RRB Group D Official Paper (Held On: 27 Nov, 2025 Shift 1) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. A coil has a resistance of 44 Ω. If it is connected across a 220 V supply, what is the power consumed by the coil?

(a) 0.2 W
(b) 5 W
(c) 1100 W
(d) 110 W

Q2. The functional group which does NOT contain oxygen hetero atom is:

(a) alcohol
(b) halo alkane
(c) ketone
(d) carboxylic acid

Q3. Which of the following options best describes the term Culture Fishery?

(a) Catching fishes from marine water
(b) Capturing fishes from artificial resources
(c) Capturing fishes from natural resources
(d) Farming of the fishes

Q4. During reproduction, why is it important to create DNA copies?

(a) For inheritance of traits
(b) For digestion
(c) For respiration
(d) For blood circulation

Q5. Which of the following is NOT used for expressing the concentration of a solution?

(a) Volume by Volume percentage of a solution
(b) Mass by volume percentage of a solution
(c) Volume by Mass percentage of a solution
(d) Mass by mass percentage of a solution

Q6. When water and nutrients are available, algae grow and multiply rapidly by the process of _____.

(a) spore formation
(b) budding
(c) fragmentation
(d) pollination

Q7. Which of the following plant tissue performs photosynthesis?

(a) Sclerenchyma
(b) Chlorenchyma
(c) Phloem

(d) Xylem

Q8. Which of the following statements is correct?

(a) Work done can only be positive.
(b) Work done can be positive or negative depending on the direction of force.
(c) Work done does not depend on force or displacement.
(d) Work done can only be negative.

Q9. When a thick glass slab is placed over printed matter, the letters appear raised. This is due to _____.

(a) Refraction of light
(b) Polarization of light
(c) Scattering of light
(d) Total internal reflection

Q10. Which of the following statements best explains the Law of Constant Proportions?

(a) A chemical compound always contains the same elements in the same proportion by mass.
(b) Elements are always found in random ratios in a compound.
(c) Mass can neither be created nor destroyed in a chemical reaction.
(d) Atoms can be divided into smaller particles during a reaction.

Q11. What is the main role of micelles in the cleansing action of soap?

(a) To reduce the hardness of water
(b) To increase the surface tension of water
(c) To trap and remove oil and dirt from clothes
(d) To produce lather with water

Q12. Through which method of cell division are the diploid chromosomes divided into haploid gametes?

(a) Amitosis
(b) Meiosis
(c) Mitosis
(d) Binary Fission

Q13. The frequency of a sound wave is 50 Hz. How much time will it take to complete one wave?

(a) 0.2 s
(b) 50 s
(c) 0.02 s
(d) 5 s

Q14. Which of the following metals is extracted in the middle of the activity series?

(a) Sodium
(b) Gold
(c) Potassium
(d) Iron

Q15. Statement 1: The potential difference is measured in volts.
Statement 2: One volt is equal to one newton per coulomb.
Which of the following is true?

(a) Both Statements 1 and 2 are incorrect.
(b) Both Statements 1 and 2 are correct.
(c) Only Statement 2 is correct.
(d) Only Statement 1 is correct.

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Q16. The power of a lens is defined as:

(a) The ratio of image distance to object distance
(b) The reciprocal of its focal length in meters
(c) The product of its focal length and refractive index
(d) The square of its focal length

Q17. Which of the following life processes is important to bring variation in species?

(a) Heterotrophic nutrition
(b) Sexual reproduction
(c) Autotrophic nutrition
(d) Transportation

Q18. Which of the following describes an example of uniform circular motion?

(a) A fan blade rotating at constant speed
(b) A ball thrown vertically upwards
(c) A car accelerating on its way
(d) A train moving on its track

Q19. A body is dropped from a height. If it falls for 3.0 s and g = 10 m/s², its final velocity (v) is _____.

(a) 20 m/s
(b) 30 m/s
(c) 10 m/s
(d) 40 m/s

Q20. The motion of a satellite orbiting the Earth in a circular path at constant speed is a classic example of uniform circular motion. What property of this motion prevents its acceleration from being zero?

(a) The direction of motion changes continuously at every point, meaning the velocity is changing.
(b) The total mechanical energy is conserved, necessitating acceleration.
(c) The speed is too high for the gravitational force to sustain a constant velocity.
(d) The object`s mass continually changes due to orbital dynamics.

Q21. The fractional atomic mass of chlorine is due to which of the following?

(a) Presence of isotopes
(b) Presence of ions
(c) Experimental error
(d) Its compound nature

Q22. Asthma primarily affects which part of the respiratory system?

(a) Trachea
(b) Alveoli
(c) Bronchi and bronchioles
(d) Diaphragm

Q23. Which poultry are birds farmed to produce eggs?

(a) Broilers
(b) Common carp
(c) Layers
(d) Milch

Q24. What happens when a zinc rod is placed in aqueous copper sulphate solution?

(a) The blue colour of the copper sulphate solution fades.
(b) Heat is required to start the reaction.
(c) The temperature of the solution falls.
(d) No chemical change observed.

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Q25. What happens when a naphthalene ball is burnt in a metal plate in open space?

(a) It burns with yellow flame with no deposit on the metal plate.
(b) It burns with a yellow flame with black soot deposited on the metal plate.
(c) It burns with a blue flame.
(d) It burns with a blue flame with black soot deposited on the metal plate.

MATHEMATICS

Q26. Two numbers have an HCF of 18 and an LCM of 1512. If one of the numbers is 126, find the positive difference between these number.

(a) 90
(b) 256
(c) 216
(d) 126

Q27. Soniya got married 15 years ago. Her present age is 8/5 times her age at the time of her marriage. Her sister was 8 years younger to her at the time of her marriage. Find the present age of her sister.

(a) 28 years
(b) 40 years
(c) 32 years
(d) 24 years

Q28. A fruit vendor bought 150 mangoes. He sold them at such a price that the selling price of 120 mangoes equals the cost price of 150 mangoes. Find his profit percentage.

(a) 25%
(b) 35%
(c) 30%
(d) 20%

Q29. A 325 m long train overtakes a man moving at a speed of 5 km/hr (in the same direction) in 45 seconds. How much time (in seconds) will it take this train to completely cross another 440 m long train, moving in the opposite direction at a speed of 20 km/hr?

(a) 51
(b) 40
(c) 54
(d) 52

Q30. The vertices of a convex pentagon (in order) are P(0,0), Q(6,0), R(8,3), S(4,7), T(0,4). Find the area of the pentagon.

(a) 36 sq. units
(b) 39 sq. units
(c) 42 sq. units
(d) 45 sq. units

Q31. 1/20 is what percentage of 10/40 ?

(a) 20%
(b) 30%
(c) 40%
(d) 35%

Q32. If Δ × 2.2 + 0.33 × 3over4 - 1over20 × 0.55 = 0.99, then the value of Δ is:

(a) 0.35
(b) 0.25
(c) 0
(d) 1

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Q33. The amount on a sum of Rs. 6,800 at 15% per annum compound interest, compounded annually, in 2 years' time, will be:

(a) Rs. 7,996
(b) Rs. 8,993
(c) Rs. 9,393
(d) Rs. 8,641

Q34. In statistics out of 100, the marks of 21 students in final exams are as 90, 95, 95, 94, 90, 85, 84, 83, 85, 81, 92, 93, 82, 78, 79, 81, 80, 82, 85, 76, 85, then the mode of data is:

(a) 85
(b) 83
(c) 87
(d) 84

Q35. The total surface area of a solid right circular cylinder is 542 cm^2. Its curved surface area is two-fifth of its total surface area. Find the curved surface area of the cylinder.

(a) 315.4 cm2
(b) 216.8 cm2
(c) 513.2 cm2
(d) 212.5 cm2

Q36. Three pipes, A, B and C, can fill a tank from empty to full in 40 minutes, 20 minutes and 30 minutes, respectively. When the tank is empty, all the three pipes are opened. A, B and C discharge chemical solutions P, Q and R, respectively. What is the proportion of solution Q in the liquid in the tank after 9 minutes?

(a) 3/13
(b) 3/4
(c) 6/13
(d) 7/13

Q37. Which of the following ratios is equivalent to 3 : 2?

(a) 52 : 34
(b) 53 : 38
(c) 54 : 36
(d) 51 : 37

Q38. Smriti goes to a shopping mall at a speed of 21 km/hr and returns at a speed of 69 km/hr. Find her average speed (in km/hr) for the entire trip.

(a) 30.3
(b) 40.2
(c) 23.4
(d) 32.2

Q39. If $\tan\theta = 12/5$, what is the value of $\sec\theta$?

(a) 13/5
(b) 5/13
(c) 12/5
(d) 13/12

Q40. The cost of a washing machine is 40% less than the cost of a TV. If the cost of the washing machine increases by 52% and that of the TV decreases by 76%, then what is the percentage change in the total cost of 5 washing machines and 2 TVs?

(a) Decrease by 2%
(b) Decrease by 3%
(c) Increase by 0.8%
(d) Increase by 5%

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Q41. An article was bought for Rs. 8,900. Its price was marked up by 40%. Thereafter, it was sold at a discount of 5% on the marked price. What was the profit percentage on the transaction?

(a) 35%
(b) 32%
(c) 33%
(d) 34%

Q42. The average age of 26 students of a class is 26 years. If the age of the teacher is also included, the average age of the whole group becomes 27 years. The age (in years) of the teacher is:

(a) 53
(b) 57
(c) 50
(d) 54

Q43. If p = 6, q = −3, then the value of $p^3 – 3p^2 + 3p + 3q + 3q^2 + q^3$ is:

(a) -117
(b) 61
(c) -61
(d) 117

Q44. P is any point inside the rectangle ABCD. If PA = 98 cm, PB = 91 cm and PC = 21 cm, then the length of PD (in cm) is equal to:

(a) 38
(b) 42
(c) 41
(d) 46

Q45. Two-fifth of a container is filled with blue liquid, one-third of the remaining container is filled with black liquid, five-sixth of the still remaining container is filled with yellow liquid and the remaining 4.2 litres is of white colour. Find the total capacity of the container.

(a) 63 litres
(b) 78 litres
(c) 60 litres
(d) 72 litres

Q46. A scheme like ‘Buy 6, Get 4 Free’ on the same kind of articles with the same MRP attracts a _____ % discount.

(a) 40
(b) 41
(c) 66.67
(d) 67.67

Q47. Simplify $([31/4 \div \{11/4 - 0.5(21/2 - 1/12)\}])/(5 \times 1/15)$.

(a) 334
(b) 434
(c) 234
(d) 134

Q48. A and B working together can do a piece of work in 6 days. B alone can do the same work in 12 days. How long (in days) will A alone take to do double the work?

(a) 12
(b) 24
(c) 27
(d) 25

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Q49. If 20% of a number is added to 90, then the result is the same number. 80% of the same number is:

(a) 90
(b) 120
(c) 100
(d) 110

Q50. A metal rod is divided into three parts, A, B and C. The lengths of A and B are in the ratio 9 : 20, and the lengths of C and B are in the ratio 5 : 11. If the difference between the lengths of A and C is 10 cm, find the total length (in cm) of the metal rod.

(a) 4190
(b) 4202
(c) 4180
(d) 4199

GENERAL INTELLIGENCE & REASONING

Q51. 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) NMK
(b) IHF
(c) UTR
(d) ZZW

Q52. 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) LPJ
(b) GKE
(c) NRL
(d) OSN

Q53. O, P, Q, R, W, X and Y are sitting in a straight line, facing north.

Only two people sit to the left of P. Only three people sit between P and W. Only one person sits between W and X. R sits to the immediate left of O. Y is not an immediate neighbour of W.

How many people sit to the right of Q?

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

Q54. In a certain code language, ‘house sip head’ is coded as ‘bm ma px’ and ‘head wood robot’ is coded as ‘pz bm ey’. How is ‘head’ coded in the given language?

(a) pz
(b) px
(c) bm
(d) ma

Q55. If + means −, − means ×, × means ÷ and ÷ means +, then what will come in place of the question mark (?) in the following equation?

84 − 6 ÷ 371 + 648 × 8 = ?

(a) 795
(b) 794
(c) 797

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(d) 799

Q56. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

HBE22 ICF29 JDG36 KEH43 ?

(a) LFJ51
(b) LFI51
(c) LFJ50
(d) LFI50

Q57. Seven people B, C, D, I, J, K and L are sitting in a straight line facing north. Only two people sit to the right of C. Only two people sit between C and B. Only two people sit between D and K. Only three people sits between C and D. J sits to the immediate right of I. How many people sit(s) to the right of L?7076

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

Q58. Read the given statement(s) and conclusions carefully. Assuming that the information given in the statement(s) is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statement(s).

Statements:

Some pizzas are cupcakes.

All buns are cupcakes.

Conclusions:

(I) Some pizzas are buns.

(II) All cupcakes are buns.

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

Q59. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one which follows the same logic.

URIC - CRUI - RIUC

KIDS - SIKD - IDKS

(a) FADE - EAFD - ADFE
(b) OPEN - OEPN - NEPO
(c) NAVY - YANV - VANY
(d) MALE - AMLE - EALM

Q60. What should come in place of the question mark (?) in the given series?

616 610 612 606 608 ?

(a) 604
(b) 601
(c) 603
(d) 602

Q61. If ‘A’ stands for ‘÷’, ‘B’ stands for ‘x’, ‘C’ stands for ‘+’ and ‘D’ stands for ‘-‘, what will be come in place of question mark ‘?’ in the following equation?

15 A 3 B 10 C 8 D 12 = ?

(a) 46
(b) 47
(c) 44

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(d) 45

Q62. RR 4 is related to UQ −14 in a certain way. In the same way, II 8 is related to LH −10. To which of the given options is MO 12 related, following the same logic?

(a) HY −5
(b) GT −2
(c) NH 9
(d) PN −6

Q63. If + means −, − means ×, × means ÷ and ÷ means +, then what will come in place of the question mark (?) in the following equation?

173 − 3 ÷ 282 + 164 × 4 = ?

(a) 760
(b) 766
(c) 769
(d) 761

Q64. 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 its constituent digits. E.g. 13 – Operations on 13 such as adding / subtracting /multiplying etc. to 13 can be performed. Breaking down 13 into 1 and 3 and then performing mathematical operations on 1 and 3 is not allowed.)

(14, 42, 3)

(12, 60, 5)552

(a) (13, 39, 3)
(b) (11, 55, 6)
(c) (15, 45, 4)
(d) (16, 42, 2)

Q65. Alex starts from Point A and drives 8 km towards the east. He then takes a left turn, drives 6 km, turns left and drives 17 km. He then takes a left turn and drives 13 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 degrees turns only, unless specified.)

(a) 7 km to the south
(b) 8 km to the north
(c) 7 km to the north
(d) 8 km to the south

Q66. What should come in place of the question mark (?) in the given series?

991 989 985 979 971 ?

(a) 963
(b) 969
(c) 967
(d) 961

Q67. Madhur ranked 58^(th) from the top and 6^(th) from the bottom in his class. How many students are there in his class?

(a) 64
(b) 63
(c) 62
(d) 61

Q68. 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) 8 $ 3 Ω 9 % 4 6 7 1 * £ 5 # 2 + @ & (Right)

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

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followed by another symbol?

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

Q69. Read the given statement(s) and conclusions carefully. Assuming that the information given in the statement(s) is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statement(s).

Statements:

Some hats are caps.

No cap is a vest.

Conclusions:

(I) Some hats are vests.

(II) Some caps are hats.

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

Q70. What should come in place of the question mark (?) in the given series?

61 85 109 133 157 ?

(a) 179
(b) 183
(c) 185
(d) 181

Q71. Ajay starts from Point A and drives 16 km towards the west. He then takes a right turn, drives 8 km, then turns left and drives 7 km. He then takes a left turn and drives 8 km. He takes a final right turn, drives 2 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-degrees turns only, unless specified.)

(a) 7 km towards north
(b) 16 km towards east
(c) 11 km towards west
(d) 25 km towards east

Q72. Refer to the following number series and answer the question that follows. All numbers are single-digit numbers only. Counting to be done from left to right only.

(Left) 4 6 5 8 2 2 1 8 2 9 8 4 7 4 8 2 4 3 1 4 1 2 7 2 6 (Right)

How many such numbers are there, each of which is immediately preceded by a perfect square and also immediately followed by a perfect square?

(Note: 1 is also a perfect square.)

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

Q73. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only). Counting to be done from left to right only.

(Left) 6 5 8 8 5 4 7 7 4 2 7 9 2 2 5 7 4 8 8 2 1 8 9 (Right)

How many such odd digits are there, each of which is immediately preceded by an odd digit and also immediately followed by an odd digit?

(a) Three
(b) None

(c) One
(d) Two

Q74. In a certain code language,
A + B means 'A is the sister of B',
A @ B means 'A is the brother of B',
A - B means 'A is the wife of B',
and A # B means 'A is the father of B'.
How is O related to V if 'O + P # T @ G - V'?
(a) Wife's mother
(b) Wife's father's sister
(c) Wife's sister
(d) Wife's father's mother

Q75. Radhika ranked 21^(st) from the top and 7^(th) from the bottom in her class. How many students are there in the class?
(a) 20
(b) 19
(c) 27
(d) 28

Q76. What should come in place of the question mark (?) in the given series, based on the English alphabetical order?
RJV QIU PHT OGS ?
(a) PFR
(b) NFR
(c) NHT
(d) PHT

Q77. UI 12 is related to YK -2 in a certain way. In the same way, OL 9 is related to SN -5. To which of the following is PQ 15 related, following the same logic?
(a) SS 1
(b) TT 3
(c) ST 3
(d) TS 1

Q78. Seven people, A, B, C, D, E, F and G, are sitting in a row, facing north. Only five people sit to the right of A. Only five people sit to the left of B. F is the immediate neighbour of G and E. C sits second to the left of E.
How many people sit to the left of G?
(a) One
(b) Two
(c) Four
(d) Three

Q79. In a certain code language, 'OVAL' is coded as '5294' and 'LOVE' is coded as '8549'. What is the code for 'E' in the given code language?1632
(a) 4
(b) 5
(c) 8
(d) 9

Q80. Refer to the following number series and answer the question that follows. (All numbers are single-digit numbers only.) (Counting to be done from left to right only.)
(Left) 2 8 2 3 2 7 9 3 5 4 6 8 9 4 4 7 8 7 5 4 3 5 5 6 2 9 8 (Right)
How many such odd numbers are there, each of which is immediately preceded by an odd number and also

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immediately followed by an odd number?

(a) 3
(b) 4
(c) 6
(d) 5

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Which of the following awards recognises children's book writers from 22 languages?

(a) Padma Shri
(b) Sahitya Ratna
(c) Sahitya Akademi Yuva Puraskar
(d) Bal Sahitya Puraskar

Q82. Which of the following shifted its Andhra Pradesh regional office to Vijayawada, inaugurating the new premises on 16 June 2025?

(a) Securities and Exchange Board of India
(b) Reserve Bank of India
(c) Bank of Baroda
(d) Life Insurance Corporation of India

Q83. Which of the following new digital facilities was launched in May 2025 by the Union Ministry of Social Justice and Empowerment during the 'Ageing with Dignity' event?

(a) Employment Exchange Portal for Senior Citizens
(b) Senior Citizens Welfare Portal
(c) Digital Life Certificate Platform
(d) One-Stop Senior Citizens Services Portal

Q84. India won the ICC Women's U19 T20 World Cup 2025 by defeating which country in the final?

(a) Sri Lanka
(b) South Africa
(c) England
(d) Australia

Q85. India set a new Guinness World Record in 2025 for the largest human formation of which of the following symbols?

(a) Heart shape
(b) Ashoka Chakra
(c) Olympic rings
(d) Peace symbol

Q86. Which sport had the most Arjuna Award recipients in January 2025?

(a) Hockey
(b) Para-Athletics
(c) Athletics
(d) Shooting

Q87. As announced by the Government of India, as on 7 July 2025, how many biotech startups does India have, compared to just 50 a decade ago?

(a) 8050
(b) Nearly 11,000
(c) Nearly 9000
(d) 7000

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Q88. What was the theme of the 78^(th) World Health Assembly, 2025, held in Geneva in May 2025?

(a) Advancing Equity in Global Health
(b) One World for Health
(c) Health for All: Building Resilient Systems
(d) Universal Health Coverage: A Global Need

Q89. Which state became the third Indian state to be recognised as fully functionally literate, under the ULLAS – New India Literacy Programme, in June 2025?

(a) Telangana
(b) Tripura
(c) Assam
(d) Karnataka

Q90. Where did the chemical factory blast occur on 30 June 2025?

(a) Vijayawada
(b) Warangal
(c) Sangareddy
(d) Nizamabad

Q91. The National Conference on Good Governance, organised by the Department of Administrative Reforms and Public Grievances (DARPG) was held in which of the following places in January 2025?

(a) Jaipur
(b) Varanasi
(c) Bhopal
(d) Gandhinagar

Q92. In 2025, which city in Maharashtra has achieved 100% segregation, collection and processing of sanitary and biomedical waste, handling an average of 300 to 350 kg of sanitary waste daily?

(a) Nasik
(b) Nagpur
(c) Pune
(d) Karad

Q93. Which of the following documentaries did the Reserve Bank of India (RBI) launch to explain its functions to the public in June 2025?

(a) RBI: Money Simplified
(b) Financial Literacy A2Z
(c) RBI Unlocked: Beyond the Rupee
(d) My RBI Story

Q94. On 24 May 2025, the order of which High Court was overturned by the Supreme Court and ruled that denying maternity leave for a third child violates a woman's constitutional right, reinforcing her dignity and reproductive freedom?

(a) Hyderabad High Court
(b) Bombay High Court
(c) Allahabad High Court
(d) Madras High Court

Q95. Which startup was selected in April 2025 to build India’s first sovereign Indic LLM under the IndiaAI Mission?

(a) Wadhwani AI
(b) Sarvam AI
(c) People+AI
(d) AI4 Bharat

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Q96. Who authored the book 'Test Cricket: A History', released in 2025?

