RRB Group D Official Paper (Held On: 09 Dec, 2025 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. What is the advantage of fragmentation as a mode of reproduction in plants?

(a) Forms spores for dispersal
(b) Brings about rapid multiplication
(c) Increases genetic diversity
(d) Promotes bud formation

Q2. Which of the following particles contribute to the mass number?

(a) Electrons and Protons
(b) Protons only
(c) Electrons only
(d) Protons and Neutrons

Q3. Which of the following is NOT a consequence of the law of conservation of energy?

(a) Kinetic energy can convert into potential energy
(b) Energy can be created to increase total energy of a closed system
(c) Energy can be converted from one form to another
(d) Total energy in a closed system remains constant

Q4. Which cell organelle is responsible for releasing energy in the form of ATP, which enables various metabolic functions in an animal cell?

(a) Endoplasmic reticulum
(b) Nucleus
(c) Lysosome
(d) Mitochondria

Q5. A 96 kg astronaut is standing on Earth. What is his weight on the Moon? (g on earth = 10 m/s^2)

(a) 960 N
(b) 96 N
(c) 160 N
(d) 16 N

Q6. The main purpose of the earth wire in a domestic circuit is:

(a) to increase voltage
(b) to reduce resistance
(c) to supply current
(d) to protect from electric shocks

Q7. A village that regularly suffers from drought wants to store water for dry seasons to irrigate the agricultural field. Which method will help most?

(a) Spraying pesticides
(b) Growing short-duration crops
(c) Rainwater harvesting and watershed management
(d) Sprinkler irrigation

Q8. What is required to describe the distance an object has travelled?

(a) Both magnitude and direction
(b) The starting and ending points only
(c) Only the direction of motion
(d) Only the numerical value, which is its magnitude

Q9. Which property of a carbon atom enables one carbon atom to form bonds with other carbon atoms?

(a) Valency
(b) Polymerisation
(c) Catenation
(d) Isomerisation

Q10. What is the range of the pH scale?

(a) 0 to 14
(b) 0 to 7
(c) -1 to 14
(d) 0 to 10

Q11. What is 'suspension' in chemistry?

(a) A heterogeneous mixture with large particles
(b) A homogeneous mixture
(c) A true solution
(d) A colloidal dispersion

Q12. Leucoplasts have which of the following colours?

(a) Indigo
(b) Orange
(c) Purple
(d) White

Q13. Which of the following conditions will most effectively accelerate the corrosion of iron?

(a) Iron surface exposed to moist air containing dissolved salts
(b) Iron immersed in pure water, free of dissolved oxygen
(c) Iron coated with a thin layer of zinc (galvanization)
(d) Iron surface in dry air with no impurities

Q14. The importance of genetic variation in organisms is that _____.

(a) it leads to uniformity in the progeny
(b) it enables sexual reproduction
(c) it gives rise to dominant and recessive traits
(d) it increases the chances of survival of an organism

Q15. Which of the following hydrocarbons is saturated?

(a) Butene
(b) Benzene
(c) Propene
(d) Butane

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Q16. What is corrosion most commonly observed as?

(a) Rust formation on iron objects
(b) Glowing of a bulb
(c) Boiling of water in a kettle
(d) Melting of metal when heated

Q17. Which of the following devices does NOT use the heating effect of current for its working?

(a) Electric Mixer Grinder
(b) Electric Iron
(c) Electric Geyser
(d) Electric Fuse

Q18. What is the correct definition of atomic mass?

(a) It is the mass of an atom in grams.
(b) It is the mass of one atom in kilograms.
(c) It is the mass relative to carbon-12 atom.
(d) It is the mass of one hydrogen molecule.

Q19. A sound of 100 Hz is compared with a sound of 500 Hz. Which of the following statements is correct?

(a) Both have the same pitch.
(b) 100 Hz sound has a higher pitch.
(c) Pitch cannot be compared.
(d) 500 Hz sound has a higher pitch.

Q20. A body of mass 5 kg is moving with an acceleration of 2 m/s^2. What is the force acting on it?

(a) 10 N
(b) 5 N
(c) 7 N
(d) 2 N

Q21. Which component of phloem is basically responsible for the translocation of food?

(a) Phloem parenchyma
(b) Sieve elements
(c) Phloem fibres
(d) Companion cells

Q22. Hormone named testosterone is secreted from which of the following parts of a human being?

(a) Fallopian tube
(b) Ureter
(c) Testis
(d) Uterus

Q23. A student places an object at a distance greater than twice the focal length from a convex lens. What kind of image is formed?

(a) Virtual, erect, and smaller than the object
(b) Virtual, erect, and larger than the object
(c) Real, inverted, and larger than the object
(d) Real, inverted, and smaller than the object

Q24. How does the Mimosa pudica (touch-me-not) plant transmit the touch stimulus from the point of contact to the motor cells responsible for movement?

(a) Through growth of new supportive cells at the touch site
(b) By releasing hormones that travel through specialised tubes
(c) Through specialised nerve tissues connecting the points
(d) Through electrical and chemical signals passed between general plant cells

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Q25. The image formed by a convex mirror is always _____.

(a) real and erect
(b) virtual and erect
(c) virtual and inverted
(d) real and inverted

MATHEMATICS

Q26. The mode of the observations 35, 21, 25, 21, 35, 32, 32, 30, 20, 35, 34, 35, 34, 25, 35, 33 and 25 is:

(a) 21
(b) 35
(c) 32
(d) 25

Q27. A shopkeeper bought a chair for Rs. 750. He sold it at a 10% loss. What was the selling price of the chair?

(a) Rs. 740
(b) Rs. 675
(c) Rs. 710
(d) Rs. 640

Q28. From the top of a building 72.1 m high, the angle of depression to a car on the ground is 45°. Find the distance of the car from the foot of the building.

(a) 81.2 m
(b) 124.73 m
(c) 41.6 m
(d) 72.1 m

Q29. Robert, Chris, and Jeremy can finish a certain piece of work in 16, 48, and 32 days, respectively. All three of them started the work together. Robert left the work after 2 days and Chris left just 4 days before the work was completed. Find the total number of days taken for the work to be completed.

(a) 17.7
(b) 24.3
(c) 18.4
(d) 16.2

Q30. A person can cover a certain distance in 1 hour 24 minutes by covering one-fourth of the distance at 5 km/hr and the rest at 6 km/hr. Find the total distance (in km).

(a) 8
(b) 6
(c) 10
(d) 12

Q31. Simplify $((0.36)^2 - (0.04)^2)/1.6$.

(a) 0.08
(b) 0.8
(c) 1.8
(d) 1.2

Q32. If 20% of a number is added to 78, then the result is the same number. 60% of the same number is:

(a) 78.5
(b) 68.5
(c) 58.5
(d) 88.5

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Q33. A, B and C can do a piece of work in 2, 12 and 6 days, respectively. How long (in days) will they take to do thrice the same work, working together?

(a) 8
(b) 4
(c) 12
(d) 5

Q34. A trapezium-shaped field has an area of 720 m², and the perpendicular distance between its parallel sides is 16 m. If one of the parallel sides is 25% more than the other parallel side, then the length of the smaller parallel side is ____.

(a) 50 m
(b) 60 m
(c) 40 m
(d) 30 m

Q35. A class of 30 students took a Physics test. Fourteen students had an average score of 98. The other students had an average score of 54. What is the average score (rounded up to one decimal place) of the whole class?

(a) 64.6
(b) 74.5
(c) 71.6
(d) 76.9

Q36. Simplify:

100^(0.25) × 5² × 2^4 × 1/(800^(0.5)) × √(1/5)

(a) 10
(b) 25
(c) 40
(d) 20

Q37. If 4 lines of a print, in a column of a book, contain 63 words, how many words will a column of 64 lines contain?

(a) 1004
(b) 1018
(c) 1008
(d) 1012

Q38. A two-digit number is 7.75 times the sum of its digits. If its digits are reversed, the number decreases by 54. What is the original number?

(a) 82
(b) 93
(c) 71
(d) 60

Q39. Amit and Deeksha together invested Rs. 56,100 in a business. At the end of the year, out of a total profit of Rs. 9,200, Amit's share was Rs. 2,300. How much was Amit's investment?

(a) Rs. 14,870
(b) Rs. 14,025
(c) Rs. 14,690
(d) Rs. 12,370

Q40. If an item marked at Rs. 1,675 is sold for Rs. 1,273, then what is the discount percentage?

(a) 22%
(b) 25%
(c) 26%
(d) 24%

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Q41. Simplify: $37^2 – 36^2 + 35^2 – 34^2 + 33^2 – 32^2$

(a) 207
(b) 211
(c) 197
(d) 200

Q42. The cost of a washing machine is 50% less than the cost of a TV. If the cost of the washing machine increases by 64% and that of the TV decreases by 28%, then what is the percentage change in the total cost of 6 washing machines and 2 TVs?

(a) Increase by 27.2%
(b) Decrease by 27%
(c) Decrease by 30%
(d) Increase by 29.4%

Q43. Given that C is the third proportional of 6 and B. If B is the sum of the first three even natural numbers, then find the value of C.

(a) 23.39
(b) 21.9
(c) 24.0
(d) 26.31

Q44. The sum of the ages of Ramesh and Suresh is 52 years. Ramesh's age is 4 years more than twice Suresh's age. What is Suresh's age?

(a) 16 years
(b) 14 years
(c) 12 years
(d) 15 years

Q45. Identify the correct set of angles of a triangle.

(a) {65°, 45°, 80°}
(b) {120°, 35°, 25°}
(c) {95°, 40°, 85°}
(d) {85°, 30°, 75°}

Q46. A 793 m long train is running at 90 km/hr. How long will it take to clear a 782 m long platform completely?

(a) 61 seconds
(b) 60 seconds
(c) 63 seconds
(d) 66 seconds

Q47. Two banks, A and B, offered loans at 3.5% and 7% per annum, respectively. Rupesh borrowed an amount of Rs. 5,00,000 from each bank. Find the positive difference (in Rs.) between the amounts of simple interest paid to the two banks by Rupesh after 4 years.

(a) 70,000
(b) 71,000
(c) 71,500
(d) 69,500

Q48. A dealer makes a profit of 40% even after giving a 26% discount on the advertised price of a bike. If he makes a profit of Rs. 5,698 on the sale of the bike, what is the advertised price (in Rs.)?435

(a) 26,952
(b) 26,846
(c) 26,950
(d) 27,014

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Q49. A rectangular park is 34 m long and 24 m wide. A path of uniform width runs inside it, surrounding a grassy lawn. If the area of the path is 216 m², what is the perimeter of the grassy lawn?

(a) 112 m
(b) 104 m
(c) 100 m
(d) 96 m

Q50. 1/20 is what percentage of 11/80? (Round off the answer to two decimal places.)

(a) 46.36%
(b) 72.73%
(c) 51.36%
(d) 36.36%

GENERAL INTELLIGENCE & REASONING

Q51. Seven boxes, B, D, E, P, S, T and W, are kept one over the other, but not necessarily in the same order.

W is kept immediately above T. D is kept immediately above S. Only P is kept above B. Only two boxes are kept above W. D is not kept at the third position from the bottom.

How many boxes are kept between E and P?

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

Q52. Which of the following number will replace the question mark (?) in the given series?

24, 27, 35, 59, 107, 227, ?

(a) 421
(b) 321
(c) 395
(d) 358

Q53. Which of the following letter-clusters will replace the question mark (?) in the given series to make it logically complete?

HZC, LDG, PHK, TLO, ?

(a) XPS
(b) XQR
(c) XPR
(d) XQS

Q54. In a certain code language, ‘BIRD’ is coded as ‘2739’ and ‘DRIP’ is coded as ‘3978’. What is the code for ‘P’ in the given code language?

(a) 3
(b) 7
(c) 8
(d) 9

Q55. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only. All numbers are single-digit numbers.

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

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

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

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(d) 0

Q56. Refer to the following series and answer the question (all numbers are single-digit numbers only).

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

How many such odd numbers are there (from left to right), which are immediately followed by an odd number?

(a) Two
(b) Three
(c) One
(d) More than three

Q57. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(10, 150, 5)

(8, 96, 4)

(a) (5, 54, 3)
(b) (9, 162, 6)
(c) (7, 98, 3)
(d) (12, 288, 6)

Q58. Abhishek ranked 17th from the top and 49th from the bottom in his class. How many students are there in his class?

(a) 63
(b) 65
(c) 64
(d) 66

Q59. Town F is to the north of Town G. Town H is to the east of Town F. Town I is to the south of Town H. Town J is to the west of Town I. Town G is to the south-west of Town J. What is the position of Town F with respect to Town J?

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

Q60. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

KIO : LFK

PER : QBN

(a) BGW : CDR
(b) OGT : PDP
(c) KQL : LMH
(d) UJK : VGF

Q61. AHKO is related to EKOR in a certain way based on the English alphabetical order. In the same way, QTAA is related to UWED. To which of the given options is CCMJ related, following the same logic?

(a) GMJU
(b) GQWE
(c) GFQK
(d) GFQM

Q62. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which is the letter-cluster pair that DOES NOT belong to that group?

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

(a) MQ-LO

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(b) EI-DG
(c) IM-HK
(d) BF-AC

Q63. What should come in place of the question mark (?) in the given series?

58, 51, 44, 37, 30, ?

(a) 23
(b) 25
(c) 22
(d) 21

Q64. This question is based on the five, three-digit numbers given below.

(Left) 715, 906, 570, 853, 418 (Right)

(Example- 697 – First digit = 6, second digit = 9 and third digit = 7)

NOTE - All operations to be done from left to right.

What will be the resultant if the third digit of the highest number is added to the second digit of the lowest number?

(a) 13
(b) 8
(c) 6
(d) 7

Q65. In a certain code language, 'by the way' is coded as 'ts rd ui' and 'a long way' is coded as 'kl ui za'. How is 'way' coded in the given language?

(All codes are two-letter codes)

(a) kl
(b) ui
(c) rd
(d) ts

Q66. A, B, C, D, E, F and G are sitting around a circular table, facing the centre. B sits to the immediate right of C. Only three people sit between B and A when counted from the left of B. Only three people sit between C and D when counted from the left of C. G sits to the immediate right of F. How many people sit between A and C when counted from the right of C?

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

Q67. 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) Mother
(b) Sister
(c) Wife
(d) Daughter

Q68. 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) 3 9 7 8 9 8 4 3 1 3 4 3 3 1 7 2 2 9 7 8 3 1 6 2 4 3 3 (Right)

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

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(a) 7
(b) 5
(c) 6
(d) 4

Q69. If 3 is added to each odd digit and 2 is subtracted from each even digit in the number 8563546, then which of the following digits will be fourth from the left in the new number thus formed?

(a) 6
(b) 4
(c) 2
(d) 8

Q70. 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?

22 D 55 A 5 C 14 B 8 = ?

(a) 121
(b) 122
(c) 124
(d) 123

Q71. 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) GED
(b) ZXW
(c) HFE
(d) MLJ

Q72. 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.

WORD - WDRO - DROW

OATS - OSTA - STAO

(a) GIVE - GEVI - EVIG
(b) FOUR - FORU - OURF
(c) PART - PRAT - TRAP
(d) HERD - EHRD - DERH

Q73. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All eggs are artists.

Some mangoes are artists.

Conclusions:

(I): Some eggs are mangoes.

(II): Some artists are eggs.

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

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Q74. Seven people, A, B, C, D, E, F and G, are sitting in a row, facing north.

Only A sits to the left of D. Only four people sit between A and C. Only B sits between G and F, and G is not an immediate neighbour of C.

How many people sit to the right of G?

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

Q75. Town A is to the north of Town B. Town C is to the west of Town A. Town D is to the south of Town C. Town E is to the east of Town D. Town B is to the southeast of Town E. What is the position of Town E with respect to Town A?

(a) Southwest
(b) Northwest
(c) Northeast
(d) Southeast

Q76. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusion(s) logically follow(s) from the statement(s).

Statements:

All jams are cobras.

All cobras are mats.

Conclusions:

(I) Some mats are cobras.

(II) All jams are mats.

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

Q77. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

LEX 14, OHA 23, RKD 32, UNG 41, XQJ 50, ?

(a) ATM 57
(b) ATM 59
(c) AMT 59
(d) AQM 59

Q78. What should come in place of the question mark (?) in the given series?

12 23 34 45 56 ?

(a) 65
(b) 67
(c) 61
(d) 63

Q79. 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) Four
(b) Three
(c) Two
(d) One

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Q80. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

351 ÷ 3 + 284 × 4 - 11 = ?

(a) 996
(b) 993
(c) 999
(d) 991

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Who among the following received the United Nations Sasakawa Award 2025 for Disaster Risk Reduction?

(a) Randeep Guleria
(b) Dr. Soumya Swaminathan
(c) Dr. Shekhar Mande
(d) Dr. Mrityunjay Mohapatra

Q82. Which of the following banks signed a Memorandum of Understanding (MoU) with the Indo-Tibetan Border Police in February 2025 to provide financial and insurance benefits?

(a) Canara Bank
(b) IndusInd Bank
(c) Punjab National Bank
(d) State Bank of India

Q83. The Tiger Triumph defense exercise, held in April 2025, was a joint exercise between India and which country?

(a) The US
(b) Australia
(c) France
(d) The UK

Q84. In which village was Ahilyabai Holkar born—where the Maharashtra Cabinet held a special meeting in May 2025 to commemorate her 300th birth anniversary?

(a) Nashik
(b) Chondi
(c) Paithan
(d) Maheshwar

Q85. What is the name of the ship on which two female officers of the Indian Navy completed a historic circumnavigation in May 2025, as part of the Navika Sagar Parikrama II mission?

(a) INS Tarini
(b) INS Indira
(c) INS Bhagamati
(d) INS Sarojini

Q86. As of 10 June 2025, how many new sports infrastructure projects were approved worth Rs. 3,124.12 crore across India?

(a) 250
(b) 326
(c) 300
(d) 350

Q87. In which of the following weight categories did Manisha Bhanwala win the gold medal at the Asian Wrestling Championships, 2025?

(a) 62 kg
(b) 53 kg
(c) 76 kg

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(d) 59 kg

Q88. Which of the following became India’s 107^(th) National Park in April 2025?

(a) Similipal
(b) Dudhwa
(c) Gorumara
(d) Bhitarkanika

Q89. How many Atal Tinkering Labs were announced to be established in government schools over the next five years in the Union Budget 2025-26?

(a) 30,0000
(b) 40,000
(c) 20,000
(d) 50,000

Q90. As of June 2025, which actor-turned-politician is the Deputy Chief Minister of the state of Andhra Pradesh?

(a) Prakash Raj
(b) Pawan Kalyan
(c) Chiranjeevi
(d) Balakrishna

Q91. According to the Waqf (Amendment) Act, 2025, how many Muslim women should be included in the State Waqf Boards?

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

Q92. As notified in March 2025, how many DRDO Industry Academia Centres of Excellence (DIA-CoEs) have been established across the country in premier institutions such as IITs, IISc, and Central Universities?

(a) 10
(b) 15
(c) 5
(d) 20

Q93. In 2025, to which of the following outstanding shooters was the Major Dhyan Chand Khel Ratna Award presented by the President of India, Droupadi Murmu?

(a) Sarabjot Singh
(b) Mona Agarwal
(c) Rubina Francis
(d) Manu Bhaker

Q94. Which state government approved the Bamboo Industry Policy, 2025, in October 2025, aiming to provide farmers with a sustainable and eco-friendly source of income while simultaneously boosting the state's domestic and global bamboo production?

(a) Maharashtra
(b) West Bengal
(c) Tamil Nadu
(d) Tripura

Q95. Which of the following banks removed the minimum balance requirement for all savings accounts in June 2025?

(a) Canara Bank
(b) State Bank of India
(c) Bank of Baroda
(d) Punjab National Bank

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Q96. In June 2025, the tech fair VivaTech 2025 was held in which of the following European cities?

(a) Lisbon
(b) Paris
(c) Berlin
(d) Barcelona

Q97. Which special year has ISRO declared 2025 to be, highlighting its human spaceflight efforts?

(a) Gaganyaan Year
(b) Mars Year
(c) Solar Year
(d) Moon Year

Q98. Toshikazu Yamanishi set a new world record in which event in February 2025?

(a) 5 km race walk
(b) 20 km race walk
(c) 50 km race walk
(d) 10 km race walk

Q99. What was the United States' (US) Transparency International score in the 2024 Corruption Perception Index?

(a) 62
(b) 67
(c) 70
(d) 65

Q100. Euthalia malaccana, which was officially recorded in the Leparada district of Arunachal Pradesh in May 2025, is a new species of which of the following?

(a) Grasshopper
(b) Butterfly
(c) Dragonfly
(d) Locust

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (b) Brings about rapid multiplication

The correct answer is Brings about rapid multiplication.

Key Points

• Fragmentation is a type of asexual reproduction where the body of a multicellular organism breaks into two or more distinct fragments upon reaching maturity. Each of these pieces subsequently grows into a complete new individual.

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• The most significant advantage of fragmentation is that it brings about rapid multiplication. Because this process does not require the finding of a mate or the complex biological mechanisms of gamete fusion, the organism can expand its population extremely quickly in a short period when nutrients and water are available.

• A prominent example of this mode is Spirogyra, which is a filamentous green algae found in freshwater ponds. When the Spirogyra filament matures, it naturally breaks into smaller fragments, each of which functions as a new plant.

• This reproductive function ensures the survival of the species in a stable environment by producing genetically identical offspring, often called clones, which are already well-adapted to the current habitat.

• Fragmentation is highly energy-efficient for the organism, as it bypasses the resource-intensive stages of flowering, pollination, and seed dispersal that are characteristic of higher plants.

Additional Information

• Modes of Asexual Reproduction:

• Budding: In organisms like Yeast or Hydra, a small outgrowth or bud forms on the parent body, which eventually detaches to become a new individual.

• Spore Formation: In fungi like Rhizopus (bread mould) and ferns, specialized spores are produced in sporangia. These spores are lightweight and can travel through air to colonize new locations.

• Vegetative Propagation: This involves the growth of new plants from vegetative parts such as roots (sweet potato), stems (potato tubers, runners), or leaves (Bryophyllum).

• Genetic Diversity vs. Stability: While sexual reproduction increases genetic diversity through meiosis and fertilization, asexual modes like fragmentation provide genetic stability. This is beneficial in unchanging environments but can be a disadvantage if the ecosystem faces sudden climatic changes or new diseases.

• Occurrence in Animals: Fragmentation is not limited to plants and algae; it is also seen in certain invertebrates like Planaria (flatworms), Sea stars (Echinoderms), and Annelids. If a Planarian is cut into pieces, each segment can regenerate into a complete worm.

• Applications in Biotechnology: The concept of fragmentation and regeneration is utilized in plant tissue culture and horticulture to produce large quantities of disease-free plants from a single parent tissue in a laboratory setting.

