artificial Intelligence (AI) and Blockchain in governance.

Q89. Answer: (a) India

The correct answer is India.

Key Points

• India won the Presidency of the International Institute of Administrative Sciences (IIAS) for the term 2025-28. This significant victory marks a major milestone for the country in the field of global administrative reforms and public governance.

• The election for the Presidency took place during the IIAS Annual Conference 2024, which was held in Mombasa, Kenya, in February 2024. India's candidacy was strongly supported by various member nations.

• S. Chockalingam, a 1996-batch IAS officer and the Director General of the Yashwantrao Chavan Academy of Development Administration (YASHADA) in Pune, was elected as the President-elect. He will represent India at the helm of this prestigious international body.

• India's victory is seen as a recognition of its robust administrative framework and its continuous efforts toward digital transformation and citizen-centric governance. The Department of Administrative Reforms and Public Grievances (DARPG), under the Ministry of Personnel, Public Grievances and Pensions, led the institutional representation for India.

• With this Presidency, India will play a pivotal role in shaping the global agenda for public administration, fostering international cooperation, and sharing best practices in governance and public policy.

Additional Information

• International Institute of Administrative Sciences (IIAS):

• Established in 1930, the IIAS is a global federation headquartered in Brussels, Belgium.

• It focuses on improving administrative sciences and public administration through research, training, and the exchange of knowledge among governments and academic institutions.

• It currently comprises several member states, national sections, and academic entities, serving as a platform for comparative public administration studies.

• Role of DARPG:

• The Department of Administrative Reforms and Public Grievances (DARPG) is the nodal agency for the Government of India for administrative reforms.

• Under the leadership of Secretary V. Srinivas, the department has been actively promoting India's administrative achievements on international forums.

• The department is responsible for formulating policies for grievance redressal, e-governance, and disseminating best practices across various sectors.

• Significance of the Presidency:

• Winning the Presidency allows India to lead the Council of Administration and the Executive Committee of the IIAS.

• It provides an opportunity for India to influence global governance standards and showcase the "Minimum Government, Maximum Governance" philosophy.

Important Points

• 2025 IIAS Annual Conference:

• As part of its rising leadership, India is set to host the 2025 IIAS Annual Conference in Kochi, Kerala.

• The conference is scheduled to be held from February 24 to 28, 2025.

• The theme for the 2025 Kochi Conference is "Next Generation Administrative Reforms - Empowering the Citizens and Reaching the Last Mile".

• This event will bring together over 30 countries and administrative experts to discuss digital governance, institutional capacity building, and sustainable development goals (SDGs).

• Historical Context:

• This is the first time an Indian official has been elected to the post of President of the IIAS since its inception in 1930.

• India has been a member of the IIAS for decades, but this 2025-2028 term marks its highest level of institutional involvement and leadership.

Q90. Answer: (b) Top National Players Stipend Scheme

The correct answer is Top National Players Stipend Scheme.

Key Points

• The All India Chess Federation (AICF) introduced the Top National Players Stipend Scheme in early 2025 as a landmark initiative to provide financial stability to budding chess prodigies across India.

• This scheme is specifically designed to support young players in age groups ranging from Under-7 (U-7) to Under-19 (U-19), covering both Open and Girls categories.

• Under this initiative, the top 12 players from each national age-group championship are eligible to receive a monthly stipend, creating a pool of approximately 156 beneficiaries annually.

• The financial aid is intended to cover essential expenses such as professional coaching, travel for international tournaments, and entry fees, helping players focus on their growth without economic pressure.

• The implementation of this scheme in 2025 aligns with the AICF's broader vision to maintain India's dominance in world chess following the country's historic Double Gold win at the 45th Chess Olympiad.

Additional Information

• All India Chess Federation (AICF):

• Established in 1951, the AICF is the central administrative body for chess in India and is headquartered in New Delhi.

• It is affiliated with FIDE (International Chess Federation) and has been instrumental in producing over 80 Grandmasters as of 2024-2025.

• The current leadership, including President Nitin Narang and Secretary Dev A. Patel, has focused on grassroots development and administrative transparency.

• Chess Development in India:

• India has emerged as a global superpower in chess, boasting world-class talents like D Gukesh, Arjun Erigaisi, and R Praggnanandhaa.

• The Top National Players Stipend Scheme is part of a larger Rs. 65 crore budget allocated for the 2024-2025 cycle to revamp the chess ecosystem.

