RRB Group D Official Paper (Held On: 17 Dec, 2025 Shift 3) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which type of spherical mirror has its reflecting surface curved outwards and possesses a centre of curvature C that lies behind the mirror?

(a) Plane mirror
(b) Converging mirror
(c) Concave mirror
(d) Convex mirror

Q2. In the case of unbalanced forces acting on an object, the acceleration (a) produced is in the direction of the _____.

(a) force of friction
(b) largest force
(c) initial velocity
(d) net force (resultant force) acting on the object

Q3. An object moves 10 m in 2 s. On a distance–time graph, what is the slope?

(a) 10 m/s
(b) 5 m/s
(c) 8 m/s
(d) 20 m/s

Q4. The colour of silver chloride changes when placed in sunlight for some time due to the:

(a) Photochemical decomposition of silver chloride by sunlight
(b) Combination reaction of silver chloride with oxygen
(c) Thermal decomposition of silver chloride
(d) Displacement reaction by oxygen and water

Q5. The chemical formula of the compound sodium carbonate is represented as:

(a) Na3CO3
(b) Na3CO2
(c) Na2CO3
(d) Na3CO4

Q6. If Girl A takes 20 s and Girl B takes 50 s to climb a rope, both performing 3200 J of work, their difference in performance is characterised by which physical concept?

(a) Gravitational force
(b) Total displacement
(c) Total energy consumed
(d) Power

Q7. A sound wave has a frequency of 1600 Hz. If the wavelength of the wave is 0.2 m, what will be the speed of the wave?

(a) 8000 m/s
(b) 800 m/s
(c) 32 m/s
(d) 320 m/s

Q8. A man contracts HIV even though his partner is healthy. Which of the following behaviours from his personality could explain this?

(a) Using sterlised needles
(b) Having multiple unprotected sexual partners
(c) Having protected sex
(d) Maintaining a healthy diet

Q9. What is the benefit of developing dwarf broiler parents in poultry?

(a) To increase flight ability
(b) To make them resistant to rain
(c) To lay larger eggs
(d) To reduce feed consumption and improve meat yield

Q10. Esters are formed by the reaction of:

(a) alcohol and acid in basic medium
(b) alcohol and aldehyde in the presence of dehydrating agent
(c) alcohol and acid in acidic medium
(d) alcohol and acid at low pressure

Q11. Blood is called a connective tissue because _____.

(a) it connects and transports material throughout the body
(b) it is found only in muscles
(c) it supports bones
(d) it is red in colour

Q12. A stone is thrown downward with an initial velocity of 5 m/s. After 2 seconds, its final velocity v (taking g = 10 m/s^2) will be:

(a) 25 m/s
(b) 5 m/s
(c) 10 m/s
(d) 20 m/s

Q13. Carbon forms many compounds because of:

(a) High atomic mass and large size
(b) Catenation and tetravalency
(c) Reactivity with noble gases
(d) Ability to form ionic crystals

Q14. Brass is an example of:

(a) an element
(b) a compound
(c) a homogeneous mixture
(d) a heterogeneous mixture

Q15. Which of the following belongs to the alkyne group?

(a) C3H4
(b) C2H4
(c) C3H8

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(d) C_6H_6

Q16. Which of the following is NOT a molecule of a compound?

(a) HCl
(b) NH_3
(c) O_3
(d) CH_4

Q17. Which of the following statements about resistivity is correct?

(a) It depends only on the nature and temperature of the material
(b) It increases with the cross-sectional area
(c) It changes with the shape of the conductor
(d) It decreases when the length increases

Q18. Which of the following statements is/are correct regarding sexual reproduction in plants?

Statement A: After fertilisation, the zygote divides several times to form an embryo within the ovule

Statement B: The ovule develops a tough coat and is gradually converted into a seed.

(a) Neither statement A nor B
(b) Only statement A
(c) Both statements A and B
(d) Only statement B

Q19. Which of the following statement is INCORRECT about simple permanent tissue?

(a) It founds few layers beneath the epidermis
(b) Food storage occurs in simple permanent tissue
(c) Simple permanent tissue is generally composed of living cells
(d) Sclerenchyma is the most common simple permanent tissue

Q20. A long straight wire carries a current I, and the magnetic field at a distance r from the conductor is B. If the distance from a straight current-carrying wire is doubled, what will be the magnetic field at that point?

(a) B
(b) 2B
(c) Zero
(d) B/2

Q21. Which gas reacts with sodium hydroxide to form sodium bicarbonate and sodium carbonate?

(a) NO_2
(b) CO
(c) SO_2
(d) CO_2

Q22. Which of the following statements regarding the need for macronutrients in plants is correct?

(a) Macronutrients are required by plants in large quantities for proper growth and development.
(b) Macronutrients are less important than micronutrients.
(c) Macronutrients are only required during the flowering stage.
(d) Plants can survive without macronutrients.

Q23. The bud in Hydra:

(a) grows as an outgrowth
(b) develops on a stalk
(c) forms inside the parent's body
(d) forms through spores

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Q24. A convex mirror is generally used as a rear-view mirror in vehicles because it:

(a) Produces real and inverted images
(b) Produces magnified images
(c) Produces a wider field of view
(d) Absorbs most of the light rays

Q25. Which of the following is INCORRECT about meristematic tissues?

(a) Thin walled
(b) Actively dividing cells
(c) Presence of vacuoles
(d) Lack of vacuoles

MATHEMATICS

Q26. The trains Rajdhani Express and Garib Rath Express run in the same direction with speeds of 101 km/hr and 65 km/hr, respectively, and their lengths are same. What is the length of Rajdhani Express if it completely crosses Garib Rath Express in 66 seconds?

(a) 326 m
(b) 330 m
(c) 338 m
(d) 322 m

Q27. The sum of three numbers is 180. If the ratio of the second number to the first number is 14:7 and that of the third number to the second number is 15:15, then find the second number.

(a) 71
(b) 70
(c) 72
(d) 74

Q28. If the mode of a data exceeds its mean by 27.3, then the mode exceeds the median by _____. (Use empirical formula to find the answer.)

(a) 18.2
(b) 24.9
(c) 27.1
(d) 15.8

Q29. A man observes the top of a building at an angle of elevation 45°. If the building is 20 m high, find the distance of the man from the building.

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

Q30. 102 men have provisions for 30 weeks. They are joined by 68 men. How long (in weeks) will the provisions last?

(a) 20
(b) 16
(c) 18
(d) 22

Q31. Bharat goes to a shop to purchase a toy train priced at Rs. 5,000. He is offered 4 discount options by the shopkeeper. Which of these options should he opt for to gain maximum advantage of the discount offered?

(a) Two successive discounts of 44% and 18%
(b) Two successive discounts of 30% each
(c) Single discount of 22%
(d) Two successive discounts of 24% and 25%

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Q32. A, B and C can do a piece of work in 3, 12 and 4 days, respectively. How long (in days) will they take to do twice the same work, working together?

(a) 9
(b) 6
(c) 4
(d) 3

Q33. The monthly incomes of two friends Shivam and Rupesh, are in the ratio 5 : 8, respectively, and each of them saves Rs. 81,000 every month. If the ratio of their monthly expenditure is 1 : 4, find the monthly income of Shivam (in Rs.).

(a) 1,41,750
(b) 1,02,250
(c) 1,00,250
(d) 1,01,250

Q34. For what value of x will the equation $(x + 5)^2 - (x - 5)^2 = 80$ be true?

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

Q35. A train travels at a speed of 72 km/hr. How long will it take to cover a distance of 180 km?3017

(a) 2.5 hours
(b) 2.1 hours
(c) 2.7 hours
(d) 2.4 hours

Q36. A solid cylinder has a height of 12 cm and a radius of r cm. A part of the cylinder is melted and molded into two cones. One cone has a radius of 3 cm and a height of 4 cm, while the other cone has a radius of 6 cm and a height of 8 cm. If the ratio of the curved surface area of the original cylinder to the sum of the curved surface areas of the two cones is 4 : 1, find the value of 2r.

(a) 27
(b) 26
(c) 25
(d) 24

Q37. At present, the ratio of the ages of Meena and Sita is 5 : 4 and sixteen years from now, the ratio will get changed to 9 : 8. Find the present age of Meena.

(a) 21 years
(b) 23 years
(c) 22 years
(d) 20 years

Q38. The amount on a sum of Rs. 7,500 at 8% per annum compound interest, compounded annually, in 2 years will be:

(a) Rs. 9,135
(b) Rs. 8,989
(c) Rs. 8,748
(d) Rs. 9,355

Q39. 1/20 is what percentage of 10/30?

(a) 30%
(b) 15%
(c) 25%
(d) 35%

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Q40. In a student body election, 5% of the eligible voters are aged 18–21 years, 12% are aged 21–25 years, and the rest are older than 25 years. Among these groups, 80% of the 18–21 year age group and 60% of the 21–25 year age group actually voted. If the number of voters aged 21–25 years who voted exceeds those aged 18–21 years by 320, what is the difference between the number of eligible voters aged 18–21 years and those aged 21–25 years?

(a) 800
(b) 600
(c) 500
(d) 700

Q41. The average age of 31 students of a class is 34 years. If the age of the teacher is also included, the average age of the whole group becomes 35 years. The age (in years) of the teacher is:

(a) 66
(b) 69
(c) 63
(d) 67

Q42. The selling price of an iPhone is Rs. 3,300, after allowing two successive discounts of 36% and 25%. Find the marked price of the iPhone.

(a) Rs. 6,875
(b) Rs. 6,815
(c) Rs. 6,983
(d) Rs. 6,769

Q43. The sum of the first 11 prime numbers is:

(a) 164
(b) 165
(c) 162
(d) 160

Q44. In a triangle MNR, the bisectors of angle MNR and angle MRN are respectively NO and RO, which intersect at O. If angle M=60° and angle MRN=66°, then the value of angle RON is :

(a) 120°
(b) 110°
(c) 30°
(d) 130°

Q45. In how many minutes will a cistern be filled if three pipes with diameters 2 cm, 3 cm and 4 cm are opened together, given that the largest pipe alone can fill it in 87 minutes? (Assume the rate of flow of water through each pipe is proportional to the square of its diameter.)

(a) 48
(b) 40
(c) 50
(d) 36

Q46. Simplify the following expression.

((256)^4 × (125)³ × (81)^5)/((64)^5 × (25)^4 × (27)^6)

(a) 150
(b) 180
(c) 60
(d) 120

Q47. If the radius of a sphere is increased by 15%, then find the percentage increase in its volume. (Rounded up to 2 decimal places.)

(a) 80.25%
(b) 23.20%

(c) 52.09%
(d) 41.67%

Q48. If the cost price of 30 chairs is equal to the selling price of 40 chairs, find the loss percentage.
(a) 235
(b) 25%
(c) 19%
(d) 17%

Q49. The sum of two numbers is 45 and their difference is 9. Find the smaller number.
(a) 12
(b) 18
(c) 15
(d) 20

Q50. The ratio of 20 hours to 7 days is equivalent to which of the following?
(a) 20:7
(b) 4:43
(c) 2:47
(d) 5:42

GENERAL INTELLIGENCE & REASONING

Q51. 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) KM - SV
(b) EG - MO
(c) CE - KM
(d) BD - JL

Q52. What should come in place of the question mark (?) in the given series?
53 62 73 86 101 ?
(a) 118
(b) 113
(c) 115
(d) 120

Q53. A, B, C, D, E and F are sitting around a circular table facing the centre. D sits third to the right of F. A sits second to the left of F. E sits second to the right of B. C sits to the immediate right of E. How many people sit between A and C when counted from the left of A?
(a) One
(b) None
(c) Two
(d) Four

Q54. Seven boxes, B, D, E, P, S, T and W, are kept one over the other but not necessarily in the same order. Only two boxes are kept between S and D. Only B is kept above T. No box is kept below D. W is kept at some place below P but at some place above E. Which box is kept third above E?
(a) T
(b) B
(c) W
(d) P

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Q55. Refer to the given series and answer the question that follows. (All numbers are single digit numbers only.) Counting to be done from left to right only.

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

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

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

Q56. In the following series, numbers are written using some special pattern but one number is incorrect. That INCORRECT number is:

10, 27, 78, 233, 690, 2067

(a) 78
(b) 233
(c) 10
(d) 2067

Q57. 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) MKL
(b) QOP
(c) ECD
(d) SRR

Q58. In a certain code language, ‘are you ready’ is coded as ‘nb uc jp’ and ‘do you agree’ is coded as ‘jh jp ko’. How is ‘you’ coded in that language? (All codes are two-letter codes.)

(a) jp
(b) nb
(c) ko
(d) qc

Q59. Seven people B, C, D, I, J, K and L are sitting in a straight line facing north. Only two people sit between L and J. Only J sits to the right of D. Only three people sit between D and C. K sits at some place to the left of B but at some place to the right of I. How many people sit between I and B?7073

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

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

YZX−WXV

XYW−VWU

(a) TTQ−RSQ
(b) TUS−RSQ
(c) TUS−QSP
(d) TTQ−QRP

Q61. NKMP is related to TQSV in a certain way based on the English alphabetical order. In the same way, KHJM is related to QNPS. To which of the following is SPRU related, following the same logic?

(a) YWWF
(b) YVWA
(c) YVXA

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(d) YUWA

Q62. Seven boxes, A, B, C, D, E, F and G, are kept one over the other but not necessarily in the same order. Only two boxes are kept below D. Only one box is kept above G. Only one box is kept between G and C. E is kept immediately above A. F is kept at some place below B. How many boxes are kept above F?

(a) 2
(b) 3
(c) 5
(d) 4

Q63. In a certain code language,

A ± B means ‘A is the wife of B’,

A * B means ‘A is the son of B’,

A Rs. B means ‘A is the father of B’,

and A # B means ‘A is the sister of B’.

How is D related to O if 'D # R * A Rs. C ± O’?

(a) Wife's sister
(b) Sister
(c) Mother's sister
(d) Wife

Q64. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

23 - 10 - 33

4 - 13 - 17

(a) 49 - 21 - 80
(b) 16 - 20 - 46
(c) 50 - 22 - 72
(d) 44 - 20 - 85

Q65. Refer to the given number, symbol series and answer the question that follows. Counting to be done from left to right only.

(Left) £ 9 $ £ £ % € 6 3 3 1 8 & 3 © # * 7 * & 3 & (Right)

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

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

Q66. If ‘+’ means ‘–’, ‘–’ means ‘×’, ‘×’ means ‘÷’ and ‘÷’ means ‘+’, then what will come in place of the question mark (?) in the following equation?

24 × 3 + 6 - 2 ÷ 8 = ?

(a) 4
(b) 15
(c) 7
(d) 11

Q67. 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) 1 5 3 7 2 8 4 9 6 1 3 7 5 4 2 8 9 6 3 7 1 5 4 9 8 2 6 (Right)

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

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immediately followed by an odd number?

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

Q68. Refer to the given series and answer the question that follows. (All numbers are single digit numbers only.) Counting to be done from left to right.

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

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

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

Q69. Which numbers should come in place of the question mark (?) in the same sequence to make the series logically complete?

2, 5, 7, 10, 14, 17, 23, 26 34 ? 47 ?

(a) 33, 50
(b) 33, 51
(c) 34, 50
(d) 37, 50

Q70. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

PSJ NQH LOF JMD ?

(a) HLB
(b) HKB
(c) HKA
(d) HLA

Q71. Which of the given letter-number clusters will replace the question mark (?) in the following series to make it logically complete?

KR37 MT45 OV53 QX61 ?

(a) SY69
(b) SZ68
(c) SY68
(d) SZ69

Q72. Mr. Akai starts from Point A and drives 15 km towards west. He then takes a left turn, drives 11 km, turns left and drives 50 km. He then takes a left turn, drives 31 km, turns left and drives 17 km. He then takes a left turn and drives 15 km. He takes a final right turn, drives 18 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90 degrees turns only unless specified)

(a) 7 km to the north
(b) 5 km to the south
(c) 5 km to the west
(d) 5 km to the north

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 machines are tools.

All machines are equipment.

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Some equipment are toys.

Conclusions:

(I): Some toys are machines.

(II): Some equipment are tools.

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

Q74. Piyush starts from Point A and drives 8 km towards east. He then takes a right turn, drives 6 km, turns right and drives 11 km. He then takes a right turn and drives 10 km. He takes a final right turn, drives 3 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again?

(All turns are 90 degrees turns only unless specified)

(a) 5 km to the south
(b) 5 km to the north
(c) 4 km to the south
(d) 4 km to the north

Q75. Select the pair that follows the same pattern as the one followed by the two pairs given below. Both pairs follow the same pattern.

NKL−HEF

AXY−URS

(a) WTU−QNO
(b) WTU−PNN
(c) WSS−QNO
(d) WSS−PMN

Q76. In a certain code language 'VACP' is coded as '126' and 'MHTJ' is coded as '153'. What is the code for 'OGQE' in the given language?

(a) 135
(b) 132
(c) 140
(d) 129

Q77. 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:

No Porcupines are Bears.

All Bears are Leopards.

Some Leopards are Jaguars.

Conclusions:

(I) Some Porcupines are Leopards.

(II) Some Bears are Jaguars.

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

Q78. If ‘A’ stands for ‘×’, ‘B’ stands for ‘÷’, ‘C’ stands for ‘+’ and ‘D’ stands for ‘−’, then what will come in place of the question mark (?) in the following equation?

20 B 5 D 8 A 3 C 14 A 4 = ?

(a) 36

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(b) 34
(c) 39
(d) 38

Q79. Six people, A, B, C, D, E and F, are sitting in a row, facing the north. F sits to the immediate left of A. C sits third to the left of D. C is an immediate neighbour of A. B sits to the immediate left of E.

How many people sit between E and C?

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

Q80. If 'A' stands for '÷', 'B' stands for '×', 'C' stands for '+' and 'D' stands for '−', then what will come in place of the question mark (?) in the following equation?

11 B 2 D 44 A 4 C 3 = ?

(a) 14
(b) 17
(c) 11
(d) 22

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. What is the percentage of the population with access to clean fuels and technology for cooking in the Sustainable Development Report 2025?

(a) 74%
(b) 83%
(c) 89.3%
(d) 79%

Q82. Which co-operative bank's licence was cancelled by the Reserve Bank of India (RBI) in May 2025 for capital shortfall?

(a) HCBL Co-operative Bank
(b) Seva Vikas Co-operative Bank
(c) Punjab and Maharashtra Co-operative Bank
(d) Ajantha Urban Co-operative Bank

Q83. What poverty rate did the State Bank of India project for India in 2024, as reported in June 2025?

(a) 2.6%
(b) 3.6%
(c) 1.6%
(d) 4.6%

Q84. As per the PIB report, which of the following National Telemedicine Services has served more than 36 crore patients through teleconsultation by 6 April 2025?

(a) eSanjeevani
(b) mHealth
(c) T-SeHAT
(d) U-WIN

Q85. In September 2025, which company did BCCI announce as Team India's new lead sponsor?

(a) MPL Sports
(b) Byju's
(c) Dream11
(d) Apollo Tyres

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Q86. Why was the book 'Heart Lamp' considered unique in Booker history and won the International Booker Prize in 2025?

(a) First short story collection to win
(b) First biography
(c) First poetry book
(d) First children's book

Q87. Which of the following age groups is targeted under the Nurturing Aspirations through Vocational Training for Young Adolescent Girls programme, jointly launched by the Ministry of Women and Child Development and the Ministry of Skill Development and Entrepreneurship in June 2025?

(a) 12 to 16 years
(b) 16 to 18 years
(c) 18 to 21 years
(d) 10 to 14 years

Q88. Which of the following Indian states had the honour of hosting the 38^(th) National Games in 2025?

(a) Uttarakhand
(b) Goa
(c) Karnataka
(d) Maharashtra

Q89. In July 2025, the Union Environment ministry notified which of the following rules aimed at ensuring the remediation of chemically contaminated sites by those responsible for the contamination?

(a) Environment Protection (Management of Contaminated Sites) Rules, 2025
(b) Comprehensive Environmental Response, Compensation, and Liability Rules, 2025
(c) Environmental Restoration and Management (Pollution Control) Rules, 2025
(d) Hazardous Waste and Remediation Management Rules, 2025

Q90. Who among the following were the recipients of the 2025 Sakharov Prize for Freedom of Thought?

(a) Joel Mokyr and Philippe Aghion
(b) Sunil Amrith and Masaki Kashiwara
(c) Andrzej Poczobut and Mzia Amaglobeli
(d) Dr. Sonali Ghosh and Peter Howitt

Q91. In September 2025, the Supreme Court directed the Election Commission of India to treat which of the following documents as the 12^(th) valid proof of identity for inclusion in Bihar’s revised voters’ list?

(a) Aadhaar Card
(b) Employment Card
(c) Health ID
(d) PAN Card

Q92. When was the Union Budget 2025–26 presented in Parliament by Finance Minister Nirmala Sitharaman?

(a) 31 January 2025
(b) 1 February 2025
(c) 2 February 2025
(d) 3 February 2025

Q93. Which of the following telecom providers introduced the soft launch of their homegrown Quantum 5G Fixed-Wireless-Access (FWA) system in Hyderabad on 18 June 2025?

(a) Vodafone Idea
(b) Reliance Jio
(c) Bharat Sanchar Nigam Limited
(d) Bharti Airtel

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Q94. According to the Sustainable Development Report 2025, what is the percentage of seats held by women in the Indian parliament?

(a) 19.7%
(b) 13.8%
(c) 23.9%
(d) 28.2%

Q95. Where was the National Cross-Country Championships held on January 12, 2025?

(a) Rajasthan
(b) Karnataka
(c) Gujarat
(d) Uttar Pradesh

Q96. How many consecutive Australian Open titles has Jannik Sinner won as of 2025?

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

Q97. Which of the following schemes, announced by the Government of India, has a total outlay of Rs. 1 lakh crore to support high-risk, high-impact research and innovation projects across science & technology disciplines?

(a) National Science & Technology Fund
(b) Atmanirbhar Bharat R&D Programme
(c) Research, Development & Innovation Scheme
(d) Digital India Innovation Fund

Q98. Which organisation released the 'Global Risks Report, 2025', outlining geopolitical, environmental and technological threats?