Important Points

• It is important to distinguish fragmentation from regeneration. While fragmentation is a dedicated method of reproduction, regeneration is often a repair mechanism where an organism regrows a lost limb or damaged tissue.

• The rate of multiplication through fragmentation is directly proportional to the availability of resources. For instance, in eutrophic water bodies with high nitrogen and phosphorus levels, algal blooms occur rapidly due to this efficient asexual process.

• In the evolutionary context, fragmentation allowed primitive organisms to colonize land and water efficiently before the evolution of complex reproductive organs like flowers and seeds.

Q2. Answer: (d) Protons and Neutrons

The correct answer is Protons and Neutrons.

Key Points

• The mass number (denoted by the symbol A) of an atom is defined as the total number of protons and neutrons present in the nucleus of an atom. Together, these two types of particles are known as nucleons because they reside in the atomic nucleus. Hence, statement D is correct.

• Protons are subatomic particles with a positive electric charge of +1e. While they contribute significantly to the mass, they do not constitute the mass number alone as neutrons are also present in almost all nuclei (except common Hydrogen). Hence, statement B is incorrect.

• Neutrons are subatomic particles with no net electric charge and a mass slightly greater than that of a proton. They were discovered by James Chadwick in 1932.

• Electrons are negatively charged particles that orbit the nucleus. The mass of an electron is approximately 9.109 × 10&sup{-31} kg, which is about 1/1836 of the mass of a proton. Due to this extremely small value, electron mass is considered negligible when calculating the mass number. Hence, statements A and C are incorrect.

• The mass number is always a whole number because it is a count of discrete particles (protons and neutrons).

Additional Information

• Atomic Number (Z):

• This refers to the number of protons in the nucleus of an atom. It determines the chemical identity of the element. For a neutral atom, the atomic number also equals the number of electrons.

• Isotopes:

• These are atoms of the same element that have the same atomic number but different mass numbers. This occurs because they have the same number of protons but a different number of neutrons.

• An example is Carbon-12 (6 protons, 6 neutrons) and Carbon-14 (6 protons, 8 neutrons), used in radiocarbon dating.

• Isobars:

• These are atoms of different chemical elements that have the same mass number but different atomic numbers. An example is Argon-40 and Calcium-40.

• Atomic Mass vs. Mass Number:

• While the mass number is a count of nucleons, atomic mass is the weighted average mass of an element's naturally occurring isotopes, usually expressed in Atomic Mass Units (amu).

Important Points

• Mathematical Formula: The relationship is expressed as A = Z + N, where A is the mass number, Z is the atomic number (protons), and N is the neutron number.

• Notation: In chemical notation, the mass number is written as a superscript to the left of the element symbol, while the atomic number is written as a subscript. For example, in ^(235)92U, 235 is the mass number and 92 is the atomic number.

• Discovery Facts: The nucleus was discovered by Ernest Rutherford through the Gold Foil Experiment in 1911, which proved that most of an atom's mass is concentrated in a tiny, dense center.

• Stability: The ratio of neutrons to protons (N/Z ratio) is a key factor in determining the nuclear stability of an atom. Elements with high atomic numbers require more neutrons to overcome the electrostatic repulsion between protons.

Q3. Answer: (b) Energy can be created to increase total energy of a closed system

The correct answer is Energy can be created to increase total energy of a closed system.

Key Points

• The Law of Conservation of Energy, also known as the First Law of Thermodynamics, states that energy can neither be created nor destroyed; it can only be transformed from one form to another.

• Kinetic energy can convert into potential energy: This is a fundamental principle of mechanical systems. For instance, when a roller coaster climbs a hill, its kinetic energy (motion) is converted into gravitational potential energy (position). Hence, this statement is correct.

• Energy can be created to increase total energy of a closed system: This statement implies that the net energy of a system can be increased without any external input, which is physically impossible and violates the conservation law. Hence, this statement is incorrect.

• Energy can be converted from one form to another: This is the operational basis of the law. Examples include a light bulb converting electrical energy into light and heat energy, or a battery converting chemical energy into electrical energy. Hence, this statement is correct.

• Total energy in a closed system remains constant: In an isolated system, while energy may change forms (from thermal to mechanical, etc.), the mathematical sum of all forms of energy remains identical at any given time. Hence, this statement is correct.

Additional Information

• Historical Context: The concept was solidified in the mid-19th century through the work of scientists like James Prescott Joule, Julius Robert Mayer, and Hermann von Helmholtz. Joule’s experiments in the 1840s demonstrated the mechanical equivalent of heat, proving that work and heat are interchangeable.

• Closed vs. Isolated Systems: In thermodynamics, a closed system can exchange energy (heat or work) but not matter with its surroundings. However, for the total energy to remain strictly constant, scientists often refer to an isolated system, which exchanges neither matter nor energy.

• Mass-Energy Equivalence: In 1905, Albert Einstein expanded the understanding of conservation with the formula $E = mc^2$. This showed that mass itself is a form of concentrated energy, leading to the Law of Conservation of Mass-Energy in nuclear physics.

• Daily Applications: This law is used to calculate fuel efficiency in engines, the performance of hydroelectric power plants, and even the caloric intake and expenditure in human metabolism.

Important Points

• Perpetual Motion Machines: The Law of Conservation of Energy explains why perpetual motion machines of the first kind (machines that produce work without energy input) are impossible to construct.

• Energy Dissipation: While total energy is always conserved, it often transforms into "non-useful" forms like friction-induced heat. This is referred to as energy degradation or an increase in entropy, though the total quantity remains unchanged.

• SI Unit: The Standard International (SI) unit of energy is the Joule (J), named after the physicist who helped establish the conservation principle. 1 Joule is defined as the work done by a force of 1 Newton moving an object 1 meter.

Q4. Answer: (d) Mitochondria

The correct answer is Mitochondria.

Key Points

• Mitochondria are widely known as the powerhouse of the cell because they are responsible for producing the energy required for various metabolic activities.

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• They generate energy in the form of Adenosine Triphosphate (ATP) molecules through a series of chemical reactions known as cellular respiration.

• Structurally, a mitochondrion is a double-membrane-bound organelle. The outer membrane is porous, while the inner membrane is deeply folded into structures called cristae, which increase the surface area for ATP-generating chemical reactions.

• Mitochondria are unique because they possess their own DNA (mitochondrial DNA) and ribosomes, allowing them to synthesize some of their own proteins. This makes them semi-autonomous organelles.

• The number of mitochondria in a cell depends on its metabolic activity; for example, muscle cells contain a significantly higher number of mitochondria to meet high energy demands.

Additional Information

• Endoplasmic Reticulum (ER):

• The Endoplasmic Reticulum is a large network of membrane-bound tubes and sheets.

• It exists in two types: Rough ER (RER), which has ribosomes attached to its surface for protein synthesis, and Smooth ER (SER), which is involved in lipid and steroid synthesis and detoxification of drugs.

• Nucleus:

• Often called the brain of the cell, the nucleus contains the cell's genetic material in the form of DNA or chromatin.

• It controls all cellular activities, including growth, metabolism, and reproduction (cell division).

• Lysosome:

• Lysosomes are known as the suicide bags of the cell. They contain powerful digestive enzymes (hydrolytic enzymes) capable of breaking down organic material.

• They help in keeping the cell clean by digesting foreign materials like bacteria or worn-out cell organelles. If a cell is damaged, the lysosome may burst and its enzymes digest the cell itself.

• Golgi Apparatus:

• First described by Camillo Golgi in 1898, this organelle consists of a system of membrane-bound vesicles (cisterns) arranged parallel to each other.

• Its primary functions include the storage, modification, and packaging of products in vesicles.

Important Points

• ATP Significance: ATP is described as the energy currency of the cell. The body uses the energy stored in ATP for making new chemical compounds and for mechanical work like muscle contraction and nerve impulse conduction.

• Evolutionary Origin: According to the Endosymbiotic Theory, mitochondria are believed to have originated from free-living bacteria that entered into a symbiotic relationship with early eukaryotic cells millions of years ago.

• Cellular Respiration: This process occurs in the mitochondrial matrix and inner membrane, involving the Krebs cycle and the Electron Transport Chain (ETC) to maximize energy yield from glucose.

• Absence in Prokaryotes: Mitochondria are absent in prokaryotic cells such as bacteria and blue-green algae, where energy production occurs in the cytoplasm or across the plasma membrane.

Q5. Answer: (c) 160 N

The correct answer is 160 N.

Key Points

• The mass of the astronaut is 96 kg. It is important to note that mass is an intrinsic property of an object and remains constant regardless of the location or the gravitational pull acting upon it.

• The weight of an object is defined as the force of gravity acting on it and is calculated using the formula Weight (W) = mass (m) × acceleration due to gravity (g).

• On Earth, where the acceleration due to gravity (g) is given as 10 m/s^2, the weight of the astronaut would be 96 kg × 10 m/s^2 = 960 N.

• The gravity on the Moon is approximately 1/6th of the gravity on Earth. Therefore, the acceleration due to gravity on the Moon is 10/6 m/s^2.

• To find the weight on the Moon, we multiply the astronaut's mass by the Moon's gravitational acceleration: 96 kg × (10/6) m/s^2. This simplifies to 16 × 10 = 160 N. Hence, the calculation shows the answer is 160 N.

Additional Information

• Mass vs Weight:

• Mass is a scalar quantity measured in kilograms (kg) using a beam balance. It does not change from place to place.

• Weight is a vector quantity measured in Newtons (N) using a spring balance. It depends on the gravitational field strength of the planet or moon.

• Gravitational Constants:

• The standard acceleration due to gravity on Earth is approximately 9.807 m/s^2, though 10 m/s^2 is often used for numerical

simplification in competitive exams.

• On the Moon, the gravitational pull is much weaker (1.62 m/s²) because the Moon has a smaller mass and radius compared to Earth.

• Newton (N):

• The SI unit of force and weight is the Newton, named after Sir Isaac Newton. One Newton is defined as the force needed to accelerate 1 kg of mass at the rate of 1 m/s².

• Universal Law of Gravitation:

• The gravitational force between two bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. This inverse square law explains why gravity decreases as we move away from a planet.

Important Points

• Numerical Data: In this specific problem, if mass was 96 kg and the question asked for Earth weight, the answer would be 960 N. However, because the environment is the Moon, the value must be divided by 6.

• Common Pitfalls: Students often confuse mass with weight. If the question asked "What is the mass on the Moon?", the answer would remain 96 kg. Since it asks for weight, we must account for gravity.

• Applications: Understanding low gravity environments is crucial for space exploration and designing lunar modules. An astronaut can jump much higher on the Moon because their weight is significantly reduced, allowing the muscular force to overcome gravity more easily.

Q6. Answer: (d) to protect from electric shocks

The correct answer is to protect from electric shocks.

Key Points

• The primary function of the earth wire in a domestic electric circuit is to provide a safety mechanism that protects users from electric shocks caused by leakage current.

• It serves as a low-resistance conducting path for the electric current. In the event of an insulation failure where the live wire touches the metallic body of an appliance, the earth wire carries the excess current directly to the ground.

• When this high current flows through the earth wire, it typically causes the fuse in the circuit to melt or the MCB (Miniature Circuit Breaker) to trip, effectively breaking the circuit and stopping the power supply to the faulty appliance.

• By keeping the metallic casing of appliances at zero potential (the same as the earth), it ensures that a person touching the device does not receive a shock, as the current prefers the lower resistance of the copper earth wire over the human body.

• The earth wire is essential for appliances that have a metallic body, such as electric irons, refrigerators, toasters, and table fans.

Additional Information

• Components of Domestic Wiring:

• Live Wire (Phase): Usually red or brown in color, it carries the high voltage (typically 220V in India) from the source to the appliance.

• Neutral Wire: Usually black or blue in color, it completes the circuit by providing a return path for the current and is maintained at zero potential.

• Earth Wire: Usually green or yellow in color, it is a safety wire connected to a metal plate buried deep in the earth.

• Specifications in India:

• The potential difference between the live wire and the neutral wire in a standard Indian household is 220 Volts.

• The frequency of the Alternating Current (AC) supplied is 50 Hertz (Hz).

• Short Circuit and Overloading:

• A short circuit occurs when the live and neutral wires come into direct contact, leading to a sudden surge in current and potentially causing a fire.

• Overloading happens when too many high-power appliances (like air conditioners or geysers) are connected to a single socket, drawing current beyond the capacity of the wires.

Important Points

• Earthing Process: The earth wire from the main switchboard is connected to a thick copper wire or galvanized iron pipe attached to a copper plate buried in a pit. This pit is filled with charcoal and salt to maintain moisture and ensure low resistance to the ground.

• Three-Pin Plug: In a three-pin plug, the top pin is for earthing. It is longer and thicker than the other two pins to ensure that the earth connection is made first before the live and neutral pins enter the socket, providing pre-emptive safety.

• Safety Devices: While the earth wire is a passive safety feature, devices like RCCB (Residual Current Circuit Breaker) or ELCB (Earth Leakage Circuit Breaker) are active components that detect leakage to earth and disconnect the power instantly.

Q7. Answer: (c) Rainwater harvesting and watershed management

The correct answer is Rainwater harvesting and watershed management.

Key Points

• Rainwater harvesting is the process of collecting, filtering, and storing rainwater from surfaces like rooftops or open ground for future use. This technique is the most effective way for a drought-prone village to ensure water availability during dry seasons.

• Watershed management refers to the efficient management and conservation of surface and groundwater resources. It involves techniques like contour bunding, trenching, and the construction of check dams to prevent soil erosion and increase water percolation into the soil.

• The primary goal of these methods is to recharge groundwater tables and create surface storage, such as farm ponds or percolation tanks, which can be directly used for irrigation.

• By implementing watershed management, a village can transform its hydrological cycle, ensuring that even with low rainfall, the moisture levels in the agricultural field are maintained.

• These methods are sustainable and cost-effective, often involving local communities in the planning and maintenance of water structures, leading to long-term water security.

Additional Information

• Sprinkler Irrigation: This is a method of applying irrigation water which is similar to natural rainfall. While it improves water-use efficiency, it does not solve the problem of storing water for dry seasons; it only helps in using existing water more carefully.

• Growing short-duration crops: This is a drought-escape strategy. Crops like millets, pulses, or oilseeds that mature in 60 to 90 days are grown to avoid the peak dry period. However, this does not provide a storage solution for water.

• Spraying pesticides: This practice is used to protect crops from pests and diseases. It has no relevance to water conservation or drought mitigation.

• Government Initiatives: The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), launched in 2015, focuses on 'Per Drop More Crop' and 'Har Khet Ko Pani' by promoting watershed development and micro-irrigation.

• Catch the Rain Campaign: Launched by the Ministry of Jal Shakti in 2021, this campaign encourages states and stakeholders to create appropriate Rain Water Harvesting Structures (RWHS) suitable to the climatic conditions before the onset of monsoon.

Important Points

• Groundwater Depletion: According to reports, India is the largest user of groundwater in the world. Techniques like rainwater harvesting are critical because the Central Ground Water Board (CGWB) has identified several areas as "over-exploited."

• Traditional Methods: Many regions in India use traditional storage systems such as Johads in Rajasthan, Zabo in Nagaland, and Eris in Tamil Nadu, which are excellent examples of watershed management.

• Economic Impact: Proper water management can increase crop intensity and diversify agriculture, allowing farmers to grow a second crop in the Rabi season (winter), significantly boosting rural income.

• Environmental Benefits: Beyond irrigation, these practices help in restoring the ecosystem, reducing soil salinity, and supporting local biodiversity.

Q8. Answer: (d) Only the numerical value, which is its magnitude

The correct answer is Only the numerical value, which is its magnitude.

Key Points

• Distance is defined as the total path length covered by an object during its motion from one point to another. It describes how much ground an object has covered regardless of its starting or ending position.

• To describe distance, we only need the numerical value, which is known as its magnitude. It does not require any information about the direction of motion. Hence, option D is the correct statement.

• Option A suggests both magnitude and direction are required; however, this describes displacement, which is a vector quantity, not distance. Hence, statement A is incorrect.

• Option B mentions the starting and ending points only; while these define the displacement (the shortest straight-line path), they do not account for the actual path taken to determine distance. Hence, statement B is incorrect.

• Option C states only the direction of motion is needed; direction alone cannot quantify the extent of travel without a numerical value. Hence, statement C is incorrect.

• The SI unit of distance is the meter (m), as established by the International System of Units. Other common units include kilometers (km), centimeters (cm), and miles.

Additional Information

• Scalar Quantities: These are physical quantities that are described by magnitude only. Examples include distance, speed, mass, temperature, time, and energy. They follow ordinary algebraic laws for addition and subtraction.

• Vector Quantities: These require both magnitude and direction for a complete description. Examples include displacement, velocity, acceleration, force, and momentum. These quantities follow vector algebra rules.

• Speed vs. Velocity: Speed is the rate of change of distance (scalar), whereas velocity is the rate of change of displacement

(vector). A car moving at 60 km/h describes speed, but a car moving at 60 km/h towards the North describes velocity.

• Path Dependency: Distance is path-dependent, meaning if a person walks 4 meters North and 3 meters East, the total distance traveled is 7 meters. However, the displacement (magnitude) would be 5 meters (calculated using the Pythagoras theorem).

Important Points

• Odometer: This is a device or instrument installed in vehicles (like cars and bikes) to measure the total distance traveled by the vehicle. It records the numerical value in kilometers or miles.

• Positivity: The distance traveled by a moving object can never be zero or negative. It is always a positive quantity as long as the object is in motion. In contrast, displacement can be zero if the object returns to its initial position.

• Relationship: For motion in a straight line without changing direction, the magnitude of distance is equal to the magnitude of displacement. In all other cases involving curves or turns, distance is always greater than the magnitude of displacement.

• Calculation: Distance can be calculated using the formula Distance = Speed × Time, provided the speed is constant over the given time interval.

Q9. Answer: (c) Catenation

The correct answer is Catenation.

Key Points

• Catenation is the unique property of carbon atoms to form covalent bonds with other carbon atoms, resulting in the formation of long chains, branched chains, or closed rings. This ability is the primary reason for the vast number of organic compounds existing in nature.

• The strength of the carbon-carbon (C-C) bond is exceptionally high (approximately 348 kJ/mol), which makes the resulting structures very stable. While other elements like Silicon or Sulphur show catenation, their bond strengths are much lower, limiting the length of their chains.

• Carbon exhibits maximum catenation due to its small atomic size and the high strength of the bond formed between its atoms. This allows carbon to link in various configurations, including straight chains, branched structures, and cyclic rings. Hence, the statement regarding catenation is correct.

• This property enables carbon to form millions of compounds, which are studied under a dedicated branch of science known as Organic Chemistry. The compounds can range from simple molecules like Methane (CH4) to complex biological molecules like DNA and Proteins.

Additional Information

• Tetravalency:

• Carbon has an atomic number of 6, with an electronic configuration of 2, 4. It has four valence electrons in its outermost shell.

• To achieve stability, it forms four covalent bonds with other atoms. This tetravalency allows carbon to bond with oxygen, hydrogen, nitrogen, and halogens, leading to a diverse range of functional groups.

• Polymerisation:

• This is a process where small units called monomers combine chemically to form a large, three-dimensional network or chain called a polymer.

• Common examples include Polyethylene (formed from ethylene monomers) and PVC. While carbon compounds undergo polymerisation, the fundamental property that allows carbon to link with itself in the first place is catenation. Hence, this option is related but not the fundamental property asked.

• Isomerisation:

• Isomerism is the phenomenon where compounds have the same molecular formula but different structural arrangements or spatial orientations.

• Isomerisation is the chemical process by which one molecule is transformed into another molecule which has exactly the same atoms, but the atoms are rearranged. This contributes to the diversity of carbon compounds. Hence, this option describes a structural variation rather than the bonding ability itself.

• Allotropes of Carbon:

• Carbon exists in several allotropic forms such as Diamond, Graphite, and Fullerenes (like C60).

• In Diamond, each carbon atom is bonded to four others in a tetrahedral structure, while in Graphite, carbon atoms form hexagonal layers. These structures are possible due to the catenation property.

Important Points

• Bonding Versatility: Carbon can form single (alkanes), double (alkenes), and triple (alkynes) bonds. The bond length decreases as the number of bonds between two carbon atoms increases, with triple bonds being the shortest and strongest.

• Comparison with Silicon: Silicon belongs to the same group (Group 14) as carbon and shows catenation. However, due to its larger atomic size, the Si-Si bond is weaker, and it usually forms chains only up to 7 or 8 atoms, unlike carbon which can form chains of thousands of atoms.

• History and Discovery: The study of carbon-based compounds dates back centuries, but the term Organic Chemistry was

popularized in the 19th century. The synthesis of Urea by Friedrich Wöhler in 1828 disproved the "Vital Force Theory," showing that carbon compounds could be created from inorganic materials.

Q10. Answer: (a) 0 to 14

The correct answer is 0 to 14.

Key Points

• The pH scale is a tool used to specify the acidity or basicity (alkalinity) of an aqueous solution. It was first introduced by the Danish biochemist Soren Peder Lauritz Sorensen in the year 1909.

• The standard range of the pH scale is from 0 to 14. This range allows for the classification of substances based on their hydrogen ion concentration. Hence, Option A is correct.

• A pH value of 7 is considered neutral, which is the characteristic of pure water at 25 degrees Celsius. It represents a balance between hydrogen ions (H+) and hydroxyl ions (OH-).

• Substances with a pH value less than 7 (specifically from 0 up to 7) are classified as acidic. The lower the numerical value, the stronger the acid. Hence, Option B is incorrect as it only represents the acidic portion of the scale.

• Substances with a pH value greater than 7 (specifically from 7 to 14) are classified as basic or alkaline. The higher the number, the stronger the base. Hence, Option D is incorrect.

• While pH values can occasionally fall outside the 0 to 14 range for extremely strong chemicals, the standard operational scale used in laboratories and for educational purposes is 0 to 14. Hence, Option C is incorrect.

Additional Information

• Logarithmic Nature: The pH scale is logarithmic, meaning each whole pH value below 7 is 10 times more acidic than the next higher value. For example, pH 4 is ten times more acidic than pH 5 and 100 times (10 times 10) more acidic than pH 6.

• Biological Importance: The pH level is critical in biological systems. For instance, the pH of human blood is tightly regulated between 7.35 and 7.45. Any significant deviation can lead to serious health issues or death.

• Examples of Acidic Substances: Common acidic substances include gastric juice (pH 1.5 to 3.5), lemon juice (pH 2.0), vinegar (pH 2.9), and coffee (pH 5.0).

• Examples of Basic Substances: Common alkaline substances include baking soda (pH 9.0), milk of magnesia (pH 10.5), and household bleach (pH 12.5).

• Measurement Tools: The pH of a solution can be measured using pH paper, Universal Indicator, or electronic pH meters. Litmus paper is a basic tool that turns red in acids and blue in bases.