(a) Michael Atherton
(b) Gideon Haigh
(c) Tim Wigmore
(d) Ramachandra Guha

Q97. On 16 May 2025, the Supreme Court invalidated the Indian Government's orders passed in which years, allowing ex-post facto environmental clearances?

(a) 2006 and 2011
(b) 2012 and 2014
(c) 2017 and 2021
(d) 2009 and 2015

Q98. As reported in May 2025, the study by Climate Trends, a Delhi-based research consultancy, examined NASA satellite data of the Himalayan glaciers from 2000-2023 to evaluate the impact of which of the following on Himalayan snow?

(a) Sulfate Aerosols
(b) Black Carbon
(c) Ozone
(d) Mineral Dust Particles

Q99. Which Indian Ministry launched the Bharat Forecasting System (BFS) on 26 May 2025 to provide weather predictions with a 6-km resolution?

(a) Ministry of Agriculture and Farmers Welfare
(b) Ministry of Defence
(c) Ministry of Environment, Forest and Climate Change
(d) Ministry of Earth Sciences

Q100. Which chess player, besides Gukesh, received the Arjuna Award in 2025?

(a) Koneru Humpy
(b) Harika Dronavalli
(c) Vantika Agrawal
(d) Pentala Harikrishna

ANSWER KEY

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

SOLUTIONS

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Q1. Answer: (c) 1100 W

The correct answer is Option 3.

Key Points

• Power formula: The power consumed by a resistor is calculated using the formula $P = V^2 / R$, where P is the power, V is the voltage, and R is the resistance.

• Given values: In the question, the resistance of the coil is 44 Ω, and the voltage applied across it is 220 V.

• Substitute the values: Substituting these values into the formula:

$P = (220)^2 / 44$

• Calculation:

$(220)^2 = 48400$

$P = 48400 / 44 = 1100$ W.

• Result: The power consumed by the coil is 1100 W, which corresponds to Option 3.

• This calculation aligns with the question, confirming that the correct answer is 1100 W.

Additional Information

• Ohm's Law:

• Ohm's Law states that V = IR, where V is voltage, I is current, and R is resistance.

• This law is fundamental in analyzing electrical circuits and understanding the relationship between voltage, current, and resistance.

• Power in Electrical Circuits:

• Power in an electrical circuit is the rate at which energy is consumed or converted.

• The formula $P = V^2 / R$ is derived by combining Ohm's Law and the general power formula P = VI.

• It highlights the quadratic relationship between voltage and power for a fixed resistance.

• Units of Measurement:

• Voltage: Measured in Volts (V).

• Resistance: Measured in Ohms (Ω).

• Power: Measured in Watts (W).

• Applications of Power Formula:

• This formula is critical in designing electrical appliances, ensuring optimal performance without overheating.

• It is also used in estimating energy consumption for billing purposes in residential, commercial, and industrial sectors.

• Resistive Load:

• The coil in the question behaves as a resistive load, where the power calculation does not involve reactive components like inductance or capacitance.

• This simplifies the calculation to a purely resistive scenario.

Q2. Answer: (b) halo alkane

The correct answer is halo alkane.

Key Points

• A functional group is a specific group of atoms within a molecule that is responsible for characteristic chemical reactions of that molecule.

• The options in the question refer to different types of functional groups: alcohols, halo alkanes, ketones, and carboxylic acids.

• Halo alkane (also known as alkyl halide) does not contain oxygen in its structure. It consists of a carbon atom bonded to a halogen atom (fluorine, chlorine, bromine, or iodine).

• All other options (alcohol, ketone, carboxylic acid) contain oxygen as part of their functional groups:

• Alcohol: Contains an -OH group.

• Ketone: Contains a carbonyl group (C=O).

• Carboxylic acid: Contains a carboxyl group (-COOH).

• Therefore, the correct answer is halo alkane, as it is the only functional group that does not contain oxygen.

Additional Information

• Alcohols:

• Alcohols are organic compounds with one or more hydroxyl (-OH) groups attached to a carbon atom.

• General formula: R-OH, where R is an alkyl group.

• They are commonly used in beverages, antiseptics, and as industrial solvents.

• Halo alkanes:

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• Also called alkyl halides, they are compounds in which one or more hydrogen atoms in an alkane are replaced by halogen atoms (F, Cl, Br, or I).
• General formula: R-X, where R is an alkyl group and X is a halogen.
• They are used in refrigerants, solvents, and as intermediates in chemical synthesis.
• Ketones:
• Ketones contain a carbonyl group (C=O) bonded to two carbon atoms.
• General formula: R-CO-R', where R and R' are alkyl or aryl groups.
• Common example: Acetone (propanone), which is widely used as a solvent and in nail polish remover.
• Carboxylic Acids:
• These are organic acids containing a carboxyl group (-COOH).
• General formula: R-COOH, where R is an alkyl or aryl group.
• They are found in substances like vinegar (acetic acid) and are used in food, pharmaceuticals, and industrial processes.

Important Points

• Halo alkanes' Characteristics:
• Halo alkanes are classified based on the type of halogen atom and the degree of substitution (primary, secondary, or tertiary).
• They undergo reactions like nucleophilic substitution and elimination, making them versatile in organic synthesis.
• Functional Groups in Chemistry:
• Functional groups determine the chemical properties and reactivity of organic compounds.
• They serve as the basis for naming and classifying organic compounds in IUPAC nomenclature.

Q3. Answer: (d) Farming of the fishes

The correct answer is Farming of the fishes.

Key Points

• Culture Fishery refers to the controlled farming of fish, where the growth and production of fish are enhanced by human intervention in a controlled environment such as ponds, tanks, or other artificial water bodies.
• The primary purpose of culture fishery is to increase fish production to meet the demand for seafood and to provide a source of livelihood to individuals engaged in aquaculture.
• This type of fishery involves techniques such as breeding, rearing, and harvesting of fish in artificial or semi-natural water bodies.
• Culture fishery is a part of aquaculture, which also includes farming of other aquatic organisms like crustaceans, mollusks, and aquatic plants.
• It plays a critical role in sustainable fish production, ensuring a consistent supply of fish while reducing pressure on natural water bodies and marine ecosystems.
• Examples of fish species commonly used in culture fishery include Rohu, Catla, Mrigal, Tilapia, and Carp.

Additional Information

• Types of Fisheries:
• Capture Fishery: This involves the harvesting of fish from their natural habitats, such as rivers, lakes, and oceans. It does not involve human intervention in the breeding or rearing of fish.
• Culture Fishery: This involves the farming of fish in controlled environments like ponds, tanks, or reservoirs, where humans control the conditions for fish growth and reproduction.
• Marine Fishery: This type of fishery deals with the capture or farming of fish in marine ecosystems, such as oceans and seas.
• Inland Fishery: This involves the capture and farming of fish in freshwater ecosystems like rivers, lakes, and reservoirs.
• Importance of Culture Fishery:
• It contributes significantly to food security by providing a consistent supply of fish protein.
• It supports the economy by creating livelihood opportunities for farmers and workers in the aquaculture sector.
• Culture fishery reduces overfishing in natural water bodies, helping to conserve marine biodiversity.
• It allows for the production of high-value fish species that are in demand in domestic and international markets.
• Features of Culture Fishery:
• It involves the use of scientific techniques to monitor water quality, feed quality, and fish health.
• Fish farming systems can be classified into extensive, semi-intensive, and intensive systems based on the level of human intervention and stocking density.
• It often includes practices like polyculture (culturing multiple species in the same water body) to optimize resource use and enhance productivity.
• India’s Role in Aquaculture:

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• India is one of the leading producers of fish through aquaculture, ranking second globally after China.

• Key states involved in culture fisheries include Andhra Pradesh, Tamil Nadu, West Bengal, Odisha, and Kerala.

• The government promotes aquaculture through initiatives like the Blue Revolution Scheme and the Pradhan Mantri Matsya Sampada Yojana (PMMSY).

Important Points

• Comparison of Capture and Culture Fisheries:

• Capture Fisheries: Depend on wild fish populations and are subject to environmental factors and overfishing.

• Culture Fisheries: Provide controlled conditions for fish farming, ensuring consistent yields and reduced environmental impact.

• Key Challenges in Culture Fishery:

• Maintaining water quality and controlling diseases in fish farms.

• Ensuring the availability of quality fish feed and seeds for farming.

• Addressing environmental concerns, such as water pollution and the ecological impact of intensive aquaculture practices.

Q4. Answer: (a) For inheritance of traits

The correct answer is For inheritance of traits.

Key Points

• DNA replication is essential for inheritance: During reproduction, DNA copying ensures that genetic information is transmitted from parent to offspring, which allows traits such as hair color, eye color, and height to be inherited. Without accurate DNA replication, this transmission of traits would not be possible.

• Ensures genetic stability across generations: DNA carries the genetic blueprint of an organism. Proper copying of DNA ensures the stability of genetic material, preserving the species' characteristics over successive generations.

• Facilitates genetic variation: While copying DNA, occasional errors (mutations) may occur. These mutations are a source of genetic variation, which is critical for evolution and adaptation to changing environments.

• Enables cellular function and growth: DNA carries instructions for protein synthesis, which are vital for cellular activities and growth. Proper DNA copying ensures cells in the offspring function like those of the parent organism.

• Prevents genetic anomalies: Errors in DNA copying can lead to genetic disorders or anomalies. Accurate replication minimizes the chances of such issues, ensuring healthy development and reproduction.

Additional Information

• DNA (Deoxyribonucleic Acid):

• DNA is the molecule that carries the genetic instructions used in growth, development, functioning, and reproduction of all living organisms.

• It is a double-helical structure composed of nucleotides, which include a sugar molecule, a phosphate group, and a nitrogen base (adenine, thymine, guanine, cytosine).

• Inheritance of Traits:

• Traits are inherited through genes, which are specific sequences of DNA. These genes code for proteins that determine an organism’s characteristics.

• Gregor Mendel is considered the father of genetics for his groundbreaking work on inheritance patterns in pea plants.

• Genetic Variation:

• Variation occurs due to mutations, recombination during sexual reproduction, and crossing over in meiosis.

• Genetic variation is crucial for species survival as it enhances adaptability to environmental changes.

• Mutations:

• Mutations are changes in the DNA sequence, which can be beneficial, harmful, or neutral.

• Examples include sickle cell anemia (harmful) and antibiotic resistance in bacteria (beneficial).

• Reproductive Processes:

• In asexual reproduction, DNA is copied and passed on to offspring without the involvement of gametes.

• In sexual reproduction, DNA from two parents combines to form a unique genetic composition in the offspring.

Q5. Answer: (c) Volume by Mass percentage of a solution

The correct answer is Volume by Mass percentage of a solution.

Key Points

• Volume by Volume percentage (v/v%): This is a common way to express the concentration of a solution, particularly for liquids. It is calculated as the volume of the solute divided by the total volume of the solution, multiplied by 100. Example: Alcohol in water solutions.

• Mass by Volume percentage (m/v%): This is a widely used method in laboratories and industries. It represents the mass of the solute in grams per 100 mL of the solution. Example: Saline solution (NaCl in water).

• Volume by Mass percentage (v/m%): This method is not commonly used for expressing the concentration of a solution, as it does not align with standard practices in chemistry. This inconsistency in units makes it impractical and rarely adopted.

• Mass by Mass percentage (m/m%): This is another standard way to express concentration. It is the mass of the solute divided by the total mass of the solution, multiplied by 100. Example: Sugar in water solutions.

• The correct answer is Volume by Mass percentage, as it is not a standard method for expressing the concentration of a solution in scientific or industrial contexts.

Additional Information

• Concentration of a solution: It refers to the amount of solute that is dissolved in a given quantity of solvent. It is usually expressed as a percentage or in molarity, molality, or normality.

• Molarity (M): It is the number of moles of solute per liter of solution. It is one of the most commonly used units of concentration in chemistry. Example: 1 M NaOH solution contains 1 mole of NaOH per liter of solution.

• Molality (m): It is the number of moles of solute per kilogram of solvent. Unlike molarity, it is not affected by temperature changes as it depends on mass rather than volume.

• Normality (N): It is the number of gram-equivalents of solute per liter of solution. It is often used in acid-base reactions and redox reactions.

• Parts per Million (ppm): It is a unit of concentration used for very dilute solutions, representing the number of parts of solute per million parts of solution.

Important Points

• Applications of concentration expressions:

• Volume by Volume percentage: Commonly used in industries like alcoholic beverages and cosmetics.

• Mass by Volume percentage: Frequently utilized in pharmaceutical preparations and clinical solutions like glucose solutions or saline.

• Mass by Mass percentage: Used in food and chemical industries for solid mixtures.

• Importance of standardization: The use of standardized units like molarity, molality, and percentage ensures uniformity in scientific communication and industrial processes.

• Practicality in laboratory settings: Units like molarity and mass by volume percentage are preferred due to ease of measurement and preparation of solutions.

Q6. Answer: (c) fragmentation

The correct answer is fragmentation.

Key Points

• Fragmentation is a common mode of reproduction in algae, particularly in filamentous forms like Spirogyra. When water and nutrients are abundant, the filaments break into smaller fragments, and each fragment grows into a new individual.

• This process occurs in non-motile algae where specialized reproductive structures are absent or limited, allowing for rapid multiplication and population growth.

• Fragmentation ensures survival and reproduction in favorable environments, making it an efficient method for propagating algae in aquatic ecosystems.

• Examples of algae that reproduce by fragmentation include Spirogyra, Ulothrix, and Oscillatoria.

• The availability of water and nutrients provides the ideal conditions for fragmentation to occur, as these resources support cell division and growth in the newly formed fragments.

Additional Information

• Spore Formation:

• Spore formation is another mode of reproduction in algae, but it involves the production of specialized reproductive units called spores, which can germinate into new individuals under favorable conditions.

• It is commonly observed in algae such as Chlamydomonas and Ulva.

• Spores are highly resistant structures that help algae survive adverse environmental conditions.

• Budding:

• Budding is a type of asexual reproduction where a new organism develops as an outgrowth or bud from the parent body.

• It is rarely observed in algae and is more common in organisms like yeast and Hydra.

• In algae, budding is not a primary mode of reproduction.

• Pollination:

• Pollination refers to the transfer of pollen grains from the male anther to the female stigma in flowering plants.

• It does not apply to algae, as they do not produce flowers or pollen grains.

• Algae reproduce through simpler mechanisms such as binary fission, fragmentation, and spore formation.

• Examples of Fragmentation:

• Spirogyra: A filamentous green alga where each fragment of a broken filament can grow into a new individual.

• Oscillatoria: A cyanobacterium that reproduces through fragmentation of filaments.

• Ulothrix: A green alga that also uses fragmentation for propagation.

Important Points

• Algae Classification: Algae are classified into different groups based on their pigmentation, storage products, and cell wall composition, such as green algae (Chlorophyceae), brown algae (Phaeophyceae), and red algae (Rhodophyceae).

• Ecological Role: Algae play a significant role in aquatic ecosystems as primary producers, forming the base of the food chain and contributing to oxygen production through photosynthesis.

• Economic Importance: Certain algae, such as Chlorella and Spirulina, are used as food supplements due to their high protein and nutrient content. Others, like Gelidium and Gracilaria, are sources of agar and carrageenan, used in various industries.

• Reproductive Adaptations: Algae exhibit a wide range of reproductive strategies, including asexual (fragmentation, spore formation) and sexual reproduction, to adapt to diverse environmental conditions.

Q7. Answer: (b) Chlorenchyma

The correct answer is Chlorenchyma.

Key Points

• Chlorenchyma is a type of parenchyma tissue in plants that contains chloroplasts, which are essential for the process of photosynthesis.

• This tissue is primarily found in the mesophyll layer of leaves and in green stems, where it plays a crucial role in capturing sunlight and synthesizing food.

• The chloroplasts in chlorenchyma cells contain chlorophyll, the pigment responsible for absorbing light energy and converting it into chemical energy.

• In addition to photosynthesis, chlorenchyma also contributes to gaseous exchange and stores the products of photosynthesis temporarily.

• Unlike other plant tissues like sclerenchyma, xylem, or phloem, chlorenchyma is a living tissue that remains metabolically active and supports the plant's growth and development.

Additional Information

• Sclerenchyma:

• Sclerenchyma is a type of plant tissue composed of dead cells with thickened, lignified walls.

• It provides mechanical support and rigidity to the plant but does not participate in photosynthesis.

• Examples include fibers and sclereids, which are found in hard parts of the plant, such as seed coats and nutshells.

• Phloem:

• Phloem is a vascular tissue responsible for the transport of food (mainly sucrose) in plants from the leaves to other parts of the plant.

• It consists of sieve elements, companion cells, phloem fibers, and phloem parenchyma.

• Although phloem is vital for the distribution of photosynthetic products, it does not perform photosynthesis itself.

• Xylem:

• Xylem is another vascular tissue that primarily functions in the transport of water and minerals from roots to leaves.

• It is composed of tracheids, vessels, xylem fibers, and xylem parenchyma.

• Similar to phloem, xylem does not carry out photosynthesis.

• Parenchyma:

• Parenchyma is a versatile plant tissue that performs various functions, such as storage, secretion, and photosynthesis (in the case of chlorenchyma).

• It is characterized by thin cell walls and large intercellular spaces, which allow efficient exchange of gases and nutrients.

Important Points

• Photosynthesis:

• Photosynthesis is the process by which green plants convert light energy into chemical energy in the form of glucose.

• This process occurs in the chloroplasts, which contain the pigment chlorophyll.

• The general equation for photosynthesis is:

Carbon dioxide + Water + Sunlight → Glucose + Oxygen

• Chloroplast:

• Chloroplasts are specialized organelles found in plant cells and some algae that are responsible for photosynthesis.

• They have a double membrane structure and contain thylakoids, where the light-dependent reactions occur, and the stroma, where the Calvin cycle takes place.

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• Role of Chlorenchyma in Plants:

• Chlorenchyma not only aids in photosynthesis but also contributes to gas exchange and water regulation in leaves.

• It ensures that the plant has a steady supply of energy for growth, reproduction, and other physiological processes.

Q8. Answer: (b) Work done can be positive or negative depending on the direction of force.

The correct answer is Work done can be positive or negative depending on the direction of force.

Key Points

• Work Done: Work is the measure of energy transfer that occurs when an object is moved over a distance by an external force. The formula for work is $W = F \times d \times \cos(\theta)$, where F is the force, d is the displacement, and θ is the angle between the force and displacement.

• Positive Work: Work is considered positive when the force applied and the displacement of the object are in the same direction. For example, lifting an object upward where the applied force and displacement are both upward.

• Negative Work: Work is negative when the force is applied in the opposite direction to the displacement. For instance, when friction acts against the motion of an object sliding on a surface.

• Dependence on Force and Displacement: Work depends on the magnitude of the force, the displacement of the object, and the angle between them. If either force or displacement is zero, no work is done.

• Direction of Force: The sign of work depends on the angle θ. If θ is less than 90°, work is positive; if θ is greater than 90°, work is negative. If θ = 90°, no work is done as the force is perpendicular to displacement.

Additional Information

• Work Done in Everyday Life:

• When you push a cart forward, positive work is done as the force and displacement are in the same direction.

• While stopping a moving car, the brakes do negative work as the frictional force opposes the motion of the car.

• Work Done in Physics:

• Work is a scalar quantity, meaning it has magnitude but no direction.

• Units of work include the joule (J) in the SI system and the erg in the CGS system.

• Zero Work:

• Work becomes zero when there is no displacement, or the force is perpendicular to the displacement (e.g., carrying a bag horizontally).

• In circular motion, when centripetal force acts perpendicular to the displacement, no work is done.

• Applications of Work:

• In engineering, work is used to calculate energy transfer in machines.

• In biomechanics, it measures the work done by muscles during physical activity.

• Important Formulae and Concepts:

• $W = F \times d \times \cos(\theta)$: Main formula for calculating work.

• Positive Work: When force and displacement are in the same direction ($\theta = 0°$).

• Negative Work: When force and displacement are in opposite directions ($\theta = 180°$).

• Zero Work: When $\theta = 90°$ or $F = 0$ or $d = 0$.

Important Points

• Statement Analysis:

• Statement 1: "Work done can only be positive." This is incorrect, as work can also be negative depending on the direction of force and displacement.

• Statement 2: "Work done can be positive or negative depending on the direction of force." This is correct, as explained above.

• Statement 3: "Work done does not depend on force or displacement." This is incorrect because work depends directly on both force and displacement.

• Statement 4: "Work done can only be negative." This is incorrect, as work can also be positive.

Q9. Answer: (a) Refraction of light

The correct answer is Refraction of light.

Key Points

• Refraction of light occurs when light passes from one medium to another, causing a change in its speed and direction. This phenomenon is responsible for the letters appearing raised when viewed through a thick glass slab.

• The glass slab acts as a medium with a higher refractive index compared to air. When light enters the glass slab, it bends toward the normal, and when it exits, it bends away from the normal.

• Due to the bending of light rays, the apparent position of the letters shifts. This shift creates the illusion that the letters are raised

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above their original position.

• The degree of refraction depends on the refractive indices of the two media (air and glass) and the angle at which light enters the glass slab.

• This optical illusion is a direct result of the physical properties of light and its interaction with different transparent materials like glass.

Additional Information

• Refraction of Light:

• Refraction is governed by Snell's Law, which states that the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant and equal to the refractive index.

• The refractive index of a medium is a measure of how much light bends when entering that medium. For example, the refractive index of glass is typically around 1.5, whereas air has a refractive index close to 1.

• Applications of refraction include lenses, prisms, optical fibers, and magnifying glasses.

• Polarization of Light:

• Polarization refers to the orientation of the oscillations of light waves. It does not affect the apparent position of objects viewed through a transparent medium.

• Polarized light is used in sunglasses, photography, and LCD screens.

• Scattering of Light:

• Scattering occurs when light interacts with particles in a medium, causing it to spread in different directions. It is responsible for phenomena like the blue color of the sky and the reddish hues at sunrise and sunset.

• Scattering does not cause the letters to appear raised under a glass slab.