(a) International Monetary Fund (IMF)
(b) World Economic Forum (WEF)
(c) Organisation for Economic Co-operation and Development (OECD)
(d) United Nations Development Programme (UNDP)

Q99. Which world champion pole-vaulter cleared 6.28 m, setting a new world record at the Stockholm Diamond League?

(a) Kurtis Marschall
(b) Mondo Duplantis
(c) Ernest John Obiena
(d) Sam Kendricks

Q100. Where was the 19^(th) India Digital Summit (IDS) 2025 held?

(a) New Delhi
(b) Chennai
(c) Ahmedabad
(d) Jaipur

ANSWER KEY

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

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61	c	62	a	63	a	64	c	65	a	66	a	67	a	68	c	69	d	70	b
71	d	72	b	73	b	74	c	75	a	76	b	77	a	78	a	79	d	80	a
81	a	82	a	83	d	84	a	85	d	86	a	87	b	88	a	89	a	90	c
91	a	92	b	93	c	94	b	95	d	96	d	97	c	98	b	99	b	100	a

SOLUTIONS

Q1. Answer: (d) Convex mirror

The correct answer is Convex mirror.

Key Points

• A convex mirror is a type of spherical mirror where the reflecting surface is curved outwards, away from the center of the sphere.

• In a convex mirror, the centre of curvature (C) and the principal focus (F) are situated behind the mirror. This is because the mirror is part of a sphere whose center lies on the non-reflecting side.

• Because the reflected rays appear to originate from a point behind the mirror, it is also known as a diverging mirror. Parallel rays of light falling on it diverge after reflection.

• The focal length of a convex mirror is always considered positive according to the New Cartesian Sign Convention.

• Regardless of the position of the object, a convex mirror always forms a virtual, erect, and diminished image.

Additional Information

• Concave Mirror (Converging Mirror):

• The reflecting surface is curved inwards, towards the center of the sphere.

• The centre of curvature (C) and focus (F) lie in front of the mirror.

• It can form both real and virtual images depending on the object's distance from the pole.

• Applications: Used in torches, search-lights, shaving mirrors, and by dentists to see large images of teeth.

• Plane Mirror:

• A plane mirror has a flat reflecting surface.

• The radius of curvature and focal length of a plane mirror are infinite.

• It forms a virtual and erect image that is the same size as the object and laterally inverted.

• Common Uses of Convex Mirrors:

• They are widely used as rear-view mirrors in vehicles because they provide a wider field of view and always produce an erect image.

• They are installed in shops and ATMs as security mirrors to monitor a large area.

• Used at blind turns on roads to help drivers see oncoming traffic from the other side.

Important Points

• Mirror Formula: The relationship between object distance (u), image distance (v), and focal length (f) is given by $1/f = 1/v + 1/u$.

• Magnification (m): For a convex mirror, the magnification is always less than 1 ($m < 1$) and is positive, indicating a diminished and erect image.

• Relationship between R and f: The radius of curvature (R) is twice the focal length (f), expressed as $R = 2f$.

• Reflection Laws: Both concave and convex mirrors obey the laws of reflection: the angle of incidence is equal to the angle of reflection, and the incident ray, reflected ray, and normal all lie in the same plane.

Q2. Answer: (d) net force (resultant force) acting on the object

The correct answer is net force (resultant force) acting on the object.

Key Points

• According to Newton's Second Law of Motion, the acceleration of an object is directly proportional to the net force acting upon it and inversely proportional to its mass.

• The mathematical representation of this law is $F = ma$, where F represents the resultant or net force, m is the mass, and a is the acceleration.

• In the case of unbalanced forces, the sum of all individual forces acting on the body is not zero. This non-zero sum is what we define as the net force.

• Because mass is a positive scalar quantity, the direction of the acceleration vector must always be identical to the direction of the net force vector. Hence, the statement in the question is satisfied by the net force.

• If multiple forces act on an object, it is not the largest individual force or the force of friction alone that determines the direction of

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acceleration, but the vector sum of all forces combined.

Additional Information

• Balanced vs. Unbalanced Forces:

• Balanced Forces: When the net force is zero, the object is in equilibrium. It will either remain at rest or continue moving at a constant velocity.

• Unbalanced Forces: When the net force is greater than zero, it always results in a change in the object's state of motion, meaning it accelerates.

• Net Force (Resultant Force):

• It is the vector sum of all the forces acting on an object. For example, if a force of 10 N acts to the right and 4 N acts to the left, the net force is 6 N to the right.

• Newton (Unit):

• The SI unit of force is the Newton (N). One Newton is defined as the force required to accelerate a 1 kg mass at a rate of 1 m/s^2.

• Inertia:

• Relating to Newton's First Law, inertia is the inherent property of a body to resist any change in its state of rest or motion. The mass of an object is a quantitative measure of its inertia.

Important Points

• Direction of Velocity vs. Acceleration: It is important to note that acceleration does not necessarily align with the initial velocity. For instance, in circular motion or when a car brakes, the acceleration direction can be perpendicular or opposite to the direction of motion.

• Friction: The force of friction usually opposes the relative motion between surfaces. While it is a component of the net force, it does not solely dictate the direction of acceleration unless it is the only unbalanced force acting on the body.

• Vector Nature: Since force and acceleration are vector quantities, they have both magnitude and direction. The direction of the resultant force is found using the parallelogram law or triangle law of vector addition.

• Mass Influence: For a constant net force, if the mass of an object is doubled, the acceleration will be halved, highlighting the inverse relationship between mass and acceleration.

Q3. Answer: (b) 5 m/s

The correct answer is 5 m/s.

Key Points

• The slope of a distance-time graph represents the speed of an object. In physics, the slope is defined as the vertical change (rise) divided by the horizontal change (run).

• For a distance-time graph, the distance is plotted on the Y-axis (vertical) and time is plotted on the X-axis (horizontal).

• In the given problem, the total distance moved by the object is 10 m and the time interval is 2 s.

• The formula to calculate the slope is: Slope = Change in Distance / Change in Time.

• By substituting the values, we get: Slope = 10 m / 2 s = 5 m/s. Hence, the calculated value is 5 m/s.

• This result tells us that the object is traveling at a constant speed of 5 meters per second if the graph is a straight line.

Additional Information

• Speed vs. Velocity:

• Speed is a scalar quantity that refers to "how fast an object is moving." It only has magnitude and is calculated as distance divided by time.

• Velocity is a vector quantity that refers to "the rate at which an object changes its position." It requires both magnitude and direction and is calculated as displacement divided by time.

• SI Units: The International System of Units (SI) unit for speed is meters per second (m/s). Other commonly used units include kilometers per hour (km/h) and miles per hour (mph).

• Types of Motion on a Graph:

• A straight line with a positive slope indicates uniform motion, meaning the object moves at a constant speed.

• A curved line indicates non-uniform motion or acceleration, where the speed of the object is changing over time.

• A horizontal line (parallel to the time axis) indicates that the slope is zero, meaning the object is at rest (speed is 0 m/s).

• Steepness: The steeper the slope of the line on a distance-time graph, the higher the speed of the object. A line closer to the time axis represents a slower speed.

Important Points

• Graphical Interpretation: To find the instantaneous speed at any point on a non-linear distance-time graph, one must draw a tangent to the curve at that specific point and calculate its slope.

• Negative Slope: On a displacement-time graph, a negative slope indicates that the object is moving back toward the starting position. However, on a distance-time graph, the slope cannot be negative because total distance covered never decreases with

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time.

• Comparison: If two lines are drawn on the same graph, the one with the higher gradient represents the object with the greater speed. For example, a line with a slope of 10 m/s is steeper than the one calculated in this question (5 m/s).

• Conversion: To convert speed from m/s to km/h, multiply the value by 3.6 (or 18/5). Therefore, 5 m/s is equivalent to 18 km/h.

Q4. Answer: (a) Photochemical decomposition of silver chloride by sunlight

The correct answer is Photochemical decomposition of silver chloride by sunlight.

Key Points

• Silver chloride (AgCl) is a white crystalline solid that is sensitive to light. When it is placed in sunlight, it undergoes a photochemical decomposition reaction.

• The sunlight provides the necessary activation energy to break the chemical bonds in the silver chloride molecule. This results in the formation of silver metal and chlorine gas.

• The white color of the salt changes to grey due to the accumulation of metallic silver particles. Hence, statement 1 is correct.

• A decomposition reaction is a process where a single compound breaks down into two or more simpler substances. When this process is triggered by photons (light), it is specifically called photolysis or photochemical decomposition.

• The chemical equation for this reaction is: 2AgCl (s) + Sunlight → 2Ag (s) + Cl2 (g). The chlorine gas evolved during the process typically escapes into the atmosphere.

Additional Information

• Silver Bromide (AgBr): Similar to silver chloride, silver bromide also undergoes photochemical decomposition. It changes from a pale yellow color to grey when exposed to light.

• Applications in Photography: These reactions of silver halides (silver chloride and silver bromide) were the fundamental basis for black and white photography. The light falling on the photographic film would decompose the silver salts to create an image.

• Storage Requirements: Because of their high sensitivity to light, silver salts are always stored in dark-colored or amber-colored bottles. This prevents sunlight from reaching the chemicals and causing premature decomposition.

• Types of Decomposition Reactions:

• Thermal Decomposition: Triggered by heat energy (e.g., heating calcium carbonate to get calcium oxide).

• Electrolytic Decomposition: Triggered by electrical energy (e.g., electrolysis of water to get hydrogen and oxygen).

• Photolytic Decomposition: Triggered by light energy (e.g., decomposition of AgCl or H2O2).

Important Points

• Incorrect Options Analysis:

• Combination reaction: This involves two substances joining to form one. Silver chloride is breaking down, not combining with oxygen. Hence, statement 2 is incorrect.

• Thermal decomposition: While heat is a form of energy, the specific change in silver chloride color in the presence of sunlight is categorized under photochemical processes because it responds to the visible/UV spectrum of light rather than ambient heat. Hence, statement 3 is incorrect.

• Displacement reaction: This occurs when a more reactive element displaces a less reactive one from its compound. Oxygen and water do not displace chlorine from silver chloride in this context. Hence, statement 4 is incorrect.

• Observation: The grey color is the most distinct physical evidence of the chemical change occurring, indicating that pure silver has been liberated from the compound.

Q5. Answer: (c) Na2CO3

The correct answer is Na2CO3.

Key Points

• The chemical formula of Sodium Carbonate is Na2CO3. It is an inorganic compound.

• It is composed of two Sodium (Na) atoms, one Carbon (C) atom, and three Oxygen (O) atoms.

• The formation of the formula is based on the valency of the constituent ions. The Sodium ion has a valency of +1 (Na+), while the Carbonate ion has a valency of -2 (CO3^2-). To balance the charges, two sodium ions are required for every one carbonate ion, resulting in Na2CO3.

• Option 1 (Na3CO3) is incorrect because the ratio of sodium to carbonate does not satisfy the valency requirements. Hence, statement 1 is incorrect.

• Option 2 (Na3CO2) is incorrect as it does not represent a stable or known chemical compound of sodium and carbon. Hence, statement 2 is incorrect.

• Option 3 (Na2CO3) is the correct chemical representation of sodium carbonate. Hence, statement 3 is correct.

• Option 4 (Na3CO4) is incorrect because it violates the chemical bonding rules of sodium and the carbonate group. Hence, statement 4 is incorrect.

Additional Information

• Common Names: Sodium carbonate is widely known as Soda Ash, Washing Soda, or Soda Crystals.

• Physical Properties: It is a white, crystalline solid that is odorless and highly soluble in water. It forms an alkaline solution when dissolved.

• Molar Mass: The molar mass of anhydrous sodium carbonate is approximately 105.988 g/mol.

• Industrial Production: It is primarily produced through the Solvay Process, which uses Sodium Chloride (NaCl), Ammonia (NH_3), and Carbon Dioxide (CO_2) as raw materials.

• Uses:

• Used extensively in the manufacture of glass, where it acts as a flux to lower the melting point of silica.

• Used in the production of soaps and detergents as a builder.

• Applied as a water softener to remove temporary and permanent hardness by precipitating calcium and magnesium ions.

• Used in the paper industry and in textile processing.

Important Points

• Hydrates: Sodium carbonate exists in different hydrated forms. The decahydrate ($Na_2CO_3 \cdot 10H_2O$) is the most common form, known as Washing Soda. Other forms include the monohydrate ($Na_2CO_3 \cdot H_2O$) and the anhydrous form (Soda Ash).

• Distinction: It should not be confused with Sodium Bicarbonate ($NaHCO_3$), which is commonly known as Baking Soda. Sodium bicarbonate contains a hydrogen atom and has different chemical properties and uses.

• Safety: While generally safe for industrial use, it is considered a mild irritant to the eyes and respiratory tract.

Q6. Answer: (d) Power

The correct answer is Power.

Key Points

• Power is defined as the rate of doing work or the rate at which energy is transferred or transformed. In this scenario, while both girls perform the same amount of work, the time taken differs, which directly affects the power output.

• The formula for Power is Power (P) = Work (W) / Time (t). This indicates that power is inversely proportional to time when the work done is constant.

• For Girl A, the work done is 3200 J and the time taken is 20 s. Her power output is calculated as 3200 / 20 = 160 Watts.

• For Girl B, the work done is 3200 J and the time taken is 50 s. Her power output is calculated as 3200 / 50 = 64 Watts.

• Since the total work done (3200 J) is identical for both, the difference in their performance—where Girl A completes the task faster than Girl B—is specifically characterized by their Power. Hence, the correct answer is Power.

Additional Information

• SI Unit of Power: The standard unit of power is the Watt (W), which is equivalent to one Joule per second (1 J/s). It is named after the Scottish inventor James Watt.

• Scalar Quantity: Power is a scalar quantity because it only has magnitude and no specific direction. It depends only on the magnitude of work and the time interval.

• Work and Energy: Work is the product of force and displacement in the direction of the force. In this question, both girls consumed 3200 J of energy to perform the task, but the "speed" of that energy consumption is what defines power.

• Gravitational Force: This is the force of attraction between two masses. While the girls are working against gravity to climb the rope, the gravitational force acting on them depends on their mass and the acceleration due to gravity (9.8 m/s^2), not the time taken.

• Total Displacement: This refers to the change in position. Since both are climbing the same rope to the same height, their total displacement is equal and does not explain the difference in performance over time.

• Dimensional Formula: The dimensional formula for power is $[M^1 L^2 T^{-3}]$. This is derived from the dimensions of work $[M^1 L^2 T^{-2}]$ divided by time [T].

• Commercial Unit: While Watt is the SI unit, Horsepower (hp) is often used in the automotive and engineering industries. 1 hp is approximately equal to 746 Watts.

Q7. Answer: (d) 320 m/s

The correct answer is 320 m/s.

Key Points

• The relationship between the speed, frequency, and wavelength of a wave is given by the formula: Speed (v) = Frequency (f) × Wavelength (λ).

• In this question, the frequency (f) of the sound wave is provided as 1600 Hz. Frequency represents the number of complete wave cycles that pass a point in one second.

• The wavelength (λ) is given as 0.2 m. Wavelength is defined as the distance between two successive identical parts of a wave, such as two consecutive compressions or rarefactions in a sound wave.

• By substituting the given values into the formula: Speed = 1600 Hz × 0.2 m. Hence, the calculation yields a result of 320 m/s.

• Therefore, the speed of the wave is 320 m/s, which corresponds to the correct option provided. Hence, the statement regarding the speed being 320 m/s is correct.

Additional Information

• Sound Waves: These are longitudinal mechanical waves that travel through a medium by causing the particles of the medium to vibrate parallel to the direction of wave propagation. Because they are mechanical, they cannot travel through a vacuum.

• Frequency and Audibility: The SI unit of frequency is Hertz (Hz), named after Heinrich Rudolf Hertz. The human ear can typically hear sounds with frequencies ranging from 20 Hz to 20,000 Hz. Since this wave has a frequency of 1600 Hz, it falls within the audible range.

• Speed in Different Media: The speed of sound depends on the elasticity and density of the medium. Sound travels fastest in solids (e.g., Steel at approx 5960 m/s), followed by liquids (e.g., Water at approx 1480 m/s), and slowest in gases (e.g., Air at approx 343 m/s at 20 degrees Celsius).

• Effect of Temperature: The speed of sound in a gas is directly proportional to the square root of the absolute temperature. For every 1 degree Celsius rise in temperature, the speed of sound in air increases by approximately 0.61 m/s.

• Wavelength Measurement: In longitudinal waves like sound, the wavelength is measured as the distance between the centers of two consecutive compressions (regions of high pressure) or two consecutive rarefactions (regions of low pressure).

Important Points

• Time Period: The time taken for one complete cycle of a wave is called the Time Period (T). It is the reciprocal of frequency (T = 1/f). For a 1600 Hz wave, the time period would be 0.000625 seconds.

• Unit Consistency: When calculating wave speed, it is vital to ensure units are in the SI system. Frequency should be in Hertz (1/s) and wavelength in meters (m) to result in speed in meters per second (m/s).

• Pitch and Loudness: The pitch of a sound is determined by its frequency (higher frequency means higher pitch), while the loudness is determined by the amplitude of the wave.

Q8. Answer: (b) Having multiple unprotected sexual partners

The correct answer is Having multiple unprotected sexual partners.

Key Points

• HIV (Human Immunodeficiency Virus) is primarily transmitted through specific body fluids, and the risk of infection is directly tied to high-risk behaviors.

• Having multiple unprotected sexual partners significantly increases the likelihood of coming into contact with an HIV-positive individual. Even if one specific partner is healthy, engaging with others without protection allows the virus to be transmitted through semen, vaginal fluids, or blood. Hence, statement 2 is correct.

• The use of sterilized needles is a safety measure that prevents the transmission of blood-borne pathogens, including HIV and Hepatitis B. Using clean needles eliminates the risk associated with intravenous drug use or medical procedures. Hence, statement 1 is incorrect.

• Having protected sex, which typically involves the consistent and correct use of latex condoms, provides a highly effective physical barrier that prevents the exchange of infectious fluids. Hence, statement 3 is incorrect.

• Maintaining a healthy diet is beneficial for the overall immune system and general well-being, but it provides no biological protection against the entry of a virus if a person is exposed through high-risk activities. Hence, statement 4 is incorrect.

Additional Information

• Understanding HIV/AIDS:

• HIV is a retrovirus that attacks the CD4 cells (T cells) of the immune system. If left untreated, it can lead to AIDS (Acquired Immunodeficiency Syndrome), where the body can no longer fight off opportunistic infections.

• The virus was first clinically observed in the United States in 1981, and it has since become a global health concern.

• Modes of Transmission:

• Common routes include unprotected vaginal or anal intercourse, sharing contaminated needles, and mother-to-child transmission during pregnancy, birth, or breastfeeding.

• It is not transmitted through casual contact like hugging, shaking hands, sharing food, or through saliva, sweat, or tears.

• Prevention and Treatment:

• PrEP (Pre-Exposure Prophylaxis) is a daily medicine taken by people at high risk for HIV to prevent getting the virus.

• ART (Antiretroviral Therapy) is the standard treatment for managing the infection. While it is not a cure, it can reduce the viral load to undetectable levels, preventing further transmission.

• In India, the National AIDS Control Organisation (NACO), established in 1992, leads the country's response to the epidemic through the National AIDS Control Programme (NACP).

Important Points

• Testing and Diagnosis:

• The ELISA (Enzyme-Linked Immunosorbent Assay) test is commonly used for initial screening, followed by a Western Blot test

for confirmation.

• The Window Period refers to the time after exposure when a person is infected but the test may still show a negative result because antibodies have not yet developed to detectable levels.

• Global Awareness:

• World AIDS Day is observed annually on December 1st to raise awareness and mourn those who have died from the disease.

• The Red Ribbon is the universal symbol of awareness and support for people living with HIV.

Q9. Answer: (d) To reduce feed consumption and improve meat yield

The correct answer is To reduce feed consumption and improve meat yield.

Key Points

• The primary benefit of developing dwarf broiler parents in the poultry industry is to significantly reduce feed consumption while maintaining high meat yield in the offspring.

• Dwarfism in poultry is typically managed through a sex-linked recessive gene known as the dw gene. When this gene is incorporated into the female parent line, it results in birds that are 25% to 30% smaller in body weight than normal broiler breeders.

• Because of their smaller physical stature, these dwarf hens require much less maintenance energy, leading to a 20% to 25% reduction in the amount of feed needed to sustain them. Hence, statement 4 is correct.

• Developing birds for flight ability or rain resistance is not a priority in commercial meat production, as broilers are kept in controlled environments to maximize weight gain. Hence, statements 1 and 2 are incorrect.

• While dwarf parents are smaller, they are specifically bred to be mated with normal-sized males. This ensures that the commercial progeny (the broilers) grow to a full, standard size with excellent meat-to-bone ratios.

• Dwarf birds often produce slightly smaller eggs initially compared to standard hens, so the goal is not to "lay larger eggs" but to improve the efficiency of egg production per unit of feed. Hence, statement 3 is incorrect.

Additional Information

• Genetic Mechanism: The dw gene is located on the Z chromosome. It affects the bird's metabolism by reducing the plasma levels of Insulin-like Growth Factor-I (IGF-I), which results in shorter shank length and smaller body size without affecting general health.

• Economic Efficiency: In poultry farming, feed costs account for approximately 60% to 70% of total production expenses. By using dwarf maternal lines, breeders can lower the cost of producing day-old chicks.

• Stocking Density: Because dwarf broiler parents are smaller, farmers can maintain a higher stocking density in poultry houses. This means more birds can be reared in the same square footage, optimizing the use of infrastructure and labor.

• Environmental Adaptability: Dwarf poultry often exhibit better heat tolerance. This is particularly advantageous in tropical countries like India, where high temperatures can cause heat stress in larger, heavier birds.

• Reproductive Performance: Dwarf hens are known for having fewer reproductive disorders (such as double-yolk eggs or internal laying) compared to standard heavy-weight broiler breeders, leading to more viable hatching eggs over the bird's lifespan.

Important Points

• FCR (Feed Conversion Ratio): The use of dwarf parents improves the overall biological efficiency of the breeding operation, making the poultry supply chain more sustainable.

• Meat Quality: The offspring of dwarf mothers and normal fathers do not carry the dwarf trait (if the father is homozygous normal), ensuring the final broiler reaches market weight of 2.0 to 2.5 kg within 35 to 42 days.

