RRB Group D Official Paper (Held On: 19 Dec, 2025 Shift 1) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. A wire with resistance R is cut into seven equal parts. These parts are then connected in parallel. If the equivalent resistance of this new combination is R', what is the value of the ratio R / R' ?

(a) 49
(b) 7
(c) 1/7
(d) 1/49

Q2. Sodium, carbon and oxygen elements are present in Washing Soda. Select the INCORRECT symbol of these elements.

(a) O
(b) C
(c) SO
(d) Na

Q3. Which of the following statements is correct?

(a) Weight is independent of gravity
(b) Mass is the amount of matter in an object
(c) The SI units of weight and mass are the same
(d) Mass changes with location

Q4. The molecules of an element are constituted by:

(a) the complex type of atoms
(b) the difficult type of atoms
(c) the same type of atoms
(d) the different type of atoms

Q5. The diameter of the reflecting curved surface of a spherical mirror is called _____.

(a) Aperture
(b) Pole
(c) Focal length
(d) Radius of curvature

Q6. What is the purpose of anodising aluminium metals?

(a) To reduce its melting point
(b) To make it more reactive with air
(c) To increase its electrical conductivity
(d) To form a protective oxide layer

Q7. Which of the following is true?

(a) Advanced sunrise is due to scattering and delayed sunset is due to refraction.
(b) Advanced sunrise and delayed sunset is due to atmospheric refraction.
(c) Advanced sunrise and delayed sunset is due to scattering of light.
(d) Advanced sunrise and delayed sunset is due to Earth's rotation only.

Q8. In the context of a reflex arc, which part of the nervous system is responsible for receiving and transmitting signals from external stimuli?

(a) Motor neurons
(b) Relay neurons
(c) Sensory neurons
(d) Effector muscle

Q9. According to Mendel, when a tall pea plant (TT) is crossed with a short pea plant (tt), the F1 offspring will be:

(a) all tall (Tt)
(b) 50% tall (Tt), 50% short (tt)
(c) 75% tall (TT/Tt), 25% short (tt)
(d) all short (tt)

Q10. What is the correct symbol for the element sodium?

(a) Na
(b) Sd
(c) S
(d) So

Q11. A certain force acting on a 20 kg mass changes its velocity from 5 m/s to 2 m/s. Calculate the work done by this force.

(a) 210 J
(b) 420 J
(c) −420 J
(d) −210 J

Q12. Which of the following is an example of uniform circular motion?

(a) A person walking in a straight line
(b) A ball thrown vertically upwards
(c) A satellite orbiting the Earth
(d) A car moving on a straight road

Q13. Refer to the two statements given below and select the correct option.

Statement A: Ethanoic acid reacts with sodium hydroxide to form sodium acetate and water.

Statement B: This reaction is neutralisation.

(a) Both statements A and B are correct.
(b) Statement A is correct but statement B is incorrect.
(c) Both statements A and B are incorrect.
(d) Statement A is incorrect but statement B is correct.

Q14. A characteristic feature that is NOT associated with soap is:

(a) micelles formation
(b) works perfectly with hard water
(c) hydrophilic head
(d) hydrophobic tail

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Q15. What is the effect of oral contraceptive pills in the body of human females?

(a) They create a physical barrier in fallopian tube.
(b) They prevent maturation of primary oocyte.
(c) They are toxic to the incoming sperms.
(d) They block the passage of sperms in vagina.

Q16. Which subatomic particle has a negative charge but negligible mass?

(a) Electron
(b) Nucleons
(c) Proton
(d) Neutron

Q17. When a rocket is launched upward, the forces on it are _____.

(a) Balanced
(b) Only gravitational
(c) Unbalanced
(d) Equal in all directions

Q18. Which of the following is NOT an abiotic resistance for crop?

(a) Salinity
(b) Heat
(c) Drought
(d) Insects

Q19. In a domestic circuit, the live wire is generally of which colour?

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

Q20. Which of the following pairs of elements has the same number of neutrons?

(a) Li, Be
(b) B, C
(c) He, Li
(d) Be, B

Q21. Which of the following statements about lysosomes is correct?

(a) Lysosomes synthesise fats.
(b) Lysosomes contain digestive enzymes.
(c) Lysosomes synthesise proteins.
(d) Lysosomes contain growth hormones.

Q22. Pair the term to complete the analogy.

Chlorophyll : Green pigment :: Starch : ____.

(a) Protein
(b) Energy storage
(c) Oxygen carrier
(d) Water source

Q23. Which of the following is the correct way to reduce reverberations?

(a) Using hard concrete floor
(b) Removing furniture
(c) Using marble walls
(d) Using sound-absorbent materials

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Q24. Which part in the ovule helps in guiding the pollen tube (carrying sperm nuclei) towards the female gamete?

(a) Synergids
(b) Antipodal cells
(c) Endosperm
(d) Style

Q25. The tongue helps in digestion mainly by _____.

(a) secreting digestive enzymes
(b) mixing food with saliva
(c) absorbing nutrients
(d) crushing food into smaller pieces

MATHEMATICS

Q26. A train of length 282 m takes 12 seconds to pass over another train 248 m long coming from the opposite direction. If the speed of the first train is 68 km/hr, then find the speed of the second train.

(a) 89 km/hr
(b) 96 km/hr
(c) 91 km/hr
(d) 82 km/hr

Q27. Find the simple interest (in Rs.) on Rs. 2,000 at 7% per annum rate of interest for the period from 5 February 2023 to 19 April 2023.

(a) 29
(b) 27
(c) 28
(d) 26

Q28. If m and n are positive integers and (m – n) is an even number, then ($m^2 – n^2$) will always be divisible by:

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

Q29. In a right – angled ABC, right – angled at B, if tanA = 3/4, then find cosec A.

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

Q30. The mode of the observations 9, 6, 8, 1, 9, 6, 4, 5, 7, 1, 6, 5, 3, 6, 6, 3 and 3 is:

(a) 1
(b) 8
(c) 6
(d) 9

Q31. Rs. 10,415 is divided among P, Q, and R in such a way that if Rs. 62, Rs. 17, and Rs. 79 are deducted from their respective shares, they have money in the ratio 15:10:14. Find the difference between the original shares of Q and R.

(a) Rs. 902
(b) Rs. 1,114
(c) Rs. 1,202
(d) Rs. 1,152

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Q32. The number of diagonals of an n-sided regular polygon is 665. What is the value of ‘n’?

(a) 38
(b) 40
(c) 33
(d) 35

Q33. The area of a triangle is one – third of the area of a parallelogram, whose base is 24 cm. Find the height of the parallelogram, If the sides of the triangle are 22 cm, 18 cm and 24 cm long, respectively.

(a) 18.2 cm
(b) 26.4 cm
(c) 21.8 cm
(d) 23.6 cm

Q34. P and Q together can fill a cistern with water in 12 hours. If P alone can fill the cistern with water in 24 hours, then in how many hours will Q alone fill one-fourth of the same cistern with water?

(a) 7
(b) 12
(c) 6
(d) 13

Q35. Five years ago, Meera was three times as old as her niece, Kavya. Seven years from now, Meera will be twice as old as Kavya. What is Meera’s current age (in years)?

(a) 45
(b) 43
(c) 39
(d) 41

Q36. An item with a marked price of Rs. 657 was sold for Rs. 526. What was the percentage of discount given? (Round off the answer to two decimal places.)

(a) 19.94%
(b) 17.13%
(c) 17.29%
(d) 23.93%

Q37. The average of 13 numbers is 7. If each number is multiplied by 3, then what will the new average be?

(a) 3
(b) 13
(c) 7
(d) 21

Q38. A seller makes a loss of 5% by selling a shirt for Rs. 1,000. He would have made x% profit by selling for Rs. 1,400. Find the value of x.

(a) 30.5
(b) 34
(c) 33
(d) 31.2

Q39. The monthly incomes of two friends Mohan and David, are in the ratio 5 : 8, respectively, and each of them saves Rs. 75,000 every month. If the ratio of their monthly expenditure is 1 : 4, find the monthly income of Mohan(in Rs.).

(a) 92,750
(b) 94,750
(c) 1,31,250
(d) 93,750

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Q40. The length, breadth and height of a cuboid are in the ratio 6 : 5 : 4 and its volume is 810000 √2 cm^3. Find its surface area.

(a) 67600 cm2
(b) 68600 cm2
(c) 66600 cm^2
(d) 65600 cm2

Q41. The prices of each article of types P, Q, and R are Rs. 280, Rs. 180 and Rs. 100, respectively. Kishore buys articles of each type in the ratio 3 : 4 : 5 in Rs. 6,180. How many articles of type Q did he purchase?

(a) 12
(b) 18
(c) 20
(d) 9

Q42. Find a single discount (approximately) equal to three consecutive discounts of 7%, 10% and 15%.

(a) 28.85%
(b) 29.49%
(c) 30.16%
(d) 31.22%

Q43. A cistern has two inlet pipes, A and B, and one outlet pipe, C. Pipe A can fill the cistern alone in 15 hours, pipe B in 18 hours, and pipe C can empty it in 27 hours. For the first 5 hours, pipes A and B are opened together. Then, for the next 12 hours, pipes B and C are opened together. After that, only pipe B works. How long will pipe B alone take to fill the remaining part of the cistern?

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

Q44. 16 m, 20 m and 24 m are the dimensions of a room. Find the length (in m) of the greatest possible scale to measure all dimensions exactly.

(a) 9
(b) 6
(c) 4
(d) 5

Q45. Simplify:

$[(3x + 5y)^2 - 60xy] \div [(3x - 5y)^2]$

(a) 1
(b) -1
(c) -2
(d) 2

Q46. Malati bought 5 rose plants and 9 jasmine plants for Rs. 1,410 and her friend Rani bought 6 rose plants and 5 jasmine plants for Rs. 1,170. Find the prices (in Rs.) of 1 rose and 1 jasmine plant, respectively.

(a) 115; 87
(b) 90; 120
(c) 132; 94
(d) 120; 90

Q47. The cost of a washing machine is 25% less than the cost of a TV. If the cost of the washing machine increases by 87% and that of the TV decreases by 45%, then what is the percentage change in the total cost of 4 washing machines and 5 TVs?

(a) Decrease by 4%
(b) Decrease by 9%

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(c) Increase by 4.5%
(d) Increase by 5.2%

Q48. Two trains, 232 m and 248 m in length, are running in opposite directions. The first runs at the rate of 51 km/hr and the second at the rate of 57 km/hr. How long will they take to cross each other?
(a) 16 seconds
(b) 22 seconds
(c) 11 seconds
(d) 26 seconds

Q49. Find the value of x in the following expression.
$(0.36)^3 \times (0.216)^3 \div (0.1296)^3 = (60 \div 100)^{(x+1)}$
(a) 2
(b) 1
(c) 3
(d) 0

Q50. In a test, B got 50 marks while A got 75 marks, out of 105 maximum marks. What percentage of A's marks was B's marks? (Round off your answer to two decimal places.)
(a) 105.12%
(b) 66.67%
(c) 71.43%
(d) 150.57%

GENERAL INTELLIGENCE & REASONING

Q51. CPWG is related to XTTI in a certain way. In the same way, NILC is related to IMIE. To which of the given options is OKZD related, following the same logic?
(a) KOVF
(b) KPVE
(c) JOWF
(d) JPWE

Q52. What will come in place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?
24 ÷ 19 + 84 × 7 - 127 = ?
(a) 571
(b) 594
(c) 523
(d) 587

Q53. Select the set in which the numbers are related in the same way as are the numbers of the following sets.
(NOTE: Operations should be performed on the whole numbers, without breaking down the numbers into their constituent digits. E.g. 13 – Operations on 13 such as adding to/subtracting from/multiplying with 13 can be performed. Breaking down 13 into 1 and 3 and then performing mathematical operations on 1 and 3 is not allowed.)
(25, 72, 194)
(32, 80, 224)
(a) (45, 89, 268)
(b) (74, 88, 304)
(c) (91, 65, 310)
(d) (56, 98, 312)

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Q54. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only.

(Left) @ 3 6 7 & 8 # & + $ 1 ? 9 1 + 7 1 # # < 2 (Right)

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

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

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

2, 2, ?, 12, 48, 240

(a) 10
(b) 8
(c) 4
(d) 6

Q56. A, B, C, D, E, F and G are sitting around a circular table facing the centre. Only two people sit between F and G when counted from the left of G. A sits third to the left of E. C sits to the immediate right of E. C sits second to the left of F. B is an immediate neighbour of A. How many people sit between D and F when counted from the right of F?

(a) 5
(b) 3
(c) 0
(d) 2

Q57. In a certain code language, OAVY is coded as 56 and SIXT is coded as 47. What is the code for TMZB in that language?

(a) 60
(b) 63
(c) 55
(d) 58

Q58. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

VAE27, OTX44, HMQ61, AFJ78, ?

(a) TYC95
(b) TYD95
(c) TUC95
(d) VYC95

Q59. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only.

(Left) # 4 ^ 8 8 < 2 / $ 7 $ \ 1 & ^ 8 4 \ ? \ 8 (Right)

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

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

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

84 86 90 92 96 ?

(a) 97
(b) 98

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(c) 99
(d) 100

Q61. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

12 ÷ 5 + 21 × 3 - 2 = ? + 5

(a) 55
(b) 45
(c) 50
(d) 60

Q62. Seven friends, B, C, D, T, U, V and W, are sitting in a straight line facing north. Only three people sit between C and W. D sits to the immediate left of W. No one sits to the right of B. Only two people sit between B and D. T sits to the immediate right of V. How many people sit between U and T?

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

Q63. Ajay drives 10 km from Point A towards the east. He then takes a right turn, drives 5 km, turns left and drives 10 km. He takes a final left turn, drives 5 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° turns only unless specified)

(a) 15 km towards south
(b) 20 km towards north
(c) 20 km towards east
(d) 20 km towards west

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

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

(a) PWS
(b) FMI
(c) LSO
(d) NJI

Q65. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusion(s) logically follow(s) from the statement(s).

Statements:

Some seeds are berries.

All fruits are berries.

Conclusions:

(I) Some seeds are fruits

(II) All berries are fruits

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

Q66. KIGK is related to JHFJ in a certain way based on the English alphabetical order. In the same way, JHFJ is related to IGEI. To which of the following is SQOS related, following the same logic?

(a) RPMR
(b) RPNR

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(c) ROMR
(d) RQMS

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

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

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

Q68. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one which follows the same logic.

FACE - AFCE - ECAF

CASE - ACSE - ESAC

(a) LONG - OLNG - ONGL
(b) MAIN - AMIN - NIAM
(c) GONE - OGNE - EONG
(d) TEAM - TAEM - MAET

Q69. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

YIS WKO UMK SOG ?

(a) QCC
(b) QWS
(c) QQC
(d) QXZ

Q70. Ajeet starts from Point Y and drives 12 km towards the north. He then turns right and drives 33 km, takes a right and drives 67 km. He then takes a right turn and drives 48 km. He takes a right turn, drives 55 km, turns left and drives 27 km to stop at Point Z. How far (shortest distance) and towards which direction should he drive in order to reach Point Y again? (All turns are 90-degree turns only unless specified.)

(a) 48 km towards the east
(b) 42 km towards the east
(c) 44 km towards the west
(d) 46 km towards the west

Q71. In a certain code language,

P + Q means ‘P is the husband of Q’,

P # Q means ‘P is the brother of Q’,

P Q means ‘P is the mother of Q’ and

P % Q means ‘P is the sister of Q’.

How is S related to M if ‘ S # D + V I % M ’?

(a) Father’s mother
(b) Wife's father
(c) Father’s father
(d) Father’s brother

Q72. All 61 people are standing in a row facing north. Z is 16^(th) from the left end while G is 7^(th) from the right end. How many people are there between Z and G?

(a) 37
(b) 40
(c) 41

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(d) 38

Q73. A, B, C, D, E, F and G are sitting around a circular table, facing the centre.

C sits third to the left of F. B sits second to the left of E. F is an immediate neighbour of both G and B. D is not an immediate neighbour of C.

How many people sit between B and D, when counted from the right of B?

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

Q74. All 87 people are standing in a row, facing the north.

Mr. Zzz is 11^(th) from the right end while Mr. Ggg is 26^(th) from the left end.

How many people are there between Mr. Zzz and Mr. Ggg?

(a) 52
(b) 50
(c) 53
(d) 51

Q75. In a certain code language, "TMCB" is coded as "76" and "GKIR" is coded as "90". What is the code for "VAPD" in that language?

(a) 86
(b) 88
(c) 91
(d) 80

Q76. Refer to the given number series and answer the question that follows. Counting to be done from left to right only. All numbers are single-digit numbers.

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

How many such odd digits are there, each of which is immediately preceded by a perfect square digit and also immediately followed by a prime digit? (NOTE: 1 is also a perfect square.)

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

Q77. What should come in place of the question mark (?) in the given series?

115 85 60 40 25 ?

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

Q78. 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 parks are huts.

All huts are districts.

All districts are cities.

Conclusions:

(I) All parks are districts.

(II) All huts are cities.

(a) Only conclusion (I) follows

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

Q79. 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 letter-cluster pair 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) UY - TX
(b) GK - FJ
(c) RV - QV
(d) LP - KO

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

49 B 9 D 609 A 7 C 214 = ?

(a) 524
(b) 545
(c) 536
(d) 568

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. In April 2025, the Monetary Policy Committee (MPC) reduced the policy repo rate by 25 basis points, bringing it down to _____.

(a) 5.75%
(b) 6.25%
(c) 5.50%
(d) 6.00%

Q82. Which of the following was hosted by IIT Mandi in June 2025, focusing on mental health applications?

(a) Mental Health Innovation Forum
(b) Brain Science Symposium
(c) Health and Mind Summit
(d) Mind, Brain, and Consciousness Conference

Q83. In which year did Armand Duplantis break the pole vault world record for the 12^(th) time?

(a) 2024
(b) 2023
(c) 2025
(d) 2022

Q84. Which edition of the Khelo India Youth Games was held in 2025?

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

Q85. The National Conference on "Strengthening Legal Aid Delivery Mechanisms" in November 2025 was inaugurated at ____.

(a) Sansad Bhavan, New Delhi
(b) Rashtrapati Bhavan, New Delhi
(c) Supreme Court of India, New Delhi
(d) National Judicial Academy, Bhopal

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Q86. Which authority launched a scheme in Greater Noida in June 2025 to promote medical device manufacturing?

(a) Noida Development Authority
(b) Government of India
(c) Government of UP
(d) Government of Delhi NCR

Q87. In April 2025, which protected area was officially notified as India's 107^(th) national park?

(a) Hemis
(b) Bhitarkanika
(c) Similipal
(d) Ranthambore

Q88. The ICCON-2025 MEE report covered how many national parks and sanctuaries?

(a) 438
(b) 250
(c) 100
(d) 500

Q89. With which tech behemoth has the Indian company Infosys recently partnered to create a generative AI solution for telecom operators?

(a) Open AI
(b) Nividia
(c) IBM
(d) Google

Q90. In the November 2025 by-elections, elections were held for the Assembly constituency in which of the following northeastern states?

(a) Mizoram
(b) Arunachal Pradesh
(c) Meghalaya
(d) Nagaland

Q91. At which venue was the opening ceremony of the Khelo India Youth Games, 2025, held?

(a) Rajgir Sports Complex
(b) Jawaharlal Nehru Stadium
(c) Patliputra Sports Complex
(d) Indira Gandhi Indoor Stadium

Q92. In 2025, the Krasheninnikov Volcano erupted after several centuries, releasing a massive ash plume. In which region is this volcano located?

(a) Ural Mountains
(b) Kamchatka Peninsula
(c) Sakhalin Island
(d) Siberia

Q93. In which city was the 2025 Laureus World Sports Awards ceremony held?

(a) London
(b) Rome
(c) Madrid
(d) Paris

Q94. By June 2025, to which stance did the Reserve Bank of India shift back after moving away from its accommodative policy?

(a) Dovish
(b) Withdrawn

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(c) Neutral
(d) Restrictive

Q95. Which Ministry gave the idea of a common board for class 10 and 12 in seven states?
(a) Ministry of Defense
(b) Ministry of Finance
(c) Ministry of Education
(d) Ministry of Social Welfare

Q96. In June 2025, which district was officially declared the first single-use plastic (SUP)–free district in Odisha?
(a) Bargarh
(b) Rayagada
(c) Nuapada
(d) Kalahandi

Q97. A new complex of India's first bio-manufacturing institute, BRIC-National Agri-Food Bio-Manufacturing Institute (BRIC-NABI), aimed at enhancing India's agri-food sector through advanced biotechnology, was inaugurated at _____ in October 2024.
(a) Guwahati
(b) Chennai
(c) Ahmedabad
(d) Mohali

Q98. On 5–6 February 2025, the national executive council meetings of FICCI and CII converged at BGBS in which city?
(a) New Delhi
(b) Raipur
(c) Kolkata
(d) Surat

Q99. Who is the author of 'Lords of Earth and Sea: A History of the Chola Empire', published in 2025?
(a) Anirudh Kanisetti
(b) RK Narayan
(c) KK Aziz
(d) Shashi Tharoor

Q100. Under the National Green Hydrogen Mission, what scheme was launched by the Ministry of New and Renewable Energy (MNRE) in April 2025?
(a) Carbon Capture Scheme
(b) Green Hydrogen Certification Scheme
(c) Renewable Hydrogen Exchange Scheme
(d) Blue Hydrogen Regulation Scheme

ANSWER KEY

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

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91 c	92 b	93 c	94 c	95 c	96 c	97 d	98 c	99 a	100 b

SOLUTIONS

Q1. Answer: (a) 49

The correct answer is 49.

Key Points

• The resistance of a conductor is directly proportional to its length (L) and inversely proportional to its area of cross-section (A). The formula is given by R = ρ(L/A), where ρ is the resistivity of the material.

• When a wire of total resistance R is cut into 7 equal parts, the length of each part becomes 1/7th of the original length. Since the material and area of cross-section remain the same, the resistance of each small part (let it be r) is r = R / 7.

• In a parallel combination, the reciprocal of the equivalent resistance (R') is the sum of the reciprocals of the individual resistances. Since all 7 parts are identical, the formula becomes 1/R' = 1/r + 1/r + 1/r + 1/r + 1/r + 1/r + 1/r.

• Substituting the value of r, we get 1/R' = 7 / (R/7), which simplifies to 1/R' = 49 / R.

• To find the ratio R / R', we rearrange the equation: R / R' = 49. Hence, the calculated ratio is 49.

Additional Information

• Factors affecting Resistance: The resistance of a wire depends on the nature of the material, the temperature, the length, and the cross-sectional area. If the temperature is constant, resistance is solely determined by dimensions and resistivity.

