RRB Group D Official Paper (Held On: 17 Dec, 2025 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. An athlete runs on a circular track with a diameter of 300 m and completes one round in 50 seconds. If the athlete runs for 2 minutes and 30 seconds, what is the total distance covered from the starting point?

(Use π = 3.14)

(a) Distance = 942 m
(b) Distance = 1500 m
(c) Distance = 2826 m
(d) Distance = 471 m

Q2. What does Snell's Law of refraction state about the relationship between the angle of incidence and the angle of refraction for the given pair of media?

(a) Both angles are always equal in all media.
(b) The ratio of the sine of the angle of incidence to the sine of the angle of refraction remains constant.
(c) Their difference is always constant.
(d) Their sum is always 90°.

Q3. A bus travels a 6 km distance in 20 minutes to go from point A to point B. The bus travels from point B to point A in 30 minutes. What is the average speed in m/s of the bus?

(a) 400
(b) 2400
(c) 24
(d) 4

Q4. If the thrust acting on a surface remains constant, how does the pressure change with the area of contact?

(a) Pressure decreases when area decreases.
(b) Pressure increases when area increases.
(c) Pressure increases when area decreases.
(d) Pressure does not depend on area.

Q5. Which of the following is INCORRECT about striated muscle?

(a) Also called voluntary muscles
(b) Each striated muscle fibre contains a single nucleus
(c) These are present in limbs
(d) Mostly attached to bones and help in body movement

Q6. How can the spread of certain sexually transmitted infections (STIs) be reduced during sexual activity?

(a) By avoiding physical contact with all people
(b) By using protection such as condoms during intercourse
(c) By engaging in sexual activity only during the day
(d) By taking antibiotics before each sexual act

Q7. If the velocity of a body is doubled, its kinetic energy becomes:

(a) eight times
(b) double
(c) four times
(d) half

Q8. Which of the following metals reacts most vigorously with cold water?

(a) Copper
(b) Sodium
(c) Iron
(d) Cobalt

Q9. Which of the following statements about coal and petroleum conservation is correct?

(a) They are renewable resources of energy.
(b) Their formation takes millions of years.
(c) They are inexpensive to extract.
(d) They do not cause pollution.

Q10. An electric bulb is connected to a 240 V generator and draws a current of 0.25 A. What is the power consumed by the bulb?

(a) 60 W
(b) 960 J
(c) 960 W
(d) 60 J

Q11. Which of the following reactions is an example of a double displacement reaction?

(a) $CaCO_3 \rightarrow CaO + CO_2$
(b) $2Mg + O_2 \rightarrow 2MgO$
(c) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
(d) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

Q12. Which of the following is NOT a base unit in the International System of Units (SI)?

(a) Joule
(b) Metre
(c) Kilogramme
(d) Second

Q13. Which of the following vitamins are maintained at high levels in chicken feed to support proper growth and health?

(a) Vitamin A, D and E
(b) Vitamin B9 and B12
(c) Vitamin C and K
(d) Vitamin B1, B2, B3

Q14. Which of the following is true about the cells of meristematic tissue?

(a) They are active cells with dense cytoplasm, thin walls, prominent nuclei and no vacuoles.
(b) They are dead cells with no nucleus or cytoplasm.
(c) They are loosely packed, mature cells with large intercellular spaces.
(d) They are inactive with large vacuoles and thick walls.

Q15. What is the primary component of the plant cell wall?

(a) Lignin
(b) Suberin
(c) Cutin
(d) Cellulose

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Q16. When fats and oils are oxidised, they develop a smell and taste that is:

(a) spicy
(b) fruity
(c) pleasant
(d) rancid

Q17. Which of the following components is represented by a zig-zag line in a circuit diagram?

(a) Resistor
(b) Battery
(c) Bulb
(d) Switch

Q18. What is an ion?

(a) A neutral atom
(b) A molecule
(c) An atom or group of atoms with a positive or negative charge.
(d) A proton

Q19. Which of the following is essential for animals to participate in the process of mating?

(a) Physical maturity
(b) They must have attractive eyes
(c) Sexual immaturity
(d) They must be tall

Q20. Select the option regarding the matter which has sufficient spaces between them or are not tightly packed.
Salt, Iron, Sugar

(a) Only sugar
(b) Only iron
(c) Both sugar and salt
(d) Both iron and salt

Q21. When a light ray passes through a rectangular glass slab, the emergent ray is _____.

(a) Along the same line as the incident ray
(b) Bent toward the normal without displacement
(c) Perpendicular to the incident ray
(d) Parallel to the incident ray but shifted sideward

Q22. How does pollination contribute to seed formation in plants?

(a) By forming a protective seed coat around the ovule
(b) By dispersing seeds to new locations
(c) By transferring pollen from the anther to the stigma, enabling fertilisation
(d) By producing nectar to attract pollinators

Q23. What is reverberation?

(a) Spreading of sound in all directions
(b) Persistence of sound due to multiple reflections of sound waves
(c) Change in pitch of sound
(d) Loss of sound energy in air

Q24. Select the correct option regarding the following two statements: Assertion (A) and Reason (R).
Assertion (A): When exposed to moist air, iron gets coated with a reddish-brown substance.
Reason (R): Rust is formed due to the reaction of iron with moisture and oxygen.

(a) Both A and R are true, and R is the correct explanation for A.
(b) A is false, but R is true.
(c) A is true, but R is false.

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(d) Both A and R are true, and R is not the correct explanation for A.

Q25. Which of the following metals is characterised by low density and softness?

(a) Copper
(b) Aluminium
(c) Potassium
(d) Magnesium

MATHEMATICS

Q26. The value of (1 - 1/2)(1 - 1/3)(1 - 1/4)(1 - 1/5) … … … (1 - 1/m) is equal to:

(a) m - 1
(b) 1/m
(c) m
(d) m + 1

Q27. A dealer purchased a ceiling fan for Rs. 391. After allowing a discount of 31% on its marked price, he still gains 68%. Find the marked price of the ceiling fan.

(a) Rs. 994
(b) Rs. 952
(c) Rs. 902
(d) Rs. 927

Q28. A and B working together can do a piece of work in 3 days. B alone can do the same work in 12 days. How long (in days) will A alone take to do double the work?

(a) 9
(b) 4
(c) 11
(d) 8

Q29. Juli is 24 years older than her daughter. In 6 years, Juli's age will be double that of her daughter. What is the present age (in years) of Juli?

(a) 48
(b) 42
(c) 30
(d) 24

Q30. The price of a commodity decreases by 5% in the first week and then increases by 8% in the second week. What is the effective percentage increase in the price after the second week?

(a) 3%
(b) 2.6%
(c) 0.8%
(d) 1.5%

Q31. A seller sells two fruits, apples and bananas. An apple costs Rs. 20 and a banana costs Rs. 10. Ravi buys 6 fruits and pays Rs. 80. How many more bananas did he buy than apples?

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

Q32. The average age of 30 students of a class is 19 years. If the age of the teacher is also included, the average age of the whole group becomes 20 years. The age (in years) of the teacher is:

(a) 52
(b) 50

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(c) 54
(d) 58

Q33. The sides of a triangle are 34 cm, 18 cm and 20 cm. What is the length of its altitude corresponding to the side with the length of 18 cm?
(a) 16 cm
(b) 42 cm
(c) 63 cm
(d) 22 cm

Q34. Given $x + y = 4$, and $xy = 2$, what is $x^2 + y^2$?
(a) 16
(b) 14
(c) 10
(d) 12

Q35. If 20% of 10% of 2/3 of a number is 697. Find the number.
(a) 56260
(b) 52990
(c) 52275
(d) 52290

Q36. In an election with two candidates, 8% of the registered voters did not vote, and 120 voters submitted blank ballots. Among the votes cast, the winning candidate received support from 48% of all registered voters and secured 780 more votes than the other candidate. Determine the total number of voters on the list.
(a) 14,840
(b) 16,500
(c) 17,800
(d) 15,690

Q37. The Rajdhani Express and Garib Rath Express run in the same direction with speeds of 87 km/hr and 51 km/hr, respectively, and their lengths are the same. What is the length of the Rajdhani Express if it completely crosses the Garib Rath Express in 175 seconds?
(a) 867 m
(b) 875 m
(c) 880 m
(d) 883 m

Q38. If P is a prime number, what is the HCF of P and P + 1 ?
(a) $P^2 + 1$
(b) $P^2 + P$
(c) 1
(d) P

Q39. The amount on a sum of Rs. 2,500 at the rate of 14% per annum compound interest, compounded annually, in 2 years will be:
(a) Rs. 2,877
(b) Rs. 3,184
(c) Rs. 2,497
(d) Rs. 3,249

Q40. Simplify: $\sqrt{(51 - \sqrt{7} + \sqrt{(11 - 4\sqrt{7})}}$
(a) 7
(b) 5
(c) 11
(d) 10

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Q41. The sides of a triangle are 87 cm, 108 cm, and 75 cm. What is the length (in cm) of its altitude corresponding to the side with a length of 108 cm?

(a) 24
(b) 60
(c) 41
(d) 17

Q42. Rs. 10,279 is divided among A, B, and C in such a way that if Rs. 67, Rs. 33, and Rs. 13 are deducted from their respective shares, they have money in the ratio 4 : 2 : 20. Find the difference between B's and C's original shares.

(a) Rs. 7018
(b) Rs. 6988
(c) Rs. 7138
(d) Rs. 7188

Q43. If the Mode is 3 and it is given that the Mode is 3/2 times the Mean, find the square of the product of the Median and the Mean.

(a) 1897/9
(b) 187/9
(c) 217/9
(d) 1697/9

Q44. Two pipes, P and Q, can fill a cistern in 37 minutes 30 seconds and 45 minutes, respectively. Both pipes are opened simultaneously. The cistern gets completely filled in exactly 30 minutes if pipe Q is turned off after x minutes. Find x.7002

(a) 12
(b) 7
(c) 9
(d) 8

Q45. The angle of elevation of a ladder leaning against a wall is 60° and the foot of the ladder is 5.6 m away from the wall. Find the length of the ladder.

(a) 11.2 m
(b) 12.2 m
(c) 14.2 m
(d) 10.2 m

Q46. An athletic track forms a shape consisting of a rectangle with semicircles on two opposite ends. If the straight portions are each 100 metres long and the total perimeter of the track is 400 metres, what is the radius of each semicircular end (rounded off to two decimal places)?

(Use π = 22/7)

(a) 30.23 metres
(b) 32.43 metres
(c) 33.73 metres
(d) 31.82 metres

Q47. How many seconds will a boy take to run one complete round around a square field of side 25 metres, if he runs at a speed of 4 km/hr?

(a) 70
(b) 90
(c) 100
(d) 80

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Q48. If the mean proportional of X and 147 is 84, then find the value of X.

(a) 49
(b) 50
(c) 48
(d) 45

Q49. A fruit vendor buys 10 kg of apples at Rs. 85/kg and sells them at Rs. 100/kg. What is his total profit?

(a) Rs. 140
(b) Rs. 150
(c) Rs. 180
(d) Rs. 120

Q50. DMART is offering Buy 30, get 11 free on grocery items. What is the net percentage discount being offered by DMART? (Correct up to two decimal places)

(a) 28.04%
(b) 23.99%
(c) 26.83%
(d) 24.84%

GENERAL INTELLIGENCE & REASONING

Q51. O, P, Q, R, W, X and Y are sitting in a straight line facing north. Only two people sit to the right of X. Only two people sit between X and Q. Only two people sit between O and P. P sits to the immediate left of X. R sits to the immediate right of Y. Who sits at the third position from the left end of the line?

(a) O
(b) P
(c) W
(d) Y

Q52. What should come in place of the question mark (?) in the given series?

24 41 58 75 92 ?

(a) 105
(b) 117
(c) 109
(d) 113

Q53. A, B, C, D, E and F are sitting around a circular table, facing the centre. E sits third to the right of F. B sits second to the left of E. C sits second to the right of A. D sits to the immediate right of C. How many people sit between E and D, when counted from the left of D?

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

Q54. Select the pair that follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

NOK−JKG

EFB−ABX

(a) TUQ−PQM
(b) TTO−PQM
(c) TTO−OPL
(d) TUQ−OQL

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Q55. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(44, 52, 18)

(50, 56, 22)

(a) (41, 82, 1)
(b) (42, 78, 4)
(c) (19, 14, 13)
(d) (30, 22, 19)

Q56. 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) TVW
(b) OQR
(c) BEE
(d) EGH

Q57. NK 16 is related to QN 12 in a certain way. In the same way, PS 20 is related to SV 16. To which of the given options is BX 30 related, following the same logic?