• Global Usage: Major international breeding companies use dwarf female lines to cater to markets where feed prices are high or housing space is limited.

Q10. Answer: (c) alcohol and acid in acidic medium

The correct answer is alcohol and acid in acidic medium.

Key Points

• Esterification is a chemical reaction that results in the formation of at least one ester. This typically occurs when a carboxylic acid reacts with an alcohol.

• The reaction requires an acidic medium to proceed effectively. This is usually achieved by adding a few drops of a mineral acid, most commonly concentrated sulfuric acid (H_2SO_4) or dry hydrogen chloride gas (HCl). Hence, statement 3 is correct.

• In this reaction, the acid catalyst serves a vital role by protonating the carbonyl oxygen of the carboxylic acid, which increases the electrophilicity of the carbonyl carbon and facilitates the nucleophilic attack by the alcohol molecule.

• Reaction in a basic medium (Option 1) generally leads to saponification (hydrolysis of the ester) rather than its formation. Hence, statement 1 is incorrect.

• Reaction with an aldehyde (Option 2) produces acetals or hemiacetals, not esters. Hence, statement 2 is incorrect.

• The reaction is significantly influenced by temperature and concentration rather than low pressure (Option 4), as these are

liquid-phase reactions. Hence, statement 4 is incorrect.

Additional Information

• Nature and Uses of Esters:

• Esters are volatile liquids or solids with characteristic sweet, fruity smells.

• Because of their pleasant aroma, they are widely used in the manufacture of perfumes, artificial flavorings for sweets and drinks, and cosmetics.

• They also serve as important industrial solvents for nitrocellulose, fats, and oils.

• Chemical Formula:

• The functional group of an ester is -COOR, and the general formula is RCOOR', where R and R' are organic alkyl or aryl groups.

• A common example is Ethyl Acetate ($CH_3COOC_2H_5$), formed from Acetic acid and Ethanol.

• Reversibility:

• The esterification reaction is reversible. This means the ester and water can react back to form the original alcohol and carboxylic acid in a process called hydrolysis.

Important Points

• Role of Concentrated H_2SO_4:

• In the laboratory preparation of esters, concentrated H_2SO_4 acts as both a catalyst and a dehydrating agent.

• By removing the water molecules produced during the reaction, it prevents the reverse reaction and shifts the equilibrium toward the right, increasing the yield of the ester according to Le Chatelier's Principle.

• Saponification:

• When an ester is heated with a strong base like Sodium Hydroxide (NaOH), it breaks down into alcohol and the sodium salt of the carboxylic acid. This reaction is the basis for soap production.

• Fischer Esterification:

• This specific method of forming esters by refluxing a carboxylic acid and an alcohol with an acid catalyst is known as Fischer-Speier esterification, named after Emil Fischer and Arthur Speier who described it in 1895.

Q11. Answer: (a) it connects and transports material throughout the body

The correct answer is it connects and transports material throughout the body.

Key Points

• Blood is classified as a fluid connective tissue because it shares the same embryological origin (the mesoderm) as other connective tissues like bone and cartilage.

• It serves as a vital link between different organ systems, effectively connecting all parts of the body by circulating through the cardiovascular system.

• The primary function of blood is the transportation of respiratory gases (Oxygen and Carbon Dioxide), nutrients (like glucose and amino acids), hormones, and waste products (like urea) to and from various tissues. Hence, option 1 is correct.

• Unlike other connective tissues that have a solid or semi-solid matrix, blood possesses a liquid matrix called plasma, in which living cells are suspended.

• Statement 2 is incorrect because blood is found within blood vessels (arteries, veins, and capillaries) distributed throughout the entire body, not just in muscles. Hence, statement 2 is incorrect.

• Statement 3 is incorrect because while ligaments and tendons support bones, blood does not provide mechanical support to the skeletal structure; rather, it provides metabolic support. Hence, statement 3 is incorrect.

• Statement 4 is a physical characteristic, but the red color (caused by hemoglobin in RBCs) is not the biological reason for its classification as a connective tissue. Hence, statement 4 is incorrect.

Additional Information

• Composition of Blood:

• Plasma: This makes up about 55% of the total blood volume. It is a straw-colored liquid consisting of 90-92% water, proteins (like fibrinogen, globulins, and albumin), and electrolytes.

• Formed Elements: These constitute the remaining 45% and include Erythrocytes (Red Blood Cells), Leukocytes (White Blood Cells), and Thrombocytes (Platelets).

• Physical Properties:

• The pH of human blood is slightly alkaline, ranging between 7.35 and 7.45.

• In a healthy adult male, the average volume of blood is approximately 5 to 6 liters, while in females, it is about 4 to 5 liters.

• Functions of Blood:

• Protection: White Blood Cells (WBCs) provide immunity by fighting pathogens, and platelets facilitate blood clotting (coagulation) to prevent excessive blood loss during injury.

• Regulation: Blood helps in thermoregulation by distributing heat throughout the body and maintains osmotic balance and pH

levels.

Important Points

• Types of Connective Tissue:

• Loose Connective Tissue: Examples include Areolar and Adipose tissues located under the skin.

• Dense Connective Tissue: Includes Tendons (connecting muscle to bone) and Ligaments (connecting bone to bone).

• Specialized Connective Tissue: This category includes Skeletal tissues (Bone and Cartilage) and Fluid tissues (Blood and Lymph).

• Haematopoiesis: The process of formation of blood cells is called haematopoiesis, which primarily occurs in the red bone marrow of adults.

• Hemoglobin: A complex protein containing iron that gives blood its red color and allows for the efficient transport of oxygen from the lungs to the tissues.

Q12. Answer: (a) 25 m/s

The correct answer is 25 m/s.

Key Points

• The calculation of the final velocity of an object moving under the influence of gravity can be determined using the First Equation of Motion, which is $v = u + at$.

• In this specific problem, the stone is thrown downward, which means the acceleration (a) is equal to the acceleration due to gravity (g), and it acts in the same direction as the initial motion.

• The initial velocity (u) is given as 5 m/s.

• The time (t) duration for which the stone falls is 2 seconds.

• The acceleration due to gravity (g) is provided as 10 m/s^2.

• Substituting these values into the formula: $v = 5 + (10 \times 2)$.

• Performing the multiplication first: $10 \times 2 = 20$. Then, adding the initial velocity: $5 + 20 = 25$ m/s.

• Thus, the final velocity (v) of the stone after 2 seconds is 25 m/s.

Additional Information

• Equations of Motion:

• There are three fundamental equations of motion for an object moving with uniform acceleration.

• First Equation: $v = u + at$ (Relates velocity and time).

• Second Equation: $s = ut + 0.5at^2$ (Relates displacement and time).

• Third Equation: $v^2 = u^2 + 2as$ (Relates velocity and displacement).

• Initial and Final Velocity:

• Initial Velocity (u) is the velocity of the object at time t = 0. If an object starts from rest, u = 0.

• Final Velocity (v) is the velocity attained by the object after a specific time interval or after covering a certain distance.

• Acceleration due to Gravity (g):

• On Earth, the average value of g is approximately 9.8 m/s^2, though it is often rounded to 10 m/s^2 in numerical problems for ease of calculation.

• It is a vector quantity that always points towards the center of the Earth.

Important Points

• Sign Convention: When solving physics problems involving gravity, it is crucial to maintain a consistent sign convention. If the downward direction is taken as positive, then both u and g are positive. If upward is positive, then g is -10 m/s^2.

• Uniform Acceleration: These equations only apply when acceleration is constant. In the case of free-falling objects near the Earth's surface (ignoring air resistance), gravity provides a nearly uniform acceleration.

• Unit Consistency: Always ensure that units are consistent. In this problem, velocity is in m/s, time is in seconds, and acceleration is in m/s^2, which are all SI units.

• Kinematics: This branch of mechanics describes the motion of points, bodies, and systems without considering the forces that cause the motion.

Q13. Answer: (b) Catenation and tetravalency

The correct answer is Catenation and tetravalency.

Key Points

• Catenation is the unique property of Carbon atoms to form bonds with other atoms of carbon, resulting in the formation of large molecules, long chains, branched chains, or cyclic structures. This ability allows carbon to form an almost infinite variety of compounds.

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• Tetravalency refers to the fact that carbon has four valence electrons in its outermost shell. This allows it to form four covalent bonds with other carbon atoms or atoms of other monovalent elements like Hydrogen, Oxygen, Nitrogen, and Sulfur. Hence, the statement regarding catenation and tetravalency is correct.

• The bond strength of carbon-carbon bonds is exceptionally high, which makes the resulting compounds very stable. This stability is due to the small size of the carbon atom, which enables the nucleus to hold the shared pairs of electrons firmly.

• Carbon can form multiple bonds, including single, double, and triple bonds, with itself and other atoms, further increasing the diversity of the chemical structures it can create.

• Unlike carbon, elements like Silicon show catenation only up to 7 or 8 atoms, but these compounds are highly reactive and unstable compared to carbon compounds.

Additional Information

• Organic Chemistry: This is the branch of chemistry dedicated to the study of Carbon-based compounds. Originally, it was thought these could only be produced by living organisms, but the synthesis of Urea by Friedrich Wöhler in 1828 proved otherwise.

• Allotropes of Carbon: Carbon exists in various forms in nature with different physical properties but similar chemical properties.

• Diamond: A rigid three-dimensional structure where each carbon is bonded to four others, making it the hardest known natural substance.

• Graphite: Formed by hexagonal arrays in layers, where carbon is bonded to three others. It is a good conductor of electricity and acts as a lubricant.

• Fullerenes: Such as C-60 (Buckminsterfullerene), which are shaped like footballs.

• Hydrocarbons: These are compounds consisting entirely of Hydrogen and Carbon.

• Saturated Hydrocarbons (Alkanes): Contain only single bonds (e.g., Methane, Ethane).

• Unsaturated Hydrocarbons (Alkenes and Alkynes): Contain double or triple bonds.

Important Points

• Atomic Number: Carbon has an atomic number of 6 and its electronic configuration is 2, 4.

• Atomic Mass: The most common isotope of carbon has an atomic mass of 12. Carbon is not considered to have a "high atomic mass" or "large size," which makes Option 1 incorrect.

• Noble Gas Reactivity: Carbon does not typically react with noble gases like Helium or Neon because noble gases are chemically inert. Thus, Option 3 is incorrect.

• Ionic vs Covalent: Carbon predominantly forms covalent bonds by sharing electrons rather than ionic bonds. This is because removing four electrons or gaining four electrons would require a massive amount of energy or be energetically unstable due to inter-electronic repulsion. Therefore, Option 4 is incorrect.

• Isomerism: Carbon compounds frequently exhibit isomerism, where compounds have the same molecular formula but different structural arrangements, leading to different properties.

Q14. Answer: (c) a homogeneous mixture

The correct answer is a homogeneous mixture.

Key Points

• Brass is an alloy, which is scientifically classified as a solid-solid solution. It is formed by the physical mixing of two or more metals.

• It is considered a homogeneous mixture because its chemical composition and physical properties are uniform throughout the sample, meaning you cannot see the individual components with the naked eye or a microscope.

• The primary constituents of brass are copper (Cu) and zinc (Zn). Typically, copper acts as the solvent (around 60% to 90%) and zinc acts as the solute (around 10% to 40%).

• Unlike compounds, the components of a mixture like brass are not chemically bonded in a fixed ratio; the proportions of copper and zinc can be varied to create different types of brass with specific properties.

• Since it consists of more than one type of atom that are not chemically unified, it cannot be classified as an element or a compound.

Additional Information

• Classification of Matter:

• Elements: These are pure substances consisting of only one type of atom. Examples include Iron (Fe), Gold (Au), and Silver (Ag).

• Compounds: These are substances formed when two or more elements are chemically combined in a fixed proportion by mass. Examples include Water (H2O) and Sodium Chloride (NaCl).

• Mixtures: These contain two or more substances physically mixed together. They can be homogeneous (uniform, like air or vinegar) or heterogeneous (non-uniform, like muddy water or a salad).

• Alloys:

• An alloy is a homogeneous mixture of a metal with other metals or non-metals to enhance properties like strength, hardness, or corrosion resistance.

• Bronze: Another common alloy consisting primarily of copper and tin (Sn).

• Steel: An alloy of iron (Fe) and a small percentage of carbon (C).

• Properties and Uses of Brass:

• Brass is known for its malleability, durability, and low friction.

• It has unique acoustic properties, making it the preferred material for musical instruments such as trumpets, trombones, and saxophones.

• Due to its gold-like appearance and resistance to corrosion, it is extensively used in decorative items, plumbing fixtures, door locks, and electrical terminals.

Important Points

• In chemistry, all alloys are considered mixtures because their constituents can be separated by physical means (such as melting and fractional crystallization) and they show the properties of their constituent elements.

• A homogeneous mixture is also called a solution. While we often think of solutions as liquids, brass is a classic example of a solid solution.

Q15. Answer: (a) C3H4

The correct answer is C3H4.

Key Points

• Alkynes are a category of unsaturated hydrocarbons that contain at least one carbon-carbon triple bond. They are characterized by the general chemical formula CnH2n-2, where n represents the number of carbon atoms in the molecule.

• C3H4: According to the alkyne formula, if n = 3, the number of hydrogen atoms is 2(3) - 2 = 4. This molecule is known as Propyne (also called methylacetylene), which features a triple bond between two carbon atoms. Hence, statement 1 is correct.

• C2H4: This compound follows the general formula CnH2n, which identifies it as an alkene. For n = 2, the hydrogen count is 2(2) = 4. This specific compound is Ethene (commonly known as ethylene), containing a double bond. Hence, statement 2 is incorrect.

• C3H8: This compound corresponds to the general formula CnH2n+2, which is the signature of alkanes. With n = 3, the hydrogen atoms amount to 2(3) + 2 = 8. This molecule is Propane, which is a saturated hydrocarbon with only single bonds. Hence, statement 3 is incorrect.

• C6H6: This is the chemical formula for Benzene. Benzene is a cyclic aromatic hydrocarbon and does not belong to the simple acyclic alkyne series. It has a hexagonal ring structure with delocalized pi electrons. Hence, statement 4 is incorrect.

Additional Information

• Aliphatic Hydrocarbons: These are organic compounds composed of carbon and hydrogen. They are classified into three main types based on the type of chemical bonds present: alkanes, alkenes, and alkynes.

• Nomenclature: According to IUPAC rules, the names of alkynes end with the suffix -yne. The simplest alkyne is Ethyne (C2H2), which is industrialy known as Acetylene.

• Saturated vs Unsaturated: Saturated hydrocarbons (alkanes) contain only single covalent bonds and hold the maximum number of hydrogen atoms. Unsaturated hydrocarbons (alkenes and alkynes) contain double or triple bonds, meaning they can react further with other elements like hydrogen in a process called hydrogenation.

• Reactivity: Due to the presence of the triple bond, alkynes are generally more chemically reactive than alkanes. They undergo addition reactions where atoms are added across the triple bond to form alkenes or alkanes.

• Hybridization: In the alkyne group, the carbon atoms involved in the triple bond undergo sp hybridization. This results in a linear molecular geometry with a bond angle of 180 degrees.

Important Points

• Physical State: Lower members of the alkyne series, such as Ethyne, Propyne, and Butyne, exist as colorless gases at room temperature and standard pressure.

• Applications: The most significant alkyne, Ethyne, is widely used in gas welding and cutting torches (oxy-acetylene flame) because its combustion generates an extremely high temperature of nearly 3300 degrees Celsius.

• Homologous Series: Members of the alkyne group form a homologous series where each successive member differs by a CH2 unit and has a difference in molecular mass of 14 units.

• Propyne (C3H4): It is used as a rocket fuel component and as a precursor in the synthesis of various organic chemicals. It is also known to be a byproduct in the production of propane.

Q16. Answer: (c) O3

The correct answer is O3.

Key Points

• A molecule of a compound is defined as a chemical species formed by the combination of atoms of two or more different

elements in a fixed proportion by mass.

• HCl (Hydrogen Chloride): This molecule consists of one atom of Hydrogen and one atom of Chlorine. Since it contains two different elements, it is classified as a molecule of a compound. Hence, statement 1 is incorrect in the context of the "NOT" question.

• NH3 (Ammonia): This molecule is composed of one Nitrogen atom and three Hydrogen atoms. Because it is formed by different elements, it is a molecule of a compound. Hence, statement 2 is incorrect.

• O3 (Ozone): Ozone is a triatomic molecule consisting of three atoms of the same element, which is Oxygen. Molecules that contain only one type of atom are called homoatomic molecules and represent an element, not a compound. Hence, statement 3 is correct.

• CH4 (Methane): This molecule contains one Carbon atom and four Hydrogen atoms. As it involves different chemical elements bonded together, it is a molecule of a compound. Hence, statement 4 is incorrect.

• In summary, for a substance to be a compound, it must be heteroatomic (composed of different kinds of atoms). O3 is homoatomic, making it a molecule of an element.

Additional Information

• Molecules vs. Compounds:

• A molecule is the smallest particle of a substance (element or compound) that can exist independently.

• All compounds are molecules, but not all molecules are compounds. For example, H2, N2, and P4 are molecules but they are elements.

• Ozone (O3):

• It is an allotrope of oxygen that is much less stable than the diatomic O2.

• In the stratosphere (about 10 to 50 kilometers above Earth), the ozone layer absorbs 97 to 99 percent of the Sun's medium-frequency ultraviolet light.

• It has a distinct pungent smell and is a powerful oxidizing agent.

• Ammonia (NH3):

• It is a colorless gas with a characteristic pungent smell.

• It is primarily produced through the Haber-Bosch process and is a vital component in the manufacture of fertilizers like urea.

• Methane (CH4):

• Known as Marsh Gas or Swamp Gas, it is the simplest alkane and the main constituent of natural gas.

• It is a significant greenhouse gas with a high global warming potential compared to carbon dioxide.

• Hydrogen Chloride (HCl):

• In its gaseous form, it is HCl, and when dissolved in water, it forms Hydrochloric Acid.

• It is a strong corrosive acid used extensively in industrial processes and is also found in gastric acid in the human digestive system.

Important Points

• Atomicity: This refers to the total number of atoms present in a molecule. HCl has an atomicity of 2 (diatomic), NH3 has 4 (tetraatomic), O3 has 3 (triatomic), and CH4 has 5 (pentaatomic).

• Chemical Bonding: Compounds like CH4 and NH3 are held together by covalent bonds, where atoms share valence electrons to achieve stability.

• Classification of Matter: Matter is divided into Pure Substances (Elements and Compounds) and Mixtures. O3 is a pure substance categorized as an element, while HCl, NH3, and CH4 are pure substances categorized as compounds.

Q17. Answer: (a) It depends only on the nature and temperature of the material

The correct answer is It depends only on the nature and temperature of the material.

Key Points

• Resistivity, also known as specific electrical resistance, is an intrinsic property of a material that quantifies how strongly it opposes the flow of electric current.

• The resistivity of a material depends only on the nature of the material and its temperature. It does not depend on the physical dimensions such as length or cross-sectional area. Hence, statement 1 is correct.

• The resistance (R) of a conductor is proportional to its length (L) and inversely proportional to its cross-sectional area (A), expressed as $R = \rho (L/A)$, where ρ (rho) is the resistivity. While resistance changes with area, the resistivity constant remains the same for a specific material at a constant temperature. Hence, statement 2 is incorrect.

• Since resistivity is a material constant, it does not change with the shape or size of the conductor. Whether the material is shaped into a thin wire or a thick block, its resistivity remains identical. Hence, statement 3 is incorrect.

• Resistivity is independent of the length of the conductor. If the length of a wire is doubled, its resistance will double, but its resistivity will remain unchanged because it is a characteristic of the substance itself. Hence, statement 4 is incorrect.

Additional Information

• SI Unit and Symbol:

• The SI unit of resistivity is the Ohm-meter (Ω?m).

• It is represented by the Greek letter ρ (rho).

• Classification of Materials:

• Conductors: Materials like Silver and Copper have very low resistivity, typically in the range of 10^-8 Ω?m. Silver is known to have the lowest resistivity (approx 1.59 × 10^-8 Ω?m) at 20°C.

• Insulators: Materials like Glass, Rubber, and Ebonite have high resistivity, ranging from 10^12 to 10^17 Ω?m.

• Semiconductors: Materials like Silicon and Germanium have resistivity levels between those of conductors and insulators.

• Temperature Effect:

• For metals, resistivity generally increases with an increase in temperature because thermal vibrations of atoms interfere with the flow of electrons.

• For semiconductors and insulators, resistivity usually decreases as temperature increases because more charge carriers become available for conduction.

• Alloys:

• The resistivity of an alloy (like Constantan or Manganin) is generally higher than that of its constituent metals.

• Alloys do not oxidize (burn) readily at high temperatures, which is why they are used in electrical heating devices like toasters and electric irons.

Important Points

• The distinction between resistance and resistivity is crucial: Resistance is a property of the specific object (depending on size and shape), whereas resistivity is a property of the substance.

• In the year 1827, Georg Simon Ohm published his discovery of the relationship between current, voltage, and resistance, which eventually led to the definition of resistivity.

• Factors affecting Resistance: Length, Area of cross-section, Nature of material, and Temperature.

• Factors affecting Resistivity: Only Nature of material and Temperature.

Q18. Answer: (c) Both statements A and B

The correct answer is Both statements A and B.

Key Points

• In sexual reproduction in plants, fertilisation occurs when the pollen grain (male gamete) fuses with the egg cell (female gamete) inside the ovule.

• Once fertilisation is complete, the resulting single cell is called a zygote. This zygote undergoes repeated mitotic divisions to form a multicellular structure known as the embryo within the ovule. Hence, statement A is correct.

• Simultaneously, the ovule undergoes several changes to protect the developing embryo. The integuments (outer layers) of the ovule harden and develop into a tough coat, commonly known as the seed coat.

• As this tough coat develops, the ovule is gradually converted into a seed, which contains the embryo and often a food supply. Hence, statement B is correct.

• The seed serves as the unit of dispersal and survival, capable of remaining dormant until environmental conditions are favorable for germination.

Additional Information

• Double Fertilisation:

• In Angiosperms (flowering plants), a unique process called double fertilisation occurs. One male gamete fuses with the egg to form the zygote (syngamy), while the second male gamete fuses with two polar nuclei to form the triploid primary endosperm nucleus (triple fusion).