• Other recent initiatives include the National Chess Academy and the introduction of Chess in Schools programs to popularize the game at the primary level.

• Impact of Stipend Schemes:

• By providing a stipend, the federation aims to prevent "talent drain," where high-potential players quit the sport due to the high costs associated with Grandmaster-level training.

• This structured support system acts as a scholarship, rewarding consistency in National Championships and encouraging competitive participation at the state and district levels.

Important Points

• The Top National Players Stipend Scheme is a merit-based system where performance in the National Age Group Championships serves as the sole criteria for selection.

• The stipend amounts are tiered, ensuring that those ranked higher (e.g., Rank 1 to 3) receive a more significant portion of the financial aid compared to those in the lower bracket of the top 12.

• This initiative marks the first time in Indian Chess history that such a large number of junior players are being brought under a direct monthly payroll by the national federation.

• The scheme also complements the Ministry of Youth Affairs and Sports' efforts under the Target Olympic Podium Scheme (TOPS), which primarily focuses on senior elite athletes.

Q91. Answer: (b) London

The correct answer is London.

Key Points

• The tragic aviation incident involving an Air India aircraft occurred in June 2025.

• The flight was operating on a scheduled international route departing from Ahmedabad, Gujarat.

• The intended destination for this specific flight was London, United Kingdom, which is one of the most prominent international routes for travelers from Western India. Hence, the correct answer is London.

• The aircraft involved was under the operation of Air India, which is the premier global airline of India and a member of the Star Alliance.

• The departure point was the Sardar Vallabhbhai Patel International Airport (SVPIA), which serves as a major hub for Air India's international operations in the region.

Additional Information

• Air India:

• Founded by J.R.D. Tata in 1932 as Tata Airlines, it was later nationalized and eventually returned to the Tata Group in January 2022.

• The airline operates a massive fleet of Boeing and Airbus aircraft, providing connectivity to over 80 destinations across the world.

• Sardar Vallabhbhai Patel International Airport:

• Located in Ahmedabad, it is the busiest airport in the state of Gujarat.

• The airport handles significant traffic to European and Middle Eastern countries due to the large Gujarati diaspora residing abroad.

• Aviation Safety and Investigation:

• Accidents of this nature are investigated by the Aircraft Accident Investigation Bureau (AAIB) in India.

• Global aviation standards are set by the International Civil Aviation Organization (ICAO), a specialized agency of the United Nations.

• London Heathrow (LHR):

• The primary destination for many flights from India, Heathrow is one of the world's busiest airports and a central node for trans-Atlantic travel.

Important Points

• Flight Data Recorder (FDR): Also known as a black box, this device preserves the history of the flight through the recording of dozens of parameters collected several times per second.

• Cockpit Voice Recorder (CVR): This is used to record the audio environment in the flight deck, which is critical for investigators to understand the pilot's actions and communications during an emergency.

• DGCA (Directorate General of Civil Aviation): This is the statutory body of the Government of India that regulates civil aviation in India and maintains safety standards for all Indian registered aircraft.

Q92. Answer: (c) Mirra Andreeva

The correct answer is Mirra Andreeva.

Key Points

• On 22 February 2025, Mirra Andreeva became the youngest player in history to win a WTA 1000 title.

• The record-breaking victory occurred at the Dubai Duty Free Tennis Championships, which is a prestigious hard-court tournament held in the United Arab Emirates.

• At the time of her triumph, Mirra Andreeva was approximately 17 years and 300 days old, surpassing the previous benchmarks set by other teenage stars in the WTA 1000 category.

• This victory marked her first career WTA 1000 title, propelling her into the Top 10 of the WTA Rankings for the first time in her career.

• Her run to the title involved defeating several established Grand Slam champions and top-seeded players, solidifying her reputation as a generational talent in professional tennis.

Additional Information

• WTA 1000 Tournaments:

• These represent the highest tier of women's professional tennis events organized by the Women's Tennis Association (WTA), second only to the Grand Slams and the WTA Finals.

• Winners of these events are awarded 1000 ranking points. Prominent WTA 1000 venues include Indian Wells, Miami, Madrid, Rome, Beijing, and Dubai.

• Mirra Andreeva:

• Born on 29 April 2007 in Krasnoyarsk, Russia, she made a rapid ascent through the professional ranks.