(a) EA 34
(b) EA 26
(c) FB 26
(d) EB 26

Q58. What should come in place of the question mark (?) in the given series, based on the English alphabetical order?

SWZ QUX OSV MQT ?

(a) KOR
(b) KPR
(c) KPS
(d) KOS

Q59. What should come in place of the question mark (?) in the given series?

256 258 262 268 ? 286

(a) 276
(b) 274
(c) 280
(d) 278

Q60. Seven boxes B, D, E, P, S, T and W are kept one over the other but not necessarily in the same order.

W is kept second from the bottom. Only three boxes are kept between W and B. P is kept at one of the positions below W. Only D is kept between B and S. E is kept at one of the positions above B.

How many boxes are kept between P and E?

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

Q61. Refer to the following number, symbol series and answer the question that follows. Counting to be done from left to right only. (All numbers are single-digit numbers.)

(Left) 3 @ © 6 5 € € 3 3 8 € % 2 7 6 # 7 * £ € 9 $ (Right)

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

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

Q62. If 'A' stands for 'x', 'B' stands for '÷', 'C' stands for '+' and 'D' stands for '-', what will come in place of the question mark '?' in the following equation?

16 B 4 D 8 A 3 C 28 = ?

(a) 6
(b) 10
(c) 8
(d) 11

Q63. If 1 is added to each odd digit and 2 is subtracted from each even digit in the number 1245367, how many digits will appear more than once in the new number thus formed?

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

Q64. Mr. Z starts from Point A and drives 13 km towards the South. He then takes a left turn, drives 15 km, then turns left and drives 27 km. He then takes a left turn and drives 31 km. He takes a final left turn, drives 14 km, and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90-degree turns only, unless specified.)

(a) 16 km to the east
(b) 19 km to the west
(c) 17 km to the east
(d) 18 km to the south

Q65. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only). Counting to be done from left to right only.

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

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

(a) Five
(b) Seven
(c) Six
(d) Eight

Q66. Refer to the number and symbol series given below and answer the question that follows. Counting to be done from left to right only.

(NOTE: All numbers are single-digit numbers only.)

(Left) % * 7 % € % 2 # € $ € © 9 5 6 # 9 & 6 % 7 & (Right)

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

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

Q67. Each of the digits in the number 6325894 is arranged in descending order from right to left. Calculate the sum of digits whose position(s) remain(s) unchanged as compared to that in the original number and the lowest digit.

(a) 17
(b) 10
(c) 12

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(d) 8

Q68. 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:

No Judges are Accountants.

Some Accountants are Nurses.

All Nurses are Librarians.

Conclusions:

(I) No Judges are Nurses.

(II) Some Accountants are Librarians.

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

Q69. In a certain code language, 'door win king' is coded as 'ab ap ly' and 'win key mom' is coded as 'dw tc ap'. How is 'win' coded in that language?

(a) ab
(b) ly
(c) ap
(d) dw

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

517 520 525 532 541 ?

(a) 553
(b) 551
(c) 552
(d) 554

Q71. In a certain code language,

P + Q means ‘P is the mother of Q’,

P # Q means ‘P is the wife of Q’,

P & Q means ‘P is the brother of Q’,

P % Q means ‘P is the father of Q’.

How is I related to M if ‘I # J % B & L + M’?

(a) Father's mother
(b) Father's sister
(c) Mother's mother
(d) Mother's sister

Q72. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

FIM19 GJN26 HKO33 ILP40 ?

(a) JMQ47
(b) JMR47
(c) JMQ48
(d) JMR48

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

Statements:

Some machines are anchors.

Some anchors are wheels.

Conclusions:

(I): Some machines are wheels.

(II): All wheels are anchors.

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

Q74. 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) TXT
(b) HLG
(c) KOJ
(d) EID

Q75. In a certain code language, ‘LAVS’ is coded as ‘3812’ and ‘VALE’ is coded as ‘1342’. What is the code for ‘E’ in the given code language?

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

Q76. 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) 5 2 3 6 9 5 1 4 7 8 5 2 3 (Right)

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

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

Q77. Preethi ranked 6^(th) from the top and 12^(th) from the bottom in her class. How many students are there in the class?

(a) 16
(b) 19
(c) 20
(d) 17

Q78. A, B, C, E, F, P, and Q are sitting around a circular table, facing the centre. A sits fourth to the left of C. P sits fourth to the right of B. Only two people sit between C and B, when counted from the left of C. E is not an immediate neighbour of P or B. F is not an immediate neighbour of P. Who sits third to the right of Q?

(a) F
(b) B
(c) P
(d) C

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Q79. LR 9 is related to PT 3 in a certain way. In the same way, TS 13 is related to XU 7. To which of the given options is GE 19 related, following the same logic?

(a) JK 11
(b) KG 13
(c) NJ 12
(d) BG 14

Q80. Akshay starts from Point M and drives 8 km towards the east. He then takes a right turn, drives 5 km, turns left and drives 3 km. He then takes a right turn and drives 7 km. He then takes a right turn and drives 11 km. He takes a final right turn, drives 5 km and stops at Point P. How far(shortest distance) and in which direction is Point P with respect to Point M?

(All turns are 90° turns only unless specified.)

(a) 9 km towards north
(b) 3 km towards north
(c) 7 km towards south
(d) 6 km towards south

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. SBM Bank India entered into a bancassurance partnership with which among the following companies in May 2025?

(a) ICICI Prudential Life Insurance
(b) Life Insurance Corporation of India
(c) Kotak Life Insurance Co. Ltd.
(d) Axis Max Life Insurance Co. Ltd.

Q82. What was the name of the bilateral Indo-French military drill held from 18 June to 1 July 2025 at Camp Larzac?

(a) Vikas 2025
(b) Prithvi 2025
(c) Trishul 2025
(d) Shakti 2025

Q83. In September 2025, the Indian cricket team refused to receive the Asia Cup trophy from the President of the Asian Cricket Council and the Home Minister of _____.

(a) Bangladesh
(b) Afghanistan
(c) Pakistan
(d) Sri Lanka

Q84. Which district in Arunachal Pradesh saw the inauguration of a Khelo India multipurpose hall in 2025?

(a) Kamle
(b) Itanagar
(c) Tawang
(d) Lohit

Q85. According to a July 2025 report by the Centre for Science and Environment, all mega cities in India—including Kolkata, Bengaluru, Mumbai, Hyderabad and Chennai—saw high concentrations of which pollutant(s) during the summer of 2025?

(a) Black carbon
(b) Nitrogen oxides
(c) Volatile organic compounds
(d) Ground-level ozone

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Q86. In November 2025, Narendra Modi presented a revolutionary indigenous innovation of India, as the country's indigenous quantum security chip called:

(a) Next-Gen Quantum Shield Chip (NQSC)
(b) Quantum Security Integrated Processor (QSIP)
(c) Quantum Cyber Defence Chip (QCDC)
(d) Indian Quantum Encryption Module (IQEM)

Q87. In March 2025, which three Central Asian countries signed the Khujand Treaty to settle border disputes?

(a) Kazakhstan, Uzbekistan, Kyrgyzstan
(b) Turkmenistan, Uzbekistan, Tajikistan
(c) Kazakhstan, Tajikistan, Turkmenistan
(d) Tajikistan, Kyrgyzstan, Uzbekistan

Q88. Who took charge as the Chief Election Commissioner of India on 19 February 2025, under the new provisions of the 2023 appointment act?

(a) Gyanesh Kumar
(b) Rajiv Kumar
(c) Sukhbir Singh Sandhu
(d) Anup Chandra Pandey

Q89. Which of the following financial institutions imposed a fine of Rs. 54.78 crore on 353 regulated entities in FY25?

(a) Reserve Bank of India (RBI)
(b) National Payments Corporation of India (NPCI)
(c) Securities and Exchange Board of India (SEBI)
(d) NSDL Payments Bank

Q90. Who among the following won the 2025 Abel Prize for contributions to algebraic analysis and representation theory?

(a) Joel Mokyr
(b) Terence Tao
(c) Masaki Kashiwara
(d) Philippe Aghion

Q91. Which of the following ministries launched the Aadhaar Good Governance Portal to streamline approval process for Aadhaar authentication requests and to make Aadhaar more people-friendly, enable ease of living, and enable better access to services for people?

(a) Ministry of Electronics and Information Technology
(b) Ministry of Personnel, Public Grievances and Pensions
(c) Ministry of Social Justice and Empowerment
(d) Ministry of Statistics and Programme Implementation

Q92. During which of the following editions of the National Finite Element Developers' meeting did Indian Space Research Organisation (ISRO) unveil the latest version of Finite Element Analysis of Structures (FEAST) software in February 2025?

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

Q93. Which athlete set a new American outdoor record in the men's 5000 m with a time of 12 : 45.27?

(a) Grant Fisher
(b) Yared Nuguse
(c) Cole Hocker
(d) Nico Young

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Q94. The 115^(th) executive council meeting of the All-India Mayor Council was held on 15-16 June 2025 in which city?

(a) New Delhi
(b) Panchkula
(c) Agra
(d) Mumbai

Q95. Where were the 2025 Asian Athletics Championships held?

(a) China
(b) India
(c) South Korea
(d) Bangladesh

Q96. As per the survey conducted by the Yale Program on Climate Change Communication and CVoter from December 5, 2024, to February 18, 2025, what percentage of Indians reported experiencing severe air pollution in the past 12 months?

(a) 52%
(b) 62%
(c) 73%
(d) 80%

Q97. The Constitutional Amendment Bill introduced in August 2025 prevents individuals in jail from holding which of the following positions?

(a) Directors of private corporations
(b) Constitutional roles like Prime Minister and Chief Ministers
(c) Heads of universities and colleges
(d) Senior bank executive roles

Q98. The 24^(th) edition of the World Sustainable Development Summit 2025, organised by TERI, commenced in _____.

(a) Hyderabad
(b) Bengaluru
(c) New Delhi
(d) Mumbai

Q99. Where was the Khelo India Winter Games 2025 second phase held?

(a) Gulmarg
(b) Leh
(c) Auli
(d) Manali

Q100. According to GS Krishnan, which of the following sectors are highlighted in the India BioEconomy Report, 2025?

(a) BioEnergy, BioIndustrial, BioPharma, and BioServices
(b) BioPharma, BioAgri, BioServices, and Robotics Biotech
(c) BioAgri, BioPharma, Renewable Energy, and BioMedical
(d) BioPharma, BioIndustrial, BioAgri, and BioServices

ANSWER KEY

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

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51	c	52	c	53	a	54	a	55	d	56	c	57	b	58	a	59	a	60	b
61	c	62	c	63	c	64	a	65	c	66	b	67	b	68	a	69	c	70	c
71	c	72	a	73	c	74	a	75	d	76	d	77	d	78	a	79	b	80	c
81	a	82	d	83	c	84	a	85	d	86	b	87	d	88	a	89	a	90	c
91	a	92	a	93	d	94	b	95	c	96	a	97	b	98	c	99	a	100	d

SOLUTIONS

Q1. Answer: (c) Distance = 2826 m

Shortcut Trick

Total time = 2 minutes 30 seconds = 150 seconds.

Number of rounds = Total time ÷ Time per round = 150 ÷ 50 = 3 rounds.

Distance of 1 round = π × Diameter = 3.14 × 300 = 942 m.

Total distance = 3 × 942 = 2826 m.

Therefore The correct answer is 2826 m.

Alternate Method

Given:

Diameter (d) = 300 m

Time for one round = 50 seconds

Total running time = 2 minutes 30 seconds

Value of π = 3.14

Formula Used:

Circumference of circular track = π × d

Total distance = Number of rounds × Circumference

=> Total running time = (2 × 60) + 30 = 150 seconds

=> Circumference (Distance of 1 round) = 3.14 × 300

=> Circumference = 942 m

=> Number of rounds = 150 / 50

=> Number of rounds = 3

=> Total Distance = 3 × 942

=> Total Distance = 2826 m

Therefore The correct answer is 2826 m.

Additional Information

Displacement on Circular Path

If an athlete completes an integer number of rounds, the net displacement is 0 as the starting and ending points are the same.

Area of Circular Track

The total area enclosed by the circular track is calculated using Area = πr^2, where r is the radius (diameter/2).

Average Speed

Average Speed = Total Distance ÷ Total Time. In this case, Speed = 2826 ÷ 150 = 18.84 m/s.

Q2. Answer: (b) The ratio of the sine of the angle of incidence to the sine of the angle of refraction remains constant.

The correct answer is The ratio of the sine of the angle of incidence to the sine of the angle of refraction remains constant.

Key Points

• Snell's Law of Refraction is a fundamental principle in optics that describes how light bends when passing from one medium to another.