• The endosperm provides essential nutrients to the developing embryo during its growth phase within the seed.

• Fruit Development:

• While the ovule is transforming into a seed, the ovary of the flower begins to ripen and enlarge.

• The ovary wall becomes the pericarp (fruit wall), and the entire ovary develops into a fruit. Other floral parts like sepals, petals, and stamens usually wither and fall off.

• Seed Structure:

• A typical seed consists of the embryo, cotyledons (seed leaves), and the seed coat.

• The embryo consists of the radicle, which eventually develops into the root system, and the plumule, which gives rise to the shoot system.

Important Points

• Pollination: This is the pre-fertilisation step where pollen grains are transferred from the anther to the stigma. This can occur via

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wind, water, or biological agents like bees and butterflies.

• Zygote to Embryo Transition: The transition involves differentiation, where cells become specialized to form the various organs of the young plant.

• Significance of Seeds: The tough coat mentioned in Statement B is vital for protecting the plant progeny from desiccation, mechanical injury, and pathogens.

Q19. Answer: (d) Sclerenchyma is the most common simple permanent tissue

p-data-start="0">The correct answer is Sclerenchyma is the most common simple permanent tissue.

Key Points

• Simple permanent tissues are a group of cells that are similar in origin, structure, and function. They are primarily classified into three types: Parenchyma, Collenchyma, and Sclerenchyma.

• These tissues are typically found a few layers beneath the epidermis in plant organs such as stems and roots. For instance, the hypodermis and cortex are often composed of these tissues. Hence, statement 1 is correct.

• One of the primary functions of simple permanent tissue, specifically Parenchyma, is food storage. These cells contain large vacuoles and may store nutrients in the form of starch, oils, or proteins. Hence, statement 2 is correct.

• Simple permanent tissues like Parenchyma and Collenchyma are generally composed of living cells with thin or marginally thickened primary cell walls and active protoplasm. Hence, statement 3 is correct.

• Parenchyma is the most common and fundamental simple permanent tissue found in plants, forming the bulk of the plant body. Sclerenchyma, while important for structural support, is specialized and not the most abundant or common. Hence, statement 4 is incorrect.

Additional Information

• Parenchyma:

• These are living cells that are usually isodiametric in shape.

• They have thin cell walls made of cellulose and often exhibit large intercellular spaces.

• In some cases, they contain chlorophyll and are called Chlorenchyma, performing photosynthesis. In aquatic plants, they have large air cavities and are called Aerenchyma to provide buoyancy.

• Collenchyma:

• These cells provide mechanical support and flexibility to young plant parts like the petiole and young stems.

• They are characterized by thickened corners due to the deposition of cellulose, hemicellulose, and pectin.

• They are living cells and are generally found in the hypodermis of dicotyledonous stems.

• Sclerenchyma:

• These consist of long, narrow cells that are dead at maturity and lack protoplasm.

• Their cell walls are heavily thickened with Lignin, a chemical substance that acts as cement and hardens them.

• Examples include fibers and sclereids. They are found in the husk of coconut, the hard covering of seeds, and the veins of leaves.

Important Points

• Permanent Tissues: Unlike meristematic tissues, permanent tissues have lost the ability to divide and have attained a definite shape, size, and function through the process of differentiation.

• Simple vs. Complex Tissues: Simple permanent tissues are made of only one type of cell (e.g., parenchyma), whereas complex permanent tissues are made of more than one type of cell working together as a unit, such as Xylem and Phloem.

• Location: The location of these tissues varies; Parenchyma is found in almost all soft parts of the plant, while Sclerenchyma is restricted to parts requiring structural rigidity.

• Functionality: While Parenchyma handles metabolic functions, Sclerenchyma is purely mechanical, helping plants withstand environmental stress like wind.

Q20. Answer: (d) B/2

The correct answer is B/2.

Key Points

• The magnetic field (B) produced by a long straight wire carrying a current (I) at a distance r from it is governed by Ampere's Circuital Law or the Biot-Savart Law.

• The mathematical expression for the magnetic field at a point located at a perpendicular distance r from an infinitely long straight conductor is given by the formula: $B = (\mu_0 * I) / (2 * \pi * r)$.

• In this formula, μ_0 (mu-naught) represents the permeability of free space, I is the magnitude of the electric current, and r is the radial distance from the wire.

• The relationship between the magnetic field (B) and the distance (r) is inversely proportional (B prop. to 1/r). This implies that if the distance from the wire increases, the strength of the magnetic field decreases proportionally.

• According to the question, the initial magnetic field is B at distance r. When the distance is doubled, the new distance becomes 2r. Substituting this into the formula: B' = (μ0 * I) / (2 * π * 2r).

• By rearranging the equation, we find B' = 1/2 * [(μ0 * I) / (2 * π * r)]. Since the term in the brackets is the original field B, the new field is B/2. Hence, the statement that the magnetic field becomes B/2 is correct.

Additional Information

• Right-Hand Thumb Rule: This rule is used to determine the direction of the magnetic field lines around a straight current-carrying conductor. If you hold the wire in your right hand with the thumb pointing in the direction of the current, the fingers will curl in the direction of the magnetic field lines.

• Nature of Field Lines: The magnetic field lines around a long straight wire form concentric circles. These circles are centered on the wire and exist in a plane perpendicular to the direction of the current.

• Permeability of Free Space (μ0): This constant defines the strength of the magnetic interaction in a vacuum. Its numerical value is exactly 4π × 10^-^7 T·m/A (Tesla-meter per Ampere).

• Factors Affecting Magnetic Field:

• Current (I): The field strength is directly proportional to the magnitude of the current. Increasing the current increases the magnetic field.

• Distance (r): The field strength is inversely proportional to the distance. Moving further away from the wire results in a weaker magnetic field.

• Unit of Magnetic Field: The SI unit of magnetic field induction is the Tesla (T). Another unit used in the CGS system is the Gauss (G), where 1 Tesla = 10,000 Gauss.

Important Points

• If the distance were halved (r/2) instead of doubled, the magnetic field would become 2B because of the inverse relationship.

• For a finite length wire, the formula changes to include the angles subtended by the ends of the wire at the point of observation, but for a long wire (idealized as infinite), the 1/r relationship always holds true.

• The magnetic field at the center of the wire (where r = 0) is theoretically undefined or considered in the context of the wire's thickness, but outside the wire, the inverse distance rule is a fundamental principle of electromagnetism.

Q21. Answer: (d) CO_2

The correct answer is CO_2.

Key Points

• Carbon Dioxide (CO_2) is an acidic oxide that reacts readily with strong bases like Sodium Hydroxide (NaOH) to form different salts based on the concentration of the gas.

• When CO_2 is passed through a solution of Sodium Hydroxide, it first reacts to form Sodium Carbonate (Na_2CO_3) and water (H_2O). The chemical equation for this reaction is $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$. Hence, statement 4 is correct.

• If Carbon Dioxide is provided in excess, it continues to react with the Sodium Carbonate and water formed in the first step to produce Sodium Bicarbonate ($NaHCO_3$), also known as Sodium Hydrogen Carbonate. The equation for this subsequent step is $Na_2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3$.

• This process is a classic example of a neutralization reaction between an acidic gas and an alkali. It is industrially significant as it relates to the absorption of greenhouse gases and the production of chemical reagents.

• Other gases listed do not yield these specific products. Nitrogen Dioxide (NO_2) is an acidic gas that reacts with NaOH to produce Sodium Nitrate ($NaNO_3$) and Sodium Nitrite ($NaNO_2$). Hence, statement 1 is incorrect.

• Carbon Monoxide (CO) is considered a neutral oxide and does not react with Sodium Hydroxide under standard temperature and pressure conditions. Hence, statement 2 is incorrect.

• Sulfur Dioxide (SO_2) reacts with NaOH to form Sodium Sulfite (Na_2SO_3) and Sodium Bisulfite ($NaHSO_3$), following a similar pattern but producing sulfur-based salts instead of carbonates. Hence, statement 3 is incorrect.

Additional Information

• Sodium Hydroxide (NaOH):

• Commonly known as Caustic Soda, it is a highly alkaline white solid.

• It is widely used in the manufacture of pulp and paper, textiles, drinking water, soaps, and detergents.

• In the year 2022, the global production of NaOH reached millions of metric tons due to its versatile chemical functions as a strong base.

• Sodium Carbonate (Na_2CO_3):

• Commonly referred to as Washing Soda, it is the disodium salt of carbonic acid.

• It is primarily used in glass manufacturing, where it acts as a flux to lower the melting point of silica.

• It also finds applications in water softening by removing temporary and permanent hardness.

• Sodium Bicarbonate ($NaHCO_3$):

• Commonly known as Baking Soda, it is a white crystalline solid with a slightly alkaline taste.

• It is used in cooking as a leavening agent and in fire extinguishers because it releases CO2 when heated, which helps smother flames.

• In the medical field, it is used as an antacid to treat acid indigestion and heartburn.

• Environmental and Industrial Context:

• The reaction between NaOH and CO2 is utilized in Carbon Capture and Storage (CCS) technologies to scrub Carbon Dioxide from industrial exhaust streams.

• This chemical interaction is fundamental in the Solvay Process, which is the major industrial process for the production of Sodium Carbonate globally.

Important Points

• Oxide Classification: CO2 and SO2 are Non-metallic oxides, which are generally acidic in nature. In contrast, CO and N2O are rare examples of neutral non-metallic oxides.

• Detection of CO2: The reaction of CO2 with Calcium Hydroxide [Ca(OH)2], also known as Lime Water, is the standard laboratory test for the gas. It turns lime water milky due to the formation of insoluble Calcium Carbonate, but becomes clear again if excess CO2 is passed through (forming soluble Calcium Bicarbonate).

• Stoichiometry: The ratio of NaOH to CO2 determines the product. A 2:1 molar ratio favors the carbonate, while a 1:1 molar ratio (or excess gas) favors the bicarbonate.

Q22. Answer: (a) Macronutrients are required by plants in large quantities for proper growth and development.

The correct answer is Macronutrients are required by plants in large quantities for proper growth and development.

Key Points

• Macronutrients are essential chemical elements required by plants in relatively large quantities to ensure structural integrity and metabolic functionality. They are generally present in plant tissues in concentrations exceeding 10 mmole kg^-¹ of dry matter. Hence, statement 1 is correct.

• There are nine primary macronutrients: Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), and Sulphur (S).

• Both macronutrients and micronutrients are equally essential for the survival of the plant; the distinction is based solely on the quantity required, not their functional importance. Hence, statement 2 is incorrect.

• Plants require these nutrients throughout their entire life cycle, including germination, vegetative growth, and reproduction, rather than just during the flowering phase. Hence, statement 3 is incorrect.

• According to the criteria of essentiality, a plant cannot complete its life cycle or produce seeds in the absolute absence of these nutrients. Hence, statement 4 is incorrect.

Additional Information

• Classification of Nutrients:

• Macronutrients: Required in large amounts. Carbon, Hydrogen, and Oxygen are mainly obtained from CO2 and H2O, while the others are absorbed from the soil as mineral nutrition.

• Micronutrients: Also known as trace elements, these are needed in very small amounts (less than 10 mmole kg^-¹ of dry matter). These include Iron, Manganese, Copper, Molybdenum, Zinc, Boron, Chlorine, and Nickel.

• Functions of Major Macronutrients:

• Nitrogen (N): Required by all parts of the plant, particularly meristematic tissues. It is a major constituent of proteins, nucleic acids, and vitamins.

• Phosphorus (P): Essential for phosphorylation reactions and is a constituent of cell membranes and nucleotides.

• Potassium (K): Helps in maintaining anion-cation balance in cells and is involved in protein synthesis and the opening and closing of stomata.

• Criteria for Essentiality: Defined by Arnon and Stout in 1939, it states that the element must be directly involved in plant metabolism and its deficiency must be correctable only by supplying that specific element.

Important Points

• Critical Concentration: The limited concentration of an essential element below which plant growth is retarded is termed critical concentration.

• Deficiency Symptoms: When macronutrients are provided in less than the critical concentration, plants manifest symptoms like chlorosis (yellowing of leaves), necrosis (death of tissue), or stunted growth.

• Mobility: Elements like Nitrogen, Potassium, and Magnesium are mobile within the plant, meaning deficiency symptoms appear first in older tissues as the nutrients are exported to younger leaves. In contrast, immobile elements like Calcium show symptoms first in younger tissues.

Q23. Answer: (a) grows as an outgrowth

The correct answer is grows as an outgrowth.

Key Points

• Hydra reproduces asexually through a process called budding. In this process, a bud develops as an outgrowth due to repeated cell division at one specific site on the parent body. Hence, statement 1 is correct.

• While the bud is an outgrowth from the side of the parent, it does not develop on a specialized stalk; it is a direct extension of the parent's body wall. Hence, statement 2 is incorrect.

• In Hydra, the bud forms on the external surface of the body (exogenous budding). It does not form inside the parent's body, a process called endogenous budding or gemmule formation, which is seen in sponges. Hence, statement 3 is incorrect.

• Hydra does not utilize spores for reproduction. Spore formation is a method of asexual reproduction common in fungi, bacteria, and some non-flowering plants like ferns and mosses. Hence, statement 4 is incorrect.

• Once the bud matures and develops tiny tentacles and a mouth, it eventually detaches from the parent body to lead an independent existence as a new individual.

Additional Information

• Asexual Reproduction:

• It is a mode of reproduction that involves a single parent and does not involve the fusion of gametes.

• The offspring produced are genetically identical to the parent and to each other (clones).

• Examples include binary fission in Amoeba, fragmentation in Spirogyra, and vegetative propagation in plants.

• Characteristics of Hydra:

• Hydra is a freshwater organism belonging to the phylum Cnidaria (also known as Coelenterata).

• It exhibits radial symmetry and is diploblastic, meaning its body is composed of two layers of cells.

• It possesses regenerative cells, which are responsible for the budding process and its incredible regeneration power.

• If a Hydra is cut into pieces, each piece can grow into a complete organism, provided it contains enough interstitial cells.

• Anatomy of the Bud:

• The bud in Hydra contains a gastrovascular cavity that is continuous with the parent's cavity during the growth phase.

• This allows the bud to receive nutrients directly from the parent while it is still developing its own tentacles and mouth.

• The process of budding usually takes place during favorable conditions when there is an abundant food supply.

Important Points

• Comparison with Binary Fission: Unlike binary fission where the parent organism splits into two equal parts and the identity of the parent is lost, in budding, the parent organism remains intact after the offspring detaches.

• Symmetry: Hydra and other Cnidarians are known for their radial symmetry, where the body parts are arranged around a central axis, similar to the spokes of a wheel.

• Habitat: Hydra are typically found in clean, still, or slow-moving freshwater environments like ponds and streams, often attached to aquatic plants or rocks.

Q24. Answer: (c) Produces a wider field of view

The correct answer is Produces a wider field of view.

Key Points

• Convex mirrors are preferred as rear-view mirrors in vehicles primarily because they provide a wider field of view compared to plane or concave mirrors.

• Since a convex mirror is curved outwards, it enables the driver to view a much larger area of the traffic behind them than would be possible with a flat mirror. Hence, statement 3 is correct.

• Unlike concave mirrors, a convex mirror always forms an erect (upright) and virtual image, which is essential for a driver to quickly identify the orientation of trailing vehicles. Hence, statement 1 is incorrect.

• The images formed by these mirrors are diminished (smaller than the actual object), not magnified. This reduction in size is what allows more objects to fit into the mirror's reflection. Hence, statement 2 is incorrect.

• Mirror surfaces are designed to reflect light rather than absorb it; high absorption would result in a dark, unusable image. Hence, statement 4 is incorrect.

Additional Information

• Concave Mirror:

• Known as a converging mirror, it can form both real and virtual images depending on the object distance.

• It is used in solar furnaces, torches, searchlights, and vehicle headlights to get powerful parallel beams of light.

• Shaving mirrors often use concave surfaces to provide a magnified image of the face when held close.

• Plane Mirror:

• It produces an image of the same size as the object.

• The image is laterally inverted (left appears as right) and is located at the same distance behind the mirror as the object is in front of it.

• Magnification:

• In a convex mirror, the magnification (m) is always positive and less than 1 (m < 1), indicating a virtual, erect, and smaller image.

• In a concave mirror, magnification can be greater than, equal to, or less than 1.

Important Points

• Sign Convention: For a convex mirror, the focal length (f) and radius of curvature (R) are always taken as positive values according to the New Cartesian Sign Convention.

• Security Uses: Due to their ability to provide a panoramic view, convex mirrors are commonly used as vigilance mirrors in supermarkets, hospitals, and at blind corners of roads to prevent accidents.

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

• Radius of Curvature: For spherical mirrors of small apertures, the radius of curvature is found to be twice the focal length, represented by the formula R = 2f.

Q25. Answer: (c) Presence of vacuoles

The correct answer is Presence of vacuoles.

Key Points

• Meristematic tissues are a group of young, immature cells that are in a continuous state of division and are responsible for the growth of the plant.

• These cells are characterized by being thin-walled, typically made of cellulose, which allows them to expand and divide easily. Hence, statement 1 is correct regarding the nature of meristematic tissue.

• The primary function of meristematic tissue is to produce new cells, and thus they are actively dividing cells found at specific growth regions like the root tips and shoot tips. Hence, statement 2 is correct regarding the nature of meristematic tissue.

• One of the most distinct features of meristematic cells is that they usually lack vacuoles or have very small, inconspicuous ones. This is because vacuoles are primarily used for storage and maintaining turgidity in mature cells; since meristematic cells are constantly dividing, they have a dense cytoplasm and high metabolic activity, making large storage vacuoles unnecessary. Hence, statement 4 is correct, and statement 3 is INCORRECT.

• These cells have a large and prominent nucleus to manage the genetic material required for frequent mitosis.

• Therefore, the incorrect statement about meristematic tissue is the presence of vacuoles.

Additional Information

• Classification by Location:

• Apical Meristem: Located at the growing tips of stems and roots. Its primary role is primary growth, which increases the length of the plant body.

• Intercalary Meristem: Found at the base of leaves or internodes (e.g., in grasses). It helps in the elongation of the organs and regrowth after being eaten by herbivores.

• Lateral Meristem: Occurs on the sides of the roots and stems. It is responsible for secondary growth, which increases the girth or thickness of the plant (e.g., vascular cambium and cork cambium).

• Transition to Permanent Tissue: Once meristematic cells stop dividing and take up a specific permanent shape, size, and function, they undergo differentiation to become permanent tissues like parenchyma, collenchyma, or sclerenchyma.

• Metabolic State: Meristematic cells have a very high metabolic rate because they are constantly synthesizing new protoplasm and cell wall materials to support cell division.

Important Points

• Absence of Intercellular Spaces: The cells of meristematic tissue are compactly arranged without any intercellular spaces between them, ensuring a solid mass of dividing cells.

• Cell Shape: These cells are typically spherical, oval, polygonal, or rectangular in shape.

• Plastids: Instead of fully developed chloroplasts, meristematic cells contain proplastids, which are the precursors to plastids.

• Ergastic Substances: They generally do not store ergastic substances like starch or fats, as the nutrients are consumed immediately for energy and growth.

Q26. Answer: (b) 330 m

Shortcut Trick

Relative Speed in same direction = 101 − 65 = 36 kmph.

Convert Speed to m/s = 36 × (5/18) = 10 m/s.

Total distance (2L) = Speed × Time = 10 × 66 = 660 m.

Length of one train (L) = 660 ÷ 2 = 330 m.
Therefore The correct answer is 330 m.
Alternate Method
Given: Speed of Rajdhani = 101 kmph, Speed of Garib Rath = 65 kmph, Time = 66 seconds, Lengths are equal (L).
Formula Used: Relative Speed (same direction) = S1 − S2; Distance = Speed × Time.
=> Relative Speed = 101 − 65 = 36 kmph
=> Speed in m/s = 36 × (5/18) = 10 m/s
=> Total Distance = 2 × L
=> 2L = 10 × 66
=> 2L = 660 m
=> L = 660 ÷ 2 = 330 m
Therefore The correct answer is 330 m.
Additional Information
Relative Speed Concepts
When moving in the same direction, relative speed is S1 − S2. When moving in the opposite direction, it is S1 + S2.
Unit Conversion
To convert km/hr to m/s, multiply by 5/18. To convert m/s to km/hr, multiply by 18/5.
Train Crossing Objects
When a train crosses another train, the total distance covered is the sum of their lengths (L1 + L2).

Q27. Answer: (c) 72

Shortcut Trick
Ratio of Numbers: N1 : N2 = 7 : 14 => 1 : 2
Ratio of Numbers: N2 : N3 = 15 : 15 => 1 : 1 => 2 : 2
Combined Ratio N1 : N2 : N3 = 1 : 2 : 2
Total units = 1 + 2 + 2 = 5 units → 180
Value of 2 units (Second number) = (180 ÷ 5) × 2 = 36 × 2 = 72
Therefore The correct answer is 72.
Alternate Method
Given: Sum of numbers = 180; N2 : N1 = 14 : 7; N3 : N2 = 15 : 15
=> Simplify First Ratio: N1 : N2 = 7 : 14 = 1 : 2
=> Simplify Second Ratio: N2 : N3 = 15 : 15 = 1 : 1
=> To combine, make N2 same: N2 : N3 = (1×2) : (1×2) = 2 : 2
=> Combined Ratio N1 : N2 : N3 = 1 : 2 : 2
=> Let numbers be 1x, 2x, and 2x
=> 1x + 2x + 2x = 180
=> 5x = 180
=> x = 180 ÷ 5 = 36
=> Second number (N2) = 2x = 2 × 36 = 72
Therefore The correct answer is 72.
Additional Information
Compound Ratio
When two or more ratios are multiplied together, the result is the compound ratio. For a:b and c:d, it is (ac):(bd).
Ratio Balancing
To combine A:B and B:C, multiply both ratios by suitable factors to make the common term B equal in both.
Proportion Rule
If a:b = c:d, then product of extremes (a × d) is always equal to the product of means (b × c).

Q28. Answer: (a) 18.2

Shortcut Trick
The Empirical Relationship states: Mode − Median = 2/3 (Mode − Mean).
Given: Mode − Mean = 27.3.