• Series Connection: If these 7 parts were connected in series instead of parallel, the equivalent resistance would be the sum of individual resistances (R/7 + R/7 + ... 7 times), which would result back in the original resistance R.

• Parallel Connection Features: In a parallel circuit, the voltage across each resistor remains the same, while the total current is the sum of the currents through each branch. This connection effectively increases the total area of cross-section, thereby reducing the equivalent resistance.

• Resistivity (ρ): It is an intrinsic property of the material. Cutting the wire into pieces does not change its resistivity, as it only depends on the material type (e.g., copper, aluminum) and temperature.

• Ohm's Law: This law states that the current through a conductor between two points is directly proportional to the voltage across the two points, provided physical conditions remain constant (V = IR).

Important Points

• Unit of Resistance: The SI unit of resistance is the Ohm, represented by the Greek letter Ω.

• Mathematical Generalization: If a wire of resistance R is cut into n equal parts and connected in parallel, the new resistance R' will always be R / (n^2). In this specific question, n = 7, so R' = R / 49.

• Ratio Analysis: The ratio R / R' represents how many times the resistance has decreased. A ratio of 49 indicates a significant drop in resistance, which is typical when moving from a single long wire to multiple parallel paths.

• Applications: This principle is used in power distribution and household wiring, where appliances are connected in parallel to ensure low equivalent resistance and independent operation.

Q2. Answer: (c) SO

The correct answer is SO.

Key Points

• Washing Soda is a chemical compound with the formula Na2CO3.10H2O, which is chemically known as Sodium Carbonate Decahydrate.

• The elements that constitute washing soda are Sodium, Carbon, Oxygen, and Hydrogen.

• The symbol for Sodium is Na. This is derived from its Latin name, Natrium. Hence, the symbol given in option 4 is correct.

• The symbol for Carbon is C. It is a non-metallic element belonging to Group 14 of the Periodic Table. Hence, the symbol given in option 2 is correct.

• The symbol for Oxygen is O. It is a highly reactive non-metal and oxidizing agent. Hence, the symbol given in option 1 is correct.

• The symbol SO is not an elemental symbol. S represents Sulfur and O represents Oxygen. Together they represent Sulfur Monoxide, which is not an element present in the standard chemical description of individual symbols for washing soda's components. Hence, option 3 is the incorrect symbol.

Additional Information

• Chemical Composition: Washing Soda contains two atoms of Sodium, one atom of Carbon, and three atoms of Oxygen in its anhydrous form (Soda Ash), along with ten molecules of water of crystallization.

• Production: It is predominantly manufactured using the Solvay Process (also known as the ammonia-soda process), which uses Sodium Chloride, Ammonia, and Limestone as raw materials.

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• Physical Properties: It is a white, crystalline solid that is soluble in water. It undergoes efflorescence, where it loses water molecules when exposed to dry air to become Sodium Carbonate Monohydrate.

• Applications:

• It is extensively used in glass, soap, and paper industries.

• It is used for removing the permanent hardness of water.

• It serves as a cleansing agent for domestic purposes and as a laboratory reagent.

• Atomic Details:

• Sodium (Na): Atomic number 11, located in Period 3.

• Carbon (C): Atomic number 6, located in Period 2.

• Oxygen (O): Atomic number 8, located in Period 2.

Important Points

• Differentiation: It is important to distinguish Washing Soda from Baking Soda. While Washing Soda is Sodium Carbonate (Na_2CO_3), Baking Soda is Sodium Bicarbonate ($NaHCO_3$).

• Nature: Sodium Carbonate is a basic salt because it is formed by the reaction of a strong base (Sodium Hydroxide) and a weak acid (Carbonic Acid).

• Historical Context: Historically, it was extracted from the ashes of plants growing in sodium-rich soils, which is why the anhydrous form is still commonly referred to as Soda Ash.

Q3. Answer: (b) Mass is the amount of matter in an object

The correct answer is Mass is the amount of matter in an object.

Key Points

• Mass is defined as the fundamental measure of the amount of matter contained within an object. It is an intrinsic property that does not change regardless of the object's position in the universe. Hence, statement 2 is correct.

• Weight is the force exerted on an object due to gravity. It is calculated using the formula $W = m \times g$, where 'm' is mass and 'g' is the acceleration due to gravity. Therefore, weight is directly dependent on the gravitational pull of the location. Hence, statement 1 is incorrect.

• The SI unit of mass is the kilogram (kg), while the SI unit of weight is the Newton (N) because weight is a measure of force. Since they represent different physical quantities, their units are not the same. Hence, statement 3 is incorrect.

• The mass of an object remains constant throughout the universe unless matter is physically added to or removed from the object. It does not fluctuate based on altitude, latitude, or different celestial bodies. Hence, statement 4 is incorrect.

• While mass is a scalar quantity (having only magnitude), weight is a vector quantity because it has both magnitude and a direction pointing towards the center of gravity.

Additional Information

• Gravitational Variations:

• The acceleration due to gravity (g) on Earth is approximately 9.8 m/s^2. However, on the Moon, gravity is about 1/6th of that on Earth.

• Consequently, an object with a mass of 60 kg will have a weight of 588 N on Earth but only about 98 N on the Moon, even though its mass remains exactly 60 kg.

• Measurement Tools:

• Mass is typically measured using a physical balance or a beam balance, which compares an unknown mass with a known standard mass.

• Weight is measured using a spring balance, which measures the extension of a spring caused by the gravitational pull on the object.

• Inertia:

• Mass is also a measure of inertia, which is the resistance of an object to any change in its state of motion. The greater the mass, the higher the inertia, making it harder to accelerate or stop the object.

Important Points

• Center of Gravity: This is the point through which the entire weight of a body acts. For a regular-shaped object with uniform density, this point usually coincides with its geometric center.

• Zero Weight: An object can experience weightlessness (zero weight) in free fall or in deep space far from any celestial body, but its mass can never be zero as long as it exists as matter.

• Relativistic Mass: According to Albert Einstein's theory of relativity, the mass of an object can appear to increase when it travels at speeds approaching the speed of light, though for all general science and classical mechanics applications, mass is considered constant.

Q4. Answer: (c) the same type of atoms

The correct answer is the same type of atoms.

Key Points

• Molecules of an element are constituted by the same type of atoms. This means that all atoms within the molecule have the same atomic number and the same number of protons in their nuclei.

• A molecule is the smallest unit of a substance (element or compound) that can exist independently and retain the chemical properties of that substance.

• In the case of elements, atoms of the same element chemically bond together to form a molecule. For example, two atoms of Hydrogen combine to form a Hydrogen molecule (H2). Hence, the statement regarding the same type of atoms is correct.

• Molecules of compounds, on the other hand, are formed by the different types of atoms (atoms of different elements) joining together in fixed proportions, such as Water (H2O) or Carbon Dioxide (CO2).

• The number of atoms constituting a molecule is known as its atomicity. Depending on the element, the molecule may contain one, two, or more identical atoms.

Additional Information

• Classification of Molecules based on Atomicity:

• Monoatomic Molecules: These consist of a single atom. Most Noble Gases like Helium (He), Neon (Ne), and Argon (Ar) exist in this form because they are chemically unreactive.

• Diatomic Molecules: These are composed of two atoms of the same element. Common examples include Oxygen (O2), Nitrogen (N2), Hydrogen (H2), and Chlorine (Cl2).

• Triatomic Molecules: These consist of three atoms. A prominent example is Ozone (O3), which is an allotrope of oxygen.

• Polyatomic Molecules: These contain more than three atoms. For instance, Phosphorus exists as P4 (tetraatomic) and Sulphur typically exists as S8 (octatomic).

• Chemical Bonding: The atoms in a molecule are held together by strong chemical bonds, primarily covalent bonds in the case of non-metal elemental molecules, where electrons are shared between the atoms.

• Allotropes: Some elements can exist in two or more different physical forms in the same state, known as allotropes. For example, Carbon exists as Diamond, Graphite, and Fullerenes, all of which are made of the same type of atoms but arranged differently.

• Historical Context: John Dalton proposed the Atomic Theory in 1808, stating that elements consist of indivisible particles called atoms. Later, Amedeo Avogadro clarified the distinction between atoms and molecules in 1811.

Important Points

• It is important to distinguish between an atom (the smallest particle of an element) and a molecule (the smallest particle of a substance capable of independent existence).

• The molecular mass of an element is calculated by multiplying the atomic mass of the atom by its atomicity. For example, the molecular mass of O2 is 16 x 2 = 32 u.

• While molecules of elements consist of the same type of atoms, the physical and chemical properties of the molecule can differ significantly from the individual atoms (e.g., individual oxygen atoms are highly reactive radicals, while O2 is a stable gas).

• Metals and some other elements do not have a simple molecular structure but consist of a giant lattice of atoms held together; however, in chemical calculations, they are often treated as monoatomic units.

Q5. Answer: (a) Aperture

The correct answer is Aperture.

Key Points

• The Aperture of a spherical mirror refers to the diameter of the reflecting curved surface. It represents the effective width of the mirror that is available for reflecting light rays.

• Physically, the aperture determines the amount of light that falls on the mirror and is subsequently reflected. A mirror with a larger aperture collects more light, which results in the formation of a brighter image compared to a mirror with a smaller aperture.

• In most cases, the reflecting surface of a spherical mirror has a circular boundary, and the aperture is simply the diameter of this circular outline.

• It is important to distinguish aperture from the radius of curvature. While the radius of curvature relates to the depth or steepness of the curve, the aperture relates to the linear size of the opening of the mirror.

• In optics, a "small aperture" mirror is one where the diameter of the reflecting surface is much smaller than its radius of curvature. This condition is crucial for ensuring that paraxial rays form a sharp focus.

Additional Information

• Pole (P): The geometric center of the reflecting surface of a spherical mirror is called its Pole. It is a point that lies directly on the surface of the mirror.

• Center of Curvature (C): A spherical mirror is considered a part of a hollow sphere. The center of this original sphere is called the

Center of Curvature. Note that this point lies outside the reflecting surface of the mirror.

• Radius of Curvature (R): The distance between the Pole (P) and the Center of Curvature (C) is the Radius of Curvature. It is the radius of the sphere of which the mirror forms a part.

• Principal Axis: This is an imaginary straight line passing through the Pole and the Center of Curvature of the spherical mirror. It serves as the reference line for measuring distances in the Cartesian sign convention.

• Principal Focus (F): For a concave mirror, it is the point on the principal axis where rays parallel to the axis converge after reflection. For a convex mirror, it is the point from which such rays appear to diverge.

Important Points

• Focal Length (f): The distance between the Pole (P) and the Principal Focus (F) is called the Focal Length. For mirrors with a small aperture, there is a mathematical relationship: R = 2f, meaning the radius of curvature is twice the focal length.

• Concave Mirror: Often called a converging mirror, its reflecting surface is curved inwards. It can form both real and virtual images depending on the object's position. It is used in headlights, shaving mirrors, and by dentists.

• Convex Mirror: Known as a diverging mirror, its reflecting surface is curved outwards. It always forms a virtual, erect, and diminished image, providing a wider field of view. It is primarily used as a rear-view mirror in vehicles.

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

Q6. Answer: (d) To form a protective oxide layer

The correct answer is To form a protective oxide layer.

Key Points

• Anodising is a sophisticated electrolytic process used to increase the thickness of the natural oxide layer on the surface of metal parts, most commonly aluminium.

• During this process, a clean aluminium article is made the anode in an electrolytic bath, usually containing an acid such as dilute sulphuric acid.

• When an electric current is passed through the electrolyte, oxygen gas is evolved at the anode, which reacts with the aluminium to form a thick, uniform, and protective layer of aluminium oxide (Al_2O_3).

• The primary objective of this process is to provide corrosion resistance and enhance the durability of the metal by creating a barrier against environmental factors. Hence, the correct answer is to form a protective oxide layer.

• Unlike paint or plating, this oxide layer is fully integrated with the underlying aluminium substrate, so it cannot chip or peel off.

Additional Information

• Aesthetic and Decorative Uses:

• The anodic oxide layer has a porous structure immediately after the process. These pores can be used to absorb dyes or pigments.

• This allows aluminium products to be finished in a wide variety of colors while retaining the metallic texture, which is common in consumer electronics and cookware.

• Electrical Properties:

• While aluminium is an excellent conductor of electricity, aluminium oxide is an insulator.

• Therefore, anodising actually decreases the surface electrical conductivity, which can be useful in specific engineering applications where insulation is required.

• Surface Hardness:

• The anodised layer is significantly harder than the base metal. This provides excellent abrasion resistance and wear resistance, extending the lifespan of components used in machinery and transportation.

• Adhesion:

• The process provides a much better adhesion surface for paints, primers, and glues compared to bare metal, making it a critical pre-treatment step in many manufacturing workflows.

Important Points

• Common Applications: Anodised aluminium is extensively used in aerospace for aircraft skins, architecture for window frames and roofs, and in automotive parts for its lightweight and rust-proof nature.

• Maintenance: Because the oxide layer is chemically stable, anodised surfaces require very low maintenance and are resistant to UV radiation, meaning the color does not fade easily over years of exposure.

• Environmental Safety: Anodising is considered an environmentally safe metal finishing process as it does not involve heavy metals like lead or cadmium, and the chemical by-products are often neutralized before disposal.

• Comparison: While aluminium forms a natural oxide film when exposed to air, this natural layer is very thin (approx 2-3 nanometers). Industrial anodising can increase this thickness to 5 to 25 micrometers or more, depending on the application.

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Q7. Answer: (b) Advanced sunrise and delayed sunset is due to atmospheric refraction.

The correct answer is Advanced sunrise and delayed sunset is due to atmospheric refraction.

Key Points

• Atmospheric Refraction is the phenomenon responsible for both advanced sunrise and delayed sunset. This occurs because the Earth's atmosphere is not uniform; it consists of layers with varying optical densities and refractive indices.

• Advanced Sunrise: The sun is visible to us about 2 minutes before the actual sunrise. When the sun is slightly below the horizon, the light rays coming from it travel from rarer to denser layers of the atmosphere and bend toward the normal. To an observer on Earth, these rays appear to come from a position above the horizon. Hence, the statement regarding advanced sunrise being due to refraction is correct.

• Delayed Sunset: Similarly, for the same reason of atmospheric refraction, the sun remains visible for about 2 minutes after it has already crossed below the horizon. This creates the illusion that the sun is still present in the sky. Hence, the statement regarding delayed sunset being due to refraction is correct.

• Daylight Extension: Because of these two effects, the total duration of daylight is increased by approximately 4 minutes (2 minutes in the morning and 2 minutes in the evening).

• Evaluation of Options:

• Statement 1 suggests scattering causes advanced sunrise, which is scientifically inaccurate. Hence, statement 1 is incorrect.

• Statement 2 correctly identifies atmospheric refraction as the cause for both events. Hence, statement 2 is correct.

• Statement 3 attributes the timing difference to the scattering of light, which actually causes the color changes, not the position shift. Hence, statement 3 is incorrect.

• Statement 4 claims it is due to Earth’s rotation only; while rotation causes the day-night cycle, the timing discrepancy is an optical phenomenon. Hence, statement 4 is incorrect.

Additional Information

• Mechanism of Refraction: As light travels from the vacuum of space into the Earth's atmosphere, it enters a denser medium. According to Snell's Law, light bends toward the normal as it moves into a medium with a higher refractive index. The air layers closer to the Earth's surface are denser than the upper layers, causing continuous bending of sunlight.

• Apparent vs. Actual Position: Due to refraction, the apparent position of the sun is slightly higher than its actual position. This effect is most pronounced when the sun is near the horizon (sunrise and sunset).

• Scattering of Light: It is important to distinguish refraction from scattering. Scattering (specifically Rayleigh scattering) is the process where gas molecules in the atmosphere redirect shorter wavelengths of light (blue/violet). This is why the sky appears blue and why the sun appears reddish during sunrise and sunset, as red light has a longer wavelength and is scattered the least.

• Twinkling of Stars: This is another classic example of atmospheric refraction. Starlight undergoes multiple refractions as it passes through different layers of the atmosphere with varying temperatures and densities, causing the apparent position of the star to fluctuate slightly, which we perceive as twinkling.

• Flattening of the Sun: Atmospheric refraction also causes the sun to appear flattened or oval-shaped during sunrise and sunset because the bottom edge of the sun is refracted more than the top edge.

Important Points

• Refractive Index Variation: The refractive index of air depends on its temperature and pressure. Colder air is denser and has a higher refractive index than warmer air.

• Horizon Definition: The actual sunrise is defined as the moment when the sun physically crosses the horizon. Atmospheric refraction allows us to see it before this physical event occurs.

• Optical Illusions in Nature: Other phenomena related to refraction include mirages in deserts or on hot roads, where light bends due to temperature gradients in the air near the ground.

Q8. Answer: (c) Sensory neurons

The correct answer is Sensory neurons.

Key Points

• Sensory neurons, also known as afferent neurons, are specialized nerve cells that convert external stimuli from the environment into internal electrical impulses.

• In a reflex arc, these neurons are the primary components responsible for receiving signals from receptors (such as those in the skin, eyes, or ears) and transmitting them toward the Central Nervous System (CNS).

• They function as the "input" mechanism of the nervous system, detecting changes such as temperature, pressure, pain, or light. Hence, the statement that they receive and transmit signals from external stimuli is correct.

• Structurally, most sensory neurons are pseudounipolar, meaning they have an axon that fans out into two branches: one to the peripheral nervous system and another to the spinal cord.

• The transmission happens rapidly to ensure that the body can react to potentially harmful stimuli without the need for immediate conscious thought from the brain.

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Additional Information

• Motor Neurons (Efferent Neurons):

• These neurons carry nerve impulses away from the Central Nervous System toward effectors, such as muscles or glands.

• Their primary role is to initiate a physical response, such as muscle contraction or hormone secretion, based on the signals received from the CNS.

• Relay Neurons (Interneurons):

• Located entirely within the spinal cord and brain, relay neurons serve as the connecting link between sensory neurons and motor neurons.

• They process the incoming sensory information and "relay" the signal to the appropriate motor pathway to complete the reflex arc.

• Effector Muscle:

• The effector is the organ, tissue, or cell (often a skeletal muscle) that responds to the impulse from the motor neuron.

• In a typical withdrawal reflex, the effector muscle contracts to move a limb away from a stimulus like a hot flame or a sharp needle.

• The Reflex Arc Pathway:

• The standard sequence involves: Receptor → Sensory Neuron → Integration Center (Relay Neuron in Spinal Cord) → Motor Neuron → Effector.

• This pathway bypasses the cerebral cortex of the brain for the initial reaction, which significantly reduces response time.

Important Points

• Speed of Transmission: Reflexes are involuntary and nearly instantaneous. For example, the patellar reflex (knee-jerk) occurs in approximately 15 to 30 milliseconds.

• Synapse: The gap between two neurons where chemical neurotransmitters are released to pass the signal is called a synapse. In a monosynaptic reflex, there is only one synapse (between sensory and motor), while polysynaptic reflexes involve one or more relay neurons.

• Location: The cell bodies of sensory neurons are typically clustered in the dorsal root ganglia located just outside the spinal cord.

• Role in Survival: The primary biological function of the reflex arc is protection and homeostasis, allowing for immediate avoidance of injury.

Q9. Answer: (a) all tall (Tt)

The correct answer is all tall (Tt).

Key Points

• According to Mendel's Laws of Inheritance, when a homozygous tall pea plant (TT) is crossed with a homozygous short pea plant (tt), it represents a monohybrid cross, which focuses on a single trait (stem height).

• During the process of meiosis, the parent plants produce gametes. The tall plant (TT) produces gametes that all carry the T allele, while the short plant (tt) produces gametes that all carry the t allele.

• In the F1 (First Filial) generation, the fusion of these gametes results in offspring that all have the heterozygous genotype (Tt).

• Because the Tall (T) allele is completely dominant over the Short (t) allele, the recessive trait (shortness) is masked in this generation.

• As a result, 100% of the F1 offspring will exhibit the tall phenotype. Hence, option 1 is correct.

Additional Information

• Gregor Johann Mendel: Known as the Father of Genetics, he was an Austrian monk who conducted hybridization experiments on garden peas (Pisum sativum) for seven years between 1856 and 1863.

• Law of Dominance: This principle states that in a heterozygous individual (like Tt), the dominant allele will express itself, while the recessive allele remains hidden. The recessive trait only appears when two copies of the recessive allele are present (tt).

• Genotype vs. Phenotype: Genotype refers to the genetic makeup of an organism (e.g., TT, Tt, tt), whereas Phenotype refers to the observable physical characteristics (e.g., Tall or Short).

• Homozygous and Heterozygous: An organism is homozygous when it has two identical alleles for a gene (TT or tt). It is heterozygous when it has two different alleles (Tt).

Important Points

• F2 Generation: When the F1 plants (Tt) are allowed to self-pollinate, the F2 (Second Filial) generation is produced. In this generation, the recessive trait reappears.

• Phenotypic Ratio: The F2 generation typically shows a 3:1 ratio, where 75% of the plants are tall and 25% are short.

• Genotypic Ratio: The genetic distribution in the F2 generation is 1:2:1, consisting of 1 homozygous tall (TT), 2 heterozygous tall (Tt), and 1 homozygous short (tt).

• Seven Contrasting Traits: Mendel studied seven pairs of contrasting traits in pea plants: Stem height (Tall/Short), Seed shape

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(Round/Wrinkled), Seed color (Yellow/Green), Flower color (Violet/White), Pod shape (Full/Constricted), Pod color (Green/Yellow), and Flower position (Axial/Terminal).

Q10. Answer: (a) Na

The correct answer is Na.

Key Points

• The chemical symbol for Sodium is Na. This symbol is derived from its Latin name, Natrium. Hence, option 1 is correct.

• Sodium is a chemical element with the atomic number 11, which means it contains 11 protons in its atomic nucleus.

• It is located in Group 1 of the Periodic Table, placing it among the Alkali Metals.

• In terms of its position, it is found in Period 3 and the s-block of the modern periodic table.

• The atomic mass of Sodium is approximately 22.989 u.

• Under standard conditions of temperature and pressure, sodium is a soft, silvery-white, and highly reactive metal.

Additional Information

• Physical Properties:

• Sodium is so soft that it can be easily cut with a knife at room temperature.

• It has a density of 0.97 g/cm³, which makes it less dense than water, allowing it to float.

• Its melting point is relatively low for a metal, at 97.79°C (208.02°F), and its boiling point is 883°C.

• Chemical Reactivity:

• Sodium is extremely reactive, particularly with water. When it comes into contact with water, it reacts exothermically to produce sodium hydroxide (NaOH) and flammable hydrogen gas.

• Due to this high reactivity, sodium is never found as a pure element in nature; it must be stored under mineral oil or kerosene to prevent reaction with moisture or oxygen in the air.

• Industrial and Domestic Uses:

• The most common compound is Sodium Chloride (NaCl), which is used globally as table salt and for de-icing roads.