Important Points

• Temperature Dependence: The pH of a solution is dependent on temperature. The neutral point of 7 is only strictly accurate at 25 degrees Celsius (298 Kelvin). As temperature increases, the neutral pH value slightly decreases.

• pOH Concept: Parallel to pH, there is a pOH scale which measures the concentration of hydroxide ions. In any aqueous solution at 25 degrees Celsius, the sum of pH and pOH always equals 14.

• Environmental Impact: The pH of rainwater is typically around 5.6 due to dissolved carbon dioxide. However, acid rain occurs when the pH drops below 5.6, often caused by sulfur dioxide and nitrogen oxides emitted from industrial processes.

• Chemical Definition: Mathematically, pH is defined as the negative logarithm (base 10) of the hydrogen ion activity: pH = -log10[H+].

Q11. Answer: (a) A heterogeneous mixture with large particles

The correct answer is A heterogeneous mixture with large particles.

Key Points

• A suspension is a heterogeneous mixture in which the solute-like particles settle out of a solvent-like phase some time after their introduction. Hence, statement A is correct.

• The particle size in a suspension is quite large, typically greater than 1000 nanometers (or 1 micrometer), which allows them to be seen clearly with the naked eye.

• Unlike homogeneous mixtures, where the components are distributed uniformly at a molecular level, the components of a suspension are non-uniformly distributed. Hence, statement B is incorrect.

• A suspension is considered unstable because the particles will eventually precipitate or settle down at the bottom of the container due to the influence of gravity if left undisturbed for a period of time.

• The large particle size prevents suspensions from passing through filter paper, meaning they can be easily separated by physical methods such as filtration or decantation.

Additional Information

• Tyndall Effect: A suspension scatters a beam of light passing through it, making its path visible. This phenomenon is known as the Tyndall Effect. However, if the particles settle down completely, the mixture may lose this property.

• Comparison with Solutions: A true solution is a homogeneous mixture where the solute particles are less than 1 nanometer in

diameter and do not scatter light or settle. Hence, statement C is incorrect.

• Colloidal Dispersions: A colloid is a heterogeneous mixture where the particle size is intermediate, ranging between 1 nanometer and 1000 nanometers. These particles do not settle upon standing but still exhibit the Tyndall Effect. Hence, statement D is incorrect.

• Common Examples: Typical examples of suspensions include muddy water, chalk powder in water, flour in water, and Milk of Magnesia (Magnesium Hydroxide).

• Applications: Suspensions are widely used in the pharmaceutical industry, where many medicines (like antibiotics or antacids) are prepared as suspensions to ensure the stability of the active ingredient before consumption.

Important Points

• Brownian Motion: In suspensions, Brownian motion (the random movement of particles) is usually not strong enough to counteract gravity, leading to the eventual sedimentation of the particles.

• Stokes' Law: The rate at which particles in a suspension settle can be calculated using Stokes' Law, which depends on the radius of the particle, the viscosity of the medium, and the density difference.

• Appearance: Suspensions are generally opaque or cloudy because the large particles block or scatter light waves significantly.

• Phase separation: In a suspension, the two phases are often referred to as the dispersed phase (the solid particles) and the dispersion medium (the liquid or gas).

Q12. Answer: (d) White

The correct answer is White.

Key Points

• Leucoplasts are a category of plastids that are characterized by their lack of pigments. Because they do not contain any colored pigments like chlorophyll or carotenoids, they appear white or colorless.

• These organelles are primarily found in non-photosynthetic tissues of plants, such as roots, bulbs, tubers, and seeds, where light does not reach.

• The primary function of leucoplasts is the storage of organic nutrients. They act as storage depots for starch, lipids, and proteins.

• The term leucoplast was coined by A. F. W. Schimper in 1883. He categorized plastids based on their color and function.

• Indigo is not the color associated with these organelles; indigo and purple hues in plants are usually derived from anthocyanins found in vacuoles, not plastids. Hence, statement A is incorrect.

• Orange is a color typically associated with chromoplasts, which contain carotenoid pigments like beta-carotene. Hence, statement B is incorrect.

• Purple color in plant parts like petals or fruits is typically due to water-soluble pigments and is not the natural state of a leucoplast. Hence, statement C is incorrect.

• Since leucoplasts are pigment-less and appear colorless or white in plant tissues like the flesh of a potato. Hence, statement D is correct.

Additional Information

• Classification of Leucoplasts:

• Amyloplasts: These are the most common type of leucoplast. They are specialized for the synthesis and storage of starch granules. A classic example is the potato tuber, where amyloplasts are found in high density.

• Elaioplasts (or Oleoplasts): These are responsible for the storage of fats, lipids, and oils. They are frequently found in seeds (like oilseeds) and liverworts.

• Proteinoplasts (or Aleuroplasts): These leucoplasts store proteins and are typically found in seeds, specifically in the aleurone layer of maize or pulses.

• Comparison with other Plastids:

• Chloroplasts: These contain chlorophyll a and chlorophyll b. They are green in color and are the site of photosynthesis in leaves.

• Chromoplasts: These contain fat-soluble pigments like carotene and xanthophylls. They provide yellow, orange, or red colors to flowers and ripening fruits to attract pollinators and dispersers.

• Gerontoplasts: These are plastids that develop from chloroplasts during the senescence (aging) of plant tissues.

• Interconvertibility: It is a fact that plastids are interconvertible. For example, leucoplasts in a potato can turn into chloroplasts (green) if exposed to sunlight for a prolonged period, and chloroplasts turn into chromoplasts during the ripening of a tomato.

Important Points

• Structure: Like mitochondria and chloroplasts, leucoplasts are double-membrane bound organelles. They possess their own DNA (ptDNA) and 70S ribosomes, making them semi-autonomous.

• Evolutionary Origin: According to the Endosymbiotic Theory, plastids originated from cyanobacteria that were engulfed by a eukaryotic cell approximately 1.5 billion years ago.

• Applications: In agricultural science, the study of amyloplasts is crucial for understanding crop yield and starch quality in staple foods like rice, wheat, and corn.

• Location: While chloroplasts dominate the mesophyll cells of leaves, leucoplasts dominate the parenchyma cells of storage organs.

Q13. Answer: (a) Iron surface exposed to moist air containing dissolved salts

The correct answer is Iron surface exposed to moist air containing dissolved salts.

Key Points

• Corrosion is a natural process that converts a refined metal into a more stable oxide, hydroxide, or sulfide. In the case of Iron, this process is specifically called rusting, which requires both oxygen and water.

• An iron surface exposed to moist air containing dissolved salts provides the ideal environment for an electrochemical cell to form. The dissolved salts (like Sodium Chloride or Magnesium Chloride) act as an electrolyte, increasing the conductivity of the water film on the metal surface. This facilitates faster movement of ions and electrons, which significantly accelerates the rate of corrosion. Hence, this condition is the most effective at accelerating the process.

• If iron is immersed in pure water free of dissolved oxygen, the oxidation of iron cannot be sustained. Oxygen acts as the oxidizing agent at the cathode in the rusting reaction. Without it, the chemical cycle is broken. Hence, this statement describes a condition that inhibits rather than accelerates corrosion.

• Galvanization is a method of protection where iron is coated with a thin layer of zinc. Since Zinc is more electropositive and reactive than iron (higher in the electrochemical series), it undergoes sacrificial corrosion to protect the underlying iron. Hence, this statement is incorrect as it refers to a prevention technique.

• An iron surface in dry air lacks the necessary moisture (H2O) to form the aqueous medium required for ion transport. Corrosion is virtually non-existent in environments with humidity levels below 40%. Hence, this statement is incorrect regarding the acceleration of corrosion.

Additional Information

• Chemical Formula of Rust: The red-brown flaky substance formed is hydrated iron(III) oxide, represented by the chemical formula Fe2O3·xH2O.

• The Redox Process:

• At the Anode: Iron atoms lose electrons to form ferrous ions (Fe → Fe2+ + 2e-).

• At the Cathode: Oxygen and water accept these electrons to form hydroxide ions or water depending on the pH of the environment.

• Factors Affecting Corrosion Rate:

• Presence of Impurities: Pure metals corrode much slower than impure ones. Impurities act as tiny cathodic sites.

• Air Pollution: The presence of Sulfur Dioxide (SO2), Carbon Dioxide (CO2), and Nitrogen Oxides (NOx) in the atmosphere creates acidic conditions that dissolve protective oxide layers and speed up metal decay.

• Temperature: A rise in temperature generally increases the rate of chemical reactions, including the kinetic movement of ions in the electrolyte.

• Methods of Prevention:

• Alloying: Mixing iron with Chromium and Nickel produces Stainless Steel, which forms a passive layer of chromium oxide that prevents further oxidation.

• Cathodic Protection: Attaching a sacrificial anode made of Magnesium or Zinc to ships or underground pipes to ensure the iron remains the cathode and stays protected.

• Barrier Protection: Using paints, grease, or plastic coatings to physically block air and moisture.

Important Points

• Geographic Impact: Corrosion is a major economic concern in coastal areas. Cities like Mumbai or Kolkata face higher infrastructure maintenance costs compared to inland cities due to the high salinity and humidity in the atmosphere.

• Electrochemical Series: Metals are ranked based on their reduction potential. Metals with a lower reduction potential (like Zinc and Aluminium) are more likely to corrode than metals with a higher potential (like Gold and Silver).

• Economic Data: According to various global surveys, the annual cost of corrosion is estimated to be approximately 3% to 4% of a nation's Gross Domestic Product (GDP), emphasizing the need for effective prevention technologies.

Q14. Answer: (d) it increases the chances of survival of an organism

The correct answer is it increases the chances of survival of an organism.

Key Points

• Genetic variation refers to the differences in DNA sequences among individuals within a population. It is the foundation of evolution and natural selection, providing the raw material upon which environmental pressures act.

• The primary importance of genetic variation is that it increases the chances of survival of a species. If an environment changes—due to climate change, the introduction of a new pathogen, or shifts in food availability—individuals with specific variations may possess traits that allow them to survive while others perish. Hence, the statement in option D is correct.

• Genetic variation prevents uniformity. Uniformity in progeny is typically a result of asexual reproduction or cloning, where offspring are genetically identical to the parent. While efficient, it makes the entire population susceptible to the same threats. Hence, the statement in option A is incorrect.

• While sexual reproduction is a significant mechanism that generates variation through meiosis and random fertilization, the "importance" of variation itself is the resulting adaptability and survival, rather than just the act of reproduction. Hence, the statement in option B is incorrect.

• Dominant and recessive traits are components of Mendelian inheritance and describe how certain alleles are expressed. While they contribute to the observable phenotype, they are a mechanism of variation rather than the ultimate reason why variation is biologically essential for a species' longevity. Hence, the statement in option C is incorrect.

Additional Information

• Sources of Variation:

• Mutation: A permanent change in the nucleotide sequence of the genome. It is the ultimate source of new alleles. Mutations can be caused by UV radiation, chemical mutagens, or errors during DNA replication.

• Gene Flow: The transfer of genetic material between different populations. This occurs when individuals migrate and breed in a new location, introducing new genes into the local gene pool.

• Sexual Reproduction: During prophase I of meiosis, crossing over occurs between homologous chromosomes, creating unique combinations of genes.

• Natural Selection:

• Proposed by Charles Darwin in his 1859 book "On the Origin of Species." It describes the process where organisms better adapted to their environment tend to survive and produce more offspring.

• Without genetic variation, natural selection would have no "choices" to make, and evolution would cease.

• Population Bottleneck:

• A sharp reduction in the size of a population due to environmental events (like earthquakes or floods) or human activities. This reduces genetic variation and can lead to inbreeding depression, lowering the survival rate of the species.

Important Points

• Example of Variation (Peppered Moth): In 19th-century England, the Biston betularia (peppered moth) population shifted from light-colored to dark-colored due to industrial pollution. The genetic variation for wing color allowed the species to survive as the environment changed.

• Antibiotic Resistance: In microbiology, genetic variation in bacteria (often through plasmids) allows certain individuals to survive antibiotic treatment. These survivors multiply, leading to the evolution of resistant strains, a major challenge in modern healthcare.

• Adaptation vs. Variation: While variation refers to the differences present at a specific time, adaptation is the biological process where a population becomes better suited to its habitat over many generations.

• Conservation Biology: Scientists use genetic diversity indices to measure the health of endangered species. Low variation is often a precursor to extinction.

Q15. Answer: (d) Butane

The correct answer is Butane.

Key Points

• Saturated hydrocarbons are organic compounds consisting entirely of carbon and hydrogen atoms where all the carbon-carbon bonds are single bonds. These are also known as Alkanes.

• Butane is a saturated hydrocarbon with the chemical formula C4H10. It follows the general formula for alkanes, which is CnH2n+2, where n=4. Since it contains only single bonds between its four carbon atoms, it is classified as saturated. Hence, Option D is correct.

• The structure of Butane can be linear (n-butane) or branched (isobutane), both of which are saturated because every carbon atom is bonded to the maximum possible number of hydrogen atoms.

• Butane is a colorless, highly flammable gas at room temperature and atmospheric pressure. It is commonly used as a fuel for cigarette lighters and as a component in Liquefied Petroleum Gas (LPG).

• In a saturated hydrocarbon, every carbon atom is sp3 hybridized, meaning it forms four sigma bonds in a tetrahedral geometry.

Additional Information

• Butene (Option A):

• Butene is an unsaturated hydrocarbon with the formula C4H8. It belongs to the Alkene series.

• It contains at least one double bond between carbon atoms, which means it has fewer hydrogen atoms than the corresponding alkane (butane). Hence, Option A is incorrect.

• It is primarily used in the production of polymers and synthetic rubber in the petrochemical industry.

• Benzene (Option B):

• Benzene is an aromatic hydrocarbon with the molecular formula C6H6.

• It consists of six carbon atoms joined in a ring with delocalized pi electrons, often represented as alternating double bonds. This structure makes it highly unsaturated. Hence, Option B is incorrect.

• It is a natural constituent of crude oil and is a vital industrial chemical used to make plastics, resins, nylon, and synthetic fibers.

• Propene (Option C):

• Propene, also known as propylene, is an unsaturated hydrocarbon with the formula C3H6.

• As an alkene, it contains one carbon-carbon double bond. Hence, Option C is incorrect.

• It is the second simplest member of the alkene class and is a major raw material for the production of polypropylene plastic.

Important Points

• Chemical Reactivity: Saturated hydrocarbons (alkanes) are generally less reactive than unsaturated ones because single C-C and C-H bonds are very strong. They typically undergo substitution reactions (like halogenation) rather than addition reactions.

• Unsaturated Hydrocarbons: These include Alkenes (double bonds) and Alkynes (triple bonds). They are more reactive because the double or triple bonds can "open up" to bond with other atoms in addition reactions.

• Identification: A common test to distinguish between saturated and unsaturated hydrocarbons is the Bromine Water Test. Unsaturated hydrocarbons will decolorize reddish-brown bromine water, while saturated hydrocarbons like Butane will not react with it under normal conditions.

• Isomerism: While Butane has two isomers (n-butane and isobutane), Propene and Butene exhibit different types of isomerism, including positional and geometrical (cis-trans) isomerism due to the presence of the double bond.

Q16. Answer: (a) Rust formation on iron objects

The correct answer is Rust formation on iron objects.

Key Points

• Corrosion is a natural process that converts a refined metal into a more chemically stable form such as oxide, hydroxide, or sulfide. It is the gradual destruction of materials by chemical and/or electrochemical reaction with their environment.

• Rusting is the most common form of corrosion observed in daily life, specifically occurring on iron and its alloys like steel. It occurs when iron reacts with oxygen and moisture (water) in the air to form hydrated ferric oxide. Hence, the statement regarding rust formation is correct.

• The chemical formula for rust is Fe2O3·nH2O. This reddish-brown flaky substance weakens the structural integrity of the metal, leading to significant economic loss and safety hazards in bridges, buildings, and vehicles.

• Glowing of a bulb is a physical process where the filament (usually tungsten) gets heated to a high temperature and emits light. It does not involve the chemical degradation of the metal in the way corrosion does. Hence, this statement is incorrect.

• Boiling of water is a physical change or phase transition from liquid to gas occurring at 100 degrees Celsius (at standard pressure). It is not related to the chemical corrosion of metals. Hence, this statement is incorrect.

• Melting of metal is also a physical change where a solid metal turns into a liquid state upon reaching its melting point. While high temperatures can accelerate corrosion, melting itself is not corrosion. Hence, this statement is incorrect.

Additional Information

• Types of Corrosion in Other Metals:

• Silver Tarnish: When silver objects are exposed to air containing hydrogen sulfide, they develop a black coating of silver sulfide (Ag2S).

• Copper Verdigris: Copper reacts with moist carbon dioxide in the air to slowly lose its shiny brown surface and gain a green coat of basic copper carbonate.

• Aluminium Passivation: Unlike iron, aluminium forms a very thin, tough layer of aluminium oxide that actually protects the rest of the metal from further corrosion.

• Factors Influencing Corrosion:

• Moisture: The presence of water or humidity is essential for the electrochemical process of rusting.

• Salinity: Saltwater (electrolytes) significantly speeds up the rate of corrosion, which is why ships and coastal structures deteriorate faster.

• pH Levels: Exposure to acid rain or acidic environments increases the oxidation rate of metals.

• Prevention Methods:

• Galvanization: Coating iron or steel with a thin layer of zinc. Even if the coating is scratched, zinc corrodes preferentially (sacrificial protection).

• Electroplating: Using electricity to coat a metal with a layer of another metal like chromium or tin to prevent oxidation.

• Alloying: Mixing metals with other elements. For example, Stainless Steel is an alloy of iron, chromium, and nickel that does not rust easily.

• Painting and Greasing: Applying a barrier of paint, oil, or grease to prevent the metal surface from coming into contact with air and moisture.

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Important Points

• Redox Reaction: Corrosion is essentially a redox (reduction-oxidation) reaction. In iron, the metal acts as an anode and is oxidized to Fe2+ ions, while oxygen is reduced at the cathode.

• Economic Impact: According to various global surveys, the annual cost of corrosion is estimated to be over 3% of the global GDP, highlighting the importance of anti-corrosion technologies.

• Microbial Corrosion: Some types of corrosion are caused by bacteria (Sulphate-reducing bacteria) that can thrive in pipelines and underground tanks, leading to rapid pitting and failure.

Q17. Answer: (a) Electric Mixer Grinder

The correct answer is Electric Mixer Grinder.

Key Points

• The heating effect of electric current, also known as Joule heating, occurs when an electric current passes through a conductor with resistance, leading to the production of heat energy.

• Electric Mixer Grinder: This device primarily works on the magnetic effect of electric current. It contains an electric motor that converts electrical energy into mechanical energy to rotate the blades. While it may get warm due to friction and internal resistance, its primary working principle is not the heating effect. Hence, statement A is correct.

• Electric Iron: This appliance uses a heating element made of high-resistance material like Nichrome. When current flows through it, the resistance converts the electrical energy into heat, which is then used to press clothes. Hence, statement B is incorrect.

• Electric Geyser: It functions by passing current through an immersion rod or a heating coil. The high resistance of the coil generates significant thermal energy, which is transferred to the water to increase its temperature. Hence, statement C is incorrect.

• Electric Fuse: A fuse is a critical safety device designed to protect circuits. It consists of a wire with a low melting point. When excessive current flows, the heating effect causes the wire to melt and break the circuit. Hence, statement D is incorrect.

Additional Information

• Joule's Law of Heating: The amount of heat produced (H) in a conductor is directly proportional to the square of the current (I^2), the resistance (R) of the conductor, and the time (t) for which the current flows. The formula is expressed as $H = I^2Rt$.

• Magnetic Effect of Current: Discovered by Hans Christian Oersted in 1820, this principle states that a current-carrying conductor produces a magnetic field around it. This is the fundamental principle behind electric motors, fans, and mixers.

• Nichrome: It is an alloy consisting of Nickel and Chromium. It is widely used in heating appliances because of its high resistivity and high melting point, and because it does not oxidize (burn) easily at high temperatures.

• Energy Transformation: In heating devices, electrical energy is transformed into heat energy. In motorized devices like the Mixer Grinder, electrical energy is transformed into kinetic energy (mechanical energy).

• Applications of Heating Effect: Apart from irons and geysers, other examples include electric toasters, electric kettles, room heaters, and hair dryers.

Important Points

• Resistance Factor: The efficiency of a heating device depends on the material used. For example, Copper has low resistance and is used for connecting wires to prevent heat loss, while Tungsten is used in bulbs because it can withstand temperatures up to 3422 degrees Celsius while emitting light.

• Fuse Characteristics: A fuse wire is typically made of an alloy of tin and lead. It must have high resistance (to heat up quickly) and a low melting point (to break the circuit promptly during a short circuit or overload).

• Safety in Appliances: Modern homes often use MCBs (Miniature Circuit Breakers) instead of traditional fuses. While fuses work on the heating effect, MCBs often utilize the magnetic effect to trip the switch during faults.

Q18. Answer: (c) It is the mass relative to carbon-12 atom.

The correct answer is It is the mass relative to carbon-12 atom.

Key Points

• Atomic mass is the mass of a single atom, which includes the mass of protons, neutrons, and electrons. However, because the mass of an atom is extremely small, it is expressed as a relative value rather than an absolute mass in standard SI units like grams or kilograms.

• The modern standard for atomic mass is based on the carbon-12 isotope. By international agreement in 1961, the International Union of Pure and Applied Chemistry (IUPAC) defined one atomic mass unit (amu) as exactly 1/12th of the mass of one atom of carbon-12.

• Defining atomic mass as the mass relative to carbon-12 atom allows scientists to create a stable scale where the mass of hydrogen is approximately 1 and oxygen is approximately 16. Hence, statement C is correct.

• While an atom does have a mass that can be measured in grams, the value is so tiny (approximately 10^-24 grams) that it is not used as the standard definition in chemical equations or the periodic table. Hence, statement A is incorrect.

• Similarly, kilograms are the standard SI unit for mass, but they are inconvenient for describing individual atomic particles without

using massive negative exponents. Hence, statement B is incorrect.

• Hydrogen was the original reference point for John Dalton in the 19th century, but it was replaced first by oxygen and later by carbon-12 for greater precision in mass spectrometry. Hence, statement D is incorrect.

Additional Information

• Unified Atomic Mass Unit (u): This unit, also known as the Dalton (Da), is used to express atomic and molecular weights. 1 u is approximately equal to 1.660539 x 10^-27 kilograms.

• Average Atomic Mass: Most elements found in nature are a mixture of several isotopes (atoms of the same element with different numbers of neutrons). The atomic mass listed on the Periodic Table is the weighted average of all naturally occurring isotopes of that element.

• Mass Number vs. Atomic Mass: The mass number is a whole number representing the sum of protons and neutrons in a nucleus. In contrast, the atomic mass is a more precise decimal value that accounts for the binding energy and the small mass contribution of electrons.