• It states that the ratio of the sine of the angle of incidence (represented as sin i) to the sine of the angle of refraction (represented as sin r) is a constant for a given pair of media and for light of a specific color or wavelength. Hence, statement 2 is correct.

• The mathematical expression for this law is sin i / sin r = μ (or n), where μ is the Refractive Index of the second medium relative to the first.

• Snell's Law is also known as the second law of refraction. It was discovered by the Dutch astronomer and mathematician Willebrord Snellius in the year 1621.

• The angle of incidence is the angle between the incoming ray and the normal (perpendicular) to the interface, while the angle of refraction is the angle between the refracted ray and the normal.

• This law applies specifically to monochromatic light, as different colors of light have different refractive indices in the same medium, a phenomenon known as dispersion.

Additional Information

• Refraction of Light:

• Refraction is the change in direction of a wave passing from one medium to another caused by its change in speed.

• When light travels from a rarer medium (like air) to a denser medium (like glass or water), it slows down and bends towards the normal.

• Conversely, when light travels from a denser medium to a rarer medium, it speeds up and bends away from the normal.

• Refractive Index (n):

• The refractive index is a dimensionless number that indicates the light-bending ability of a medium.

• It is defined as the ratio of the speed of light in a vacuum (approximately 3 x 10^8 m/s) to the speed of light in the medium.

• Absolute Refractive Index is calculated relative to a vacuum, while Relative Refractive Index is calculated between two specific media.

• Behavior of Other Options:

• The statement that "Both angles are always equal" refers to the Law of Reflection, not refraction. Hence, statement 1 is incorrect.

• The statement "Their difference is always constant" does not correspond to any standard physical law of optics. Hence, statement 3 is incorrect.

• The statement "Their sum is always 90°" is only true in the specific case of Brewster's Law, where the reflected and refracted rays are perpendicular to each other. Hence, statement 4 is incorrect.

Important Points

• Change in Properties: During the process of refraction, the velocity and wavelength of light change, but the frequency remains constant. The frequency is a characteristic of the source of light.

• Normal Incidence: If a ray of light strikes the interface of two media at an angle of 0 degrees (along the normal), the angle of refraction is also 0 degrees. In this specific case, the ray passes through without bending, although its speed still changes.

• Total Internal Reflection (TIR): This occurs when light travels from a denser medium to a rarer medium at an angle of incidence greater than the critical angle. In this scenario, Snell’s Law implies that the sine of the angle of refraction would be greater than 1, which is mathematically impossible, resulting in the light reflecting back entirely into the denser medium.

• Applications: Snell’s Law is essential in the design of optical lenses, spectacles, microscopes, telescopes, and fiber optic cables used in telecommunications.

Q3. Answer: (d) 4

Shortcut Trick

Total distance covered = 6 km + 6 km = 12 km = 12,000 m

Total time taken = 20 min + 30 min = 50 min = 3,000 s

Average speed = Total Distance ÷ Total Time

Average speed = 12,000 ÷ 3,000 = 4 m/s

Therefore The correct answer is 4.

Alternate Method

Given:

Distance from A to B = 6 km

Time from A to B = 20 minutes

Time from B to A = 30 minutes

Formula Used:

Average Speed = Total Distance ÷ Total Time

1 km = 1,000 m | 1 minute = 60 seconds

=> Total Distance = 6 km + 6 km = 12 km

=> Total Distance in meters = 12 × 1,000 = 12,000 m

=> Total Time = 20 min + 30 min = 50 min

=> Total Time in seconds = 50 × 60 = 3,000 s

=> Average Speed = 12,000 ÷ 3,000

=> Average Speed = 4 m/s

Therefore The correct answer is 4.

Additional Information

Average Speed for Equal Distances

When an object travels equal distances at speeds x and y, the average speed is given by the harmonic mean: 2xy ÷ (x + y).

Unit Conversion Shortcut

To convert speed from km/h to m/s, multiply the value by 5/18. To convert m/s to km/h, multiply by 18/5.

Uniform Speed vs Average Speed

Uniform speed is constant throughout the journey, whereas average speed is the ratio of total path length to the total time interval taken.

Q4. Answer: (c) Pressure increases when area decreases.

The correct answer is Pressure increases when area decreases.

Key Points

• Pressure is defined as the thrust (force acting perpendicular to a surface) acting per unit area of that surface.

• The mathematical relationship between these physical quantities is expressed by the formula: Pressure = Thrust / Area.

• When the thrust remains constant, pressure is inversely proportional to the area of contact. This means that if the area increases, the pressure decreases, and if the area decreases, the pressure increases.

• Evaluating the given options based on the inverse relationship (P prop. to 1/A):

• Option 1: Pressure decreases when area decreases. This statement is incorrect because pressure should increase.

• Option 2: Pressure increases when area increases. This statement is incorrect because pressure should decrease.

• Option 3: Pressure increases when area decreases. This statement is correct as it aligns with the inverse proportionality.

• Option 4: Pressure does not depend on area. This statement is incorrect because area is a primary factor in calculating pressure.

• Hence, the correct answer is Pressure increases when area decreases.

Additional Information

• Thrust:

• It is the total force acting perpendicularly on a surface.

• The S.I. unit of thrust is the Newton (N), the same as force.

• Thrust is a vector quantity, meaning it has both magnitude and direction.

• Pressure Units:

• The S.I. unit of pressure is Newton per square metre (N/m^2).

• In honour of the scientist Blaise Pascal, the unit is also called the Pascal (Pa). 1 Pa = 1 N/m^2.

• Other common units include the bar, torr, and atmosphere (atm). 1 atm is approximately 101,325 Pa.

• Practical Applications of Pressure-Area Relationship:

• Sharp Knives: A sharp knife has a very small area at its cutting edge. For the same thrust applied by the hand, it produces a high pressure that easily cuts through objects.

• School Bags: These are provided with broad straps so that the weight (thrust) of the bag is distributed over a larger area of the shoulder, resulting in less pressure and more comfort for the student.

• Foundations of Buildings: High-rise buildings have wide foundations to ensure the massive weight is spread over a large surface area, preventing the structure from sinking into the ground due to excessive pressure.

• Tractors: Tractors have broad tires to reduce the pressure on the soft ground of agricultural fields, preventing them from sinking.

Important Points

• While force and thrust are vector quantities, pressure is a scalar quantity because it does not have a specific direction associated with it at a point in a fluid or on a surface; it acts in all directions.

• In fluids (liquids and gases), pressure increases with depth because the weight of the fluid column above (which acts as the thrust) increases as you go deeper.

• Atmospheric Pressure: The weight of the Earth's atmosphere exerts pressure on everything on the surface. At sea level, the standard atmospheric pressure is 1.013 x 10^5 Pa.

Q5. Answer: (b) Each striated muscle fibre contains a single nucleus

The correct answer is Each striated muscle fibre contains a single nucleus.

Key Points

• Striated muscles are primarily those muscles that are under the conscious control of the somatic nervous system, which is why they are commonly referred to as voluntary muscles. Hence, statement 1 is correct.

• A defining structural feature of striated muscle fibers is that they are multinucleated. During development, several myoblasts fuse

together to form a single muscle fiber, resulting in a syncytium where multiple nuclei are present in a single cell, typically located at the periphery. Hence, statement 2 is incorrect.

• These muscles are found extensively throughout the body, particularly in the limbs (arms and legs), body wall, face, and neck, where they facilitate complex movements. Hence, statement 3 is correct.

• Striated muscles are mostly attached to bones via tendons. Their primary function is to contract and relax to produce force and motion, helping in body movement and maintaining posture. Hence, statement 4 is correct.

• Microscopically, these muscles appear to have alternating light and dark bands (striations) when viewed under a microscope, which is caused by the specific arrangement of actin and myosin filaments.

Additional Information

• Types of Muscles:

• Smooth Muscles: These are involuntary muscles found in the walls of internal organs like the stomach, intestines, and blood vessels. They are spindle-shaped and, unlike striated muscles, contain only a single nucleus (uninucleated) and lack striations.

• Cardiac Muscles: Located exclusively in the heart, these muscles are striated but involuntary. They are characterized by branched fibers and intercalated discs that allow for synchronized contractions. They usually contain one or two nuclei.

• Structural Components:

• The functional unit of a striated muscle is the sarcomere. It is the segment between two Z-lines and contains the machinery required for muscle contraction.

• The Sarcolemma is the specialized cell membrane that surrounds the striated muscle fiber, while the Sarcoplasm is the cytoplasm containing high amounts of glycosomes and myoglobin.

• Functions of Skeletal Muscle:

• Beyond locomotion, these muscles play a critical role in heat production (thermogenesis) to maintain body temperature.

• They also serve as a storage site for amino acids and glucose (in the form of glycogen), which can be utilized by the body during metabolic stress.

Important Points

• Muscle Contraction Mechanism: The process is explained by the Sliding Filament Theory, proposed in 1954. It states that muscle contraction occurs when thin filaments (actin) slide over thick filaments (myosin), shortening the sarcomere without the filaments themselves changing length.

• Fast-twitch vs. Slow-twitch: Striated muscles can be categorized into Type I (slow-twitch), which are dense with capillaries and mitochondria for endurance, and Type II (fast-twitch), which are used for short bursts of strength or speed.

• Energy Source: These muscles utilize Adenosine Triphosphate (ATP) as the primary energy source for contraction, which is replenished through aerobic respiration or anaerobic glycolysis depending on the intensity of the physical activity.

Q6. Answer: (b) By using protection such as condoms during intercourse

The correct answer is By using protection such as condoms during intercourse.

Key Points

• Sexually Transmitted Infections (STIs) are infections primarily passed from one person to another through vaginal, anal, or oral sexual contact, caused by more than 30 different pathogens including bacteria, viruses, and parasites.

• Condoms are highly effective barrier methods that prevent the transmission of infections by blocking the direct exchange of bodily fluids like semen, pre-ejaculate, and vaginal secretions.

• According to scientific data, consistent and correct use of latex condoms reduces the risk of Human Immunodeficiency Virus (HIV) transmission by approximately 80% to 90%.

• Condoms also significantly lower the transmission rates of other fluid-borne bacterial infections such as Gonorrhea (caused by Neisseria gonorrhoeae) and Chlamydia (caused by Chlamydia trachomatis) by preventing the pathogens from reaching the mucous membranes.

• While they are most effective against fluid-borne diseases, they also provide a degree of protection against infections spread through skin-to-skin contact, such as Syphilis and Genital Herpes, provided the infected area is covered by the barrier.

Additional Information

• Pathogen Categories:

• Bacterial STIs: Infections like Syphilis, Gonorrhea, and Chlamydia can be cured with a full course of antibiotics prescribed by medical professionals.

• Viral STIs: Infections like HIV, Human Papillomavirus (HPV), and Hepatitis B are generally incurable but manageable with antiviral therapy and vaccines.

• Preventive Misconceptions:

• Antibiotic Prophylaxis: Taking antibiotics before sexual activity without a medical diagnosis is ineffective against viruses and contributes to the global threat of antimicrobial resistance.

• Environmental Factors: The time of day or the setting of sexual activity has zero biological impact on the viability or transmission

of STI-causing pathogens.

Q7. Answer: (c) four times

The correct answer is four times.

Key Points

• Kinetic Energy (KE) is the energy possessed by an object due to its motion. It is mathematically expressed by the formula: KE = 1/2 mv^2, where m represents the mass of the body and v represents its velocity.

• From the formula, it is evident that the kinetic energy of a body is directly proportional to the square of its velocity (KE prop. to v^2), assuming the mass remains constant.

• If the velocity of a body is doubled (v becomes 2v), the new kinetic energy (KE') can be calculated as: KE' = 1/2 m(2v)^2 = 1/2 m(4v^2) = 4 (1/2 mv^2).

• Therefore, when the velocity is increased by a factor of 2, the kinetic energy increases by a factor of 2 squared, which is 4. Hence, the kinetic energy becomes four times its original value.

• This relationship highlights that kinetic energy is highly sensitive to changes in speed compared to changes in mass. For instance, if the velocity were tripled, the kinetic energy would become nine times the original.

Additional Information

• Work-Energy Theorem: This theorem states that the net work done on an object is equal to the change in its kinetic energy. If positive work is done on a body, its velocity increases, leading to a rise in kinetic energy.

• Relationship with Momentum: Kinetic energy is also related to linear momentum (p) by the formula KE = p^2 / 2m. This shows that if the momentum of a body is doubled, its kinetic energy also becomes four times, provided the mass is constant.

• Units and Nature: The SI unit of kinetic energy is the Joule (J), which is equivalent to 1 kg m^2/s^2. Kinetic energy is a scalar quantity, meaning it has only magnitude and no direction, and it can never be negative because mass is positive and the square of velocity is always non-negative.