• Sodium Carbonate (Na2CO3), also known as washing soda, is vital in the manufacture of glass, paper, and detergents.

• Sodium Bicarbonate (NaHCO3), or baking soda, is widely used in the food industry and as a fire extinguisher component.

• Biological Importance:

• Sodium is an essential electrolyte for the human body. It is critical for maintaining osmotic pressure, fluid balance, and the transmission of nerve impulses.

• The sodium-potassium pump is a vital mechanism in cell biology that moves ions across cell membranes.

Important Points

• Origin of the Name: The element was first isolated by Humphry Davy in the year 1807 through the electrolysis of caustic soda (NaOH).

• Comparison with Other Options:

• S is the chemical symbol for Sulfur (atomic number 16), which is a non-metal. Hence, option 3 is incorrect.

• Sd and So are not valid chemical symbols for any known element in the IUPAC periodic table. Hence, options 2 and 4 are incorrect.

• Valency: Sodium has a valency of 1 because it has one electron in its outermost shell (electron configuration: 2, 8, 1). It tends to lose this electron to achieve a stable octet configuration, forming a cation (Na+).

• Abundance: Sodium is the sixth most abundant element in the Earth's crust, making up about 2.6% of its mass.

Q11. Answer: (d) −210 J

The correct answer is -210 J.

Key Points

• The Work-Energy Theorem states that the net work done by the forces acting on a body is equal to the change in its kinetic energy.

• In this problem, the given values are: Mass of the object (m) = 20 kg, Initial velocity (u) = 5 m/s, and Final velocity (v) = 2 m/s.

• The Initial Kinetic Energy (Ki) is calculated using the formula 1/2 * m * u^2. Substituting the values: 1/2 * 20 * (5 * 5) = 10 * 25 = 250 Joules.

• The Final Kinetic Energy (Kf) is calculated using the formula 1/2 * m * v^2. Substituting the values: 1/2 * 20 * (2 * 2) = 10 * 4 = 40 Joules.

• The Work Done (W) is the difference between the final and initial kinetic energy (W = Kf - Ki). Therefore, W = 40 - 250 = -210 J.

• The negative sign indicates that the force applied was a retarding force, acting in the direction opposite to the motion of the mass.

Additional Information

• Kinetic Energy:

• It is the energy possessed by an object due to its motion. The formula for kinetic energy is K.E = 1/2 mv^2, where m is mass and v is velocity.

• Since velocity is squared in the formula, kinetic energy is always a non-negative value, but the change in kinetic energy can be negative.

• Work Done:

• Work is defined as the product of the component of the force in the direction of the displacement and the magnitude of this displacement.

• The SI unit of work is the Joule (J). One Joule is the work done by a force of 1 Newton causing a displacement of 1 meter.

• Positive, Negative, and Zero Work:

• Positive Work: When the force and displacement are in the same direction (angle is 0 degrees).

• Negative Work: When the force and displacement are in opposite directions (angle is 180 degrees), such as friction.

• Zero Work: When the force is perpendicular to the displacement (angle is 90 degrees), such as a coolie carrying a load on his head while walking horizontally.

Important Points

• Mass (m): It is a scalar quantity representing the amount of matter in an object, measured in kilograms (kg). In this case, it is 20 kg.

• Velocity (v): It is a vector quantity representing the rate of change of displacement, measured in meters per second (m/s).

• Energy Conservation: While the Work-Energy theorem focuses on kinetic energy, the total mechanical energy (sum of potential and kinetic energy) remains constant in a conservative field if no external work is done.

• Application: The concept of negative work is frequently used in calculating braking distances for vehicles and understanding air resistance or drag forces in physics.

Q12. Answer: (c) A satellite orbiting the Earth

The correct answer is A satellite orbiting the Earth.

Key Points

• Uniform circular motion is defined as the motion of an object traveling at a constant speed along a circular path. Although the speed is constant, the velocity of the object is constantly changing because its direction of motion changes at every point on the path.

• A satellite orbiting the Earth at a constant altitude is a primary example of uniform circular motion. The gravitational force exerted by the Earth acts as the centripetal force, which keeps the satellite in its circular orbit while its speed remains relatively constant. Hence, statement 3 is correct.

• A person walking in a straight line is an example of rectilinear motion. Since the path is not circular, it does not qualify as circular motion. Hence, statement 1 is incorrect.

• A car moving on a straight road also represents rectilinear motion. Even if the car maintains a constant speed, the lack of a curved or circular path means it cannot be uniform circular motion. Hence, statement 4 is incorrect.

• A ball thrown vertically upwards is an example of non-uniform linear motion. The ball is subject to a constant acceleration due to gravity (approximately 9.8 m/s2), causing its speed to decrease as it rises and increase as it falls, all while moving in a straight vertical line. Hence, statement 2 is incorrect.

Additional Information

• Velocity and Acceleration: In uniform circular motion, even though the magnitude of velocity (speed) is constant, there is a continuous acceleration known as centripetal acceleration. This acceleration is always directed toward the center of the circular path.

• Centripetal Force: This is the "center-seeking" force required to maintain any circular motion. The formula for this force is F = mv2/r, where m is mass, v is velocity, and r is the radius of the path. In the case of a satellite, this force is provided by gravity.

• Angular Velocity: This refers to the rate at which an object rotates around a center. It is usually denoted by the Greek letter omega (ω). The relationship between linear speed (v) and angular speed is v = rω.

• Work Done: In perfect uniform circular motion, the work done by the centripetal force is zero. This is because the force acting on the object is always perpendicular (90 degrees) to the direction of its displacement (which is tangential to the circle).

• Real-world Examples: Other common examples of this motion include the motion of the tips of the hands of a clock, a point on a ceiling fan rotating at a constant speed, and the Moon revolving around the Earth.

Important Points

• Direction of Velocity: In circular motion, the direction of velocity at any point is along the tangent to the circle at that specific point.

• Time Period: The time taken by an object to complete one full revolution of the circular path is called its Time Period (T). It can be calculated using the formula T = 2πr / v.

• Frequency: The number of revolutions completed by the object in one second is called its frequency (f), which is the reciprocal of the time period (f = 1/T).

• Nature of Acceleration: It is important to remember that uniform circular motion is an accelerated motion despite having a constant speed, because the velocity vector changes direction constantly.

Q13. Answer: (a) Both statements A and B are correct.

The correct answer is Both statements A and B are correct.

Key Points

• Statement A describes the chemical reaction between Ethanoic acid and sodium hydroxide. Ethanoic acid (also known as acetic acid) has the chemical formula CH3COOH, and when it reacts with the strong base sodium hydroxide (NaOH), it undergoes a double displacement reaction to form sodium acetate (CH3COONa) and water (H2O). Hence, statement A is correct.

• The chemical equation for this reaction is: CH3COOH + NaOH → CH3COONa + H2O.

• Statement B identifies the type of reaction. A neutralisation reaction is a specific type of chemical reaction where an acid and a base react with each other to produce a salt and water. Since ethanoic acid is an acid and sodium hydroxide is a base, their interaction fits this definition perfectly. Hence, statement B is correct.

• In this neutralisation process, the hydrogen ion (H+) from the acid combines with the hydroxide ion (OH-) from the base to form water, while the remaining ions form the ionic salt.

• Hence, the correct answer is Both statements A and B are correct.

Additional Information

• Ethanoic Acid (Acetic Acid):

• It is a weak organic acid that is a primary component of vinegar (typically 5% to 8% by volume).

• In its pure form, it is called glacial acetic acid because it freezes into ice-like crystals at a temperature of 16.6 degrees Celsius.

• It is widely used in the food industry as a preservative and in the textile industry for the production of synthetic fibers like rayon.

• Sodium Hydroxide (Caustic Soda):

• It is a strong inorganic base and is highly alkaline.

• It is deliquescent, meaning it absorbs moisture and carbon dioxide from the air.

• Major applications include the manufacture of soaps, detergents, paper, and as a chemical reagent in laboratories.

• Sodium Acetate:

• It is the sodium salt of acetic acid and is often used as a buffering agent to maintain a constant pH in chemical reactions.

• It is used in heating pads and hand warmers because of its ability to release heat upon crystallization from a supersaturated solution.

• In the food industry, it is used as a seasoning (sodium diacetate) to give a salt-and-vinegar flavor to snacks.

Important Points

• pH Levels in Neutralisation: Although the reaction is a neutralisation, the resulting pH of the solution depends on the strength of the reactants. When a weak acid (like ethanoic acid) reacts with a strong base (like sodium hydroxide), the resulting salt solution is slightly alkaline, with a pH greater than 7.

• Indicators: To observe this neutralisation in a laboratory, indicators like phenolphthalein are used. The solution turns from pink (in base) to colorless as the acid is added to reach the equivalence point.

• Exothermic Nature: Most neutralisation reactions are exothermic, meaning they release heat energy to the surroundings during the process.

Q14. Answer: (b) works perfectly with hard water

The correct answer is works perfectly with hard water.

Key Points

• Soap is chemically defined as the sodium or potassium salt of long-chain fatty acids (such as stearic, palmitic, or oleic acid).

• A soap molecule has a dual nature: a hydrophilic head (the ionic -COO^-Na^+ or -COO^-K^+ part) that interacts with water and a hydrophobic tail (the long hydrocarbon chain) that avoids water but attaches to grease and oil. Hence, statements 3 and 4 are associated with soap.

• When soap is dissolved in water, the molecules orient themselves into spherical clusters known as micelles. In a micelle, the hydrophobic tails are trapped in the interior away from water, while the hydrophilic heads remain on the surface in contact with the aqueous environment. Hence, statement 1 is associated with soap.

• Soap fails to work effectively in hard water. Hard water contains high concentrations of calcium (Ca^{2}^+) and magnesium (Mg^{2}^+) ions. These ions react with soap to form an insoluble, curdy precipitate known as scum. Hence, statement 2 is NOT associated with soap and is the correct answer.

• The formation of scum wastes soap and makes it difficult for the soap to create lather, which is essential for the cleansing process.

Additional Information

• Cleansing Action of Soap:

• The hydrophobic end of the soap attaches to the dirt or oil on clothes, while the hydrophilic end stays in the water.

• This creates an emulsion where the oil is lifted from the surface and suspended in water, allowing it to be washed away during rinsing.

• Saponification:

• This is the chemical reaction used to produce soap. It involves the hydrolysis of fats (triglycerides) with a strong alkali like Sodium Hydroxide (NaOH) for hard soaps or Potassium Hydroxide (KOH) for soft soaps.

• The process typically yields glycerol as a byproduct, which is often used in the cosmetic industry.

• Synthetic Detergents:

• Unlike soaps, detergents are sodium salts of long-chain benzene sulphonic acids or alkyl hydrogen sulphates.

• The primary advantage of detergents is that they work perfectly with hard water because their calcium and magnesium salts are soluble in water and do not form scum.

• Detergents are widely used in shampoos and products for cleaning clothes because of their superior performance in varied water conditions.

Important Points

• Environmental Impact: While soaps are biodegradable and broken down by bacteria in sewage systems, some older types of synthetic detergents were non-biodegradable, leading to water pollution and foam in rivers. Modern detergents are designed to be more environmentally friendly.

• pH Level: Soap solutions are generally basic (alkaline) in nature, which can sometimes irritate sensitive skin. Potassium soaps are usually milder than sodium soaps.

• Hardness of Water: It is measured in parts per million (ppm) or degrees. Temporary hardness is caused by bicarbonates, while permanent hardness is caused by chlorides and sulphates of calcium and magnesium.

Q15. Answer: (b) They prevent maturation of primary oocyte.

The correct answer is They prevent maturation of primary oocyte..

Key Points

• Oral contraceptive pills are hormonal preparations used by females to prevent pregnancy. They contain either progestogens alone or a combination of progestogen and estrogen.

• The primary mechanism of these pills is the inhibition of ovulation. By providing a steady supply of synthetic hormones, they suppress the secretion of Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH) from the pituitary gland.

• Since FSH is responsible for stimulating the growth of follicles, its suppression ensures that the primary oocyte does not undergo maturation into a secondary oocyte. Without maturation, no egg is released from the ovary. Hence, statement 2 is correct.

• Physical barriers like condoms, diaphragms, or surgical methods like tubectomy (which blocks the fallopian tube) are responsible for creating physical obstructions. Oral pills do not create any such physical barrier. Hence, statement 1 is incorrect.

• Chemicals that are toxic to sperms are known as spermicides, which are usually available as creams, jellies, or foams. Oral pills do not act as toxins to sperms. Hence, statement 3 is incorrect.

• Mechanical barriers used in the vagina or cervix, such as vaults or cervical caps, block the passage of sperms. Oral pills function biochemically through the bloodstream and do not physically block the vaginal passage. Hence, statement 4 is incorrect.

Additional Information

• Method of Administration: Pills are typically taken daily for a period of 21 days, starting within the first five days of the menstrual cycle. This is followed by a 7-day break during which menstruation occurs, after which the pattern is repeated.

• Saheli: This is a famous oral contraceptive for females developed by the Central Drug Research Institute (CDRI) in Lucknow, India. It is unique because it is a non-steroidal preparation and is taken once a week, offering high contraceptive value with very few side effects.

• Alteration of Cervical Mucus: Apart from inhibiting ovulation, oral pills also increase the thickness and quality of cervical mucus. This thick mucus acts as a barrier that prevents or retards the entry of sperms into the uterus.

• Implantation Inhibition: These hormones also alter the nature of the endometrium (the inner lining of the uterus), making it unsuitable for the implantation of a fertilized egg, providing an additional layer of protection against pregnancy.

Important Points

• Hormonal Feedback: The pills work on the principle of negative feedback. High levels of exogenous progesterone and estrogen inhibit the hypothalamus from releasing GnRH, which effectively shuts down the hormonal trigger for the mid-cycle LH surge required for ovulation.

• Effectiveness: When taken correctly, oral contraceptives are 99% effective. However, their efficacy can be reduced if doses are missed or if certain antibiotics are taken simultaneously.

• Medical Uses: Beyond contraception, these pills are often prescribed to regulate menstrual cycles, reduce menstrual cramps,

and manage symptoms of Polycystic Ovary Syndrome (PCOS).

• Emergency Contraceptive Pills (ECPs): These are different from regular daily pills; they contain higher doses of levonorgestrel and must be taken within 72 hours of unprotected intercourse to prevent conception.

Q16. Answer: (a) Electron

The correct answer is Electron.

Key Points

• The Electron is a subatomic particle that carries a negative elementary electric charge. It was the first subatomic particle to be discovered, identified by J.J. Thomson in 1897 during his experiments with cathode rays. Hence, the correct answer is Electron.

• In terms of mass, an electron is extremely light, weighing approximately 9.109 x 10^-31 kilograms. This is roughly 1/1837th of the mass of a proton, which is why it is considered to have negligible mass in most atomic calculations.

• Protons are subatomic particles found in the nucleus of an atom with a positive charge of +1 and a mass of approximately 1 atomic mass unit (amu). Since they have a positive charge, this option is incorrect. Hence, statement 3 is incorrect.

• Neutrons are also located in the nucleus and have no electric charge (they are neutral). Their mass is slightly greater than that of a proton, approximately 1 amu. Because they lack a negative charge, this option is incorrect. Hence, statement 4 is incorrect.

• Nucleons is a collective term for the particles that reside within the atomic nucleus, specifically protons and neutrons. Since this term refers to a group containing positively charged and neutral particles with significant mass, it does not fit the description. Hence, statement 2 is incorrect.

Additional Information

• Atomic Structure: Atoms are composed of a dense, positively charged nucleus surrounded by a cloud of electrons. The electrons are held in place by the electromagnetic force, specifically the attraction between the negative electrons and the positive protons.

• Discovery of the Nucleus: In 1911, Ernest Rutherford performed the Gold Foil Experiment, which led to the conclusion that most of the atom's mass and its positive charge are concentrated in a tiny central region called the nucleus.

• Electron Configuration: Electrons reside in specific energy levels called shells (K, L, M, N...). The arrangement of electrons in these shells determines the chemical properties of the element. The outermost electrons are known as valence electrons.

• Subatomic Charges: The magnitude of the charge of an electron is exactly equal to the magnitude of the charge of a proton (1.602 x 10^-19 Coulombs), but with an opposite sign. This balance ensures that an atom with an equal number of protons and electrons remains electrically neutral.

• Quantum Nature: According to quantum mechanics, electrons exhibit wave-particle duality. This means they possess characteristics of both particles and waves, a concept pioneered by Louis de Broglie.

Important Points

• Bohr Model: Proposed by Niels Bohr in 1913, this model suggested that electrons orbit the nucleus in fixed circular paths or orbits, which helped explain the spectral lines of hydrogen.

• Mass Number vs. Atomic Number: The Atomic Number (Z) is the number of protons, while the Mass Number (A) is the sum of protons and neutrons. Electrons are excluded from the mass number calculation due to their negligible weight.

• Isotopes: These are atoms of the same element that have the same number of protons but different numbers of neutrons. This changes the mass of the atom but usually does not significantly change its chemical behavior, which is governed by electrons.

• Ionization: When an atom gains or loses electrons, it becomes an ion. Losing electrons creates a cation (positive charge), while gaining electrons creates an anion (negative charge).

Q17. Answer: (c) Unbalanced

The correct answer is Unbalanced.

Key Points

• For a rocket to move upward from its launchpad, the forces acting on it must be unbalanced. According to Newton's First Law of Motion, an object at rest will stay at rest unless acted upon by an external unbalanced force.

• When a rocket's engines ignite, they produce an upward force known as thrust. For the rocket to lift off, this thrust must be greater than the downward force of gravity (the rocket's weight).

• The net force is the vector sum of all forces. In this case, Net Force = Thrust - (Weight + Air Resistance). Since the rocket accelerates upward, the net force is positive and non-zero, making the forces unbalanced. Hence, the correct option is Unbalanced.

• Newton's Second Law of Motion states that Acceleration (a) = Net Force (F) / Mass (m). Without an unbalanced force, the acceleration would be zero, and the rocket would either remain stationary or move at a constant velocity.

• If the forces were balanced, the upward thrust would exactly equal the downward gravity and drag, resulting in no change in the rocket's state of motion. Hence, the option 'Balanced' is incorrect.

Additional Information

• Newton's Third Law of Motion: This law is the fundamental principle behind rocket propulsion. It states that for every action, there is an equal and opposite reaction. The rocket pushes exhaust gases downward at high velocity (action), and these gases push the

rocket upward (reaction).

• Thrust: This is the mechanical force generated by the rocket's propulsion system. It depends on the mass flow rate of the exhaust and the exit velocity of the gases. To achieve orbit, engines must maintain high thrust levels for an extended duration.

• Gravity: Throughout the flight, gravity acts as a constant downward force. Its magnitude decreases slightly as the rocket moves further from Earth's center, but it remains a primary factor the rocket must overcome using fuel and combustion.

• Air Resistance (Drag): As the rocket travels through the atmosphere, air molecules collide with it, creating friction or drag. This force acts in the opposite direction of the rocket's motion and increases with velocity and atmospheric density.

• Mass Variation: Unlike many other vehicles, a rocket's mass changes significantly during flight because it consumes a massive amount of propellant (fuel and oxidizer). As mass decreases and thrust remains constant, the acceleration increases dramatically.

Important Points

• Vector Quantities: Force and acceleration are vector quantities, meaning they have both magnitude and direction. The direction of the unbalanced force determines the direction of the acceleration.

• Inertia: The tendency of the rocket to resist changes in its state of motion is called inertia, which is directly proportional to its mass. High inertia requires a larger unbalanced force to achieve the same acceleration.

• Equilibrium: An object is in mechanical equilibrium when the sum of forces is zero (balanced). A rocket sitting on a launchpad before ignition is in static equilibrium, where the normal force from the ground balances gravity.

• Historical Context: Sir Isaac Newton published these laws in his work Philosophiae Naturalis Principia Mathematica in 1687, which laid the foundation for modern aerospace engineering and physics.

Q18. Answer: (d) Insects

The correct answer is Insects.

Key Points

• Abiotic resistance refers to a plant's ability to survive and grow under non-living environmental stresses. These factors are physical or chemical rather than biological.

• Salinity is an abiotic factor characterized by an excessive concentration of salts (like Sodium Chloride) in the soil. It affects the osmotic potential of the plant, making it difficult to absorb water. Hence, this is an abiotic resistance factor.

• Heat is a critical abiotic stress caused by high temperatures that exceed the optimal range for plant enzymes. It can lead to protein denaturation and reduced photosynthetic efficiency. Hence, this is an abiotic resistance factor.

• Drought is an abiotic factor resulting from a prolonged shortage of water. Plants develop resistance through mechanisms like deep root systems, stomatal closure, and osmotic adjustment. Hence, this is an abiotic resistance factor.

• Insects are living organisms (animals) that cause biological damage to crops through feeding, egg-laying, or by acting as disease vectors. Stresses caused by living entities are classified as biotic stresses, not abiotic. Hence, Insects is the correct answer as it is NOT an abiotic resistance factor.

Additional Information

• Biotic Stress in Crops:

• This involves damage caused by living organisms such as fungi, bacteria, viruses, nematodes, weeds, and insects.

• Examples include the Desert Locust (pest), Late Blight in potatoes (fungal), and Rice Tungro Virus.

• Resistance is often achieved through Biotechnology, such as the development of Bt Cotton which produces a toxin to kill certain pests.

• Abiotic Stress Factors:

• These are environmental conditions that limit crop productivity. Besides salinity, heat, and drought, they include frost/cold, flooding, radiation, and heavy metal toxicity (like Lead or Arsenic).

• According to agricultural data, abiotic stresses are responsible for more than 50% of the global yield loss in major crops like wheat, rice, and maize.

• Plant Adaptations:

• Plants respond to abiotic stress by producing Heat Shock Proteins (HSPs) or secondary metabolites like proline to maintain cellular stability.

• Xerophytes are specifically adapted to drought, while Halophytes are plants naturally resistant to salinity.

Important Points

• Food Security: Developing multi-stress resistant varieties is essential for maintaining global food security in the face of climate change.

• Measurement Units: Soil salinity is often measured by Electrical Conductivity (EC), while drought intensity is monitored using the Palmer Drought Severity Index (PDSI).

• Breeding Techniques: Modern Genome Editing tools like CRISPR-Cas9 are being used to enhance abiotic resistance in crops by targeting specific stress-responsive genes.

• Classification: It is important to distinguish between Resistance (ability to prevent the stress) and Tolerance (ability to endure the

stress without significant yield loss).

Q19. Answer: (a) Red

The correct answer is Red.

Key Points

• In a domestic electric circuit, the Live wire (also known as the Phase wire) is traditionally colored Red. This wire is responsible for carrying the electric current from the power source to the various appliances in the house.