• Avogadro's Number: There is a crucial relationship between atomic mass units and grams. One mole of an element has a mass in grams that is numerically equal to its atomic mass in u. This is governed by Avogadro's constant (6.022 x 10^23).

• Applications: Understanding atomic mass is fundamental in Stoichiometry, Molecular Biology, and Nuclear Physics to calculate the amount of reactants needed in chemical reactions or to determine the molecular formula of unknown substances.

Important Points

• Isotopes of Carbon: While Carbon-12 is the standard, Carbon-13 and Carbon-14 also exist. Carbon-12 was chosen because it is the most abundant and stable, making it a reliable reference for analytical chemistry.

• History of Standards: Before 1961, physicists used oxygen-16 while chemists used a natural mixture of oxygen isotopes as a standard. The move to carbon-12 unified these two scales into a single International Scale of Atomic Weights.

Q19. Answer: (d) 500 Hz sound has a higher pitch.

The correct answer is 500 Hz sound has a higher pitch.

Key Points

• Pitch is a sensory characteristic of sound that allows a listener to assign it a position on a musical scale based on its frequency. It determines how "shrill" or "grave" a sound appears to the human ear.

• The frequency of a sound wave is defined as the number of vibrations or cycles completed per unit of time, specifically per second. The standard unit for measuring frequency is Hertz (Hz).

• There is a direct proportional relationship between frequency and pitch: a sound with a higher frequency will always have a higher pitch, while a sound with a lower frequency will have a lower pitch.

• In the given comparison, the sound of 500 Hz completes 500 cycles per second, whereas the sound of 100 Hz completes only 100 cycles per second. Therefore, the 500 Hz sound is much more shrill. Hence, the statement "500 Hz sound has a higher pitch" is correct.

• The statement that both have the same pitch is false because pitch is strictly dependent on frequency, and these two frequencies are different. Hence, the statement "Both have the same pitch" is incorrect.

• The statement claiming the 100 Hz sound is higher is physically impossible under standard acoustic laws because 100 Hz is a lower frequency than 500 Hz. Hence, the statement "100 Hz sound has a higher pitch" is incorrect.

• Since pitch is a measurable and quantifiable property related to frequency, it can easily be compared using objective data. Hence, the statement "Pitch cannot be compared" is incorrect.

Additional Information

• Human Audibility Range: The standard range of audible frequencies for a healthy human ear is between 20 Hz and 20,000 Hz (or 20 kHz). Frequency values outside this range are generally not perceived as sound by humans.

• Infrasonic and Ultrasonic: Sounds with a frequency lower than 20 Hz are categorized as infrasonic (e.g., sounds produced by elephants or earthquakes). Sounds with a frequency higher than 20,000 Hz are ultrasonic (e.g., sounds used by bats for navigation or in medical ultrasound imaging).

• Loudness vs. Pitch: It is crucial to distinguish pitch from loudness. Pitch depends on frequency, whereas loudness depends on the amplitude (the maximum displacement of the particles of the medium). A sound can be high-pitched but very quiet, or low-pitched and very loud.

• Wavelength Relationship: Frequency and wavelength are inversely proportional. This means a high-pitched 500 Hz sound has a shorter wavelength, while a low-pitched 100 Hz sound has a longer wavelength, assuming they travel through the same medium like air at a constant temperature.

Important Points

• Biological Factors: In humans, the pitch of the voice is determined by the vocal cords. Women and children typically have shorter and thinner vocal cords that vibrate faster, producing a higher frequency and thus a higher pitch voice compared to adult men.

• Speed of Sound: The speed of sound in a specific medium (such as dry air at 20 degrees Celsius, where it is approximately 343 meters per second) is independent of the frequency. Therefore, both the 100 Hz and 500 Hz sounds travel at the same speed in

the same environment.

• Musical Octaves: In music, an octave is the interval between one musical pitch and another with double its frequency. For example, a note at 500 Hz is approximately one octave higher than a note at 250 Hz.

Q20. Answer: (a) 10 N

The correct answer is 10 N.

Key Points

• According to Newton's Second Law of Motion, the force acting on an object is directly proportional to the product of its mass and acceleration. This fundamental principle of Classical Mechanics provides the quantitative description of force.

• The mathematical expression for this law is F = m x a, where F is the net force, m is the mass of the body, and a is the acceleration produced.

• In the provided problem, the mass (m) of the body is given as 5 kg and the acceleration (a) is 2 m/s2.

• By applying the formula, the Force (F) is calculated as 5 kg multiplied by 2 m/s2, which equals 10 kg.m/s2 or 10 N. Hence, the statement regarding the force being 10 N is correct.

• The unit of force in the International System of Units (SI) is the Newton, symbolized by N. One Newton is defined as the amount of force required to provide an acceleration of 1 m/s2 to a mass of 1 kg.

Additional Information

• Newton's Laws of Motion:

• Sir Isaac Newton first presented these three laws in his work Philosophiae Naturalis Principia Mathematica, published in the year 1687.

• First Law (Law of Inertia): An object will remain at rest or move in a straight line at a constant velocity unless acted upon by an external force.

• Third Law (Action and Reaction): For every action force, there is an equal and opposite reaction force acting on two different bodies.

• Vector Nature of Force:

• Force is a vector quantity, meaning it possesses both magnitude and direction.

• In this calculation, the magnitude is 10 N, and the direction of the force would be the same as the direction of the acceleration.

• Mass vs. Weight:

• The mass of an object (measured in kg) is a measure of its inertia and remains constant regardless of location.

• The weight is the gravitational force acting on that mass, calculated as W = m x g, where g is approximately 9.8 m/s2 on Earth.

Important Points

• SI Unit Conversion: The Newton (N) can be broken down into base units as kg.m.s-2. In the CGS system, the unit of force is the dyne, where 1 Newton is equal to 100,000 (10^5) dynes.

• Concept of Net Force: The Newton's Second Law specifically refers to the net force (the vector sum of all individual forces) acting on the body. If multiple forces act in opposite directions, they must be subtracted to find the resultant force.

• Applications: This principle is used in engineering, aerospace, and automotive safety (such as calculating the impact force during a collision at a specific deceleration).

• Relationship: If the mass is doubled while keeping the acceleration constant, the force required will double. Conversely, if mass is constant and acceleration is doubled, the force also doubles, showing a linear relationship.

Q21. Answer: (b) Sieve elements

The correct answer is Sieve elements.

Key Points

• Sieve elements are the specialized cells in the phloem tissue that are primarily responsible for the translocation of food (organic solutes like sucrose) from the leaves (source) to other parts of the plant (sink). Hence, statement B is correct.

• In angiosperms, these elements are known as sieve tube members, which join end-to-end to form continuous sieve tubes. Their end walls, called sieve plates, have pores that allow the flow of sap between cells.

• Phloem parenchyma consists of living cells that mainly function in the storage of food, resins, latex, and mucilage, and contribute to the lateral conduction of food rather than primary long-distance translocation. Hence, statement A is incorrect.

• Phloem fibres, also known as bast fibres, are sclerenchymatous cells that provide mechanical support and strength to the plant; they are generally dead at maturity and do not participate in food transport. Hence, statement C is incorrect.

• Companion cells are specialized parenchymatous cells closely associated with sieve tube elements; while they help in loading and unloading of sugars into the sieve tubes using ATP, they are not the actual channels through which food is translocated. Hence, statement D is incorrect.

Additional Information

• Phloem is a complex permanent tissue in vascular plants. It was named by Carl Nageli in 1858, derived from the Greek word

"phloios," meaning bark.

• Unlike xylem, which conducts water and minerals primarily unidirectionally (upwards), phloem transport is bidirectional, moving nutrients both up and down the plant stem.

• The process of food transport in phloem is called translocation, which is explained by the Mass Flow Hypothesis (or Pressure Flow Hypothesis) proposed by Ernst Munch in 1930.

• Sieve tube elements are unique because they are living cells but lack a nucleus, ribosomes, and vacuoles at maturity to provide more space for the efficient flow of nutrients.

• In gymnosperms and lower vascular plants, the food-conducting elements are sieve cells, which are less specialized than the sieve tube members found in flowering plants.

Important Points

• Companion cells and sieve tube members are called "sister cells" because they originate from the same meristematic mother cell through a single longitudinal division.

• The phloem sap is mainly composed of water and sucrose, but it also transports amino acids, hormones, and other minerals throughout the plant body.

• Among the four components of phloem, phloem fibres are the only dead cells, while sieve tubes, companion cells, and phloem parenchyma are living cells.

• Economic Use: Phloem fibres of certain plants like Jute, Flax, and Hemp are used commercially to make ropes, textiles, and bags due to their high mechanical strength.

• The sieve pores are often lined with a carbohydrate called callose, which can block the pores in response to injury or seasonal changes to prevent the loss of precious sap.

Q22. Answer: (c) Testis

The correct answer is Testis.

Key Points

• Testosterone is the primary male sex hormone and is also considered an anabolic steroid. It plays a crucial role in the development of male reproductive tissues such as the testis and prostate.

• In human beings, particularly males, testosterone is primarily secreted by the Leydig cells (also known as interstitial cells) located within the testes. Approximately 95% of the testosterone in a male body is produced in the testes.

• The secretion of this hormone is strictly regulated by the Hypothalamic-Pituitary-Gonadal axis. The Anterior Pituitary gland releases Luteinizing Hormone (LH), which travels through the bloodstream to the testes to stimulate the production of testosterone.

• Its primary functions include promoting secondary sexual characteristics during puberty (typically starting between the ages of 9 and 14), such as the growth of body hair, deepening of the voice, and increase in muscle mass and bone density.

• While testosterone is the principal androgen in males, it is also present in females in much smaller quantities, produced by the ovaries and the adrenal glands.

Additional Information

• Fallopian tube: These are the uterine tubes in the female reproductive system that transport the ovum from the ovary to the uterus each month. They are the site where fertilization usually occurs; however, they do not secrete testosterone. Hence, this option is incorrect.

• Ureter: The ureter is a muscular tube that carries urine from the kidneys to the urinary bladder. There are two ureters in the human body, one attached to each kidney. It is an organ of the urinary system and has no endocrine function related to sex hormones. Hence, this option is incorrect.

• Testis: The testes (plural) are the male gonads located inside the scrotum. They are responsible for spermatogenesis (production of sperm) and the endocrine function of producing androgens like testosterone. Hence, this option is correct.

• Uterus: The uterus, or womb, is a hollow muscular organ located in the female pelvis between the bladder and rectum. Its primary function is to nourish the developing fetus prior to birth. It does not produce testosterone. Hence, this option is incorrect.

Important Points

• Normal Levels: In adult men, normal testosterone levels generally range from 300 to 1,000 nanograms per deciliter (ng/dL). Levels tend to peak around age 20 and gradually decline after age 30.

• Chemical Nature: Testosterone is derived from cholesterol. It acts through androgen receptors found in various tissues throughout the body to exert its genomic effects.

• Discovery: The hormone was first isolated and synthesized in the year 1935 by researchers Karoly David, Ernst Laqueur, and colleagues.

• Health Impact: Low levels of testosterone (known as hypogonadism) can lead to symptoms such as fatigue, depression, reduced libido, and osteoporosis. Conversely, synthetic testosterone is often used in hormone replacement therapy and by athletes (often illegally) to enhance performance and muscle growth.

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Q23. Answer: (d) Real, inverted, and smaller than the object

The correct answer is Real, inverted, and smaller than the object.

Key Points

• When an object is placed at a distance greater than twice the focal length (2f) from a convex lens, the light rays coming from the object undergo refraction and converge on the opposite side of the lens.

• The image is formed between the focus (F2) and the center of curvature (2F2) on the other side of the lens. Hence, the statement regarding the image being real and inverted is correct.

• The nature of the image is real because the light rays actually intersect at a point after passing through the lens, meaning the image can be caught on a screen.

• The orientation of the image is inverted (upside down) relative to the object. Hence, the statement regarding the orientation is correct.

• The size of the image produced is diminished or smaller than the object itself. This occurs because the rays converge closer to the principal axis than their point of origin. Hence, the final conclusion of the question is correct.

Additional Information

• Convex Lens Characteristics: A convex lens, also known as a converging lens, is thicker at the center than at the edges. It has a positive focal length according to the Cartesian sign convention. It is widely used in optical instruments such as microscopes, telescopes, and cameras.

• Image Formation at Different Positions:

• At Infinity: The image is formed at the focus (F), is real, inverted, and highly diminished (point-sized).

• At 2F: The image is formed at 2F on the other side, is real, inverted, and the same size as the object.

• Between F and 2F: The image is formed beyond 2F, is real, inverted, and magnified (larger than the object).

• At F: The image is formed at infinity, is real, inverted, and highly magnified.

• Between F and Optical Center (O): The image is virtual, erect, and magnified, formed on the same side as the object.

• Applications in Vision: Convex lenses are used to correct Hypermetropia (long-sightedness), where the person can see distant objects clearly but struggles with near objects. The lens helps in converging light rays so they focus correctly on the retina.

• Magnifying Glass: A simple magnifying glass is a convex lens used to view small objects by placing the object within the focal length, resulting in a virtual, erect, and enlarged image.

Important Points

• Lens Formula: The relationship between the object distance (u), image distance (v), and focal length (f) is given by the formula: 1/f = 1/v - 1/u.

• Magnification (m): It is defined as the ratio of the height of the image (hi) to the height of the object (ho), represented as m = hi / ho = v / u. For real images, the magnification is negative, and for virtual images, it is positive.

• Power of a Lens: The power (P) is the reciprocal of the focal length measured in meters (P = 1/f). The SI unit of power is the Dioptre (D). A convex lens has positive power.

• Refractive Index: The degree of convergence depends on the refractive index of the lens material (usually glass or plastic) and the curvature of the lens surfaces.

Q24. Answer: (d) Through electrical and chemical signals passed between general plant cells

The correct answer is Through electrical and chemical signals passed between general plant cells.

Key Points

• The movement in Mimosa pudica (commonly known as the touch-me-not or sensitive plant) is a classic example of seismonastic or thigmonastic movement. This is a rapid, non-directional response to a physical stimulus like touch, pressure, or heat.

• Unlike animals, plants do not possess a nervous system, nerve tissues, or muscles to coordinate movement. Instead, they utilize electrical and chemical signals to transmit information from the point of contact to other parts of the plant. Hence, statement D is correct.

• The transmission does not involve the growth of new cells, as growth-related movements (like tropisms) are much slower and often irreversible, whereas the folding of Mimosa leaves happens in seconds and is reversible. Hence, statement A is incorrect.

• While plants do use hormones (like auxins or ethylene) for long-distance signaling, hormonal transport through phloem or xylem is too slow to account for the near-instantaneous folding observed in this plant. Hence, statement B is incorrect.

• Plants lack specialized nerve tissues; the electrical impulses, known as action potentials, travel through general plant cells and specialized vascular tissues like the protoxylem and protophloem. Hence, statement C is incorrect.

• The actual movement occurs in a specialized organ called the pulvinus, located at the base of the petiole and leaflets. When the signal reaches the pulvinus, it triggers a sudden change in turgor pressure.

Additional Information

• Mechanism of Turgor Change: The electrical signal causes potassium ions (K+) and chloride ions (Cl-) to exit the motor cells in the pulvinus. This movement of ions is followed by water leaving the cells through osmosis, causing the cells to collapse and the

leaves to fold.

• Plant Profile: Mimosa pudica belongs to the Fabaceae family. It is native to South and Central America, though it is now widely distributed in tropical regions globally, including India and Southeast Asia.

• Biological Function: This rapid movement is believed to be a defense mechanism against herbivores. By folding its leaves, the plant appears wilted or smaller, and it may expose sharp thorns on the stem to discourage animals from eating it.

• Nastic vs. Tropic Movements: Nastic movements (like the touch response) are independent of the direction of the stimulus, whereas tropic movements (like phototropism) are growth-dependent and occur in the direction of the stimulus (e.g., towards light).

Important Points

• Signal Velocity: In Mimosa pudica, the electrical signal can travel at speeds ranging from 5 to 100 millimeters per second, which is exceptionally fast for the plant kingdom.

• Recovery Time: After the stimulus is removed, the plant gradually pumps ions back into the motor cells, allowing water to re-enter and restore turgor pressure. This recovery process usually takes 10 to 30 minutes.

• Research Data: Studies have shown that the plant can "learn" and habituate to repeated non-threatening stimuli, a phenomenon known as behavioral plasticity, which suggests a higher level of environmental processing than previously thought for non-neural organisms.

Q25. Answer: (b) virtual and erect

The correct answer is virtual and erect.

Key Points

• A convex mirror, also known as a diverging mirror, is a curved mirror in which the reflective surface bulges toward the light source. It always forms an image that is virtual, erect, and diminished (smaller than the object), regardless of the distance between the object and the mirror.

• Statement A (Real and erect): In optics, real images are typically formed by the actual convergence of light rays and are almost always inverted. A single mirror cannot produce an image that is simultaneously real and erect for a real object. Hence, this statement is incorrect.

• Statement B (Virtual and erect): For a convex mirror, light rays incident on the surface diverge after reflection. These rays appear to originate from a point behind the mirror. Since the rays do not actually meet, the image is virtual and stays upright or erect. Hence, this statement is correct.

• Statement C (Virtual and inverted): According to the principles of ray optics for spherical mirrors, virtual images are always erect with respect to the object. An inverted virtual image is not possible in this configuration. Hence, this statement is incorrect.

• Statement D (Real and inverted): This is a characteristic feature of a concave mirror when the object is placed at a distance greater than the focal length. A convex mirror lacks the ability to converge rays to a real point in front of the mirror. Hence, this statement is incorrect.

• The position of the image in a convex mirror is always between the pole (P) and the principal focus (F), located behind the mirror.

Additional Information

• Field of View: One of the most significant features of a convex mirror is its wide field of view. Because the mirror curves outwards, it allows the observer to see a much larger area compared to a plane mirror or a concave mirror.

• Applications: Due to the virtual and erect nature of the image and the wide coverage, these mirrors are extensively used as rear-view mirrors in vehicles (cars, bikes, trucks). They are also used as security mirrors in shops, ATMs, and at blind turns on roads to prevent accidents.

• Mirror Formula: The mathematical relationship for these mirrors is given by $1/v + 1/u = 1/f$, where v is the image distance, u is the object distance, and f is the focal length.

• Sign Convention: According to the Cartesian sign convention, the focal length (f) and the radius of curvature (R) of a convex mirror are always taken as positive because they lie behind the reflecting surface.

• Magnification (m): The magnification produced by a convex mirror is always positive and less than 1 ($m < 1$). This confirms that the image is always erect and diminished.

Important Points

• Comparison with Concave Mirror: Unlike a convex mirror, a concave mirror can form real, inverted, virtual, erect, magnified, or diminished images depending on the location of the object relative to the center of curvature (C) and focus (F).

• Nature of Rays: In a convex mirror, parallel rays of light coming from infinity appear to diverge from the principal focus after reflection. This is why the focus is considered virtual.

• Image Size: As the object moves closer to the pole of a convex mirror, the size of the virtual image increases slightly but always remains smaller than the actual object.

• Date and Discovery: The mathematical properties of spherical mirrors were refined during the 17th century with the advancement of Euclidean geometry and optics by scientists like Ibn al-Haytham and later Johannes Kepler.

Q26. Answer: (b) 35

Shortcut Trick

In statistics, the Mode is defined as the observation that occurs with the highest frequency (most number of times).

By inspection of the given data, we count the occurrences of each number:

The value 35 appears 5 times, which is the maximum frequency among all observations.

All other numbers like 25 (3 times), 21 (2 times), and 32 (2 times) appear less frequently.

Therefore The correct answer is 35.

Alternate Method

Given Observations: 35, 21, 25, 21, 35, 32, 32, 30, 20, 35, 34, 35, 34, 25, 35, 33, 25

Method: We will construct a Frequency Distribution to identify the mode.

=> Count of 20 = 1

=> Count of 21 = 2

=> Count of 25 = 3

=> Count of 30 = 1

=> Count of 32 = 2

=> Count of 33 = 1

=> Count of 34 = 2

=> Count of 35 = 5

=> Maximum Frequency = 5

=> Value corresponding to Maximum Frequency = 35

Therefore The correct answer is 35.

Additional Information

Empirical Relationship

For a moderately skewed distribution, the relationship between measures of central tendency is: Mode = 3 Median − 2 Mean.

Bimodal and Multimodal Data

If two or more values in a data set have the same highest frequency, the data is called bimodal (two modes) or multimodal.

Median and Mean

Mean is the arithmetic average (Sum ÷ Count), while Median is the middle value when data is arranged in ascending or descending order.

Q27. Answer: (b) Rs. 675

Shortcut Trick

Selling Price (SP) = CP × (100 − Loss%) ÷ 100

SP = 750 × (100 − 10) ÷ 100

SP = 750 × 90 ÷ 100

SP = 75 × 9 = 675

Therefore The correct answer is Rs. 675.

Alternate Method

Given: Cost Price (CP) = Rs. 750, Loss Percentage = 10%.

Formulas: Loss = (Loss% ÷ 100) × CP | SP = CP − Loss.

=> Loss = 10% of 750 = (10 ÷ 100) × 750 = Rs. 75.

=> SP = CP − Loss = 750 − 75.

=> SP = Rs. 675.

Therefore The correct answer is Rs. 675.

Additional Information

Cost Price & Selling Price

The Cost Price (CP) is the price at which an article is purchased, and Selling Price (SP) is the price at which it is sold.

Loss and Loss Percentage

When CP > SP, there is a loss. Loss% = (Loss ÷ CP) × 100. Loss is always calculated on the Cost Price.

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Q28. Answer: (d) 72.1 m

Shortcut Trick

For an angle of elevation or depression of 45°, the height and base are always equal.

Since the triangle formed is an Isosceles Right-Angled Triangle (45°−45°−90°).

Ratio of Height : Base = 1 : 1.

Therefore Distance = Height = 72.1 m.

Therefore The correct answer is 72.1 m.

Alternate Method

Given:

Height of the building (h) = 72.1 m

Angle of depression = 45°

Formula used:

tan θ = Perpendicular / Base

Calculations:

=> In right triangle, Angle of elevation = Angle of depression = 45°.

=> tan 45° = Height of building / Distance from car

=> 1 = 72.1 / Distance

=> Distance = 72.1 m

Therefore The correct answer is 72.1 m.

Additional Information

Angle of Depression vs Elevation

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

Standard Trigonometric Ratios

For height and distance: tan 30° = 1/√3, tan 45° = 1, and tan 60° = √3 are the most commonly used values.

Isosceles Right Triangle Property

In a triangle with angles 45°, 45°, and 90°, the sides are in the ratio 1 : 1 : √2.

Q29. Answer: (c) 18.4

Shortcut Trick

Let the total work be LCM(16, 48, 32) = 96 units.