• Total Internal Reflection:

• Total internal reflection occurs when light traveling within a denser medium hits the boundary with a less dense medium at an angle greater than the critical angle, causing it to reflect entirely within the denser medium.

• This principle is used in optical fibers, but it is not relevant to the phenomenon described in the question.

• Important Points:

• The bending of light due to refraction is crucial for many optical devices, such as microscopes and telescopes.

• Understanding refraction is essential in fields like physics, engineering, and medical imaging.

• Phenomena like mirages and rainbows are also explained through refraction of light.

Q10. Answer: (a) A chemical compound always contains the same elements in the same proportion by mass.

The correct answer is A chemical compound always contains the same elements in the same proportion by mass..

Key Points

• The Law of Constant Proportions, also known as the Law of Definite Proportions, states that a given chemical compound always contains its constituent elements in a fixed ratio by mass, regardless of the source or how it was prepared.

• This law was proposed by Joseph Proust in 1794 and is fundamental to the study of chemistry.

• For example, water (H2O) is always composed of hydrogen and oxygen in a mass ratio of approximately 1:8, irrespective of its origin—whether it comes from a river, ocean, or laboratory.

• It demonstrates that the composition of a compound is always uniform and consistent, which is essential for chemical reactions and stoichiometry.

• The law applies to pure chemical compounds and does not hold for mixtures, where the composition can vary.

Additional Information

• Understanding the Options:

• Option 1: "A chemical compound always contains the same elements in the same proportion by mass." This is the correct explanation of the Law of Constant Proportions.

• Option 2: "Elements are always found in random ratios in a compound." This is false, as elements combine in specific ratios to form compounds, as per the law.

• Option 3: "Mass can neither be created nor destroyed in a chemical reaction." This is the Law of Conservation of Mass, not the Law of Constant Proportions.

• Option 4: "Atoms can be divided into smaller particles during a reaction." This statement is false, as chemical reactions involve the rearrangement of atoms, not their division. The division of atoms occurs only in nuclear reactions.

• Significance of the Law:

• The Law of Constant Proportions is crucial for determining the empirical formula and molecular formula of compounds.

• It provides the foundation for understanding the quantitative relationships in chemical reactions (stoichiometry).

• Exceptions to the Law:

• It does not apply to compounds with non-stoichiometric compositions, such as metal oxides (e.g., FeO).

• Isotopic variations of elements can slightly alter the mass ratios in some cases.

• Related Laws in Chemistry:

• Law of Conservation of Mass: Proposed by Antoine Lavoisier, it states that mass is neither created nor destroyed in chemical reactions.

• Law of Multiple Proportions: Proposed by John Dalton, it states that when two elements form more than one compound, the ratios of the masses of one element that combine with a fixed mass of the other are in small whole numbers.

Important Points

• The Law of Constant Proportions is applicable to pure chemical compounds only and not to mixtures.

• It is a fundamental principle used in determining the purity of chemical substances.

• The law supports atomic theory, which states that compounds are formed by the combination of atoms in fixed ratios.

• This law is used extensively in industries like pharmaceuticals and chemical manufacturing to ensure product consistency.

Q11. Answer: (c) To trap and remove oil and dirt from clothes

The correct answer is To trap and remove oil and dirt from clothes.

Key Points

• Micelles are aggregates of soap molecules formed when soap is dissolved in water. These molecules are made up of two parts: a hydrophilic (water-attracting) head and a hydrophobic (water-repelling) tail.

• The hydrophobic tails of soap molecules attach to grease, oil, or dirt particles, while the hydrophilic heads remain in water. This forms a structure called a micelle, where the dirt or grease is trapped inside.

• When water is rinsed, these micelles, containing dirt and grease, are washed away, effectively cleaning the surface or fabric.

• This process is the primary mechanism by which soaps clean clothes, utensils, and skin. It is particularly effective in breaking down non-polar substances like grease and oil, which are otherwise insoluble in water.

• Soap's ability to form micelles makes it a crucial cleaning agent in both household and industrial applications.

Additional Information

• Formation of Micelles:

• Micelles form when the concentration of soap molecules reaches a critical point called the critical micelle concentration (CMC).

• At this concentration, the soap molecules aggregate in such a way that their hydrophobic tails are shielded from water while their hydrophilic heads remain exposed to water.

• Structure of Soap Molecules:

• Soap molecules are long-chain fatty acid salts, typically sodium or potassium salts of fatty acids.

• The hydrophobic tail is a long hydrocarbon chain, while the hydrophilic head is an ionic group, such as a carboxylate ion (COO^-).

• Role of Soap in Hard Water:

• Hard water contains calcium and magnesium ions, which can react with soap to form insoluble scum.

• Despite this limitation, soaps are still effective cleaners in soft water or when used with certain additives to counteract hardness.

• Applications of Micelle Formation:

• Besides cleaning, micelle formation is used in various industries, including pharmaceuticals, where micelles are used to deliver hydrophobic drugs in aqueous solutions.

• Micelles are also studied in nanotechnology for their potential in targeted drug delivery systems.

Important Points

• Option 1: "To reduce the hardness of water" is incorrect as soap does not reduce water hardness; instead, it reacts with the ions in hard water to form scum.

• Option 2: "To increase the surface tension of water" is incorrect because soap reduces the surface tension of water, allowing it to spread and penetrate surfaces more effectively.

• Option 4: "To produce lather with water" is partially correct but not the primary function of micelles. Lather is a byproduct of soap usage and does not directly contribute to cleaning action.

Q12. Answer: (b) Meiosis

The correct answer is Meiosis.

Key Points

• Meiosis is a type of cell division that reduces the chromosome number by half, producing four haploid gametes from one diploid parent cell.

• It is essential for sexual reproduction as it ensures the maintenance of the chromosome number across generations.

• Meiosis occurs in two stages: Meiosis I and Meiosis II. Meiosis I includes reduction division, where homologous chromosomes are separated, while Meiosis II resembles mitosis.

• During meiosis, processes like crossing over and independent assortment introduce genetic variation, which is crucial for evolution.

• Haploid gametes produced by meiosis (e.g., sperm and egg cells in animals, pollen and ovules in plants) combine during fertilization to form a diploid zygote.

Additional Information

• Amitosis:

• Amitosis is a simple form of cell division that occurs without spindle formation or chromosome condensation.

• It is found in some unicellular organisms and involves direct splitting of the nucleus and cytoplasm.

• Unlike meiosis, it does not produce haploid gametes or ensure genetic variation.

• Mitosis:

• Mitosis is a type of cell division resulting in two genetically identical diploid daughter cells.

• It occurs during growth, repair, and asexual reproduction, but does not produce haploid gametes.

• Mitosis is crucial for maintaining genetic stability within an organism.

• Binary Fission:

• Binary fission is a mode of asexual reproduction found in prokaryotes like bacteria.

• It involves the replication of genetic material followed by division into two identical daughter cells.

• This process does not involve meiosis or the production of haploid gametes.

• Genetic Variation in Meiosis:

• Crossing over occurs during Prophase I, where homologous chromosomes exchange genetic material, creating unique combinations.

• Independent assortment in Metaphase I ensures that chromosomes are distributed randomly to gametes.

• These mechanisms increase diversity within a population, contributing to adaptation and evolution.

Important Points

• Chromosome Number: In humans, meiosis reduces the chromosome number from 46 (diploid) to 23 (haploid).

• Stages of Meiosis: Meiosis I includes Prophase I, Metaphase I, Anaphase I, and Telophase I, while Meiosis II includes similar phases resembling mitosis.

• Applications of Meiosis: It is essential for gametogenesis (sperm and egg production) and contributes to genetic diversity in sexually reproducing organisms.

• Evolutionary Significance: Genetic variation introduced by meiosis plays a vital role in the survival of species in changing environments.

Q13. Answer: (c) 0.02 s

The correct answer is 0.02 seconds.

Key Points

• The frequency of a wave is defined as the number of oscillations or cycles the wave completes in one second. It is measured in Hertz (Hz).

• The time period (T) of a wave is the time taken to complete one oscillation. It is the reciprocal of the frequency (f). This relationship is mathematically expressed as:

T = 1/f

• In the given question, the frequency of the sound wave is 50 Hz. Substituting this into the formula:

T = 1/f = 1/50 = 0.02 seconds.

• Thus, the time period of the wave is 0.02 seconds, indicating that the wave completes one cycle in this duration.

• Hence, the correct answer is 0.02 seconds.

Additional Information

• Frequency (f):

• The frequency of a wave refers to the number of cycles completed per second.

• It is measured in Hertz (Hz). For example, a frequency of 50 Hz means the wave completes 50 cycles in 1 second.

• Frequency is an important parameter in understanding wave behavior, particularly in sound, light, and electromagnetic waves.

• Time Period (T):

• The time period is the time taken by a wave to complete one cycle of oscillation.

• It is measured in seconds (s).

• The formula connecting time period and frequency is T = 1/f.

• Relationship between Frequency and Time Period:

• Frequency and time period are inversely proportional to each other. If the frequency is high, the time period will be low, and vice versa.

• For example, a wave with a frequency of 100 Hz will have a time period of 0.01 seconds, while a wave with a frequency of 10 Hz will have a time period of 0.1 seconds.

• Applications of Frequency and Time Period:

• In sound waves, frequency determines the pitch of the sound. A higher frequency corresponds to a higher pitch.

• In light waves, frequency determines the color of light. For example, blue light has a higher frequency than red light.

• The concept of frequency and time period is also critical in electronics, communication systems, and mechanics.

Important Points

• Wave Characteristics:

• Wavelength (λ): The distance between two consecutive points in phase on a wave, such as crest to crest or trough to trough.

• Amplitude: The maximum displacement of the wave from its mean position, which determines the wave's energy or intensity.

• Speed of a Wave:

• The speed of a wave (v) is given by the formula $v = f \times \lambda$, where f is the frequency and λ is the wavelength.

• Wave speed depends on the medium through which the wave is propagating. For example, sound travels faster in solids than in gases.

• Real-Life Examples:

• In music, the frequency of sound waves determines the notes we hear, while the time period helps understand rhythm and beats.

• In communication systems, different frequencies are used for broadcasting radio, television, and mobile signals.

Q14. Answer: (d) Iron

The correct answer is Iron.

Key Points

• Iron is located in the middle of the activity series of metals. The activity series ranks metals based on their reactivity with water, acids, and other substances.

• Iron is neither highly reactive like sodium and potassium nor unreactive like gold. It shows moderate reactivity, making it a middle-series metal.

• Metals in the middle of the activity series, such as iron, zinc, and lead, are usually extracted from their ores through reduction processes, often using carbon or carbon monoxide as a reducing agent.

• The activity series helps determine the method of extraction for different metals. For example, metals high in the series (e.g., sodium, potassium) are extracted via electrolysis, while middle-series metals (e.g., iron) are extracted using smelting or reduction techniques.

• Iron's moderate reactivity makes it a widely used metal in construction, manufacturing, and various industries. Its ores, such as hematite and magnetite, are abundant and economically viable for extraction.

Additional Information

• Activity Series of Metals:

• The activity series is a list of metals arranged in order of decreasing reactivity. Highly reactive metals like potassium and sodium are at the top, while less reactive metals like gold and platinum are at the bottom.

• The series is crucial for understanding how metals react with substances like water, acids, and oxygen. It also determines the method of extraction of metals from their ores.

• Characteristics of Metals in the Middle of the Activity Series:

• These metals, including iron, zinc, and lead, are moderately reactive. They do not react as vigorously with water or acids as metals at the top of the activity series.

• They are usually extracted from their ores through reduction using carbon, as they are not reactive enough to require electrolysis.

• Iron is extracted from ores such as hematite (Fe_2O_3) and magnetite (Fe_3O_4) in a blast furnace. The process involves reduction with carbon monoxide to produce iron.

• Specific Characteristics of the Options:

• Sodium and Potassium: Highly reactive metals found at the top of the activity series. They are extracted via electrolysis of their molten salts.

• Gold: A noble metal with very low reactivity, found at the bottom of the activity series. It is typically found in its native state in nature and does not require extensive extraction processes.

• Iron: A metal in the middle of the activity series, extracted using reduction methods such as smelting. It is widely used in

construction, tools, and machinery.

• Important Facts About Iron:

• Iron is the fourth most abundant element in the Earth's crust.

• It is primarily extracted from hematite and magnetite ores through the blast furnace process.

• Iron is a key component in the production of steel, which is essential for construction and industrial purposes.

• It is prone to corrosion (rusting) when exposed to moisture and oxygen, but this can be prevented through processes like galvanization or painting.

Q15. Answer: (d) Only Statement 1 is correct.

The correct answer is Only Statement 1 is correct.

Key Points

• Statement 1: The potential difference is measured in volts.

• This statement is correct.

• Potential difference refers to the amount of work done to move a unit charge from one point to another in an electric field.

• The unit of measurement for potential difference is the volt (V), named after the Italian scientist Alessandro Volta.

• One volt is defined as the potential difference between two points in a circuit when one joule of energy is used to move one coulomb of charge between those points.

• Statement 2: One volt is equal to one newton per coulomb.

• This statement is incorrect.

• The correct relationship for one volt is: 1 volt = 1 joule/coulomb (J/C).

• A volt measures energy per unit charge, not force per unit charge (which is measured in newtons per coulomb).

• Newton per coulomb actually refers to the unit of electric field strength, not potential difference.

• Hence, only Statement 1 is correct, and the correct answer is Only Statement 1 is correct.

Additional Information

• Potential Difference:

• It is the difference in electric potential energy between two points in an electric circuit.

• The SI unit for potential difference is the volt (V).

• The formula for potential difference is: V = W/Q, where:

• V = Potential difference

• W = Work done (in joules)

• Q = Charge (in coulombs)

• Electric Field Strength:

• The electric field strength is a measure of the force per unit charge experienced by a charged particle in an electric field.

• The unit of electric field strength is newton per coulomb (N/C).

• It is related to potential difference, as electric field strength = potential difference/distance.

• Volt:

• The volt is a derived unit in the International System of Units (SI).

• 1 volt = 1 joule per coulomb (1 V = 1 J/C).

• It is widely used in electrical circuits to describe the potential difference between two points.

• Applications of Potential Difference:

• Used to measure the voltage of batteries and power supplies.

• Helps in understanding the functioning of electrical devices such as resistors, capacitors, and transistors.

• Plays a crucial role in the transmission of electricity over long distances.

Important Points

• SI Units:

• Work: Measured in joules (J).

• Charge: Measured in coulombs (C).

• Electric Field Strength: Measured in newtons per coulomb (N/C).

• Key Formula:

• Potential Difference (V): V = W/Q (work done divided by charge).

• Electric Field Strength (E): E = V/d (potential difference divided by distance).

• Common Misunderstandings:

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• Potential difference (volts) should not be confused with electric field strength (N/C).

• Newton per coulomb is not a unit of potential difference; it is a unit of electric field strength.

Q16. Answer: (b) The reciprocal of its focal length in meters

The correct answer is The reciprocal of its focal length in meters.

Key Points

• The power of a lens is defined as the ability of the lens to converge (focus) or diverge light rays. Mathematically, it is given by the formula: P = 1/f, where P is the power of the lens and f is the focal length in meters.

• The unit of lens power is the diopter (D), where 1 diopter corresponds to a lens with a focal length of 1 meter.

• A lens with a positive power (e.g., +2D) is a convex lens, which converges light rays, and is used to correct hypermetropia (farsightedness).

• A lens with a negative power (e.g., -2D) is a concave lens, which diverges light rays, and is used to correct myopia (nearsightedness).

• Hence, the correct answer is "The reciprocal of its focal length in meters".

Additional Information

• Convex Lens:

• A convex lens is a lens that is thicker at the center than at the edges.

• It is also known as a converging lens because it bends light rays inward, focusing them at a single point called the focal point.

• Applications: Used in magnifying glasses, projectors, cameras, and correcting hypermetropia (farsightedness).

• Concave Lens:

• A concave lens is a lens that is thinner at the center and thicker at the edges.

• It is also known as a diverging lens because it bends light rays outward, causing them to diverge away from a focal point.

• Applications: Used in telescopes, binoculars, and correcting myopia (nearsightedness).

• Calculation of Lens Power:

• The power of a lens is calculated as the reciprocal of its focal length in meters: P = 1/f.

• If the focal length is given in centimeters, convert it to meters by dividing by 100 (e.g., 50 cm = 0.5 m).

• Diopter (D):

• The unit of power of a lens, the diopter (D), indicates the degree of convergence or divergence of light rays caused by the lens.

• A lens with a power of +1D has a focal length of 1 meter, while a lens with a power of -1D also has a focal length of 1 meter but diverges light rays.

Important Points

• Sign Convention:

• Focal length of a convex lens is considered positive, while that of a concave lens is negative.

• Combination of Lenses:

• When multiple lenses are placed in contact, the total power is the algebraic sum of their individual powers: P = P1 + P2 + P3 + ...

• This principle is widely used in optical instruments such as microscopes and telescopes.

• Practical Applications:

• In optometry, lens power is used to prescribe corrective lenses for vision problems like myopia and hypermetropia.

• In photography, lenses with different focal lengths and powers are used to achieve various effects.

Q17. Answer: (b) Sexual reproduction

The correct answer is Sexual reproduction.

Key Points

• Sexual reproduction is a biological process where genetic material from two parents combines to produce offspring with genetic variation.

• It is a key driver of genetic diversity in a species, which enhances their ability to adapt and survive in changing environments.

• During sexual reproduction, meiosis occurs, a specialized form of cell division that shuffles genetic material and ensures unique combinations of genes in the gametes (sperm and egg).

• Fertilization combines these gametes, leading to the formation of a zygote with a unique genetic makeup.

• This variation is important for natural selection, enabling populations to evolve over time and resist diseases or environmental changes.

Additional Information

• Heterotrophic Nutrition:

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• This process involves organisms deriving energy by consuming other organisms or organic substances. Examples include humans and animals.

• It is essential for survival but does not contribute to genetic variation in a species.

• Autotrophic Nutrition:

• In this process, organisms like plants synthesize their own food using sunlight, carbon dioxide, and water through photosynthesis.

• While crucial for energy production, it does not play a direct role in generating genetic diversity.

• Transportation:

• This refers to the movement of water, nutrients, and other substances within an organism, such as in plants or animals.

• It is vital for maintaining life processes but does not influence genetic variation.

• Importance of Genetic Variation:

• Genetic variation is the foundation of evolution and helps populations adapt to environmental changes, resist diseases, and survive long-term.

• Sexual reproduction ensures this variation through processes like crossing over and the independent assortment of chromosomes during meiosis.

• Examples of species exhibiting high genetic diversity due to sexual reproduction include humans, plants, and animals.

Important Points

• Meiosis and Crossing Over:

• Meiosis is a type of cell division that reduces the chromosome number by half, producing four gamete cells.

• During meiosis, crossing over occurs, where homologous chromosomes exchange genetic material, leading to unique genetic combinations.

• Advantages of Sexual Reproduction:

• It enhances evolutionary adaptability, allowing species to respond to changing environments.

• It provides a mechanism to eliminate harmful mutations over time and maintain genetic health.

• Examples of Sexual Reproduction:

• Humans and other mammals reproduce sexually, combining genetic material from both parents to produce diverse offspring.

• Plants, such as flowering plants, also use sexual reproduction mechanisms like pollination to ensure genetic diversity.

• Role of Genetic Variation in Evolution:

• Natural selection acts on genetic variation, favoring advantageous traits that enhance survival and reproduction.

• This process leads to the emergence of new species and adaptations over generations.

Q18. Answer: (a) A fan blade rotating at constant speed

The correct answer is A fan blade rotating at constant speed.

Key Points

• Uniform Circular Motion (UCM): It refers to the motion of an object in a circular path with a constant speed. Although the speed remains constant, the direction of velocity changes continuously, resulting in acceleration known as centripetal acceleration.

• A fan blade rotating at constant speed: The fan blade undergoes uniform circular motion because each point on the blade moves along a circular path at a constant speed, with centripetal force acting towards the center of the fan. This is the correct example of UCM.

• A ball thrown vertically upwards: This motion is linear (not circular) and is influenced by gravitational force, causing the ball to decelerate while moving up and accelerate while coming down. Hence, this is not an example of UCM.

• A car accelerating on its way: The car's motion is typically along a straight or curved path with changing speed and direction. Both the velocity and acceleration change, making it non-uniform motion. This is not an example of UCM.

• A train moving on its track: Unless specified that the train is moving in a circular path at constant speed, this is generally linear motion. Hence, this is not an example of UCM.

Additional Information

• Characteristics of Uniform Circular Motion (UCM):

• Constant Speed: The magnitude of velocity remains unchanged throughout the motion.

• Changing Velocity Direction: Since the object is moving in a circle, the direction of velocity changes continuously.

• Centripetal Acceleration: The acceleration is directed towards the center of the circle and is responsible for changing the direction of velocity.

• Centripetal Force: The force that keeps the object in circular motion acts towards the center of the circle.

• Examples: A satellite orbiting Earth, a stone tied to a string and whirled in a circle, and planets revolving around the Sun.

• Non-Uniform Circular Motion:

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• If the speed of the object moving in a circular path changes, it is called non-uniform circular motion.

• In this case, both tangential acceleration (due to changing speed) and centripetal acceleration (due to changing direction) are present.

• Difference Between Uniform and Non-Uniform Circular Motion:

• Uniform Circular Motion: Constant speed with changing velocity direction; only centripetal acceleration is present.

• Non-Uniform Circular Motion: Changing speed and direction of velocity; both centripetal and tangential accelerations are present.

• Applications of UCM:

• Artificial Satellites: Satellites revolve around Earth in uniform circular motion under the influence of gravitational force.

• Vehicle Turns: Vehicles negotiating circular turns demonstrate the concept of centripetal force.

• Amusement Rides: Many rides in amusement parks use uniform circular motion principles to ensure thrilling yet safe experiences.

Q19. Answer: (b) 30 m/s

The correct answer is Option 2 (30 m/s).

Key Points

• Final velocity (v) of a freely falling body can be calculated using the formula: $v = u + g \times t$, where:

• u is the initial velocity of the body (0 m/s for a body dropped from rest).