• She gained global attention in 2023 after reaching the fourth round of Wimbledon at just 16 years old.

• Her elder sister, Erika Andreeva, is also a professional tennis player on the WTA Tour.

• Comparison with Other Players:

• Coco Gauff (Option 4) previously held records as one of the youngest WTA 1000 winners when she won the Cincinnati Open in 2023 at the age of 19.

• Iga Świątek (Option 1) is a dominant force in women's tennis who won her first Grand Slam (French Open) at age 19 in 2020 and became the World No. 1 in 2022.

• Clara Tauson (Option 2) is another young talent from Denmark known for her powerful baseline game, though she has not yet reached the record-breaking milestones achieved by Andreeva in the WTA 1000 circuit as of early 2025.

• Dubai Duty Free Tennis Championships:

• This event is a major stop on the tennis calendar and features both ATP and WTA draws.

• The tournament is known for its high prize money and state-of-the-art facilities at the Aviation Club Tennis Centre.

Q93. Answer: (d) Indian Navy

The correct answer is Indian Navy.

Key Points

• In May 2025, the Defence Research and Development Organisation (DRDO) successfully conducted a combat firing trial of the indigenous Multi-Influence Ground Mine in collaboration with the Indian Navy.

• The test was carried out with reduced explosives to validate the sophisticated sensor systems and triggering mechanisms against the actual physical signatures of naval vessels without causing structural damage to the test platforms.

• This state-of-the-art underwater weapon has been designed and developed by the Naval Science and Technological Laboratory (NSTL), a premier laboratory of DRDO located in Visakhapatnam.

• The Multi-Influence Ground Mine is a highly advanced sea mine that can be deployed from ships and submarines to protect Indian waters and deny sea access to enemy forces. Hence, the correct answer is the Indian Navy.

Additional Information

• Multi-Influence Technology:

• Unlike traditional contact mines, influence mines do not require physical contact with a ship's hull. They use microprocessor-based sensors to detect magnetic, acoustic, and pressure signatures of passing vessels.

• The mine is programmable, allowing it to target specific types of ships or submarines while ignoring friendly vessels or decoys, making it a "smart" underwater weapon.

• Design and Production:

• The development of this mine is a significant step toward Aatmanirbhar Bharat (Self-Reliant India) in the defense sector, reducing the Indian Navy's reliance on imported naval mines.

• Following successful combat trials, the technology is typically transferred to production agencies like Bharat Dynamics Limited (BDL) for mass manufacturing.

• Strategic Importance:

• Sea mines are cost-effective tools for sea denial and harbor defense. They can be laid in shipping lanes or near enemy ports to restrict their naval movement during a conflict.

• The Multi-Influence Ground Mine is designed to be laid on the seabed (ground mine) in shallow or medium-depth waters, making it extremely difficult for enemy minesweepers to detect and neutralize.

Important Points

• Technical Specifications: The full-scale version of these mines typically carries a high-explosive warhead of approximately 480 kg to 500 kg, capable of crippling large warships.

• Operational Life: These indigenous mines are designed with a shelf life of over 10 to 15 years and can remain active on the seabed for long durations (up to one year) after deployment.

• Safety Features: The mines include advanced arming and safety devices to ensure they only become active after reaching a specific depth and after a pre-set time delay, preventing accidents during deployment by Indian Navy personnel.

• Context of Trial: The May 2025 trial marks the final stages of user validation trials before the weapon system is formally inducted into the permanent arsenal of the Indian Navy.

Q94. Answer: (d) Ministry of Statistics and Programme Implementation

The correct answer is Ministry of Statistics and Programme Implementation.

Key Points

• The Ministry of Statistics and Programme Implementation (MoSPI) released the 8th issue of the publication titled 'EnviStats India 2025: Environment Statistics' in June 2025.

• The publication is compiled and brought out by the National Statistical Office (NSO), which is the statistical wing of MoSPI. It serves as a comprehensive document providing data on various environmental indicators in India.

• EnviStats India 2025 is prepared in accordance with the Framework for the Development of Environment Statistics (FDES 2013), which was developed by the United Nations Statistics Division (UNSD).

• The report provides essential data for monitoring the Sustainable Development Goals (SDGs), particularly those related to Clean Water and Sanitation (Goal 6), Affordable and Clean Energy (Goal 7), and Climate Action (Goal 13).