• Practical Applications: This principle is critical in road safety. Since KE prop. to v^2, doubling the speed of a car quadruples the energy involved in a collision and significantly increases the braking distance required to stop the vehicle.

Important Points

• Mass vs. Velocity: While kinetic energy is linearly proportional to mass, it is quadratically proportional to velocity. Doubling the mass only doubles the kinetic energy, but doubling the velocity quadruples it.

• Frame of Reference: The value of kinetic energy depends on the observer's frame of reference. A person sitting in a moving train has zero kinetic energy relative to the train but significant kinetic energy relative to an observer standing on the platform.

• Types of Kinetic Energy: Besides translational kinetic energy (1/2 mv^2), objects can also possess rotational kinetic energy (1/2 Iω^2) and vibrational kinetic energy, depending on their type of motion.

Q8. Answer: (b) Sodium

The correct answer is Sodium.

Key Points

• Sodium is a soft, silvery-white, highly reactive alkali metal belonging to Group 1 of the periodic table with atomic number 11.

• It reacts most vigorously with cold water among the given options, producing sodium hydroxide and hydrogen gas. This reaction is highly exothermic, often generating enough heat to ignite the hydrogen gas produced. Hence, the correct answer is Sodium.

• The chemical equation for the reaction is 2Na + 2H2O → 2NaOH + H2 + heat energy.

• Due to its extreme reactivity with oxygen and moisture in the air, sodium must be stored under kerosene or mineral oil to prevent accidental combustion.

• In the Reactivity Series, Sodium is placed near the top, just below Potassium, indicating its high tendency to lose its valence electron and form positive ions.

Additional Information

• Copper (Option 1):

• Copper is a transition metal located in Group 11 of the periodic table.

• It is highly unreactive with water. It does not react with cold water, hot water, or even steam.

• Because of its low reactivity and high thermal conductivity, it is used for making hot water tanks and electrical wires. Hence, statement 1 is incorrect.

• Iron (Option 3):

• Iron is a transition metal with atomic number 26.

• It does not react with cold water or hot water. It only reacts with steam to form iron(III) oxide and hydrogen gas.

• The reaction with steam is 3Fe + 4H2O → Fe3O4 + 4H2. Hence, statement 3 is incorrect.

• Cobalt (Option 4):

• Cobalt is a transition metal (atomic number 27) found in Group 9.

• Like iron, it is relatively stable and does not react vigorously with cold water under standard conditions.

• It is primarily used in batteries, magnets, and high-strength alloys. Hence, statement 4 is incorrect.

Important Points

• Potassium: It is even more reactive than sodium and reacts violently with cold water, catching fire instantly.

• Calcium: It reacts with cold water but the reaction is less violent. The hydrogen bubbles produced stick to the surface of the metal, causing the calcium to float.

• Magnesium: It does not react with cold water at all. It reacts with hot water to form magnesium hydroxide and hydrogen.

• Noble Metals: Metals like Gold, Silver, and Platinum do not react with water in any form, which is why they are used in jewelry.

Q9. Answer: (b) Their formation takes millions of years.

The correct answer is Their formation takes millions of years.

Key Points

• Coal and petroleum are categorized as fossil fuels, which are derived from the organic remains of prehistoric plants and organisms buried under layers of sediment.

• Fossil fuels are non-renewable resources of energy because they are available in limited quantities in nature and cannot be replenished at the same rate they are consumed. Hence, statement 1 is incorrect.

• The process of carbonization (for coal) and the transformation of marine organisms into petroleum occur under conditions of high temperature and high pressure over a period of millions of years. Hence, statement 2 is correct.

• The extraction of these resources is not inexpensive; it requires massive capital investment, deep-sea drilling, advanced machinery, and refining processes to make them usable. Hence, statement 3 is incorrect.

• The combustion of coal and petroleum products releases significant amounts of carbon dioxide (CO_2), sulfur dioxide, and nitrogen oxides, which are major contributors to air pollution and global warming. Hence, statement 4 is incorrect.

• Hence, the correct answer is Their formation takes millions of years.

Additional Information

• Types of Coal:

• Coal is classified into different types based on its carbon content and age. Anthracite is the highest quality coal with over 80% carbon, followed by Bituminous, Lignite (brown coal), and Peat (the first stage of coal formation).

• In India, coal is the most abundantly available fossil fuel and meets a substantial part of the country's energy needs.

• Petroleum and its Products:

• Petroleum is often called "Black Gold" because of its high commercial value. Through fractional distillation in refineries, crude oil is separated into petrol, diesel, kerosene, wax, and lubricants.

• It is primarily found in sedimentary rocks and is often associated with deposits of natural gas.

• Conservation Strategies:

• Conservation is essential because these resources are exhaustible. Strategies include the 3Rs (Reduce, Reuse, Recycle) and shifting toward renewable energy sources like solar energy, wind energy, and tidal power.

• The Petroleum Conservation Research Association (PCRA) in India provides guidelines for saving fuel, such as maintaining constant speed and ensuring regular vehicle maintenance.

Important Points

• Environmental Impact: The excessive use of fossil fuels leads to the greenhouse effect, which results in a rise in the Earth's average temperature. Furthermore, the release of sulfur and nitrogen oxides leads to acid rain, which damages soil, vegetation, and aquatic life.

• Geological Significance: The Carboniferous Period, roughly 300 to 360 million years ago, was a major era for the formation of the world's coal beds, highlighting the vast geological timescale required to produce these energy sources.

• Energy Security: Many countries are now focusing on Sustainable Development to ensure that the energy needs of the present are met without compromising the ability of future generations to meet their own needs.

Q10. Answer: (a) 60 W

The correct answer is 60 W.

Key Points

• Electric Power is defined as the rate at which electrical energy is consumed or dissipated in an electric circuit. It represents the work done per unit time.

• In this problem, the Voltage (V) provided by the generator is 240 V and the Current (I) drawn by the electric bulb is 0.25 A.

• The standard mathematical formula to calculate electric power is $P = V \times I$, where P is the power, V is the potential difference (voltage), and I is the current.

• Substituting the given numerical values into the formula: Power = 240 × 0.25.

• The calculation yields 60. Since the SI unit of power is the Watt (W), the power consumed by the bulb is 60 W. Hence, the correct answer is 60 W.

Additional Information

• Ohm's Law and Resistance:

• According to Ohm's Law, the relationship between voltage, current, and resistance is given by V = IR.

• If we calculate the resistance of this specific bulb, R = V / I, which is 240 / 0.25 = 960 Ohms. Note that 960 is the Resistance, not the power.

• Alternative Power Formulas:

• Power can also be expressed in terms of resistance: $P = I^2R$ or $P = V^2 / R$.

• Using $P = V^2 / R$ for this bulb: (240 × 240) / 960 = 57600 / 960 = 60 W. These formulas are useful when the current or voltage is unknown but resistance is provided.

• Units of Measurement:

• The Watt is named after the Scottish inventor James Watt. 1 Watt is equal to 1 Joule per second (1 J/s).

• Larger units of power include the Kilowatt (kW), where 1 kW = 1,000 Watts, and the Horsepower (hp), where 1 hp is approximately 746 Watts.

Important Points

• Distinction between Power and Energy:

• Power (measured in Watts) is the rate of energy consumption, whereas Energy (measured in Joules) is the total amount of work done over a period.

• The options 60 J and 960 J are incorrect because the Joule is a unit of energy, not power.

• Commercial Unit of Electrical Energy:

• The commercial unit used for electricity bills is the Kilowatt-hour (kWh), which is often referred to as a "unit."

• 1 kWh is the energy consumed by a 1,000 W appliance running for one hour, which equals 3.6 × 10^6 Joules.

• Practical Application:

• Most domestic appliances in India operate at a standard voltage of 220 V to 240 V. The current rating helps in determining the appropriate fuse or circuit breaker required for safety features.

Q11. Answer: (d) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

The correct answer is $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$.

Key Points

• A double displacement reaction is a type of chemical reaction where two compounds react, and the positive ions (cations) and the negative ions (anions) of the two reactants switch places, forming two new compounds.

• In the reaction $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$, the silver ion ($Ag^+$) from silver nitrate combines with the chloride ion (Cl^-) from sodium chloride to form silver chloride (AgCl). Simultaneously, the sodium ion (Na^+) combines with the nitrate ion (NO_3^-) to form sodium nitrate ($NaNO_3$). Hence, statement 4 is correct.

• The reaction $CaCO_3 \rightarrow CaO + CO_2$ involves a single reactant breaking down into two simpler products upon heating. This is classified as a thermal decomposition reaction. Hence, statement 1 is incorrect.

• The reaction $2Mg + O_2 \rightarrow 2MgO$ involves two reactants (magnesium and oxygen) combining to form a single product (magnesium oxide). This is known as a combination reaction or synthesis reaction. Hence, statement 2 is incorrect.

• The reaction $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ involves Zinc displacing Hydrogen from sulfuric acid because zinc is more reactive. This is a single displacement reaction. Hence, statement 3 is incorrect.

• Hence, the correct answer is $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$.

Additional Information

• Precipitation Reactions: Many double displacement reactions result in the formation of an insoluble solid that settles out of the solution, known as a precipitate. In the given correct option, AgCl is a white precipitate.

• Neutralization Reactions: This is another common type of double displacement reaction that occurs between an acid and a base to produce salt and water. For example, $HCl + NaOH \rightarrow NaCl + H_2O$.

• Reactivity Series: While single displacement depends heavily on the reactivity series (where a more active metal displaces a less active one), double displacement usually depends on the solubility rules or the formation of a stable product like water or a gas.

• Gas Evolution: Some double displacement reactions produce a gas. For instance, the reaction between sodium carbonate and hydrochloric acid eventually releases carbon dioxide (CO_2) gas after an initial ion exchange.

Important Points

• Ionic State: These reactions typically occur in aqueous solutions where the compounds are dissociated into free ions, allowing them to move and collide to form new bonds.

• Balanced Equations: In all chemical reactions, including $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$, the law of conservation of mass must be satisfied, meaning the number of atoms of each element must be the same on both the reactant and product sides.

• Oxidation State: Unlike redox reactions (like single displacement or combination), the oxidation states of the elements in a typical double displacement reaction usually remain unchanged.

• Example Compounds: $AgNO_3$ (Silver Nitrate) is often used in photography and medical antiseptics, while NaCl is common table salt used in food preservation and industrial chemistry.

Q12. Answer: (a) Joule

The correct answer is Joule.

Key Points

• The International System of Units (SI) is founded on seven base units, which are the fundamental building blocks for all other physical measurements.

• The Metre (m) is the SI base unit for length. It is defined by taking the fixed numerical value of the speed of light in vacuum. Hence, statement 2 is a base unit.

• The Kilogramme (kg) is the SI base unit for mass. Following the 2019 redefinition, it is defined in terms of the Planck constant (h). Hence, statement 3 is a base unit.

• The Second (s) is the SI base unit for time. It is determined by the fixed numerical value of the caesium frequency, which is the unperturbed ground-state hyperfine transition frequency of the caesium-133 atom. Hence, statement 4 is a base unit.

• The Joule (J) is the unit of energy, work, or heat. It is classified as a derived unit rather than a base unit because it is expressed in terms of the base units as 1 kg m^2/s^2. Hence, statement 1 is NOT a base unit.

Additional Information

• The Seven SI Base Units:

• Metre (m): Measures length.

• Kilogramme (kg): Measures mass.

• Second (s): Measures time.

• Ampere (A): Measures electric current.

• Kelvin (K): Measures thermodynamic temperature.

• Mole (mol): Measures the amount of substance.

• Candela (cd): Measures luminous intensity.

• Derived Units:

• These units are formed by combining base units according to the algebraic relations linking the corresponding quantities.

• Examples include the Newton (force), Pascal (pressure), Watt (power), and Hertz (frequency).

• The Joule is named after the English physicist James Prescott Joule (1818–1889), who studied the nature of heat and its relationship to mechanical work.

Important Points

• The SI system was officially established in 1960 by the 11th General Conference on Weights and Measures (CGPM).

• In May 2019, a historic revision of the SI came into force, where all base units are now defined by constants of nature rather than physical artifacts like the "International Prototype of the Kilogram."

• The International Bureau of Weights and Measures (BIPM), located in France, ensures worldwide unification of measurements and their traceability to the International System of Units.

• Understanding the distinction between base units and derived units is essential in physics and engineering for maintaining dimensional consistency in equations.

Q13. Answer: (a) Vitamin A, D and E

The correct answer is Vitamin A, D and E.

Key Points

• Poultry nutrition requires a precise balance of nutrients to support rapid growth and high productivity in intensive farming systems.

• Vitamin A is crucial for maintaining the health of epithelial tissues, improving vision, and enhancing the overall growth rate of chickens.