• g is the acceleration due to gravity (10 m/s^2 in this case).

• t is the time for which the body falls (3.0 seconds).

• Substituting the values into the formula:

• $v = 0 + (10 \times 3) = 30$ m/s.

• Final velocity v = 30 m/s, which matches Option 2.

• This calculation assumes no air resistance, meaning the motion occurs in a vacuum or idealized free fall conditions.

• The result directly demonstrates the effect of uniform acceleration due to gravity on a freely falling object.

Additional Information

• Equations of motion:

• These equations describe the motion of objects under constant acceleration. The three primary equations are:

1. $v = u + a \times t$

2. $s = u \times t + 0.5 \times a \times t^2$

3. $v^2 = u^2 + 2 \times a \times s$

• In this case, the first equation is used as the distance (s) is not required.

• Free fall:

• When an object falls under the influence of gravity alone, it is said to be in free fall.

• During free fall, the acceleration of the object is equal to the acceleration due to gravity ($g \approx 9.8$ m/s^2 or 10 m/s^2 for approximation).

• Initial velocity (u):

• If an object is dropped (not thrown), its initial velocity is 0 m/s.

• Factors affecting free fall:

• Free fall neglects air resistance; if air resistance is considered, the motion becomes non-uniform.

• In reality, objects with different shapes and masses may fall at different rates due to air drag, even though gravity affects all objects equally.

• Applications of free fall:

• Understanding free fall is essential in physics and engineering, such as designing parachutes or calculating projectile motion.

Q20. Answer: (a) The direction of motion changes continuously at every point, meaning the velocity is changing.

The correct answer is The direction of motion changes continuously at every point, meaning the velocity is changing..

Key Points

• Uniform circular motion refers to the motion of an object moving in a circular path at a constant speed.

• Even though the speed remains constant, the direction of motion changes continuously as the object moves along the circular path. This results in a change in the velocity vector.

• Acceleration in circular motion is caused by this continuous change in the direction of the velocity vector, even when the magnitude of velocity (speed) remains constant. This acceleration is known as centripetal acceleration.

• Centripetal acceleration acts towards the center of the circle, ensuring the object stays on the circular path. Without this

acceleration, the object would move tangentially to the circle due to inertia.

• Thus, the motion cannot have zero acceleration, as the continuous change in direction of motion inherently necessitates acceleration. Hence, the statement is correct.

Additional Information

• Option Analysis:

• Option 1: Correct. The direction of motion changes continuously, causing velocity to change and necessitating acceleration.

• Option 2: Incorrect. Conservation of total mechanical energy does not directly imply acceleration; it refers to the sum of kinetic and potential energy being constant.

• Option 3: Incorrect. The speed is sustained by the balance between gravitational force and centripetal force, not because of high speed alone.

• Option 4: Incorrect. The mass of a satellite does not change significantly during circular motion.

• Properties of Uniform Circular Motion:

• The motion is characterized by a constant speed but a continuously changing velocity due to directional changes.

• The force responsible for maintaining circular motion is called centripetal force, directed towards the center of the circle.

• Examples of such motion include the orbit of planets, motion of satellites, and vehicles turning on a circular track.

• Centripetal Force and Acceleration:

• Centripetal acceleration is calculated using the formula $a = v^2/r$, where v is the speed and r is the radius of the circular path.

• This acceleration is perpendicular to the velocity and is responsible for changing the direction of the object's motion.

• Common sources of centripetal force include gravitational force in planetary motion and frictional force in vehicle turns.

• Misconceptions about Circular Motion:

• It is often incorrectly assumed that there is no acceleration in uniform circular motion because the speed is constant. However, acceleration exists due to the continuous change in direction.

• Acceleration does not imply an increase in speed; it can also mean a change in the direction of velocity.

• Applications of Circular Motion:

• Used in designing centrifugal pumps, roller coasters, and rotating machinery.

• Helps in understanding the behavior of celestial bodies like planets and satellites.

• Critical for analyzing the motion of vehicles on curved roads or tracks.

Q21. Answer: (a) Presence of isotopes

The correct answer is Presence of isotopes.

Key Points

• The fractional atomic mass of chlorine arises due to the presence of isotopes, which are atoms of the same element with the same number of protons but a different number of neutrons.

• Chlorine primarily exists as two naturally occurring isotopes: Chlorine-35 (35Cl) and Chlorine-37 (37Cl), with relative abundances of approximately 75% and 25%, respectively.

• The atomic mass of chlorine is calculated as the weighted average of these isotopes, which results in a fractional value of approximately 35.5 amu (atomic mass units).

• This average is derived using the formula: (% abundance of isotope 1 × atomic mass of isotope 1) + (% abundance of isotope 2 × atomic mass of isotope 2) / 100.

• Fractional atomic masses are common for elements that have multiple isotopes with varying natural abundances.

Additional Information

• Chlorine Isotopes:

• Chlorine-35: This isotope has 17 protons and 18 neutrons. It constitutes approximately 75% of natural chlorine.

• Chlorine-37: This isotope has 17 protons and 20 neutrons. It accounts for roughly 25% of natural chlorine.

• The slight difference in the number of neutrons between these isotopes is responsible for their different atomic masses.

• Isotopes and Atomic Mass:

• Isotopes have the same chemical properties because they have the same number of protons and electrons, which govern chemical behavior.

• However, their physical properties, such as mass, may differ due to the difference in neutron numbers.

• The existence of isotopes is the reason why many elements have non-integer atomic masses.

• How Fractional Atomic Mass is Calculated:

• For chlorine:

• Mass of 35Cl = 34.96885 amu

• Mass of 37Cl = 36.96590 amu

• Weighted average = (0.75 × 34.96885) + (0.25 × 36.96590) = 35.453 amu.

• This value is what is reported as the atomic mass of chlorine on the periodic table.

• Other Elements with Fractional Atomic Masses:

• Many elements like carbon, hydrogen, and oxygen also exhibit fractional atomic masses due to their isotopic compositions.

• For example, the atomic mass of carbon is approximately 12.011 amu because it has two main isotopes, Carbon-12 and Carbon-13.

Important Points

• Other Options Explained:

• Presence of ions: Ions are charged particles formed by the loss or gain of electrons. They do not influence the atomic mass of an element. Incorrect.

• Experimental error: Modern techniques ensure precise measurements, so atomic mass values are highly accurate. Incorrect.

• Its compound nature: Compounds are formed by chemical bonds between elements and do not affect the atomic mass of individual atoms. Incorrect.

Q22. Answer: (c) Bronchi and bronchioles

The correct answer is Bronchi and Bronchioles.

Key Points

• Asthma is a chronic respiratory condition that primarily affects the bronchi and bronchioles, which are part of the lower respiratory tract.

• In asthma, the airways become inflamed, swollen, and constricted, leading to difficulty in breathing. This is often triggered by allergens, irritants, or other environmental factors.

• During an asthma attack, the muscles surrounding the bronchi and bronchioles tighten, and the airway lining produces excessive mucus, further narrowing the passage for airflow.

• The primary symptoms of asthma include wheezing, shortness of breath, chest tightness, and coughing, particularly at night or early in the morning.

• Asthma is managed using bronchodilators (to relax airway muscles) and anti-inflammatory medications (to reduce swelling and prevent symptoms).

Additional Information

• Structure and Function of Bronchi and Bronchioles:

• The bronchi are large air passages branching from the trachea and leading into each lung. They further divide into smaller branches called bronchioles.

• Bronchi and bronchioles are lined with smooth muscles and mucus-producing cells, which help trap dust and other particles, protecting the lungs.

• In asthma, these smooth muscles contract, and the lining becomes swollen, leading to airway narrowing and obstruction.

• Triggers of Asthma:

• Common triggers include pollen, dust mites, pet dander, mold, cold air, exercise, smoke, and respiratory infections.

• Other factors like stress, strong emotions, and certain medications can also exacerbate asthma symptoms.

• Diagnostic Methods:

• Asthma is typically diagnosed using a combination of medical history, physical examination, and lung function tests such as spirometry.

• Spirometry measures the amount and speed of air a person can exhale, helping identify obstructed airways.

• Treatment Options:

• Quick-relief medications: Inhaled bronchodilators (e.g., albuterol) provide immediate relief during an asthma attack by relaxing airway muscles.

• Long-term control medications: Inhaled corticosteroids reduce inflammation in the airways over time, preventing symptoms.

• Other treatments include leukotriene modifiers, long-acting beta-agonists (LABAs), and immunotherapy in severe cases.

• Preventive Measures:

• Avoid known triggers like allergens, irritants, and respiratory infections.

• Use prescribed medications, such as inhalers, as directed by healthcare professionals.

• Maintain a healthy lifestyle, including regular exercise and a balanced diet, to improve lung function and overall health.

Important Points

• Other Parts of the Respiratory System:

• Trachea: The windpipe that connects the throat to the bronchi. Asthma does not primarily affect the trachea, although it plays a

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role in airflow.

• Alveoli: Tiny air sacs in the lungs where gas exchange occurs. Asthma does not directly affect alveoli but can indirectly impact oxygen exchange due to airflow obstruction.

• Diaphragm: The main respiratory muscle responsible for breathing. Asthma does not directly affect the diaphragm, but breathing difficulties may result in diaphragm strain.

• Global Prevalence:

• Approximately 262 million people were affected by asthma globally in 2019, according to the World Health Organization (WHO).

• Asthma is more common in children and is a significant cause of school absenteeism and hospital visits.

• Economic and Social Impact:

• Asthma can lead to reduced productivity, increased healthcare costs, and a lower quality of life if not managed effectively.

• Awareness campaigns and affordable access to medications are essential to mitigate its impact, especially in low- and middle-income countries.

Q23. Answer: (c) Layers

The correct answer is Layers.

Key Points

• Layers are a category of poultry birds that are specifically bred and raised for the purpose of producing eggs. They are distinct from broilers, which are raised for meat production.

• These birds are genetically optimized to lay a high number of eggs, often producing around 250 to 300 eggs per year under optimal conditions.

• Common breeds of layer chickens include Leghorn, Rhode Island Red, and Sussex. These breeds are widely used in commercial egg production.

• Layer chickens usually start laying eggs at around 18 to 20 weeks of age and continue to produce eggs efficiently for up to 72 to 80 weeks.

• To maintain high egg production, layers are provided with a balanced diet rich in calcium, proteins, and essential nutrients. Proper lighting and temperature control are also critical for their productivity.

Additional Information

• Broilers:

• Broilers are poultry birds raised specifically for meat production. They are bred to grow quickly and reach market weight in about 6 to 8 weeks.

• Common broiler breeds include Cornish Cross and Plymouth Rock.

• Broilers are not suitable for egg production due to their genetic focus on rapid growth and meat yield.

• Common Carp:

• Common carp is a type of fish and not related to poultry. It is extensively farmed for aquaculture purposes, primarily for food production.

• Carp farming is prevalent in countries like China and India, where it plays a significant role in meeting the demand for fish.

• It has no association with egg production or poultry farming.

• Milch:

• Milch animals refer to animals like cows and buffaloes that are raised for milk production, not eggs or meat.

• Examples include breeds like Gir, Sahiwal, and Murrah buffalo.

• Milch animals contribute significantly to the dairy industry rather than poultry farming.

• Egg Production in India:

• India is one of the largest producers of eggs globally, with states like Andhra Pradesh, Tamil Nadu, and Telangana leading in production.

• Egg production is a crucial part of the poultry industry, contributing significantly to the protein needs of the population.

• Efforts by the government, such as the National Livestock Mission, aim to support poultry farming and increase egg production.

Important Points

• Egg as a source of nutrition: Eggs are a rich source of proteins, vitamins, and minerals. They play a vital role in addressing malnutrition and are considered one of the most complete natural foods.

• Poultry farming techniques: Modern techniques such as battery cages, free-range farming, and organic farming are used to increase the efficiency of egg production.

• Environmental considerations: Poultry farming for egg production has a lower environmental impact compared to meat production, making it a more sustainable option.

• Government initiatives: Various schemes like Rural Backyard Poultry Development aim to promote egg production in rural areas, thus enhancing livelihoods.

Q24. Answer: (a) The blue colour of the copper sulphate solution fades.

The correct answer is The blue colour of the copper sulphate solution fades..

Key Points

• When a zinc rod is placed in an aqueous copper sulphate solution, a chemical reaction occurs due to the difference in reactivity of zinc and copper.

• Zinc (Zn) is more reactive than copper (Cu) and displaces copper from copper sulphate solution, forming zinc sulphate (ZnSO4). This process is known as a displacement reaction.

• The reaction is represented as: Zn + CuSO4 → ZnSO4 + Cu. Here, zinc replaces copper in the solution, forming zinc sulphate and depositing copper metal.

• The fading of the blue colour of the copper sulphate solution is due to the formation of colourless zinc sulphate in the solution.

• This reaction is an example of the reactivity series, where a more reactive metal displaces a less reactive metal from its compound. Hence, this statement is correct.

Additional Information

• Reactivity Series:

• The reactivity series is a list of metals arranged in order of their reactivity. Zinc is placed higher than copper in the reactivity series, indicating it is more reactive.

• Metals higher in the series can displace metals lower in the series from their compounds. For example, zinc can displace copper, but copper cannot displace zinc.

• This principle is commonly used in various industrial applications, including metal extraction and purification processes.

• Displacement Reactions:

• A displacement reaction occurs when a more reactive element replaces a less reactive element in a compound.

• Displacement reactions are widely observed in aqueous solutions of salts, such as copper sulphate, where reactive metals like zinc or iron displace copper.

• Example: Iron displacing copper from copper sulphate solution: Fe + CuSO4 → FeSO4 + Cu.

• Characteristics of Zinc:

• Zinc is a metal with atomic number 30 and symbol Zn.

• It is commonly used in galvanization, alloys, batteries, and chemical reactions due to its high reactivity.

• Zinc reacts with acids, bases, and other compounds, often forming salts like zinc sulphate.

• Copper Sulphate Solution:

• Copper sulphate (CuSO4) is a blue-coloured salt used in agriculture (as a fungicide), laboratory experiments, and industry.

• In aqueous solutions, copper sulphate dissociates into Cu²^+ and SO4²^- ions, contributing to its characteristic blue colour.

• The blue colour fades when copper ions are displaced by zinc or other reactive metals.

• Applications:

• Displacement reactions like this are used in metal refining, electroplating, and chemical synthesis.

• The reactivity series helps predict the feasibility of reactions involving metals and their compounds.

Important Points

• Option 2: Heat is not required to start this reaction as it occurs spontaneously due to the reactivity difference between zinc and copper. Hence, this statement is incorrect.

• Option 3: The temperature of the solution does not fall significantly; rather, there might be a slight heat release due to the exothermic nature of the reaction. Hence, this statement is incorrect.

• Option 4: A chemical change is clearly observed, as copper is displaced from the solution and zinc sulphate is formed. Hence, this statement is incorrect.

• The fading of the blue colour is the key observation in this reaction, confirming the displacement of copper by zinc. Hence, option 1 is correct.

Q25. Answer: (b) It burns with a yellow flame with black soot deposited on the metal plate.

The correct answer is It burns with a yellow flame with black soot deposited on the metal plate..

Key Points

• Naphthalene is a hydrocarbon compound consisting of fused aromatic rings. When it burns, it undergoes incomplete combustion due to insufficient oxygen supply in open air.

• During the combustion of naphthalene, it produces a yellow flame. This yellow color arises due to the incandescence of hot soot particles formed during the process.

• Incomplete combustion leads to the deposition of black soot on the surface of the metal plate. Soot is primarily composed of carbon particles that are not fully oxidized.

• The reason for the incomplete combustion is the high carbon content of naphthalene and the limited availability of oxygen in open air. This results in the formation of carbon monoxide (CO) and soot instead of carbon dioxide (CO_2).

• Hence, the correct observation is that naphthalene burns with a yellow flame and leaves black soot on the metal plate.

Additional Information

• Combustion Process:

• Combustion is a chemical reaction between a fuel and an oxidant (usually oxygen), resulting in the release of heat and light.

• Combustion can be complete or incomplete. Complete combustion produces carbon dioxide and water, while incomplete combustion generates carbon monoxide, soot, and other particulates.

• Soot Formation:

• Soot is a black powdery or flaky substance consisting largely of carbon. It is formed due to the incomplete combustion of organic materials.

• Soot particles are harmful to health, as they can penetrate deep into the lungs and cause respiratory problems.

• Properties of Naphthalene:

• Naphthalene is a polycyclic aromatic hydrocarbon (PAH) with the chemical formula $C_{10}H_8$.

• It is widely used in mothballs and as a precursor for the manufacture of dyes, resins, and other chemicals.

• It is volatile and sublimes at room temperature, releasing a strong odor.

• Other Observations During Combustion:

• The flame color can vary depending on the composition of the substance and the amount of oxygen available.

• In the case of hydrocarbons with high carbon content, yellow flames and soot deposition are common indicators of incomplete combustion.

Important Points

• Difference Between Complete and Incomplete Combustion:

• Complete Combustion: Requires adequate oxygen supply, produces carbon dioxide and water, and releases maximum energy.

• Incomplete Combustion: Occurs with limited oxygen, generates carbon monoxide, soot, and less energy, and can be harmful to health and the environment.

• Environmental Impact of Soot:

• Soot contributes to air pollution and global warming as it absorbs sunlight and heats the atmosphere.

• It can settle on ice and snow, reducing their albedo (reflectivity) and accelerating melting.

• Practical Implications:

• In industrial applications, efforts are made to ensure complete combustion to maximize efficiency and minimize pollution.

• Devices like catalytic converters are used in automobiles to reduce emissions from incomplete combustion.

Q26. Answer: (a) 90

Shortcut Trick

Product of two numbers = HCF × LCM

Let the second number be x.

126 × x = 18 × 1512

x = (18 × 1512) ÷ 126 = 216

Difference = 216 − 126 = 90

Therefore The correct answer is 90.

Alternate Method

Given:

HCF = 18

LCM = 1512

First Number (n1) = 126

Formula Used:

n1 × n2 = HCF × LCM

Calculations:

=> 126 × n2 = 18 × 1512

=> n2 = (18 × 1512) ÷ 126

=> n2 = 1512 ÷ 7

=> n2 = 216

=> Difference = 216 − 126

=> Difference = 90

Therefore The correct answer is 90.

Additional Information

HCF and LCM Relation

The product of any two numbers is always equal to the product of their Highest Common Factor (HCF) and Least Common Multiple (LCM).

Co-prime Numbers

If two numbers are co-prime, their HCF is 1 and their LCM is equal to their product.

HCF of Fractions

HCF of fractions = (HCF of Numerators) ÷ (LCM of Denominators).

Q27. Answer: (c) 32 years

Shortcut Trick

Age ratio (Present : Marriage) = 8 : 5

Difference in ratio units = 8 − 5 = 3 units

Given time gap = 15 years => 3 units = 15 years => 1 unit = 5 years

Soniya's present age = 8 × 5 = 40 years

Sister is always 8 years younger than Soniya.

Sister's present age = 40 − 8 = 32 years

Therefore The correct answer is 32 years.

Alternate Method

Given: Marriage occurred 15 years ago. Present age = 8/5 × Marriage age. Sister's age difference = 8 years.

Let Soniya's age at marriage be M.

=> Present age P = M + 15

=> M + 15 = (8/5) × M

=> 5(M + 15) = 8M

=> 5M + 75 = 8M

=> 3M = 75 => M = 25 years

=> Soniya's present age = 25 + 15 = 40 years

=> Sister's present age = Soniya's present age − 8

=> Sister's present age = 40 − 8 = 32 years

Therefore The correct answer is 32 years.

Additional Information

Constant Age Difference

The difference between the ages of two people remains constant regardless of how many years pass.

Ratio Method for Age

If the ratio changes from a:b to c:d over n years, the value of 1 unit is calculated by equating the parts difference to n.

Fractional Relation

When Present Age = (x/y) × Past Age, the difference (x − y) units represents the time elapsed between the two periods.

Q28. Answer: (a) 25%

Shortcut Trick

When SP of x items = CP of y items, the Profit % = (y − x) ÷ x × 100.

Here, x = 120 and y = 150.

Profit % = (150 − 120) ÷ 120 × 100 = 30 ÷ 120 × 100 = 1/4 × 100.

Therefore The correct answer is 25%.

Alternate Method

Given: Selling Price (SP) of 120 mangoes = Cost Price (CP) of 150 mangoes.

Formula: Profit % = [(SP − CP) ÷ CP] × 100

=> Let CP of 1 mango be Rs. 1.

=> CP of 150 mangoes = Rs. 150.

=> According to the question, SP of 120 mangoes = CP of 150 mangoes = Rs. 150.

=> CP of 120 mangoes = Rs. 120.
=> Profit on 120 mangoes = SP − CP = 150 − 120 = Rs. 30.
=> Profit % = (30 ÷ 120) × 100.
=> Profit % = 1/4 × 100 = 25%.
Therefore The correct answer is 25%.
Additional Information
Cost Price & Selling Price Ratio
If SP of A items = CP of B items, then the ratio SP/CP = B/A. Profit or Loss is determined by the ratio value.
Profit and Loss Basics
Profit occurs when SP > CP; Loss occurs when CP > SP. Both are always calculated on Cost Price (CP) unless stated otherwise.
Marked Price & Discount
Discount is always calculated on the Marked Price (MP). SP = MP − Discount.