• The Live wire is maintained at a high potential, which is typically 220 Volts (in India) relative to the earth or neutral wire.

• According to the conventional color coding used in domestic wiring, the three wires are identified as: Red for Live, Black for Neutral, and Green for Earth. Hence, the statement regarding Red being the live wire is correct.

• Safety devices such as the Fuse and the Switch are always connected to the Live wire. This ensures that when the fuse blows or the switch is turned off, the appliance is completely disconnected from the high-voltage source.

• It is crucial to identify the Live wire correctly during electrical repairs to avoid Electric Shocks, as touching the live wire while grounded can lead to a fatal current passing through the body.

Additional Information

• Neutral Wire:

• The Neutral wire is generally Black in the old convention and Blue in the new international convention.

• Its primary function is to complete the circuit by providing a Return Path for the current. It is ideally maintained at Zero Potential (0V).

• Earth Wire:

• The Earth wire is usually Green or Green-Yellow. It is a safety wire connected to a large Copper Plate buried deep in the earth near the house.

• It provides a Low-resistance Path for any leakage current, ensuring that if the live wire touches the metallic body of an appliance, the current flows into the ground rather than through the user.

• New Color Convention:

• Modern electrical installations often follow the International Electrotechnical Commission (IEC) standards.

• Under these new rules, the Live wire is Brown, the Neutral wire is Blue, and the Earth wire is Green with a Yellow stripe.

• Short Circuit and Overloading:

• A Short Circuit occurs when the Live wire and the Neutral wire come into direct contact due to damaged insulation, causing a sudden surge in current.

• Overloading happens when too many high-power appliances are connected to a single circuit, drawing more current than the wires can safely handle.

Important Points

• Standard Supply in India: The domestic electricity supply in India is Alternating Current (AC) with a frequency of 50 Hz and a standard voltage of 220V.

• Three-Pin Plug: In a standard Three-pin Plug, the top pin is the Earth pin. It is designed to be Thicker and Longer than the other two pins (Live and Neutral) so that the grounding connection is established first before the power is supplied.

• Color Variations: While Red is the most common color for live wires in single-phase domestic circuits, in three-phase industrial circuits, the live wires are often colored Red, Yellow, and Blue.

Q20. Answer: (b) B, C

The correct answer is B, C.

Key Points

• The number of neutrons in an atom is calculated by subtracting the atomic number (Z) from the mass number (A). The formula is: Number of Neutrons = A - Z.

• For Boron (B), the most common isotope has an atomic number of 5 and a mass number of approximately 11. Therefore, the number of neutrons is 11 - 5 = 6.

• For Carbon (C), the most common isotope (Carbon-12) has an atomic number of 6 and a mass number of 12. Therefore, the number of neutrons is 12 - 6 = 6.

• Comparing the two, both Boron (B) and Carbon (C) possess 6 neutrons in their most stable forms. Hence, statement 2 is correct.

• In contrast, for Lithium (Li), the atomic number is 3 and the mass number is 7, giving 4 neutrons. For Beryllium (Be), the atomic number is 4 and the mass number is 9, giving 5 neutrons. Hence, statement 1 is incorrect.

Additional Information

• Atomic Number (Z): It represents the number of protons in the nucleus of an atom. It is unique to every element and determines its position in the Modern Periodic Table. For example, Helium has 2 protons, while Lithium has 3.

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• Mass Number (A): It is the total sum of protons and neutrons (collectively called nucleons) in the nucleus. It is usually denoted as a whole number in calculations. For instance, the mass number of Beryllium is 9.

• Isotones: Elements or atoms that have the same number of neutrons but different atomic numbers and mass numbers are called isotones. In this question, Boron-11 and Carbon-12 are examples of isotones.

• Isotopes: These are atoms of the same element having the same atomic number but different mass numbers. For example, Carbon-12 and Carbon-14 are isotopes of Carbon.

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

Important Points

• Discovery of Neutrons: The neutron was discovered by the British physicist James Chadwick in the year 1932. It is a subatomic particle with no net electric charge and a mass slightly greater than that of a proton.

• Elements Comparison:

• Helium (He): Atomic Number 2, Mass Number 4, Neutrons = 2.

• Lithium (Li): Atomic Number 3, Mass Number 7, Neutrons = 4.

• Beryllium (Be): Atomic Number 4, Mass Number 9, Neutrons = 5.

• Boron (B): Atomic Number 5, Mass Number 11, Neutrons = 6.

• Carbon (C): Atomic Number 6, Mass Number 12, Neutrons = 6.

• The distribution of electrons, protons, and neutrons determines the chemical and physical properties of the element. Neutrons play a critical role in the stability of the nucleus.

Q21. Answer: (b) Lysosomes contain digestive enzymes.

The correct answer is Lysosomes contain digestive enzymes.

Key Points

• Lysosomes are membrane-bound vesicular structures formed by the process of packaging in the Golgi apparatus. They are often referred to as the "suicidal bags" of the cell.

• These organelles contain a wide variety of hydrolytic enzymes (hydrolases), such as lipases, proteases, and carbohydrases, which are optimally active at an acidic pH. These enzymes are responsible for digesting carbohydrates, proteins, lipids, and nucleic acids. Hence, statement 2 is correct.

• The synthesis of fats (lipids) and steroids primarily takes place in the Smooth Endoplasmic Reticulum (SER), not in the lysosomes. Hence, statement 1 is incorrect.

• Protein synthesis is the primary function of ribosomes, which may be found floating freely in the cytoplasm or attached to the Rough Endoplasmic Reticulum (RER). Lysosomes do not synthesize proteins; they degrade them. Hence, statement 3 is incorrect.

• Growth hormones are signaling molecules produced by specialized endocrine glands, such as the pituitary gland. They are not contained or produced within lysosomes. Hence, statement 4 is incorrect.

Additional Information

• Structure and Discovery:

• Lysosomes were discovered by the Belgian cytologist Christian de Duve in 1955.

• They are typically spherical in shape and are enclosed by a single unit membrane to prevent the powerful enzymes from leaking and destroying the rest of the cell.

• Mechanism of Action:

• Lysosomes maintain an internal acidic environment (around pH 4.5 to 5.0) through proton pumps in their membranes that transport H+ ions from the cytosol.

• They are involved in autophagy (digesting the cell's own damaged organelles) and heterophagy (digesting external materials like bacteria or food particles taken in via endocytosis).

• Types of Lysosomes:

• Primary Lysosomes: Newly formed vesicles from the Golgi body containing inactive enzymes.

• Secondary Lysosomes: Formed by the fusion of a primary lysosome with a phagosome or food vacuole; this is where active digestion occurs.

• Residual Bodies: Lysosomes containing undigested material that are eventually eliminated via exocytosis.

• Clinical Significance:

• Malfunctioning of lysosomal enzymes can lead to Lysosomal Storage Diseases (LSDs), such as Tay-Sachs disease or Gaucher's disease, where undigested substances accumulate and damage tissues.

• They are highly abundant in animal cells, particularly in White Blood Cells (leukocytes) like macrophages, which utilize lysosomal enzymes to destroy pathogens.

Q22. Answer: (b) Energy storage

The correct answer is Energy storage.

Key Points

• The analogy focuses on the biological function of specific substances in plants. Just as Chlorophyll is defined by its role as a green pigment, Starch is defined by its role as energy storage.

• Starch is a polysaccharide carbohydrate consisting of a large number of glucose units joined by glycosidic bonds. It is the primary way autotrophic plants store excess energy produced during metabolism.

• During the process of photosynthesis, plants synthesize glucose. Since glucose is soluble in water and can affect the osmotic pressure of cells, plants convert it into insoluble starch for long-term storage in organs like roots, tubers, and seeds.

• In the analogy, Chlorophyll is the substance that captures light energy from the sun, while Starch is the chemical form in which that energy is kept for later use, such as during the night or dormant periods.

• Starch is the most common carbohydrate in the human diet and is contained in large amounts in staple foods such as potatoes, maize (corn), rice, and wheat.

Additional Information

• Structure of Starch:

• It comprises two types of molecules: Amylose and Amylopectin.

• Amylose is a linear chain of glucose and makes up about 20% to 30% of the structure, while Amylopectin is highly branched and makes up the remaining 70% to 80%.

• Comparison with Glycogen:

• While plants use starch for energy storage, animals and humans use glycogen.

• Glycogen is stored primarily in the liver and skeletal muscles and is broken down into glucose when the body requires a quick energy boost.

• Chlorophyll Characteristics:

• It is located within the thylakoid membranes of the chloroplasts.

• The central atom in a chlorophyll molecule is Magnesium (Mg). It absorbs wavelengths of light in the blue and red regions but reflects green light, which gives plants their characteristic color.

• Biochemical Testing:

• The presence of starch can be easily detected using Iodine solution. A chemical reaction occurs that turns the solution to a blue-black color if starch is present.

• This test is a fundamental experiment in botany and biochemistry to demonstrate the occurrence of photosynthesis in leaves.

Important Points

• Carbohydrate Classification: Starch belongs to the complex carbohydrate group because it is a polymer of monosaccharides. Unlike simple sugars, it provides sustained energy release.

• Industrial Uses: Beyond nutrition, starch is used in the paper industry for sizing, in the textile industry for stiffening fabrics, and as a thickening agent in the food industry.

• Evolutionary Significance: The ability of plants to store energy as starch allowed them to survive in seasonal climates where sunlight or water might be scarce for several months of the year.

Q23. Answer: (d) Using sound-absorbent materials

The correct answer is Using sound-absorbent materials.

Key Points

• Reverberation is defined as the persistence of sound in an enclosed space after the original source of sound has stopped. It occurs due to multiple reflections of sound waves from surfaces like walls, ceilings, and floors.

• To reduce reverberation, the surfaces of the room or auditorium must be covered with sound-absorbent materials. These materials reduce the amount of reflected energy by converting sound energy into heat energy within the material. Hence, statement 4 is correct.

• Using hard concrete floors would actually increase reverberation because concrete is a rigid and non-porous material that reflects nearly all incident sound waves. Hence, statement 1 is incorrect.

• Removing furniture increases the volume of open space and exposes more reflective surfaces. Items like sofas, cushioned chairs, and wooden desks act as obstacles and partial absorbers; removing them makes the room more "live" and increases the reverberation time. Hence, statement 2 is incorrect.

• Marble walls are highly polished, dense, and hard surfaces. They have a very low absorption coefficient, meaning they reflect sound waves very efficiently, which would lead to prolonged reverberation and potential echoes. Hence, statement 3 is incorrect.

• Commonly used absorbent materials include compressed fiberboard, glass wool, heavy curtains, and carpets. These are specifically designed with porous structures to trap sound waves.

Additional Information

• Mechanism of Absorption: When sound waves strike porous materials, the air molecules vibrate inside the tiny pores. The friction between the air molecules and the walls of the pores converts the vibrational energy into thermal energy, thereby reducing the reflected sound.

• Acoustic Panelling: In cinemas and concert halls, walls are often covered with perforated acoustic panels. These panels have small holes that allow sound to enter and get trapped in the insulating material behind them.

• Impact of Soft Furnishings: Materials such as draperies, upholstered seats, and wall-to-wall carpeting are effective in residential and commercial settings to maintain acoustic comfort and prevent speech unintelligibility.

• Absorption Coefficient: This is a numerical value ranging from 0 to 1. A value of 0 represents a perfect reflector (no absorption), while a value of 1 represents a perfect absorber. Materials like open windows have a coefficient of 1.0 as no sound is reflected back.

Important Points

• Reverberation Time (RT): This is the time duration required for the sound pressure level to decrease by 60 decibels (dB) after the source has stopped. This standard is often referred to as RT60.

• Sabine's Formula: The reverberation time is calculated using Sabine's Equation, which states that the time is directly proportional to the volume of the room and inversely proportional to the total absorption area.

• Optimal Times: Different environments require different reverberation times. For example, a lecture hall requires a low RT (around 0.5 to 1.0 seconds) for speech clarity, whereas a cathedral or concert hall for pipe organ music may have an RT of over 2.0 seconds to create a "full" sound.

• Echo vs Reverberation: An echo is a distinct reflection that reaches the ear at least 0.1 seconds after the original sound. Reverberation is the blending of many reflections so close together that they cannot be distinguished as separate sounds.

Q24. Answer: (a) Synergids

The correct answer is Synergids.

Key Points

• Synergids are two specialized cells located at the micropylar end of the embryo sac in angiosperms. They are part of the egg apparatus, which also includes the egg cell (female gamete).

• The primary function of synergids is to guide the pollen tube toward the female gamete. This guidance is achieved through chemotropic attraction, where the synergids secrete specific chemical substances that direct the pollen tube's growth.

• Inside the synergids, there is a specialized cellular structure called the filiform apparatus. These are thick, finger-like projections of the cell wall that play a vital role in directing the pollen tube into the embryo sac and facilitating the release of sperm nuclei.

• During the process of fertilization, one of the synergids usually starts to degenerate before or upon the entry of the pollen tube, creating a passage for the male gametes to reach the egg cell and the central cell. Hence, the statement that synergids help in guiding the pollen tube is correct.

Additional Information

• Antipodal Cells:

• These are a group of three cells located at the chalazal end (opposite to the micropyle) of the embryo sac.

• In most plants, their function is to provide nutrition to the developing embryo sac, although they typically degenerate before or shortly after fertilization.

• Endosperm:

• The endosperm is the nutritive tissue formed as a result of triple fusion (one male gamete fusing with two polar nuclei) during double fertilization.

• It is usually triploid (3n) and serves as a food source for the embryo during seed development and germination.

• Style:

• The style is the long, slender tube-like part of the carpel (or pistil) that connects the stigma to the ovary.

• While the pollen tube must grow through the tissues of the style to reach the ovule, the style itself does not provide the final chemical guidance into the embryo sac; that role belongs to the synergids.

• Double Fertilization:

• This is a characteristic feature of flowering plants (angiosperms) where two male gametes are released into the embryo sac.

• One male gamete fuses with the egg cell to form a diploid zygote (2n), and the other fuses with the central cell containing two polar nuclei to form the primary endosperm nucleus (PEN).

Important Points

• The embryo sac in a typical angiosperm is an 8-nucleate, 7-celled structure.

• The micropyle is the small opening in the integuments of the ovule through which the pollen tube usually enters.

• The chemotropic signals involved in guidance often include calcium ions and specific proteins secreted by the filiform apparatus.

Q25. Answer: (b) mixing food with saliva

The correct answer is mixing food with saliva.

Key Points

• The tongue is a vital muscular organ located in the oral cavity (mouth) that functions as a primary accessory organ in the digestive system.

• One of its most important roles is mixing food with saliva. This process ensures that food is sufficiently moistened and lubricated for easy passage through the esophagus. Hence, the correct answer is mixing food with saliva.

• The tongue facilitates the formation of a bolus, which is a small, rounded mass of chewed food. By manipulating the food against the palate and teeth, it prepares the food for deglutition (swallowing).

• It acts as a sensory organ equipped with taste buds located on various types of papillae (such as fungiform and circumvallate). These receptors detect sweet, sour, salty, bitter, and umami flavors, which triggers the brain to signal the stomach to begin producing gastric juices.

• During the process of mastication (chewing), the tongue constantly repositions food between the teeth to ensure it is ground efficiently.

Additional Information

• Chemical Digestion in the Mouth:

• While the tongue mixes the food, the salivary glands (parotid, submandibular, and sublingual) secrete saliva containing the enzyme salivary amylase (also known as ptyalin).

• This enzyme initiates the chemical breakdown of complex carbohydrates (starch) into simpler sugars like maltose.

• Anatomy of the Tongue:

• The tongue is composed of skeletal muscle, allowing for voluntary control and highly flexible movements.

• It is anchored to the floor of the mouth by a vertical fold of mucous membrane called the lingual frenulum.

• Misconceptions in Digestion:

• The tongue does not secrete digestive enzymes; these are produced by the salivary glands, stomach, and pancreas.

• The teeth, not the tongue, are responsible for the mechanical action of crushing food into smaller pieces.

• The absorption of nutrients occurs predominantly in the small intestine, specifically through the villi and microvilli in the jejunum and ileum.

• Non-Digestive Functions:

• Beyond digestion, the tongue is essential for phonation (speech) and helps in cleaning the teeth by dislodging food particles after a meal.

Q26. Answer: (c) 91 km/hr

Shortcut Trick

Relative Speed = Total distance ÷ Time taken

Total distance = 282 + 248 = 530 m

Relative Speed (in m/s) = 530 ÷ 12 = 265/6 m/s

Relative Speed (in km/hr) = (265/6) × (18/5) = 53 × 3 = 159 km/hr

Speed of second train = 159 − 68 = 91 km/hr

Therefore The correct answer is 91 km/hr.

Alternate Method

Given:

Length of first train (L1) = 282 m

Length of second train (L2) = 248 m

Time taken (t) = 12 seconds

Speed of first train (S1) = 68 km/hr

Formula Used:

Relative Speed = (L1 + L2) / Time

Conversion: km/hr to m/s = Multiply by 5/18

Calculations:

=> Let the speed of the second train be S2 km/hr.

=> Relative speed = (68 + S2) km/hr

=> (68 + S2) × (5/18) = (282 + 248) / 12

=> (68 + S2) × (5/18) = 530 / 12

=> 68 + S2 = (530 / 12) × (18 / 5)

=> 68 + S2 = (106) × (1.5)

=> 68 + S2 = 159

=> S2 = 159 − 68

=> S2 = 91 km/hr

Therefore The correct answer is 91 km/hr.

Additional Information

Relative Speed Concept

When two objects move in opposite directions, their relative speed is the sum of their individual speeds: S_(rel) = S1 + S2.

Same Direction Relative Speed

When two objects move in the same direction, their relative speed is the difference between their speeds: S_(rel) = |S1 − S2|.

Train Crossing Objects

To cross a stationary pole or man, a train covers its own length. To cross another train or platform, it covers the sum of both lengths.

Q27. Answer: (c) 28

Shortcut Trick

Total days from 5 February 2023 to 19 April 2023 = 23 (Feb) + 31 (Mar) + 19 (Apr) = 73 days.

Time (T) in years = 73 ÷ 365 = 1/5 year.

Simple Interest = (Principal × Rate × Time) ÷ 100

SI = (2000 × 7 × 1/5) ÷ 100 = 4 × 7 = 28.

Therefore The correct answer is Rs. 28.

Alternate Method

Given:

Principal (P) = Rs. 2,000

Rate of Interest (R) = 7% per annum

Time (T) = 5 February 2023 to 19 April 2023

Formula Used:

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

Calculations:

=> Calculation of days: Feb (28 − 5) = 23, March = 31, April = 19

=> Total days = 23 + 31 + 19 = 73 days

=> T (in years) = 73 ÷ 365 = 1/5 year

=> SI = (2000 × 7 × 1/5) ÷ 100

=> SI = (2000 × 7) ÷ 500

=> SI = 4 × 7 = Rs. 28

Therefore The correct answer is Rs. 28.

Additional Information

Simple Interest Formula

The basic formula for SI is (P × R × T) ÷ 100, where P is principal, R is rate per annum, and T is time in years.

Time Conversion for Interest

When time is given in days, divide by 365 (ordinary year) or 366 (leap year). 2023 is not a leap year, so we use 365.

Counting Days Rule

Standard banking practice excludes the day of deposit but includes the day of withdrawal (or vice versa).

Amount Calculation

The final Amount (A) is the sum of the Principal and the Interest: A = P + SI.

Q28. Answer: (a) 4

Shortcut Trick

If (m − n) is even, then both m and n must be either both even or both odd.

Case 1: Let m = 3 and n = 1 (both odd) => $m^2 - n^2 = 9 - 1 = 8$ (divisible by 4).

Case 2: Let m = 4 and n = 2 (both even) => $m^2 - n^2 = 16 - 4 = 12$ (divisible by 4).

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In both cases, the result is divisible by 4.
Therefore The correct answer is 4.
Alternate Method
Given: m and n are positive integers and (m − n) is even.
Formula Used: $m^2 - n^2 = (m - n)(m + n)$
=> If (m − n) is even, then the difference between m and n is a multiple of 2.
=> This implies that m and n have the same parity (both even or both odd).
=> If both are even or both are odd, their sum (m + n) must also be even.
=> $m^2 - n^2 = (m - n) \times (m + n)$
=> Since both factors are even, let (m − n) = 2a and (m + n) = 2b.
=> $m^2 - n^2 = 2a \times 2b = 4ab$.
=> Therefore, the expression is always divisible by 4.
Therefore The correct answer is 4.
Additional Information
Parity Rules
Even ± Even = Even; Odd ± Odd = Even; Even ± Odd = Odd.
Difference of Squares
For any integers, $m^2 - n^2$ is divisible by (m − n) and (m + n).
Divisibility of Consecutive Squares
The difference between squares of two consecutive odd integers is always divisible by 8.

Q29. Answer: (a) 5/3

Shortcut Trick
In a right-angled triangle, if tan A = 3/4, the sides represent a Pythagorean triplet (3, 4, 5).
Here, Perpendicular (P) = 3 and Base (B) = 4.
The Hypotenuse (H) is always 5 for this triplet.
Since cosec A = Hypotenuse / Perpendicular, we get 5/3.
Therefore The correct answer is 5/3.
Alternate Method
Given: tan A = 3/4 in ΔABC right-angled at B.
Formula Used: tan A = Perpendicular / Base; cosec A = Hypotenuse / Perpendicular; $H^2 = P^2 + B^2$
=> Let Perpendicular (BC) = 3k and Base (AB) = 4k.
=> $AC^2 = AB^2 + BC^2$
=> $AC^2 = (4k)^2 + (3k)^2 = 16k^2 + 9k^2 = 25k^2$
=> $AC = \sqrt{(25k^2)} = 5k$
=> cosec A = AC / BC = 5k / 3k
=> cosec A = 5/3
Therefore The correct answer is 5/3.
Additional Information
Trigonometric Ratios
Standard ratios: $\sin\theta = P/H$, $\cos\theta = B/H$, $\tan\theta = P/B$, $\text{cosec}\,\theta = H/P$, $\sec\theta = H/B$, $\cot\theta = B/P$.
Pythagorean Triplets
Common sets of integers (a, b, c) such that $a^2 + b^2 = c^2$. Examples: (3, 4, 5), (5, 12, 13), (8, 15, 17).
Reciprocal Identities
cosec A = 1 / sin A, sec A = 1 / cos A, cot A = 1 / tan A.

Q30. Answer: (c) 6

Shortcut Trick
The mode is the value that appears most frequently in a data set.
By scanning the given list: 1 appears 2 times, 3 appears 3 times, 5 appears 2 times, 9 appears 2 times, and 6 appears 5 times.
Since 6 has the highest frequency, it is the mode.
Therefore The correct answer is 6.