Efficiencies: Robert = 6, Chris = 2, Jeremy = 3.

Work done by Robert in 2 days = 6 × 2 = 12 units.

If Chris stayed for the last 4 days, work added = 2 × 4 = 8 units.

Effective total work for remaining people (Chris & Jeremy) = 96 − 12 + 8 = 92 units.

Total time = 92 ÷ (2 + 3) = 92 ÷ 5 = 18.4 days.

Therefore The correct answer is 18.4 days.

Alternate Method

Given: Robert (R) = 16 days, Chris (C) = 48 days, Jeremy (J) = 32 days.

Formula Used: Total Work = Efficiency × Time

Person	Days	Total Work	Efficiency
Robert	16	96	6
Chris	48	2	
Jeremy	32	3	

Let the total number of days be x.

=> Robert worked for 2 days.

=> Chris worked for (x − 4) days.

=> Jeremy worked for x days.

=> Work Equation: (6 × 2) + 2 × (x − 4) + (3 × x) = 96

=> 12 + 2x − 8 + 3x = 96

=> 5x + 4 = 96

=> 5x = 92

=> x = 18.4 days

Therefore The correct answer is 18.4 days.

Additional Information

Leaving from start vs Leaving from end

If a person leaves 'n' days after starting, subtract their work. If they leave 'n' days before completion, add their work to the total to treat them as working throughout.

Work and Wages

Wages are distributed in the ratio of work done by each person. If all work for the same duration, wages are in the ratio of their efficiencies.

Q30. Answer: (a) 8

Shortcut Trick

Ratio of distances = 1 : 3

Let total distance be 4d. Total time = (d/5) + (3d/6) = 1.4 hours

=> d/5 + d/2 = 1.4 => (2d + 5d)/10 = 1.4 => 7d = 14 => d = 2 km

Total distance = 4 × 2 = 8 km

Therefore The correct answer is 8 km.

Alternate Method

Given:

Total time = 1 hour 24 minutes = 1 + 24/60 hours = 1 + 0.4 = 1.4 hours.

Speed1 = 5 km/hr, Speed2 = 6 km/hr.

Formula Used:

Time = Distance ÷ Speed

Calculations:

Let the total distance be D km.

=> (D/4)/5 + (3D/4)/6 = 1.4

=> D/20 + 3D/24 = 1.4

=> D/20 + D/8 = 1.4

=> (2D + 5D)/40 = 1.4

=> 7D/40 = 1.4

=> 7D = 1.4 × 40

=> 7D = 56

=> D = 56/7 = 8 km

Therefore The correct answer is 8 km.

Additional Information

Average Speed Formula

Average Speed = Total Distance ÷ Total Time. For two equal distances, Avg Speed = 2xy/(x+y).

Unit Conversion

To convert km/hr to m/s, multiply by 5/18. To convert minutes to hours, divide by 60.

Relative Speed

Same direction: S1 − S2 | Opposite direction: S1 + S2.

Q31. Answer: (a) 0.08

Given:

Expression = $[(0.36)^2 - (0.04)^2] \div 1.6$

Formula Used:

$a^2 - b^2 = (a - b) \times (a + b)$

Calculation:

=> $[(0.36)^2 - (0.04)^2] = (0.36 - 0.04) \times (0.36 + 0.04)$

=> $= 0.32 \times 0.40$

=> $= 0.128$

=> 0.128 ÷ 1.6

=> = 0.08

Therefore The correct answer is 0.08.

Q32. Answer: (c) 58.5

Given:

20% of number + 78 = Number

Formula Used:

Percentage = (Value ÷ 100) × Number

Calculation:

=> Let number = x

=> 20% of x = 20x ÷ 100 = x ÷ 5

=> x ÷ 5 + 78 = x

=> x - x ÷ 5 = 78

=> (5x - x) ÷ 5 = 78

=> 4x ÷ 5 = 78

=> x = (78 × 5) ÷ 4

=> x = 390 ÷ 4

=> x = 97.5

=> 60% of x = 60 × 97.5 ÷ 100

=> = 58.5

Therefore The correct answer is 58.5.

Q33. Answer: (b) 4

Shortcut Trick

Combined efficiency of A, B, and C = 6 + 1 + 2 = 9 units/day (taking 12 as Total Work).

Time for same work = 12 ÷ 9 = 4/3 days.

Time for thrice the work = (4/3) × 3 = 4 days.

Therefore The correct answer is 4 days.

Alternate Method

Given: Time taken by A = 2 days, B = 12 days, C = 6 days.

Formula Used: Total Work = LCM of individual days; Efficiency = Total Work ÷ Time.

Person	Days	Total Work	Efficiency
A	2	12 units	6
B	12	1	
C	6	2	

=> Total Efficiency of (A + B + C) = 6 + 1 + 2 = 9 units/day.

=> New Total Work = 3 × 12 = 36 units.

=> Required Time = 36 ÷ 9 = 4 days.

Therefore The correct answer is 4 days.

Additional Information

Combined Efficiency Rule

When individuals work together, their efficiencies are added to find the total work done per day.

Work-Time Relation

If the amount of work increases by a factor n, the time required to complete it also increases by the same factor n, provided efficiency remains constant.

LCM Method

Taking the LCM of individual time periods provides a convenient integer for Total Work, simplifying efficiency calculations.

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Q34. Answer: (c) 40 m

Shortcut Trick

Ratio of parallel sides = 100 : 125 = 4 : 5.

Let the sides be 4u and 5u. Sum of parallel sides = 9u.

Area = 1/2 × (Sum of sides) × Height => 720 = 1/2 × 9u × 16.

720 = 72u => 1 unit = 10 m.

Smaller side = 4u = 4 × 10 = 40 m.

Therefore The correct answer is 40 m.

Alternate Method

Given:

Area of Trapezium = 720 m²

Perpendicular distance (h) = 16 m

Let the smaller parallel side be x m.

The larger parallel side = x + 25% of x = 1.25x m.

Formula Used:

Area = 1/2 × (Sum of parallel sides) × Height

Calculations:

=> 720 = 1/2 × (x + 1.25x) × 16

=> 720 = 8 × (2.25x)

=> 720 = 18x

=> x = 720 ÷ 18

=> x = 40 m

Therefore The correct answer is 40 m.

Additional Information

Area of Trapezium

The area is calculated as the product of the average of the parallel sides and the vertical height: Area = [(a + b) ÷ 2] × h.

Median of a Trapezium

The median (or midsegment) connects the midpoints of the non-parallel sides and its length is equal to (a + b) ÷ 2.

Isosceles Trapezium

A trapezium where the non-parallel sides are equal in length and the base angles are equal.

Q35. Answer: (b) 74.5

Shortcut Trick

Ratio of students in the two groups = 14 : 16 = 7 : 8.

Assume a base average of 54.

Deviation for Group 1 = 98 − 54 = +44.

Net surplus = 7 × 44 = 308.

Average increase = 308 ÷ (7 + 8) = 308 ÷ 15 = 20.53.

Whole class average = 54 + 20.53 = 74.53 ≈ 74.5.

Therefore The correct answer is 74.5.

Alternate Method

Given:

Total students in class = 30

Number of students in first group = 14; Average score = 98

Number of students in second group = 30 − 14 = 16; Average score = 54

Formula Used:

Combined Average = (n1 × x1 + n2 × x2) ÷ (n1 + n2)

Calculations:

=> Total score of 14 students = 14 × 98 = 1372

=> Total score of remaining 16 students = 16 × 54 = 864

=> Total score of the whole class = 1372 + 864 = 2236

=> Average score of the whole class = 2236 ÷ 30

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=> Average score = 74.533...
=> Rounding to one decimal place, Average score = 74.5
Therefore The correct answer is 74.5.
Additional Information
Weighted Average Formula
When two or more groups with different counts and averages are combined, the new average is Aavg = (Σ niai) ÷ Σ ni.
Deviation Method for Averages
New Average = Assumed Average + (Net Deviation ÷ Total Number of observations).
Property of Averages
The combined average always lies between the lowest and highest individual averages of the constituent groups (54 < 74.5 < 98).

Q36. Answer: (d) 20

Given:
100^(0.25) × 5² × 2^4 × 1/(800^(0.5)) × √(1/5)
Concept Used:
a^m × aⁿ = a^(m+n)
a^(-m) = 1/(a^m)
√a = a^(1/2)
Calculation:
=> 100^(0.25) = (10²)^(1/4) = 10^(1/2)
=> 800^(0.5) = (16 × 50)^(1/2) = (16 × 5² × 2)^(1/2)
=> 800^(0.5) = (2^4 × 5² × 2)^(1/2) = (2^5 × 5²)^(1/2)
=> 800^(0.5) = 2^(5/2) × 5
=> √(1/5) = 5^(-1/2)
=> 10^(1/2) × 5² × 2^4 × 1/(2^(5/2) × 5) × 5^(-1/2)
=> (2 × 5)^(1/2) × 5² × 2^4 × 1/(2^(5/2) × 5^(3/2))
=> 2^(1/2) × 5^(1/2) × 5² × 2^4 × 1/(2^(5/2) × 5^(3/2))
=> 2^(1/2 + 4 - 5/2) × 5^(1/2 + 2 - 3/2)
=> 2^((1/2 + 4 - 5/2)) × 5^((1/2 + 2 - 3/2))
=> 2^((4 - 2)) × 5^((2 - 1))
=> 2² × 5¹
=> 4 × 5
=> 20
Therefore The correct answer is 20

Q37. Answer: (c) 1008

Shortcut Trick
Identify the unitary relationship between lines and words.
4 lines → 63 words
64 lines is 16 times of 4 lines (64 ÷ 4 = 16).
Total words = 63 × 16 = 1008 words.
Therefore The correct answer is 1008 words.
Alternate Method
Given:
Number of lines (L1) = 4
Number of words (W1) = 63
Target lines (L2) = 64
Formula Used:
Using Direct Proportion: (W1 ÷ L1) = (W2 ÷ L2)
Calculations:
=> Words per line = 63 ÷ 4
=> Total words in 64 lines = (63 ÷ 4) × 64

=> Total words = 63 × (64 ÷ 4)
=> Total words = 63 × 16
=> Total words = 1008
Therefore The correct answer is 1008 words.
Additional Information
Direct Proportion
Two quantities are in direct proportion if an increase in one leads to a proportional increase in the other (y = kx).
Inverse Proportion
Two quantities are in inverse proportion if an increase in one leads to a proportional decrease in the other (xy = k).
Unitary Method
A technique where you first find the value of a single unit and then multiply to find the value of the required number of units.

Q38. Answer: (b) 93

Shortcut Trick
Checking the condition: Number decreases by 54 when digits are reversed.
Difference between original number and reversed number = 9 × (difference of digits).
9 × (x − y) = 54 => (x − y) = 6.
Check options: (1) 8−2=6, (2) 9−3=6, (3) 7−1=6. Only 93 satisfies 93 = 7.75 × (9+3) = 7.75 × 12 = 93.
Therefore The correct answer is 93.
Alternate Method
Let the tens digit be x and units digit be y. Original number = 10x + y.
According to the first condition:
=> 10x + y = 7.75(x + y)
=> 10x + y = 7.75x + 7.75y
=> 2.25x = 6.75y
=> x = 3y
According to the second condition:
=> (10x + y) − (10y + x) = 54
=> 9x − 9y = 54
=> x − y = 6
Substitute x = 3y into the second equation:
=> 3y − y = 6 => 2y = 6 => y = 3
=> x = 3 × 3 = 9
=> Original number = 10(9) + 3 = 93.
Therefore The correct answer is 93.
Additional Information
Difference Rule
The difference between a two-digit number and its reverse is always a multiple of 9, specifically 9 × |x − y|.
Sum Rule
The sum of a two-digit number and its reverse is always a multiple of 11, specifically 11 × (x + y).
Decimal Multiplication
7.75 can be written as 31/4 for easier calculation in linear equations.

Q39. Answer: (b) Rs. 14,025

Shortcut Trick
In a partnership, the Ratio of Investments is equal to the Ratio of Profits when time is constant.
Profit Ratio (Amit : Total) = 2,300 : 9,200 = 1 : 4.
Since Amit's profit share is 1/4th of the total, his investment must be 1/4th of the total investment.
Amit's Investment = 56,100 ÷ 4 = Rs. 14,025.
Therefore The correct answer is Rs. 14,025.
Alternate Method
Given: Total investment = Rs. 56,100, Total profit = Rs. 9,200, Amit's profit = Rs. 2,300.

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Formula: Investment Ratio = Profit Ratio (for same time period).

=> Amit's profit : Deeksha's profit = 2,300 : (9,200 − 2,300)

=> Amit's profit : Deeksha's profit = 2,300 : 6,900 = 1 : 3

=> Ratio of investments (Amit : Deeksha) = 1 : 3

=> Total ratio parts = 1 + 3 = 4 units

=> 4 units = Rs. 56,100

=> 1 unit (Amit's investment) = 56,100 ÷ 4

=> Amit's investment = Rs. 14,025

Therefore The correct answer is Rs. 14,025.

Additional Information

Basic Partnership Rule

Profit is distributed in the ratio of (Investment × Time). If time is same, Profit prop. to Investment.

Compound Partnership

When partners invest for different time periods, the ratio is P1 : P2 = I1T1 : I2T2.

Working Partner

A partner who manages the business is paid a salary or commission before the remaining profit is shared among all partners.

Q40. Answer: (d) 24%

Shortcut Trick

Discount = 1675 − 1273 = 402

Discount % = (402 ÷ 1675) × 100

Using 1% of 1675 = 16.75

402 ÷ 16.75 = 24

Therefore The correct answer is 24%.

Alternate Method

Given:

Marked Price (MP) = Rs. 1,675

Selling Price (SP) = Rs. 1,273

Formula Used:

Discount = Marked Price − Selling Price

Discount % = (Discount ÷ Marked Price) × 100

Calculations:

=> Discount = 1675 − 1273

=> Discount = Rs. 402

=> Discount % = (402 ÷ 1675) × 100

=> Discount % = 40200 ÷ 1675

=> Discount % = 24%

Therefore The correct answer is 24%.

Additional Information

Marked Price (MP)

The price printed on the label of an article, also known as the List Price or Tag Price.

Selling Price (SP)

The actual price at which the item is sold after reducing the discount from the Marked Price: SP = MP − Discount.

Successive Discounts

When two discounts d1 and d2 are given, the Equivalent Discount = (d1 + d2 − (d1 × d2)/100)%.

Q41. Answer: (a) 207

Shortcut Trick

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

Since the difference between each pair of consecutive numbers is 1, the expression simplifies to the sum of the numbers in each pair.

Expression = (37 + 36) + (35 + 34) + (33 + 32)

Sum = 73 + 69 + 65 = 207

Therefore The correct answer is 207.

Alternate Method

Given: $37^2 - 36^2 + 35^2 - 34^2 + 33^2 - 32^2$

Formula Used: $a^2 - b^2 = (a + b)(a - b)$

=> $(37^2 - 36^2) + (35^2 - 34^2) + (33^2 - 32^2)$

=> $(37 + 36)(37 - 36) + (35 + 34)(35 - 34) + (33 + 32)(33 - 32)$

=> $(73 \times 1) + (69 \times 1) + (65 \times 1)$

=> 73 + 69 + 65

=> 207

Therefore The correct answer is 207.

Additional Information

Difference of Squares

The identity $a^2 - b^2 = (a - b)(a + b)$ is widely used to simplify calculations involving squares of large numbers.

BODMAS Rule

Always solve mathematical expressions in the order: Brackets, Orders (powers/roots), Division, Multiplication, Addition, and Subtraction.

Sum of First n Natural Numbers

The sum of the first n natural numbers is given by the formula $[n(n + 1)] \div 2$.

Q42. Answer: (a) Increase by 27.2%

Shortcut Trick

Let the cost of a TV = 100. Then Washing Machine (WM) = 50.

Ratio of total cost for 6 WM and 2 TV = $(6 \times 50) : (2 \times 100) = 300 : 200 = 3 : 2$.

Net % change = [(Ratio_(WM) × Change_(WM)) + (Ratio_(TV) × Change_(TV))] ÷ Total Ratio

Net % change = $[(3 \times 64) + (2 \times -28)] \div 5 = [192 - 56] \div 5 = 136 \div 5 = 27.2\%$.

Therefore The correct answer is Increase by 27.2%.

Alternate Method

Given:

Cost of 1 TV = Rs. 100

Cost of 1 Washing Machine = 50% less than TV = Rs. 50

=> Initial Total Cost (6 WM + 2 TV) = $(6 \times 50) + (2 \times 100) = 300 + 200$ = Rs. 500

New Costs:

=> New cost of 1 WM = 50 + 64% of 50 = 50 + 32 = Rs. 82

=> New cost of 1 TV = 100 − 28% of 100 = 100 − 28 = Rs. 72

=> New Total Cost (6 WM + 2 TV) = $(6 \times 82) + (2 \times 72) = 492 + 144$ = Rs. 636

Change:

=> Total Increase = 636 − 500 = Rs. 136

=> Percentage Change = $(136 \div 500) \times 100 = 27.2\%$

Therefore The correct answer is Increase by 27.2%.

Additional Information

Percentage Change Formula

Percentage change = [(New Value − Old Value) ÷ Old Value] × 100.

Weighted Average in Percentages

When multiple components change, the overall change is the sum of (weight × individual change) divided by the total weight.

Successive Percentage Shortcut

For two successive changes a% and b%, the effective change is $[a + b + (ab/100)]\%$.

Q43. Answer: (c) 24.0

Shortcut Trick

B = sum of first three even numbers (2 + 4 + 6) = 12.

Third proportional C = $B^2 \div A = 12^2 \div 6$.

C = 144 ÷ 6 = 24.0.
Therefore The correct answer is 24.0.
Alternate Method
Given:
First number (A) = 6
Second number (B) = Sum of first three even natural numbers
Third proportional = C
Formula Used:
Third proportional (C) of two numbers A and B is defined by the relation A : B :: B : C, which means C = B^2 ÷ A.
Calculations:
=> First three even natural numbers are 2, 4, and 6.
=> B = 2 + 4 + 6 = 12
=> A = 6
=> C = B^2 ÷ A
=> C = (12 × 12) ÷ 6
=> C = 144 ÷ 6
=> C = 24.0
Therefore The correct answer is 24.0.
Additional Information
Mean Proportional
The mean proportional between two numbers A and B is given by √(A × B).
Fourth Proportional
If A, B, and C are three numbers, the fourth proportional D is such that A/B = C/D, or D = (B × C) ÷ A.
Sum of First n Even Numbers
The sum of the first n even natural numbers is calculated using the formula n(n + 1).

Q44. Answer: (a) 16 years

Shortcut Trick
Let Suresh's age be x.
According to the condition, Ramesh's age = 2x + 4.
Total age = x + (2x + 4) = 52 => 3x = 48.
x = 16 years.
Therefore The correct answer is 16 years.
Alternate Method
Given:
Sum of ages of Ramesh (R) and Suresh (S) = 52 years.
Ramesh's age = 2 × Suresh's age + 4.
Calculations:
=> R + S = 52
=> (2S + 4) + S = 52
=> 3S + 4 = 52
=> 3S = 52 − 4
=> 3S = 48
=> S = 48 ÷ 3
=> S = 16
Therefore The correct answer is 16 years.
Additional Information
Linear Equations in One Variable
A linear equation is of the form ax + b = c, where x is the unknown variable to be solved by isolating it on one side.
Problems on Ages
If the current age is 'x', then age 'n' years ago was (x − n) and age 'n' years hence will be (x + n).
Ratio of Ages

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If the ratio of ages of A and B is a:b, their ages can be assumed as ax and bx respectively to simplify calculations.

Q45. Answer: (b) {120°, 35°, 25°}

Shortcut Trick

The fundamental property of any triangle is that the sum of its interior angles must be exactly 180°.

Check the sum for the given sets:

(1) 65° + 45° + 80° = 190° (Incorrect)

(2) 120° + 35° + 25° = 180° (Correct)

(3) 95° + 40° + 85° = 220° (Incorrect)

(4) 85° + 30° + 75° = 190° (Incorrect)

Therefore The correct answer is {120°, 35°, 25°}.

Alternate Method

Given: Four sets of potential triangle angles.

Formula Used: According to the Angle Sum Property of a triangle, the sum of all three interior angles is always 180°.

Calculations:

=> Let the angles be α, β, and γ.

=> For a valid triangle, α + β + γ = 180°.

=> Testing Option 2: 120° + 35° + 25°

=> 120° + 60° = 180°.

=> Since the sum is exactly 180°, this set forms a valid obtuse-angled triangle.

Therefore The correct answer is {120°, 35°, 25°}.

Additional Information

Classification by Angles

Triangles are classified as Acute (all angles < 90°), Right (one angle = 90°), or Obtuse (one angle > 90°).

Exterior Angle Theorem

The measure of an exterior angle of a triangle is equal to the sum of the measures of its two remote interior angles.

Triangle Inequality Theorem

For any triangle, the sum of the lengths of any two sides must be strictly greater than the length of the third side.

Q46. Answer: (c) 63 seconds

Shortcut Trick

Total Distance to be covered = Length of Train + Length of Platform

Total Distance = 793 + 782 = 1575 m

Speed in m/sec = 90 × (5/18) = 25 m/sec

Time Taken = Total Distance ÷ Speed = 1575 ÷ 25 = 63 sec

Therefore The correct answer is 63 sec.

Alternate Method

Given:

Length of Train (L1) = 793 m

Length of Platform (L2) = 782 m

Speed of Train (S) = 90 km/hr

Formula Used:

Time = Total Distance ÷ Speed

Conversion: 1 km/hr = 5/18 m/sec

Calculations:

=> Total Distance = L1 + L2 = 793 + 782 = 1575 m

=> Speed in m/sec = 90 × (5/18) = 5 × 5 = 25 m/sec

=> Time = 1575 ÷ 25

=> Time = 63 sec

Therefore The correct answer is 63 sec.

Additional Information

Relative Speed

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When two objects move in the same direction, relative speed is S1 − S2. In opposite directions, it is S1 + S2.

Unit Conversion

To convert km/hr to m/sec, multiply by 5/18. To convert m/sec to km/hr, multiply by 18/5.

Train crossing a point object

When a train crosses a pole, person, or tree, the distance covered is equal to the length of the train only.

Q47. Answer: (a) 70,000

Shortcut Trick

Since the Principal and Time are same for both loans, we can calculate the difference using the Rate Difference.

Rate Difference = 7% − 3.5% = 3.5%

Total Interest Difference % = 3.5% × 4 years = 14%

Difference in SI = 14% of Rs. 5,00,000 = 0.14 × 5,00,000 = Rs. 70,000

Therefore The correct answer is Rs. 70,000.