• Vitamin D, particularly in the form of Vitamin D3, is essential for the metabolism of calcium and phosphorus, which ensures strong bone development and eggshell quality.

• Vitamin E acts as a potent biological antioxidant, protecting cell membranes from oxidative damage and supporting the immune system and reproductive health.

• Maintaining high levels of these fat-soluble vitamins in the feed helps prevent specific deficiency diseases such as

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xerophthalmia, rickets, and encephalomalacia.

Additional Information

• Vitamin A:

• Primary sources include yellow maize and green fodder rich in carotene.

• Deficiency leads to nutritional roup and poor resistance to coccidiosis.

• Vitamin D:

• Poultry utilize Cholecalciferol (D3) much more efficiently than Ergocalciferol (D2).

• It is critical for the prevention of osteomalacia in laying hens.

• Vitamin E:

• Its requirement is closely linked to the Selenium content in the diet.

• It prevents exudative diathesis and muscular dystrophy in growing chicks.

• B-complex Vitamins:

• While Vitamin B2 (Riboflavin) prevents curled-toe paralysis and Vitamin B12 is needed for growth, the core health-supportive trio typically emphasized at high levels for broad-spectrum growth is A, D, and E.

Q14. Answer: (a) They are active cells with dense cytoplasm, thin walls, prominent nuclei and no vacuoles.

The correct answer is They are active cells with dense cytoplasm, thin walls, prominent nuclei and no vacuoles.

Key Points

• Meristematic tissues are a group of immature cells that are in a continuous state of division or retain the power of cell division.

• The cells of meristematic tissue are very active, have dense cytoplasm, thin cellulose walls, and prominent nuclei. Hence, statement 1 is correct.

• These cells lack vacuoles. Vacuoles are typically used for storage of food or waste and providing turgidity to the cell. Since meristematic cells are rapidly dividing, they do not need to store food and a large vacuole might obstruct the process of cell division.

• The cells are compactly arranged, meaning there are no intercellular spaces between them.

• They are generally small in size and can be spherical, oval, polygonal, or rectangular in shape.

Additional Information

• Classification of Meristematic Tissue based on Location:

• Apical Meristem: Located at the growing tips of stems and roots. It is responsible for the increase in the length of the plant, known as primary growth.

• Lateral Meristem (Cambium): Located on the lateral sides of stems and roots. It is responsible for increasing the girth or thickness of the plant, known as secondary growth.

• Intercalary Meristem: Located at the base of leaves or internodes (on twigs). It helps in the longitudinal growth of the plant parts.

• Permanent Tissues:

• When meristematic cells take up a specific role and lose the ability to divide, they form permanent tissue. This process is called differentiation.

• Parenchyma: These are live cells, usually loosely packed with large intercellular spaces. They provide support and store food. Hence, statement 3 is incorrect.

• Sclerenchyma: These are dead cells with thickened walls (due to lignin) and no internal space. They make the plant hard and stiff. Hence, statement 2 and 4 are incorrect.

Important Points

• The term Meristem was coined by C. Nageli in 1858.

• Metabolic Activity: Meristematic cells have a very high metabolic rate because they are constantly preparing for and undergoing mitosis.

• Ergastic Substances: These cells generally do not contain ergastic substances (non-living inclusions like starch grains, oil droplets) because they consume nutrients as fast as they are produced.

• Cell Wall Composition: The cell wall is primary in nature and made exclusively of cellulose to remain flexible for expansion and division.

Q15. Answer: (d) Cellulose

The correct answer is Cellulose.

Key Points

• Cellulose is the primary structural component of the plant cell wall, providing the necessary mechanical strength, rigidity, and protection to the plant cell.

• Chemically, it is a polysaccharide (a complex carbohydrate) consisting of a long, linear chain of hundreds to thousands of

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glucose units joined by beta(1→4) glycosidic bonds.

• It is considered the most abundant organic polymer on Earth, making up a significant portion of the biomass in terrestrial ecosystems.

• In the cell wall, cellulose molecules are bundled together to form microfibrils, which create a high-tensile scaffold that helps the cell withstand turgor pressure and maintain its shape.

• Unlike starch, humans cannot digest cellulose because they lack the enzyme cellulase; however, it serves as essential dietary fiber in the human diet.

Additional Information

• Lignin:

• It is a complex organic polymer found primarily in the secondary cell walls of vascular plants.

• Lignin provides structural support, making the plant woody and rigid, and plays a crucial role in water transport by making cell walls hydrophobic. Hence, option 1 is incorrect.

• Suberin:

• This is a waxy, fatty substance found in the cell walls of cork tissues and the endodermis of roots.

• It acts as a protective barrier against water loss and pathogen entry, effectively waterproofing specific plant tissues. Hence, option 2 is incorrect.

• Cutin:

• Cutin is one of the main components of the plant cuticle, which covers the epidermis of leaves, fruits, and soft stems.

• It is a waxy polymer that prevents excessive transpiration (water loss) and protects the plant from ultraviolet radiation and external stress. Hence, option 3 is incorrect.

• Hemicellulose and Pectin:

• While cellulose provides the framework, hemicellulose acts as a cross-linking agent between cellulose microfibrils.

• Pectin is a gel-like polysaccharide that fills the spaces between the fibers, providing flexibility and helping in cell-to-cell adhesion through the middle lamella.

Important Points

• Composition: The plant cell wall is typically composed of approximately 35% to 50% cellulose, 20% to 35% hemicellulose, and 10% to 25% lignin.

• Turgor Pressure: The rigidity of the cellulose-based cell wall is vital for maintaining turgor pressure, which allows plants to stand upright without a skeletal system.

• Discovery: Cellulose was first discovered and isolated by the French chemist Anselme Payen in the year 1838.

• Industrial Uses: Beyond its biological role, cellulose is used extensively in the production of paper, textiles (like cotton and rayon), and biofuels.

Q16. Answer: (d) rancid

The correct answer is rancid.

Key Points

• When fats and oils are exposed to air, they undergo a chemical reaction known as oxidation. This process results in the development of a foul smell and an unpleasant taste, a condition commonly referred to as rancidity.

• The primary cause of this phenomenon is the oxidation of unsaturated fatty acids present in the food. During this reaction, oxygen molecules attack the double bonds of the fatty acid chains.

• This chemical breakdown leads to the formation of highly volatile substances, including aldehydes, ketones, and short-chain carboxylic acids, which provide the characteristic "off" flavor and pungent odor.

• Rancidification is a form of food spoilage that not only makes the food unpalatable but can also lead to the loss of essential vitamins and the formation of potentially harmful free radicals.

• The rate of oxidation is significantly influenced by environmental factors such as temperature, light, and the presence of moisture or metal catalysts. Hence, the correct answer is rancid.

Additional Information

• Types of Rancidity:

• Oxidative Rancidity: This is the most common type, occurring when oxygen reacts with fats. It is often accelerated by exposure to ultraviolet (UV) light and heat.

• Hydrolytic Rancidity: This occurs when water breaks down the triglyceride bonds into free fatty acids and glycerol. This process is often catalyzed by enzymes known as lipases, which are produced by microorganisms.

• Ketonic Rancidity: This involves the action of molds (like Penicillium) on short-chain fatty acids, resulting in the production of ketones.

• Methods to Prevent Rancidity:

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• Use of Antioxidants: Synthetic chemicals like BHA (Butylated Hydroxyanisole) and BHT (Butylated Hydroxytoluene), or natural ones like Vitamin E (Tocopherol) and Vitamin C, are added to foods to inhibit the oxidation process.

• Nitrogen Flushing: Commercial food manufacturers often pack snacks like potato chips in bags filled with Nitrogen gas. Since Nitrogen is an inert gas, it displaces Oxygen, preventing the oil in the chips from turning rancid.

• Vacuum Packaging: Removing air completely from the packaging ensures that there is no Oxygen available to react with the fats.

• Refrigeration: Storing food at low temperatures slows down the kinetic energy of the molecules, thereby reducing the rate of the chemical oxidation reaction.

• Storage in Dark Containers: Using opaque or amber-colored containers helps block light, which acts as a catalyst for photo-oxidation.

• Health and Industrial Impact:

• Consuming rancid fats can lead to oxidative stress in the human body, potentially contributing to digestive issues and long-term health complications.

• In the industrial sector, the Peroxide Value (PV) and Acid Value are standard tests used to measure the degree of rancidity in oils and fats to ensure quality control.

Q17. Answer: (a) Resistor

The correct answer is Resistor.

Key Points

• A resistor is a passive electrical component that provides resistance to the flow of electric current. In circuit diagrams, it is most commonly represented by a zig-zag line (standard in the United States and Japan) or a rectangular box (standard in International Electrotechnical Commission - IEC).

• The primary function of a resistor is to limit current, divide voltage, or generate heat. By controlling the flow of electrons, it protects sensitive components like transistors and Light Emitting Diodes (LEDs) from damage caused by excessive current.

• The value of resistance is measured in Ohms, denoted by the symbol Ω (Omega). This relationship is defined by Ohm’s Law, which states that Voltage (V) = Current (I) × Resistance (R).

• Resistors are essential in almost all electronic circuits, ranging from simple household appliances to complex industrial machinery and communication systems. Hence, the correct answer is Resistor.

Additional Information

• Battery:

• In a circuit diagram, a battery is represented by two or more parallel lines of unequal length.

• The longer line represents the positive terminal, while the shorter, thicker line represents the negative terminal.

• A battery provides the Potential Difference required to drive the flow of electric charge in a closed loop.

• Electric Bulb:

• An electric bulb is typically represented by a circle with a cross (X) inside it or a circle with a loop-like filament symbol.

• It converts electrical energy into light energy and thermal energy.

• In an ideal circuit, the brightness of the bulb depends on the power it consumes, which is a product of voltage and current.

• Switch:

• A switch is a device used to make or break an electrical circuit.

• In a diagram, an open switch is shown as a line with a gap, indicating that current cannot flow. A closed switch is shown as a continuous line, allowing current to pass.

• It is a fundamental control element in any electrical system.

Important Points

• Variable Resistor (Rheostat): This is a resistor whose value can be changed. It is represented by a zig-zag line with an arrow passing through it diagonally. It is widely used in volume controls for audio devices.

• Ammeter and Voltmeter:

• An Ammeter measures electric current in Amperes (A) and is always connected in series with the circuit.

• A Voltmeter measures electric potential difference in Volts (V) and is always connected in parallel to the component across which voltage is measured.

• Ohm’s Law: Discovered by Georg Simon Ohm in 1827, it remains the foundation of electrical engineering. It establishes that at a constant temperature, the current through a conductor is directly proportional to the voltage across it.

• Materials: Resistors are often made from carbon composition, metal films, or wire-wound coils, depending on the required precision and power rating.

Q18. Answer: (c) An atom or group of atoms with a positive or negative charge.

The correct answer is An atom or group of atoms with a positive or negative charge..

Key Points

• An ion is a chemical species that carries a net electrical charge because the number of electrons is unequal to the number of protons in the species.

• Ions are formed through a process called ionization, where an atom or a molecule either gains or loses electrons to achieve a stable electronic state, often resembling the nearest noble gas.

• These species can be classified as monatomic ions, which consist of a single charged atom (like K^+), or polyatomic ions, which consist of two or more atoms covalently bonded that act as a single charged unit (like SO4^(2-)).

• The presence of a charge allows ions to conduct electricity in aqueous solutions or molten states, and they are the primary components of ionic compounds held together by electrostatic forces.

Additional Information

• Classification of Ions:

• Cations: Positively charged ions formed when an atom loses electrons. Metals typically form cations (e.g., Magnesium Mg^(2+)).

• Anions: Negatively charged ions formed when an atom gains electrons. Non-metals typically form anions (e.g., Fluoride F^-).

• Explanation of Other Terms:

• Neutral Atom: An atom where the number of protons equals the number of electrons, resulting in a net charge of zero.

• Molecule: An electrically neutral group of two or more atoms held together by chemical bonds.

• Proton: A subatomic particle located in the nucleus of an atom with a positive charge of +1; it defines the atomic number of an element.

Q19. Answer: (a) Physical maturity

The correct answer is Physical maturity.

Key Points

• Physical maturity is the state of full development of an organism's body, including its reproductive system, which is essential for the process of mating and reproduction.

• Without reaching a certain age or biological stage, animals do not possess the functional gametes (sperm or eggs) or the developed organs necessary to successfully participate in mating. Hence, statement 1 is correct.

• While attractive eyes or physical traits like being tall might be factors in sexual selection for specific species (like peacocks or giraffes), they are not universal biological requirements for the act of mating across the animal kingdom. Hence, statements 2 and 4 are incorrect.