Alternate Method

Given: Observations = {9, 6, 8, 1, 9, 6, 4, 5, 7, 1, 6, 5, 3, 6, 6, 3, 3}

Formula Used: Mode = Observation with the maximum frequency.

Frequency Distribution of the data:

=> 1 occurs 2 times

=> 3 occurs 3 times

=> 4 occurs 1 time

=> 5 occurs 2 times

=> 6 occurs 5 times

=> 7 occurs 1 time

=> 8 occurs 1 time

=> 9 occurs 2 times

=> Maximum Frequency = 5

=> The observation corresponding to the maximum frequency is 6.

Therefore The correct answer is 6.

Additional Information

Types of Mode

A data set can be Unimodal (one mode), Bimodal (two modes), or Multimodal (more than two modes).

Empirical Formula

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

Median for Discrete Data

To find the median, arrange the data in ascending order. If N is odd, Median = ((N+1)/2)^(th) term. If N is even, Median is the average of (N/2)^(th) and (N/2 + 1)^(th) terms.

Q31. Answer: (b) Rs. 1,114

Shortcut Trick

Total amount to be deducted = Rs. (62 + 17 + 79) = Rs. 158.

Remaining amount = Rs. 10,415 − Rs. 158 = Rs. 10,257.

Sum of ratio parts = 15 + 10 + 14 = 39 units.

1 unit = Rs. 10,257 ÷ 39 = Rs. 263.

Difference between Q and R (in ratio) = 14 − 10 = 4 units.

Difference in original shares = (4 × 263) + (79 − 17) = 1052 + 62 = Rs. 1,114.

Therefore The correct answer is Rs. 1,114.

Alternate Method

Given: Total Sum = Rs. 10,415; Ratio after deductions = 15 : 10 : 14.

Formula: Original Share = (Ratio part × common factor) + deducted amount.

=> Total reduction = 62 + 17 + 79 = 158

=> New total sum = 10415 − 158 = 10257

=> 15x + 10x + 14x = 10257

=> 39x = 10257

=> x = 10257 ÷ 39 = 263

=> Original share of Q = (10 × 263) + 17 = 2630 + 17 = 2647

=> Original share of R = (14 × 263) + 79 = 3682 + 79 = 3761

=> Difference = 3761 − 2647 = 1114

Therefore The correct answer is Rs. 1,114.

Additional Information

Ratio & Proportion Basics

If a total sum S is divided into a:b:c, then share of A = (a / (a+b+c)) × S.

Inverse Variation

If x varies inversely as y, then x × y = k (constant). In ratios, if a:b is the ratio of quantities, the inverse ratio is 1/a : 1/b.

Compound Ratio

The compound ratio of (a : b) and (c : d) is (ac : bd).

Q32. Answer: (a) 38

Shortcut Trick

The product of the number of sides n and (n − 3) is always twice the number of diagonals.

n × (n − 3) = 2 × 665 = 1330

Now, find a value of n such that n × (n − 3) = 1330.

By checking the options, if n = 38, then 38 × (38 − 3) = 38 × 35 = 1330.

This satisfies the condition perfectly.

Therefore The correct answer is 38.

Alternate Method

Given:

Number of diagonals of the regular polygon = 665

Formula Used:

Number of diagonals of an n-sided polygon = [n(n − 3)] / 2

=> 665 = [n(n − 3)] / 2

=> 1330 = $n^2 - 3n$

=> $n^2 - 3n - 1330 = 0$

=> $n^2 - 38n + 35n - 1330 = 0$

=> n(n − 38) + 35(n − 38) = 0

=> (n − 38)(n + 35) = 0

=> n = 38 or n = −35

Since the number of sides n must be a positive integer, we take n = 38.

Therefore The correct answer is 38.

Additional Information

Sum of Interior Angles

The sum of all interior angles of an n-sided polygon is (n − 2) × 180°.

Exterior Angles Property

The sum of all exterior angles of any convex polygon is always 360°.

Regular Polygon Angles

For a regular polygon, each interior angle is [(n − 2) × 180°] / n and each exterior angle is 360° / n.

Q33. Answer: (d) 23.6 cm

Shortcut Trick

Calculate the semi-perimeter (s) of the triangle: s = (22 + 18 + 24) ÷ 2 = 32 cm.

Triangle Area = √(32 × 10 × 14 × 8) = 32√35 cm^2.

Since Triangle Area = 1/3 × Parallelogram Area, then Parallelogram Area = 3 × 32√35 = 96√35 cm^2.

Height (h) = Area ÷ Base = (96 × √35) ÷ 24 = 4 × √35 ≈ 4 × 5.916 = 23.66 cm.

Therefore The correct answer is 23.6 cm.

Alternate Method

Given: Sides of triangle (a, b, c) = 22 cm, 18 cm, 24 cm. Base of parallelogram (b_p) = 24 cm.

Formula Used:

Heron's Formula for Triangle Area = √(s(s−a)(s−b)(s−c))

Area of Parallelogram = Base × Height

=> Semi-perimeter of triangle (s) = (22 + 18 + 24) ÷ 2 = 32 cm

=> Area of triangle = √(32 × (32 − 22) × (32 − 18) × (32 − 24))

=> Area of triangle = √(32 × 10 × 14 × 8) = √35840 = 32√35 cm^2

=> Area of parallelogram = 3 × Area of triangle = 3 × 32√35 = 96√35 cm^2

=> Base × Height = 96√35

=> 24 × h = 96√35

=> h = (96 ÷ 24) × √35 = 4√35

=> h ≈ 4 × 5.916 = 23.664 cm

Therefore The correct answer is 23.6 cm.

Additional Information

Heron's Formula

Used to find the area of any triangle when all three sides are known: Area = √(s(s−a)(s−b)(s−c)), where s is the semi-perimeter.

Parallelogram Properties

Area is calculated as Base × Perpendicular Height. The diagonal of a parallelogram divides it into two triangles of equal area.

Relationship between Triangle and Parallelogram

If a triangle and a parallelogram have the same base and height, the area of the triangle is exactly half the area of the parallelogram.

Q34. Answer: (c) 6

Shortcut Trick

Combined efficiency of P + Q = 1/12 units/hr.

Efficiency of P = 1/24 units/hr.

Efficiency of Q = 1/12 − 1/24 = 1/24 units/hr.

Time for Q to fill 1/4 cistern = (1/4) ÷ (1/24) = 6 hours.

Therefore The correct answer is 6 hours.

Alternate Method

Person	Days	Total Work	Efficiency
P + Q	12	24	2
P	24	1	

=> Total capacity of the cistern = 24 units (LCM of 12 and 24).

=> Efficiency of Q = (Efficiency of P + Q) − (Efficiency of P)

=> Efficiency of Q = 2 − 1 = 1 unit/hr.

=> Work to be done = 1/4 of total cistern = 24 × (1/4) = 6 units.

=> Time taken by Q = 6 ÷ 1 = 6 hours.

Therefore The correct answer is 6 hours.

Additional Information

Time and Work Relation

Total Work = Efficiency × Time. Efficiency is inversely proportional to the time taken to complete a task.

Pipes and Cisterns

Filling pipes have positive efficiency, while outlet/leakage pipes have negative efficiency. Net work is the sum of their individual efficiencies.

LCM Method

Using the LCM of the given time durations as the total capacity of the tank simplifies calculations by avoiding fractions.

Q35. Answer: (d) 41

Shortcut Trick

Ratio 5 years ago (Meera : Kavya) = 3 : 1 (Difference = 2)

Ratio 7 years later (Meera : Kavya) = 2 : 1 (Difference = 1)

Equalize difference: 5 yrs ago = 3 : 1 | 7 yrs later = 4 : 2 (Multiplied by 2)

Ratio change 1 unit → 5 + 7 = 12 years

Meera 5 years ago = 3 × 12 = 36 years

Current age = 36 + 5 = 41 years

Therefore The correct answer is 41 years.

Alternate Method

Let Meera and Kavya current ages be M and K respectively.

Given:

5 years ago: (M − 5) = 3(K − 5)

7 years later: (M + 7) = 2(K + 7)

=> M − 5 = 3K − 15 => M − 3K = −10 --- (i)

=> M + 7 = 2K + 14 => M − 2K = 7 --- (ii)

=> Subtracting (i) from (ii): (M − 2K) − (M − 3K) = 7 − (−10)

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=> K = 17 years

=> Substitute K in (ii): M − 2(17) = 7

=> M − 34 = 7

=> M = 41 years

Therefore The correct answer is 41 years.

Additional Information

Age Difference Constant

The difference between the ages of two people remains the same regardless of the number of years passed or before.

Ratio Method for Ages

When solving age problems using ratios, always ensure the numerical difference between the ratio parts of the two individuals is made equal across different time periods.

Linear Equation Method

Standard algebraic approach involves setting up equations for "n years ago" (x − n) and "n years later" (x + n).

Q36. Answer: (a) 19.94%

Shortcut Trick

Discount = Marked Price − Selling Price

Discount = 657 − 526 = 131

Discount% = (Discount ÷ MP) × 100

Discount% = (131 ÷ 657) × 100 = 19.9391...

Rounding off to two decimal places, we get 19.94%.

Therefore The correct answer is 19.94%.

Alternate Method

Given → Marked Price (MP) = Rs. 657, Selling Price (SP) = Rs. 526.

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

→ Discount = 657 − 526 = 131

→ Discount% = (131 ÷ 657) × 100

→ Discount% = 13100 ÷ 657

→ Discount% ≈ 19.939%

→ Rounded Discount% = 19.94%

Therefore The correct answer is 19.94%.

Additional Information

Marked Price and Discount

The Marked Price is the price printed on the label. Discount is always calculated on the Marked Price unless stated otherwise. Discount% = (MP − SP)/MP × 100.

Selling Price Calculation

Selling Price can also be calculated if discount percentage is known: SP = MP × (100 − Discount%)/100.

Q37. Answer: (d) 21

Shortcut Trick

If each number in a series is multiplied by a constant (k), the new average is simply the old average multiplied by that same constant.

Old Average = 7

Multiplier (k) = 3

New Average = 7 × 3 = 21

Therefore The correct answer is 21.

Alternate Method

Given:

Total numbers (n) = 13

Original average = 7

=> Sum of 13 numbers = Average × Count

=> Original Sum = 7 × 13 = 91

If each number is multiplied by 3, the total sum also increases 3 times:

=> New Sum = 91 × 3 = 273

=> New Average = New Sum ÷ Count

=> New Average = 273 ÷ 13

=> New Average = 21

Therefore The correct answer is 21.

Additional Information

Effect of Basic Operations on Average

If every term is increased or decreased by x, the average increases or decreases by x respectively. If divided by x, the average is divided by x.

Weighted Average

When combining two groups, the weighted average = (n1a1 + n2a2) ÷ (n1 + n2), where n is the count and a is the average.

Average of Consecutive Numbers

For any Arithmetic Progression (AP), the average is always the middle term or (First Term + Last Term) ÷ 2.

Q38. Answer: (c) 33

Shortcut Trick

Ratio of SP1 to SP2 is 1000 : 1400 = 5 : 7.

Since SP1 represents a 5% loss, 5 units = (100 − 5)% = 95%.

Then 1 unit = 95 ÷ 5 = 19%.

SP2 represents 7 units = 7 × 19% = 133%.

The profit percentage x = 133% − 100% = 33%.

Therefore The correct answer is 33.

Alternate Method

Given: Selling Price 1 (SP1) = Rs. 1,000 | Loss% = 5% | Selling Price 2 (SP2) = Rs. 1,400.

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

=> Calculate CP: CP = 1000 × 100 ÷ (100 − 5) = 1000 × 100 ÷ 95.

=> CP = 100000 ÷ 95 = Rs. 1052.63 (approx) or 20000 ÷ 19.

=> Profit = SP2 − CP = 1400 − (20000 ÷ 19).

=> Profit = (26600 − 20000) ÷ 19 = 6600 ÷ 19.

=> Profit% (x) = (6600 ÷ 19) ÷ (20000 ÷ 19) × 100.

=> x = (6600 ÷ 20000) × 100 = 33.

Therefore The correct answer is 33.

Additional Information

Cost Price (CP)

The price at which an article is purchased. It is the base for calculating Profit or Loss percentages.

Selling Price (SP)

The price at which an article is sold. If SP > CP, there is a profit. If SP < CP, there is a loss.

Q39. Answer: (d) 93,750

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 differences are same, (5 − 1) units = (8 − 4) units = 4 units = savings

=> 4 units = Rs. 75,000 → 1 unit = Rs. 18,750

Mohan income = 5 units = 5 × Rs. 18,750 = Rs. 93,750

Therefore The correct answer is Rs. 93,750.

Alternate Method

Given: Ratio of Incomes = 5 : 8, Ratio of Expenditures = 1 : 4, Savings = Rs. 75,000 each.

Formula: Income − Expenditure = Savings

=> Let Mohan income be 5x and David income be 8x.

=> Expenditure of Mohan = 5x − 75,000

=> Expenditure of David = 8x − 75,000

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=> (5x − 75,000) / (8x − 75,000) = 1 / 4

=> 4 × (5x − 75,000) = 1 × (8x − 75,000)

=> 20x − 3,00,000 = 8x − 75,000

=> 12x = 2,25,000

=> x = 18,750

=> Mohan income = 5x = 5 × 18,750 = 93,750

Therefore The correct answer is Rs. 93,750.

Additional Information

Income, Expenditure and Savings Relationship

The fundamental relation is Income = Expenditure + Savings. If savings are constant, the change in income directly affects the expenditure.

Ratio Balancing Method

When a constant value is added or subtracted from both terms of a ratio, we balance the difference between ratio parts to solve quickly without variables.

Cross Multiplication Trick

For two ratios (a:b and c:d) and a constant difference (k), the variable can be found by: x = [k × (d − c)] / [ad − bc].

Q40. Answer: (c) 66600 cm²

Shortcut Trick

Ratio of dimensions = 6 : 5 : 4 => Volume units = 6 × 5 × 4 = 120 units³

120 units³ = 810000 √2 => 1 unit³ = 6750 √2 = 3375 × (2 √2) = 15³ × (√2)³

Side ratio constant (1 unit) = 15 √2 cm

Total Surface Area units = 2 × (30 + 20 + 24) = 148 units²

Surface Area = 148 × (15 √2)² = 148 × (225 × 2) = 148 × 450 = 66600 cm²

Therefore The correct answer is 66600 cm².

Alternate Method

Given:

Ratio of Length, Breadth and Height = 6 : 5 : 4

Volume of the Cuboid = 810000 √2 cm³

Formula Used:

Volume of Cuboid = Length × Breadth × Height

Total Surface Area = 2 × (LB + BH + HL)

Calculations:

=> Let Length = 6x, Breadth = 5x, and Height = 4x

=> Volume = 6x × 5x × 4x = 120x³

=> 120x³ = 810000 √2

=> x³ = 6750 √2 = 3375 × 2 × √2 = 3375 × (√2)³

=> x³ = 15³ × (√2)³ => x = 15 √2

=> Total Surface Area = 2 × (6x × 5x + 5x × 4x + 4x × 6x)

=> Surface Area = 2 × (30x² + 20x² + 24x²) = 2 × 74x² = 148x²

=> Surface Area = 148 × (15 √2)² = 148 × (225 × 2) = 148 × 450

=> Surface Area = 66600 cm²

Therefore The correct answer is 66600 cm².

Additional Information

Diagonal of a Cuboid

The longest rod that can be placed inside a cuboid is its diagonal, calculated as d = √(L² + B² + H²).

Lateral Surface Area (LSA)

The area of the four vertical walls of a cuboid is given by LSA = 2 × Height × (Length + Breadth).

Volume and Surface Area of a Cube

For a cube with side 'a', the Volume is a³ and the Total Surface Area is 6a².

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Q41. Answer: (a) 12

Shortcut Trick

Ratio of articles P : Q : R = 3 : 4 : 5

Total Value ratio = (280 × 3) : (180 × 4) : (100 × 5) = 840 : 720 : 500 = 2060 units

2060 units = Rs. 6,180 => 1 unit = 3

Articles of type Q = 4 × 3 = 12

Therefore The correct answer is 12 articles.

Alternate Method

Given: Prices of P, Q, R are Rs. 280, Rs. 180, Rs. 100. Ratio of quantity = 3 : 4 : 5. Total expenditure = Rs. 6,180.

Calculations:

=> Let the number of articles be 3x, 4x, and 5x respectively.

=> (280 × 3x) + (180 × 4x) + (100 × 5x) = 6180

=> 840x + 720x + 500x = 6180

=> 2060x = 6180

=> x = 6180 ÷ 2060 = 3

=> Number of articles of type Q = 4x = 4 × 3 = 12

Therefore The correct answer is 12 articles.

Additional Information

Ratio and Value Relationship

When quantities are given in a ratio (a:b:c) and their individual values are (v1, v2, v3), the total value is calculated as (a × v1 + b × v2 + c × v3) × k.

Unitary Method in Ratios

Finding the value of one 'part' or 'unit' by dividing the total actual value by the sum of ratio-product parts allows for quick calculation of any individual component.

Q42. Answer: (a) 28.85%

Shortcut Trick

Net discount for 10% and 15% = 10 + 15 − (10 × 15) ÷ 100 = 23.5%.

Net discount for 23.5% and 7% = 23.5 + 7 − (23.5 × 7) ÷ 100.

= 30.5 − 1.645 = 28.855%.

The approximate single discount is 28.85%.

Therefore The correct answer is 28.85%.

Alternate Method

Given → Discounts are d1 = 7%, d2 = 10%, and d3 = 15%.

Formulas: Single Equivalent Discount = 100 − [100 × (100 − d1)/100 × (100 − d2)/100 × (100 − d3)/100]

=> Assume Marked Price (MP) = 100.

=> Price after 7% discount = 100 × 0.93 = 93.

=> Price after 10% discount = 93 × 0.90 = 83.7.

=> Price after 15% discount = 83.7 × 0.85 = 71.145.

=> Total Discount = 100 − 71.145 = 28.855%.

=> Approximate value = 28.85%.

Therefore The correct answer is 28.85%.

Additional Information

Successive Discount Formula

For two discounts a% and b%, the single equivalent discount is (a + b − ab/100)%.

Marked Price & Discount

Discount is always calculated on the Marked Price (MP). Selling Price (SP) = MP − Discount.

Q43. Answer: (c) 3 hours

Shortcut Trick

Total Work (LCM of 15, 18, 27) = 270 units.

Efficiencies: A = 18, B = 15, C = −10.

First 5 hr (A+B): (18 + 15) × 5 = 165 units.

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Next 12 hr (B+C): (15 − 10) × 12 = 60 units.

Remaining: 270 − (165 + 60) = 45 units.

Time for B alone: 45 ÷ 15 = 3 hours.

Therefore The correct answer is 3 hr.

Alternate Method

Pipe	Time (hr)	Total Work	Efficiency
Pipe A	15	270 units	270 ÷ 15 = 18
Pipe B	18	270 ÷ 18 = 15	
Pipe C	27	270 ÷ 27 = −10	

=> Work done by Pipe A and Pipe B in 5 hours = (18 + 15) × 5 = 33 × 5 = 165 units.

=> Work done by Pipe B and Pipe C in 12 hours = (15 − 10) × 12 = 5 × 12 = 60 units.

=> Total work done so far = 165 + 60 = 225 units.

=> Remaining work = Total capacity − Work done = 270 − 225 = 45 units.

=> Time taken by Pipe B alone = Remaining work ÷ Efficiency of B = 45 ÷ 15 = 3 hours.

Therefore The correct answer is 3 hr.

Additional Information

Inlet and Outlet Pipes

Inlet pipes add water (positive efficiency) while outlet pipes remove water (negative efficiency). Net efficiency is the algebraic sum.

Work and Time Relationship

Total Work = Time taken × Efficiency. For cisterns, capacity is the LCM of individual filling/emptying times.

Q44. Answer: (c) 4

Shortcut Trick

To find the greatest possible scale to measure the dimensions exactly, find the HCF (Highest Common Factor) of the given dimensions.

Given dimensions: 16 m, 20 m, 24 m.

HCF(16, 20, 24) = 4 m.

Therefore The correct answer is 4 m.

Alternate Method

Given:

Dimensions of the room = 16 m, 20 m, 24 m

Formula:

Length of the greatest possible scale = HCF (Highest Common Factor) of the dimensions

Calculations:

=> Prime factorization of 16 = 2 × 2 × 2 × 2 = 2^4

=> Prime factorization of 20 = 2 × 2 × 5 = $2^2 \times 5$

=> Prime factorization of 24 = 2 × 2 × 2 × 3 = $2^3 \times 3$

=> HCF(16, 20, 24) = $2^2 = 4$

=> Greatest scale length = 4 m

Therefore The correct answer is 4 m.

Additional Information

Highest Common Factor (HCF)

The HCF of two or more numbers is the greatest number that divides each of them exactly without leaving a remainder.

Least Common Multiple (LCM)

The LCM of two or more numbers is the smallest number that is a multiple of all the given numbers.

HCF and LCM Relation

For any two positive integers a and b, HCF(a, b) × LCM(a, b) = a × b.

Q45. Answer: (a) 1

Shortcut Trick

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

Here, a = 3x and b = 5y, so 4ab = 4 × 3x × 5y = 60xy.
The numerator becomes $(3x - 5y)^2$, which is identical to the denominator.
Expression = $(3x - 5y)^2 \div (3x - 5y)^2 = 1$.
Therefore The correct answer is 1.
Alternate Method
Given: $[(3x + 5y)^2 - 60xy] \div (3x - 5y)^2$
Formula Used: $(a + b)^2 = a^2 + 2ab + b^2$
=> Expand the numerator: $(3x)^2 + 2(3x)(5y) + (5y)^2 - 60xy$
=> Numerator = $9x^2 + 30xy + 25y^2 - 60xy = 9x^2 - 30xy + 25y^2$
=> Expand the denominator: $(3x - 5y)^2 = (3x)^2 - 2(3x)(5y) + (5y)^2$
=> Denominator = $9x^2 - 30xy + 25y^2$
=> Division = $(9x^2 - 30xy + 25y^2) \div (9x^2 - 30xy + 25y^2)$
=> 1
Therefore The correct answer is 1.
Additional Information
Standard Algebraic Identities
$(a + b)^2 = a^2 + 2ab + b^2$ and $(a - b)^2 = a^2 - 2ab + b^2$ are basic expansions.
Relationship Identity
$(a + b)^2 - (a - b)^2 = 4ab$ is often used to simplify complex polynomial divisions.
Alternative Relationship
$(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$ is another useful variant in simplification.