Q29. Answer: (c) 54

Shortcut Trick
Relative Speed (Train − Man) = Distance ÷ Time = 325 ÷ 45 = 65/9 m/s.
In km/hr: (65/9) × (18/5) = 26 km/hr. Since same direction, Train Speed = 26 + 5 = 31 km/hr.
Relative speed (Opposite direction) = 31 + 20 = 51 km/hr = 51 × (5/18) = 85/6 m/s.
Time to cross = Total Length ÷ Relative Speed = (325 + 440) ÷ (85/6) = 765 × 6 ÷ 85 = 9 × 6 = 54 seconds.
Therefore The correct answer is 54 seconds.
Alternate Method
Given: Length of train1 = 325 m, Speed of man = 5 km/hr, Time = 45 s, Length of train2 = 440 m, Speed of train2 = 20 km/hr.
Formula Used: Time = Total Distance ÷ Relative Speed; km/hr → m/s = Multiply by 5/18.
=> Let speed of train1 be V1.
=> Relative speed with man = V1 − 5 (Same direction).
=> (V1 − 5) × 5/18 = 325 ÷ 45
=> (V1 − 5) × 5/18 = 65/9
=> V1 − 5 = (65/9) × (18/5) = 13 × 2 = 26
=> V1 = 31 km/hr.
=> Case 2: Relative speed (Opposite) = 31 + 20 = 51 km/hr.
=> Total Distance = 325 + 440 = 765 m.
=> Time = 765 ÷ (51 × 5/18) = 765 × 18 ÷ 255 = 3 × 18 = 54 s.
Therefore The correct answer is 54 seconds.
Additional Information
Relative Speed Concept
When two objects move in the same direction, relative speed = V1 − V2. In the opposite direction, relative speed = V1 + V2.
Unit Conversion
To convert km/hr to m/s, multiply by 5/18. To convert m/s to km/hr, multiply by 18/5.
Train Crossing Distance
When a train crosses a stationary pole or man, distance = length of train. When it crosses another train/platform, distance = sum of both lengths.

Q30. Answer: (b) 39 sq. units

Shortcut Trick
The Shoelace Formula is the fastest method to find the area of a polygon with given coordinates.
Sum of products (downward): (0×0) + (6×3) + (8×7) + (4×4) + (0×0) = 18 + 56 + 16 = 90
Sum of products (upward): (0×6) + (0×8) + (3×4) + (7×0) + (4×0) = 12
Area = 1/2 × |90 − 12| = 1/2 × 78 = 39 sq. units.
Therefore The correct answer is 39 sq. units.
Alternate Method
Given: Vertices of the convex pentagon are P(0,0), Q(6,0), R(8,3), S(4,7), and T(0,4).
Formula Used: Area of a polygon with vertices (x1, y1), (x2, y2), ..., (x_n, y_n) is:

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Area = 1/2 |(x1y2 + x2y3 + ... + x_ny1) − (y1x2 + y2x3 + ... + y_nx1)|

Calculations:

=> Area = 1/2 |(0×0 + 6×3 + 8×7 + 4×4 + 0×0) − (0×6 + 0×8 + 3×4 + 7×0 + 4×0)|

=> Area = 1/2 |(0 + 18 + 56 + 16 + 0) − (0 + 0 + 12 + 0 + 0)|

Q31. Answer: (a) 20%

Given:

First fraction = 1 ÷ 20

Second fraction = 10 ÷ 40

Formula Used:

Percentage = (Value ÷ Reference value) × 100

Calculation:

=> 10 ÷ 40 = 1 ÷ 4

=> Required percentage = ((1 ÷ 20) ÷ (1 ÷ 4)) × 100

=> Required percentage = (1 ÷ 20) × (4 ÷ 1) × 100

=> Required percentage = 4 ÷ 20 × 100

=> Required percentage = 1 ÷ 5 × 100

=> Required percentage = 20%

Therefore The correct answer is 20%.

Q32. Answer: (a) 0.35

Given:

triangle × 2.2 + 0.33 × (3 ÷ 4) − (1 ÷ 20) × 0.55 = 0.99

Formula Used:

BODMAS rule

Calculation:

=> 0.33 × (3 ÷ 4) = 0.33 × 0.75 = 0.2475

=> (1 ÷ 20) × 0.55 = 0.05 × 0.55 = 0.0275

=> triangle × 2.2 + 0.2475 − 0.0275 = 0.99

=> triangle × 2.2 + 0.22 = 0.99

=> triangle × 2.2 = 0.99 − 0.22

=> triangle × 2.2 = 0.77

=> triangle = 0.77 ÷ 2.2

=> triangle = 0.35

Therefore The correct answer is 0.35.

Q33. Answer: (b) Rs. 8,993

Shortcut Trick

Effective Rate of Interest for 2 years = x + y + (xy/100)

Effective Rate = 15 + 15 + (15 × 15)/100 = 30 + 2.25 = 32.25%

Total Amount = 132.25% of Principal

Amount = 1.3225 × 6800 = 8993

Therefore The correct answer is Rs. 8,993.

Alternate Method

Given:

Principal (P) = Rs. 6,800

Rate (R) = 15% per annum

Time (n) = 2 years

Formula Used:

Amount (A) = $P(1 + R/100)^n$

Calculations:

=> $A = 6800 \times (1 + 15/100)^2$

=> $A = 6800 \times (1 + 3/20)^2$

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=> A = 6800 × (23/20)²

=> A = 6800 × (529 / 400)

=> A = 17 × 529

=> A = Rs. 8,993

Therefore The correct answer is Rs. 8,993.

Additional Information

Compound Interest Formula

The interest earned is calculated as CI = A − P, where A = P(1 + r/100)ⁿ.

Difference between CI and SI

For a period of 2 years, the difference between Compound Interest and Simple Interest is given by D = P(r/100)².

Effective Rate for Successive Years

If rates for two successive years are r1% and r2%, the effective rate is r1 + r2 + (r1 × r2)/100.

Q34. Answer: (a) 85

Shortcut Trick

The Mode of a data set is the value that occurs most frequently.

By observing the given list of 21 student marks, we count the occurrences:

The value 85 appears 4 times (85, 85, 85, 85).

The values 90, 95, 81, and 82 appear only 2 times each, while all others appear once.

Therefore The correct answer is 85.

Alternate Method

Given Data: 90, 95, 95, 94, 90, 85, 84, 83, 85, 81, 92, 93, 82, 78, 79, 81, 80, 82, 85, 76, 85

To find the Mode, we construct a frequency distribution of the marks:

=> Count of 85 → 4 times

=> Count of 81, 82, 90, 95 → 2 times each

=> Count of 76, 78, 79, 80, 83, 84, 92, 93, 94 → 1 time each

=> Total Students = 4 + (4 × 2) + (9 × 1) = 4 + 8 + 9 = 21

=> Since 85 has the maximum frequency (4), it is the mode.

Therefore The correct answer is 85.

Additional Information

Measures of Central Tendency

Mean is the arithmetic average, Median is the middle value when data is sorted, and Mode is the most repeated value.

Empirical Relationship

In a moderately skewed distribution: Mode = 3 × Median − 2 × Mean.

Bimodal and Multimodal Data

A data set with two values having the same highest frequency is called bimodal. If more than two values share the highest frequency, it is multimodal.

Q35. Answer: (b) 216.8 cm2

Shortcut Trick

Given that the Total Surface Area (TSA) is 542 cm².

The Curved Surface Area (CSA) is defined as 2/5 of the TSA.

CSA = (2 ÷ 5) × 542 = 0.4 × 542 = 216.8 cm².

Therefore The correct answer is 216.8 cm².

Alternate Method

Given:

Total Surface Area (TSA) of the cylinder = 542 cm²

Relation: Curved Surface Area (CSA) = (2 ÷ 5) × TSA

Formula Used:

CSA = (2 ÷ 5) × TSA

Calculations:

=> CSA = (2 ÷ 5) × 542

=> CSA = (2 × 542) ÷ 5

=> CSA = 1084 ÷ 5

=> CSA = 216.8 cm²

Therefore The correct answer is 216.8 cm².

Additional Information

Total Surface Area (TSA) of a Cylinder

The TSA includes the curved surface area plus the area of the two circular bases: TSA = 2πrh + 2πr² = 2πr(h + r).

Curved Surface Area (CSA) of a Cylinder

The CSA represents the area of the lateral side only: CSA = 2πrh.

Volume of a Cylinder

The amount of space inside the cylinder: Volume = πr²h.

Q36. Answer: (c) 6/13

Shortcut Trick

Total Capacity = LCM(40, 20, 30) = 120 units.

Efficiencies: A = 3, B = 6, C = 4.

Proportion of solution Q (from Pipe B) = Efficiency of B ÷ Total efficiency of (A + B + C).

Proportion = 6 ÷ (3 + 6 + 4) = 6/13.

Therefore The correct answer is 6/13.

Alternate Method

Pipe	Time (min)	Total Work (LCM)	Efficiency
A (P)	40	120	3
B (Q)	20	6	
C (R)	30	4	

=> Total efficiency of all three pipes = 3 + 6 + 4 = 13 units/min.

=> Total liquid in tank after 9 minutes = 13 × 9 = 117 units.

=> Quantity of solution Q filled by Pipe B in 9 minutes = 6 × 9 = 54 units.

=> Proportion of solution Q = 54 / 117.

=> Dividing both numerator and denominator by 9, we get 6/13.

Therefore The correct answer is 6/13.

Additional Information

Combined Efficiency

When multiple pipes work together, their combined efficiency is the sum of their individual efficiencies (Work = Rate × Time).

Proportion in Mixture

The proportion of a specific component in a mixture is equal to its individual rate divided by the total rate of all components entering simultaneously.

Q37. Answer: (c) 54 : 36

Shortcut Trick

To find the equivalent ratio, simplify the given options by dividing both terms by their Highest Common Factor (HCF).

Check option (3): 54 ÷ 18 = 3 and 36 ÷ 18 = 2.

The simplified form is 3 : 2.

Therefore The correct answer is 54 : 36.

Alternate Method

Given: Base ratio = 3 : 2

Formula Used: Ratio a : b is equivalent to (a × k) : (b × k) where k is a non-zero constant.

=> Option 1: 52 : 34 = 26 : 17 (Not equivalent)

=> Option 2: 53 : 38 (Irreducible, Not equivalent)

=> Option 3: 54 : 36

=> Dividing by HCF (18): 54/18 : 36/18

=> Result: 3 : 2

=> Option 4: 51 : 37 (Not equivalent)

Therefore The correct answer is 54 : 36.

Additional Information

Equivalent Ratios

Ratios that express the same relationship between numbers. They are formed by multiplying or dividing both terms of a ratio by the same non-zero number.

Simplest Form

A ratio a : b is in its simplest form if the HCF of a and b is 1.

Compound Ratio

For two ratios a : b and c : d, the compound ratio is (a × c) : (b × d).

Q38. Answer: (d) 32.2

Shortcut Trick

When the distance is constant for two parts of a journey, Average Speed = (2 × S1 × S2) ÷ (S1 + S2)

Average Speed = (2 × 21 × 69) ÷ (21 + 69)

Average Speed = 2898 ÷ 90 = 32.2 km/hr

Therefore The correct answer is 32.2 km/hr.

Alternate Method

Given:

Forward speed (S1) = 21 km/hr

Return speed (S2) = 69 km/hr

Formula Used:

Average Speed = Total Distance ÷ Total Time

If distance is 'd', then Time1 = d/21 and Time2 = d/69

Calculations:

=> Average Speed = (d + d) ÷ (d/21 + d/69)

=> Average Speed = 2d ÷ [d(69 + 21) ÷ (21 × 69)]

=> Average Speed = (2 × 21 × 69) ÷ 90

=> Average Speed = 2898 ÷ 90

=> Average Speed = 32.2 km/hr

Therefore The correct answer is 32.2 km/hr.

Additional Information

Average Speed (Equal Distances)

For three equal distances covered at speeds u, v, and w, Average Speed = (3uvw) ÷ (uv + vw + wu).

General Average Speed

Always defined as Total Distance ÷ Total Time. Use this if distances or time intervals are unequal.

Relative Speed

Objects moving in same direction: S1 − S2. Objects moving in opposite directions: S1 + S2.

Q39. Answer: (a) 13/5

Shortcut Trick

Identify the Pythagorean triplet for the given ratio: (5, 12, 13).

Since tanθ = perpendicular / base = 12/5, then perpendicular = 12 and base = 5.

Hypotenuse = $\sqrt{(12^2 + 5^2)} = 13$.

secθ = hypotenuse / base = 13/5.

Therefore The correct answer is 13/5.

Alternate Method

Given: tanθ = 12/5

Formula Used: $1 + \tan^2\theta = \sec^2\theta$

=> $\sec^2\theta = 1 + (12/5)^2$

=> $\sec^2\theta = 1 + 144/25$

=> $\sec^2\theta = (25 + 144) / 25$

=> $\sec^2\theta = 169/25$

=> $\sec\theta = \sqrt{(169/25)} = 13/5$

Therefore The correct answer is 13/5.

Additional Information

Trigonometric Identities

Standard identities: $\sin^2\theta + \cos^2\theta = 1$; $1 + \tan^2\theta = \sec^2\theta$; $1 + \cot^2\theta = \operatorname{cosec}^2\theta$.

Pythagorean Triplets

Common right-triangle sets: (3, 4, 5), (5, 12, 13), (7, 24, 25), (8, 15, 17), (9, 40, 41).

Reciprocal Relations

$\sec\theta = 1/\cos\theta$; $\operatorname{cosec}\theta = 1/\sin\theta$; $\cot\theta = 1/\tan\theta$.

Q40. Answer: (c) Increase by 0.8%

Shortcut Trick

Let TV cost = 100. Then Washing Machine (WM) cost = 60.

Initial total cost of 5 WM and 2 TV = (5 × 60) + (2 × 100) = 300 + 200 = 500.

New WM cost = 60 × 1.52 = 91.2 | New TV cost = 100 × 0.24 = 24.

New total cost = (5 × 91.2) + (2 × 24) = 456 + 48 = 504.

% Change = (504 − 500) ÷ 500 × 100 = 4 ÷ 5 = 0.8%.

Therefore The correct answer is Increase by 0.8%.

Alternate Method

Given: Cost Price (CP) of Washing Machine = 60% of TV.

=> Let CP of TV = Rs. 100; CP of Washing Machine = Rs. 60.

=> Initial cost of 5 WM and 2 TV = (5 × 60) + (2 × 100) = 300 + 200 = Rs. 500.

=> New CP of WM = 60 + (52% of 60) = 60 + 31.2 = Rs. 91.2.

=> New CP of TV = 100 − (76% of 100) = Rs. 24.

=> New total cost for 5 WM and 2 TV = (5 × 91.2) + (2 × 24) = 456 + 48 = Rs. 504.

=> Increase in total cost = 504 − 500 = Rs. 4.

=> Percentage Change = (4 ÷ 500) × 100 = 0.8%.

Therefore The correct answer is Increase by 0.8%.

Additional Information

Percentage Increase/Decrease

The percentage change is calculated as: [(New Value − Old Value) ÷ Old Value] × 100.

Weighted Average Method

When components of a group change by different percentages, the net change is the weighted average of individual percentage changes.

Successive Percentage Change

For two successive changes x% and y%, the effective change is [x + y + (xy/100)]%.

Q41. Answer: (c) 33%

Shortcut Trick

Net change formula for Markup and Discount: Profit % = m − d − (m × d)/100

Given Markup (m) = 40% and Discount (d) = 5%

Profit % = 40 − 5 − (40 × 5)/100

Profit % = 35 − 200/100 = 35 − 2 = 33%

Therefore The correct answer is 33%.

Alternate Method

Given: Cost Price (CP) = Rs. 8,900, Markup % = 40%, Discount % = 5%

=> Let CP = 100 units

=> Marked Price (MP) = 100 + 40% of 100 = 140 units

=> Selling Price (SP) = MP − Discount = 140 − 5% of 140

=> Discount = (5/100) × 140 = 7 units

=> SP = 140 − 7 = 133 units

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=> Profit % = (SP − CP)/CP × 100 = (133 − 100)/100 × 100 = 33%

Therefore The correct answer is 33%.

Additional Information

Marked Price and Discount

MP is the price set by the seller above CP. Discount is always calculated on the Marked Price: SP = MP × (100 − D%)/100.

Successive Percentage Change

Profit % can be viewed as successive change of markup (+) and discount (−). Net % = a + b + (ab/100).

CP-MP Relation Formula

CP/MP = (100 − Discount%)/(100 + Profit%). This formula is used to find the ratio between Cost Price and Marked Price directly.

Q42. Answer: (a) 53

Shortcut Trick

Teacher's age = New Average + (Original Number × Increase in Average)

New Average = 27 years | Original Number of students = 26 | Increase = 27 − 26 = 1 year

Teacher's age = 27 + (26 × 1)

Teacher's age = 27 + 26 = 53 years

Therefore The correct answer is 53 years.

Alternate Method

Given: Initial average age of 26 students = 26 years; New average age including teacher = 27 years.

Formula: Total Age = Average × Number of persons

=> Total age of 26 students = 26 × 26 = 676 years

=> Total number of persons (students + teacher) = 26 + 1 = 27

=> Total age of 27 persons = 27 × 27 = 729 years

=> Age of Teacher = Total age of 27 persons − Total age of 26 students

=> Age of Teacher = 729 − 676 = 53 years

Therefore The correct answer is 53 years.

Additional Information

Definition of Average

The average (Arithmetic Mean) is the sum of all observations divided by the total number of observations. Formula: Average = Sum ÷ Count.

Inclusion Property

When a new member is added to a group, if the average increases, the age of the new member is greater than the old average. If it decreases, the age is less than the old average.

Weighted Average

If two groups with averages A1 and A2 and counts n1 and n2 are combined, the combined average is (n1A1 + n2A2) ÷ (n1 + n2).

Q43. Answer: (d) 117

Shortcut Trick

Identify the binomial expansion components: $(p - 1)^3 = p^3 - 3p^2 + 3p - 1$ and $(q + 1)^3 = q^3 + 3q^2 + 3q + 1$.

The given expression is equivalent to $(p - 1)^3 + 1 + (q + 1)^3 - 1 = (p - 1)^3 + (q + 1)^3$.

Substitute p = 6 and q = −3: $(6 - 1)^3 + (-3 + 1)^3 = 5^3 + (-2)^3$.

Calculation: 125 − 8 = 117.

Therefore The correct answer is 117.

Alternate Method

Given: p = 6, q = −3

Formula Used: Direct substitution in the algebraic expression: $p^3 - 3p^2 + 3p + 3q + 3q^2 + q^3$

=> $p^3 - 3p^2 + 3p = 6^3 - 3(6)^2 + 3(6)$

=> 216 − 108 + 18 = 126

=> $q^3 + 3q^2 + 3q = (-3)^3 + 3(-3)^2 + 3(-3)$

=> −27 + 27 − 9 = −9

=> Total Value = 126 + (−9) = 117

Therefore The correct answer is 117.

Additional Information

Binomial Cubes

The cube of a sum $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$ and the cube of a difference $(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$.

Sum of Two Cubes

The factorization for the sum of two cubes is given by $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$.

Algebraic Substitution

Always look for patterns or identities before direct substitution to simplify complex calculations and avoid arithmetic errors.

Q44. Answer: (b) 42

Shortcut Trick

Apply the British Flag Theorem for any point P inside a rectangle ABCD:

$PA^2 + PC^2 = PB^2 + PD^2$

Substitute the given values: $98^2 + 21^2 = 91^2 + PD^2$

=> $9604 + 441 = 8281 + PD^2$

=> $10045 - 8281 = PD^2$

=> $PD^2 = 1764$ => $PD = \sqrt{1764} = 42$ cm

Therefore The correct answer is 42 cm.

Alternate Method

Given:

Length of PA = 98 cm

Length of PB = 91 cm

Length of PC = 21 cm

Formula Used:

For a rectangle ABCD and any point P in its plane, the sum of the squares of the distances from P to opposite vertices is equal:

$PA^2 + PC^2 = PB^2 + PD^2$

Calculations:

=> $PA^2 + PC^2 = PB^2 + PD^2$

=> $98^2 + 21^2 = 91^2 + PD^2$

=> $(98 \times 98) + (21 \times 21) = (91 \times 91) + PD^2$

=> $9604 + 441 = 8281 + PD^2$

=> $10045 = 8281 + PD^2$

=> $PD^2 = 10045 - 8281$

=> $PD^2 = 1764$

=> $PD = \sqrt{1764}$

=> PD = 42 cm

Therefore The correct answer is 42 cm.

Additional Information

British Flag Theorem

This theorem states that for any point P in the plane of a rectangle ABCD, the sum of the squares of the distances from P to two opposite vertices equals the sum of the squares of the distances to the other two opposite vertices: $PA^2 + PC^2 = PB^2 + PD^2$.

Pythagoras Theorem

The British Flag Theorem is derived by dropping perpendiculars from point P to the sides of the rectangle and applying the Pythagoras Theorem ($a^2 + b^2 = c^2$) to the resulting right-angled triangles.

Point Location

The theorem holds true regardless of whether the point P is inside, outside, or on the boundary of the rectangle.

Q45. Answer: (a) 63 litres

Shortcut Trick

Let total capacity be 1 unit.

Remaining after blue = $1 - 2/5 = 3/5$

Remaining after black = $3/5 \times (1 - 1/3) = 3/5 \times 2/3 = 2/5$

Remaining after yellow (White) = $2/5 \times (1 - 5/6) = 2/5 \times 1/6 = 1/15$

1/15 units = 4.2 litres => 1 unit = $4.2 \times 15 = 63$ litres.

Therefore The correct answer is 63 litres.

Alternate Method

Given: Blue liquid = 2/5, Black liquid = 1/3 of remaining, Yellow liquid = 5/6 of still remaining, White liquid = 4.2 litres.

Step-by-step Calculation:

=> Let the Total Capacity of the container be 'x' litres.

=> Quantity of Blue liquid = 2/5 of x = 2x/5

=> First Remaining quantity = x − 2x/5 = 3x/5

=> Quantity of Black liquid = 1/3 × 3x/5 = x/5

=> Second Remaining quantity = 3x/5 − x/5 = 2x/5

=> Quantity of Yellow liquid = 5/6 × 2x/5 = x/3

=> Final Remaining (White liquid) = 2x/5 − x/3

=> Taking LCM of 5 and 3 (15): (6x − 5x)/15 = x/15

=> According to question: x/15 = 4.2

=> x = 4.2 × 15

=> x = 63 litres

Therefore The correct answer is 63 litres.