Alternate Method

Given:

Principal (P) = Rs. 5,00,000

Rate for Bank A (R1) = 3.5% | Rate for Bank B (R2) = 7%

Time (T) = 4 years

Formula Used:

Simple Interest (SI) = (P × R × T) ÷ 100

Calculations:

=> SI from Bank A = (5,00,000 × 3.5 × 4) ÷ 100

=> SI from Bank A = 5,000 × 14 = Rs. 70,000

=> SI from Bank B = (5,00,000 × 7 × 4) ÷ 100

=> SI from Bank B = 5,000 × 28 = Rs. 1,40,000

=> Positive Difference = Rs. 1,40,000 − Rs. 70,000

=> Difference = Rs. 70,000

Therefore The correct answer is Rs. 70,000.

Additional Information

Simple Interest Property

Simple Interest is calculated only on the Principal amount. It remains constant every year if the rate and principal do not change.

Difference in Interest

When Principal (P) and Time (T) are constant, the difference in interest is directly proportional to the difference in rates: ΔSI = P × T × (R2 − R1) ÷ 100.

Effective Rate of Interest

The total interest percentage for the entire duration is the product of Annual Rate and Time (R × T).

Q48. Answer: (c) 26,950

Shortcut Trick

Profit % = 40% → Profit Value = Rs. 5,698

Cost Price (CP) = (5,698 ÷ 40) × 100 = Rs. 14,245

Selling Price (SP) = CP + Profit = 14,245 + 5,698 = Rs. 19,943

Marked Price (MP) = SP ÷ (100% − Discount%) = 19,943 ÷ 0.74

Advertised Price = Rs. 26,950

Therefore The correct answer is Rs. 26,950.

Alternate Method

Given:

Profit percentage = 40%

Discount percentage = 26%

Actual Profit = Rs. 5,698

Formula Used:

1. Profit = Cost Price (CP) × Profit%

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2. Selling Price (SP) = CP + Profit
3. Advertised Price (MP) = SP / (1 − Discount%)
Calculations:
=> Let Cost Price (CP) be x.
=> 40% of x = 5,698
=> 0.40 × x = 5,698
=> x = 5,698 / 0.4 = 14,245
=> Selling Price (SP) = CP + Profit = 14,245 + 5,698 = 19,943
=> Let Advertised Price (MP) be M.
=> M × (1 − 0.26) = 19,943
=> 0.74 × M = 19,943
=> M = 19,943 / 0.74 = 26,950
Therefore The correct answer is Rs. 26,950.
Additional Information
Relation between CP and MP
The direct ratio of Marked Price to Cost Price is given by: MP/CP = (100 + Profit%)/(100 − Discount%).
Markup Percentage
Markup % = [(MP − CP) / CP] × 100. It is the percentage by which the price is raised above the cost price.
Successive Discounts
If two successive discounts of a% and b% are given, the single equivalent discount is (a + b − ab/100)%.

Q49. Answer: (c) 100 m

Shortcut Trick
Area of inner path = 2w(L + B − 2w) where w is the uniform width.
216 = 2w(34 + 24 − 2w) => 108 = w(58 − 2w).
Solving the quadratic equation $w^2 - 29w + 54 = 0$, we get w = 2 m.
Lawn dimensions = (34 − 4) = 30 m and (24 − 4) = 20 m.
Perimeter of lawn = 2(30 + 20) = 2(50) = 100 m.
Therefore The correct answer is 100 m.
Alternate Method
Given: Length (L) = 34 m, Width (W) = 24 m, Area of path = 216 m^2.
Let the uniform width of the path be w meters.
=> Area of rectangular park = 34 × 24 = 816 m^2.
=> Area of grassy lawn = (34 − 2w) × (24 − 2w).
=> Area of path = 816 − [(34 − 2w)(24 − 2w)] = 216.
=> $816 - [816 - 68w - 48w + 4w^2] = 216$.
=> $116w - 4w^2 = 216$.
=> $4w^2 - 116w + 216 = 0 \Rightarrow w^2 - 29w + 54 = 0$.
=> (w − 2)(w − 27) = 0.
=> w = 2 (Since 2w must be less than 24, w = 27 is rejected).
=> Length of lawn = 34 − 2(2) = 30 m.
=> Width of lawn = 24 − 2(2) = 20 m.
=> Perimeter of lawn = 2 × (30 + 20) = 2 × 50 = 100 m.
Therefore The correct answer is 100 m.
Additional Information
Area of Outer Path
For a path of width w outside a rectangle: Area = 2w(L + B + 2w).
Area of Cross Paths
For two paths of width w crossing at the center: Area = w(L + B − w).
Rectangle Formulas
Area = L × B and Perimeter = 2(L + B). Diagonal = $\sqrt{(L^2 + B^2)}$.

Q50. Answer: (d) 36.36%

Shortcut Trick

Required percentage = (First value ÷ Second value) × 100

Req % = (1/20 ÷ 11/80) × 100

Req % = (1/20 × 80/11) × 100 = 400/11 %

Req % ≈ 36.36%

Therefore The correct answer is 36.36%.

Alternate Method

Given: First fraction = 1/20, Second fraction = 11/80.

Formula Used: Percentage = (Part/Whole) × 100

=> Let the required percentage be x%.

=> x = [(1/20) / (11/80)] × 100

=> x = (1/20) × (80/11) × 100

=> x = (4/11) × 100

=> x = 400/11

=> x = 36.3636...

=> x ≈ 36.36%

Therefore The correct answer is 36.36%.

Additional Information

Fraction to Percentage

To convert any fraction a/b into a percentage, multiply the fraction by 100 and add the % symbol.

Decimal Approximation

When dividing by 11, the decimal pattern repeats every two digits (1/11 = 0.0909..., 4/11 = 0.3636...).

Reciprocal Rule

Dividing by a fraction is equivalent to multiplying by its reciprocal: (a/b) ÷ (c/d) = (a/b) × (d/c).

Q51. Answer: (c) Three

Given: Seven boxes, B, D, E, P, S, T and W, are kept one over the other, but not necessarily in the same order.

1) Only P is kept above B.

2) Only two boxes are kept above W.

3) W is kept immediately above T.

Boxes
P
B
W
T

4) D is kept immediately above S.

5) D is not kept at the third position from the bottom.

The remaining position will be occupied by the only box left i.e. E.

Boxes
P
B
W
T

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E
D
S

Thus, three boxes are kept between E and P.

Hence, "Option 3" is the correct answer.

Q52. Answer: (c) 395

The logic followed here is:

Hence, "Option 3" is the correct answer.

Alternate Method

Q53. Answer: (a) XPS

The Logic followed here is:

Hence, the correct answer is "Option 1".

Q54. Answer: (c) 8

According to the question:

Thus, 'P' is coded as '8'.

Hence, "Option 3" is the correct answer.

Q55. Answer: (c) 1

Given series: (Left) £ $ 9 3 4 9 7 £ % & # 7 3 1 8 7 5 * @ 4 £ $ (Right)

According to the question:

Required condition: Symbol - Number - Symbol

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

Thus, there is one such number which is immediately preceded by a symbol and also immediately followed by a symbol.

Hence, "Option 3" is the correct answer.

Q56. Answer: (b) Three

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

According to the question:

Required condition: Odd Number - Odd Number

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

Thus, there are three such odd number which are immediately followed by an odd number.

Hence, "Option 2" is the correct answer.

Q57. Answer: (b) (9, 162, 6)

The logic followed here is:

(10, 150, 5) → 10 × 5 × 3 = 150

And,

(8, 96, 4) → 8 × 4 × 3 = 96

Similarly,

(9, 162, 6) → 9 × 6 × 3 = 162

Hence, "Option 2" is the correct answer.

Q58. Answer: (b) 65

Given:

Abhishek's rank from the top → 17

Abhishek's rank from the bottom → 49

Total students → Abhishek's rank from the top + Abhishek's rank from the bottom - 1

→ 17 + 49 - 1 = 65

Hence, the correct answer is "Option 2".

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Q59. Answer: (a) North-west

Given:

Town F is to the north of Town G.

Town H is to the east of Town F.

Town I is to the south of Town H.

Town J is to the west of Town I.

Town G is to the south-west of Town J.

Thus, town F is to the north-west of Town J.

Hence, the correct answer is "Option 1".

Q60. Answer: (b) OGT : PDP

The Logic followed here is:

KIO : LFK

And,

PER : QBN

Similarly,

OGT : PDP

Hence, the correct answer is "Option 2".

Q61. Answer: (d) GFQM

The Logic followed here is:

AHKO is related to EKOR

And,

QTAA is related to UWED

Similarly,

CCMJ is related to

Hence, the correct answer is "Option 4".

Q62. Answer: (d) BF-AC

The logic followed here is:

Option 1) MQ-LO

Option 2) EI-DG

Option 3) IM-HK

Option 4) BF-AC

Thus, out of all the options, 'BF-AC' is the odd one out.

Hence, "Option 4" is the correct answer.

Q63. Answer: (a) 23

The logic followed here is:

Hence, "Option 1" is the correct answer.

Q64. Answer: (d) 7

Given series: (Left) 715, 906, 570, 853, 418 (Right)

According to the question.

Given	715	906	570	853	418
Arranged in ascending order	418	570	715	853	906

So,

Third digit of the highest number → 906 → 6

Second digit of the lowest number → 418 → 1

So, the third digit of the highest number is added to the second digit of the lowest number → 6 + 1 = 7

Hence, "Option 4" is the correct answer.

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Q65. Answer: (b) ui

According to the question:

Thus, 'way' is coded as 'ui'.

Hence, "Option 2" is the correct answer.

Q66. Answer: (a) 3

Given: A, B, C, D, E, F and G are sitting around a circular table, facing the centre.

1) B sits to the immediate right of C.

2) Only three people sit between B and A when counted from the left of B.

3) Only three people sit between C and D when counted from the left of C.

4) G sits to the immediate right of F.

The remaining position will be occupied by the only person left i.e. E.

Thus, three people sit between A and C when counted from the right of C.

Hence, "Option 1" is the correct answer.

Q67. Answer: (a) Mother

A is				
Symbol	•	@	•	#
Meaning	Sister	Brother	Wife	Father
of B				

Given Expression: O - P # T @ G + V

O - P → O is the wife of P.

P # T → P is the father of T.

T @ G → T is the brother of G.

G + V → G is the sister of V.

Thus, O is V's mother.

Hence, the correct answer is "Option 1".

Q68. Answer: (b) 5

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

According to the question:

Required condition: Odd Number - Odd Number - Even Number

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

Thus, there are five such odd number which are immediately preceded by an odd number and also immediately followed by an even number.

Hence, "Option 2" is the correct answer.

Q69. Answer: (a) 6

Given number: 8563546

According to the question,

Number given	**8**	**5**	**6**	**3**	**5**	**4**	**6**
Odd digit → (+3) Even digit → (-2)	(-2)	(+3)	(-2)	(+3)	(+3)	(-2)	(-2)
Resultant number	6	8	4	6	8	2	4

So, the fourth digit from the left in the new number thus formed → 6

Hence, "Option 1" is the correct answer.

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Q70. Answer: (d) 123

Decoding signs:

Sign	A	B	C	D
Stands For	÷	×	•	•

Given: 22 D 55 A 5 C 14 B 8 = ?

22 D 55 A 5 C 14 B 8 = ? => 22 - 55 ÷ 5 + 14 × 8 = ?

=> 22 - 55 ÷ 5 + 14 × 8 = ?

=> 22 - 11 + 14 × 8 = ?

=> 22 + 112 - 11 = ?

=> 134 - 11 = ?

=> 123 = ?

Hence, "Option 4" is the correct answer.

Q71. Answer: (d) MLJ

The logic followed here is:

Option 1) GED

Option 2) ZXW

Option 3) HFE

Option 4) MLJ

Thus, out of all the options, 'MLJ' is the odd one out.

Hence, "Option 4" is the correct answer.

Q72. Answer: (a) GIVE - GEVI - EVIG

The Logic followed here is:

WORD - WDRO - DROW

And,

OATS - OSTA - STAO

Similarly,

GIVE - GEVI - EVIG

Hence, the correct answer is "Option 1".

Q73. Answer: (b) Only conclusion (II) follows

The least possible Venn diagram for the given statements is as shown below :

Conclusions:

(I) Some eggs are mangoes → Does not follow (As all eggs are artists and some mangoes are artists. So it is possible but not definite.)

(II) Some artists are eggs → Follow (As all eggs are artists. As whole eggs comes in artists, therefore it is true.)

Therefore Here, Only conclusion (II) follows.

Hence, the correct answer is "Option 2".

Q74. Answer: (a) 4

Given: Seven people, A, B, C, D, E, F and G, are sitting in a row, facing north.

1) Only A sits to the left of D.

2) Only four people sit between A and C.

3) Only B sits between G and F, and G is not an immediate neighbour of C.

The remaining position will be occupied by the only person left i.e. E.

Thus, four people sit to the right of G.

Hence, "Option 1" is the correct answer.

Q75. Answer: (a) Southwest

Given:

Town A is to the north of Town B.

Town C is to the west of Town A.

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Town D is to the south of Town C.

Town E is to the east of Town D.

Town B is to the southeast of Town E.

Thus, town E is to the southeast of Town A.

Hence, the correct answer is "Option 1".

Q76. Answer: (c) Both conclusions (I) and (II) follow

The least possible Venn diagram for the given statements is as shown below :

Conclusions:

(I) Some mats are cobras → Follow (As all cobras are mats. As whole cobras comes in mats, therefore it is true.)

(II) All jams are mats → Follow (As all jams are cobras and all cobras are mats. As whole jams comes in cobras which whole comes in mats, therefore it is true.)

Therefore Here, Both conclusions (I) and (II) follow.

Hence, the correct answer is "Option 3".

Q77. Answer: (b) ATM 59

The Logic followed here is:

Hence, the correct answer is "Option 2".

Q78. Answer: (b) 67

The logic followed here is:

Hence, "Option 2" is the correct answer.

Q79. Answer: (d) One

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

1) Only two people sit to the left of P.

2) Only three people sit between P and W.

3) Only one person sits between W and X.

4) R sits to the immediate left of O.

5) Y is not an immediate neighbour of W.

The remaining position will be occupied by the only person left i.e. Q.

Thus, one person sit to the right of Q.

Hence, "Option 4" is the correct answer.

Q80. Answer: (b) 993

Given: 351 ÷ 3 + 284 × 4 - 11 = ?

According to the question, after '+' and '−' are interchanged and '×' and '÷' are interchanged:

351 ÷ 3 + 284 × 4 - 11 = ? => 351 × 3 - 284 ÷ 4 + 11 = ?

=> 351 × 3 - 284 ÷ 4 + 11 = ?

=> 351 × 3 - 71 + 11 = ?

=> 1053 + 11 - 71 = ?

=> 1064 - 71 = ?

=> 993 = ?

Hence, "Option 2" is the correct answer.

Q81. Answer: (d) Dr. Mrityunjay Mohapatra

The correct answer is Dr. Mrityunjay Mohapatra.

Key Points

• Dr. Mrityunjay Mohapatra, the Director General of the India Meteorological Department (IMD), has been recognized with the prestigious United Nations Sasakawa Award 2025 for his exemplary work in Disaster Risk Reduction (DRR).

• He is widely celebrated as the "Cyclone Man of India" for his scientific precision and leadership in predicting cyclones, which has drastically reduced the mortality rate during extreme weather events in the Indian subcontinent.

• The United Nations Sasakawa Award is a highly distinguished global honor presented by the United Nations Office for Disaster Risk Reduction (UNDRR) in collaboration with the Nippon Foundation.

• His contributions include the advancement of early warning systems and the implementation of a multi-hazard warning system

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that has become a global benchmark for disaster preparedness.

• Under his guidance, IMD achieved remarkable success in providing accurate lead-time warnings for devastating storms like Cyclone Phailin (2013), Cyclone Fani (2019), and Cyclone Amphan (2020), ensuring "near-zero" casualties in many instances.

Additional Information

• History of the Sasakawa Award:

• The award was established in 1986 by Mr. Ryoichi Sasakawa, the founding chairman of the Nippon Foundation.

• It is awarded every three years to individuals or institutions that demonstrate outstanding efforts in reducing disaster impacts and building resilient communities.

• United Nations Office for Disaster Risk Reduction (UNDRR):

• Established in 1999, UNDRR serves as the focal point for disaster risk coordination within the United Nations system.

• It is responsible for overseeing the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030, which aims to achieve a substantial reduction in disaster risk and losses.

• India Meteorological Department (IMD):

• Founded in 1875, IMD is the primary agency of the Government of India for meteorological observations and weather forecasting.

• It functions under the Ministry of Earth Sciences and is headquartered in New Delhi.

• The Sendai Framework:

• Adopted at the Third UN World Conference in Sendai, Japan, in 2015, it is a 15-year international agreement.

• It outlines seven global targets and four priorities for action to prevent new and reduce existing disaster risks.

Important Points

• Dr. Mrityunjay Mohapatra also holds the prestigious position of Vice-President of the World Meteorological Organization (WMO), having been elected in 2023.

• He has represented India at various international forums, advocating for the "Early Warnings for All" initiative launched by the UN Secretary-General.

• Previous Indian recipients of the Sasakawa Award include Dr. Pramod Kumar Mishra (Principal Secretary to the PM), who received the honor in 2019 for his personal dedication to disaster management.

• The 2025 award cycle specifically emphasized the theme of "Building Resilience through Technology and Local Action," perfectly aligning with Mohapatra's efforts in digitizing weather services in India.

• The award ceremony is typically a highlight of the Global Platform for Disaster Risk Reduction, which brings together world leaders and experts to discuss safety protocols and risk mitigation.

Q82. Answer: (c) Punjab National Bank

The correct answer is Punjab National Bank.

Key Points

• In February 2025, Punjab National Bank (PNB) entered into a Memorandum of Understanding (MoU) with the Indo-Tibetan Border Police (ITBP) to provide a comprehensive package of financial services and insurance benefits to its personnel.

• The agreement was signed at the ITBP Headquarters located in New Delhi, in the presence of senior officials from both the bank and the paramilitary force.

• Under this MoU, the PNB Rakshak Plus scheme will be extended to the ITBP personnel, which is a specialized salary account designed specifically for the Indian Defense Forces and Central Armed Police Forces (CAPFs).

• The primary function of this collaboration is to ensure enhanced social security and financial inclusion for the brave jawans guarding the Himalayan borders of the country.

• This partnership aims to offer customized banking solutions that cater to the unique requirements of security personnel who often serve in remote and high-altitude locations.

Additional Information

• Indo-Tibetan Border Police (ITBP):

• It was established on 24 October 1962, during the Indo-China War, and is one of the seven Central Armed Police Forces (CAPF) of India.

• The force is primarily responsible for guarding the 3,488 km long Indo-China border from the Karakoram Pass in Ladakh to Jachep La in Arunachal Pradesh.

• The motto of the ITBP is "Shaurya-Dridhata-Karma Nishtha" (Valour – Determination – Devotion to Duty).

• The Headquarters of ITBP is situated in New Delhi, and it operates under the Ministry of Home Affairs.

• Punjab National Bank (PNB):

• PNB is a leading Public Sector Bank in India, founded in May 1894 by Lala Lajpat Rai and Dyal Singh Majithia.

• The bank started its operations from Lahore and was the first bank purely managed by Indians with Indian capital.

• Following the merger of United Bank of India and Oriental Bank of Commerce in 2020, it became one of the largest nationalized banks in the country in terms of business volume and network.

Important Points

• Key Features of PNB Rakshak Plus:

• The scheme offers Personal Accidental Insurance (Death) cover of up to Rs. 1 Crore to the personnel.

• It includes Air Accidental Insurance coverage and benefits for Permanent Total Disability.

• The MoU also provides for Zero-balance savings accounts and overdraft facilities ranging from Rs. 1 Lakh to Rs. 3 Lakh.

• Educational financial assistance is provided for the children of personnel in the event of an accidental death, supporting their higher education.

• The concessions on interest rates for Home Loans, Car Loans, and Personal Loans are also part of the features offered to ITBP members.

Q83. Answer: (a) The US

The correct answer is The US.

Key Points

• Tiger Triumph is a bilateral Tri-Service exercise involving the Army, Navy, and Air Force of both India and the United States (US). It serves as a platform to exchange best practices and improve interoperability between the two nations' armed forces.

• The primary objective of the Tiger Triumph exercise is to enhance cooperation in Humanitarian Assistance and Disaster Relief (HADR) operations. It focuses on developing Standard Operating Procedures (SOPs) to ensure a rapid and coordinated response to natural disasters in the Indo-Pacific region.

• The exercise is typically conducted on the Eastern Seaboard of India. The 2024 edition took place in Visakhapatnam and Kakinada, Andhra Pradesh, featuring amphibious operations and disaster response simulations.

• The inaugural edition of Tiger Triumph was held in November 2019. It marked a significant milestone in India-US defense relations, as it was only the second time India conducted a Tri-Service exercise with a foreign country, the first being with Russia (Indra).

• The exercise underscores the Comprehensive Global Strategic Partnership between India and the USA, emphasizing a Free and Open Indo-Pacific.

Additional Information

• Other India-US Bilateral Exercises:

• Yudh Abhyas: This is a major Army exercise conducted annually between India and the US to enhance counter-insurgency and counter-terrorism skills in various terrains, including high-altitude areas.

• Vajra Prahar: A specialized exercise between the Special Forces of both countries, focusing on tactical drills and sharing experiences in counter-terrorism operations.

• Cope India: A series of bilateral air combat exercises between the Indian Air Force (IAF) and the United States Air Force (USAF) to improve operational capabilities.

• Multilateral Engagements:

• Malabar Exercise: Originally a bilateral naval exercise between India and the US starting in 1992, it has expanded to include Japan and Australia, forming the core of the QUAD security dialogue.

• RIMPAC: India also participates in the Rim of the Pacific exercise, which is the world's largest international maritime warfare exercise hosted by the US Navy.

• Defense Frameworks: The defense relationship is bolstered by foundational agreements such as LEMOA (Logistics Exchange Memorandum of Agreement), COMCASA (Communications Compatibility and Security Agreement), and BECA (Basic Exchange and Cooperation Agreement).

Important Points

• Strategic Location: Most iterations of Tiger Triumph are held under the aegis of the Eastern Naval Command. The use of Kakinada for amphibious landing drills allows the forces to practice beachhead operations essential for delivering aid during coastal disasters.

• Asset Participation: The exercise involves Landing Platform Docks (LPD), guided-missile destroyers, and P-8I long-range maritime patrol aircraft from the Indian side, alongside US Navy amphibious transport docks and US Marine Corps assets.

• Timeline: Following the 2019 debut and the 2024 iteration, the 2025 exercise continues the momentum of high-level military engagement, ensuring that both nations remain prepared for non-combatant evacuation operations (NEO) and maritime security challenges.

Q84. Answer: (b) Chondi

The correct answer is Chondi.

Key Points

• Ahilyabai Holkar was born on May 31, 1725, in the village of Chondi, located in the Jamkhed taluka of the Ahmednagar district (now renamed Ahilyanagar) in Maharashtra.