• The primary objective of this publication is to provide policy-makers, researchers, and stakeholders with reliable data on biological resources, soil, water, and forest cover to enable informed environmental decision-making.

Additional Information

• Ministry of Statistics and Programme Implementation (MoSPI):

• MoSPI came into existence as an independent Ministry on 15th October 1999 after the merger of the Department of Statistics and the Department of Programme Implementation.

• The Ministry has two wings: the Statistics Wing (called NSO) and the Programme Implementation Wing.

• It is headquartered in New Delhi and is responsible for the coverage and quality aspects of statistics released in the country.

• EnviStats India Series:

• The first issue of EnviStats India was released in 2018. It marked a shift towards structured environmental accounting in India.

• The series follows the System of Environmental-Economic Accounting (SEEA) framework, which helps in understanding the interactions between the economy and the environment.

• It covers six components of environment statistics: Environmental Conditions and Quality, Environmental Resources and their Use, Residuals, Extreme Events and Disasters, Human Settlements and Environmental Health, and Environmental Protection, Management and Engagement.

• Ministry of Environment, Forest and Climate Change (MoEFCC):

• This Ministry is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies.

• While MoEFCC implements policies like the National Clean Air Programme (NCAP), the specialized statistical reporting on the environment is primarily handled by MoSPI.

• National Green Tribunal (NGT):

• The NGT is a specialized body set up under the National Green Tribunal Act (2010) for effective and expeditious disposal of cases relating to environmental protection.

• It is a judicial body and does not traditionally publish the EnviStats statistical reports, which are the mandate of the national statistical system.

Important Points

• Asset Accounts: The 8th issue includes detailed Asset Accounts for Forests, Land, and Water, following the SEEA Central Framework.

• Data Sources: The data in the publication is sourced from various specialized agencies like the Forest Survey of India (FSI), Central Water Commission (CWC), and Central Pollution Control Board (CPCB).

• Global Alignment: By utilizing the FDES 2013, India ensures its environment statistics are comparable at an international level, assisting in global environmental monitoring reports.

Q95. Answer: (b) Bihar

The correct answer is Bihar.

Key Points

• In the Union Budget 2025–26, presented by the Finance Minister in February 2025, a major emphasis was placed on the infrastructure development of Bihar under the "Purvodaya" plan.

• The Government of India announced the development of new Greenfield Airports in Bihar to improve regional air connectivity and boost economic growth in the eastern part of the country. Hence, the correct option is Bihar.

• Specifically, the budget proposed the establishment of three new Greenfield Airports at Purnea, Bhagalpur, and Rajgir.

• This initiative aims to cater to the increasing passenger traffic and support the Buddhist Circuit, which attracts international tourists to the state.

• The total financial support for various infrastructure projects in Bihar, including these airports, roads, and power plants, is part of a special package to transform the state into an industrial hub.

Additional Information

• Greenfield Airports:

• A Greenfield Airport is a new airport constructed from scratch on previously undeveloped land or "green" land.

• Unlike Brownfield projects, which involve the expansion or upgrading of existing facilities, Greenfield projects allow for modern planning, advanced environmental standards, and state-of-the-art infrastructure.

• The Government of India has a Greenfield Airports (GFA) Policy, 2008, which provides guidelines for the establishment of such airports across the country.

• Purvodaya Initiative:

• The Purvodaya scheme is aimed at the comprehensive development of the eastern states of India, including Bihar, Jharkhand, West Bengal, Odisha, and Andhra Pradesh.

• It focuses on making this region an engine of growth for the nation through investments in human capital, infrastructure, and industrial opportunities.

• UDAN Scheme:

• The Ude Desh ka Aam Nagrik (UDAN) is a regional airport development and "Regional Connectivity Scheme" (RCS) of the Government of India.

• Launched in 2016, it aims to make air travel affordable and widespread, particularly connecting unserved and underserved airports.

Important Points

• Strategic Impact in Bihar:

• The Purnea airport is expected to serve the Seemanchal region, providing a vital link for trade and commerce near the borders of Nepal and West Bengal.

• The development in Rajgir is strategically linked to religious tourism, as it is a significant site for Buddhists, Jains, and Hindus.

• The Airports Authority of India (AAI) will play a central role in the technical planning and operationalization of these new sites.

• Multimodal Connectivity:

• The airport projects are integrated with the PM Gati Shakti National Master Plan, ensuring that they are well-connected to highways and railways for seamless logistics.