Additional Information

Fractional Remainder Rule

If fractions a/b, c/d, and e/f are removed successively from a total T, the final remaining part is T × (1−a/b) × (1−c/d) × (1−e/f).

Effective Ratio

To simplify calculations involving "remaining" parts, assume the total to be the LCM of the denominators (5, 3, 6 in this case, i.e., 30 or 90).

Unitary Method in Fractions

If a fraction 'f' of a whole represents value 'V', then the whole (1 unit) is calculated as V ÷ f.

Q46. Answer: (a) 40

Shortcut Trick

Discount % = [Free Items ÷ Total Items] × 100

Here, Free Items = 4 and Paid Items = 6

Total Items = 6 + 4 = 10

Discount % = (4 ÷ 10) × 100 = 40%

Therefore The correct answer is 40%.

Alternate Method

Given: Articles bought = 6, Articles free = 4.

Formula: Discount % = (Total Discount ÷ Total Marked Price) × 100

=> Let MRP of each article = Rs. 1

=> Total MRP for 10 articles = 10 × 1 = Rs. 10

=> Selling Price (SP) = Price of 6 articles = Rs. 6

=> Discount = MRP − SP = 10 − 6 = Rs. 4

=> Discount % = (4 ÷ 10) × 100 = 40%

Therefore The correct answer is 40%.

Additional Information

Marked Price (MP)

The price printed on the article or the List Price on which discounts are calculated.

Successive Discounts

When two discounts d1 and d2 are given, the net discount = (d1 + d2 − (d1 × d2)/100)%.

Profit and Loss Relation

CP × (100 + Profit%) = MP × (100 − Discount%) allows finding the ratio of CP to MP.

Q47. Answer: (c) 234

Given:

([31/4 ÷ {11/4 - 0.5(21/2 - 1/12)}])/(5 × 1/15)

Formula Used:

a ÷ b = a × (1 ÷ b)

Calculation:

=> = ([13/4 ÷ {5/4 - 1/2(5/2 - 1/12)}])/(5/15)

=> = ([13/4 ÷ {5/4 - 1/2(29/12)}])/(1/3)

=> = ([13/4 ÷ (5/4 - 29/24)])/(1/3)

=> = ([13/4 ÷ (1/24)])/(1/3)

=> = 78/(1/3)

=> = 234

Therefore The correct answer is 234.

Q48. Answer: (b) 24

Shortcut Trick

Efficiency of A + B = 1/6 and Efficiency of B = 1/12.

Efficiency of A = (1/6) − (1/12) = 1/12.

Time taken by A for single work = 12 days.

Time taken by A for double work = 12 × 2 = 24 days.

Therefore The correct answer is 24 days.

Alternate Method

Given: Time taken by (A + B) = 6 days, Time taken by B = 12 days.

Formula Used: Total Work = LCM of days; Efficiency = Total Work ÷ Days.

Person	Days	Total Work	Efficiency
A + B	6	12 units	12 ÷ 6 = 2
B	12	12 ÷ 12 = 1	

=> Efficiency of A = Efficiency of (A + B) − Efficiency of B

=> Efficiency of A = 2 − 1 = 1 unit/day

=> Double Work = 12 × 2 = 24 units

=> Time taken by A alone for double work = 24 ÷ 1 = 24 days

Therefore The correct answer is 24 days.

Additional Information

Combined Efficiency Rule

If two people work together, their combined efficiency is the sum of their individual efficiencies: E_(total) = E1 + E2.

Work-Time Relation

Time is directly proportional to the amount of work for a constant efficiency: T1/W1 = T2/W2.

Q49. Answer: (a) 90

Given:

20% of a number + 90 = Number

Formula Used:

Percentage = (Rate ÷ 100) × Number

Calculation:

=> Let the number = x

=> 20 ÷ 100 × x + 90 = x

=> 0.2x + 90 = x

=> x − 0.2x = 90

=> 0.8x = 90

=> x = 90 ÷ 0.8

=> x = 112.5

=> 80% of the number = 80 ÷ 100 × 112.5

=> 80% of the number = 0.8 × 112.5

=> 80% of the number = 90

Therefore The correct answer is 90.

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Q50. Answer: (a) 4190

Shortcut Trick

Combine ratios A : B = 9 : 20 and B : C = 11 : 5 (inverted from C:B).

Ratio A : B : C = (9×11) : (20×11) : (20×5) = 99 : 220 : 100.

Difference |C − A| = |100 − 99| = 1 unit = 10 cm.

Total length = (99 + 220 + 100) units = 419 units = 419 × 10 = 4190 cm.

Therefore The correct answer is 4190 cm.

Alternate Method

Given: Ratio A : B = 9 : 20 and Ratio C : B = 5 : 11. Difference |A − C| = 10 cm.

Formula: To combine ratios, equate the common term B.

=> A : B = 9 : 20 (× 11) → 99 : 220

=> B : C = 11 : 5 (× 20) → 220 : 100

=> A : B : C = 99 : 220 : 100

=> Length of C − Length of A = 100x − 99x = 1x

=> 1x = 10 cm

=> Total Length = (99 + 220 + 100)x = 419x

=> Total Length = 419 × 10 = 4190 cm

Therefore The correct answer is 4190 cm.

Additional Information

Compound Ratio

When two or more ratios are multiplied together, the result is the compound ratio. For A:B and B:C, the combined ratio is found by making B common.

Ratio Scaling

To compare ratios like A:B and B:C, multiply the first ratio by the B-value of the second, and the second ratio by the B-value of the first.

Proportion Rule

If a : b = c : d, then Product of Extremes (a×d) = Product of Means (b×c).

Q51. Answer: (d) ZZW

The logic followed here is:

Option 1) NMK

Option 2) IHF

Option 3) UTR

Option 4) ZZW

Here, 'ZZW' is odd among the given options.

Hence, the correct answer is "Option 4".

Q52. Answer: (d) OSN

The logic followed here is:

Option 1) LPJ

Option 2) GKE

Option 3) NRL

Option 4) OSN

Here, 'OSN' is odd among the given options.

Hence, the correct answer is "Option 4".

Q53. Answer: (d) One

Given: O, P, Q, R, W, X and Y are sitting in a straight line, facing north.

Only two people sit to the left of P.

Only three people sit between P and W.

Only one person sits between W and X.

R sits to the immediate left of O.

Y is not an immediate neighbour of W.

So, only one person sits to the right of Q.

Hence, the correct answer is "Option 4".

Q54. Answer: (c) bm

The logic followed here is:

'house sip head' is coded as 'bm ma px',

'head wood robot' is coded as 'pz bm ey'.

Here, the common word in both sentences is 'head'.

Now, look at the codes:

The common code in both code groups is 'bm'.

So,

Code for 'head' is 'bm'.

Hence, the correct answer is "Option 3".

Q55. Answer: (b) 794

BODMAS Table:

Given equation:

84 − 6 ÷ 371 + 648 × 8 = ?

Now, if '+' means '–', '–' means '×', '×' means '÷' and '÷' means '+', then:

=> 84 × 6 + 371 − 648 ÷ 8 = ?

Now apply BODMAS:

=> 84 × 6 + 371 − 81 = ?

=> 504 + 371 − 81 = ?

=> 875 − 81 = 794.

Hence, the correct answer is "Option 2".

Q56. Answer: (d) LFI50

The logic followed here is:

So, 'LFI50' will replace the question mark in the given series.

Hence, the correct answer is "Option 4".

Q57. Answer: (c) Four

Given: Seven people B, C, D, I, J, K and L are sitting in a straight line facing north.

Only two people sit to the right of C. So, C is third from the right.

Only three people sit between C and D. So, D is at the extreme left.

Only two people sit between C and B. So, B is placed accordingly leaving two people between C and B.

Only two people sit between D and K. So, K is placed leaving two people between D and K.

J sits to the immediate right of I. So, I and J occupy the remaining consecutive places.

And, L will sit at the remaining place.

Now, only one person sits to the right of L.

Hence, the correct answer is "Option 3".

Q58. Answer: (d) Neither conclusion (I) nor (II) follows.

Given Statements:

Some pizzas are cupcakes.

All buns are cupcakes.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some pizzas are buns - False (Because, No definite relation is given between pizzas and buns. They may or may not overlap. Hence, it is possible only.)

II. All cupcakes are buns - False (Because, All buns are cupcakes does not mean all cupcakes are buns. Cupcakes can have elements other than buns.)

So, Neither conclusion I nor II follow.

Hence, the correct answer is "Option 4".

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Q59. Answer: (a) FADE - EAFD - ADFE

The position and positional values or English Alphabets are:

URIC → CRUI → RIUC

KIDS → SIKD → IDKS

Now,

URIC → CRUI

Here, the last letter comes to first position, and the first three letters shift one position to the right.

CRUI → RIUC

Again, the last letter comes to first position, and remaining letters shift right.

So, it is a cyclic right shift pattern.

Now, let's check each Option One by One.

Option 1) FADE → EAFD → ADFE

Option 2) OPEN → OEPN → NEPO

Option 3) NAVY → YANV → VANY

Option 4) MALE → AMLE → EALM

So, Only FADE → EAFD → ADFE follows the pattern of given letter cluster.

Hence, the correct answer is 'Option 1'.

Q60. Answer: (d) 602

The logic followed here is:

thus, "602" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q61. Answer: (a) 46

BODMAS Table:

Given equation:

15 A 3 B 10 C 8 D 12 = ?

Now, if ‘A’ stands for ‘÷’, ‘B’ stands for ‘×’, ‘C’ stands for ‘+’ and ‘D’ stands for ‘−’, then:

=> 15 ÷ 3 × 10 + 8 − 12 = ?

Now apply BODMAS:

=> 5 × 10 + 8 − 12 = ?

=> 50 + 8 − 12 = ?

=> 58 − 12 = 46.

Hence, the correct answer is "Option 1".

Q62. Answer: (d) PN −6

The logic followed here is:

For, RR 4 is related to UQ −14

For, II 8 is related to LH −10

Similarly, for MO 12

So, MO 12 will be related to PN −6.

Hence, the correct answer is "Option 4".

Q63. Answer: (a) 760

BODMAS Table:

Given equation:

173 − 3 ÷ 282 + 164 × 4 = ?

Now, if ‘+’ means ‘−’, ‘−’ means ‘×’, ‘×’ means ‘÷’ and ‘÷’ means ‘+’, then:

=> 173 × 3 + 282 − 164 ÷ 4 = ?

Now apply BODMAS:

=> 173 × 3 + 282 − 41 = ?

=> 519 + 282 − 41 = ?

=> 801 − 41 = 760.

Hence, the correct answer is "Option 1".

Q64. Answer: (a) (13, 39, 3)

The logic followed here is:
Logic: (1st number) × (3rd number) = 2nd number.
Given,
14 : 42 : 3
=> 14 × 3
=> 42
And,
12 : 60 : 5
=> 12 × 5
=> 60
Now, checking the options:
Option 1) 13 : 39 : 3
=> 13 × 3
=> 39
Option 2) 11 : 55 : 6
=> 11 × 6
=> 66 ≠ 55
Option 3) 15 : 45 : 4
=> 15 × 4
=> 60 ≠ 45
Option 4) 16 : 42 : 2
=> 16 × 2
=> 32 ≠ 42
Hence, the correct option is "Option 1".

Q65. Answer: (c) 7 km to the north

Given:
Alex starts from Point A and drives 8 km towards the east.
He then takes a left turn, drives 6 km, turns left and drives 17 km.
He then takes a left turn and drives 13 km.
He takes a final left turn, drives 9 km and stops at Point P.
So, He should drive 7 km to the north in order to reach Point A again.
Hence, the correct answer is "Option 3".

Q66. Answer: (d) 961

The logic followed here is:
thus, "961" will replace the question mark in the given series.
Hence, the correct option is "Option 4".

Q67. Answer: (b) 63

Given:
Madhur is 58th from the top,
Madhur is 6th from the bottom.
Total number of students = 58 + 6 − 1 = 63.
So, there are '63' students in the class.
Hence, the correct answer is "Option 2".

Q68. Answer: (d) 2

Given: (Left) 8 $ 3 Ω 9 % 4 6 7 1 * £ 5 # 2 + @ & (Right)
Now,
Symbols which is immediately preceded by a number and also immediately followed by another symbol.

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So, Needed pattern is: Number - Symbol - Symbol.

There are 2 Symbols which is immediately preceded by a number and also immediately followed by another symbol.

Hence, the correct answer is 'Option 4'.

Q69. Answer: (c) Only conclusion (II) follows.

Given Statements:

Some hats are caps.

No cap is a vest.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some hats are vests - False (Because, Caps do not overlap with vests, and the hats that overlap with caps cannot be vests. There is no definite relation given between hats and vests. Hence, it is possible only.)

II. Some caps are hats - True (Because, Some hats are caps clearly implies that some caps are hats.)

So, Only conclusion II follows.

Hence, the correct answer is "Option 3".

Q70. Answer: (d) 181

The logic followed here is:

thus, "181" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q71. Answer: (d) 25 km towards east

Given:

Ajay starts from Point A and drives 16 km towards the west.

He then takes a right turn, drives 8 km, then turns left and drives 7 km.

He then takes a left turn and drives 8 km.

He takes a final right turn, drives 2 km, and stops at Point P.

So, He should drive 25 km towards east in order to reach Point A again.

Hence, the correct answer is "Option 4".

Q72. Answer: (a) Four

Given: (Left) 4 6 5 8 2 2 1 8 2 9 8 4 7 4 8 2 4 3 1 4 1 2 7 2 6 (Right)

Now,

Numbers which is immediately preceded by a perfect square and also immediately followed by a perfect square.

So, Needed pattern is: Perfect Square - Number - Perfect Square.

There are Four Numbers (984, 474, 431, 141) which is immediately preceded by a perfect square and also immediately followed by a perfect square.

Hence, the correct answer is 'Option 1'.

Q73. Answer: (b) None

Given: (Left) 6 5 8 8 5 4 7 7 4 2 7 9 2 2 5 7 4 8 8 2 1 8 9 (Right)

Now,

Odd digits which is immediately preceded by an odd digit and also immediately followed by an odd digit.

So, Needed pattern is: Odd - Odd - Odd.

There are None Odd digits which is immediately preceded by an odd digit and also immediately followed by an odd digit.

Hence, the correct answer is 'Option 2'.

Q74. Answer: (b) Wife's father's sister

Family Chart:

Decoding the Symbols:

Symbol	•	@	•	#
Meaning	Sister	Brother	Wife	Father

Given: ‘O + P # T @ G - V’

It means: O is the Sister of P, P is the Father of T, T is the Brother of G, G is the Wife of V.

So, O is the Wife's father's sister of V.

Hence, the correct answer is "Option 2".

Q75. Answer: (c) 27

Given:

Radhika is 21st from the top,

Radhika is 7th from the bottom.

Total number of students = 21 + 7 − 1 = 27.

So, there are '27' students in the class.

Hence, the correct answer is "Option 3".

Q76. Answer: (b) NFR

The Logic followed here is:

Hence, the correct answer is "Option 2".

Q77. Answer: (d) TS 1

The Logic followed here is:

UI 12 is related to YK -2

And,

OL 9 is related to SN -5

Similarly,

PQ 15 is related to

Hence, the correct answer is "Option 4".

Q78. Answer: (c) Four

Given: Seven people, A, B, C, D, E, F and G, are sitting in a row, facing north.

1) Only five people sit to the right of A.

2) Only five people sit to the left of B.

3) F is the immediate neighbour of G and E.

4) C sits second to the left of E.

After positioning all, the remaing position will be occupied by the only person left i.e. D.

Thus, four people sit to the left of G.

Hence, "Option 3" is the correct answer.

Q79. Answer: (c) 8

According to the question:

Thus, 'E' is coded as '8'.

Hence, "Option 3" is the correct answer.

Q80. Answer: (a) 3

Given series: (Left) 2 8 2 3 2 7 9 3 5 4 6 8 9 4 4 7 8 7 5 4 3 5 5 6 2 9 8 (Right)

Required condition: Odd number ← Odd number → Odd number

(Left) 2 8 2 3 2 7 9 3 5 4 6 8 9 4 4 7 8 7 5 4 3 5 5 6 2 9 8 (Right)

There are three such odd numbers, each of which is immediately preceded by an odd number and also immediately followed by an odd number.

Hence, the correct answer is “Option 1”.

Q81. Answer: (d) Bal Sahitya Puraskar

The correct answer is Bal Sahitya Puraskar.

Key Points

• Bal Sahitya Puraskar is an award presented by the Sahitya Akademi, India’s National Academy of Letters, to recognize outstanding contributions in children's literature.

• The award covers works written in 22 recognized Indian languages as per the Eighth Schedule of the Constitution of India, including Hindi, English, Bengali, Tamil, and others.

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• It is awarded annually and aims to promote children's literature and encourage writers who contribute significantly to this genre.

• The award includes a citation, a shawl, and a monetary prize, acknowledging the efforts of authors in enhancing literary culture for children.

• The Bal Sahitya Puraskar was instituted by the Sahitya Akademi in 2010 to fill the gap in recognizing literary excellence in children's literature.

Additional Information

• Sahitya Akademi:

• The Sahitya Akademi was established in 1954 as an autonomous organization under the Government of India to promote literature in Indian languages.

• It recognizes works in 24 languages, including English and Rajasthani, in addition to the 22 scheduled languages of the Constitution.

• It also confers awards like the Sahitya Akademi Award and Sahitya Akademi Yuva Puraskar to honor literary excellence.

• Children's Literature in India:

• Children's literature in India includes folk tales, moral stories, and contemporary fiction written for young audiences.

• Renowned authors like Ruskin Bond, R.K. Narayan, and Sudha Murthy have significantly contributed to this genre.

• Sahitya Akademi Yuva Puraskar:

• This award recognizes promising young authors below the age of 35 years for their literary contributions in 24 languages.

• It was instituted in 2011 to encourage young literary talent in India.

• Other Literary Awards in India:

• Padma Shri: One of India's highest civilian honors, awarded for distinguished contributions in various fields, including literature.

• Sahitya Ratna: This is not a nationally recognized award but is used by various organizations to honor literary achievements.

Important Points

• The Bal Sahitya Puraskar is specifically designed to recognize children's literature, which is distinct from other literary awards meant for general or adult literature.

• The award promotes the importance of nurturing a reading habit among children, emphasizing the role of literature in shaping young minds.

• The inclusion of 22 languages ensures the representation of diverse cultural and linguistic groups in India.

• The award has encouraged many authors to venture into children's literature, enriching the literary landscape of the country.

Q82. Answer: (b) Reserve Bank of India

The correct answer is Reserve Bank of India.

Key Points

• The Reserve Bank of India (RBI) shifted its Andhra Pradesh regional office to Vijayawada and inaugurated the new premises on 16 June 2025.

• The decision to relocate the office aligns with the reorganization of Andhra Pradesh and the establishment of Amaravati as its capital region, which led to Vijayawada becoming a major administrative hub.

• The RBI regional office in Vijayawada will cater to the banking and financial needs of the state, ensuring better accessibility and operational efficiency for stakeholders.

• The move is also aimed at strengthening the RBI's presence in Andhra Pradesh, which is an important state for agriculture, industry, and commerce.

• The inauguration was attended by top officials from the RBI and state government, emphasizing the importance of this development in fostering economic growth in the region.

Additional Information

• Reserve Bank of India (RBI):

• The RBI is India's central bank and regulatory authority responsible for managing the country's monetary policy and ensuring financial stability.

• It was established on 1 April 1935, under the Reserve Bank of India Act, 1934.

• The RBI is headquartered in Mumbai, and it oversees banking regulations, currency issuance, and the management of foreign exchange reserves.

• It plays a pivotal role in implementing government policies to facilitate economic growth and stability.

• Regional Offices of the RBI:

• The RBI operates through a network of regional offices across India to ensure efficient administration and monitoring of financial institutions.

• These offices handle various functions, such as banking supervision, currency management, financial inclusion initiatives, and public grievance redressal.

• Economic Importance of Vijayawada:

• Vijayawada, located on the banks of the Krishna River, is a major commercial and administrative hub in Andhra Pradesh.

• The city is known for its agriculture, trade, and connectivity, with a robust transportation network comprising railways, roadways, and airways.

• It has emerged as a key center for government offices and businesses following the reorganization of Andhra Pradesh in 2014.

• Banking and Financial Sector in Andhra Pradesh:

• Andhra Pradesh is home to a diverse economy with significant contributions from agriculture, aquaculture, manufacturing, and IT services.

• The establishment of the RBI office in Vijayawada is expected to enhance financial inclusion and provide better support to industries and entrepreneurs in the region.

Important Points

• Reorganization of Andhra Pradesh:

• The state of Andhra Pradesh was reorganized in 2014, leading to the formation of Telangana as a separate state.

• Amaravati was proposed as the new capital region of Andhra Pradesh, with Vijayawada playing a key role in its administrative framework.

• Role of the RBI in Regional Development:

• The RBI's presence in a region facilitates better banking supervision, policy implementation, and financial services.

• It also helps in fostering economic growth by ensuring the availability of credit and financial services to key sectors like agriculture and MSMEs (Micro, Small, and Medium Enterprises).

Q83. Answer: (b) Senior Citizens Welfare Portal

The correct answer is Senior Citizens Welfare Portal.

Key Points

• The Union Ministry of Social Justice and Empowerment launched the Senior Citizens Welfare Portal during the 'Ageing with Dignity' event held in May 2025.

• The portal was developed to address the growing needs of India's elderly population, ensuring their access to welfare services, healthcare, and social support systems.

• This digital initiative aims to create a centralized platform for senior citizens to avail various government schemes and services efficiently.

• The portal also includes features like helpline services, financial assistance tools, and information dissemination to empower senior citizens and improve their quality of life.

• The launch of this portal aligns with the government's commitment to promoting age-inclusive policies and ensuring the dignity, security, and welfare of the elderly.

Additional Information

• India's Ageing Population:

• As per the Census 2011, India has around 104 million senior citizens, with this number expected to increase significantly by 2050.

• The country faces challenges in providing adequate healthcare, financial security, and social engagement for its ageing population.