• Sexual immaturity refers to the stage where an animal has not yet reached puberty. At this stage, the endocrine system has not triggered the release of sex hormones required for mating behaviors and fertility. Hence, statement 3 is incorrect.

• The process of reaching maturity involves significant physiological changes, governed by hormones such as testosterone in males and estrogen or progesterone in females.

Additional Information

• Puberty and Maturity:

• In most mammals, the onset of puberty marks the transition from a juvenile state to sexual maturity.

• The age at which maturity is reached varies greatly by species; for example, mice may reach maturity in 6 to 8 weeks, while elephants may take 10 to 15 years.

• Secondary Sexual Characteristics:

• Upon reaching physical maturity, many animals develop secondary sexual characteristics, such as manes in lions, antlers in deer, or colorful plumage in birds.

• These features serve as signals to other members of the species that the individual is physically mature and ready to mate.

• Role of the Endocrine System:

• The Hypothalamus-Pituitary-Gonadal (HPG) axis is the primary regulatory system that controls the timing of physical maturity.

• Environmental factors such as nutrition, climate, and daylight length (photoperiod) can influence the year or month an animal reaches maturity.

• Reproductive Success:

• Mating is not just about the physical act but also about the ability to produce viable offspring. Physical maturity ensures that the parent's body is capable of gametogenesis and, in females, supporting pregnancy or egg-laying.

Important Points

• Mating Rituals: Once physical maturity is attained, animals often engage in courtship rituals. These are behaviors like singing, dancing, or fighting to demonstrate fitness to a potential mate.

• Biological Fitness: In the context of evolution, reaching maturity is a key component of fitness, as it allows an individual to pass

its genes to the next generation.

• Fertility Windows: Many mature animals are not fertile year-round but follow estrus cycles or breeding seasons, which are only activated once physical maturity has been established.

Q20. Answer: (c) Both sugar and salt

The correct answer is Both sugar and salt.

Key Points

• Matter is generally classified into three states: solids, liquids, and gases, based on the arrangement of their particles.

• Iron is a metallic solid where the atoms are arranged in a very tightly packed crystalline lattice, held together by strong metallic bonds. Because it is a continuous solid mass, there is negligible macroscopic space between its constituent parts. Hence, iron is not the correct choice for having sufficient spaces.

• Sugar and salt are considered granular solids. Although the individual crystals of sugar and salt are solids with tightly packed molecules, their bulk form consists of many tiny particles.

• When sugar or salt is placed in a container, they do not pack perfectly. There are sufficient spaces (air gaps) between the individual granules, allowing them to flow and take the shape of the container. Hence, sugar and salt are correct as they are not tightly packed in their common aggregate form.

• The inter-particle space in granular materials like salt and sugar is much higher compared to a solid block of iron, which has a very high density and low porosity.

• Hence, the correct answer is Both sugar and salt.

Additional Information

• Iron (Fe):

• It is a metal with the atomic number 26.

• In its solid state, iron has a density of approximately 7.87 g/cm³ at room temperature.

• It is used extensively in construction and manufacturing due to its high strength and rigidity, which results from its closely packed atomic structure.

• Sugar (Sucrose):

• Common table sugar has the chemical formula C12H22O11.

• It is a carbohydrate that forms monoclinic crystals.

• In a jar, the bulk density of sugar is much lower than its actual particle density (1.59 g/cm³) because of the air trapped in the interstitial spaces.

• Salt (Sodium Chloride):

• Commonly known as NaCl, it is an ionic compound.

• It forms cubic crystals where sodium and chloride ions are arranged in a lattice.

• Like sugar, it is handled as a granular material, and the void fraction between grains is significant.

Important Points

• Porosity: This is a measure of the "empty" spaces in a material. Granular substances like salt and sugar have high porosity, whereas a piece of iron has nearly zero macroscopic porosity.

• States of Matter Comparison:

• Solids: Particles are closely packed; have a fixed shape and volume.

• Liquids: Particles are less tightly packed than solids; have a fixed volume but no fixed shape.

• Gases: Particles have large spaces between them; have no fixed shape or volume.

• Granular Flow: Because of the spaces between them, granular solids like sand, salt, and sugar exhibit fluid-like behavior, which is a key feature used in industrial applications such as silo storage and food processing.

Q21. Answer: (d) Parallel to the incident ray but shifted sideward

The correct answer is Parallel to the incident ray but shifted sideward.

Key Points

• When a ray of light enters a rectangular glass slab from air, it undergoes refraction twice: once at the air-glass interface and again at the glass-air interface.

• At the first surface, light travels from a rarer medium (air) to a denser medium (glass), causing the ray to bend towards the normal.

• At the second surface, light travels from the denser medium (glass) back into the rarer medium (air), causing the ray to bend away from the normal.

• Since the opposite faces of a rectangular glass slab are parallel to each other, the extent of bending of the ray of light at the first surface is equal and opposite to the extent of bending at the second surface.

• As a result, the emergent ray emerges in a direction parallel to the incident ray. However, there is a lateral shift or sideward displacement between the original path of the incident ray and the emergent ray. Hence, the statement describing it as parallel but shifted sideward is correct.

Additional Information

• Refractive Index: It is a dimensionless number that describes how fast light travels through a medium. The refractive index of glass is typically around 1.5, while for air, it is approximately 1.0003.

• Snell's Law: This law governs refraction and is expressed as n1 sin(i) = n2 sin(r), where n1 and n2 are refractive indices of the two media, i is the angle of incidence, and r is the angle of refraction.

• Lateral Displacement: The perpendicular distance between the direction of the incident ray and the emergent ray is known as lateral displacement.

• Factors Affecting Lateral Displacement:

• Thickness of the glass slab: Lateral displacement is directly proportional to the thickness of the slab. A thicker slab causes a larger sideward shift.

• Angle of Incidence: As the angle of incidence (i) increases, the lateral displacement also increases.

• Refractive Index: A higher refractive index of the material leads to greater lateral displacement.

• Wavelength of Light: Lateral displacement depends on the wavelength (color) of light. Since violet light bends more than red light, it experiences more lateral displacement.

Important Points

• If a light ray falls normally (perpendicularly) on the surface of the glass slab, the angle of incidence is 0 degrees. In this specific case, the ray passes through without any deviation or lateral displacement.

• The angle of incidence is always equal to the angle of emergence (i = e) for a rectangular glass slab when the medium on both sides of the slab is the same.

• This phenomenon is a practical application of optics and is used to demonstrate the rectilinear propagation of light and the laws of refraction in laboratory experiments.

• In 2024, understanding these principles remains fundamental in fields like lens design, fiber optics, and microscopy.

Q22. Answer: (c) By transferring pollen from the anther to the stigma, enabling fertilisation

The correct answer is By transferring pollen from the anther to the stigma, enabling fertilisation.

Key Points

• Pollination is defined as the act of transferring pollen grains from the male anther of a flower to the female stigma. This process is the vital first step in the sexual reproduction of flowering plants.

• The primary contribution of pollination to seed formation is that it enables fertilisation. Without this transfer, the male gametes contained within the pollen would never reach the female gametes (ovules) located in the ovary. Hence, option 3 is correct.

• Once a compatible pollen grain lands on the stigma, it germinates and produces a pollen tube. This tube grows down through the style to deliver two male gametes into the embryo sac within the ovule.

• Upon reaching the ovule, one male gamete fuses with the egg cell to form a zygote. This fusion is the essence of fertilisation, which eventually triggers the transformation of the ovule into a seed.

• While nectar production (Option 4) attracts pollinators, it is a biological "bribe" and not the direct mechanism that forms a seed. Similarly, seed dispersal (Option 2) occurs only after the seed is fully formed.

Additional Information

• Types of Pollination:

• Self-pollination: Occurs when pollen from the anther is deposited on the stigma of the same flower or another flower on the same plant. This is common in plants like peas and wheat.

• Cross-pollination: The transfer of pollen from the anther of one flower to the stigma of another flower on a different individual of the same species. This promotes genetic diversity and is seen in species like maize and sunflowers.

• Agents of Pollination:

• Biotic Agents: These include living organisms such as bees, butterflies, birds, and bats. Insects are the most common pollinators, often attracted by brightly coloured petals or scent.

• Abiotic Agents: These involve non-living forces such as wind (Anemophily) and water (Hydrophily). Wind-pollinated plants, like grasses and conifers, usually produce massive amounts of lightweight pollen.

• Double Fertilisation: This is a characteristic feature of Angiosperms (flowering plants). One male gamete fuses with the egg to form the zygote, while the second male gamete fuses with two polar nuclei to form the triploid endosperm, which provides nourishment to the developing embryo.

Important Points

• Post-Fertilisation Changes: After successful pollination and fertilisation, the flower undergoes significant changes. The sepals, petals, and stamens usually wither and fall off.

• Seed and Fruit Development: The ovule develops into the seed, which contains the embryo (the future plant) and is encased in a protective seed coat (Option 1 refers to this post-fertilisation structure). Simultaneously, the ovary ripens and develops into the fruit.

• Significance: Pollination is not only essential for the survival of plant species but is also critical for global food security. Approximately 75% of the world's food crops depend, at least in part, on pollination.

• Economic Value: Many agricultural sectors, including the production of almonds, apples, and coffee, rely heavily on honeybee pollination services to ensure high yields and quality seeds.

Q23. Answer: (b) Persistence of sound due to multiple reflections of sound waves

The correct answer is Persistence of sound due to multiple reflections of sound waves.

Key Points

• Reverberation is defined as the persistence of sound in a particular space after the original sound source has stopped. It occurs because sound waves undergo multiple reflections from surfaces such as walls, ceilings, and floors in an enclosed area.

• In a large room or auditorium, a sound created will continue to be heard by repeated reflection until its intensity is reduced to a level where it is no longer audible.

• The human ear has a persistence of hearing of approximately 0.1 seconds. When reflected sound waves arrive at the ear in intervals shorter than this, the brain perceives them as a single, continuous, and prolonged sound rather than distinct echoes. Hence, statement 2 is correct.

• While some reverberation can enhance the richness of music, excessive reverberation is undesirable in cinemas and lecture halls because it causes sounds to overlap and become garbled, making speech unintelligible.

• The other options provided, such as the spreading of sound (diffusion/diffraction), change in pitch (Doppler Effect), and loss of energy (attenuation), describe different acoustic phenomena. Hence, statements 1, 3, and 4 are incorrect.

Additional Information

• Reverberation Time:

• This is the duration required for the sound pressure level to decay by 60 decibels (dB) after the source is silenced.

• Wallace Clement Sabine, a pioneer in architectural acoustics in the late 19th century, formulated Sabine's Law, which calculates this time based on the volume of the room and the absorption coefficients of its surfaces.

• Echo vs. Reverberation:

• An echo is a distinct, separate repetition of sound caused by reflection from a distant object.

• To hear a clear echo, the minimum distance between the source and the reflecting surface must be roughly 17.2 meters (assuming the speed of sound is 344 m/s in air). In contrast, reverberation involves reflections from much closer surfaces arriving rapidly.

• Acoustic Treatment:

• To control reverberation, architects use sound-absorbent materials. Common examples include compressed fiberboard, glass wool, heavy curtains, and carpets.

• Even the upholstery of seats in theaters is specifically chosen for its sound-absorbing properties to ensure clarity whether the hall is empty or full.

Important Points

• Multiple Reflection Applications:

• Megaphones and Horns: These are designed to use multiple reflections to direct sound waves in a specific forward direction, preventing them from spreading out.

• Stethoscopes: This medical device transmits the sound of a patient's heartbeat to the doctor's ears through multiple reflections within the tube.

• Curved Ceilings: In concert halls and conference rooms, ceilings are often curved so that sound, after reflection, is distributed uniformly across the entire width of the hall.

• Speed of Sound: The speed varies depending on the medium (solid, liquid, or gas) and temperature. In air at 20°C, it is approximately 344 m/s, which is a critical constant used in calculating reflection timings.

Q24. Answer: (a) Both A and R are true, and R is the correct explanation for A.

The correct answer is Both A and R are true, and R is the correct explanation for A.

Key Points

• Assertion (A): When iron is exposed to moist air (i.e., air containing both oxygen and water vapor), a reddish-brown layer forms on its surface. This layer is commonly referred to as Rust. Therefore, Assertion (A) is correct.

• Reason (R): The primary reason for the formation of this reddish-brown substance is that iron undergoes a chemical reaction with the oxygen and moisture present in the air. This reaction results in the formation of Hydrated Iron(III) Oxide ($Fe_2O_3 \cdot nH_2O$). Therefore, Reason (R) is correct, and it provides the correct explanation for Assertion (A).

• Rusting is an Oxidation Reaction.

• In this process, iron loses electrons and combines with oxygen to form an oxide.

• This process not only affects the surface of the iron but, over time, weakens the metal from within.