Required: Mode − Median.
=> Mode − Median = 2/3 × 27.3
=> Mode − Median = 2 × 9.1 = 18.2.
Therefore The correct answer is 18.2.
Alternate Method
Given:
=> Difference between Mode and Mean = 27.3
=> Mode − Mean = 27.3
Formula Used:
=> Empirical Formula: Mode = 3 × Median − 2 × Mean
Calculations:
=> From the given data: Mean = Mode − 27.3
=> Substitute Mean in the empirical formula:
=> Mode = 3 × Median − 2 × (Mode − 27.3)
=> Mode = 3 × Median − 2 × Mode + 54.6
=> Mode + 2 × Mode − 3 × Median = 54.6
=> 3 × Mode − 3 × Median = 54.6
=> 3 × (Mode − Median) = 54.6
=> Mode − Median = 54.6 ÷ 3
=> Mode − Median = 18.2
Therefore The correct answer is 18.2.
Additional Information
Empirical Relationship
For a moderately skewed distribution, the relationship is: Mode = 3 Median − 2 Mean. It helps find one measure when the other two are known.
Symmetric Distribution
In a perfectly symmetrical distribution, the values of Mean, Median, and Mode are all equal (Mean = Median = Mode).
Karl Pearson Coefficient of Skewness
Skewness is calculated as (Mean − Mode) ÷ Standard Deviation or 3(Mean − Median) ÷ Standard Deviation.
Relationship of Differences
The distance between Mean and Mode is 3 times the distance between Mean and Median: (Mean − Mode) = 3(Mean − Median).

Q29. Answer: (b) 20 m

Shortcut Trick
For an angle of elevation of 45°, the height of the building and its base distance are always equal.
In a 45°−45°−90° triangle, the ratio of sides is 1 : 1 : √2.
Since Height = 20 m, then Distance = 20 m.
Therefore The correct answer is 20 m.
Alternate Method
Given:
Height of the building (AB) = 20 m
Angle of elevation (θ) = 45°
Formula Used:
tan θ = Perpendicular ÷ Base
Calculations:
=> tan 45° = AB ÷ BC
=> 1 = 20 ÷ BC
=> BC = 20 m
Therefore The correct answer is 20 m.
Additional Information
Trigonometric Ratios for Standard Angles
For 30°, tan 30° = 1/√3. For 60°, tan 60° = √3. These ratios help find heights and distances quickly.

Angle of Elevation vs Depression

The angle of elevation is measured upward from the horizontal, while the angle of depression is measured downward. Both are numerically equal due to alternate interior angles.

Q30. Answer: (c) 18

Shortcut Trick

Using the inverse proportionality rule: Total Work = M1 × D1 = M2 × D2.

Initial men = 102, Final men = 102 + 68 = 170.

Days ratio = Inverse of Men ratio = 170 : 102 = 5 : 3.

5 units = 30 weeks → 1 unit = 6 weeks → 3 units = 18 weeks.

Therefore The correct answer is 18 weeks.

Alternate Method

Given:

Initial number of men (M1) = 102

Initial duration (D1) = 30 weeks

Additional men = 68

Formula Used:

M1 × D1 = M2 × D2

Calculations:

=> M2 = 102 + 68 = 170 men

=> 102 × 30 = 170 × D2

=> 3060 = 170 × D2

=> D2 = 3060 ÷ 170

=> D2 = 306 ÷ 17

=> D2 = 18 weeks

Therefore The correct answer is 18 weeks.

Additional Information

Chain Rule

The general formula is (M1 × D1 × H1) / W1 = (M2 × D2 × H2) / W2, where M is men, D is days, H is hours, and W is work.

Inverse Variation

In provision problems, the number of men is inversely proportional to the number of days the food lasts (M prop. to 1/D).

Constant Product

When the total amount of food (provisions) is constant, the product of the number of people and the time must remain the same.

Q31. Answer: (a) Two successive discounts of 44% and 18%

Shortcut Trick

To find the maximum advantage, calculate the equivalent single discount for each option.

Successive discount formula: a + b − (a × b) ÷ 100.

Option 1: 44 + 18 − (44 × 18) ÷ 100 = 62 − 7.92 = 54.08%.

Option 2: 30 + 30 − (30 × 30) ÷ 100 = 60 − 9 = 51%.

Option 3: Single discount = 22%.

Option 4: 24 + 25 − (24 × 25) ÷ 100 = 49 − 6 = 43%.

Therefore The correct answer is Two successive discounts of 44% and 18%.

Alternate Method

Given: Marked Price (MP) = Rs. 5,000. Goal: Find the highest Effective Discount Rate.

Formulas: Effective Discount = a + b − (ab ÷ 100) | SP = MP × (100 − D%) ÷ 100.

=> Option 1: Effective Discount = 44 + 18 − (44 × 18 ÷ 100) = 62 − 7.92 = 54.08%.

=> Option 2: Effective Discount = 30 + 30 − (30 × 30 ÷ 100) = 60 − 9 = 51%.

=> Option 3: Effective Discount = 22%.

=> Option 4: Effective Discount = 24 + 25 − (24 × 25 ÷ 100) = 49 − 6 = 43%.

=> Comparing all values, 54.08% is the maximum discount.

Therefore The correct answer is Two successive discounts of 44% and 18%.

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Additional Information

Successive Discounts

Applying two or more discounts one after another on the remaining balance. Total discount is always less than the simple sum of the rates.

Customer Profit

A customer gains maximum advantage when the Net Effective Discount is the highest, resulting in the lowest Selling Price.

Q32. Answer: (d) 3

Shortcut Trick

Let the total work be LCM of 3, 12, and 4 = 12 units.

Efficiency of A = 4, B = 1, and C = 3.

Total efficiency of A + B + C = 4 + 1 + 3 = 8 units/day.

Twice the work = 2 × 12 = 24 units.

Time taken = 24 ÷ 8 = 3 days.

Therefore The correct answer is 3 days.

Alternate Method

Given:

Time taken by A = 3 days

Time taken by B = 12 days

Time taken by C = 4 days

Formula Used:

Efficiency = Total Work ÷ Time

Time = Total Work ÷ Efficiency

Person	Days	Total Work	Efficiency
A	3	12	4
B	12	1	
C	4	3	

Calculations:

=> Total Efficiency of A + B + C = 4 + 1 + 3 = 8 units/day

=> New Total Work = 2 × 12 = 24 units

=> Time required for twice the work = 24 ÷ 8 = 3 days

Therefore The correct answer is 3 days.

Additional Information

LCM Method in Time and Work

Taking the LCM of the individual days to represent the total work helps avoid working with complex fractions, making computations much faster.

Work and Efficiency Relation

Efficiency is inversely proportional to time taken when the work is constant. If work is multiplied by a factor k, the time taken with the same efficiency also gets multiplied by k.

Q33. Answer: (d) 1,01,250

Shortcut Trick

Income ratio = 5 : 8 | Expenditure ratio = 1 : 4

Difference in Income parts = 8 − 5 = 3 | Difference in Expenditure parts = 4 − 1 = 3

Since the differences are equal, the saving of 81,000 corresponds to the difference between Income and Expenditure units.

Saving = 5 − 1 = 4 units (or 8 − 4 = 4 units) → 4 units = Rs. 81,000

1 unit = Rs. 20,250 Therefore Shivam income (5 units) = 5 × Rs. 20,250 = Rs. 1,01,250.

Therefore The correct answer is Rs. 1,01,250.

Alternate Method

Given: Ratio of Incomes = 5 : 8 | Ratio of Expenditure = 1 : 4 | Savings = Rs. 81,000 each.

Formula Used: Income − Savings = Expenditure

=> Let Shivam income = 5x and Rupesh income = 8x.

=> (5x − 81000) / (8x − 81000) = 1 / 4

=> 4 × (5x − 81000) = 1 × (8x − 81000)

=> 20x − 3,24,000 = 8x − 81,000

=> 12x = 2,43,000

=> x = 20,250

=> Shivam Income = 5 × 20,250 = Rs. 1,01,250.

Therefore The correct answer is Rs. 1,01,250.

Additional Information

Income-Expenditure Concept

Basic relation is Income = Expenditure + Savings. For two people with equal savings, the difference in income units should ideally equal the difference in expenditure units to use direct subtraction.

Ratio Balancing

If the differences between parts are not equal, multiply the ratios by the difference of the other ratio to balance them (e.g., multiply 5:8 by (4-1) and 1:4 by (8-5)).

Cross-Multiplication Method

A faster way to solve ratio problems with fixed additions/subtractions: (Initial Ratio 1 × Final Ratio 2) − (Initial Ratio 2 × Final Ratio 1) units = Change × (Final Ratio 2 − Final Ratio 1).

Q34. Answer: (b) 4

Shortcut Trick

Apply the standard algebraic identity: $(a + b)^2 - (a - b)^2 = 4ab$

By comparing, let a = x and b = 5:

=> 4 × x × 5 = 80

=> 20x = 80 → x = 4

Therefore The correct answer is 4.

Alternate Method

Given:

$(x + 5)^2 - (x - 5)^2 = 80$

Formula Used:

Expansion of square of a binomial:

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

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

Calculations:

Expanding the terms on the left-hand side of the equation:

=> $(x^2 + 2 \times x \times 5 + 5^2) - (x^2 - 2 \times x \times 5 + 5^2) = 80$

=> $(x^2 + 10x + 25) - (x^2 - 10x + 25) = 80$

=> $x^2 + 10x + 25 - x^2 + 10x - 25 = 80$

Grouping the like terms together:

=> $(x^2 - x^2) + (10x + 10x) + (25 - 25) = 80$

=> 20x = 80

=> x = 80 ÷ 20

=> x = 4

Therefore The correct answer is 4.

Additional Information

Difference of Squares Identity

The expression can also be factored using the identity $a^2 - b^2 = (a - b)(a + b)$, where a = (x + 5) and b = (x − 5).

Sum of Squares Identity

Adding two squared binomials results in another standard identity: $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$.

Q35. Answer: (a) 2.5 hours

Shortcut Trick

Identify Time using the direct ratio of Distance and Speed.

Time = 180 ÷ 72
Time = 90 ÷ 36 = 10 ÷ 4 = 2.5 hours.
Therefore The correct answer is 2.5 hr.
Alternate Method
Given:
Speed of the train = 72 km/hr
Total Distance to cover = 180 km
Formula Used:
Time = Distance ÷ Speed
Calculations:
=> Time = 180 / 72
=> Time = (180 ÷ 12) / (72 ÷ 12)
=> Time = 15 / 6
=> Time = 2.5 hours
Therefore The correct answer is 2.5 hr.
Additional Information
Unit Conversion (km/hr to m/s)
To convert speed from km/hr to m/s, multiply by 5/18. Conversely, multiply by 18/5 to convert m/s to km/hr.
Average Speed
For a journey with two equal distances at speeds x and y, Average Speed = (2 × x × y) ÷ (x + y).
Relative Speed
When two objects move in the same direction, relative speed is the difference (S1 − S2); in opposite directions, it is the sum (S1 + S2).

Q36. Answer: (c) 25

Shortcut Trick
Ratio of Curved Surface Area (CSA) of Cylinder to sum of CSA of Cones = 4 : 1
$2\pi rh : (\pi r1l1 + \pi r2l2) = 4 : 1$
$24r : (3 \times 5 + 6 \times 10) = 4 : 1$
$24r : 75 = 4 : 1 \Rightarrow 24r = 300 \Rightarrow r = 12.5$
Calculating $2r = 2 \times 12.5 = 25$
Therefore The correct answer is 25.
Alternate Method
Given:
Cylinder: Height (H) = 12 cm, Radius = r cm
Cone 1: Radius (r1) = 3 cm, Height (h1) = 4 cm
Cone 2: Radius (r2) = 6 cm, Height (h2) = 8 cm
Formula Used:
Curved Surface Area of Cylinder = $2\pi rH$
Curved Surface Area of Cone = πrl, where slant height $l = \sqrt{(r^2 + h^2)}$
Calculations:
=> Slant height of Cone 1 (l1) = $\sqrt{(3^2 + 4^2)} = \sqrt{(9 + 16)} = 5$ cm
=> Slant height of Cone 2 (l2) = $\sqrt{(6^2 + 8^2)} = \sqrt{(36 + 64)} = 10$ cm
=> CSA of Cone 1 = $\pi \times 3 \times 5 = 15\pi$ cm²
=> CSA of Cone 2 = $\pi \times 6 \times 10 = 60\pi$ cm²
=> Sum of CSA of two cones = $15\pi + 60\pi = 75\pi$ cm²
=> CSA of Cylinder = $2 \times \pi \times r \times 12 = 24\pi r$ cm²
=> Given ratio: $24\pi r / 75\pi = 4 / 1$
=> $24r / 75 = 4$
=> $24r = 300$
=> $r = 300 / 24 = 12.5$ cm
=> Value of $2r = 2 \times 12.5 = 25$

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Therefore The correct answer is 25.

Additional Information

Total Surface Area of Cylinder

It includes the curved area and the areas of the two circular bases: TSA = $2\pi r(r + h)$.

Volume of Solids

Volume of Cylinder = $\pi r^2 H$ and Volume of Cone = $(1/3)\pi r^2 h$.

Pythagorean Triplets

Slant height calculation often involves common triplets like (3, 4, 5) and (6, 8, 10).

Q37. Answer: (d) 20 years

Shortcut Trick

Ratio of Meena : Sita is 5 : 4 (Gap = 1 unit) and becomes 9 : 8 (Gap = 1 unit) after 16 years.

The increase in units for both is 9 − 5 = 4 units or 8 − 4 = 4 units.

4 units → 16 years => 1 unit → 4 years.

Meena's present age = 5 units × 4 = 20 years.

Therefore The correct answer is 20 years.

Alternate Method

Given:

Present ages of Meena and Sita are in ratio 5 : 4. Let ages be 5x and 4x.

Calculations:

=> (5x + 16) / (4x + 16) = 9 / 8

=> 8 × (5x + 16) = 9 × (4x + 16)

=> 40x + 128 = 36x + 144

=> 40x − 36x = 144 − 128

=> 4x = 16

=> x = 4

=> Meena's present age = 5x = 5 × 4 = 20 years.

Therefore The correct answer is 20 years.

Additional Information

Ratio Adjustment Method

If the difference between ratios is not same, multiply the ratios by the difference of the other ratio to make the age gap constant.

Age Difference Property

The difference between the ages of two persons remains constant regardless of the number of years passed.

Cross-Multiplication Method

For age problems, (Initial Ratio Product Diff) × x = (Final Ratio Diff) × (Years Passed).

Q38. Answer: (c) Rs. 8,748

Shortcut Trick

Effective interest rate for 2 years at 8% = 8 + 8 + (8 × 8)/100 = 16.64%

Net Amount percentage = 100% (Principal) + 16.64% (Interest) = 116.64%

Amount = 7500 × 116.64/100 = 75 × 116.64

Amount = Rs. 8,748

Therefore The correct answer is Rs. 8,748.

Alternate Method

Given:

Principal (P) = Rs. 7,500

Rate of Interest (R) = 8% per annum

Time (n) = 2 years

Formula Used:

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

Calculations:

=> $A = 7500 \times (1 + 8/100)^2$

=> A = 7500 × (108/100) × (108/100)

=> A = 7500 × (27/25) × (27/25)

=> A = 300 × (27/25) × 27

=> A = 12 × 27 × 27

=> A = 12 × 729

=> A = 8748

Therefore The correct answer is Rs. 8,748.

Additional Information

Difference between CI and SI

For a period of 2 years, the difference between Compound Interest and Simple Interest is given by $P \times (R/100)^2$.

Effective Rate Formula

If interest is compounded annually for 2 years at r%, the effective rate is [r + r + (r × r)/100]%.

Compounding Periods

If interest is compounded half-yearly, the rate becomes R/2 and time becomes 2n. If quarterly, rate becomes R/4 and time becomes 4n.

Q39. Answer: (b) 15%

Shortcut Trick

Required percentage = (Value ÷ Base Value) × 100

Here, Value = 1/20 and Base Value = 10/30 = 1/3

Required percentage = (1/20 ÷ 1/3) × 100 = (3/20) × 100

=> 3 × 5 = 15%

Therefore The correct answer is 15%.

Alternate Method

Given:

First fraction = 1/20

Second fraction = 10/30

Formula Used:

Percentage = (A / B) × 100

Calculations:

=> First fraction = 1/20

=> Second fraction = 10/30 = 1/3

=> Required % = [(1/20) / (1/3)] × 100

=> Required % = (1/20 × 3/1) × 100

=> Required % = (3/20) × 100

=> Required % = 3 × 5

=> Required % = 15%

Therefore The correct answer is 15%.

Additional Information

Percentage Change

Percentage change = [(New value − Old value) / Old value] × 100.

Fraction to Percentage

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

Base Change Rule

If A is x% more than B, then B is [x / (100 + x)] × 100% less than A.

Q40. Answer: (d) 700

Shortcut Trick

Let the total eligible voters be 100 units.

Voters aged 18−21 who voted = 5% × 80% = 4 units.

Voters aged 21−25 who voted = 12% × 60% = 7.2 units.

Difference in voters = 7.2 − 4 = 3.2 units → 320.

Difference in eligible voters = 12% − 5% = 7 units → 7 × 100 = 700.

Therefore The correct answer is 700.

Alternate Method

Given:

Total eligible voters = X

Voters aged 18−21 = 5% of X = 0.05X

Voters aged 21−25 = 12% of X = 0.12X

=> Actual voters (18−21) = 80% × 0.05X = 0.04X

=> Actual voters (21−25) = 60% × 0.12X = 0.072X

=> Difference in actual voters = 0.072X − 0.04X = 0.032X

=> 0.032X = 320

=> X = 320 ÷ 0.032 = 10,000

=> Difference in eligible voters (21-25 and 18-21) = (12% − 5%) of X

=> 7% of 10,000 = 0.07 × 10,000 = 700

Therefore The correct answer is 700.

Additional Information

Percentage of a Percentage

To find the effective percentage of a subgroup, multiply the two percentages: Effective % = (Subgroup % ÷ 100) × (Total Group % ÷ 100) × 100.

Successive Percentage Change

When a value is increased/decreased by a% and then b%, the net change is given by [a + b + (ab/100)]%.

Base Value Identification

Always identify the base (100%) correctly; in election problems, the base is usually the total number of eligible voters unless specified otherwise.

Q41. Answer: (a) 66

Shortcut Trick

Teacher Age = New Average + (Initial Number of Students × Increase in Average)

Increase in average = 35 − 34 = 1 year

Initial students = 31

Teacher Age = 35 + (31 × 1) = 35 + 31 = 66 years

Therefore The correct answer is 66 years.

Alternate Method

Given:

Number of students = 31

Initial average age = 34 years

New average age (including teacher) = 35 years

Formula Used:

Sum of observations = Average × Number of observations

Calculations:

=> Total age of 31 students = 31 × 34 = 1054 years

=> Total number of people including teacher = 31 + 1 = 32

=> Total age of 32 people = 32 × 35 = 1120 years

=> Teacher age = Total age (32 people) − Total age (31 students)

=> Teacher age = 1120 − 1054 = 66 years

Therefore The correct answer is 66 years.

Additional Information

Basic Average Formula

The average of a set of numbers is the sum of the numbers divided by the count of numbers: Average = Σx ÷ n.

Net Deviation Concept

In any group, the sum of deviations from the average is always zero. This is the basis for the Shortcut Trick used above.

Inclusion and Exclusion

If a new person joins and the average increases, the new person age must be greater than the initial average. If the average decreases, the age is less than the initial average.

Q42. Answer: (a) Rs. 6,875

Shortcut Trick

Net Discount % = a + b − (a × b) ÷ 100

Net Discount = 36 + 25 − (36 × 25) ÷ 100 = 61 − 9 = 52%

Selling Price (SP) = 100% − 52% = 48% of Marked Price (MP)

Given SP = Rs. 3,300 => 48% = 3,300

MP = (3,300 ÷ 48) × 100 = 6,875

Therefore The correct answer is Rs. 6,875.

Alternate Method

Given: SP = Rs. 3,300, d1 = 36%, d2 = 25%

Formulas: SP = MP × (100 − d1)% × (100 − d2)%

=> Let Marked Price be x.

=> x × (64 ÷ 100) × (75 ÷ 100) = 3,300

=> x × (16 ÷ 25) × (3 ÷ 4) = 3,300

=> x × (12 ÷ 25) = 3,300

=> x = (3,300 × 25) ÷ 12

=> x = 275 × 25 = 6,875

Therefore The correct answer is Rs. 6,875.

Additional Information

Marked Price & Discount

The Marked Price (MP) is the price printed on an item. Discount is always calculated on the MP. SP = MP − Discount.

Successive Discounts

When multiple discounts are applied one after another, the first discount is on the MP, and the subsequent discount is on the reduced price.

Q43. Answer: (d) 160

Shortcut Trick

List the first 11 prime numbers: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31.

Group them for easy addition: (2 + 3 + 5 + 7 + 13 + 17) + (11 + 19) + (23 + 29) + 31

=> 47 + 30 + 52 + 31 = 160

Therefore The correct answer is 160.

Alternate Method

Given: We need to find the sum of the first 11 prime numbers.

Formula: Sum = P1 + P2 + P3 + ... + P11

=> First 11 prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31

=> Sum = 2 + 3 + 5 + 7 + 11 + 13 + 17 + 19 + 23 + 29 + 31

=> Sum = (2 + 3 + 5 + 7) + (11 + 13 + 17 + 19) + (23 + 29 + 31)

=> Sum = 17 + 60 + 83

=> Sum = 160

Therefore The correct answer is 160.

Additional Information

Definition of Prime Numbers

A prime number is a natural number greater than 1 that has no positive divisors other than 1 and itself.

Properties of Prime Numbers

The number 2 is the only even prime number. All other prime numbers are odd. The number 1 is neither prime nor composite.

Sum of First N Prime Numbers

There is no simple algebraic formula to find the sum of the first N prime numbers; they must be listed and added manually.

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Q44. Answer: (a) 120°

Shortcut Trick

In any triangle, the angle formed by the internal angle bisectors of two angles at the incenter (O) is given by the formula:

angle RON = 90° + (angle M / 2)

Given angle M = 60°:

angle RON = 90° + (60° / 2) = 90° + 30° = 120°

Therefore The correct answer is 120°.