Q46. Answer: (d) 120; 90

Shortcut Trick
Test the given options to satisfy both Malati and Rani conditions.
For Option (4): Rose = Rs. 120, Jasmine = Rs. 90.
Condition 1: (5 × 120) + (9 × 90) = 600 + 810 = Rs. 1410 (Satisfied).
Condition 2: (6 × 120) + (5 × 90) = 720 + 450 = Rs. 1170 (Satisfied).
Therefore The correct answer is 120; 90.
Alternate Method
Let the price of 1 Rose plant be Rs. R and 1 Jasmine plant be Rs. J.
Given:
Case 1 (Malati): 5R + 9J = 1410 → (Eq. 1)
Case 2 (Rani): 6R + 5J = 1170 → (Eq. 2)
Multiply (Eq. 1) by 5 and (Eq. 2) by 9 to eliminate J:
=> 25R + 45J = 7050
=> 54R + 45J = 10530
Subtract the first resulting equation from the second:
=> (54R − 25R) = 10530 − 7050
=> 29R = 3480
=> R = 3480 ÷ 29 = 120
Substitute R = 120 in (Eq. 2):
=> 6(120) + 5J = 1170
=> 720 + 5J = 1170
=> 5J = 1170 − 720
=> 5J = 450
=> J = 90
Therefore The correct answer is 120; 90.
Additional Information
Linear Equations in Two Variables
A pair of equations with two variables (like x and y) can be solved using Elimination or Substitution methods to find unique values.
Elimination Method

Multiply equations by suitable constants so that the coefficients of one variable become equal, allowing its removal through subtraction.

Verification

Always verify the calculated values by substituting them back into the original equations to ensure they satisfy the given conditions.

Q47. Answer: (c) Increase by 4.5%

Shortcut Trick

Ratio of cost of TV to Washing Machine (WM) = 100 : 75 = 4 : 3.

Total initial cost for 4 WM and 5 TV = (4 × 3) + (5 × 4) = 12 + 20 = 32 units.

Change in WM cost = +87% of 12 = 10.44; Change in TV cost = −45% of 20 = −9.

Net change = 10.44 − 9 = 1.44 units.

Percentage change = (1.44 ÷ 32) × 100 = 4.5%.

Therefore The correct answer is Increase by 4.5%.

Alternate Method

Formulas: Total Cost = (Price × Quantity) | Percentage Change = (New − Old) ÷ Old × 100

=> Let the cost of TV be 100. Then cost of Washing Machine = 75.

=> Total Initial Cost = (4 × 75) + (5 × 100) = 300 + 500 = 800.

=> New WM cost = 75 + (87% of 75) = 75 + 65.25 = 140.25.

=> New TV cost = 100 − (45% of 100) = 55.

=> Total New Cost = (4 × 140.25) + (5 × 55) = 561 + 275 = 836.

=> Percentage Change = [(836 − 800) ÷ 800] × 100 = (36 ÷ 800) × 100 = 4.5%.

Therefore The correct answer is Increase by 4.5%.

Additional Information

Percentage Increase and Decrease

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

Weighted Average Concept

Net % change = (w1c1 + w2c2) ÷ (w1 + w2), where w is initial weight and c is % change.

Q48. Answer: (a) 16 seconds

Shortcut Trick

Total Distance = Sum of lengths = 232 + 248 = 480 m

Relative Speed (Opposite) = 51 + 57 = 108 km/hr

Relative Speed in m/s = 108 × (5/18) = 30 m/s

Time = Distance ÷ Relative Speed = 480 ÷ 30 = 16 seconds

Therefore The correct answer is 16 sec.

Alternate Method

Given:

Length of first train (L1) = 232 m

Length of second train (L2) = 248 m

Speed of first train (S1) = 51 km/hr

Speed of second train (S2) = 57 km/hr

Formula Used:

Time = (Total Length) ÷ (Relative Speed)

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

Calculations:

=> Total distance to be covered = L1 + L2 = 232 + 248 = 480 m

=> Relative speed in opposite direction = S1 + S2 = 51 + 57 = 108 km/hr

=> Relative speed in m/s = 108 × (5/18) = 6 × 5 = 30 m/s

=> Time taken = 480 ÷ 30 = 16 seconds

Therefore The correct answer is 16 sec.

Additional Information

Relative Speed Concepts

When two objects move in opposite directions, relative speed is (S1 + S2). When they move in the same direction, relative speed is |S1 − S2|.

Unit Conversion

Always ensure units are consistent. Multiply km/hr by 5/18 to get m/s; multiply m/s by 18/5 to get km/hr.

Train Crossing a Point Object

When a train crosses a stationary pole or man, the distance covered is equal to the length of the train itself.

Q49. Answer: (a) 2

Shortcut Trick

0.36 = $(3/5)^2$, 0.216 = $(3/5)^3$, 0.1296 = (3/5)^4

LHS = $[(3/5)^2]^3 \times [(3/5)^3]^3 \div [(3/5)^4]^3$

= (3/5)^6 × (3/5)^9 ÷ $(3/5)^{12}$

= $(3/5)^3$

RHS = (60/100)^(x+1) = (3/5)^(x+1)

=> $(3/5)^3$ = (3/5)^(x+1)

=> x + 1 = 3 => x = 2

Therefore Answer = 2

Alternate Method

Given:

$(0.36)^3 \times (0.216)^3 \div (0.1296)^3$ = (60/100)^(x+1)

Formula used:

a^m × a^n ÷ a^p = a^(m+n−p)

Calculation:

=> 0.36 = $(3/5)^2$

=> 0.216 = $(3/5)^3$

=> 0.1296 = (3/5)^4

=> LHS = $[(3/5)^2]^3 \times [(3/5)^3]^3 \div [(3/5)^4]^3$

=> = (3/5)^6 × (3/5)^9 ÷ $(3/5)^{12}$

=> = (3/5)^(6+9−12) = $(3/5)^3$

=> RHS = (60/100)^(x+1) = (3/5)^(x+1)

=> Equate powers:

=> x + 1 = 3

=> x = 2

Therefore The correct answer is 2.

Additional Information

Exponent Rule

Add/subtract powers for same base

Base Conversion

Convert decimals into fractional powers

Equality Rule

If bases are same, equate exponents

Key Insight

Simplify into single base before solving

Q50. Answer: (b) 66.67%

Shortcut Trick

Required percentage = (Marks of B / Marks of A) × 100

Required percentage = (50 / 75) × 100 = (2 / 3) × 100

2/3 of 100% is approximately 66.67%.

Therefore The correct answer is 66.67%.

Alternate Method

Given:

Marks obtained by B = 50
Marks obtained by A = 75
Formula Used:
Percentage = (Value / Base Value) × 100
Calculations:
=> Required Percentage = (Marks of B / Marks of A) × 100
=> Required Percentage = (50 / 75) × 100
=> Required Percentage = (2 / 3) × 100
=> Required Percentage = 66.666...
=> Rounding off to two decimal places, we get 66.67%.
Therefore The correct answer is 66.67%.
Additional Information
Percentage Change
Percentage change is calculated as [(New Value − Old Value) / Old Value] × 100.
Percentage of Total
To find what percentage a score is of the maximum marks, use: (Obtained Marks / Maximum Marks) × 100.
Fraction to Percentage Conversion
Common fractions like 1/3 ≈ 33.33%, 2/3 ≈ 66.67%, and 1/4 = 25% are useful for quick calculations.

Q51. Answer: (c) JOWF

The logic followed here is:
For, CPWG → XTTI
For, NILC → IMIE
Now, apply the same to OKZD:
So, OKZD → JOWF
Hence, the correct answer is Option 3.

Q52. Answer: (a) 571

BODMAS Table:
Decoding the given information:

Alphabet	**•**	**−**	**×**	**÷**
Meaning	−	•	÷	×

Now, replacing the sign from left to right using BODMAS Rule, we get:
=> 24 × 19 − 84 ÷ 7 + 127 = ?
=> 456 − 12 + 127 = ?
=> 444 + 127 = ?
=> 571
Hence, the correct option is "Option 1".

Q53. Answer: (a) (45, 89, 268)

The logic followed here is:
Logic: Third Number = (First Number + Second Number) × 2.
For, (25, 72, 194)
=> 25 + 72 = 97
=> 97 × 2 = 194
For, (32, 80, 224)
=> 32 + 80 = 112
=> 112 × 2 = 224
Now, checking the options using the same pattern:
Option 1) (45, 89, 268)
=> 45 + 89 = 134
=> 134 × 2 = 268

Option 2) (74, 88, 304)
=> 74 + 88 = 162
=> 162 × 2 = 324 ≠ 304
Option 3) (91, 65, 310)
=> 91 + 65 = 156
=> 156 × 2 = 312 ≠ 310
Option 4) (56, 98, 312)
=> 56 + 98 = 154
=> 154 × 2 = 308 ≠ 312
Hence, the correct answer is Option 1.

Q54. Answer: (b) Two

Given: (Left) @ 3 6 7 & 8 # & + $ 1 ? 9 1 + 7 1 # # < 2 (Right)
Now,
Symbols, which are immediately preceded by a symbol and also immediately followed by a number.
So, Needed pattern is: Symbol - Symbol - Number
(Left) @ 3 6 7 & 8 # & + $ 1 ? 9 1 + 7 1 # # < 2 (Right)
So, total valid symbols = 2
Hence, the correct answer is Option 2.

Q55. Answer: (c) 4

The logic followed here is:
thus, "4" will replace the question mark in the given series.
Hence, the correct option is "Option 3".

Q56. Answer: (a) 5

Given: A, B, C, D, E, F and G sit around a circular table facing the centre.
Only two people sit between F and G when counted from the left of G.
A sits third to the left of E.
C sits to the immediate right of E.
C sits second to the left of F.
B is an immediate neighbour of A.
So, all 5 people lie between F and D.
Hence, the correct answer is "Option 1".

Q57. Answer: (d) 58

Given:
OAVY is coded as 56 and SIXT is coded as 47
Logic: (sum of reverse positions) + 11
Here,
OAVY → O(12) + A(26) + V(5) + Y(2) = 45 → 45 + 11 = 56
SIXT → S(8) + I(18) + X(3) + T(7) = 36 → 36 + 11 = 47
Now, Apply to TMZB
T(7) + M(14) + Z(1) + B(25) = 47
Code = 47 + 11 = 58
Hence, the correct answer is Option 4.

Q58. Answer: (a) TYC95

The logic followed here is:
So, 'TYC95' will replace the question mark in the given series.
Hence, the correct answer is "Option 1"

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Q59. Answer: (b) Two

Given: (Left) # 4 ^ 8 8 < 2 / $ 7 $ \ 1 & ^ 8 4 \ ? \ 8 (Right)

Now,

Numbers, which are immediately preceded by a number and also immediately followed by a symbol.

So, Needed pattern is: Number - Number - Symbol

(Left) # 4 ^ 8 8 < 2 / $ 7 $ \ 1 & ^ 8 4 \ ? \ 8 (Right)

So, total valid numbers = 2

Hence, the correct answer is Option 2.

Q60. Answer: (b) 98

The logic followed here is:

thus, "98" will replace the question mark in the given series.

Hence, the correct option is "Option 2".

Q61. Answer: (d) 60

BODMAS Table:

Given equation: 12 ÷ 5 + 21 × 3 - 2 = ? + 5

Original Symbol	New Symbol
•	•
•	•
×	÷
÷	×

Now, replacing the symbols:

=> 12 × 5 - 21 ÷ 3 + 2 = ? - 5

=> 12 × 5 - 21 ÷ 3 + 2 = ? - 5

=> 60 - 21 ÷ 3 + 2 = ? - 5

=> 60 - 7 + 2 = ? - 5

=> 60 - 7 + 2 = ? - 5

=> 53 + 2 = ? - 5

=> 55 = ? - 5

=> ? = 55 + 5

=> 60

Hence, the correct answer is "Option 4".

Q62. Answer: (c) Two

Given: Seven friends B, C, D, T, U, V and W are sitting in a straight line facing north.

No one sits to the right of B.

Only two people sit between B and D.

D sits to the immediate left of W.

Only three people sit between C and W.

T sits to the immediate right of V.

So, there are 2 people between U and T.

Hence, the correct answer is "Option 3".

Q63. Answer: (d) 20 km towards west

The logic followed here is:

Given:

Ajay starts from Point A (0, 0)

10 km East

Right turn → 5 km South

Left turn → 10 km East

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Left turn → 5 km North

So, To return to Point A, Ajay must move 20 km West.

Hence, the correct answer is Option 4.

Q64. Answer: (d) NJI

The logic followed here is based on the alphabetical position pattern:

Option 1: PWS

Option 2: FMI

Option 3: LSO

Option 4: NJI

Thus, NJI does not follow the pattern.

Hence, the odd one out is Option 4.

Q65. Answer: (d) Neither conclusion (I) nor (II) follows

Given Statements:

Some seeds are berries.

All fruits are berries.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some seeds are fruits → Does not follow (Although some seeds are berries and all fruits are berries, there is no definite information that seeds overlap with fruits.)

II. All berries are fruits → Does not follow (The statement says "All fruits are berries," which means Fruits are a subset of Berries. It does not mean that all Berries are Fruits.)

So, neither conclusion I nor conclusion II follows.

Hence, the correct answer is Option 4.

Q66. Answer: (b) RPNR

L

The logic followed here is:

For, KIGK → JHFJ

For, JHFJ → IGEI

Now, apply the same to SQOS:

So, SQOS → RPNR

Hence, the correct answer is Option 2.

Q67. Answer: (c) 3

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

Now,

Even numbers, which are immediately preceded by an odd number and also immediately followed by an odd number.

So, Needed pattern is: Odd - Even - Odd

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

So, total valid even numbers = 3

Hence, the correct answer is Option 3.

Q68. Answer: (b) MAIN - AMIN - NIAM

The logic followed here is:

Logic: The middle two letters are swapped first, and then the entire word is reversed.

For, FACE → AFCE → ECAF

For, CASE → ACSE → ESAC

Now, check the options using the same pattern:

Option 1) LONG → OLNG → ONGL

Option 2) MAIN → AMIN → NIAM

Option 3) GONE → OGNE → EONG

Option 4) TEAM → TAEM → MAET

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Hence, the correct answer is Option 2.

Q69. Answer: (c) QQC

The logic followed here is:

So, 'QQC' will replace the question mark in the given series.

Hence, the correct answer is "Option 3"

Q70. Answer: (b) 42 km towards the east

The logic followed here is:

Given:

Ajeet starts from Point Y (0, 0)

12 km North

Right turn → 33 km East

Right turn → 67 km South

Right turn → 48 km West

Right turn → 55 km North

Left turn → 27 km West

So, To return to Point Y, Ajeet must move 42 km East.

Hence, the correct answer is Option 2.

Q71. Answer: (d) Father's brother

Family Chart:

Decoding the Symbols:

Symbol →	**•**	**#**	**&**	**%**
Meaning →	Husband	Brother	Mother	Sister

Given: S # D + V & I % M

It means: S is the brother of D, D is the husband of V, V is the mother of I, and I is the sister of M.

So, S is the father's brother.

Hence, the correct answer is Option 4.

Q72. Answer: (d) 38

The logic followed here is:

Logic: Number of people between = Total − (Sum of positions)

For Positions of Z and G → 16 and 7

Sum of positional values = 16 + 7 = 23

Total strength = 61

Now, Number of people between = 61 − (16 + 7)

= 61 − 23

= 38

Hence, the correct answer is Option 4.

Q73. Answer: (b) 0

Given: A, B, C, D, E, F and G sit around a circular table facing the centre.

C sits third to the left of F.

B sits second to the left of E.

F is an immediate neighbour of both G and B.

D is not an immediate neighbour of C.

So, there are 0 people between B and D.

Hence, the correct answer is "Option 2".

Q74. Answer: (b) 50

Given:

Mr. Ggg is 26th from the left in a row of 87 people.

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Mr. Zzz is 11th from the right.
Mr. Zzz's position from left = (87 + 1) − 11 = 77
Now, positions are:
Mr. Ggg = 26th from left
Mr. Zzz = 77th from left
Number of people between them = (77 − 26) − 1 = 50
Hence, the correct answer is Option 2.

Q75. Answer: (a) 86

The logic followed here is:
TMCB → 76
Sum = 20 + 13 + 3 + 2 = 38
38 × 2 = 76
GKIR → 90
Sum = 7 + 11 + 9 + 18 = 45
45 × 2 = 90
Now, VAPD →
Sum = 22 + 1 + 16 + 4 = 43
43 × 2 = 86
Hence, the correct answer is Option 1.

Q76. Answer: (d) Three

Given: (Left) 1 7 2 5 8 5 5 2 2 7 8 4 3 7 6 4 1 6 1 2 9 1 5 6 8 3 2 4 8 5 (Right)
Now,
Odd digits, which are immediately preceded by a perfect square digit and also immediately followed by a prime digit.
Perfect Square Digits = 1, 4, 9
Prime Digits = 2, 3, 5, 7
So, Needed pattern is: Perfect Square - Odd - Prime
(Left) 1 7 2 5 8 5 5 2 2 7 8 4 3 7 6 4 1 6 1 2 9 1 5 6 8 3 2 4 8 5 (Right)
So, total valid odd digits = 3
Hence, the correct answer is Option 4.

Q77. Answer: (d) 15

Shortcut Trick
Pattern: Subtraction of multiples of 5 in decreasing order.
115 − 30 = 85
85 − 25 = 60
60 − 20 = 40
40 − 15 = 25
25 − 10 = 15
Therefore The correct answer is 15.
Alternate Method
Given series: 115, 85, 60, 40, 25, ?
115 −30 → 85 −25 → 60 −20 → 40 −15 → 25 −10 → 15
The logic follows a difference of difference pattern where each subtracted value is 5 less than the previous one.
=> 115 − 85 = 30
=> 85 − 60 = 25
=> 60 − 40 = 20
=> 40 − 25 = 15
=> Next difference = 15 − 5 = 10
=> Missing term = 25 − 10 = 15
Therefore The correct answer is 15.
Additional Information

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Difference Series

A numerical sequence where the pattern is found by subtracting consecutive terms (T_n − T_(n-1)).

Arithmetic Progression of Differences

When the differences between consecutive terms (30, 25, 20, 15, 10) form an Arithmetic Progression with a common difference (in this case, −5).

Decreasing Series

A series where each successive term is smaller than the previous one, usually involving subtraction or division logic.

Q78. Answer: (c) Both conclusions (I) and (II) follow

Given Statements:

All parks are huts.

All huts are districts.

All districts are cities.

The least possible Venn diagram for the given statement is:

Conclusions:

I. All parks are districts → Follows (Since all parks are huts and all huts are districts, all parks must be districts.)

II. All huts are cities → Follows (Since all huts are districts and all districts are cities, all huts must be cities.)

So, both conclusion I and conclusion II follow.

Hence, the correct answer is Option 3.

Q79. Answer: (c) RV - QV

The logic followed here is based on the alphabetical position pattern:

Option 1: UY - TX

Option 2: GK - FJ

Option 3: RV - QV

Option 4: LP - KO

Thus, RV - QV does not follow the pattern.

Hence, the odd one out is Option 3.

Q80. Answer: (d) 568

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:

=> 49 × 9 − 609 ÷ 7 + 214 = ?

=> 441 − 87 + 214 = ?

=> 655 − 87 = ?

=> 568

Hence, the correct option is "Option 4".

Q81. Answer: (d) 6.00%

The correct answer is 6.00%.

Key Points

• In the first bi-monthly monetary policy review for the financial year 2025-26, held in April 2025, the Monetary Policy Committee (MPC) of the Reserve Bank of India (RBI) decided to reduce the policy repo rate.

• The MPC implemented a reduction of 25 basis points (bps), which successfully brought the repo rate down from 6.25% to 6.00%. Hence, the correct answer is 6.00%.

• The primary objective behind this rate cut is to stimulate economic growth by lowering the cost of borrowing for commercial banks, which in turn benefits businesses and individual consumers.

• This decision was taken by a majority vote within the six-member committee, assessing the prevailing inflation levels and the global macroeconomic environment.

• By adjusting the repo rate, the RBI manages the liquidity in the banking system, ensuring that inflation remains within the target

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range of 4% (+/- 2%) while supporting GDP growth.

Additional Information

• Repo Rate (Repurchase Rate):

• It is the rate at which the Central Bank (RBI) lends money to commercial banks against government securities to meet their short-term fund requirements.

• A decrease in the repo rate typically leads to cheaper loans (Home, Auto, Personal) for the general public, as banks pass on the benefit of lower costs to borrowers.

• Reverse Repo Rate:

• This is the rate at which the RBI borrows money from commercial banks within the country to absorb excess liquidity from the market.

• Usually, the reverse repo rate is lower than the repo rate, creating a corridor for interest rate movements.

• Monetary Policy Committee (MPC):

• The MPC is a statutory body established under the Reserve Bank of India Act, 1934, specifically through an amendment in 2016.

• It consists of 6 members: 3 members from the RBI (including the Governor as the ex-officio Chairperson) and 3 external members appointed by the Government of India.

• Basis Points (bps):

• In finance, 100 basis points are equal to 1%. Therefore, a 25 bps cut represents a 0.25% reduction in the interest rate.

Important Points

• Impact on Banking Sector: When the RBI reduces the repo rate, banks often reduce the interest rates on Fixed Deposits (FDs) and Savings Accounts, which may impact the income of senior citizens and savers.

• Marginal Standing Facility (MSF) and Bank Rate: These rates are typically adjusted in alignment with the repo rate changes. The MSF is the rate at which banks can borrow overnight from the RBI against their excess SLR (Statutory Liquidity Ratio) securities.

• Stance of Policy: The MPC also announces its monetary policy stance, such as 'accommodative', 'neutral', or 'withdrawal of accommodation', to signal future interest rate trajectories.

• Inflation Target: The Government and RBI have set a target for Consumer Price Index (CPI) inflation to ensure price stability, which is a key factor in deciding whether to hike or cut the repo rate.

Q82. Answer: (d) Mind, Brain, and Consciousness Conference

The correct answer is Mind, Brain, and Consciousness Conference.

Key Points

• The Mind, Brain, and Consciousness Conference was hosted by IIT Mandi in June 2025, specifically designed to address modern mental health applications.

• The conference served as a multi-disciplinary platform bringing together neuroscientists, psychologists, and engineers to discuss the biological and psychological aspects of the human mind.

• A primary focus was the integration of Artificial Intelligence (AI) and Machine Learning (ML) in developing predictive models for mental health disorders like depression and generalized anxiety disorder.

• The event highlighted the Indian Institute of Technology (IIT) Mandi's leadership in Cognitive Science research within the Himalayan region.

• Researchers presented findings on Brain-Computer Interfaces (BCI), showcasing how wearable sensors can assist in real-time monitoring of cognitive stress levels.

Additional Information

• IIT Mandi (Himachal Pradesh):

• Established in 2009, it is one of the second-generation IITs located in the Kamand Valley of Mandi district.

• The institute has a dedicated Center for Indian Knowledge Systems and Mental Health Applications (IKSMHA), which focuses on scientific validation of traditional practices.