• Both air (oxygen) and moisture (water) are essential for rusting to occur. If either of these is absent, the rusting process will not take place.

Additional Information

• Corrosion: The gradual deterioration of metals due to environmental factors such as air, moisture, or acids is known as corrosion. In the specific case of iron, this process is referred to as rusting.

• Methods for Preventing Rust:

• Painting: Applying paint to iron creates a barrier that prevents air and moisture from coming into direct contact with the metal.

• Applying Grease or Oil: Applying grease to machine parts provides protection against moisture.

• Galvanization: The process of coating iron or steel with a thin layer of the metal known as Zinc is called galvanization. Since zinc reacts more readily than iron, it protects the iron.

• Electroplating: The process of coating iron with corrosion-resistant metals—such as chromium or nickel—using electricity.

• Alloys: Iron is combined with carbon, chromium, and nickel to produce Stainless Steel, which does not rust.

Important Points

• Chemical Equation: The rusting process is generally represented as $4Fe + 3O2 + 6H2O \rightarrow 4Fe(OH)3$, or ultimately as $Fe2O3 \cdot xH2O$ (hydrated ferric oxide).

• Environmental Impact: In coastal or industrial regions, the rate of rusting is significantly higher than in ordinary areas due to the elevated levels of salts and moisture present in the air.

• Mass Change: When iron rusts, its weight gradually increases as oxygen and water combine with the metal.

• Historical Example: The Iron Pillar located within the precincts of the Qutub Minar in Delhi stands as a testament to ancient Indian metallurgical expertise; despite having been constructed nearly 1600 years ago, it remains free of rust.

Q25. Answer: (c) Potassium

The correct answer is Potassium.

Key Points

• Potassium (chemical symbol K, from Neo-Latin kalium) is a chemical element with Atomic Number 19. It is a silvery-white metal that is soft enough to be easily cut with a knife with little force.

• It is characterized by an extremely low density of approximately 0.862 g/cm^3 at 20°C, which is less than that of water (1.0 g/cm^3). This physical property causes the metal to float on the surface of water while it reacts. Hence, the correct answer is Potassium.

• As a member of the Alkali Metals (Group 1 of the periodic table), it possesses only one valence electron in its outer shell. This single electron is involved in metallic bonding, which is relatively weak, leading to the characteristic softness and low melting point (approx 63.5°C) of the metal.

• Due to its extreme chemical reactivity, especially with moisture and air, it is never found as a free element in nature and is typically stored under mineral oil or kerosene to prevent oxidation.

Additional Information

• Copper (Cu):

• It is a transition metal located in Group 11 of the periodic table.

• Unlike potassium, copper has a high density of approximately 8.96 g/cm^3 and is significantly harder. It is known for its excellent electrical conductivity and thermal conductivity. Hence, option 1 is incorrect.

• Aluminium (Al):

• It is a post-transition metal in Group 13.

• While aluminium is known for being lightweight compared to steel (density 2.70 g/cm^3), it is much denser than potassium and is a structural metal, not "soft" in the chemical sense of being cut like wax. Hence, option 2 is incorrect.

• Magnesium (Mg):

• It is an alkaline earth metal found in Group 2 of the periodic table with Atomic Number 12.

• Its density is approximately 1.74 g/cm^3. While it is the lightest structural metal, it is harder than alkali metals like potassium and sodium because it has two valence electrons, strengthening its metallic lattice. Hence, option 4 is incorrect.

Important Points

• Periodic Trends: In the periodic table, alkali metals (Lithium, Sodium, Potassium, Rubidium, Cesium) generally show a decrease in hardness and melting points as you move down the group due to the increasing atomic radius and weakening of metallic bonds.

• Density Comparisons: Only three metals in the periodic table are light enough to float on water: Lithium (lightest solid element), Sodium, and Potassium.

• Applications: Potassium is vital for biological functions in the human body, specifically for nerve impulses and muscle

contractions. Industrially, it is widely used in the production of fertilizers (as potash) and in specialty glasses.

• Identification: Potassium can be identified through a flame test, where it emits a characteristic lilac or light purple color.

Q26. Answer: (b) 1/m

Shortcut Trick

Solve the first few terms: (1 − 1/2) = 1/2; (1 − 1/3) = 2/3; (1 − 1/4) = 3/4.

Notice the cancellation pattern: The denominator of one term cancels the numerator of the next.

In this telescoping product, only the first numerator and the last denominator remain.

Result = First Numerator / Last Denominator = 1 / m.

Therefore The correct answer is 1/m.

Alternate Method

Given: A product of terms in the form (1 − 1/n) from n = 2 to m.

Formula Used: (1 − 1/n) = (n − 1)/n

=> Term 1: (1 − 1/2) = 1/2

=> Term 2: (1 − 1/3) = 2/3

=> Term 3: (1 − 1/4) = 3/4

=> Term m: (1 − 1/m) = (m − 1)/m

=> Product = (1/2) × (2/3) × (3/4) × (4/5) × ... × (m−1)/m

=> After cross-cancellation of intermediate terms: 1/m

Therefore The correct answer is 1/m.

Additional Information

Telescoping Series

A sequence where most terms cancel out, leaving only the first and last parts. For addition: ∑(a_n − a_(n+1)) = a1 − a_(last).

Successive Fractions Product

In products like (1 + 1/n), the pattern is (n+1)/n. Here, denominators cancel numerators differently: result is (m+1)/initial_denominator.

Pattern Recognition

Always simplify the first three terms of an infinite or large finite mathematical series to identify the cancellation behavior.

Q27. Answer: (b) Rs. 952

Shortcut Trick

Use the direct relation between Marked Price (MP) and Cost Price (CP): MP ÷ CP = (100 + Gain%) ÷ (100 − Discount%).

MP ÷ 391 = (100 + 68) ÷ (100 − 31) = 168 ÷ 69.

MP = (168 ÷ 69) × 391.

Dividing 391 by 69: 69 × 5 = 345, 391 − 345 = 46 (not direct). Simplification: 391 ÷ 23 = 17 and 69 ÷ 23 = 3.

MP = (168 ÷ 3) × 17 = 56 × 17 = 952.

Therefore The correct answer is Rs. 952.

Alternate Method

Given → CP = Rs. 391, Gain% = 68%, Discount% = 31%.

Formulas: SP = CP × (100 + P%) ÷ 100 | MP = SP × 100 ÷ (100 − D%).

=> Step 1: Find Selling Price (SP).

=> SP = 391 × (168 ÷ 100) = 391 × 1.68 = 656.88.

=> Step 2: Find Marked Price (MP).

=> MP × (100 − 31) ÷ 100 = 656.88.

=> MP × 0.69 = 656.88.

=> MP = 656.88 ÷ 0.69 = 952.

Therefore The correct answer is Rs. 952.

Additional Information

Relation between CP and MP

When both profit percentage and discount percentage are known, the ratio of MP to CP is always (100 + Profit%) / (100 − Discount%).

Marked Price & Discount

The price printed on an item is the Marked Price. Discount is always calculated on the MP to arrive at the Selling Price (SP = MP −

Discount).

Q28. Answer: (d) 8

Shortcut Trick

Combined efficiency of A and B = 1/3

Efficiency of B alone = 1/12

Efficiency of A = 1/3 − 1/12 = (4 − 1)/12 = 3/12 = 1/4

Time for A to do single work = 4 days

Time for A to do double the work = 4 × 2 = 8 days

Therefore The correct answer is 8 days.

Alternate Method

Given: Time taken by (A + B) = 3 days; Time taken by B = 12 days.

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

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

=> Efficiency of A = Efficiency of (A + B) − Efficiency of B

=> Efficiency of A = 4 − 1 = 3 units/day

=> Double the work = 12 × 2 = 24 units

=> Time taken by A alone = 24 ÷ 3 = 8 days

Therefore The correct answer is 8 days.

Additional Information

Efficiency-Time Relationship

Efficiency is inversely proportional to the time taken to complete the work. Efficiency = Work ÷ Time.

Work-Time Formula

If A can do a work in x days and B in y days, together they take (xy)/(x+y) days.

Work & Wages

Wages are distributed in the ratio of the efficiency of the workers or the amount of work done.

Q29. Answer: (b) 42

Shortcut Trick

The age difference between Juli and her daughter is always constant at 24 years.

In 6 years, the ratio of their ages will be 2 : 1.

Difference in ratio parts = 2 − 1 = 1 unit.

1 unit → 24 years. Therefore, Juli's age in 6 years = 2 × 24 = 48 years.

Present age of Juli = 48 − 6 = 42 years.

Therefore The correct answer is 42 years.

Alternate Method

Let the present age of the daughter be x years.

Given: Juli is 24 years older than her daughter.

=> Juli's present age = x + 24

=> In 6 years, Juli's age = (x + 24) + 6 = x + 30

=> In 6 years, Daughter's age = x + 6

=> According to the problem: x + 30 = 2 × (x + 6)

=> x + 30 = 2x + 12

=> 2x − x = 30 − 12

=> x = 18

=> Juli's present age = 18 + 24 = 42

Therefore The correct answer is 42 years.

Additional Information

Constant Age Difference

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The numerical difference between the ages of two people remains constant throughout their lives, regardless of how many years pass.

Ratio Method for Age

If the ratio of ages at two different times is known, equate the parts of the ratio to the constant age difference to find the multiplier.

Linear Equations in Ages

Always define present age as the base variable (x) to simplify calculations for future (+n years) or past (−n years) conditions.

Q30. Answer: (b) 2.6%

Shortcut Trick

Apply the successive percentage formula: a + b + (a × b)/100

Here, a = −5% (decrease) and b = +8% (increase).

Effective % = −5 + 8 + (−5 × 8)/100 = 3 − 0.4 = 2.6%

Positive result indicates an increase.

Therefore The correct answer is 2.6%.

Alternate Method

Given: First week decrease = 5%, Second week increase = 8%.

Assume initial price = 100 units

=> Price after 5% decrease = 100 − 5 = 95 units

=> Price after 8% increase = 95 + (8/100 × 95)

=> Price after 8% increase = 95 + 7.6 = 102.6 units

=> Net change = 102.6 − 100 = 2.6 units

=> Effective percentage increase = (2.6/100) × 100 = 2.6%

Therefore The correct answer is 2.6%.

Additional Information

Successive Percentage Change

Used when a value is changed multiple times consecutively. Formula: Net % = a + b + (ab/100). Use positive for increase and negative for decrease.

Multiplying Factor Method

Final Value = Initial Value × (1 ± r1/100) × (1 ± r2/100). For 5% decrease and 8% increase, factor = 0.95 × 1.08 = 1.026.

Base Change Property

If price increases by x%, then to restore it, consumption must decrease by [x/(100+x)] × 100%.

Q31. Answer: (d) 2

Shortcut Trick

Assume all 6 fruits are bananas: Cost = 6 × Rs. 10 = Rs. 60.

Total difference from actual cost = Rs. 80 − Rs. 60 = Rs. 20.

Extra cost of an apple compared to a banana = Rs. 20 − Rs. 10 = Rs. 10.

Number of apples = 20 ÷ 10 = 2.

Number of bananas = 6 − 2 = 4.

Difference (Bananas − Apples) = 4 − 2 = 2.

Therefore The correct answer is 2.

Alternate Method

Given:

Cost of 1 apple = Rs. 20

Cost of 1 banana = Rs. 10

Total fruits = 6

Total amount paid = Rs. 80

Let the number of apples be 'a' and the number of bananas be 'b'.

=> a + b = 6 --- (Equation 1)

=> 20a + 10b = 80 --- (Equation 2)

Divide Equation 2 by 10:

=> 2a + b = 8 --- (Equation 3)

Subtract Equation 1 from Equation 3:

=> (2a + b) − (a + b) = 8 − 6

=> a = 2

Substitute a = 2 in Equation 1:

=> 2 + b = 6

=> b = 4

The number of bananas is 4 and the number of apples is 2.

=> Difference = b − a = 4 − 2 = 2

Therefore The correct answer is 2.

Additional Information

Linear Equations in Two Variables

A system of two equations like ax + by = c can be solved using substitution, elimination, or cross-multiplication methods.

Alligation Method

The ratio of the quantities can be found using (Price_(higher) − Average) : (Average − Price_(lower)). Here, Average = 80 ÷ 6 = Rs. 13.33.

Unitary Method Application

Calculating the cost by assuming an extreme case (e.g., all items are of one type) helps identify the quantity of the other type through the residual cost.

Q32. Answer: (b) 50

Shortcut Trick

Teacher's Age = New Average + (Initial Count × Increase in Average)

=> Teacher's Age = 20 + (30 × (20 − 19))

=> Teacher's Age = 20 + 30 = 50

Therefore The correct answer is 50 years.