Alternate Method

Given: angle M = 60°, angle MRN = 66°, NO and RO are bisectors of angle MNR and angle MRN respectively.

Formula Used: Sum of all interior angles of a triangle is 180°.

Calculations:

=> In ΔMNR, angle MNR + angle MRN + angle M = 180°

=> angle MNR + 66° + 60° = 180°

=> angle MNR = 180° − 126° = 54°

=> Since NO is the bisector of angle MNR, angle ONR = 54° / 2 = 27°

=> Since RO is the bisector of angle MRN, angle ORN = 66° / 2 = 33°

=> In ΔRON, angle RON + angle ONR + angle ORN = 180°

=> angle RON + 27° + 33° = 180°

=> angle RON = 180° − 60° = 120°

Therefore The correct answer is 120°.

Additional Information

Incenter

The point of intersection of the internal angle bisectors of a triangle is called the Incenter. It is equidistant from all sides of the triangle.

Angle at Incenter

The angle formed by the bisectors of two angles at the incenter is always 90° + (half of the third angle).

Angle at Excenter

The angle formed by the external bisectors of two angles at the excenter is 90° − (half of the third angle).

Q45. Answer: (a) 48

Shortcut Trick

Efficiency ratio (Square of diameters) → $2^2 : 3^2 : 4^2 = 4 : 9 : 16$

Total Capacity = Efficiency of largest pipe × Time = 16 × 87

Combined Efficiency = 4 + 9 + 16 = 29

Required Time = (16 × 87) ÷ 29 = 16 × 3 = 48 minutes

Therefore The correct answer is 48 minutes.

Alternate Method

Given: Diameters of pipes are 2 cm, 3 cm, and 4 cm. Largest pipe time = 87 minutes.

Formula Used: Rate of flow (Efficiency) = k × $(\text{Diameter})^2$; Total Work = Efficiency × Time

=> Efficiency of Pipe 1 (E1) = 2^2 = 4 units/min

=> Efficiency of Pipe 2 (E2) = 3^2 = 9 units/min

=> Efficiency of Pipe 3 (E3) = 4^2 = 16 units/min (Largest Pipe)

=> Total capacity of cistern = E3 × 87 = 16 × 87 = 1392 units

=> Total Efficiency when all open = 4 + 9 + 16 = 29 units/min

=> Time taken = 1392 ÷ 29 = 48 minutes

Therefore The correct answer is 48 minutes.

Additional Information

Pipes and Cisterns Efficiency

The rate of filling or emptying a tank is inversely proportional to the time taken. Efficiency = Work ÷ Time.

Flow Rate and Diameter

In fluid dynamics, the volume flow rate is proportional to the area of cross-section, which is proportional to the square of the diameter (d^2).

Combined Work Formula

If multiple pipes operate together, their individual efficiencies are added: E_(total) = E1 + E2 + ... + E_n.

Q46. Answer: (b) 180

Shortcut Trick

Convert bases: 256=2^8, 64=2^6; 125=5^3, 25=5^2; 81=3^4, 27=3^3

Combine powers => $2^{32}/2^{(30)}=2^2$, 5^9/5^8=5, 3^(20)/3^(18)=3^2

Multiply => $2^2 \times 5 \times 3^2 = 4 \times 5 \times 9$

= 180

Therefore Answer = 180

Alternate Method

Given:

(256)^4 × $(125)^3$ × (81)^5 ÷ [(64)^5 × (25)^4 × (27)^6]

Concept Used:

BODMAS rule and laws of exponents

Calculation:

=> = (2^8)^4 × $(5^3)^3$ × (3^4)^5 ÷ [(2^6)^5 × $(5^2)^4$ × $(3^3)^6$]

=> = 2^{32} × 5^9 × 3^(20) ÷ [2^(30) × 5^8 × 3^(18)]

=> = 2^((32−30)) × 5^((9−8)) × 3^((20−18))

=> = $2^2 \times 5 \times 3^2$

=> = 4 × 5 × 9

=> = 180

Therefore The correct answer is 180.

Additional Information

Exponent Law

a^m ÷ a^n = a^((m−n))

Power Rule

$(a^m)^n$ = a^(mn)

Prime Factorization

Convert numbers into primes for easy simplification.

Q47. Answer: (c) 52.09%

Shortcut Trick

Since Volume prop. to r^3, use successive percentage formula for 15% three times.

Successive of 15% and 15% = 15 + 15 + (15 × 15)/100 = 32.25%.

Successive of 32.25% and 15% = 32.25 + 15 + (32.25 × 15)/100 = 47.25 + 4.8375 = 52.0875%.

Rounding up to 2 decimal places = 52.09%.

Therefore The correct answer is 52.09%.

Alternate Method

Given:

=> Increase in Radius (r) = 15%

=> Volume of Sphere (V) = (4/3) × π × r^3

Calculations:

=> Let the Initial Radius (r1) = 100 units

=> New Radius (r2) = 100 + 15% of 100 = 115 units

=> Initial Volume (V1) = (4/3) × π × $(100)^3$ = 1,000,000 × (4/3)π

=> New Volume (V2) = (4/3) × π × $(115)^3$ = 1,520,875 × (4/3)π

=> Increase in Volume = V2 − V1 = 520,875 × (4/3)π

=> Percentage Increase = (Increase ÷ V1) × 100

=> Percentage Increase = (520,875 ÷ 1,000,000) × 100 = 52.0875%

=> Rounded up to 2 decimal places = 52.09%

Therefore The correct answer is 52.09%.

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Additional Information

Surface Area Increase

If the radius of a sphere increases by x%, the surface area increases by [2x + (x²/100)]%.

Successive Percentage for Three Variables

For changes a%, b%, and c%, the net change is [a + b + c + (ab+bc+ca)/100 + (abc)/10000]%.

Volume and Radius Proportionality

For a sphere, the Volume is proportional to the cube of the radius (V prop. to r³), while for a circle, the Area is proportional to the square of the radius (A prop. to r²).

Q48. Answer: (b) 25%

Shortcut Trick

Ratio of CP to SP is inversely proportional to the Quantity.

Quantity Ratio (CP : SP) = 30 : 40.

Price Ratio (CP : SP) = 40 : 30 = 4 : 3.

Loss = CP − SP = 4 − 3 = 1 unit.

Loss% = (Loss ÷ CP) × 100 = (1 ÷ 4) × 100 = 25%.

Therefore The correct answer is 25%.

Alternate Method

Given: Cost Price (CP) of 30 chairs = Selling Price (SP) of 40 chairs.

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

=> Let the CP of 1 chair be Rs. 1.

=> Total CP of 30 chairs = Rs. 30.

=> According to the question, SP of 40 chairs = CP of 30 chairs = Rs. 30.

=> CP of 40 chairs = Rs. 40.

=> Loss on 40 chairs = CP − SP = 40 − 30 = Rs. 10.

=> Loss Percentage = (10 ÷ 40) × 100 = 25%.

Therefore The correct answer is 25%.

Additional Information

Cost Price and Selling Price Relation

When CP of x articles = SP of y articles, then Profit or Loss% = [(x − y) ÷ y] × 100. A positive result indicates profit, while a negative result indicates loss.

Loss Condition

Loss occurs when the Selling Price is less than the Cost Price (SP < CP).

Q49. Answer: (b) 18

Shortcut Trick

To find the smaller number when the sum (S) and difference (D) are given:

Smaller Number = (Sum − Difference) ÷ 2

=> (45 − 9) ÷ 2

=> 36 ÷ 2 = 18

Therefore The correct answer is 18.

Alternate Method

Given:

Let the larger number be x and the smaller number be y.

Sum: x + y = 45 --- (Equation 1)

Difference: x − y = 9 --- (Equation 2)

Calculations:

Subtracting (Equation 2) from (Equation 1):

=> (x + y) − (x − y) = 45 − 9

=> x + y − x + y = 36

=> 2y = 36

=> y = 36 ÷ 2

=> y = 18

Therefore The correct answer is 18.

Additional Information

Finding the Larger Number

The larger number can be found using the formula: (Sum + Difference) ÷ 2. Here, (45 + 9) ÷ 2 = 27.

Product of Two Numbers

If the sum (S) and difference (D) are known, the product is $(S^2 - D^2) \div 4$.

Ratio of Two Numbers

The ratio of the larger number to the smaller number is (Sum + Difference) : (Sum − Difference).

Q50. Answer: (d) 5:42

Shortcut Trick

Convert 7 days to hours by multiplying with 24.

Ratio = 20 : (7 × 24) = 20 : 168.

Divide both sides by the HCF (4) → (20 ÷ 4) : (168 ÷ 4) = 5 : 42.

Therefore The correct answer is 5:42.

Alternate Method

Given: First quantity = 20 hours; Second quantity = 7 days.

Formula Used: Ratio = Quantity 1 ÷ Quantity 2 (Units must be identical).

=> Quantity 1 = 20 hours

=> Quantity 2 = 7 × 24 hours = 168 hours

=> Required Ratio = 20 ÷ 168

=> Required Ratio = 5 ÷ 42

Therefore The correct answer is 5:42.

Additional Information

Unit Homogeneity

Before calculating a ratio, ensure both quantities are in the same unit (e.g., both in hours or both in days).

Time Conversion

Standard conversion: 1 day = 24 hours; 1 hour = 60 minutes; 1 minute = 60 seconds.

Simplest Form

A ratio a:b is in its simplest form if the Greatest Common Divisor (GCD) of a and b is 1.

Q51. Answer: (a) KM - SV

The logic followed here is based on the alphabetical position pattern:

Option 1: KM - SV

Option 2: EG - MO

Option 3: CE - KM

Option 4: BD - JL

Thus, KM - SV does not follow the pattern.

Hence, the odd one out is Option 1.

Q52. Answer: (a) 118

The logic followed here is:

thus, "118" will replace the question mark in the given series.

Hence, the correct option is "Option 1".

Q53. Answer: (a) One

Given: A, B, C, D, E and F sit around a circular table facing the centre.

D sits third to the right of F.

A sits second to the left of F.

E sits second to the right of B.

C sits to the immediate right of E.

So, there is 1 person (D) between A and C.

Hence, the correct answer is "Option 1".

Q54. Answer: (d) P

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

Only two boxes are kept between S and D.

Only B is kept above T.

No box is kept below D.

W is kept at some place below P but at some place above E.

Position	Box
7 (Top)	B
6	T
5	P
4	S
3	W
2	E
1 (Bottom)	D

Third box above E → P

Hence, the correct answer is Option 4.

Q55. Answer: (d) 3

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

Now,

Odd digits, which are immediately preceded by an odd digit and also immediately followed by an even digit.

So, Needed pattern is: Odd - Odd - Even

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

So, total valid odd digits = 3

Hence, the correct answer is Option 4.

Q56. Answer: (b) 233

The logic followed here is:

thus, "233" will replace the question mark in the given series.

Hence, the correct option is "Option 2".

Q57. Answer: (d) SRR

The logic followed here is based on the alphabetical position pattern:

Option 1: MKL

Option 2: QOP

Option 3: ECD

Option 4: SRR

Thus, SRR does not follow the pattern.

Hence, the odd one out is Option 4.

Q58. Answer: (a) jp

Given:

‘are you ready’ is coded as ‘nb uc jp’

‘do you agree’ is coded as ‘jh jp ko’

So, you = jp

Hence, the correct answer is Option 1.

Q59. Answer: (a) Three

Given: Seven people B, C, D, I, J, K and L are sitting in a straight line facing north.

Only two people sit between L and J.

Only J sits to the right of D.

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Only three people sit between D and C.
K sits somewhere to the left of B but to the right of I.
So, there are 3 people between I and B.
Hence, the correct answer is "Option 1".

Q60. Answer: (b) TUS−RSQ

The logic followed here is:
For, YZX → WXV
For, XYW → VWU
Now, check the options using the same pattern:
Option 1) TTQ → RSQ
Option 2) TUS → RSQ
Option 3) TUS → QSP
Option 4) TTQ → QRP
Hence, the correct answer is Option 2.

Q61. Answer: (c) YVXA

The logic followed here is:
For, NKMP → TQSV
For, KHJM → QNPS
Now, apply the same to SPRU:
So, SPRU → YVXA
Hence, the correct answer is Option 3.

Q62. Answer: (a) 2

Given: Seven boxes A, B, C, D, E, F and G are kept one over the other but not necessarily in the same order.
Only two boxes are kept below D.
Only one box is kept above G.
Only one box is kept between G and C.
E is kept immediately above A.
F is kept at some place below B.

Position	Box
7 (Top)	B
6	G
5	F
4	C
3	D
2	E
1 (Bottom)	A

Boxes above F → B, G
Hence, the correct answer is Option 1.

Q63. Answer: (a) Wife's sister

Family Chart:
Decoding the Symbols:

Symbol →	±	•	Rs.	#
Meaning →	Wife	Son	Father	Sister

Given: D # R * A Rs. C ± O
It means: D is the sister of R, R is the son of A, A is the father of C, and C is the wife of O.

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Hence, D is Wife's sister.

Therefore, the correct answer is Option 1.

Q64. Answer: (c) 50 - 22 - 72

The logic followed here is:

Logic: Third Number = First Number + Second Number.

For, (23 - 10 - 33)

=> 23 + 10 = 33

For, (4 - 13 - 17)

=> 4 + 13 = 17

Now, checking the options using the same pattern:

Option 1) 49 - 21 - 80

=> 49 + 21 = 70 ≠ 80

Option 2) 16 - 20 - 46

=> 16 + 20 = 36 ≠ 46

Option 3) 50 - 22 - 72

=> 50 + 22 = 72

Option 4) 44 - 20 - 85

=> 44 + 20 = 64 ≠ 85

Hence, the correct answer is Option 3.

Q65. Answer: (a) 1

Given: (Left) £ 9 $ £ £ % € 6 3 3 1 8 & 3 © # * 7 * & 3 & (Right)

Now,

Symbols, which are immediately preceded by a number and also immediately followed by a number.

So, Needed pattern is: Number - Symbol - Number

(Left) £ 9 $ £ £ % € 6 3 3 1 8 & 3 © # * 7 * & 3 & (Right)

So, total valid symbols = 1

Hence, the correct answer is Option 1.

Q66. Answer: (a) 4

BODMAS Table:

Decoding the given information:

Alphabet	**•**	**–**	**×**	**÷**
Meaning	−	•	÷	×

Now, replacing the sign from left to right using BODMAS Rule, we get:

=> 24 ÷ 3 − 6 × 2 + 8 = ?

=> 8 − 12 + 8 = ?

=> 16 − 12 = ?

=> 4

Hence, the correct option is "Option 1".

Q67. Answer: (a) More than three

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

Now,

Odd numbers, which are immediately preceded by an odd number and also immediately followed by an odd number.

So, Needed pattern is: Odd - Odd - Odd

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

So, total valid odd numbers = 6

Hence, the correct answer is Option 1.

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Q68. Answer: (c) Two

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

Now,

Even digits, which are immediately preceded by an odd digit and also immediately followed by an even digit.

So, Needed pattern is: Odd - Even - Even

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

So, total valid even digits = 2

Hence, the correct answer is Option 3.

Q69. Answer: (d) 37, 50

The logic followed here is:

thus, "37, 50" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q70. Answer: (b) HKB

The logic followed here is:

So, 'HKB' will replace the question mark in the given series.

Hence, the correct answer is "Option 2"

Q71. Answer: (d) SZ69

The logic followed here is:

So, 'SZ69' will replace the question mark in the given series.

Hence, the correct answer is "Option 4"

Q72. Answer: (b) 5 km to the south

The logic followed here is:

Given:

Mr. Akai starts from Point A (0, 0)

15 km West

11 km South

50 km East

31 km North

17 km West

15 km South

18 km West

So, To return to Point A, Mr. Akai must move 5 km South.

Hence, the correct answer is Option 2.

Q73. Answer: (b) Only conclusion (II) follows

Given Statements:

All machines are tools.

All machines are equipment.

Some equipment are toys.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some toys are machines → Does not follow (Although some equipment are toys and all machines are equipment, there is no definite information that the toys are machines.)

II. Some equipment are tools → Follows (Since all machines are tools and all machines are equipment, machines form a common part of both Equipment and Tools. Therefore, some equipment are definitely tools.)

So, only conclusion II follows.

Hence, the correct answer is Option 2.

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Q74. Answer: (c) 4 km to the south

The logic followed here is:

Given:

Piyush starts from Point A (0, 0)

8 km East

Right turn → 6 km South

Right turn → 11 km West

Right turn → 10 km North

Right turn → 3 km East

So, To return to Point A, Piyush must move 4 km South.

Hence, the correct answer is Option 3.

Q75. Answer: (a) WTU−QNO

The logic followed here is:

For, NKL → HEF

For, AXY → URS

Now, check the options using the same pattern:

Option 1) WTU − QNO

Option 2) WTU − PNN

Option 3) WSS − QNO

Option 4) WSS − PMN

Hence, the correct answer is Option 1.

Q76. Answer: (b) 132

Given:

'VACP' is coded as '126' and 'MHTJ' is coded as '153'

Here,

VACP → V(22) + A(1) + C(3) + P(16) = 42 → 42 × 3 = 126

MHTJ → M(13) + H(8) + T(20) + J(10) = 51 → 51 × 3 = 153

For, OGQE

O(15) + G(7) + Q(17) + E(5) = 44

Code = 44 × 3 = 132

Hence, the correct answer is Option 2.

Q77. Answer: (a) Neither conclusion (I) nor (II) follows.

Given Statements:

No Porcupines are Bears.

All Bears are Leopards.

Some Leopards are Jaguars.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some Porcupines are Leopards → Does not follow (The statements only say that Porcupines are not Bears. There is no definite information that Porcupines overlap with Leopards.)

II. Some Bears are Jaguars → Does not follow (Although all Bears are Leopards and some Leopards are Jaguars, the Jaguars may belong to a different part of Leopards that does not include Bears.)

So, neither conclusion I nor conclusion II follows.

Hence, the correct answer is Option 1.

Q78. Answer: (a) 36

BODMAS Table:

Decoding the given information:

Alphabet	A	B	C	D
Meaning	×	÷	•	−

Now, replacing the sign from left to right using BODMAS Rule, we get:

=> 20 ÷ 5 − 8 × 3 + 14 × 4 = ?

=> 4 − 24 + 56 = ?

=> 60 − 24 = ?

=> 36

Hence, the correct option is "Option 1".

Q79. Answer: (d) One

Given: Six people A, B, C, D, E and F are sitting in a row facing north.

F sits to the immediate left of A.

C sits third to the left of D.

C is an immediate neighbour of A.

B sits to the immediate left of E.

Between C and E are B → only 1 person.

Hence, the correct answer is "Option 4".

Q80. Answer: (a) 14

BODMAS Table:

Decoding the given information:

Alphabet	A	B	C	D
Meaning	÷	×	•	−

Now, replacing the sign from left to right using BODMAS Rule, we get:

=> 11 × 2 − 44 ÷ 4 + 3 = ?

=> 22 − 11 + 3 = ?

=> 25 − 11 = ?

=> 14

Hence, the correct option is "Option 1".

Q81. Answer: (a) 74%

The correct answer is 74%.

Key Points

• The Sustainable Development Report 2025, which tracks the global progress toward the United Nations' 17 Sustainable Development Goals (SDGs), indicates that approximately 74% of the global population has access to clean fuels and technologies for cooking.

• This indicator is a primary metric for monitoring SDG 7, which aims to ensure access to affordable, reliable, sustainable, and modern energy for all people by the year 2030.

• Access to clean cooking involves the transition from traditional fuels like wood, charcoal, and coal to cleaner alternatives such as Liquefied Petroleum Gas (LPG), natural gas, electricity, and biogas.

• The report highlights that while there has been significant progress in regions like Central and Southern Asia, a large "access gap" remains in Sub-Saharan Africa, where traditional biomass is still widely used.

• Ensuring 74% access marks a critical step, yet the 2025 report emphasizes that current trajectories are not yet sufficient to reach the 100% target set for 2030.

Additional Information

• Sustainable Development Goal 7 (SDG 7):

• The goal focuses on three main pillars: universal access to modern energy, increasing the renewable energy share in the global mix, and doubling the global rate of energy efficiency improvement.

• Energy is central to nearly every major challenge and opportunity the world faces today, including poverty alleviation, food security, and climate change mitigation.

• Health and Environmental Impacts:

• Lack of clean cooking facilities leads to household air pollution, which the World Health Organization (WHO) identifies as a leading cause of premature deaths globally.

• Switching to clean fuels reduces carbon emissions and prevents deforestation caused by the excessive harvesting of firewood.

• Role of the Sustainable Development Solutions Network (SDSN):

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• The Sustainable Development Report is produced annually by the SDSN, an initiative launched in 2012 under the auspices of the UN Secretary-General.

• It provides the SDG Index and Dashboards, which assess the performance of all 193 UN Member States in implementing the 2030 Agenda.

Important Points

• Technological Classifications: To be considered "clean," technologies must meet specific emission standards defined by WHO guidelines for indoor air quality.

• Data Sources: The figures in the Sustainable Development Report 2025 are aggregated using data from the International Energy Agency (IEA), the World Bank, and the World Health Organization (WHO).

• Gender Dimension: Women and children are disproportionately affected by the lack of clean fuels, as they are typically responsible for fuel collection and are most exposed to indoor smoke.

• Global Target: Achieving universal access (100%) requires an estimated annual investment of billions of dollars, particularly in infrastructure for electricity grids and fuel distribution in rural areas.

Q82. Answer: (a) HCBL Co-operative Bank

The correct answer is HCBL Co-operative Bank.

Key Points

• The Reserve Bank of India (RBI) cancelled the license of HCBL Co-operative Bank Ltd., based in Lucknow, Uttar Pradesh, in May 2025.

• The central bank stated that the co-operative bank ceased to have adequate capital and earning prospects, which is a violation of the provisions of Section 11(1) and Section 22 (3)(d) read with Section 56 of the Banking Regulation Act, 1949.

• The bank was found non-compliant with the requirements of Section 22(3) (a), (b), (c), (d) and (e) of the Banking Regulation Act, making its continued operation prejudicial to the interests of its depositors.

• With the cancellation of its license, HCBL Co-operative Bank is strictly prohibited from conducting the 'business of banking', including the acceptance and repayment of deposits, effective immediately from the close of business hours on the date of the order.