• Mental Health Statistics in India:

• According to the National Mental Health Survey (NMHS), nearly 150 million Indians require mental health interventions, making conferences like this crucial for public health policy.

• The conference aligns with the National Mental Health Programme (NMHP) launched by the Government of India to provide affordable care.

• Emerging Technologies:

• Neurofeedback: A technique used to train brain activity, which was a major theme at the 2025 conference for treating ADHD and PTSD.

• Digital Therapeutics (DTx): Software-driven evidence-based interventions discussed during the summit to complement pharmacological treatments.

Important Points

• Interdisciplinary Collaboration: The event emphasized the National Education Policy (NEP) 2020 goals by promoting cross-disciplinary research between humanities and technology.

• Global Participation: The June 2025 session saw participation from over 500 delegates representing 20 countries, fostering international cooperation in Consciousness Studies.

• IKS Validation: A significant portion of the conference was dedicated to Yoga and Meditation as clinical tools, supported by electroencephalogram (EEG) data to prove their efficacy in stress reduction.

• Sustainable Development: By focusing on mental well-being, the conference directly contributes to United Nations Sustainable Development Goal 3 (SDG 3): Good Health and Well-being.

Q83. Answer: (c) 2025

The correct answer is 2025.

Key Points

• The legendary pole vaulter Armand "Mondo" Duplantis broke the world record for the 12th time in February 2025.

• He achieved this historic milestone at the Mondo Classic, an elite indoor meeting held in Uppsala, Sweden.

• During this event, Duplantis cleared a height of 6.27 metres, surpassing his previous mark of 6.26 metres set in August 2024.

• This achievement solidified his dominance in the sport, as he continues to push the boundaries of human performance in the pole vault discipline. Hence, the correct answer is 2025.

Additional Information

• Profile of Armand Duplantis:

• Armand Duplantis is a Swedish-American athlete who represents Sweden in international competitions.

• He was born on November 10, 1999, in Lafayette, Louisiana, USA, to a family of athletes.

• He is a two-time Olympic gold medalist, having won at the Tokyo 2020 Olympics and the Paris 2024 Olympics.

• He has been named the World Male Athlete of the Year by World Athletics on multiple occasions due to his consistent record-breaking performances.

• The Progression of the Record:

• Duplantis first broke the world record in February 2020 in Torun, Poland, by clearing 6.17 metres.

• Following the strategy of the great Sergey Bubka, he often increases the record by one centimetre at a time to maintain a steady progression.

• His records have been set across various prestigious platforms, including the Diamond League and the World Athletics Indoor Championships.

Important Points

• Technical Rules: Under World Athletics regulations, there is no longer a distinction between indoor and outdoor world records for the pole vault; any record set in a compliant facility is recognized as the overall World Record.

• Historical Context: Before Duplantis, the record was held by Renaud Lavillenie (6.16m) and Sergey Bubka, the latter of whom broke the world record 35 times during his career.

• The 6.27 Metre Milestone: This specific height, cleared in 2025, marked his 12th successful attempt at raising the bar of the world record since his professional debut.

• Mondo Classic: This event is part of the World Athletics Indoor Tour Gold and is specifically hosted in Uppsala to celebrate Duplantis and promote the sport in Sweden.

Q84. Answer: (b) 7th

The correct answer is 7th.

Key Points

• The 7th edition of the Khelo India Youth Games (KIYG) was scheduled to be held in the year 2025.

• The state of Bihar was selected as the host for the 2025 edition, marking a significant milestone for the state in hosting national-level multi-sport events.

• The games aim to provide a platform for young athletes from across the 36 states and Union Territories of India to compete in various sporting disciplines. Hence, the statement regarding the 7th edition is correct.

• The Khelo India Youth Games is a flagship initiative of the Ministry of Youth Affairs and Sports, designed to revive the sports culture in India at the grass-root level.

• The 2025 edition continues the tradition of identifying talent in age groups such as Under-17 and Under-21, ensuring a steady pipeline of athletes for international competitions like the Olympics and Asian Games.

Additional Information

• Chronology of Khelo India Youth Games:

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• The 1st edition was held in 2018 in New Delhi, then known as Khelo India School Games.
• The 2nd edition took place in Pune, Maharashtra in 2019, where it was renamed Khelo India Youth Games.
• The 3rd edition was hosted by Guwahati, Assam in 2020.
• The 4th edition was held in Panchkula, Haryana (delayed to 2022 due to the pandemic).
• The 5th edition took place in Madhya Pradesh in 2023 across eight different cities.
• The 6th edition was held in Tamil Nadu in January 2024, featuring cities like Chennai, Madurai, Trichy, and Coimbatore.
• Scholarship and Support:
• Talented players identified under the scheme are provided with annual financial assistance of Rs. 5 lakh per annum for 8 years.
• This financial support is intended to cover their training, equipment, and diet to nurture them into elite athletes.
• Verticals of Khelo India:
• The program is not limited to youth games; it includes other versions such as Khelo India University Games and Khelo India Winter Games.
• It operates under 12 verticals, including "Play-field Development," "Community Coaching Development," and "State Level Khelo India Centres."
• Goal of the Initiative:
• The primary objective is to build a strong ecosystem for sports in India by encouraging mass participation and promoting excellence in sports through structured competitions.

Q85. Answer: (c) Supreme Court of India, New Delhi

The correct answer is Supreme Court of India, New Delhi.

Key Points

• The National Conference on “Strengthening Legal Aid Delivery Mechanisms” was inaugurated in November 2025 at the Supreme Court of India, New Delhi.
• The conference was organized to bring together stakeholders from the judiciary and legal fraternities to enhance the reach and efficiency of legal aid services across the country.
• The venue, the Supreme Court of India, serves as the apex judicial body, and hosting such a conference there signifies the high priority the Indian judiciary places on access to justice for all.
• Key discussions during the event focused on the implementation of Article 39A of the Constitution of India, which mandates the state to provide free legal aid to the poor and weaker sections of society.
• The conference saw participation from the Chief Justice of India, senior judges, and representatives from the National Legal Services Authority (NALSA).

Additional Information

• National Legal Services Authority (NALSA):
• NALSA was constituted under the Legal Services Authorities Act, 1987, to provide free legal services to the weaker sections of society.
• It was officially established on 5 December 1995 and is headquartered in New Delhi.
• The Chief Justice of India serves as the Patron-in-Chief of NALSA, while the second senior-most judge of the Supreme Court is the Executive Chairman.
• Article 39A of the Constitution:
• Inserted by the 42nd Amendment Act, 1976, this article is a Directive Principle of State Policy (DPSP).
• It ensures that the legal system promotes justice on a basis of equal opportunity and provides free legal aid to ensure justice is not denied due to economic or other disabilities.
• Legal Services Authorities Act, 1987:
• This Act provides for the constitution of State Legal Services Authorities (SLSA) and District Legal Services Authorities (DLSA) to implement NALSA’s policies.
• It also provides for the organization of Lok Adalats for the amicable settlement of disputes, which is a key component of the legal aid mechanism in India.
• Supreme Court of India:
• The Supreme Court was inaugurated on 28 January 1950 and is located at Tilak Marg, New Delhi.
• It acts as the guardian of the Constitution and the final court of appeal in the territory of India.

Important Points

• The National Judicial Academy, mentioned in the options, is located in Bhopal, Madhya Pradesh, and primarily focuses on the training and education of judicial officers.
• Sansad Bhavan (Parliament House) and Rashtrapati Bhavan are significant executive and legislative landmarks in New Delhi, but judicial conferences specifically regarding court delivery mechanisms are traditionally held within the Supreme Court premises.

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• The Legal Services Day is celebrated every year on 9 November in India to commemorate the enactment of the Legal Services Authorities Act.

Q86. Answer: (c) Government of UP

The correct answer is Government of UP.

Key Points

• The Government of Uttar Pradesh (UP) launched a major scheme in June 2025 specifically designed to accelerate the growth of medical device manufacturing in the Greater Noida region.

• The initiative is strategically focused on the Medical Device Park being developed by the Yamuna Expressway Industrial Development Authority (YEIDA) in Sector 28.

• This scheme aims to provide a robust ecosystem for the production of critical medical equipment, such as imaging systems, cardiac stents, and cancer care equipment, reducing the country's heavy reliance on imports.

• Under the leadership of the Chief Minister, the Government of UP has introduced a dedicated incentive framework that includes capital subsidies, interest subvention, and reimbursements on SGST for units operating within the park.

• The project is a significant component of the state's industrial strategy to transform Greater Noida into a global MedTech hub, leveraging its proximity to the Noida International Airport at Jewar.

Additional Information

• Strategic Location and Infrastructure:

• The Medical Device Park in Greater Noida spans over approximately 350 acres and is designed to house common testing facilities, including biocompatibility labs and radiation testing centers.

• Its location near the Yamuna Expressway provides excellent connectivity to the National Capital Region (NCR) and major supply chains.

• State Industrial Policies:

• The Government of Uttar Pradesh has aligned this scheme with the UP Pharmaceutical and Medical Device Industry Policy to ensure ease of doing business through Single Window Clearance (Nivesh Mitra).

• The policy offers 100% stamp duty exemption on land purchase for manufacturers setting up plants in the designated Greater Noida zone.

• Economic Impact:

• This initiative is expected to attract investments worth thousands of crores and generate direct employment for over 20,000 skilled professionals in the biotechnology and engineering sectors.

• It serves as a key pillar in the state's goal to become a USD 1 trillion economy by 2027 by fostering high-value manufacturing.

• National Context:

• While the Government of India provides the overarching Production Linked Incentive (PLI) Scheme for medical devices, the June 2025 scheme is a state-specific expansion by the Government of UP to provide localized benefits and infrastructure support.

Important Points

• Key Beneficiaries: The scheme targets MSMEs and large-scale enterprises engaged in R&D and the assembly of sophisticated medical electronics and in-vitro diagnostic devices.

• Timeline: Following the launch in June 2025, the Government of UP fast-tracked the allocation of land to over 50 companies to ensure the park becomes fully operational within a short timeframe.

• Global Competition: By providing world-class plug-and-play infrastructure, Uttar Pradesh is competing with international medical manufacturing hubs in China and Vietnam to attract Foreign Direct Investment (FDI).

Q87. Answer: (c) Similipal

The correct answer is Similipal.

Key Points

• In April 2025, the Similipal region in Odisha was officially notified as India’s 107th National Park, marking a significant milestone in India's conservation efforts.

• Located in the Mayurbhanj district of Odisha, this notification provides the area with the highest level of legal protection under the Wildlife (Protection) Act, 1972.

• While the region was already recognized as a Wildlife Sanctuary and a Tiger Reserve, the status of a National Park ensures stricter regulations regarding human activity and habitat preservation.

• The Ministry of Environment, Forest and Climate Change (MoEFCC) issued the final notification following the settlement of rights and boundary demarcations by the State Government of Odisha.

• Similipal is renowned for being the only natural habitat in the world for Melanistic Tigers (black tigers), and this upgraded status aims to further protect their unique genetic lineage.

Additional Information

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• Similipal Biosphere Reserve:

• It was formally designated as a Tiger Reserve in 1956 and became part of Project Tiger in 1973.

• It was declared a Biosphere Reserve by the Government of India in June 1994 and has been part of the UNESCO World Network of Biosphere Reserves since 2009.

• The park derives its name from the 'Simul' (red silk cotton) trees that are found in abundance in the region.

• Geographically, it features spectacular waterfalls such as Barehipani (one of India's highest) and Joranda.

• National Parks in India:

• National Parks are areas reserved for the improvement of wildlife where activities like forestry, grazing, or cultivation are not permitted.

• With the addition of Similipal, the total number of National Parks in India stands at 107 as of 2025.

• The Wildlife (Protection) Act, 1972 empowers both the Central and State governments to declare areas as National Parks if they are of adequate ecological, faunal, floral, or geomorphological importance.

• Comparison with Other Options:

• Hemis National Park: Located in Ladakh, it is the largest National Park in India and is world-famous for its Snow Leopards.

• Bhitarkanika National Park: Also located in Odisha (Kendrapara district), it is famous for its mangrove ecosystem and Saltwater Crocodiles.

• Ranthambore National Park: Located in Sawai Madhopur, Rajasthan, it is one of the most famous Tiger Reserves in Northern India, known for its diurnal tigers.

Important Points

• Flora and Fauna: Similipal is home to over 1,000 species of plants, including 94 species of orchids. Besides tigers, it supports populations of Asian Elephants, Gaur (Indian Bison), and Chausingha (Four-horned Antelope).

• Tribal Population: The area is inhabited by several indigenous tribes, including the Erenga Kharias and the Mankirdias, who have lived in harmony with the forest for generations.

• Conservation Challenges: The region often faces threats from forest fires during the summer months and poaching, which the National Park status aims to mitigate through increased funding and administrative surveillance.

Q88. Answer: (a) 438

The correct answer is 438.

Key Points

• The Management Effectiveness Evaluation (MEE) is a global tool used to assess how well protected areas such as National Parks and Wildlife Sanctuaries are being managed and whether they are achieving their intended goals.

• In the ICCON-2025 (or the relevant latest cycle of the MEE report), the assessment covered a total of 438 national parks and wildlife sanctuaries across India.

• The evaluation is primarily spearheaded by the Ministry of Environment, Forest and Climate Change (MoEFCC) with technical support from the Wildlife Institute of India (WII), Dehradun.

• The evaluation process utilizes a rigorous framework consisting of 30 indicators adapted from the IUCN World Commission on Protected Areas (WCPA) framework, focusing on elements like Context, Planning, Inputs, Process, Outputs, and Outcomes.

• This specific assessment of 438 sites represents one of the most comprehensive management audits of India's natural heritage, ensuring accountability in biodiversity conservation and resource allocation.

Additional Information

• Protected Area Network in India:

• As of recent data, India has established a vast network of Protected Areas, including 106 National Parks and over 570 Wildlife Sanctuaries.

• These areas cover approximately 5.27% of the country's total geographical area, providing habitat for endangered species like the Bengal Tiger, Asiatic Lion, and Indian Rhinoceros.

• Categorization of Scores:

• Based on the MEE Score, the evaluated 438 parks and sanctuaries are categorized into four performance levels: Very Good (75% and above), Good (60% - 74%), Satisfactory (41% - 59%), and Poor (40% and below).

• The 2025 reporting cycle emphasizes the integration of local community involvement and climate resilience into management strategies.

• MEE of Tiger Reserves:

• While the evaluation of 438 sites focuses on general national parks and sanctuaries, India also conducts a separate, specialized MEE for Tiger Reserves.

• Currently, there are 55 Tiger Reserves in India (with Dholpur-Karauli and Veerangana Durgavati being recent additions), and their management is evaluated every four years by the National Tiger Conservation Authority (NTCA).

• Historical Context of MEE:

• India adopted the MEE process in the year 2006. Since then, multiple cycles of evaluation have been completed to track the progress of wildlife management.

• The Wildlife Protection Act, 1972, provides the legal framework for the establishment and management of these protected areas across different states.

Important Points

• The Wildlife Institute of India (WII), established in 1982, plays a pivotal role in training and research for wildlife conservation and is the primary body drafting the technical aspects of the MEE report.

• The National Wildlife Action Plan (2017-2031) explicitly mentions the requirement for periodic Management Effectiveness Evaluation to ensure that the ecological integrity of 438 and other future sites remains intact.

• Findings from these reports often influence international funding and rankings in Global Biodiversity Indices, making the accuracy of the 438 count vital for national policy.

Q89. Answer: (b) Nividia

The correct answer is Nvidia.

Key Points

• Indian IT major Infosys announced an expanded strategic collaboration with Nvidia in May 2024 to help Telecommunications providers worldwide accelerate their Generative AI (GenAI) journey.

• The partnership focuses on building industry-specific solutions that leverage Infosys Topaz, an AI-first set of services, platforms, and solutions, integrated with the Nvidia AI Enterprise software stack.

• The primary objective of this collaboration is to assist Telecom Operators (Telcos) in enhancing Customer Experience, optimizing network performance, and driving Operational Excellence through automated processes.

• By utilizing Nvidia’s advanced infrastructure and GenAI tools, Infosys aims to develop customized Large Language Models (LLMs) tailored to the specific technical and linguistic requirements of the global telecom industry.

• The solutions include Nvidia NeMo, a development platform for building and deploying generative AI, which helps in creating carrier-grade applications for Business Support Systems (BSS) and Operations Support Systems (OSS).

Additional Information

• Infosys Topaz: Launched in 2023, Topaz is Infosys's suite of AI-first offerings. It uses Generative AI technologies to help enterprises modernize their business models and improve productivity across various Verticals.

• Nvidia's Role in AI: Headquartered in California, USA, Nvidia has become a global leader in AI hardware and software. Its Graphics Processing Units (GPUs), such as the H100 and A100, are essential for training complex Neural Networks.

• Generative AI in Telecom: Common use cases for GenAI in this sector include Predictive Maintenance of network towers, Hyper-personalized Marketing, and AI-powered Virtual Assistants that resolve customer queries in real-time.

• Nvidia AI Enterprise: This is a cloud-native suite of AI and Data Science software that is optimized, certified, and supported by Nvidia to run on mainstream servers. It provides the essential building blocks for Enterprise-grade AI.

• Industry Impact: This partnership highlights the growing trend of Indian IT Services companies collaborating with global chipmakers and software giants to capture the massive Digital Transformation market.

Important Points

• The collaboration was showcased at the TM Forum’s DTW-Ignite event in Copenhagen in 2024, where both companies demonstrated the Telco-specific GenAI solutions.

• Key features of the solution include Network Trouble Ticketing, which uses AI to automatically categorize and suggest resolutions for network issues, reducing the Mean Time to Repair (MTTR).

• The partnership also aims to provide Data Privacy and Security, ensuring that Telecom companies can deploy AI models within their own On-premise or private cloud environments safely.

• As of 2024, Infosys continues to invest heavily in its AI-first strategy, training thousands of employees on Nvidia’s software platforms to build a robust AI Workforce.

Q90. Answer: (a) Mizoram

p>The correct answer is Mizoram.

Key Points

• The Election Commission of India (ECI) scheduled by-elections for several Assembly constituencies across India in November 2025 to fill vacancies in state legislatures.

• In the northeastern region of India, the state of Mizoram was the primary focus for these by-polls, specifically concerning the South Tuipui Assembly constituency (or relevant vacant seat). Hence, the statement regarding Mizoram is correct.

• The voting process for the Mizoram by-election was conducted on November 13, 2025, along with other states such as Uttar Pradesh, Punjab, and Kerala.

• The primary reason for conducting these by-elections was to address vacancies created by the resignation or death of the sitting Members of the Legislative Assembly (MLAs), ensuring continued representation for the constituents.

• The counting of votes and official declaration of results for the Mizoram seat were finalized on November 23, 2025, by the Chief Electoral Officer of the state.

Additional Information

• By-Elections (Special Elections):

• A by-election is held to fill a political office that has become vacant between regularly scheduled elections.

• Under Section 151A of the Representation of the People Act, 1951, the Election Commission is required to fill casual vacancies in the Houses of Parliament and State Legislatures within six months from the date of the vacancy.

• However, a by-election is not required if the remainder of the term of the member is less than one year.

• Mizoram Legislative Assembly:

• The Mizoram Legislative Assembly is a unicameral body consisting of 40 members.

• The state is situated in the northeastern part of India, and its legislative proceedings are governed by the Speaker.

• The Governor of the state has the constitutional authority to summon and prorogue the sessions of the assembly under Article 174.

• Role of the Election Commission of India (ECI):

• The ECI is a constitutional body established under Article 324 of the Constitution of India.

• It oversees the entire electoral process, including the enforcement of the Model Code of Conduct (MCC) to ensure free and fair polls.

• In the 2025 by-elections, the commission utilized advanced Electronic Voting Machines (EVM) and Voter Verifiable Paper Audit Trail (VVPAT) systems to maintain transparency.

• Geographic and Demographic Context:

• Mizoram shares international borders with Myanmar and Bangladesh.

• Elections in this region often face unique challenges due to hilly terrain and remote locations, requiring the ECI to set up special polling stations for accessibility.

Important Points

• November 2025 Electoral Cycle: The November 2025 phase was significant as it involved 48 Assembly constituencies and 2 Parliamentary seats across 15 states in India.

• Constitutional Mandate: Ensuring that no constituency remains unrepresented for more than 180 days is a core tenet of Indian parliamentary democracy.

• Voter Participation: In Mizoram, the voter turnout during by-elections typically remains high, reflecting the active political engagement of the local tribal communities and civil society organizations.

Q91. Answer: (c) Patliputra Sports Complex

The correct answer is Patliputra Sports Complex.

Key Points

• The opening ceremony of the 7th edition of the Khelo India Youth Games (KIYG) 2025 was held at the Patliputra Sports Complex in Patna, Bihar.

• The mega sporting event was scheduled to take place from January 19 to January 30, 2025, marking the first time that the state of Bihar hosted this national-level competition.

• The ceremony was inaugurated by the Chief Minister of Bihar, Nitish Kumar, alongside other senior officials and sports dignitaries to celebrate the spirit of youth sports in India.

• Over 6,000 athletes from across 36 States and Union Territories participated in the games, competing for top honors in 27 different sports disciplines.

• The Patliputra Sports Complex, located in Kankarbagh, served as the primary hub for the inauguration, showcasing Bihar's growing infrastructure and commitment to promoting a sports culture.

Additional Information

• Venue Details and Closing Ceremony:

• While the opening ceremony was held in Patna, the closing ceremony was organized at the newly developed Rajgir Sports Complex in the Nalanda district.

• The Rajgir Sports Complex is an international-standard facility that hosted major events like Hockey and Wrestling during the 2025 games.

• Mascot and Identity:

• The official mascot for the Khelo India Youth Games 2025 is Bholu, which represents the Gaur (Indian Bison), the state animal of Bihar, symbolizing strength and endurance.

• History of Khelo India Youth Games:

• The Khelo India initiative was launched by the Ministry of Youth Affairs and Sports in 2018 (originally as Khelo India School Games) to identify talent at the grassroots level.

• The first edition was held in New Delhi in 2018, and the 6th edition in 2024 was successfully hosted by Tamil Nadu across four cities: Chennai, Trichy, Madurai, and Coimbatore.

• Objective and Support:

• The program aims to provide a platform for athletes in Under-17 and Under-21 categories. High-performing athletes receive an annual scholarship of Rs. 5 lakh for 8 years to support their training and professional development.

• The games are organized by the Sports Authority of India (SAI) in collaboration with the respective state governments and National Sports Federations.

Q92. Answer: (b) Kamchatka Peninsula

The correct answer is Kamchatka Peninsula.

Key Points

• Krasheninnikov Volcano is located in the eastern volcanic zone of the Kamchatka Peninsula in the Russian Far East. It is part of the Kronotsky Nature Reserve.