• The Union Budget 2025–26 also allocated funds for the Patna-Purnea Expressway and other road projects to complement the aviation infrastructure.

Q96. Answer: (a) United States Food and Drug Administration

The correct answer is United States Food and Drug Administration.

Key Points

• The United States Food and Drug Administration (FDA) granted approval for Lenacapavir as a breakthrough medication for HIV prevention in June 2025.

• Lenacapavir, marketed under the brand name Sunlenca, is developed by the biopharmaceutical company Gilead Sciences.

• It represents a revolutionary shift in Pre-Exposure Prophylaxis (PrEP) as it is the first twice-yearly (six-month) injection approved for preventing HIV-1 infection.

• The approval was supported by data from the PURPOSE clinical trial program, which demonstrated superior efficacy compared to daily oral PrEP options like Truvada.

• The drug functions as a capsid inhibitor, a novel class of antiretroviral medication that targets the protein shell of the HIV virus at multiple stages of its lifecycle.

Additional Information

• HIV Pre-Exposure Prophylaxis (PrEP):

• PrEP is an HIV prevention strategy where individuals who do not have HIV but are at high risk of contracting it take medicine to reduce the risk of infection.

• Prior to Lenacapavir, PrEP was primarily available as daily oral tablets (e.g., TDF/FTC) or bimonthly injections (e.g., Cabotegravir).

• Mechanism of Action:

• Lenacapavir is designed to inhibit the HIV-1 capsid, which is essential for viral replication.

• It interferes with capsid-mediated nuclear uptake of viral DNA and the assembly of new virus particles.

• Clinical Trials (PURPOSE 1 & 2):

• The PURPOSE 1 trial focused on cisgender women in South Africa and Uganda, showing zero infections in the Lenacapavir group.

• The PURPOSE 2 trial evaluated the drug in cisgender men, transgender women, and gender non-binary individuals across North America, South America, and Africa.

• Long-Acting Injectables:

• Long-acting formulations address the challenge of medication adherence, which is a major barrier to the effectiveness of daily oral HIV regimens.

• The six-month dosing interval (twice a year) offers a more discrete and convenient option for high-risk populations.

Important Points

• Regulatory History: Before being approved for prevention in 2025, Lenacapavir received FDA approval in December 2022 for the treatment of multi-drug resistant HIV in heavily treatment-experienced adults.

• Global Access: Following the US FDA approval, global health organizations like the World Health Organization (WHO) often review such medications for inclusion in global health guidelines to improve access in low-income countries.

• Administration: The drug is administered via subcutaneous injection by a healthcare provider, ensuring that the patient remains protected for a full six-month period.

• Significance: This approval is considered a major step toward the United Nations goal of ending the HIV epidemic by 2030 by providing highly effective and easy-to-maintain prevention tools.

Q97. Answer: (d) Kirsty Coventry

The correct answer is Kirsty Coventry.

Key Points

• Kirsty Coventry was elected as the President of the International Olympic Committee (IOC) in March 2025, marking a historic milestone in sports administration.

• She is the first female and the first African individual to serve as the President of the IOC since its establishment in 1894. Hence, option 4 is correct.

• The election was conducted during the 143rd IOC Session, which was held in the symbolic location of Ancient Olympia, Greece.

• She succeeded Thomas Bach, who served as the IOC President from 2013 until 2025. Thomas Bach reached the term limit after serving an initial eight-year term and a subsequent four-year term. Hence, statement 1 is incorrect.

• Other prominent candidates considered for the position included Sebastian Coe (the head of World Athletics) and Juan Antonio Samaranch Jr. (IOC Vice President). Hence, statements 2 and 3 are incorrect.

Additional Information

• Kirsty Coventry's Athletic Career:

• She is the most decorated Olympian from the continent of Africa, having won a total of seven Olympic medals.

• Her achievements include two gold medals in the 200m backstroke, won at the 2004 Athens Olympics and the 2008 Beijing Olympics.

• In Zimbabwe, she is celebrated as the "Golden Girl" for her immense contribution to the country's sporting legacy.

• Role in Administration:

• Before her presidency, she served as the Minister of Youth, Sport, Arts and Recreation in the Government of Zimbabwe, appointed in September 2018.

• She became an IOC member in 2013 and chaired the IOC Athletes' Commission from 2018 to 2021, representing the voice of athletes worldwide.