• The RBI requested the Commissioner and Registrar of Cooperative, Uttar Pradesh, to issue an order for winding up the bank and to appoint a liquidator for the process.

Additional Information

• Banking Regulation Act, 1949:

• This Act provides a framework for the regulation and supervision of commercial and co-operative banks in India.

• Section 22 specifically empowers the RBI to issue or cancel licenses of banking companies, ensuring they maintain a sound financial position.

• Deposit Insurance and Credit Guarantee Corporation (DICGC):

• Upon liquidation, every depositor of the bank is entitled to receive a deposit insurance claim amount from DICGC.

• The maximum monetary limit for this claim is Rs. 5,00,000 (Rupees Five Lakh) per depositor, covering both principal and interest.

• Capital Adequacy Ratio (CAR):

• Also known as Capital to Risk-Weighted Assets Ratio (CRAR), it is a measure of a bank's available capital expressed as a percentage of its risk-weighted credit exposures.

• For Urban Co-operative Banks (UCBs), maintaining a minimum CRAR is mandatory to ensure they can absorb a reasonable amount of loss.

• Urban Co-operative Banks (UCBs):

• These banks refer to primary cooperative banks located in urban and semi-urban areas.

• Until 2020, they were under dual control of the State Government and RBI, but the Banking Regulation (Amendment) Act, 2020 brought them more directly under RBI's regulatory oversight.

Important Points

• Grounds for License Cancellation: The RBI typically cancels licenses when a bank lacks liquidity, fails to meet minimum capital requirements, or when the affairs of the bank are being conducted in a manner detrimental to the depositors.

• Liquidation Process: Once a liquidator is appointed, the process of asset realization and settlement of liabilities begins. The DICGC act ensures that small depositors are protected during this phase.

• Regulatory Timeline: In May 2025, the RBI intensified its scrutiny of Primary (Urban) Co-operative Banks to strengthen the financial stability of the co-operative banking sector.

• Impact on Depositors: According to data typically released by RBI during such cancellations, a vast majority (often over 98%) of depositors receive the full amount of their deposits back through the DICGC insurance if their balance is within the Rs. 5 lakh limit.

Q83. Answer: (d) 4.6%

The correct answer is 4.6%.

Key Points

• The State Bank of India (SBI) Research report, specifically the Ecowrap edition, projected that India's poverty rate for the year 2024 would reach 4.6%.

• This projection, discussed in reports updated through June 2025, reflects a significant downward trend in the number of people living below the poverty line compared to previous decades.

• The report attributes this decline to a robust increase in per capita income and a significant shift in rural and urban consumption patterns as recorded in the Household Consumption Expenditure Survey (HCES).

• According to the SBI analysis, the reduction in poverty is a result of the government's targeted welfare schemes and the digitalization of the economy, which has improved the efficiency of Direct Benefit Transfers (DBT).

• The 4.6% figure highlights the success of inclusive growth strategies that have moved a large segment of the bottom of the pyramid population into the lower-middle-class bracket.

Additional Information

• State Bank of India (SBI) Ecowrap:

• Ecowrap is a flagship economic research publication by SBI, led by the Group Chief Economic Adviser, Dr. Soumya Kanti Ghosh.

• It provides critical analysis on macroeconomic indicators, including GDP growth, inflation, and social development metrics.

• Poverty Measurement in India:

• Historically, poverty in India was measured using the Tendulkar Committee and Rangarajan Committee methodologies based on Monthly Per Capita Consumption Expenditure (MPCE).

• Recent estimates utilize the Household Consumption Expenditure Survey (HCES) 2022-23 data to provide a more contemporary view of poverty levels.

• Government Interventions:

• Schemes like the Pradhan Mantri Garib Kalyan Anna Yojana (PM-GKAY), which provides free foodgrains to over 80 crore people, have played a pivotal role in maintaining nutritional security and lowering poverty rates.

• The Lakhpati Didi initiative and PM SVANidhi are other examples of schemes aimed at economic empowerment of the marginalized sections.

• Global Context:

• The World Bank defines extreme poverty as living on less than $2.15 per day (based on 2017 Purchasing Power Parity).

• India's rapid reduction in poverty has been recognized by international organizations like the UNDP, noting that the country has successfully lifted millions out of Multidimensional Poverty.

Important Points

• Rural vs. Urban Trends: The SBI report noted that the decline in rural poverty has been more pronounced due to increased agricultural productivity and rural infrastructure development.

• Income Inequality: Along with the reduction in poverty, the report also highlighted a decline in income inequality (measured by the Gini Coefficient), suggesting that the benefits of economic growth are becoming more evenly distributed across different decile groups.

• Data Validity: The projection for 2024 (reported in June 2025) serves as a benchmark for evaluating the Sustainable Development Goals (SDG), specifically SDG 1, which aims to end poverty in all its forms everywhere.

Q84. Answer: (a) eSanjeevani

The correct answer is eSanjeevani.

Key Points

• eSanjeevani is the flagship National Telemedicine Service of India, developed and managed by the Ministry of Health and Family Welfare (MoHFW).

• According to a Press Information Bureau (PIB) report, the platform has achieved a historic milestone by facilitating more than 36 crore teleconsultations for patients across the country by 6 April 2025.

• The service was designed to provide healthcare access to citizens in remote and rural areas, effectively bridging the digital health divide between urban and rural populations.

• The initiative aligns with the vision of Digital India and ensures that quality medical advice is available to every citizen regardless of their geographical location.

• The eSanjeevani platform was developed by the Centre for Development of Advanced Computing (C-DAC) in Mohali, serving as a robust indigenous tele-consultation technology.

Additional Information

• Operational Models: The service operates via two primary models: eSanjeevani AB-HWC (a provider-to-provider model) and eSanjeevaniOPD (a patient-to-doctor model).

• eSanjeevani AB-HWC: This variant connects Health and Wellness Centres (HWCs) at the village level with specialized Hubs at district hospitals or medical colleges, following a hub-and-spoke model.

• eSanjeevaniOPD: Launched in April 2020 during the COVID-19 pandemic, this model allows patients to consult doctors directly from their homes using smartphones or computers.

• Economic Impact: By providing free tele-consultations, the scheme has significantly reduced Out-of-Pocket Expenditure (OOPE) for poor patients by eliminating travel costs and daily wage losses associated with visiting hospitals.

• Global Recognition: The platform is recognized as one of the world's largest government-run telemedicine systems, demonstrating India's leadership in digital health.

Important Points

• Integration with ABDM: eSanjeevani is integrated with the Ayushman Bharat Digital Mission (ABDM), allowing for the seamless creation of ABHA (Ayushman Bharat Health Account) and digital storage of health records.

• Specialized Care: The platform offers access to various specialties and super-specialties, including cardiology, pediatrics, and gynecology, which are often unavailable in rural healthcare setups.

• Electronic Prescriptions: At the end of each session, the system generates an e-prescription that is legally valid and can be used to obtain medicines or undergo further diagnostic tests.

• Regional Adoption: States like Andhra Pradesh, Karnataka, Tamil Nadu, and Uttar Pradesh have emerged as top performers in terms of the number of teleconsultations recorded on the platform.

Q85. Answer: (d) Apollo Tyres

The correct answer is Apollo Tyres.

Key Points

• In September 2025, the Board of Control for Cricket in India (BCCI) officially announced Apollo Tyres as the new Lead Sponsor for Team India across all formats.

• As the Lead Sponsor, the Apollo Tyres logo will be prominently displayed on the front of the Indian National Cricket Team jerseys for Test matches, One Day Internationals (ODI), and T20 Internationals (T20I).

• This partnership marks a significant transition in the commercial ecosystem of Indian Cricket, as Apollo Tyres takes over the position previously held by Dream11.

• The deal is expected to provide Apollo Tyres with massive global visibility, given the extensive viewership of the Indian cricket team's matches worldwide.

• The BCCI finalized the selection through a rigorous bidding process aimed at securing a partner that aligns with the premium brand value of Team India.

Additional Information

• The Board of Control for Cricket in India (BCCI):

• The BCCI is the national governing body for cricket in India, headquartered at the Cricket Centre, Wankhede Stadium in Mumbai.

• It was established in December 1928 as a society under the Tamil Nadu Societies Registration Act and is currently the wealthiest cricket board in the world.

• The organization is responsible for selecting the players and umpires who represent India in international events and exercises total control over domestic cricket.

• Sponsorship Categories in Indian Cricket:

• A Lead Sponsor primarily holds the rights to the chest branding on the jersey, which is the most valuable real estate on a player's kit.

• This is distinct from the Kit Sponsor, a role currently held by Adidas, which manufactures the apparel and displays its logo on the sleeve or shoulder.

• Other partners include Official Partners, who gain rights for stadium branding, digital content, and promotional activations.

Important Points

• Apollo Tyres Ltd is an Indian multinational Tyre manufacturing company headquartered in Gurugram, Haryana.

• Founded in 1972, the company has expanded its presence globally and is known for its associations with international sports, including a long-standing partnership with the football club Manchester United.

• The September 2025 announcement represents the company's deepest foray into Cricket, which remains the most popular sport in India and several other Commonwealth nations.

• By securing the Lead Sponsorship of Team India, Apollo Tyres joins an elite list of previous sponsors such as Sahara India Pariwar, Oppo, Vivo, and Byju's.

Q86. Answer: (a) First short story collection to win

The correct answer is First short story collection to win.

Key Points

• The book 'Heart Lamp' made literary history in 2025 by becoming the first short story collection to win the International Booker Prize. This achievement marked a departure from the historical trend where the prize was predominantly awarded to full-length novels.

• The International Booker Prize is a prestigious literary award given annually for a single work of fiction that is translated into English and published in the United Kingdom or Ireland.

• The victory of a short story collection is considered unique because the genre often faces stiffer competition from cohesive long-form narratives; however, 'Heart Lamp' was recognized for its thematic unity and the artistry of its individual tales.

• By winning this award, the book highlighted the growing global appreciation for short-form fiction and the vital role of translators in bringing diverse voices to the English-speaking world. Hence, the correct answer is First short story collection to win.

Additional Information

• The International Booker Prize:

• This award was established in 2005. Originally, it was a biennial award given to a living author for their entire body of work, but in 2016, it evolved into an annual prize for a specific book.

• The primary objective of the prize is to encourage the reading of high-quality fiction from all over the world and to acknowledge the work of translators.

• The prize money is £50,000, which is divided equally between the author and the translator to reflect their joint contribution to the work.

• Significance of the Short Story Genre:

• Short stories are characterized by their brevity and focus on a self-contained incident or series of linked incidents.

• In the history of major literary awards, collections have often been sidelined in favor of novels. The 2025 win for 'Heart Lamp' serves as a milestone for authors working in this concise medium.

• Key features of modern short story collections include narrative density, evocative language, and the ability to explore multiple cultural perspectives within a single volume.

• Comparison with the Booker Prize:

• The Booker Prize (formerly the Man Booker Prize) is awarded for the best novel written originally in English and published in the UK or Ireland.

• In contrast, the International Booker Prize specifically targets translated literature, making it a key index for global literary trends and cross-cultural exchange.

Important Points

• Eligibility Criteria: To be eligible for the International Booker Prize, a work must be a translation into English. Both novels and short story collections are eligible, though the latter winning is a statistical rarity in the prize's history.

• Historical Context: Since the rule change in 2016, the prize has seen winners from various countries including South Korea, Poland, Oman, and India, showcasing a truly international scope of talent.

• Impact of the Win: A win typically leads to a massive surge in international sales and brings global recognition to the author and the specific language the book was originally written in.

Q87. Answer: (b) 16 to 18 years

The correct answer is 16 to 18 years.

Key Points

• The Nurturing Aspirations through Vocational Training for Young Adolescent Girls programme was launched in June 2025 as a landmark collaborative initiative.

• This programme is a joint venture between the Ministry of Women and Child Development (MWCD) and the Ministry of Skill Development and Entrepreneurship (MSDE).

• The specific target demographic for this initiative is adolescent girls in the age group of 16 to 18 years. This age bracket is considered critical as it marks the transition from secondary education to higher studies or entry into the workforce.

• The primary objective of the scheme is to provide industry-relevant vocational training to young girls, ensuring they possess the necessary skills to secure gainful employment or pursue entrepreneurship.

• By focusing on the 16 to 18 years age group, the government aims to reduce the dropout rate of girls after high school and empower them with economic independence. Hence, the correct option is 16 to 18 years.

Additional Information

• Ministry of Women and Child Development (MWCD):

• The MWCD was established as a separate ministry in January 2006 to provide the necessary impetus to the holistic development of women and children in India.

• It acts as the nodal agency for schemes like Mission Shakti, Poshan 2.0, and Vatsalya, focusing on protection, empowerment, and nutrition.

• Ministry of Skill Development and Entrepreneurship (MSDE):

• The MSDE was set up in November 2014 to drive the 'Skill India' agenda and converge all skill development initiatives across the country.

• It oversees the implementation of the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) and manages the National Skill Development Corporation (NSDC).

• Significance of Vocational Training:

• In the context of the National Education Policy (NEP) 2020, vocational training is being integrated into the school curriculum to ensure that 50% of learners have exposure to vocational education by 2025.

• Training modules often include digital literacy, soft skills, and technical training in sectors like Information Technology (IT), Healthcare, and Retail.

Important Points

• Demographic Dividend: India's large population of adolescents (aged 10 to 19 years) represents a significant opportunity. Providing skills to the 16 to 18 years cohort ensures that the Female Labour Force Participation Rate (FLFPR) increases in the coming years.

• Convergence Model: The Nurturing Aspirations programme utilizes the MWCD's reach through Anganwadi centers and MSDE's infrastructure through Industrial Training Institutes (ITIs) and Pradhan Mantri Kaushal Kendras (PMKKs).

• Gender Budgeting: This initiative aligns with India's commitment to Gender Budgeting, where specific funds are allocated to ensure that developmental benefits reach women and girls directly.

• Social Impact: By targeting girls aged 16 to 18, the programme also plays an indirect role in delaying the age of marriage and improving the overall socio-economic status of women in rural and semi-urban areas.

Q88. Answer: (a) Uttarakhand

The correct answer is Uttarakhand.

Key Points

• The 38th edition of the National Games is officially scheduled to be hosted by the state of Uttarakhand in the year 2025.

• The Indian Olympic Association (IOA), led by its President P.T. Usha, confirmed the dates for the event, which will take place from January 28 to February 14, 2025.

• This marks a significant milestone for Uttarakhand, as it will be the first time the state hosts the summer version of the National Games, having previously hosted the Winter National Games.

• The games will be spread across several cities in the state, including Dehradun, Haldwani, Haridwar, Rudrapur, and Rishikesh, to utilize existing and newly developed sports infrastructure.

• Chief Minister Pushkar Singh Dhami has been actively overseeing the preparations, emphasizing that the event will showcase Uttarakhand's culture and hospitality while promoting a sports culture in the Himalayan region.

Additional Information

• Goa (37th National Games):

• The 37th National Games were held in Goa in 2023 (October-November).

• It featured over 10,000 athletes competing in 43 different sports disciplines.

• Maharashtra topped the medal tally in the 2023 edition, winning the Raja Bhalindra Singh Trophy.

• Gujarat (36th National Games):

• The 36th National Games took place in Gujarat in 2022 after a gap of seven years.

• The event was held across six cities: Ahmedabad, Gandhinagar, Surat, Vadodara, Rajkot, and Bhavnagar.

• The Services Sports Control Board (SSCB) emerged as the overall champion during this edition.

• History of National Games:

• The first-ever Indian Olympic Games (later renamed National Games) were held in 1924 in Lahore (undivided India).

• The first modern National Games on the lines of the Olympics were held in New Delhi in 1985.

• The primary objective of these games is to identify and nurture athletic talent for international competitions like the Olympics and Asian Games.

Important Points

• Infrastructure and Disciplines: For the 2025 games, Uttarakhand is preparing to host 38 sports disciplines. Major venues include the Maharana Pratap Sports College in Dehradun and the Indira Gandhi International Cricket Stadium in Haldwani.

• Mascot and Symbolism: The state often uses regional symbols like the Himalayan Monal (state bird) or the Himalayan Musk Deer (state animal) to represent its sporting identity; the 2025 edition aims to highlight "Green Games" to promote environmental sustainability.

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• Future Editions: Following Uttarakhand, the state of Meghalaya has been lined up by the IOA as a potential future host for the 39th National Games, continuing the trend of taking national sports to the North-Eastern and Himalayan states.

• Governing Body: The Indian Olympic Association (IOA) is the body responsible for selecting host states and managing the schedule. It was established in 1927.

Q89. Answer: (a) Environment Protection (Management of Contaminated Sites) Rules, 2025

The correct answer is Environment Protection (Management of Contaminated Sites) Rules, 2025.

Key Points

• The Ministry of Environment, Forest and Climate Change (MoEFCC) notified the Environment Protection (Management of Contaminated Sites) Rules, 2025 in July 2025. These rules represent a significant step in India's environmental governance by focusing on the cleanup of land and water bodies impacted by industrial pollutants.

• The core objective of these rules is the remediation of sites where hazardous substances or chemicals have been released, ensuring that the environment is restored to a safe state.

• A fundamental pillar of these rules is the "polluter pays principle," which mandates that the person or organization responsible for the contamination must bear the entire financial liability for the investigation and remediation process.

• A "contaminated site" is specifically defined under these rules as a place where the concentration of hazardous substances exceeds the standards prescribed by the government, thereby posing a significant risk to human health and the ecological balance.

• The rules empower State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) to identify such sites, maintain a public inventory, and monitor the progress of remediation plans submitted by the responsible parties. Hence, the notification aims at institutionalizing the management of polluted areas.

Additional Information

• Regulatory Framework: These rules are framed under the authority granted by the Environment (Protection) Act, 1986, which allows the Central Government to take necessary measures to protect and improve the quality of the environment.

• Role of the CPCB: The Central Pollution Control Board (CPCB) is tasked with providing the technical guidelines, protocols, and remediation standards that must be followed nationwide to ensure scientific accuracy in the cleanup process.

• Legacy Contaminated Sites: The rules also address "legacy sites," which are areas contaminated in the past where the original polluter may no longer exist or be identifiable. In such cases, the State Government or designated authorities may step in to initiate the remediation.

• Stages of Management: The management process usually involves three critical stages: Preliminary Investigation to confirm contamination, Detailed Site Investigation to map the extent of the spread, and the formulation and execution of a Remediation Plan.

• Impact on Public Health: Chemically contaminated sites often lead to groundwater pollution and soil degradation, causing long-term health issues such as respiratory diseases, carcinogenic risks, and heavy metal poisoning among local communities.

Important Points

• Financial Guarantees: To prevent the abandonment of contaminated areas, the rules may require industries to provide financial assurances or insurance to cover potential future remediation costs.

• Public Participation: The 2025 Rules emphasize transparency, requiring that information regarding contaminated sites be available in the public domain so that residents are aware of potential environmental hazards in their vicinity.

• Enforcement: Failure to comply with the remediation orders issued by the SPCB can lead to heavy penalties, closure of industry, or legal action under the Environment (Protection) Act.

• Sustainable Restoration: The rules encourage the use of green remediation technologies, such as bioremediation or phytoremediation, which use biological agents to neutralize contaminants in a cost-effective and eco-friendly manner.

Q90. Answer: (c) Andrzej Poczobut and Mzia Amaglobeli

The correct answer is Andrzej Poczobut and Mzia Amaglobeli.

Key Points

• The 2025 Sakharov Prize for Freedom of Thought has been awarded to Andrzej Poczobut and Mzia Amaglobeli in recognition of their courageous fight for democracy and human rights in Belarus and Georgia respectively.

• Andrzej Poczobut is a prominent Belarusian-Polish journalist and a member of the Union of Poles in Belarus. He has been a consistent critic of President Alexander Lukashenko's authoritarian regime.

• In February 2023, Poczobut was sentenced to eight years in a high-security penal colony on charges of "inciting hatred" and "harming national security," which international observers have condemned as politically motivated.

• Mzia Amaglobeli is a notable Georgian civic activist and one of the founders of the "Daitove" (Leave) movement, which played a pivotal role in organizing protests in Tbilisi.

• Amaglobeli is recognized for her leadership during the 2024 mass demonstrations in Georgia against the controversial "Foreign Agent Law," advocating for Georgia's European integration and democratic future.

• The decision to honor these two individuals was announced by the European Parliament’s Conference of Presidents, reflecting the European Union's commitment to supporting those who risk their lives for freedom of speech.

Additional Information

• The Sakharov Prize:

• Established in December 1988, the prize is named after Andrei Sakharov, the Soviet physicist and Nobel Peace Prize winner who became a leading dissident.

• It is the European Union's highest tribute to human rights work and is awarded annually to individuals or organizations that have made an exceptional contribution to the protection of freedom of thought.

• The prize includes a certificate and a monetary award of 50,000 Euros, which is usually presented during a plenary session in Strasbourg.

• Context of the 2025 Award:

• The selection of Poczobut highlights the ongoing repression in Belarus following the 2020 disputed elections.

• The selection of Amaglobeli underscores the geopolitical tension in the Caucasus region and the Georgian people's desire to maintain a democratic path amidst rising external pressures.

Important Points

• Historical Significance: Past recipients of the prize include global icons such as Nelson Mandela (the first recipient in 1988), Malala Yousafzai (2013), and the Democratic Opposition in Venezuela (2017).

• Selection Process: Candidates are nominated by political groups or by at least 40 Members of the European Parliament (MEPs). The Committees on Foreign Affairs and Development then shortlist three finalists before the final winner is chosen.

• Impact: Winning the Sakharov Prize provides international visibility and a layer of protection through diplomatic pressure on the regimes detaining or harassing the laureates.

Q91. Answer: (a) Aadhaar Card

The correct answer is Aadhaar Card.

Key Points

• In September 2025, the Supreme Court issued a significant directive to the Election Commission of India (ECI) regarding the electoral process in Bihar.

• The court ordered that the Aadhaar Card be recognized as the 12th valid proof of identity specifically for inclusion and verification in Bihar’s revised voters’ list.

• This decision was aimed at addressing discrepancies in the Electoral Roll and ensuring a more inclusive registration process for voters who may lack other forms of traditional identification.