• Government Initiatives for Senior Citizens:

• The Integrated Programme for Senior Citizens (IPSrC) provides financial assistance to NGOs for running elderly care homes and day-care centers.

• The Rashtriya Vayoshri Yojana distributes physical aids and assistive devices to senior citizens belonging to below poverty line (BPL) families.

• The Maintenance and Welfare of Parents and Senior Citizens Act, 2007 ensures legal protection for elderly individuals against neglect and abuse.

• Digital Initiatives for Senior Citizens:

• Digital platforms like the Senior Citizens Welfare Portal aim to bridge the gap between technology and elderly care.

• These platforms provide access to healthcare services, financial planning tools, and social interaction opportunities, fostering independence among senior citizens.

• Employment Exchange Portal for Senior Citizens:

• This portal facilitates the re-employment of senior citizens in various sectors, utilizing their experience and expertise.

• It is particularly beneficial for retired professionals seeking to contribute to the workforce or engage in part-time employment.

• Digital Life Certificate Platform:

• Launched under the Jeevan Pramaan initiative, this platform enables pensioners to submit their life certificates online without

visiting banks or government offices.

• It uses biometric authentication to ensure security and ease of use for senior citizens.

Important Points

• Key Features of Senior Citizens Welfare Portal:

• Centralized access to government schemes and welfare programs.

• Integration with helpline services for emergency assistance and counseling support.

• Dedicated sections for financial planning, healthcare resources, and legal aid.

• Regular updates on policy changes and new initiatives for senior citizens.

• Global Trends in Elderly Care:

• Countries like Japan and Sweden have implemented advanced technologies like robotic caregivers and smart homes for elderly care.

• India is gradually adopting similar digital solutions to address challenges related to its ageing population.

Q84. Answer: (b) South Africa

The correct answer is South Africa.

Key Points

• The ICC Women's U19 T20 World Cup 2025 was won by India, marking a significant achievement for the country in women's cricket history.

• India defeated South Africa in the final to secure the championship title. This victory highlighted India's dominance in the tournament.

• The tournament witnessed exceptional performances by young Indian cricketers, showcasing their talent and potential for the future of women's cricket in India.

• The final match was held in a high-energy environment, and India's win was a testament to their consistent performance throughout the tournament.

• This victory is particularly notable as it continues India's strong legacy in cricket and strengthens the country's position in international women's cricket competitions.

Additional Information

• ICC Women's U19 T20 World Cup:

• This tournament is an initiative by the International Cricket Council (ICC) to promote women's cricket at the grassroots level.

• The first-ever ICC Women's U19 T20 World Cup was held in 2023, and it aims to provide a platform for young female cricketers to showcase their talent on an international stage.

• It is played in the T20 format, which is known for its fast-paced and exciting nature, attracting younger audiences.

• India's Performance in Women's Cricket:

• India has been consistently improving in international women's cricket, with notable achievements in various ICC tournaments.

• The victory in the U19 T20 World Cup 2025 highlights the strength of India's cricket development programs for young players.

• Key players like Shafali Verma and Smriti Mandhana have inspired many young girls to take up cricket as a career.

• South Africa's Role in the Final:

• South Africa played exceptionally well throughout the tournament and reached the final by showcasing strong team performance and resilience.

• Their journey to the final is a reflection of the growing competitiveness in women's cricket globally.

• Impact of the Tournament:

• The ICC Women's U19 T20 World Cup serves as a stepping stone for young players to transition into senior-level cricket.

• It encourages countries to invest more in their women's cricket infrastructure and talent development programs.

• The success of such tournaments helps in increasing the visibility of women's cricket and inspires the next generation of players worldwide.

Q85. Answer: (b) Ashoka Chakra

The correct answer is Ashoka Chakra.

Key Points

• India set a new Guinness World Record in 2025 for the largest human formation of the Ashoka Chakra, a symbol of peace, dharma, and progress.

• The event took place with the participation of thousands of people who came together to form the intricate design of the Ashoka Chakra, which is featured prominently on the Indian national flag.

• The Ashoka Chakra consists of 24 spokes, representing the 24 virtues such as love, courage, patience, and righteousness,

which are significant in Indian cultural and philosophical heritage.

• This record-breaking event was organized to promote unity, patriotism, and the values that the Ashoka Chakra symbolizes in Indian society.

• The Guinness World Record team verified the formation's accuracy and adherence to the dimensions of the Ashoka Chakra as depicted on the national flag.

Additional Information

• Ashoka Chakra:

• The Ashoka Chakra is derived from the Lion Capital of Ashoka at Sarnath, which is one of the most prominent symbols of India's rich heritage.

• It represents the wheel of dharma, embodying the principles of truth, justice, and progress.

• The 24 spokes in the chakra symbolize the life cycle and virtues essential for maintaining harmony and balance.

• It is prominently displayed in the center of the Indian national flag, signifying motion and dynamism.

• Significance of Guinness World Records:

• Guinness World Records is an internationally recognized authority for documenting extraordinary feats and achievements.

• India has consistently set records in various domains, showcasing its cultural, social, and scientific achievements.

• Events like the formation of the Ashoka Chakra highlight the nation's unity and collective spirit.

• Other Notable Symbols:

• Heart Shape: Globally recognized as a symbol of love and compassion.

• Olympic Rings: Representing the unity of five continents and the Olympic spirit.

• Peace Symbol: Widely used to signify harmony and the absence of conflict.

• Historical Context of the Ashoka Chakra:

• The chakra is named after Emperor Ashoka, one of India's greatest rulers, who embraced Buddhism and propagated values of peace and dharma.

• It is a reminder of India's commitment to universal values and moral principles.

Important Points

• Guinness World Record Verification:

• The record-breaking formation required precise planning and execution to accurately depict the Ashoka Chakra.

• Participants were trained to understand the design and significance of the symbol.

• Such events foster patriotism and are a celebration of India's national identity.

• Role of Symbols in National Identity:

• Symbols like the Ashoka Chakra play a pivotal role in expressing the ethos and values of a nation.

• They are used in national events, government documents, and cultural representations.

• Educational programs often emphasize their importance to instill respect and pride in citizens.

Q86. Answer: (b) Para-Athletics

The correct answer is Para-Athletics.

Key Points

• Para-Athletics had the most recipients of the Arjuna Awards in January 2025, recognizing the exceptional achievements of Indian athletes with disabilities in various sports disciplines.

• The Arjuna Award is one of India's most prestigious national sports honors, aimed at acknowledging outstanding performance in sports and games.

• A significant number of Para-Athletes received the Arjuna Award due to their remarkable contributions, including medals in international competitions such as the Paralympics and World Para-Athletics Championships.

• The increased recognition for Para-Athletics showcases India's focus on promoting inclusive sports culture and supporting athletes with disabilities.

• Prominent awardees include athletes excelling in events like track and field, wheelchair sports, and powerlifting, among others, making Para-Athletics the leading category in terms of awardees.

Additional Information

• Arjuna Award:

• Established in 1961, the Arjuna Award honors excellence in sports and is conferred by the Ministry of Youth Affairs and Sports, Government of India.

• Recipients are selected based on their performance at national and international levels, as well as their ability to inspire others through sports.

• The award includes a bronze statuette of Arjuna, a certificate, and a cash prize.

• It recognizes achievements in both Olympic and Paralympic sports, as well as indigenous and non-Olympic sports.

• Para-Athletics:

• Para-Athletics is a category of sports designed for athletes with physical disabilities, featuring events like running, jumping, throwing, and wheelchair racing.

• India has made significant strides in Para-Athletics, with athletes like Devendra Jhajharia and Mariyappan Thangavelu achieving global recognition.

• The Paralympic Games serve as the pinnacle event for Para-Athletes, offering opportunities to compete at the highest level.

• India's Para-Athletes have brought home numerous medals from events like the Tokyo 2020 Paralympics, boosting awareness and support for disabled athletes.

• Inclusive Sports Initiatives:

• The Government of India has launched several schemes to promote sports among disabled individuals, such as the Khelo India Programme.

• Specialized training centers and funding mechanisms have been established to provide world-class facilities and support for Para-Athletes.

• Programs like Target Olympic Podium Scheme (TOPS) have been extended to Para-Athletes, ensuring they receive adequate financial and coaching support.

• Other Sports Categories:

• Hockey: Historically a popular category for Arjuna Award recipients due to India’s legacy in international hockey tournaments.

• Athletics: Covers track and field events, with awardees often excelling in international competitions like the Olympics and Asian Games.

• Shooting: A high-achieving category where Indian shooters have won multiple medals in events like the Olympics and Commonwealth Games.

Important Points

• Recognition for Para-Athletes:

• Para-Athletes receiving the Arjuna Award signifies growing support for inclusive sports.

• India’s performance in Para-Athletics on global platforms has led to increased acknowledgment and funding opportunities.

• These awards encourage more disabled individuals to pursue sports professionally.

• Role of Government:

• Various government schemes, including the National Sports Development Fund, aim to support athletes with disabilities.

• The Ministry of Youth Affairs and Sports ensures that Para-Athletes have access to modern equipment, training, and coaching facilities.

• Government recognition through awards like Arjuna highlights the importance of fostering an inclusive environment in sports.

Q87. Answer: (b) Nearly 11,000

The correct answer is Nearly 11,000.

Key Points

• As of 7 July 2025, India has nearly 11,000 biotech startups, according to the Government of India. This marks a significant growth from just 50 biotech startups a decade ago (2015).

• The biotech industry in India has been growing at a rapid pace due to increased government initiatives, funding, and policy support aimed at fostering innovation and entrepreneurship in the sector.

• India's biotech sector is supported by initiatives like Make in India and Startup India, which encourage innovation in fields such as healthcare, agriculture, bioinformatics, and industrial biotechnology.

• The country is now among the top 12 biotech destinations globally and ranks third in the Asia-Pacific region.

• The establishment of biotech parks, incubators, and research institutions, coupled with government schemes, has created a favorable ecosystem for startups in the biotechnology domain.

Additional Information

• Biotechnology Industry in India:

• The Indian biotechnology industry is valued at approximately $100 billion, with projections to grow exponentially in the coming years.

• It is divided into five major segments: biopharma, bioagriculture, bioindustry, bioinformatics, and bioservices.

• India is one of the largest producers of vaccines in the world and is a major exporter of generic medicines and biopharmaceuticals.

• Government Initiatives for Biotech Growth:

• Biotechnology Industry Research Assistance Council (BIRAC): A public sector enterprise that promotes innovation and entrepreneurship in the biotech industry by providing financial and infrastructural support.

• National Biotechnology Development Strategy: Aims to establish India as a global hub for biotechnology innovation and manufacturing by promoting research and entrepreneurship.

• Startup India Initiative: Provides funding, mentoring, and incubation support to startups, including those in biotechnology.

• Applications of Biotechnology:

• Used in healthcare for drug development, gene therapy, and diagnostics.

• Plays a vital role in agriculture through genetically modified crops and biofertilizers.

• Contributes to industrial applications such as bioplastics, biofuels, and environmental conservation.

• Global Standing of Indian Biotechnology:

• India ranks among the top 12 biotech destinations globally and is recognized for its affordable innovation.

• Major Indian biotech companies include Biocon, Serum Institute of India, Panacea Biotech, and Dr. Reddy's Laboratories.

Important Points

• Biotech Parks in India:

• India has established numerous biotech parks, including Genome Valley in Hyderabad, the Biotech Park in Lucknow, and the Biotechnology City in Bangalore, to promote research, development, and entrepreneurship.

• These parks provide state-of-the-art infrastructure, R&D facilities, and funding opportunities for startups and researchers.

• Key Challenges in Biotech Sector:

• Lack of sufficient funding for early-stage startups and high R&D costs.

• Stringent regulatory policies and intellectual property issues pose significant hurdles.

• Limited availability of skilled manpower in niche areas of biotechnology.

Q88. Answer: (b) One World for Health

The correct answer is One World for Health.

Key Points

• The 78th World Health Assembly, held in May 2025 in Geneva, focused on the theme "One World for Health," emphasizing the need for global collaboration in tackling health challenges.

• The theme highlighted the importance of a unified global response to health crises such as pandemics, climate change, and inequities in healthcare systems.

• It stressed the significance of cross-border partnerships to strengthen healthcare infrastructure, promote equity, and achieve sustainable health outcomes worldwide.

• This initiative aimed at aligning the efforts of various countries, organizations, and stakeholders towards the goal of Universal Health Coverage (UHC) and ensuring equitable access to healthcare for all populations.

• The Assembly brought together health ministers, policymakers, and international organizations to discuss strategies for building resilient health systems capable of addressing future global health challenges.

Additional Information

• World Health Assembly:

• The World Health Assembly (WHA) is the decision-making body of the World Health Organization (WHO).

• It is attended by delegations from all WHO Member States and focuses on key health issues and policies affecting global populations.

• The WHA meets annually in Geneva, Switzerland, and serves as a platform for global health discussions.

• Universal Health Coverage (UHC):

• UHC refers to ensuring that all individuals and communities have access to essential health services without financial hardship.

• It is a key component of the United Nations Sustainable Development Goals (SDG 3), which aims to achieve health and well-being for all.

• Efforts under UHC include improving healthcare infrastructure, reducing inequalities, and providing affordable healthcare services.

• Health Challenges Discussed:

• The Assembly addressed pressing global health issues such as the COVID-19 pandemic, emerging infectious diseases, and vaccine equity.

• It also focused on climate change and its impact on health, especially in vulnerable regions such as low-income countries.

• Strategies were discussed to enhance global preparedness and response to health emergencies.

• Global Health Partnerships:

• The theme "One World for Health" underlined the importance of partnerships between nations, NGOs, and international organizations like the WHO, UNICEF, and GAVI.

• These partnerships aim to ensure equitable distribution of health resources, including vaccines and medical supplies.

• Collaborations also focused on capacity building in low-resource settings to strengthen healthcare systems.

Important Points

• Global Health Funding:

• The WHA emphasized the role of global health financing to achieve equitable healthcare delivery.

• It called for sustained investments in healthcare systems, particularly in developing countries.

• Funding priorities included pandemic preparedness, vaccine development, and primary healthcare systems.

• Climate Change and Health:

• The Assembly discussed the impact of climate change on global health, including rising temperatures, vector-borne diseases, and air pollution.

• It encouraged member states to integrate climate resilience into their health policies and action plans.

• Future Directions:

• The WHA set future goals to achieve global health equity by improving access to quality healthcare.

• It also proposed the creation of an international framework to enhance pandemic preparedness and response mechanisms.

Q89. Answer: (b) Tripura

The correct answer is Tripura.

Key Points

• Tripura became the third Indian state to achieve the status of being fully functionally literate under the ULLAS – New India Literacy Programme in June 2025.

• The state achieved functional literacy by ensuring that all individuals above the age of 15 could read, write, and perform basic arithmetic operations, a significant milestone in improving education accessibility.

• The ULLAS – New India Literacy Programme aims to provide universal functional literacy and numeracy to individuals in the age group of 15 and above who missed the opportunity for formal schooling.

• Tripura follows the path of two other states, Kerala and Bihar, which were earlier recognized as fully functionally literate states.

• The initiative was implemented with the active participation of teachers, volunteers, and community members, which significantly contributed to the state's success.

Additional Information

• ULLAS – New India Literacy Programme:

• ULLAS stands for Understanding Lifelong Learning for All in Society and is an initiative by the Government of India to eradicate adult illiteracy.

• It targets individuals aged 15 and above who were unable to complete formal education, focusing on basic literacy, numeracy, and life skills.

• The program uses innovative teaching methods, including digital platforms, for effective outreach and participation.

• ULLAS aligns with the broader goals of Sustainable Development Goal 4 (SDG 4) – Quality Education, ensuring inclusive and equitable education for all.

• Functional Literacy:

• Functional literacy refers to the ability of an individual to read, write, and perform basic arithmetic operations necessary for day-to-day functioning and economic participation.

• This includes skills such as filling out forms, reading labels, and performing calculations like budgeting and financial transactions.

• Achieving functional literacy is considered a crucial step toward reducing poverty and enhancing individual empowerment.

• Tripura's Literacy Achievements:

• Tripura has consistently performed well in literacy indicators, with a literacy rate of over 87% (as per the 2011 Census).

• The state's government has implemented numerous literacy campaigns, including adult education programs, to ensure inclusive educational development.

• Kerala's Functional Literacy:

• Kerala was the first Indian state to achieve complete literacy in 1991 and continues to lead in educational advancements.

• The state emphasizes universal education access, with significant investments in public education and teacher training programs.

Important Points

• Government Initiatives to Promote Literacy:

• Saakshar Bharat: A Government of India program launched in 2009 to promote adult literacy, especially among women and marginalized groups.

• National Literacy Mission (NLM): Established in 1988, the NLM aims to eradicate illiteracy among adults aged 15 and above by promoting voluntary literacy campaigns.

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• Digital Literacy Campaigns: Efforts to enhance digital literacy among rural populations, such as the Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA).

• Global Context:

• According to the UNESCO Institute for Statistics, approximately 773 million adults worldwide lack basic literacy skills as of 2023.

• India's literacy initiatives contribute significantly to global efforts to achieve universal literacy under SDG 4.

Q90. Answer: (c) Sangareddy

The correct answer is Sangareddy.

Key Points

• The chemical factory blast on 30 June 2025 occurred in Sangareddy, a district in the Indian state of Telangana.

• Sangareddy is known for its industrial setup, including pharmaceutical and chemical factories, which may pose risks due to mishandling of chemicals or technical failures.

• Such incidents in industrial areas highlight the importance of stringent safety protocols and regular audits to prevent accidents.

• The blast led to significant damage in the vicinity and raised concerns about industrial safety standards in the region.

• Authorities initiated an investigation to determine the cause of the explosion, which could include factors like chemical reactions, equipment failure, or human error.

Additional Information

• Sangareddy District:

• Sangareddy is located in the Indian state of Telangana and serves as a hub for various industries, particularly in the sectors of pharmaceuticals, chemicals, and manufacturing.

• It is situated close to the state capital, Hyderabad, making it a strategic location for industrial development.

• The district also houses the Patencheru Industrial Area, which is one of the major industrial zones in Telangana.

• Industrial Accidents:

• Industrial accidents occur due to factors like negligence in safety measures, equipment failure, improper handling of chemicals, or lack of training for workers.

• Such incidents may lead to loss of lives, injuries, property damage, and environmental degradation.

• They highlight the need for stringent enforcement of Occupational Safety and Health (OSH) regulations.

• Safety Measures in Chemical Factories:

• Regular inspection and maintenance of machinery and equipment are crucial to prevent technical failures.

• Implementation of Standard Operating Procedures (SOPs) and training for workers to handle hazardous materials safely.

• Proper storage and labeling of chemicals to avoid accidents due to incorrect handling.

• Emergency response systems, including firefighting equipment, evacuation plans, and medical facilities, are essential to mitigate the impact of accidents.

• Examples of Industrial Accidents:

• The Bhopal Gas Tragedy in 1984 is one of the most infamous industrial disasters, caused by the leakage of methyl isocyanate from a pesticide plant in Madhya Pradesh.

• The Visakhapatnam Gas Leak in 2020 involved the leakage of styrene gas from a chemical plant, causing deaths and health issues.

• Such incidents emphasize the importance of learning from past failures and implementing preventive measures.

Important Points

• Legal Framework:

• The Factories Act of 1948 governs the safety, health, and welfare of workers in factories in India.

• It mandates employers to provide proper safety equipment, training, and emergency response mechanisms.

• Failure to comply with safety regulations can lead to legal penalties and closure of operations.

• Environmental Impact:

• Chemical blasts can result in air and water pollution, affecting nearby communities and ecosystems.

• Proper disposal and containment of hazardous waste are necessary to minimize long-term environmental damage.

• Government Initiatives:

• The National Disaster Management Authority (NDMA) provides guidelines for managing industrial disasters and mitigating risks.

• State governments often collaborate with industries to conduct safety audits and ensure compliance with regulations.

Q91. Answer: (d) Gandhinagar

The correct answer is Gandhinagar.

Key Points

• The National Conference on Good Governance was organized by the Department of Administrative Reforms and Public Grievances (DARPG) in January 2025.

• The conference aimed to promote effective governance practices and foster transparency, accountability, and citizen-centric administration.

• Gandhinagar, the capital city of Gujarat, was chosen as the venue for this significant event.

• The conference witnessed participation from government officials, policy experts, and representatives from various states to share best practices and innovations in governance.

• The event focused on discussions related to digital transformation in public administration, grievance redressal mechanisms, and citizen engagement strategies.

Additional Information

• Department of Administrative Reforms and Public Grievances (DARPG):

• The DARPG operates under the Ministry of Personnel, Public Grievances, and Pensions.

• Its primary role includes policy formulation, promoting administrative reforms, and grievance redressal mechanisms.

• The department is actively involved in initiatives like e-governance, citizen charters, and simplifying procedures to enhance public service delivery.

• Gandhinagar:

• Gandhinagar is the capital of Gujarat and a planned city known for its serene environment and well-organized infrastructure.

• It serves as a hub for government activities and is equipped with facilities for hosting large-scale conferences and events.

• The city is home to institutions like Gujarat Vidhan Sabha and Swarnim Sankul, which are key administrative establishments.

• Good Governance Practices:

• Good governance emphasizes principles such as transparency, accountability, efficiency, and inclusivity.

• Initiatives like Digital India, Ease of Doing Business, and MyGov platform are examples of steps taken by the Indian government to improve governance.

• Annual conferences like the National Conference on Good Governance serve as a platform for sharing best practices and innovations in administration.

• Importance of Governance Conferences:

• These conferences provide opportunities for knowledge exchange among policymakers, administrators, and experts.

• They act as a platform to showcase successful case studies from different regions and sectors.

• Recommendations from such events often contribute to policy development and the implementation of reforms.

Important Points

• Good Governance Index:

• The Good Governance Index (GGI) is released by the Department of Administrative Reforms and Public Grievances to assess the state of governance across Indian states and union territories.

• It evaluates performance across various sectors such as agriculture, health, infrastructure, and public service delivery.