• About the International Olympic Committee (IOC):

• The IOC is a non-governmental, non-profit organization based in Lausanne, Switzerland.

• It is the supreme authority of the Olympic Movement and is responsible for the supervision of the Summer, Winter, and Youth Olympic Games.

• The IOC President is elected by the IOC Session via a secret ballot and serves as the primary legal representative of the organization.

Important Points

• Election Context: The 2025 election was highly anticipated as it signaled a shift toward gender parity and global representation at the highest levels of sports governance.

• Term Duration: Under the Olympic Charter, the President is elected for a first term of eight years and can be re-elected for one additional term of four years.

• Geographic Diversity: Prior to Kirsty Coventry, the IOC had been led almost exclusively by Europeans (with the exception of Avery Brundage from the USA). Her election represents a significant breakthrough for Global South nations.

• Responsibilities: As President, Coventry will oversee the preparations for the 2028 Los Angeles Olympics and the 2032 Brisbane Olympics, while navigating the challenges of digital transformation and sustainability in sports.

Q98. Answer: (d) 6.5%

The correct answer is 6.5%.

Key Points

• The Reserve Bank of India (RBI), in its Monetary Policy Committee (MPC) meeting held in February 2025, projected the Real Gross Domestic Product (GDP) growth for the financial year 2025-26 at 6.5%.

• The quarterly growth projections for FY 2025-26 are distributed as follows: Q1 at 6.7%, Q2 at 6.5%, Q3 at 6.4%, and Q4 at 6.5%. Hence, the statement regarding the 6.5% projection is correct.

• The MPC, led by Governor Shaktikanta Das, noted that the growth trajectory is supported by a sustained momentum in investment activity and a recovery in rural consumption.

• The projection assumes a normal south-west monsoon and the continued strengthening of the manufacturing and services sectors within the Indian economy.

• Global factors, including volatile commodity prices and geopolitical tensions, were considered as potential risks to this growth outlook, though domestic demand remains a primary driver.

Additional Information

• Real GDP vs. Nominal GDP:

• Real GDP is an inflation-adjusted measure that reflects the value of all goods and services produced by an economy in a given year, expressed in base-year prices (currently 2011-12 in India).

• Nominal GDP is the market value of goods and services produced in an economy, unadjusted for inflation, calculated at current market prices.

• Monetary Policy Committee (MPC):

• The MPC is a six-member committee of the Reserve Bank of India, established under the RBI Act, 1934.

• Its primary mandate is to fix the benchmark policy interest rate (Repo Rate) to contain inflation within the target level of 4%, with a tolerance band of +/- 2%.

• Economic Indicators:

• The Index of Industrial Production (IIP) and Purchasing Managers' Index (PMI) for both manufacturing and services are key indicators used by the RBI to assess growth momentum.

• Gross Value Added (GVA) is another critical metric that provides the value of goods and services produced in an economy after deducting the cost of inputs and raw materials.

Important Points

• Fiscal Year Cycle: In India, the Fiscal Year (FY) begins on April 1st and concludes on March 31st of the following year. FY 2025-26 refers to the period from April 2025 to March 2026.

• Investment and Capex: The government's focus on Capital Expenditure (Capex) in infrastructure development is expected to crowd in private investment, aiding the 6.5% growth target.

• External Sector: India's Foreign Exchange Reserves and stable Current Account Deficit (CAD) provide a buffer against external shocks, supporting the stability of the Indian Rupee (INR) and domestic growth.

• Inflation Context: The growth projection is closely linked to the Consumer Price Index (CPI) inflation, which the RBI aims to align with its 4% target on a durable basis to ensure sustainable economic expansion.

Q99. Answer: (a) Grand Palais, Paris

The correct answer is Grand Palais, Paris.

Key Points

• The AI Action Summit was held on February 10-11, 2025, in Paris, France, at the iconic Grand Palais.

• The summit was co-chaired by France and India, marking a significant milestone in international cooperation for Artificial Intelligence governance and innovation.

• This event followed the trajectory of previous global gatherings, specifically the AI Safety Summit held at Bletchley Park, UK in 2023, and the AI Seoul Summit in South Korea in 2024.

• The primary objective of the 2025 summit was to move beyond theoretical safety concerns toward concrete "Action," focusing on the inclusive and sustainable deployment of AI technologies worldwide.