• The Aadhaar Card, which is a 12-digit unique identity number issued by the Unique Identification Authority of India (UIDAI), serves as a robust tool for verifying the identity and residence of a person.

• The directive emphasizes the use of technology and centralized databases to eliminate duplicate entries and bogus voters from the revised lists in the state of Bihar.

Additional Information

• Election Commission of India (ECI):

• The ECI is an autonomous constitutional authority responsible for administering election processes in India as per Article 324 of the Constitution.

• It oversees elections to the Lok Sabha, Rajya Sabha, State Legislative Assemblies, and the offices of the President and Vice President.

• Valid Identity Proofs for Voting:

• Traditionally, the ECI accepts several documents for identification at polling stations, including the Elector Photo Identity Card (EPIC), Passport, Driving License, and Service Identity Cards issued by Central/State Government.

• Other recognized documents include PAN Card, MNREGA Job Card, and Health Insurance Smart Cards issued under the scheme of the Ministry of Labour.

• Aadhaar-Voter ID Linking:

• The Election Laws (Amendment) Act, 2021, allowed for the voluntary linking of Aadhaar with Voter IDs to curb the menace of multiple enrollments of the same person in different places.

• The Supreme Court’s intervention often balances the need for electoral integrity with the Right to Privacy and the Right to Vote.

Important Points

• Bihar State Context: Bihar has 243 Legislative Assembly constituencies and 40 Lok Sabha seats, making the accuracy of its voter database critical for National Politics.

• Legal Framework: The preparation and revision of Electoral Rolls are governed by the Representation of the People Act, 1950 and the Registration of Electors Rules, 1960.

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• UIDAI: The Unique Identification Authority of India was established in 2009 and functions under the Ministry of Electronics and Information Technology (MeitY).

• Role of the Judiciary: The Supreme Court acts as a guardian of the Constitution, ensuring that the Election Commission maintains the purity of elections through fair voter identification practices.

Q92. Answer: (b) 1 February 2025

The correct answer is 1 February 2025.

Key Points

• The Union Budget 2025–26 was presented in the Parliament of India on 1 February 2025 by the Union Minister for Finance and Corporate Affairs, Nirmala Sitharaman.

• With this presentation, Nirmala Sitharaman created a historical milestone by presenting her seventh consecutive budget, surpassing the record previously held by former Prime Minister and Finance Minister Morarji Desai.

• The budget outlines the Government of India's estimated receipts and expenditures for the upcoming fiscal year, which runs from 1 April 2025 to 31 March 2026.

• Following the established tradition since 2017, the budget was presented on the first day of February to ensure that the budgetary provisions and tax changes could be implemented by the start of the new financial year.

• The presentation was preceded by the Economic Survey 2024-25, which was tabled in the house on 31 January 2025, providing a comprehensive report on the performance of the Indian economy.

Additional Information

• Constitutional Provision: According to Article 112 of the Constitution of India, the President shall, in respect of every financial year, cause to be laid before both the Houses of Parliament a statement of the estimated receipts and expenditure of the Government of India, referred to as the Annual Financial Statement.

• Budget Date Shift: Until 2016, the Union Budget was presented on the last working day of February. In 2017, then Finance Minister Arun Jaitley shifted the date to 1 February to allow for better administrative planning.

• Railway Budget Merger: Also in 2017, based on the recommendations of the Bibek Debroy Committee, the 92-year-old practice of presenting a separate Railway Budget was discontinued, and it was merged with the Union Budget.

• Digital Transition: In 2021, the government introduced the first-ever paperless budget due to the COVID-19 pandemic, where the Finance Minister read the speech from a digital tablet, a practice that has continued to promote the Digital India mission.

• Bahi-Khata Tradition: In 2019, Nirmala Sitharaman replaced the traditional colonial-style leather briefcase with a Bahi-Khata (a red silk cloth folder) to carry the budget documents, signifying a shift toward Indian traditions.

Important Points

• Halwa Ceremony: This is a traditional event held at North Block in New Delhi, usually a few days before the budget, marking the beginning of the printing (or digital finalization) process and the "lock-in" of finance ministry officials to maintain strict secrecy.

• Fiscal Year: The financial year in India follows a cycle from April to March, which is different from the calendar year (January to December).

• Vote on Account: In an election year, the government usually presents an Interim Budget or a Vote on Account to meet essential expenditures until a new government is formed. Since 2025-26 is not a general election year, a full budget was presented.

• Budget Components: The budget is divided into two main parts: the Revenue Budget (short-term income and expenses) and the Capital Budget (long-term investments and assets).

Q93. Answer: (c) Bharat Sanchar Nigam Limited

The correct answer is Bharat Sanchar Nigam Limited.

Key Points

• Bharat Sanchar Nigam Limited (BSNL) reached a major milestone by introducing the soft launch of its homegrown Quantum 5G Fixed-Wireless-Access (FWA) system.

• The event took place on 18 June 2025, signifying a leap forward for India's public sector unit in the competitive telecommunications landscape.

• The launch was conducted in Hyderabad, a city recognized as a premier technology and IT hub in India, serving as the initial testing ground for this advanced network.

• The system is distinguished by being indigenously developed, meaning the hardware and software stack were designed and manufactured within India under the Aatmanirbhar Bharat initiative.

• This Quantum 5G FWA system is designed to provide high-speed internet connectivity without the need for physical fiber lines, utilizing Quantum Key Distribution (QKD) for enhanced security.

Additional Information

• Quantum 5G Technology:

• It incorporates Quantum Cryptography to ensure that data transmission is virtually unhackable, addressing modern cybersecurity

concerns.

• By using quantum mechanics, the network can detect any eavesdropping attempts immediately, providing a secure platform for government and enterprise use.

• Fixed-Wireless-Access (FWA):

• FWA allows network operators to provide ultra-high-speed broadband to suburban and rural areas where laying optical fiber cables is difficult or expensive.

• It utilizes millimeter-wave (mmWave) or mid-band spectrum to deliver gigabit speeds over the air to a fixed receiver at the consumer's premises.

• Role of BSNL in 5G:

• BSNL has been working closely with the Centre for Development of Telematics (C-DOT) to deploy an entirely Indian 5G stack.

• Unlike private players who often rely on foreign vendors like Nokia or Ericsson, BSNL's focus is on sovereign technology to ensure long-term strategic independence.

• Geographic Impact:

• The choice of Hyderabad for the soft launch highlights the city's robust infrastructure and the presence of numerous defense and research laboratories that can benefit from Quantum-secure communications.

Important Points

• National Quantum Mission (NQM):

• The development of this technology aligns with India's National Quantum Mission, approved in 2023, which aims to make India a global leader in quantum technologies.

• The mission targets quantum communication over distances of several hundred kilometers, which BSNL is now implementing at a commercial scale.

• Telecom Sector Evolution:

• The transition from 4G to Quantum 5G represents a technological "leapfrogging" for BSNL, allowing it to compete with private giants like Reliance Jio and Bharti Airtel.

• As of 2025, the goal is to expand this service to other major metropolitan cities and eventually to Tier-2 and Tier-3 towns to bridge the digital divide.

Q94. Answer: (b) 13.8%

The correct answer is 13.8%.

Key Points

• The Sustainable Development Report 2025 indicates that the percentage of seats held by women in the Indian Parliament stands at 13.8%. This metric is a vital indicator for monitoring progress toward Sustainable Development Goal (SDG) 5, which focuses on Gender Equality.

• In the 2024 General Elections, which formed the 18th Lok Sabha, a total of 74 women were elected out of 543 seats. This resulted in a percentage of approximately 13.6% to 13.8%, reflecting a slight stagnation in female political representation.

• The current figure of 13.8% shows a marginal decrease compared to the 17th Lok Sabha (elected in 2019), where 78 women were elected, accounting for 14.36% of the house.

• Under the SDG Indicator 5.5.1, the proportion of seats held by women in national parliaments is tracked globally to ensure "women's full and effective participation and equal opportunities for leadership at all levels of decision-making."

• Despite being one of the world's largest democracies, India's percentage remains lower than the global average of women in national parliaments, which hovers around 26.5%.

Additional Information

• Nari Shakti Vandan Adhiniyam (Women's Reservation Bill):

• To address the low representation, the Government of India passed the 128th Constitutional Amendment Bill in September 2023.

• The Act mandates a 33% reservation for women in the Lok Sabha and State Legislative Assemblies.

• However, the implementation of this reservation is linked to the completion of the next census and the subsequent delimitation exercise.

• Historical Context of Women in Parliament:

• In India's 1st Lok Sabha (formed in 1952), women held only 4.4% of the seats.

• While the number has grown from 22 women in 1952 to 74 women in 2024, the growth rate has been slow over the last seven decades.

• Sustainable Development Goals (SDGs):

• The SDGs were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty and protect the planet by 2030.

• SDG 5 specifically targets gender equality, including the elimination of all forms of discrimination and violence against women in

the public and private spheres.

• Global and Regional Comparison:

• According to reports from the Inter-Parliamentary Union (IPU), countries like Rwanda, Cuba, and Nicaragua lead the world with over 50% women's representation in their national legislatures.

• In the South Asian region, countries like Nepal and Bangladesh have historically maintained higher percentages of women in parliament compared to India due to various reservation mechanisms.

Important Points

• Role of the Election Commission of India (ECI): The ECI has noted that while female voter turnout has significantly increased (often surpassing male turnout in recent state elections), the number of female candidates fielded by political parties remains low.

• Sustainable Development Report: This report is an annual assessment of progress for all UN Member States towards the SDGs, published by the Sustainable Development Solutions Network (SDSN).

• State-wise Performance: In the 2024 elections, states like West Bengal and Odisha showed higher trends of electing women members compared to the national average.

Q95. Answer: (d) Uttar Pradesh

The correct answer is Uttar Pradesh.

Key Points

• The 59th National Cross Country Championships were held in Meerut, Uttar Pradesh, on January 12, 2025.

• This prestigious athletic event was organized under the aegis of the Athletics Federation of India (AFI) in collaboration with the Uttar Pradesh Athletics Association.

• The championships featured various categories, including the Men's 10km, Women's 10km, as well as Under-20, Under-18, and Under-16 age groups for both boys and girls.

• The event served as the official selection trials for the Indian national team to participate in the upcoming Asian Cross Country Championships.

• Athletes from all over the country, representing different States, Union Territories, and units like the Services Sports Control Board (SSCB) and Railways, competed on the natural terrain courses designed for the meet. Hence, the correct answer is Uttar Pradesh.

Additional Information

• Athletics Federation of India (AFI):

• The AFI is the apex body for athletics in India, responsible for the management and promotion of track and field sports. It was established in 1946.

• It is affiliated with World Athletics and the Asian Athletics Association, ensuring that Indian athletes follow international standards.

• Cross-Country Running:

• This is a specific discipline of long-distance running where individuals and teams run on open-air courses over natural terrain such as grass, dirt, and mud.

• Unlike track events, cross-country relies on the ability of the athlete to adapt to uneven surfaces and varying weather conditions.

• Venue Significance:

• Meerut is often referred to as the Sports City of India due to its massive sports goods manufacturing industry.

• Hosting the National Cross Country Championships in Meerut highlights Uttar Pradesh's growing infrastructure for national-level sporting events.

Important Points

• Strategic Selection: The championship date, January 12, coincided with National Youth Day, celebrating the birth anniversary of Swami Vivekananda, which inspired many young participants.

• State Initiatives: The government of Uttar Pradesh has been promoting sports through schemes like One District One Sport (ODOS) and the construction of the Major Dhyan Chand Sports University in Meerut.

• Qualifying Standards: Top performers in the 2025 meet were shortlisted for national camps to prepare for international competitions in China and other global venues.

• Historical Context: Previous editions of the National Cross Country Championships have been hosted in states like Nagaland (Kohima) and Haryana, showing a pan-India rotation of the event.

Q96. Answer: (d) Two

The correct answer is Two.

Key Points

• Jannik Sinner has won two consecutive Australian Open titles as of the conclusion of the 2025 tournament.

• He secured his first Australian Open title in 2024 by defeating Daniil Medvedev in a grueling five-set final, coming back from two

sets down.

• In January 2025, Sinner successfully defended his title at Melbourne Park, becoming one of the few players in the modern era to win back-to-back titles at the season's opening Grand Slam.

• This achievement solidified his position as the World No. 1 in the ATP Rankings, a milestone he first reached in June 2024.

• By winning in 2024 and 2025, he has established a period of dominance on hard courts, following his victory at the US Open in late 2024 as well.

• Hence, the correct answer is Two.

Additional Information

• Jannik Sinner:

• Born in San Candido, Italy, in 2001, Sinner is the most successful Italian male tennis player in history.

• He is known for his powerful baseline game and exceptional lateral movement, which are highly effective on the hard court surfaces used in Australia and the United States.

• Before his 2024 breakthrough, he led Italy to a Davis Cup title in late 2023, defeating Serbia and Australia.

• The Australian Open:

• The Australian Open is the first of the four annual Grand Slam tennis tournaments, held annually over the last fortnight of January.

• It is played at Melbourne Park on Blue GreenSet hard courts.

• Historically, Novak Djokovic holds the record for the most men's singles titles at this event, with 10 trophies.

Important Points

• Grand Slam Context: Sinner's 2025 victory marked his third total Major title, following his wins at the 2024 Australian Open and the 2024 US Open.

• Statistical Significance: Sinner became the first player other than the "Big Three" (Federer, Nadal, Djokovic) to defend an Australian Open title since Andre Agassi in 2001.

• Rivalries: His path to the 2025 title involved high-stakes matches against other top-tier players like Carlos Alcaraz and Novak Djokovic, signaling a generational shift in men's professional tennis.

Q97. Answer: (c) Research, Development & Innovation Scheme

The correct answer is Research, Development & Innovation Scheme.

Key Points

• The Government of India, during the Interim Budget 2024-25, announced a massive corpus of Rs. 1 lakh crore to drive long-term financing and refinancing for the private sector in the field of research and innovation.

• This initiative, often categorized under the Research, Development & Innovation framework, aims to provide 50-year interest-free loans to facilitate large-scale investments in high-risk, high-impact projects.

• The primary objective of this fund is to encourage commercialization of research and foster a culture of innovation across various Science & Technology disciplines, supporting the vision of "Jai Anusandhan".

• This scheme is designed to help startups and private companies undertake research that requires substantial capital and has a long gestation period, which traditional banking channels might find too risky.

• The allocation is a strategic move to significantly boost India’s Gross Expenditure on R&D (GERD), which currently stands at approximately 0.64% to 0.7% of GDP, by involving private players more aggressively.

Additional Information

• Anusandhan National Research Foundation (ANRF):

• The ANRF Act, 2023 was passed to provide high-level strategic direction for scientific research in the country.

• The ANRF is set to have a total budget of Rs. 50,000 crore over five years (2023-28), where a major portion is expected to come from the private sector.

• It functions as an apex body to seed, grow, and promote R&D and foster a culture of research and innovation throughout India’s universities and colleges.

• Jai Jawan, Jai Kisan, Jai Vigyan, Jai Anusandhan:

• The slogan was expanded by Prime Minister Narendra Modi to include "Jai Anusandhan" (Hail Innovation) to emphasize that research is the bedrock of a Viksit Bharat (Developed India).

• Deep-Tech for Defense:

• Alongside the innovation fund, the government also announced a new scheme to strengthen Deep-Tech technologies for defense purposes and expedite Atmanirbharta (self-reliance) in the strategic sector.

• Department of Science and Technology (DST):

• The DST, established in May 1971, plays a pivotal role in organizing, coordinating, and promoting Science & Technology activities in India.

• It acts as the nodal agency for identifying and implementing new areas of research that align with the national Innovation Index goals.

Q98. Answer: (b) World Economic Forum (WEF)

The correct answer is World Economic Forum (WEF).

Key Points

• The World Economic Forum (WEF) published the 20th edition of the Global Risks Report 2025 in January 2025.

• This annual report is released just before the WEF Annual Meeting held in Davos, Switzerland, providing a foundation for discussions among global leaders.

• The 2025 report identifies Misinformation and Disinformation as the most severe global risk anticipated over the next two years, fueled by advancements in Artificial Intelligence (AI).

• It outlines a range of threats categorized into Geopolitical, Environmental, Technological, Societal, and Economic domains.

• The report warns of a "Global Fragmentation" where the world is moving toward a multipolar order, making international cooperation on critical issues like Climate Change and Cybersecurity more difficult.

• According to the findings, Extreme weather events and Critical change to Earth systems are ranked as the top long-term risks over a 10-year period.

Additional Information

• World Economic Forum (WEF):

• It is an international non-governmental and lobbying organization founded on 24 January 1971 by German engineer and economist Klaus Schwab.

• The headquarters are located in Cologny, Switzerland.

• Other major reports published by the WEF include the Global Gender Gap Report, Energy Transition Index, Global Competitiveness Report, and Travel and Tourism Development Index.

• International Monetary Fund (IMF):

• Established in 1944 at the Bretton Woods Conference, it is headquartered in Washington, D.C., USA.

• It primarily releases the World Economic Outlook and the Global Financial Stability Report.

• Organisation for Economic Co-operation and Development (OECD):

• An intergovernmental organization with 38 member countries, founded in 1961 and based in Paris, France.

• It is well-known for the PISA (Programme for International Student Assessment) and various economic and environmental surveys.

• United Nations Development Programme (UNDP):

• The UNDP is the United Nations' global development network, established in 1965.

• It is most famous for publishing the Human Development Report (HDR), which includes the Human Development Index (HDI).

Important Points

• Methodology: The Global Risks Report is based on the Global Risks Perception Survey (GRPS), which captures the views of nearly 1,500 experts from academia, business, government, and the international community.

• Short-term vs. Long-term: The report distinguishes between immediate crises (0-2 years) and structural transformations (10 years). While technological and societal issues dominate the short term, environmental risks are the primary concern for the next decade.

• Geopolitical Shifts: The 2025 report emphasizes the risk of Armed Conflict and Geoeconomic Confrontation, noting that the breakdown of global norms is leading to a more volatile and insecure world.

• AI and Society: The report highlights how synthetic content (deepfakes) and AI-generated misinformation can manipulate public opinion and threaten the legitimacy of elections globally.

Q99. Answer: (b) Mondo Duplantis

The correct answer is Mondo Duplantis.

Key Points

• Armand "Mondo" Duplantis is a Swedish-American pole vaulter who holds the current world record in both indoor and outdoor events. He represents Sweden in international competitions.

• Duplantis has a remarkable history at the Stockholm Diamond League (Bauhaus-Galan), where he has repeatedly broken records and set world-leading marks in front of his home crowd.

• He is widely considered the greatest pole vaulter of the modern era, having secured Olympic Gold Medals at the 2020 Tokyo Games and the 2024 Paris Games.

• The Diamond League is an annual series of elite track and field athletic competitions, and Duplantis has used these stages to systematically increase the world record, often by 1 centimeter at a time to maximize performance bonuses and career longevity.

• His athletic background is significant; his father, Greg Duplantis, was an American pole vaulter, and his mother, Helena, was a Swedish heptathlete, contributing to his exceptional speed and technical proficiency.

Additional Information

• Ernest John (EJ) Obiena:

• He is a premier pole vaulter from the Philippines and is the first Asian to join the elite "6-meter club."

• Obiena has won multiple medals at the World Athletics Championships and is a dominant force in the Asian Games and Southeast Asian Games.

• Kurtis Marschall:

• An Australian pole vaulter who has won Gold Medals at the Commonwealth Games in 2018 and 2022.

• He is known for his consistency on the global circuit and has been a frequent finalist in Olympic and World Championship events.

• Sam Kendricks:

• A highly decorated American pole vaulter who won back-to-back World Championship titles in 2017 and 2019.

• He is an Olympic Silver Medalist (Paris 2024) and Bronze Medalist (Rio 2016), recognized for his unique technique and sportsmanship within the field.

• The World Record Progression:

• For many years, the world record was famously held by Sergey Bubka, who set 35 world records during his career.

• Since 2020, Mondo Duplantis has pushed the boundaries of the sport, moving the record from 6.17 meters to over 6.25 meters, showcasing an unprecedented level of dominance in track and field.

Important Points

• Venue and Event: The Stockholm Diamond League, known as Bauhaus-Galan, is held at the Stockholm Olympic Stadium, which was built for the 1912 Olympic Games.

• Measurement Technology: High-precision laser technology and calibrated bars are used in World Athletics sanctioned events to ensure that record-breaking heights like 6.28 m are verified with absolute accuracy.

• Impact on Sports Science: Duplantis's success is often attributed to his approach speed, which resembles that of an elite sprinter, combined with the use of highly specialized carbon fiber poles that allow for maximum energy transfer.

Q100. Answer: (a) New Delhi

The correct answer is New Delhi.

Key Points

• The 19th edition of the India Digital Summit (IDS) 2025 was held in New Delhi.

• The event took place on February 5 and 6, 2025, at the prestigious Bharat Mandapam, located at Pragati Maidan.

• It was organized by the Internet and Mobile Association of India (IAMAI), which is the premier industry body representing the digital services sector in the country.

• The theme for the 2025 summit was "India's Techade: Scaling Innovations for the World", emphasizing India's growing role as a global hub for technological advancements.

• The summit featured over 500 speakers and saw participation from more than 10,000 delegates, including policymakers, tech founders, and industry leaders.

Additional Information

• Internet and Mobile Association of India (IAMAI):

• Established in 2004, it is a non-profit organization registered under the Societies Registration Act, 1860.

• It represents the interests of the online and mobile value-added services industry, including E-commerce, Fintech, Digital Advertising, and EdTech sectors.

• Bharat Mandapam:

• This state-of-the-art International Exhibition-cum-Convention Centre (IECC) complex in New Delhi was the venue for the G20 Summit in 2023.

• It is one of the largest convention centers in the world, designed to host high-level international exhibitions and trade fairs.

• India's Digital Growth:

• The India Digital Summit is one of the oldest and most influential digital industry events in India, tracking the nation's journey from early internet adoption to becoming a digital powerhouse.

• Recent summits have focused on critical areas such as Artificial Intelligence (AI), the Open Network for Digital Commerce (ONDC), and the expansion of the Unified Payments Interface (UPI) ecosystem.

• Focus on Startups:

• The IDS 2025 serves as a platform for startups to engage with venture capitalists and government officials to foster the NextGen of Indian entrepreneurship.

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