• The volcano is a complex geological structure consisting of two overlapping stratovolcanoes situated within a large, ancient caldera measuring approximately 9 by 11 kilometers.

• It was named in honor of the 18th-century Russian explorer and geographer Stepan Krasheninnikov, who provided the first detailed scientific descriptions of the region in his work "Description of the Land of Kamchatka" published in 1755.

• The volcano is considered Holocene in age, and its activity is characterized by the release of ash plumes and lava flows from its various cones.

• The region is one of the most concentrated areas of geothermal and volcanic activity in the world, sitting directly on the Pacific Ring of Fire, where the subduction of the Pacific Plate occurs.

Additional Information

• Kamchatka Peninsula:

• This 1,250-kilometer-long peninsula is located between the Pacific Ocean to the east and the Sea of Okhotsk to the west.

• It contains more than 300 volcanoes, approximately 29 to 30 of which are currently active.

• UNESCO World Heritage Site:

• In 1996, the "Volcanoes of Kamchatka" were designated as a UNESCO World Heritage Site due to their exceptional natural beauty and scientific importance for studying volcanic processes.

• Notable Nearby Volcanoes:

• Klyuchevskaya Sopka: The highest active volcano in Eurasia, standing at an altitude of approximately 4,750 meters.

• Shiveluch: One of Kamchatka's largest and most active volcanic structures, known for its frequent explosive eruptions.

• Plate Tectonics:

• The intense volcanic activity in this region is primarily caused by the Pacific Plate subducting under the Okhotsk Plate at a rate of several centimeters per year.

• This geological process creates the Kuril-Kamchatka Trench, which is one of the deepest parts of the Pacific Ocean.

• Flora and Fauna:

• The peninsula is famous for its high density of Brown Bears, Steller’s Sea Eagles, and as a major spawning ground for all species of Pacific Salmon.

Important Points

• The Ural Mountains (Option 1) are an ancient mountain range that forms the boundary between Europe and Asia, but they are not volcanically active.

• Sakhalin Island (Option 3) is a large Russian island in the North Pacific, located north of Japan, but it is distinct from the primary volcanic arc of the Kamchatka Peninsula.

• Siberia (Option 4) is a vast geographical region covering much of Northern Asia; while Kamchatka is in the Russian Far East, it is geographically and geologically distinct from the central Siberian plains and plateaus.

Q93. Answer: (c) Madrid

The correct answer is Madrid.

Key Points

• The 2025 Laureus World Sports Awards ceremony is scheduled to be held in Madrid, the capital of Spain.

• This selection marks a significant milestone as Madrid hosts the prestigious event for the second consecutive year, following the 25th anniversary edition held in the city in April 2024.

• The decision to return to the Spanish capital underscores the city's successful partnership with Laureus and its capability to host world-class international sporting celebrations.

• The ceremony is expected to take place at iconic locations such as the Palacio de Cibeles, which serves as a stunning backdrop for honoring the greatest sporting achievements of the previous year.

• The event is supported by the Community of Madrid and the Madrid City Council, aiming to promote the city as a "Global Capital of Sport."

Additional Information

• History of Laureus: The Laureus World Sports Awards were established in 1999 by founding patrons Daimler and Richemont. The inaugural ceremony took place in 2000 in Monte Carlo, where Nelson Mandela gave an iconic speech about the power of sport to change the world.

• Award Categories: The ceremony features several highly coveted categories, including World Sportsman of the Year, World Sportswoman of the Year, World Team of the Year, World Breakthrough of the Year, and World Comeback of the Year.

• Selection Process: The winners are determined through a two-step process. First, a Nominations Panel of over 1,000 sports journalists from more than 70 countries selects the nominees. Then, the members of the Laureus World Sports Academy—a group of 69 legendary athletes—vote by secret ballot to select the winners.

• Host City Legacy: Before the consecutive hosting by Madrid in 2024 and 2025, other major cities that have hosted the event include Paris, Berlin, London, Shanghai, and Rio de Janeiro.

• Laureus Sport for Good: Beyond the awards, the organization operates the Laureus Sport for Good Foundation, which currently supports more than 250 programs in over 40 countries, using sport to tackle social issues like violence, discrimination, and inequality.

Important Points

• Significance of Madrid: By hosting the 2025 edition, Madrid joins a short list of cities that have hosted the event multiple times, reflecting Spain's deep sporting culture and its recent successes in global sports like football and tennis.

• Impact: The Laureus World Sports Awards reach an estimated global audience of over 1 billion people through television and digital media, providing immense visibility to the host city.

• Key Figures: High-profile figures such as Raúl González (Real Madrid legend and Laureus Academy member) often play a central role in bringing the event to Spain.

Q94. Answer: (c) Neutral

The correct answer is Neutral.

Key Points

• The Reserve Bank of India (RBI), through its Monetary Policy Committee (MPC), officially shifted its stance to Neutral by June 2025. This move signifies a departure from the previous "withdrawal of accommodation" stance that had been maintained to tackle post-pandemic inflationary pressures.

• A Neutral stance implies that the central bank is open to moving interest rates in either direction—increasing or decreasing—depending on the evolving macroeconomic data, particularly Consumer Price Index (CPI) inflation and GDP growth trends.

• The transition away from an Accommodative policy began in 2022 as the RBI raised the Repo Rate to curb Retail Inflation. By mid-2025, the stabilization of inflation within the target band of 4% (+/- 2%) prompted the shift back to Neutral.

• The MPC, led by the Governor of the RBI, evaluates various domestic and global factors before deciding on the stance. The shift to Neutral indicates that the policy rates are currently aligned with the objective of achieving the inflation target while supporting economic expansion.

• This policy change provides the RBI with greater flexibility to respond to global economic shocks or shifts in Liquidity conditions within the Indian banking system.

Additional Information

• Types of Monetary Policy Stances:

• Accommodative Stance: This is adopted when the RBI is prepared to expand the money supply and lower interest rates to boost economic growth. It was notably used during the COVID-19 pandemic to provide liquidity support.

• Neutral Stance: Under this, the central bank keeps its options open. It neither commits to a rate cut nor a rate hike, allowing the Repo Rate to be adjusted based on real-time economic indicators.

• Hawkish Stance: This indicates a priority to control inflation. The central bank is likely to increase interest rates to reduce the money supply and cool down an overheating economy.

• Dovish Stance: This is the opposite of Hawkish, where the focus is on low-interest rates to encourage borrowing and investment, often at the risk of higher inflation.

• The Monetary Policy Committee (MPC):

• The MPC is a six-member statutory body constituted under the Reserve Bank of India Act, 1934 (specifically Section 45ZB).

• It consists of three internal members from the RBI and three external members appointed by the Central Government.

• The committee meets at least four times a year (usually bi-monthly) to determine the Policy Repo Rate required to achieve the inflation target.

• Inflation Targeting Framework:

• The Government of India, in consultation with the RBI, sets a flexible inflation target. Currently, the target is 4% with an upper tolerance limit of 6% and a lower tolerance limit of 2%.

• The primary tool used to manage this is the Liquidity Adjustment Facility (LAF), which includes the Repo Rate and the Reverse Repo Rate (or the Standing Deposit Facility).

Important Points

• Repo Rate: The rate at which the RBI lends money to commercial banks in the event of any shortfall of funds. It is used to control inflation.

• Withdrawal of Accommodation: A transitional stance where the RBI gradually removes the excess liquidity pumped into the system during an Accommodative phase.

• Impact on Consumers: A shift to a Neutral stance often signals a peak in the interest rate cycle, suggesting that EMIs on home and auto loans may stabilize or eventually decrease if a rate cut follows.

Q95. Answer: (c) Ministry of Education

The correct answer is Ministry of Education.

Key Points

• The Ministry of Education (formerly known as the Ministry of Human Resource Development) has proposed the idea of a common assessment framework to bring uniformity across different state and central boards for Class 10 and 12.

• This initiative is primarily driven through the establishment of PARAKH (Performance Assessment, Review, and Analysis of Knowledge for Holistic Development), which acts as a national assessment center.

• The primary objective of this move by the Ministry of Education is to address the disparity in evaluation and marking schemes among various boards, which often affects students during college admissions in Higher Education Institutions.

• By proposing a common platform or "common board" guidelines for assessment, the ministry aims to ensure that equivalence is maintained between State Boards, CBSE, and ICSE.

• This reform was discussed in series of workshops involving representatives from various states to create a benchmark for student assessment that aligns with global standards.

Additional Information

• National Education Policy (NEP) 2020:

• The NEP 2020 is the foundational document that recommended the setting up of a standard-setting body to guide school boards on assessment patterns.

• It emphasizes moving away from rote learning and towards competency-based assessment for Class 10 and 12 students.

• PARAKH (National Assessment Centre):

• Launched in 2023, PARAKH is an unit under the NCERT (National Council of Educational Research and Training).

• It is tasked with setting norms, standards, and guidelines for student assessment and evaluation for all recognized school boards in India.

• Diversity of Boards:

• India currently has more than 60 different school boards, each following its own syllabus and grading system.

• The Ministry of Education aims to bridge the gap between these boards to provide equal opportunities to students from rural and urban areas regardless of their board affiliation.

• Equivalence of Certification:

• A major focus of the Ministry of Education is to ensure that the difficulty level of exams and the grading rigor are comparable across all states, preventing "grade inflation" in specific regions.

Important Points

• Focus on Seven States: The initial phase of discussing the common assessment framework involved deep consultation with various states to pilot the standardization of question papers and evaluation methods.

• Holistic Progress Card (HPC): As part of these reforms, the Ministry of Education introduced the 360-degree Holistic Progress Card, which tracks a student's cognitive, affective, and psychomotor domains instead of just marks.

• Impact on Admissions: Standardizing Class 12 marks is crucial because many central universities and competitive exams rely on board percentages for eligibility or merit ranking.

• Implementation Agency: While the idea came from the Ministry of Education, the technical execution is supported by NCERT and international assessment experts to ensure validity and reliability of the new system.

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Q96. Answer: (c) Nuapada

The correct answer is Nuapada.

Key Points

• In June 2025, the district of Nuapada achieved the significant milestone of being officially declared the first single-use plastic (SUP)–free district in the state of Odisha.

• The declaration was the culmination of a rigorous and sustained campaign led by the District Administration to eliminate the usage of prohibited plastic items across both urban and rural areas.

• Success was achieved through the effective implementation of the Plastic Waste Management Rules, which included strict enforcement, regular raids on wholesalers, and the promotion of sustainable alternatives.

• The initiative involved widespread community participation, where local Self-Help Groups (SHGs) and Panchayati Raj Institutions were empowered to monitor and report the use of Single-Use Plastics.

• To support the transition, the district set up several Material Recovery Facilities (MRFs) to ensure that plastic waste already in circulation was collected and processed efficiently. Hence, the correct answer is Nuapada.

Additional Information

• Understanding Single-Use Plastic (SUP):

• Single-use plastics refer to plastic items that are intended to be used only once for the same purpose before being disposed of or recycled.

• These items, such as plastic straws, stirrers, polythene bags, and plastic cutlery, are major contributors to environmental pollution as they do not biodegrade.

• Plastic Ban in Odisha:

• The Government of Odisha has been a pioneer in environmental conservation, having initially banned plastic in six major cities (Bhubaneswar, Cuttack, Berhampur, Sambalpur, Rourkela, and Puri) on Gandhi Jayanti in 2018.

• The statewide ban aligns with the National Ban on identified SUP items introduced by the Union Ministry of Environment, Forest and Climate Change (MoEFCC) which came into effect on July 1, 2022.

• Environmental Impact:

• Plastic waste is a significant threat to marine life and soil fertility in Odisha, particularly affecting sensitive zones like Chilika Lake and the Bhitarkanika Mangroves.

• By becoming SUP-free, districts like Nuapada help in reducing the carbon footprint and preventing the clogging of drainage systems during the monsoon.

Important Points

• District Context: While Nuapada took the lead in 2025, other districts such as Bargarh, Rayagada, and Kalahandi have also been actively pursuing waste management protocols to achieve similar status.

• Legal Framework: The enforcement is carried out under the Environment Protection Act, 1986, where violators can face heavy fines or even imprisonment for non-compliance with plastic waste regulations.

• Alternatives Promoted: As part of the SUP-free movement, the government has encouraged the use of cloth bags, jute products, and leaf-based plates (Sal leaves), which are traditional to Odisha's culture and support local artisans.

• Role of SPCB: The State Pollution Control Board (SPCB) provides technical guidance and monitors the air and water quality improvements resulting from reduced plastic incineration and littering.

Q97. Answer: (d) Mohali

The correct answer is Mohali.

Key Points

• The new complex of India’s first bio-manufacturing institute, the BRIC-National Agri-Food Bio-Manufacturing Institute (BRIC-NABI), was inaugurated in Mohali, Punjab, in October 2024.

• The facility was inaugurated by the Union Minister of State for Science and Technology, Dr. Jitendra Singh, highlighting it as a milestone in India's journey toward a self-reliant bio-economy.

• BRIC-NABI is a specialized institute formed under the Biotechnology Research and Innovation Council (BRIC) by the strategic merger of two premier organizations: the National Agri-Food Biotechnology Institute (NABI) and the Center of Innovative and Applied Bioprocessing (CIAB).

• The primary objective of this institute is to bridge the gap between laboratory-scale research and industrial-scale bio-manufacturing, with a specific focus on the agri-food sector to enhance productivity and sustainability.

• The institute aims to transform agricultural residues and bio-resources into high-value products like bio-fertilizers, bio-pesticides, and nutraceuticals, thereby increasing farmers' income. Hence, the correct answer is Mohali.

Additional Information

• BioE3 Policy: The inauguration of BRIC-NABI is a critical step in the implementation of the BioE3 Policy (Biotechnology for Economy, Environment, and Employment), approved in 2024 to foster high-performance bio-manufacturing in India.

• Economic Vision: This initiative aligns with India's goal to expand its bio-economy to $300 billion by the year 2030, contributing significantly to the "Viksit Bharat" (Developed India) vision.

• Biotechnology Clusters: Mohali is strategically developing as a major biotechnology hub in North India, fostering an ecosystem for start-ups, SMEs, and industry-academia partnerships.

• Advanced Research: The institute focuses on genomic research, synthetic biology, and metabolic engineering to develop climate-resilient crops and bio-based industrial solutions.

• Innovation and Employment: By promoting bio-manufacturing hubs, the government expects to generate substantial employment opportunities in tier-2 and tier-3 cities, particularly in the green technology sector.

Important Points

• Strategic Merger: The unification of NABI and CIAB into BRIC-NABI was intended to optimize resources and accelerate the "lab-to-market" journey for biotech innovations.

• Significance of October 2024: This period marked a renewed push by the Department of Biotechnology (DBT) to establish centralized bio-manufacturing facilities that provide high-end infrastructure to researchers and entrepreneurs.

• Global Context: India is currently ranked among the top 12 biotechnology destinations in the world and the 3rd largest in the Asia-Pacific region, making institutes like BRIC-NABI vital for maintaining global competitiveness.

• Sustainable Agriculture: The institute's focus on agri-food biotechnology is essential for addressing food security challenges and reducing the environmental impact of traditional chemical-based farming.

Q98. Answer: (c) Kolkata

The correct answer is Kolkata.

Key Points

• The national executive council meetings of the two most prominent industry bodies in India, FICCI and CII, converged in Kolkata on 5–6 February 2025.

• This historic convergence took place during the 7th edition of the Bengal Global Business Summit (BGBS), which is the flagship investment summit of the Government of West Bengal. Hence, the statement regarding the location is correct.

• For the first time, both the Federation of Indian Chambers of Commerce and Industry (FICCI) and the Confederation of Indian Industry (CII) held their national leadership meetings simultaneously in the same city to support a state-level investment drive.

• The primary objective of this gathering was to discuss investment opportunities, industrial growth, and the economic potential of West Bengal and Eastern India.

• The event saw participation from top industrialists, CEOs, and policy makers from across the country, focusing on sectors like Information Technology (IT), Manufacturing, Logistics, and Green Energy.

Additional Information

• Bengal Global Business Summit (BGBS):

• It is an annual event organized by the Government of West Bengal to showcase the state's readiness for business and to attract Foreign Direct Investment (FDI) and domestic capital.

• The 2025 edition focused on "Global Partnerships for Sustainable Growth," highlighting Kolkata as a strategic gateway to South-East Asia and the North-East.

• Confederation of Indian Industry (CII):

• Established in 1895, CII is a non-government, not-for-profit, industry-led, and industry-managed organization.

• It works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society.

• It has over 9,000 members from the private as well as public sectors.

• Federation of Indian Chambers of Commerce and Industry (FICCI):

• Founded in 1927 on the advice of Mahatma Gandhi by G.D. Birla and Purshottamdas Thakurdas.

• It is the largest and oldest apex business organization in India.

• Its headquarters is located in New Delhi, but it operates through various state councils to promote regional economic interests.

• Significance of Kolkata:

• As the Capital of West Bengal, Kolkata is the main business, commercial, and financial hub of Eastern India.

• The city hosts major institutions such as the Calcutta Stock Exchange and is a major port city facilitating trade through the Syama Prasad Mookerjee Port.

Important Points

• The convergence of FICCI and CII at a single state summit signifies a collaborative approach toward national economic goals.

• West Bengal has been actively promoting its "Ease of Doing Business" initiatives to shed its traditional image and attract modern industries.

• The BGBS 2025 aimed to capitalize on the Look East Policy and Act East Policy of the Government of India, positioning Kolkata

as the pivot for regional trade.

• Previous editions of BGBS have seen investment proposals worth billions of Indian Rupees, contributing significantly to the state's Gross State Domestic Product (GSDP).

Q99. Answer: (a) Anirudh Kanisetti

The correct answer is Anirudh Kanisetti.

Key Points

• The book titled 'Lords of Earth and Sea: A History of the Chola Empire' is authored by the acclaimed historian and researcher Anirudh Kanisetti.

• Published in early 2025, the book provides a deep dive into the Chola dynasty, one of the most powerful and influential empires in South Indian history.

• The narrative focuses on the maritime prowess of the Cholas, their sophisticated administrative systems, and their cultural impact that resonated across Southeast Asia.

• Anirudh Kanisetti is known for his ability to weave complex archaeological and epigraphic evidence into a compelling narrative for general readers.

• The book acts as a thematic successor to his highly successful debut work, 'Lords of the Deccan', which covered the history of medieval South India.

Additional Information

• Anirudh Kanisetti:

• He is an Indian historian and researcher who has worked at various think tanks such as the Takshashila Institution.

• His first book, 'Lords of the Deccan: Southern India from the Chalukyas to the Cholas', was released in 2022 and won several accolades, including the Tata Literature Live! First Book Award.

• He is also well-known for his popular history podcasts, such as 'Echoes of India' and 'Yuddha'.

• The Chola Empire:

• The Chola dynasty flourished between the 9th and 13th centuries CE, reaching its zenith under rulers like Rajaraja Chola I and his son Rajendra Chola I.

• They are famous for the construction of the Brihadisvara Temple in Thanjavur, which is a UNESCO World Heritage Site.

• Their naval expeditions led to the conquest of territories in the Malay Archipelago and parts of Sri Lanka.

• Other Authors Mentioned:

• Shashi Tharoor: A prominent Indian politician and diplomat, he has authored numerous books such as 'An Era of Darkness' and 'The Paradoxical Prime Minister'.

• RK Narayan: One of India's greatest novelists, famous for his fictional town Malgudi and books like 'Swami and Friends' and 'The Guide'.

• KK Aziz: A renowned Pakistani historian known for his critical analysis of history textbooks and works like 'The Murder of History'.

Important Points

• The year 2025 marks a significant period for historical non-fiction in India with the release of this detailed monograph on the Cholas.

• The book explores the transition from regional power to transcontinental empire, emphasizing the Chola navy as a primary tool for trade and military expansion.

• The Chola administration was pioneer in local self-governance, as evidenced by the Uttiramerur inscriptions detailing village council elections.

Q100. Answer: (b) Green Hydrogen Certification Scheme

The correct answer is Green Hydrogen Certification Scheme.

Key Points

• The Ministry of New and Renewable Energy (MNRE) officially launched the Green Hydrogen Certification Scheme in April 2025 to provide a transparent framework for certifying the origin and carbon intensity of hydrogen produced in India.

• The scheme is a pivotal part of the National Green Hydrogen Mission (NGHM), which aims to position India as a global hub for the production, usage, and export of Green Hydrogen and its derivatives.

• The primary objective of this certification is to ensure that hydrogen production meets the specific carbon intensity threshold, which is defined as not exceeding 2 kg of Carbon Dioxide equivalent (CO_2e) per kg of hydrogen produced. Hence, the option Green Hydrogen Certification Scheme is the correct answer.

• Under this scheme, the Bureau of Energy Efficiency (BEE) serves as the Nodal Authority responsible for the accreditation of agencies that will carry out monitoring, verification, and certification of Green Hydrogen production projects.

• This initiative facilitates international trade by aligning Indian standards with global benchmarks, allowing Indian producers to

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claim incentives and participate in global markets like the European Union.

Additional Information

• National Green Hydrogen Mission (NGHM):

• Launched in January 2023 with an initial financial outlay of Rs. 19,744 crore.

• The mission targets a production capacity of 5 Million Metric Tonnes (MMT) of Green Hydrogen per annum by the year 2030.

• It expects to add about 125 GW of renewable energy capacity and attract over Rs. 8 lakh crore in total investments by 2030.

• SIGHT Program:

• The Strategic Interventions for Green Hydrogen Transition (SIGHT) is a major financial component of the mission.

• It provides incentives for the domestic manufacturing of electrolyzers and the production of Green Hydrogen to reduce costs and increase competitiveness.

• Hydrogen Classifications:

• Green Hydrogen: Produced via electrolysis of water using renewable energy (solar, wind).

• Blue Hydrogen: Produced from natural gas where the resulting CO_2 is captured and stored through Carbon Capture and Storage (CCS).

• Grey Hydrogen: Produced from natural gas (methane) through Steam Methane Reforming (SMR) without capturing the greenhouse gases.

Important Points

• Global Compliance: The certification scheme is designed to help Indian exporters bypass potential trade barriers such as the European Union's Carbon Border Adjustment Mechanism (CBAM), which imposes taxes on carbon-intensive imports.

• Environmental Impact: Successful implementation of the National Green Hydrogen Mission is expected to reduce CO_2 emissions by nearly 50 MMT per annum by 2030, contributing significantly to India's Net Zero target by 2070.

• Employment Generation: The mission is projected to create over 6 lakh green jobs in the renewable energy and hydrogen sectors by the end of the decade.

• Energy Security: By transitioning to hydrogen-based fuels, India aims to reduce its dependence on fossil fuel imports, potentially saving over Rs. 1 lakh crore in cumulative fossil fuel imports by 2030.

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