• India’s role as a co-chair underscores its growing influence in the digital economy and its leadership within the Global Partnership on Artificial Intelligence (GPAI).

Additional Information

• The Venue - Grand Palais:

• The Grand Palais is a historic site located on the Champs-Élysées in Paris, originally built for the Exposition Universelle of 1900.

• Known for its massive glass roof and iron structure, it recently underwent extensive renovations and served as a major venue for the Paris 2024 Olympic and Paralympic Games.

• Hosting the AI Action Summit at this venue symbolized the union of historic European heritage with the cutting-edge future of technology.

• Evolution of AI Summits:

• Bletchley Park (2023): The inaugural summit where the Bletchley Declaration was signed by 28 countries, focusing on "frontier AI" risks.

• Seoul Summit (2024): This summit expanded the focus to include AI safety, innovation, and inclusivity, resulting in the Seoul Declaration.

• Paris Summit (2025): Emphasized Global Governance and the practical application of AI to solve real-world problems like climate change and healthcare.

• The Five Pillars of the Paris Summit:

• The discussions were structured around five themes: AI for Public Interest, Future of Work, Innovation and Culture, Safety and Trust, and Global AI Governance.

• A major focus was placed on ensuring that Artificial Intelligence benefits the Global South, preventing a widening digital divide.

Important Points

• India-France Strategic Partnership:

• The co-chairing of the summit is a result of the Horizon 2047 roadmap signed between Prime Minister Narendra Modi and President Emmanuel Macron.

• The two nations have collaborated deeply on Supercomputing, Quantum Computing, and Digital Sovereignty.

• Global Governance:

• Participants at the Grand Palais discussed the alignment of the European Union's AI Act with other international frameworks to create a unified standard for ethical AI.

• The summit advocated for the establishment of an international scientific network for AI safety, similar to the IPCC for climate change.

Q100. Answer: (a) 12.3%

The correct answer is 12.3%.

Key Points

• According to the Periodic Labour Force Survey (PLFS) data, the Unemployment Rate (UR) for youth in the age group of 15–29 years in urban areas was recorded at 12.3% for the period of April 2025.

• The survey is conducted and released by the National Statistical Office (NSO), which functions under the Ministry of Statistics and Programme Implementation (MoSPI) of the Government of India.

• The quarterly bulletins of the PLFS primarily focus on urban areas and utilize the Current Weekly Status (CWS) to estimate labor market indicators. Hence, the data point of 12.3% is specific to the youth urban segment during this timeframe.

• A person is classified as unemployed under the CWS if they did not work for even one hour during the reference period of seven days preceding the survey but were available for and seeking work.

• Monitoring the youth unemployment rate (ages 15 to 29) is crucial for the government to evaluate the effectiveness of employment generation programs and the absorption of the demographic dividend into the formal and informal sectors.

Additional Information

• Periodic Labour Force Survey (PLFS):

• The PLFS was launched by the NSO in April 2017 to provide more frequent labor force data.

• Before its inception, the National Sample Survey Organisation (NSSO) used to conduct Employment and Unemployment Surveys every five years.

• Unemployment Rate (UR):

• It is defined as the percentage of persons unemployed among the total persons in the Labour Force.

• Formula: UR = (Unemployed Persons / Labour Force) × 100.

• Labour Force Participation Rate (LFPR):

• The LFPR represents the percentage of the population that is either working (employed) or actively seeking work (unemployed).

• In recent years, India has seen a steady increase in LFPR, particularly among females in rural areas.

• Worker Population Ratio (WPR):

• The WPR is the percentage of employed persons in the total population. It serves as an indicator of the employment level in the economy.

Important Points

• Current Weekly Status (CWS): This approach determines the activity status based on a reference period of the last 7 days. It is considered a more dynamic measure of unemployment compared to the Usual Status (which looks at the last 365 days).

• Classification of Employment: The PLFS categorizes workers into self-employed (including own-account workers and unpaid helpers), regular wage/salaried employees, and casual labor.

• Policy Impact: The 12.3% figure for youth unemployment highlights the necessity for targeted interventions like the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) and the Atmanirbhar Bharat Rojgar Yojana to boost job creation in the urban service and manufacturing sectors.

• Quarterly vs Annual: While the Quarterly Bulletins cover only urban areas using CWS, the Annual Reports of PLFS cover both rural and urban sectors using both Usual Status and CWS methodologies.

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