• To mark the 300th birth anniversary of the legendary Maratha queen in 2025, the Maharashtra Cabinet planned a special meeting at her birthplace, Chondi, to honor her monumental contributions to Indian administration and culture.

• She was the daughter of Mankoji Rao Shinde, who served as the Patil (village head) of Chondi village. It was here that her character and values were shaped before she married into the Holkar family.

• The Government of Maharashtra has actively promoted Chondi as a significant historical tourism site, establishing monuments and memorials to educate the public about her 30-year reign.

• The decision to hold a cabinet meeting at her birthplace is part of a broader initiative to celebrate the Tercentenary year (1725-2025), highlighting her status as a symbol of women's empowerment and social justice.

Additional Information

• Reign and Governance: Ahilyabai Holkar ruled the Malwa kingdom from 1767 to 1795. Following the deaths of her husband Khande Rao Holkar and father-in-law Malhar Rao Holkar, she assumed power and is remembered for her diplomatic skills and tax reforms that benefited the peasantry.

• The Capital at Maheshwar: She shifted the administrative capital from Indore to Maheshwar on the banks of the Narmada River. Under her patronage, Maheshwar became a major center for the arts and the textile industry, specifically the world-renowned Maheshwari sarees.

• Religious Contributions: She is credited with rebuilding numerous Hindu temples, ghats, and dharamshalas across the Indian subcontinent. Her most famous work is the reconstruction of the Kashi Vishwanath Temple in Varanasi in 1780, which had been destroyed by earlier invasions.

• Legacy and Titles: Often referred to as "Punya Shloka" (one who is remembered for her pious deeds) or "Rajmata," she is celebrated for her secular administration and efforts to protect her subjects from bandits and invaders.

Important Points

• Renaming of Ahmednagar: In March 2024, the Maharashtra Government officially approved the renaming of Ahmednagar district to Ahilyanagar to pay a lasting tribute to the queen born in Chondi.

• Infrastructure Projects: Her administration was known for building roads connecting major cities like Calcutta and Varanasi, as well as providing wells and rest houses for travelers and pilgrims.

• Military Leadership: Despite being a queen known for peace, she personally led her troops into battle to defend Malwa from Bhil and Gond insurgents, demonstrating her prowess as a warrior queen.

• Global Recognition: Historians like John Keay and Annie Besant have lauded her as one of the greatest female rulers in world history, comparing her favorably to Elizabeth I of England.

Q85. Answer: (a) INS Tarini

The correct answer is INS Tarini.

Key Points

• Navika Sagar Parikrama II is the second edition of the Indian Navy's ambitious global circumnavigation expedition, featuring two courageous female officers, Lieutenant Commander Roopa A and Lieutenant Commander Dilna K.

• The mission was conducted aboard the Indian Naval Sailing Vessel (INSV) Tarini, which is a 56-foot sailing yacht built indigenously in India by M/s Aquarius Shipyard Pvt Ltd located in Goa. Hence, the correct answer is INS Tarini.

• The expedition is a historic double-handed circumnavigation, meaning it was completed by only two crew members without any external assistance or use of fossil fuels for propulsion, relying entirely on wind power.

• The voyage was flagged off from Ocean Sailing Node at INS Mandovi, Goa, in October 2024 and successfully concluded in May 2025, covering a distance of approximately 21,600 nautical miles.

• This mission follows the legacy of Navika Sagar Parikrama I, which took place in 2017-2018, but sets a new record as the first double-handed global voyage by Indian women.

Additional Information

• Vessel Characteristics: INSV Tarini was inducted into the Indian Navy in February 2017. It is designed for extreme ocean conditions and is equipped with advanced satellite navigation and communication systems. The boat is named after the Tara Tarini temple in Odisha, which is dedicated to the patron deity of sailors.

• Training and Mentorship: The two officers, Lt Cdr Dilna K and Lt Cdr Roopa A, underwent rigorous training for over three years. They were mentored by Commander Abhilash Tomy (Retd), a Kirti Chakra recipient and the first Indian to complete a solo, non-stop circumnavigation under sail.

• Mission Route: The route taken by INSV Tarini during this mission involved crossing the equator twice and rounding the three great Capes: Cape Leeuwin, Cape Horn, and the Cape of Good Hope, traversing the Indian, Pacific, and Atlantic Oceans.

• Objectives: The primary objective of Navika Sagar Parikrama II is to promote Nari Shakti (women empowerment) and showcase India’s indigenous shipbuilding capabilities under the Atmanirbhar Bharat initiative. It also aims to encourage maritime adventure and enhance the Indian Navy's global footprint.

Important Points

• Comparison with Previous Missions: While Navika Sagar Parikrama I featured a six-member all-woman crew led by Lieutenant Commander Vartika Joshi, the 2024-25 mission was significantly more challenging due to the reduced crew size (only two officers), requiring them to manage all navigation, maintenance, and weather routing duties in shifts.

• Environmental and Scientific Impact: Throughout the journey, the crew collected meteorological and oceanographic data, which is vital for climate change research and improving weather forecasting models for the Indian Ocean Region (IOR).

• National Significance: The successful completion of the mission in May 2025 was celebrated as a major milestone in Indian maritime history, further solidifying India's status as a leading maritime nation with highly skilled naval personnel.

Q86. Answer: (b) 326

The correct answer is 326.

Key Points

• The Union Ministry of Youth Affairs and Sports has been instrumental in the rapid expansion of sports infrastructure in India. As of 10 June 2025, the government has officially approved a total of 326 sports infrastructure projects across various states and union territories.

• These 326 projects have been sanctioned with a massive financial outlay of Rs. 3,124.12 crore. This funding is primarily funneled through the Khelo India Scheme, which aims to provide state-of-the-art facilities to athletes at the grassroots level.

• The primary objective behind approving 326 projects is to ensure that talent in rural and tribal areas has access to modern sporting facilities such as synthetic athletic tracks, hockey turfs, and multipurpose indoor halls.

• The Rs. 3,124.12 crore investment includes the construction of new stadiums as well as the upgradation of existing facilities to meet international standards. This is expected to significantly improve India's medal prospects in upcoming Olympic Games and Asian Games.

• Option A (250) suggests a much lower number of projects than those actually sanctioned by the Ministry of Youth Affairs and Sports to match the budget of Rs. 3,124.12 crore. Hence, this option is incorrect.

• Option B (326) accurately reflects the administrative data regarding the number of projects approved for the specified financial value. Hence, this option is correct.

• Option C (300) is a rounded figure that does not align with the official reports of the Khelo India mission. Hence, this option is incorrect.

• Option D (350) represents an overestimation of the projects currently sanctioned under the specific budgetary allocation mentioned in the question. Hence, this option is incorrect.

Additional Information

• Khelo India Programme: Introduced in 2018, this is a national program for the development of sports in India. It was launched by the Ministry of Youth Affairs and Sports to revive the sports culture at the grass-root level by building a strong framework for all sports played in the country.

• Target Olympic Podium Scheme (TOPS): This is another flagship program aimed at providing customized training and support to India’s elite athletes. It covers specialized coaching, international competition exposure, and equipment for potential medal winners in the Olympics.

• Budget Allocation for Sports: In recent years, the budget for Youth Affairs and Sports has seen a steady increase. For the Financial Year 2024-25, the allocation was significantly enhanced to support the 326 infrastructure projects and the Khelo India Youth Games.

• Sports Authority of India (SAI): Established in 1984, SAI is the apex national sports body of India. It plays a crucial role in managing the infrastructure created under these projects and conducting national-level training camps.

Important Points

• Geographical Distribution: The 326 projects are distributed across 28 States and 8 Union Territories, with a special focus on the North-Eastern Region and Left-Wing Extremism (LWE) affected areas to promote social integration through sports.

• Financial Monitoring: The Rs. 3,124.12 crore is monitored through the Public Financial Management System (PFMS) to ensure transparency and timely completion of the sports infrastructure.

• Employment Generation: Beyond sports, these infrastructure projects generate significant employment opportunities in construction, facility management, and coaching within local communities.

• National Sports Policy: These developments are in line with the National Sports Policy, which emphasizes "Sports for All" and "Excellence in Sports" as two pillars for making India a global sporting powerhouse.

Q87. Answer: (a) 62 kg

The correct answer is 62 kg.

Key Points

• Manisha Bhanwala secured the gold medal in the 62 kg women's freestyle category at the Asian Wrestling Championships 2025. Her victory marks a significant achievement for India on the continental stage, highlighting the nation's prowess in combat sports.

• She displayed exceptional technique and endurance throughout the tournament, overcoming top-seeded wrestlers from countries like Japan and Kazakhstan to reach the top of the podium in the 62 kg division.

• The Asian Wrestling Championships is a premier annual event sanctioned by United World Wrestling (UWW), the international governing body for the sport. Winning a gold medal in this competition provides crucial ranking points that determine seeding for global events.

• Manisha's performance in the 2025 edition held in Amman, Jordan (or the designated host city), solidified her status as one of the leading contenders in the 62 kg weight class, which is also an Olympic weight category.

Additional Information

• Weight Categories in Women's Wrestling:

• Women's freestyle wrestling typically features 10 weight categories in international competitions. These include 50 kg, 53 kg, 55 kg, 57 kg, 59 kg, 62 kg, 65 kg, 68 kg, 72 kg, and 76 kg.

• Out of these, only six categories are featured in the Olympic Games, namely 50 kg, 53 kg, 57 kg, 62 kg, 68 kg, and 76 kg. Manisha's success in the 62 kg category is therefore vital for Olympic qualification prospects.

• Wrestling Federation of India (WFI):

• The WFI is the governing body for wrestling in India, responsible for selecting athletes for the Asian Championships and other international meets.

• Under its aegis, many wrestlers from the state of Haryana, like Manisha, have received world-class training and exposure.

• History of Asian Wrestling Championships:

• The Men's edition of the championships began in 1979, while the Women's competition was officially added in 1996.

• India has hosted this prestigious event multiple times, including in New Delhi in 2017 and 2020, fostering a strong culture of wrestling in the country.

• United World Wrestling (UWW) Rankings:

• The UWW maintains a points-based ranking system. A gold medal win at the Asian Championships often moves an athlete into the top 10 of the World Rankings, facilitating easier draws in the World Championships.

Important Points

• Manisha Bhanwala's Background: She hails from Rohtak, Haryana, a region often referred to as the "cradle of Indian wrestling." Her journey involves rigorous training at regional SAI (Sports Authority of India) centers.

• Financial Support: Top athletes like Manisha are often supported by the Ministry of Youth Affairs and Sports through the Target Olympic Podium Scheme (TOPS), which provides customized training and financial assistance for international competitions.

• Technical Superiority: In the final match of the 2025 championships, Manisha won by Technical Superiority (a lead of 10 points), demonstrating the gap between her and the silver medalist.

Q88. Answer: (a) Similipal

The correct answer is Similipal.

Key Points

• In April 2025, the Odisha government officially notified Similipal as India's 107th National Park.

• It became the second national park in the state of Odisha, joining Bhitarkanika which was established in 1998.

• Melanistic Tigers: It is the world’s only natural habitat for pseudo-melanistic tigers, characterized by thick black stripes that almost cover their tawny coats.

• Biodiversity: The park is home to a significant population of Bengal tigers, Asian elephants, and over 94 species of orchids.

• Conservation Status: While it has been a Tiger Reserve since 1973 and a UNESCO Biosphere Reserve since 2009, the new designation provides the highest level of legal protection under the Wildlife Protection Act, 1972.

Additional Information

• Gorumara National Park (West Bengal):

• Located in the Dooars region at the foothills of the Eastern Himalayas, it lies on the floodplains of the Murti River and Jaldhaka River.

• The park is primarily known for the Great Indian One-horned Rhinoceros, Asian Elephant, and Malayan Giant Squirrel.

• The vegetation consists of Tropical Moist Deciduous forests, predominantly featuring Sal (Shorea robusta), Teak, and Silk Cotton trees.

• Similipal National Park (Odisha):

• It derives its name from the Semul (Red Silk Cotton) trees that bloom abundantly in the region.

• The area was formally designated a Tiger Reserve in 1956 and under Project Tiger in May 1973.

• It serves as a vital habitat for the Bengal Tiger and Wild Buffalo, covering an area of approximately 2,750 square kilometers.

• Dudhwa National Park (Uttar Pradesh):

• It is a part of the Dudhwa-Katerniaghat-Kishanpur landscape, which forms one of the most important Tiger Conservation Units in

India.

• The park was established as a result of the efforts of Billy Arjan Singh, a renowned conservationist.

• It is one of the few places in India where one-horned rhinoceros were successfully reintroduced in 1984.

• Bhitarkanika National Park (Odisha):

• Surrounded by the Brahmani, Baitarani, and Dhamra rivers, it is the second-largest mangrove ecosystem in India after the Sundarbans.

• The park is home to the Olive Ridley Sea Turtles, which nest on the nearby Gahirmatha Beach.

• It contains estuarine crocodiles, water monitor lizards, and over 215 species of birds.

Important Points

• National Parks in India:

• Under the Wildlife Protection Act, 1972, the State Government has the power to declare an area as a National Park if it is considered of adequate ecological, faunal, floral, or geomorphological importance.

• No human activity is permitted inside a National Park except for those sanctioned by the Chief Wildlife Warden of the state.

• As of 2025, the number of national parks has grown significantly to 107 to protect India’s diverse biodiversity and endangered species.

• The first National Park established in India was the Hailey National Park (now known as Jim Corbett National Park) in 1936 in the state of Uttarakhand.

Q89. Answer: (d) 50,000

The correct answer is 50,000.

Key Points

• In the Union Budget 2025-26, the Government of India announced a significant expansion of the Atal Innovation Mission (AIM) by setting a target to establish 50,000 Atal Tinkering Labs (ATLs) in government schools across the country.

• The initiative is designed to be implemented over the next five years, ensuring that the spirit of innovation reaches the grassroots level, particularly in rural and semi-urban government educational institutions. Hence, the numerical value of 50,000 is the correct answer.

• The Union Finance Minister, Nirmala Sitharaman, emphasized that this expansion is part of the broader Viksit Bharat @2047 vision, aiming to equip young students with 21st-century skills such as computational thinking and adaptive learning.

• The primary objective of these 50,000 labs is to foster curiosity, creativity, and imagination in young minds (specifically students from Grade 6 to 12) and inculcate skills such as design mindset and physical computing.

• This massive scale-up from the existing network (which was approximately 10,000 labs previously) highlights the government's commitment to STEM (Science, Technology, Engineering, and Mathematics) education within the public schooling system.

Additional Information

• Atal Innovation Mission (AIM):

• It is the flagship initiative launched by NITI Aayog to promote a culture of innovation and entrepreneurship in India.

• Apart from ATLs, AIM also manages Atal Incubation Centers (AICs) to support startups and Atal Community Innovation Centers (ACICs) for unserved regions.

• National Education Policy (NEP) 2020:

• The expansion of Atal Tinkering Labs aligns with the NEP 2020, which advocates for vocational training and hands-on learning starting from the middle school level.

• It aims to reduce the gap between theoretical knowledge and practical application in STEM subjects.

• Technical Components of ATLs:

• Each Atal Tinkering Lab is equipped with "Do-it-yourself" (DIY) kits and equipment related to Robotics, Internet of Things (IoT), and 3D Printing.

• Students are encouraged to work with microcontrollers like Arduino and Raspberry Pi to create prototypes that solve local community problems.

• Digital India and Skill India:

• The 50,000 lab target acts as a catalyst for the Digital India mission by increasing digital literacy among the youth.

• It also supports the Skill India mission by providing technical exposure to students at an early age, preparing them for the future workforce.

Important Points

• Funding Model: NITI Aayog typically provides a grant-in-aid of Rs. 20 Lakhs to each school. This includes a one-time establishment cost of Rs. 10 Lakhs and operational expenses of Rs. 10 Lakhs provided over a maximum period of 5 years.

• Selection Criteria: Schools must have a minimum dedicated space (about 1,500 sq. ft. in hilly states and 1,000 sq. ft. in other states) and a regular science teacher to oversee the ATL activities.

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• Impact and Reach: Since its inception in 2016, AIM has successfully established over 10,000 ATLs in over 700 districts of India, reaching over 7.5 million students. The new target of 50,000 in the 2025-26 budget is a five-fold increase in the mission's scope.

• ATL Marathon: This is a national-level innovation challenge where students identify community problems and develop innovative solutions. The expansion will allow millions more government school students to participate in such national platforms.

Q90. Answer: (b) Pawan Kalyan

The correct answer is Pawan Kalyan.

Key Points

• Konidela Pawan Kalyan assumed the office of the Deputy Chief Minister of Andhra Pradesh on June 12, 2024, following the landslide victory of the National Democratic Alliance (NDA) in the state.

• He represents the Pithapuram Assembly Constituency, winning the seat with a significant margin of over 70,000 votes in the 2024 Andhra Pradesh Legislative Assembly elections.

• As the Deputy Chief Minister, he has been allocated several crucial portfolios, including Panchayati Raj, Rural Development & Rural Water Supply, Environment, Forest, and Science and Technology.

• He is the founder and president of the Jana Sena Party (JSP), which he established on March 14, 2014. In the 2024 elections, his party achieved a 100% strike rate by winning all 21 assembly seats and 2 Lok Sabha seats it contested.

• His appointment marks a significant milestone in Andhra Pradesh politics, as he serves as the second-in-command to Chief Minister N. Chandrababu Naidu. Hence, the statement regarding his role as Deputy Chief Minister is correct.

Additional Information

• Jana Sena Party (JSP): Founded by Pawan Kalyan, the party's symbol is the Glass Tumbler. The party was formed with the ideology of social justice and questioning the government on behalf of the common man. It played a pivotal role in the TDP-JSP-BJP alliance that secured 164 out of 175 seats in the assembly.

• Chiranjeevi: He is the elder brother of Pawan Kalyan and a legendary Mega Star of the Telugu film industry. He founded the Praja Rajyam Party in 2008, which later merged with the Indian National Congress. He served as the Union Minister of State (Independent Charge) for Ministry of Tourism between 2012 and 2014. He is not the current Deputy CM. Hence, this option is incorrect.

• Nandamuri Balakrishna: A famous actor and the son of legendary actor-politician N.T. Rama Rao. He is a member of the Telugu Desam Party (TDP) and has been elected as an MLA from the Hindupur constituency for three consecutive terms (2014, 2019, and 2024). While he is a key figure in the ruling alliance, he does not hold the post of Deputy CM. Hence, this option is incorrect.

• Prakash Raj: A versatile actor who has worked in multiple Indian languages. While he is politically active and has contested as an Independent candidate for the Bengaluru Central Lok Sabha seat in 2019, he is not a member of the Andhra Pradesh cabinet or the Deputy CM. Hence, this option is incorrect.

Important Points

• Constitutional Provision: The post of Deputy Chief Minister is not explicitly mentioned in the Constitution of India (like Articles 163 or 164, which mention the Chief Minister and Council of Ministers). It is a political post used for maintaining coalition stability or giving representation to specific communities or alliance partners.

• Election Year: The General Elections and State Assembly Elections in Andhra Pradesh were held simultaneously in May 2024. The results were declared on June 4, 2024.

• State Capital: Under the current government led by N. Chandrababu Naidu, the focus has returned to developing Amaravati as the sole capital of Andhra Pradesh, moving away from the previous government's three-capital proposal.

• Personal Profile: Pawan Kalyan was born on September 2, 1971. He made his acting debut in 1996 with the film "Akkada Ammayi Ikkada Abbayi" and has since become one of the highest-paid actors in India, known for films like "Thammudu", "Kushi", and "Gabbar Singh".

Q91. Answer: (a) Two

The correct answer is Two.

Key Points

• The Waqf (Amendment) Bill, 2024, which was introduced in the Lok Sabha in August 2024 and discussed extensively through 2024 and 2025, proposes significant reforms to the Waqf Act, 1995.

• One of the primary structural changes proposed is the mandatory inclusion of two Muslim women in the State Waqf Boards. This is intended to ensure gender diversity and provide women with a voice in the management of religious and charitable endowments.

• The Bill mandates that the State Waqf Board composition must include these two Muslim women alongside other members appointed by the State Government. Hence, the statement regarding the inclusion of two women is correct.

• In addition to women, the Bill also introduces a requirement for two non-Muslim members to be included in the State Waqf Boards, aiming for a more inclusive administrative structure.

• These amendments seek to replace the existing provisions where the boards were predominantly composed of members from

the Muslim community without specific mandates for women or non-Muslim representation.

Additional Information

• Central Waqf Council: The proposed legislation also modifies the composition of the Central Waqf Council. It mandates that the Council must include two Muslim women among its members to provide better oversight at the National Level.

• Waqf Act, 1995: This is the parent Act that currently governs the administration of Auqaf (assets donated for Muslim religious or charitable purposes) in India. The 2024-2025 amendments are the most comprehensive changes since the 2013 amendment.

• Definition of Waqf: The Bill proposes that only a person who has been practicing Islam for at least five years and owns the property can create a Waqf. This is a shift from the broader earlier definitions.

• Waqf-alal-aulad: The Bill addresses Waqf-alal-aulad (Waqf for the benefit of the donor's family), ensuring that such dedications do not lead to the deprivation of inheritance rights for women heirs of the donor.

• Authority of the Collector: A major feature of the Waqf (Amendment) Bill is granting the District Collector the power to determine whether a property is Waqf property or Government land, shifting this power away from the Waqf Tribunal in specific disputes.

Important Points

• Removal of Waqf by User: The Bill proposes to abolish the concept of "Waqf by User," which allowed land to be declared Waqf simply because it had been used for religious purposes for a long duration without formal documentation.

• Registration Process: It makes the registration of all Waqf properties mandatory on a centralized online portal. This aims to increase transparency and reduce litigation regarding land ownership.

• Separate Boards: The Bill provides for the establishment of separate Waqf Boards for the Bohra and Aghakhani communities if deemed necessary, acknowledging the diversity within the Muslim community.

• Audit and Accountability: It introduces stricter audit requirements for the accounts of Waqf Boards, allowing the Central Government or State Government to order audits by the Comptroller and Auditor General (CAG) or designated officers.

• Legal Challenges: The Bill was referred to a Joint Parliamentary Committee (JPC) in 2024 for detailed scrutiny due to concerns raised by various stakeholders regarding federalism and religious autonomy.

Q92. Answer: (b) 15

The correct answer is 15.

Key Points

• As of March 2025, the Defence Research and Development Organisation (DRDO) has successfully established 15 DRDO Industry Academia Centres of Excellence (DIA-CoEs) across India.

• These centres are situated in premier academic institutions including various Indian Institutes of Technology (IITs), the Indian Institute of Science (IISc), and several Central Universities to foster advanced research in defense.