• The index serves as a benchmark for identifying areas that require improvement and incentivizing better governance practices.

• Digital Governance Initiatives:

• Digital India is a flagship program aimed at transforming India into a digitally empowered society and knowledge economy.

• Projects like UMANG App and e-Hospital services are examples of digital governance applications that enhance public service accessibility.

• Efforts are being made to improve cybersecurity and ensure the reliability of digital platforms used for governance purposes.

Q92. Answer: (d) Karad

The correct answer is Karad.

Key Points

• Karad, a city in Maharashtra, achieved 100% segregation, collection, and processing of sanitary and biomedical waste by 2025.

• The city successfully handles an average of 300 to 350 kg of sanitary waste daily, showcasing its commitment to efficient waste management practices.

• This achievement is a result of strict implementation of waste segregation at the source, supported by awareness campaigns and cooperation from citizens.

• The sanitary and biomedical waste is processed using advanced methods, ensuring eco-friendly disposal and minimizing environmental impact.

• This milestone places Karad as a model city for waste management practices, inspiring other cities in Maharashtra and India to follow suit.

Additional Information

• Biomedical Waste Management:
• Biomedical waste includes infectious and hazardous materials generated during medical and healthcare activities.
• According to the Biomedical Waste Management Rules, 2016, proper segregation, treatment, and disposal are mandatory to prevent contamination.
• Methods of disposal include incineration, autoclaving, and chemical disinfection.
• Sanitary Waste Management:
• Sanitary waste refers to used personal hygiene products like sanitary napkins, diapers, and tampons.
• Improper disposal of sanitary waste can lead to health hazards and environmental pollution.
• Innovative techniques such as composting and incineration are employed to manage sanitary waste effectively.
• Waste Management Initiatives in India:
• The Swachh Bharat Abhiyan, launched in 2014, aimed to achieve universal sanitation and waste management across India.
• The Solid Waste Management Rules, 2016, focus on segregation, recycling, and disposal of solid waste.
• Several cities, including Indore, Surat, and Karad, have been recognized for their efficient waste management systems.
• Role of Technology in Waste Management:
• Technologies like GPS-enabled tracking for waste collection vehicles ensure better monitoring and efficiency.
• Advanced waste processing facilities use mechanical sorting, composting, and biogas generation.
• Mobile apps and digital platforms help citizens report waste-related issues and track collection schedules.

Important Points

• Karad:
• Karad is a prominent city in the Satara district of Maharashtra, India.
• Known for its eco-friendly initiatives, Karad has been at the forefront of sustainable waste management practices.
• It is also famous for its geographical location at the confluence of rivers Krishna and Koyna.
• Waste Management Challenges:
• Rapid urbanization and population growth have led to an increase in waste generation.
• Lack of awareness and infrastructure often hampers efficient waste management.
• Innovative solutions and active citizen participation are crucial to overcoming these challenges.
• Government Policies:
• Policies like Extended Producer Responsibility (EPR) ensure producers are accountable for post-consumer waste.
• State governments encourage decentralized waste management through community participation.
• Financial incentives and grants are provided to cities achieving waste management milestones.

Q93. Answer: (c) RBI Unlocked: Beyond the Rupee

The correct answer is RBI Unlocked: Beyond the Rupee.

Key Points

• RBI Unlocked: Beyond the Rupee is a documentary launched by the Reserve Bank of India (RBI) in June 2025 to educate the public on the diverse functions performed by the central bank.
• The initiative aimed to enhance financial literacy by providing a comprehensive understanding of the operations and role of the RBI in India's economic framework.
• The documentary covered various aspects such as monetary policy formulation, currency management, banking regulation, and the digital payments ecosystem.
• It was designed to address the knowledge gap about the central bank's role in maintaining financial stability and promoting economic growth.
• The launch of this initiative aligns with RBI's ongoing efforts to engage with citizens and make financial systems more accessible and transparent.

Additional Information

• Functions of RBI:
• The Reserve Bank of India is the central bank of India, responsible for the issuance and supply of the Indian rupee and the regulation of the Indian banking system.
• The RBI formulates monetary policy to control inflation, stabilize currency, and ensure economic growth.
• It manages foreign exchange under the Foreign Exchange Management Act, 1999.
• RBI also supervises and regulates commercial banks, cooperative banks, and non-banking financial companies (NBFCs) to maintain financial stability.
• It plays a pivotal role in the promotion and development of the country's digital payment ecosystem.

• RBI's Financial Literacy Initiatives:

• The RBI has launched various programs to educate citizens about financial products, services, and the importance of financial planning.

• Examples include RBI Kehta Hai, which uses mass media to raise awareness about rights and responsibilities as a banking consumer.

• The Financial Literacy Week is another major initiative promoting awareness about financial literacy topics such as credit discipline and digital payments.

• RBI and Currency Management:

• RBI is tasked with the design, production, and distribution of Indian currency to ensure adequate supply and prevent counterfeiting.

• It also ensures the implementation of security features and designs in Indian currency notes.

• RBI's currency management role is integral to maintaining public confidence in the monetary system.

• Importance of Financial Literacy:

• Financial literacy is crucial for individuals to make informed decisions regarding money management, savings, investments, and retirement planning.

• It helps in mitigating risks associated with fraud, high-interest debts, and poor financial planning.

• By understanding RBI's roles and functions, citizens can better appreciate its efforts in ensuring a stable financial ecosystem.

• Documentary as a Tool for Awareness:

• Documentaries like RBI Unlocked: Beyond the Rupee serve as effective tools to engage and educate the public on complex topics in an accessible manner.

• They help bridge the gap between institutions and citizens, making financial systems more transparent.

Q94. Answer: (d) Madras High Court

The correct answer is Madras High Court.

Key Points

• The Supreme Court of India overturned the order of the Madras High Court on 24 May 2025, ruling that denying maternity leave for a third child is unconstitutional.

• This judgment upheld a woman's constitutional right, emphasizing her dignity and reproductive freedom.

• The court stated that maternity leave for a third child is crucial for ensuring women's health and well-being.

• The decision aligns with the principles of gender equality enshrined in the Constitution of India.

• This ruling reinforces the importance of social security measures for working women, particularly in the context of maternal care.

Additional Information

• Constitutional Provisions Related to Maternity Rights:

• Article 14: Guarantees equality before the law and protection against discrimination.

• Article 15: Prohibits discrimination based on gender, ensuring equal rights for women.

• Article 42: Directs the state to make provisions for securing maternity benefits and ensuring just working conditions.

• Maternity Benefit Act, 1961:

• Under this act, women are entitled to 26 weeks of paid maternity leave for the first two children.

• For the third child, the leave entitlement is limited to 12 weeks.

• The Supreme Court ruling challenges restrictions for third-child maternity leave, promoting equal treatment.

• Impact of the Ruling:

• This decision ensures that women can exercise their reproductive rights without fear of losing employment benefits.

• It highlights the importance of healthcare and social security for working mothers.

• The judgment sets a precedent for future cases concerning women's rights and maternity benefits.

• Other High Courts:

• The Hyderabad High Court, Bombay High Court, and Allahabad High Court have also addressed women's rights in various cases.

• However, in this instance, the Madras High Court ruling was specifically overturned.

Important Points

• Supreme Court Judgment:

• The ruling reinforces women's rights to workplace equality and maternity benefits.

• This is a significant development in improving gender equity in India.

• Global Context:

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• Many countries, including Sweden and Norway, offer comprehensive maternity leave policies to support working mothers.

• The Indian Supreme Court ruling aligns with global efforts to promote women's empowerment.

Q95. Answer: (b) Sarvam AI

The correct answer is Sarvam AI.

Key Points

• Sarvam AI was selected in April 2025 to develop India’s first sovereign Indic Large Language Model (LLM) under the prestigious IndiaAI Mission.

• The IndiaAI Mission is a strategic initiative launched by the Government of India aimed at advancing Artificial Intelligence (AI) capabilities to empower various sectors, including education, healthcare, and governance.

• Indic LLM refers to a large-scale language model specifically designed to cater to Indian languages, ensuring inclusivity for regional and vernacular language users across the nation.

• Sarvam AI, a cutting-edge startup, specializes in developing AI solutions tailored to linguistic, cultural, and societal needs, making it an ideal choice for building the Indic LLM.

• The decision to select Sarvam AI aligns with the broader objective of fostering technological innovation and promoting self-reliance (Atmanirbhar Bharat) in the rapidly evolving AI domain.

Additional Information

• IndiaAI Mission:

• The IndiaAI Mission was launched by the Government of India to accelerate AI research and development in the country.

• Its objectives include developing AI-powered solutions for sectors like agriculture, healthcare, education, and governance.

• The mission also focuses on creating inclusive AI technologies to bridge the digital divide and cater to the linguistic diversity of India.

• It aims to position India as a global leader in the field of Artificial Intelligence through collaborations between academia, industry, and government institutions.

• Large Language Models (LLMs):

• LLMs are advanced AI models capable of understanding and generating human-like text based on vast datasets.

• They are used in applications such as chatbots, machine translation, text summarization, and sentiment analysis.

• Developing Indic LLMs ensures that AI technologies support India’s linguistic diversity, including regional languages like Hindi, Tamil, Bengali, Telugu, and Marathi.

• These models are essential for enhancing accessibility and inclusivity in digital services for non-English speaking users.

• Sarvam AI:

• Sarvam AI is a leading Indian startup focusing on AI-driven solutions for societal and linguistic challenges.

• Its expertise lies in developing AI systems that respect cultural contexts and address the unique needs of the Indian demographic.

• Sarvam AI's approach emphasizes ethical AI development, ensuring fairness, inclusivity, and transparency in its solutions.

• By being chosen for the IndiaAI Mission, Sarvam AI reinforces its position as a key player in India's AI ecosystem.

• Other AI Startups:

• Wadhwani AI: Focuses on AI solutions for social impact, particularly in agriculture and healthcare.

• People+AI: Specializes in developing AI systems that enhance human productivity and collaboration.

• AI4 Bharat: Known for its contributions to natural language processing (NLP) and AI research for Indian languages.

• While these startups are significant players in the AI domain, Sarvam AI was chosen for its expertise in Indic LLM development.

Important Points

• India’s AI landscape:

• India is rapidly emerging as a global hub for AI innovation and research.

• Government initiatives like Digital India and Atmanirbhar Bharat are driving the adoption of AI technologies.

• Developing sovereign AI capabilities, like the Indic LLM, ensures data security and self-reliance in critical technologies.

• Linguistic diversity:

• India is home to 22 officially recognized languages and hundreds of dialects.

• Indic LLMs are crucial for enabling digital inclusivity and ensuring access to AI-powered services for non-English speakers.

• This initiative supports the vision of bridging the digital divide and empowering marginalized communities.

Q96. Answer: (c) Tim Wigmore

The correct answer is Tim Wigmore.

Key Points

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• Tim Wigmore is the author of Test Cricket: A History, released in 2025.

• The book chronicles the evolution of Test cricket since its beginning in 1877.

• It includes insights and interviews with some of the game's greatest players, making it a significant work on the sport

Additional Information

• Michael Atherton – Former England Test captain and respected cricket journalist; writes opinion and analysis but not the author of this book.

• Gideon Haigh – Australian cricket writer known for acclaimed cricket books, but not associated with Test Cricket: A History.

• Ramachandra Guha – Indian historian and author of cricket histories (e.g., A Corner of a Foreign Field), but not the author of this specific book.

Important Points

• Test Cricket: A History was published by Quercus and is widely reviewed as a comprehensive account of the game's heritage.

Q97. Answer: (c) 2017 and 2021

The correct answer is 2017 and 2021.

Key Points

• On 16 May 2025, the Supreme Court of India invalidated the Indian Government's orders that were passed in the years 2017 and 2021. These orders permitted ex-post facto environmental clearances.

• Ex-post facto environmental clearance refers to the practice of granting environmental approval for projects that have already started construction or operation without prior clearance, which is against the provisions of environmental laws.

• The Supreme Court ruling stated that such clearances violate the principles of environmental sustainability and the requirements laid down under the Environment (Protection) Act, 1986.

• The judgment emphasized that environmental clearances must be obtained before initiating any project that has significant environmental impacts to ensure compliance with environmental protection standards.

• The invalidation of these orders by the Supreme Court is considered a step toward strengthening environmental governance and ensuring accountability in project approvals.

Additional Information

• Environment (Protection) Act, 1986:

• This Act provides the framework for the protection and improvement of the environment in India.

• It empowers the Central Government to take measures to prevent, control, and reduce environmental pollution.

• The Act also specifies that environmental clearance must be obtained before starting any project with potential environmental impacts.

• Ex-Post Facto Environmental Clearance:

• This refers to the practice of granting environmental clearance after a project has already commenced its operations or construction.

• Such a practice is considered legally and ethically problematic as it undermines the precautionary principle of environmental protection.

• Supreme Court's Role in Environmental Protection:

• The Supreme Court of India has played a pivotal role in enforcing environmental laws and ensuring sustainable development.

• Landmark judgments such as the Vellore Citizens Welfare Forum vs Union of India (1996) have emphasized the need for stricter compliance with environmental regulations.

• Environmental Clearances in India:

• Environmental clearances are mandatory for projects that fall under the Environment Impact Assessment (EIA) Notification, 2006.

• These clearances assess the environmental impact of proposed projects and suggest measures to mitigate any potential damage.

Important Points

• Precautionary Principle:

• This principle is a cornerstone of environmental law and mandates that preventive measures must be taken when there is a lack of scientific certainty about environmental harm.

• It is enshrined in the Rio Declaration on Environment and Development (1992) and has been upheld in various Indian judicial decisions.

• Significance of the Supreme Court Judgment:

• The judgment reinforces the need for timely environmental clearances and rejects the practice of post-facto approvals, which could lead to environmental degradation.

• This ruling strengthens the legal framework for environmental governance and ensures greater accountability for project

developers.

Q98. Answer: (b) Black Carbon

The correct answer is Black Carbon.

Key Points

• Black Carbon is a type of particulate matter that results from the incomplete combustion of fossil fuels, biofuels, and biomass.

• The study by Climate Trends (May 2025) examined NASA satellite data (2000-2023) to assess the impact of black carbon on Himalayan snow and glaciers.

• Black carbon particles settle on snow and ice, reducing their albedo (reflectivity). This causes the snow to absorb more sunlight, leading to faster melting.

• The Himalayan region is particularly sensitive to black carbon as it is home to some of the world's largest glaciers, which are a critical water source for millions of people.

• The deposition of black carbon in the Himalayas is primarily linked to human activities such as vehicle emissions, industrial processes, and agricultural burning in South Asia.

Additional Information

• Black Carbon:

• Black carbon is a short-lived climate pollutant with a lifespan of only a few days to weeks in the atmosphere.

• It is a major contributor to global warming due to its ability to absorb sunlight and convert it into heat.

• Sources of black carbon include diesel engines, residential wood and coal stoves, agricultural burning, and forest fires.

• Black carbon emissions are a pressing issue in South Asia due to rapid urbanization and industrialization.

• Impact on Himalayan Glaciers:

• The Himalayas are often referred to as the "Third Pole" due to their vast ice reserves, which are a critical water source for Asia’s major rivers.

• Black carbon deposition reduces the reflectivity of snow and ice, causing them to absorb more heat and melt faster.

• Accelerated melting of Himalayan glaciers impacts water availability, agriculture, and energy generation in the region.

• It also increases the risk of glacial lake outburst floods (GLOFs), which can cause widespread destruction downstream.

• Other Aerosols and Particles:

• Sulfate Aerosols: These are primarily cooling agents as they reflect sunlight away from the Earth. However, they can also contribute to acid rain.

• Ozone: While ozone in the stratosphere protects Earth from harmful UV radiation, ground-level ozone is a greenhouse gas that contributes to global warming.

• Mineral Dust Particles: These are natural aerosols that can have a warming or cooling effect depending on their composition and location. They have less direct impact on snowmelt compared to black carbon.

• Mitigation Efforts:

• Reducing black carbon emissions through cleaner technologies, stricter regulations on industrial emissions, and promoting renewable energy sources.

• International initiatives like the Climate and Clean Air Coalition (CCAC) focus on reducing short-lived climate pollutants, including black carbon.

• Raising awareness and implementing policies to reduce agricultural burning in South Asia, a major contributor to black carbon emissions.

Important Points

• Black Carbon and Climate Change: Unlike CO2, black carbon is not a long-lived greenhouse gas, but it has a strong warming potential due to its ability to absorb sunlight.

• Regional Impact: South Asia is a hotspot for black carbon emissions due to high population density, industrial activities, and reliance on biomass for cooking and heating.

• Role of NASA Data: NASA’s satellite data provides valuable insights into the spatial and temporal distribution of black carbon and its impact on glaciers worldwide.

• Global Efforts: Black carbon reduction is part of the broader goal to limit global warming to 1.5°C under the Paris Agreement.

Q99. Answer: (d) Ministry of Earth Sciences

The correct answer is Ministry of Earth Sciences.

Key Points

• The Bharat Forecasting System (BFS) was launched by the Ministry of Earth Sciences on 26 May 2025 to enhance weather prediction capabilities in India.

• This system provides weather forecasts with a high resolution of 6 kilometers, which is a significant improvement over previous

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models.

• The BFS enhances the prediction of monsoons, cyclones, thunderstorms, and other weather events, helping in disaster preparedness and mitigation.

• The initiative aligns with the government's efforts to utilize advanced numerical weather prediction models and improve weather-related services.

• The BFS was developed under the leadership of the Indian Meteorological Department (IMD), a part of the Ministry of Earth Sciences, which is responsible for weather forecasting and climate research in India.

Additional Information

• Ministry of Earth Sciences (MoES):

• The Ministry of Earth Sciences is responsible for providing weather, climate, ocean, and seismological services in India.

• It oversees various institutions, including the Indian Meteorological Department (IMD), the National Centre for Medium-Range Weather Forecasting (NCMRWF), and the Indian National Centre for Ocean Information Services (INCOIS).

• The ministry works on advancing Earth System Science to meet societal needs for weather and climate information.

• Importance of High-Resolution Weather Prediction:

• High-resolution models like BFS provide detailed weather forecasts, which are crucial for agriculture, disaster management, and urban planning.

• They help predict localized weather events such as urban flooding, heatwaves, and thunderstorms.

• Such systems also contribute to climate research by providing data for long-term studies.

• Indian Meteorological Department (IMD):

• IMD, founded in 1875, is one of the oldest meteorological organizations in the world.

• It provides weather forecasts, issues warnings for natural disasters, and monitors the monsoon in India.

• IMD has adopted advanced technologies such as satellite-based observations and numerical models for accurate weather predictions.

• Applications of BFS:

• The BFS improves preparedness for natural disasters like cyclones, floods, and droughts, minimizing damage and saving lives.

• It supports sectors like aviation, agriculture, fisheries, and water resource management by providing accurate weather data.

• The system also contributes to research on climate change and its impacts on India.

Important Points

• Other Ministries in Context:

• Ministry of Agriculture and Farmers Welfare: It focuses on agricultural development and farmers' welfare but does not directly handle weather forecasting systems.

• Ministry of Defence: While it may utilize weather data for strategic purposes, it is not involved in the development of national weather forecasting systems.

• Ministry of Environment, Forest and Climate Change: This ministry addresses environmental conservation and climate change policies but does not manage operational weather models.

• Global Examples of Weather Systems:

• The European Centre for Medium-Range Weather Forecasts (ECMWF) is known for its high-accuracy global weather predictions.

• The National Oceanic and Atmospheric Administration (NOAA) in the USA provides advanced weather and climate services globally.

Q100. Answer: (c) Vantika Agrawal

The correct answer is Vantika Agrawal.

Key Points

• Vantika Agrawal, a talented and emerging chess player from India, was awarded the prestigious Arjuna Award in 2025 along with Gukesh.

• The Arjuna Award is conferred by the Government of India to recognize outstanding achievement in national sports. It is one of the highest civilian honors for sports in the country.

• Vantika Agrawal has made remarkable contributions to Indian chess, especially in international competitions, by consistently performing well in individual and team events.

• She has represented India in several prestigious tournaments, including Chess Olympiads and the Asian Games, showcasing her strategic brilliance and sharp tactical skills.

• The Arjuna Award recognizes not just her exceptional talent but also her dedication, discipline, and determination, which have inspired many young chess players in the country.

Additional Information

• Arjuna Award:

• The Arjuna Award was instituted in 1961 by the Government of India to honor exceptional athletes in various sports disciplines.

• It includes a bronze statuette of Arjuna, a certificate, ceremonial dress, and a cash award.

• The award aims to recognize consistent performance over a period of four years and qualities like leadership, sportsmanship, and discipline.

• About Vantika Agrawal:

• Vantika Agrawal is a rising star in Indian chess, known for her aggressive playing style and exceptional problem-solving skills.

• She has won numerous accolades, including medals in national and international chess tournaments.

• She is also a role model for young chess enthusiasts, encouraging more participation in the sport, especially among young girls in India.

• Other Indian Chess Players:

• Koneru Humpy: A legendary Indian chess player and the second woman to achieve the Grandmaster title. She has been awarded the Padma Shri and the Arjuna Award.

• Harika Dronavalli: Another prominent Indian chess player who has won multiple medals in international tournaments, including the Chess Olympiad.

• Pentala Harikrishna: One of the top male chess players in India, known for his exceptional endgame skills and consistency in international competitions.

• Chess and India:

• India has a rich history in chess, with legends like Viswanathan Anand putting Indian chess on the global map.

• In recent years, young players like Gukesh, Praggnanandhaa, and Vantika Agrawal have emerged as strong contenders in global chess events.

• India has also hosted several international chess tournaments, further promoting the sport.

Important Points

• The Arjuna Award is one of the highest honors for athletes in India and is awarded annually for outstanding performance.

• Chess has gained immense popularity in India due to the emergence of talented players and the success of legends like Viswanathan Anand.

• Vantika Agrawal's recognition with the Arjuna Award highlights the growing recognition of chess as a prominent sport in India.

• Young players like Vantika Agrawal are a testament to the bright future of Indian chess on the international stage.

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