• The primary function of these DIA-CoEs is to facilitate directed research and translational technology development, bridging the gap between academic innovation and the requirements of the Indian Armed Forces.

• The establishment of 15 centres marks a significant milestone in the Ministry of Defence's effort to build a robust ecosystem for indigenous technology under the Atmanirbhar Bharat initiative.

• The transformation of existing Research Innovation Centres (RICs) into DIA-CoEs was part of a strategic overhaul to ensure more focused and time-bound research outcomes in critical technology areas.

Additional Information

• DRDO (Defence Research and Development Organisation):

• It was established in 1958 by merging the Technical Development Establishment (TDEs) of the Indian Army and the Directorate of Technical Development & Production (DTDP) with the Defence Science Organisation (DSO).

• It operates under the Department of Defence Research and Development in the Ministry of Defence, Government of India.

• The headquarters is located in New Delhi, and it is led by the Secretary, Department of Defence R&D and Chairman, DRDO.

• List of Major DIA-CoEs:

• Notable centres include DIA-CoE IIT Delhi, DIA-CoE IIT Bombay, DIA-CoE IIT Madras, and DIA-CoE IISc Bangalore.

• Other locations include IIT Roorkee, IIT Kanpur, IIT Hyderabad, IIT Kharagpur, IIT BHU, Jadavpur University, Central University of Jammu, Mizoram University, and Bharathiar University.

• Research Focus Areas:

• These centres work on diverse applications such as Hypersonics, Artificial Intelligence (AI), Quantum Technologies, Directed Energy Weapons, Advanced Materials, and Robotics.

• The research projects are funded by DRDO, providing a platform for PhD students and faculty to work on national security challenges.

Important Points

• Numerical Value and Growth: The number of centres grew from a few initial RICs to a total of 15 by 2024-2025, reflecting an accelerated year-on-year investment in Defense-Academia synergy.

• Industry Integration: While these are academic centres, they specifically emphasize the participation of Start-ups and MSMEs to ensure that the technology developed can be mass-produced for the country.

• Policy Framework: The functioning of these centres is governed by the DRDO's Industry Academia partnership guidelines, which aim to streamline Intellectual Property Rights (IPR) and technology transfer processes.

• Geographical Reach: By including Mizoram University and Central University of Jammu, DRDO has ensured a wide geographical distribution of defense research capabilities across India.

Q93. Answer: (d) Manu Bhaker

The correct answer is Manu Bhaker.

Key Points

• Manu Bhaker was conferred with the prestigious Major Dhyan Chand Khel Ratna Award in 2025 by the President of India, Droupadi Murmu, at Rashtrapati Bhavan.

• This award recognized her historic performance at the Paris 2024 Olympics, where she became the first athlete from independent India to win two medals in a single edition of the Olympic Games.

• She secured a Bronze medal in the Women’s 10m Air Pistol event and another Bronze medal in the 10m Air Pistol Mixed Team event along with Sarabjot Singh.

• The Major Dhyan Chand Khel Ratna is the highest sporting honor in India, awarded annually by the Ministry of Youth Affairs and Sports for spectacular performance over a period of four years.

• Hailing from Goria village in the Jhajjar district of Haryana, she has been a consistent performer at the international level since her debut, winning multiple golds at the ISSF World Cup and Commonwealth Games.

Additional Information

• Major Dhyan Chand Khel Ratna Award:

• Previously known as the Rajiv Gandhi Khel Ratna Award, it was renamed in August 2021 in honor of the hockey wizard Major Dhyan Chand.

• The award includes a medallion, a certificate, and a cash prize of Rs. 25 lakh.

• The first recipient of this award was Chess Grandmaster Viswanathan Anand in 1991-92.

• Arjuna Award for Shooting:

• In the same 2025 ceremony, several other shooters like Sarabjot Singh, Mona Agarwal, and Rubina Francis were recognized with the Arjuna Award for their outstanding achievements.

• The Arjuna Award carries a cash prize of Rs. 15 lakh and is given for consistent performance over four years combined with qualities of leadership and sportsmanship.

• India's Performance at Paris 2024 Olympics:

• India finished the Paris 2024 Olympics with a total of 6 medals, including 1 Silver and 5 Bronze.

• Shooting was the most successful discipline for India in this edition, contributing 3 medals (Two by Manu Bhaker and one by Swapnil Kusale in the 50m Rifle 3 Positions).

Important Points

• Manu Bhaker (born 18 February 2002) became the youngest Indian to win a gold medal at the ISSF World Cup at the age of 16.

• The National Sports Awards are typically presented on August 29, which marks the National Sports Day (birth anniversary of Major Dhyan Chand), though the schedule may vary during Olympic years.

• President Droupadi Murmu, the 15th President of India, has been proactive in felicitating athletes to boost the sporting culture under the Khelo India initiative.

• The selection committee for these awards is usually headed by a retired Supreme Court or High Court Judge and includes eminent sportspersons and sports journalists.

• Shooting has historically been a strong suit for India at the Olympics, starting with Rajyavardhan Singh Rathore's Silver in 2004, Abhinav Bindra's Gold in 2008, and Vijay Kumar and Gagan Narang's medals in 2012.

Q94. Answer: (a) Maharashtra

The correct answer is Maharashtra.

Key Points

• The Maharashtra state government, in a cabinet meeting held in October 2024/2025, approved the Bamboo Industry Policy aimed at transforming the state's rural economy. This policy is designed to provide farmers with a sustainable and eco-friendly source of income by incentivizing the cultivation of bamboo on private and forest lands.

• The primary objective of the policy is to boost domestic and global bamboo production, positioning Maharashtra as a hub for bamboo-based industries. It focuses on the entire value chain, from plantation to processing and marketing.

• Under this policy, the state government intends to increase the area under bamboo plantation significantly, targeting land that is currently underutilized or degraded. This initiative aligns with the broader goal of environmental conservation and climate change

mitigation.

• The policy provides financial incentives and subsidies for setting up bamboo processing units, including those for furniture, construction materials, and bio-fuel production. This will generate significant employment opportunities in rural areas.

• The implementation of this policy is expected to benefit tribal communities and small-scale farmers, who can utilize bamboo as a "cash crop" with relatively low maintenance compared to traditional crops.

Additional Information

• National Bamboo Mission (NBM): The Government of India launched the restructured National Bamboo Mission in 2018-19 to promote the holistic growth of the bamboo sector. It is a Centrally Sponsored Scheme under the Ministry of Agriculture and Farmers Welfare.

• Legal Status of Bamboo: A landmark amendment to the Indian Forest Act, 1927, was made in 2017. This amendment removed bamboo grown in non-forest areas from the definition of "trees," thereby exempting it from the requirement of felling and transit permits. This has been a major catalyst for bamboo trade and farming.

• Green Gold: Bamboo is often referred to as "Green Gold" because of its high economic value and diverse applications. It is used in more than 1,500 products, including paper, textiles, charcoal, and even as a source of ethanol.

• Global Production: India is the second-largest producer of bamboo in the world after China. The North-Eastern states of India contribute a significant portion of the country's bamboo resources, with states like Tripura and Assam being key players.

• Maharashtra's Initiative: The state has established the Maharashtra Bamboo Development Board (MBDB) to streamline the growth of the sector. The board works toward research and development, providing quality saplings, and facilitating market linkages for the growers.

Important Points

• Environmental Benefits: Bamboo is one of the fastest-growing plants on Earth. It acts as an excellent carbon sink, absorbing up to 35% more carbon dioxide than an equivalent stand of trees, and helps in preventing soil erosion.

• Economic Impact: The policy in Maharashtra specifically targets the creation of secondary income for marginalized farmers. By integrating bamboo into agro-forestry, farmers can achieve crop diversification and reduce risks associated with traditional agriculture.

• Applications in Energy: Bamboo is increasingly being viewed as a feedstock for bio-ethanol and green hydrogen. The Maharashtra Bamboo Industry Policy encourages the use of bamboo in biomass power plants, contributing to India's renewable energy goals.

• Aatmanirbhar Bharat: By reducing the import of bamboo products (like incense sticks/agarbatti and plywood), the state's policy contributes to the national vision of a self-reliant India or Aatmanirbhar Bharat.

Q95. Answer: (a) Canara Bank

The correct answer is Canara Bank.

Key Points

• In a major move aimed at enhancing financial inclusion, Canara Bank officially removed the Average Monthly Balance (AMB) requirement for all categories of its savings bank accounts starting 1 June 2025.

• Announced on 31 May 2025 that effective from the following day (1 June), it would abolish all penalties for non-maintenance of a minimum balance across regular, salary, and NRI savings accounts.

• This made it the first prominent public sector bank to implement such a comprehensive blanket waiver in 2025.

Additional Information

• State Bank of India (SBI): It is the largest public sector bank in India and a Fortune 500 company, headquartered in Mumbai, Maharashtra.

• Historical Background: The bank traces its ancestry to the Bank of Calcutta (founded in 1806). It later became the Imperial Bank of India in 1921 and was nationalized as the State Bank of India on July 1, 1955.

• Network and Scale: SBI possesses a massive network of over 22,400 branches and more than 65,000 ATMs across India, holding nearly 25% of the total market share in loans and deposits.

• Global Footprint: It is one of the few Indian banks with a strong international presence, operating over 230 offices in 30 countries, including major hubs like New York, London, and Tokyo.

• Leadership: The current Chairman of the State Bank of India is Challa Sreenivasulu Setty (appointed in 2024), who succeeded Dinesh Kumar Khara.

Important Points

• YONO App: SBI launched its integrated digital banking platform YONO (You Only Need One) in November 2017, providing a one-stop solution for banking, shopping, and investments.

• Merger of Associates: On April 1, 2017, SBI merged with five of its associate banks (State Bank of Bikaner & Jaipur, Hyderabad, Mysore, Patiala, and Travancore) and the Bhartiya Mahila Bank, propelling it into the Top 50 global banks list.

• Financial Inclusion: SBI plays a pivotal role in the Pradhan Mantri Jan Dhan Yojana (PMJDY), opening the highest number of zero-balance accounts to support the government's financial inclusion drive.

• Taglines: The bank is known by several popular taglines, including "The Banker to Every Indian", "The Nation banks on us", and "Pure Banking Nothing Else".

• Subsidiaries: The bank has successful subsidiaries like SBI Card (credit cards), SBI Life Insurance, and SBI Mutual Fund, which contribute significantly to the Indian financial ecosystem.

Q96. Answer: (b) Paris

The correct answer is Paris.

Key Points

• Viva Technology, popularly known as VivaTech, is scheduled to host its 2025 edition from June 11 to June 14, 2025.

• The event will take place at the Paris Expo Porte de Versailles, which is a major exhibition and conference center located in Paris, France.

• VivaTech is recognized as Europe's largest startup and tech event, acting as a global hub where the world's most innovative minds, startups, and major corporations meet to discuss the future of technology.

• The tech fair is co-organized by the Publicis Groupe and Groupe Les Échos, two prominent French media and communications entities, ensuring massive global media coverage and participation.

• The event serves as a platform for digital transformation and the promotion of innovative ecosystems, typically attracting over 150,000 attendees from across the globe.

Additional Information

• History and Founding: VivaTech was first launched in 2016 and has grown exponentially each year, becoming a cornerstone event for the French Tech initiative promoted by the French Government.

• Core Themes: For the 2025 edition, the focus is expected to remain on high-growth sectors such as Artificial Intelligence (AI), Quantum Computing, Cybersecurity, and Climate Tech (Sustainability).

• Global Participation: The fair typically hosts more than 11,000 startups and 2,500 investors from over 120 countries, making it a critical venue for Venture Capital (VC) deals and networking.

• Prominent Speakers: In previous years, the event has featured world-renowned speakers including Elon Musk (Tesla/SpaceX/X), Tim Cook (Apple), Satya Nadella (Microsoft), and Bernard Arnault (LVMH).

• Economic Impact: VivaTech significantly boosts the European technology sector by providing a stage for "Unicorn" companies (startups valued at over 1 billion dollars) to showcase their breakthroughs.

Important Points

• Next Unicorn Awards: A major highlight of the fair is the Next Unicorn Awards, which recognizes the most promising European scale-ups with the potential to reach unicorn status in the near future.

• LVMH Innovation Award: VivaTech often hosts the LVMH Innovation Award, where startups focusing on luxury tech, retail experience, and sustainability are honored.

• AI Focus: Given the global trend, the 2025 summit is anticipated to dedicate significant space to Generative AI and its ethical implementation across healthcare, finance, and manufacturing.

• Governmental Support: The President of France, Emmanuel Macron, is a regular attendee, often using the platform to announce new funding and policies for the European digital economy.

• Exhibition Features: The venue features massive discovery zones including Mobility Park, where the latest electric and autonomous vehicles are displayed, and GreenTech zones focused on Decarbonization.

Q97. Answer: (a) Gaganyaan Year

The correct answer is Gaganyaan Year.

Key Points

• The Indian Space Research Organisation (ISRO) Chairman, S. Somanath, officially declared that the year 2025 will be celebrated as the "Year of Gaganyaan". This declaration underscores India’s commitment to its maiden human spaceflight mission. Hence, the option Gaganyaan Year is correct.

• The primary objective of 2025 is to conduct a series of critical test flights and preparatory missions to ensure the safety and success of the eventual crewed mission. These include the G1, G2, and G3 missions, which are uncrewed flights designed to test the orbital module and recovery systems.

• The Gaganyaan mission aims to demonstrate human spaceflight capability by launching a crew of three members to an orbit of 400 km for a 3-day mission and bringing them back safely to earth, landing in Indian sea waters.

• The declaration of 2025 as a dedicated year for this project highlights the transition from the design and experimental phase to the actual execution phase of the Human Spaceflight Centre (HSFC).

• The LVM3 (Launch Vehicle Mark-3), formerly known as GSLV Mk III, has been identified as the launch vehicle for the mission, specifically reconfigured to meet human-rating requirements.

Additional Information

• Astronaut Selection and Training: Four designated test pilots from the Indian Air Force (IAF)—Group Captain Prashanth Nair, Group Captain Ajit Krishnan, Group Captain Angad Pratap, and Wing Commander Shubhanshu Shukla—have been selected for the mission. They underwent extensive training at the Gagarin Cosmonaut Training Center in Russia and are currently training at ISRO's facilities in Bengaluru.

• Mars Year: While ISRO achieved global fame with the Mars Orbiter Mission (MOM) or Mangalyaan in 2014, 2025 is not designated as Mars Year. Future plans include Mangalyaan-2, but the immediate priority remains human spaceflight. Hence, the option Mars Year is incorrect.

• Solar Year: This would typically refer to missions like Aditya-L1, India's first solar observatory launched in September 2023. While 2024 saw significant data collection from Aditya-L1, 2025 is specifically branded for the human mission. Hence, the option Solar Year is incorrect.

• Moon Year: Following the historic success of Chandrayaan-3 in August 2023, India became the first country to land near the Lunar South Pole. Future lunar missions like LUPEX (with JAXA) and Chandrayaan-4 (sample return) are planned, but 2025 is not designated as Moon Year. Hence, the option Moon Year is incorrect.

Important Points

• Vyommitra: To ensure the safety of human astronauts, ISRO will first launch a female robot humanoid named Vyommitra in the uncrewed missions (specifically G1). This humanoid is designed to simulate human functions in the space environment and monitor life support systems.

• Budget and Infrastructure: The Union Cabinet initially approved a budget of approximately Rs. 9,023 Crore for the Gaganyaan programme. Infrastructure like the Crew Escape System (CES) and the Service Module have undergone rigorous testing, including the TV-D1 (Test Vehicle Abort Mission-1) conducted in October 2023.

• Global Context: If successful, India will become the fourth nation in the world to launch a crewed spaceflight mission, following the USA, Russia (Soviet Union), and China. This achievement will be a major milestone for the Department of Space and the Indian government's vision for an Atmanirbhar Bharat in high-end technology.

• Axiom-4 Mission: As a precursor to the main mission, India is collaborating with NASA to send one of its selected astronauts (Shubhanshu Shukla) to the International Space Station (ISS) via the Axiom-4 mission scheduled for late 2024 or early 2025.

Q98. Answer: (b) 20 km race walk

The correct answer is 20 km race walk.

Key Points

• On 16 February 2025, Toshikazu Yamanishi set a new world record at the Japanese 20km Race Walking Championships in Kobe.

• He completed the race in 1 hour, 16 minutes, and 10 seconds, breaking the previous record by 26 seconds.

• Previous Record: 1:16:36, set by fellow Japanese athlete Yusuke Suzuki in 2015.

• Significant Achievement: This victory marked Yamanishi's third title in the event and secured his place in the Japanese team for the World Athletics Championships in Tokyo.

• Technique: Yamanishi is noted for maintaining high speeds while strictly adhering to the technical requirements of race walking, ensuring one foot is always in contact with the ground.

Additional Information

• Toshikazu Yamanishi's Career Profile:

• Yamanishi is a two-time World Champion in the 20 km race walk, having won gold medals at the 2019 World Athletics Championships in Doha and the 2022 World Athletics Championships in Eugene.

• He also secured a Bronze Medal at the Tokyo 2020 Olympics (held in 2021) in the 20 km event, demonstrating consistent excellence on the global stage.

• Japan's Dominance in Race Walking:

• In recent years, Japan has become a global powerhouse in race walking, producing several world-class athletes like Koki Ikeda and Yusuke Suzuki.

• The infrastructure and coaching programs in Japan specifically target the technical nuances of the sport, leading to multiple records and podium finishes in Asian Games and Olympic competitions.

Important Points

• Technical Rules of Race Walking:

• Athletes can be disqualified if they lose contact with the ground (lifting) or fail to keep the knee straight (creeping). These rules are strictly monitored by World Athletics judges using yellow paddles and red cards.

• The 10 km race walk world record requires formal ratification by World Athletics, involving drug testing and course measurement certification.

• Significance of the Year 2025:

• Setting a world record in February 2025 is crucial for Yamanishi as it sets the momentum for the 2025 World Athletics Championships scheduled to be held in Tokyo in September.

• This performance marks one of the earliest major world records broken in the 2025 athletics season.

Q99. Answer: (d) 65

The correct answer is 65.

Key Points

• The 2023 Corruption Perceptions Index (CPI) was officially released by Transparency International on January 30, 2024.

• In this 2024 report, the United States of America received a score of 65 out of 100.

• The score of 65 indicates that the United States is perceived as having a relatively low level of public sector corruption, although it remains below its 2015 peak score of 76.

• The United States was ranked 24th out of the 180 countries and territories included in the 2023 index.

• The score of 65 has remained unchanged for the USA for two consecutive years (covering the 2022 and 2023 data cycles), showing a recovery from the score of 67 recorded in 2021.

Additional Information

• Corruption Perceptions Index (CPI):

• The CPI is a composite index that ranks countries based on how corrupt their public sector is perceived to be by experts and business people.

• It uses a scale from 0 (highly corrupt) to 100 (very clean).

• The index aggregates data from 13 different data sources, including the World Bank, World Economic Forum, and private risk and consulting companies.

• Global Rankings in 2024:

• Denmark topped the 2023 index (released in 2024) for the sixth year in a row with a score of 90.

• Finland and New Zealand followed closely with scores of 87 and 85, respectively.

• Countries like Norway (84), Singapore (83), and Sweden (82) also ranked among the top performers globally.

• India's Performance:

• In the 2024 release, India's rank slipped to 93rd position among 180 countries.

• India's overall score was 39, a slight decrease from the score of 40 (rank 85) in the previous year's survey.

• Regional Trends:

• The Americas region, where the United States is located, had an average score of 43.

• Transparency International noted that the lack of judicial independence and weak rule of law are major factors hindering progress against corruption in the region.

Important Points

• Historical Data: The United States saw its lowest score in recent history in 2020 and 2021, where it scored 67. Its score of 69 in 2024 suggests a period of relative stability but highlights ongoing concerns regarding political integrity and checks and balances.

• Transparency International: This is a global non-governmental organization founded in 1993, headquartered in Berlin, Germany. Its primary goal is to take action to combat corruption and prevent criminal activities arising from corruption.

• Bottom Performers: The lowest-scoring countries in the 2024 index included Somalia (11), Venezuela (13), Syria (13), and South Sudan (13), all of which are affected by prolonged conflict and instability.

• Recommendations: The 2024 report emphasizes that for countries to improve their CPI scores, they must strengthen their justice systems, ensure judicial independence, and protect whistleblowers and journalists.

Q100. Answer: (b) Butterfly

The correct answer is Butterfly.

Key Points

• The species Euthalia malaccana, commonly known as the Fruhstorfer's Baron, is a rare and beautiful species of Butterfly.

• It was officially recorded and documented in the Leparada district of Arunachal Pradesh in May 2025, marking a significant addition to the entomological records of the state.

• The Euthalia genus belongs to the Nymphalidae family, which is also known as the family of brush-footed butterflies because their front legs are usually reduced and hairy.

• The discovery of Euthalia malaccana in India highlights the immense biodiversity of the Eastern Himalayas, which serves as a critical habitat for various endemic and rare Lepidoptera species.

• This specific recording involved researchers and nature enthusiasts who documented the physical characteristics and wing patterns of the specimen to distinguish it from other closely related species like the Common Baron.

Additional Information

• Arunachal Pradesh:

• Known as the "Orchid State of India" or the "Paradise of the Botanists", it is a hotspot for biodiversity.

• The state is home to over 50% of the total butterfly species found in India, including the state butterfly, Kaiser-i-Hind (Teinopalpus imperialis).

• Geographically, it borders Bhutan, China (Tibet), and Myanmar, creating a unique confluence of various biogeographic zones.

• The Genus Euthalia:

• The genus Euthalia contains medium to large-sized butterflies typically found in South and Southeast Asia.

• These butterflies are often referred to as Barons, Counts, or Admirals, depending on their specific sub-groupings.

• They are known for their cryptic coloration on the underside of their wings, which helps them camouflage against leaf litter and forest floors.

• Nymphalidae Family:

• This is the largest family of butterflies with about 6,000 species worldwide.

• Members are characterized by a reduced pair of forelegs that lack claws and are not used for walking.

• Important examples include the Monarch, Painted Lady, and the Common Nawab.

Important Points

• Significance of Leparada Recording:

• The Leparada district, with its temperate and subtropical climate, provides the perfect ecosystem for rare insects.

• Documenting Euthalia malaccana in 2025 adds to the data required for conservation planning under the Wildlife Protection Act of India.

• Butterflies are considered indicator species; their presence or absence provides data regarding the health of the environment and the impact of climate change on local habitats.

• Other Options Overview:

• Grasshopper: These are orthopteran insects known for jumping and stridulation (producing sound by rubbing body parts). They are not part of the Lepidoptera order.

• Dragonfly: Belonging to the order Odonata, they are predatory insects with multifaceted eyes and two pairs of strong transparent wings.

• Locust: These are a collection of certain species of short-horned grasshoppers in the family Acrididae that have a swarming phase; they are major agricultural pests.

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