Alternate Method

Given:

Initial number of students = 30

Initial average age = 19 years

New number of people (students + teacher) = 31

New average age = 20 years

Formula Used:

Sum of ages = Average × Number of persons

=> Sum of ages of 30 students = 30 × 19 = 570 years

=> Sum of ages of 31 persons (including teacher) = 31 × 20 = 620 years

=> Age of the teacher = Total sum − Sum of students

=> Age of the teacher = 620 − 570 = 50 years

Therefore The correct answer is 50 years.

Additional Information

Average Concept

Average is the sum of observations divided by the total number of observations. Average = Σx ÷ n.

Inclusion Rule

When a new person joins and the average increases, the new person's value = Old Average + (New Total Strength × Increase in Average).

Exclusion Rule

When a person leaves and the average decreases, the excluded person's value = Old Average + (Initial Strength × Decrease in Average).

Q33. Answer: (a) 16 cm

Shortcut Trick

First, calculate the semi-perimeter (s): s = (34 + 18 + 20) ÷ 2 = 36 cm.

Find the Area using Heron's formula: Area = √(36 × (36−34) × (36−18) × (36−20)) = √(36 × 2 × 18 × 16).

Area = √(36 × 36 × 16) = 6 × 6 × 4 = 144 cm².

The altitude (h) corresponding to the 18 cm base: h = (2 × Area) ÷ Base = (2 × 144) ÷ 18 = 16 cm.

Therefore The correct answer is 16 cm.

Alternate Method

Given:

Sides of the triangle: a = 34 cm, b = 18 cm, c = 20 cm.

Formula Used:

1. Heron's Formula for Area: Area = √[s(s − a)(s − b)(s − c)], where s = (a + b + c) ÷ 2.

2. General Area formula: Area = (1/2) × Base × Altitude.

Calculations:

=> Semi-perimeter (s) = (34 + 18 + 20) ÷ 2

=> s = 72 ÷ 2 = 36 cm

=> Area = √[36 × (36 − 34) × (36 − 18) × (36 − 20)]

=> Area = √[36 × 2 × 18 × 16]

=> Area = √[36 × 36 × 16]

=> Area = 6 × 6 × 4 = 144 cm²

=> Area = (1/2) × 18 × Altitude

=> 144 = 9 × Altitude

=> Altitude = 144 ÷ 9

=> Altitude = 16 cm

Therefore The correct answer is 16 cm.

Additional Information

Triangle Inequality Theorem

The sum of the lengths of any two sides of a triangle must be greater than the length of the third side (a + c).

Smallest Side and Altitude

In any triangle, the longest altitude always corresponds to the shortest side, and the shortest altitude corresponds to the longest side.

Area via Sine of Angle

Area can also be calculated if an angle is known: Area = (1/2) × a × b × sin(C), where C is the angle between sides a and b.

Q34. Answer: (d) 12

Shortcut Trick

Apply the algebraic identity: $x^2 + y^2 = (x + y)^2 - 2xy$.

Substitute the given values: Sum = 4 and Product = 2.

Calculation: $4^2 - 2 \times 2 = 16 - 4$.

Result = 12.

Therefore The correct answer is 12.

Alternate Method

Given:

Sum of variables (x + y) = 4

Product of variables (xy) = 2

Formula Used:

$(x + y)^2 = x^2 + y^2 + 2xy$

Calculations:

=> $(x + y)^2 = x^2 + y^2 + 2xy$

=> $(4)^2 = x^2 + y^2 + 2 \times 2$

=> $16 = x^2 + y^2 + 4$

=> $x^2 + y^2 = 16 - 4$

=> $x^2 + y^2 = 12$

Therefore The correct answer is 12.

Additional Information

Square of a Difference

The identity for the square of a subtraction is $(x - y)^2 = x^2 + y^2 - 2xy$. This can be used to find $x^2 + y^2$ if the difference and product are known.

Difference of Two Squares

The formula $x^2 - y^2 = (x - y)(x + y)$ is used to factorize the difference of two squared terms.

Relationship between Identities

The two basic square identities are related by the formula: $(x + y)^2 - (x - y)^2 = 4xy$.

Q35. Answer: (c) 52275

Shortcut Trick

Let the number be x.

20% × 10% × 2/3 × x = 697

1/5 × 1/10 × 2/3 × x = 697

1/75 × x = 697 => x = 697 × 75 = 52275

Therefore The correct answer is 52275.

Alternate Method

Given: Result of the calculation = 697

=> 20% of 10% of 2/3 × number = 697

=> (20/100) × (10/100) × (2/3) × number = 697

=> (1/5) × (1/10) × (2/3) × number = 697

=> (2/150) × number = 697

=> (1/75) × number = 697

=> number = 697 × 75

=> number = 52275

Therefore The correct answer is 52275.

Additional Information

Percentage to Fraction Conversion

To simplify calculations, convert percentages to fractions: 20% = 1/5 and 10% = 1/10.

Successive Percentage

When applying successive percentages, multiply the fraction equivalents directly: a% of b% of X = (a/100) × (b/100) × X.

Reverse Calculation

If the final value is known, find the initial number by multiplying the final value by the reciprocal of each factor.

Q36. Answer: (b) 16,500

Shortcut Trick

Let the total registered voters be 100%.

Voters who did not vote = 8%, so voters who cast votes = 92%.

Winner received 48% of total voters. Runner-up received (92% − 48%) − 120 blank votes = 44% − 120.

Victory Margin = 48% − (44% − 120) = 4% + 120.

Given 4% + 120 = 780 => 4% = 660 => 100% = 16,500.

Therefore The correct answer is 16,500.

Alternate Method

Given:

=> Let Total Voters = x

=> Votes Cast = 92% of x = 0.92x

=> Winner's Votes = 48% of x = 0.48x

=> Runner-up's Votes = (Total Cast − Blank − Winner) = (0.92x − 120 − 0.48x) = 0.44x − 120

Calculations:

=> Winner − Runner-up = 780

=> 0.48x − (0.44x − 120) = 780

=> 0.04x + 120 = 780

=> 0.04x = 660

=> x = 660 ÷ 0.04

=> x = 16,500

Therefore The correct answer is 16,500.

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Additional Information

Election Base Percentage

Always identify if the percentage is of total registered voters or valid votes cast to set the correct base for calculations.

Valid vs Invalid Votes

Valid Votes = (Total Cast − Invalid/Blank). The sum of votes of all candidates must equal the Total Valid Votes.

Victory Margin Formula

Margin = Votes of Winner − Votes of Runner-up. In percentage terms: (Winner% − Runner-up%) × Total = Margin.

Q37. Answer: (b) 875 m

Shortcut Trick

Relative Speed in same direction = 87 − 51 = 36 kmph.

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

Total distance (2L) = Speed × Time = 10 × 175 = 1750 m.

Length of one train (L) = 1750 ÷ 2 = 875 m.

Therefore The correct answer is 875 m.

Alternate Method

Given: Speed of Rajdhani Express = 87 km/hr, Speed of Garib Rath Express = 51 km/hr, Time taken = 175 seconds, Lengths are equal (L1 = L2 = L).

Formula Used: Relative Speed (Same Direction) = S1 − S2; Total Distance = L1 + L2; Distance = Speed × Time.

=> Relative Speed = 87 − 51 = 36 km/hr

=> Relative Speed in m/s = 36 × (5/18) = 10 m/s

=> Total distance to be covered = L + L = 2L

=> 2L = 10 × 175

=> 2L = 1750 m

=> L = 1750 ÷ 2 = 875 m

Therefore The correct answer is 875 m.

Additional Information

Relative Speed Concepts

When moving in the same direction, subtract speeds (S1 − S2). When moving in opposite directions, add speeds (S1 + S2).

Unit Conversion

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

Train Crossing Rules

The distance covered when one train crosses another is always the sum of their lengths (L1 + L2), regardless of the direction.

Q38. Answer: (c) 1

Shortcut Trick

Any two consecutive integers are always co-prime to each other.

Since P and P + 1 are consecutive integers, their highest common factor (HCF) must be 1.

Therefore The correct answer is 1.

Alternate Method

Given values: P is a prime number.

The consecutive number is P + 1.

=> Let us assume a prime number, P = 3.

=> Then, P + 1 = 3 + 1 = 4.

=> Factors of 3 are 1 and 3.

=> Factors of 4 are 1, 2, and 4.

=> Common factor is 1.

=> HCF(3, 4) = 1.

Therefore The correct answer is 1.

Additional Information

Co-prime Numbers

Two numbers are said to be co-prime if their highest common factor (HCF) is equal to 1.

HCF of Prime Numbers

The HCF of any two distinct prime numbers is always 1, because prime numbers only have 1 and themselves as factors.

LCM of Co-prime Numbers

The Least Common Multiple (LCM) of any two co-prime numbers, such as P and P + 1, is their product, which is P × (P + 1) = P^2 + P.

Q39. Answer: (d) Rs. 3,249

Shortcut Trick

The effective interest rate for 2 years at 14% = 14 + 14 + (14 × 14 ÷ 100) = 29.96%.

Total Interest = 2500 × 29.96 ÷ 100 = Rs. 749.

Total Amount = Principal + Interest = 2500 + 749 = Rs. 3249.

Therefore The correct answer is Rs. 3249.

Alternate Method

Given:

Principal (P) = Rs. 2,500

Rate (R) = 14% per annum

Time (n) = 2 years

Formula Used:

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

Calculations:

=> $A = 2500 \times (1 + 14 \div 100)^2$

=> $A = 2500 \times (114 \div 100) \times (114 \div 100)$

=> $A = 2500 \times (57 \div 50) \times (57 \div 50)$

=> $A = 2500 \times (3249 \div 2500)$

=> A = Rs. 3249

Therefore The correct answer is Rs. 3249.

Additional Information

Compound Interest Formula

The interest is calculated on the principal plus the accumulated interest. CI = A − P.

Effective Rate of Interest

For a two-year period at rate R%, the effective percentage is $2R + (R^2 \div 100)$%.

CI vs SI Difference

For 2 years, the difference between CI and SI is given by $P \times (R \div 100)^2$.

Q40. Answer: (a) 7

Shortcut Trick

Start with the innermost square root: $\sqrt{(11 - 4\sqrt{7})} = \sqrt{(\sqrt{7} - 2)^2} = \sqrt{7} - 2$.

Substitute this value back into the intended expression: $\sqrt{(51 - \sqrt{7} + \sqrt{7} - 2)}$.

The irrational terms $-\sqrt{7}$ and $+\sqrt{7}$ cancel each other out perfectly.

This simplifies the remaining expression to: $\sqrt{(51 - 2)} = \sqrt{49}$.

Finally, the square root of 49 is 7.

Therefore The correct answer is 7.

Alternate Method

Given:

Expression: $\sqrt{(51 - \sqrt{7} + \sqrt{(11 - 4\sqrt{7})})}$

Formula Used:

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

Calculation:

=> First, evaluate the innermost radical: $\sqrt{(11 - 4\sqrt{7})}$

=> The term inside can be rewritten as: $11 - 4\sqrt{7} = 7 + 4 - 2 \times 2 \times \sqrt{7}$

=> Applying the algebraic identity, we get: $(\sqrt{7})^2 + (2)^2 - 2 \times \sqrt{7} \times 2$

=> This perfectly forms a square: $(\sqrt{7} - 2)^2$

=> Therefore, the square root simplifies to: $\sqrt{(\sqrt{7} - 2)^2} = \sqrt{7} - 2$

=> Now, substitute this result into the complete expression:

=> $\sqrt{(51 - \sqrt{7} + \sqrt{7} - 2)}$

=> The $-\sqrt{7}$ and $+\sqrt{7}$ terms offset and cancel each other out.

=> The expression now becomes: $\sqrt{(51 - 2)}$

=> $\sqrt{49}$

=> 7

Therefore The correct answer is 7.

Additional Information

Simplifying Surds of the Form $\sqrt{(a \pm \sqrt{b})}$

To simplify such surds, we convert the inner expression into a perfect square $(x \pm y)^2 = x^2 + y^2 \pm 2xy$, where the rational part equals $x^2 + y^2$ and the irrational part matches $2xy$.

Addition and Subtraction of Surds

Only like surds (surds having the same index and same radicand) can be added or subtracted. For example, $m\sqrt{x} \pm n\sqrt{x} = (m \pm n)\sqrt{x}$.

Nested Radicals and BODMAS

When solving expressions with nested radicals, always begin simplification from the innermost radical and work your way outward step by step.

Q41. Answer: (b) 60

Shortcut Trick

Calculate semi-perimeter (s): s = (87 + 108 + 75) ÷ 2 = 135 cm.

Calculate Area using Heron's: Area = $\sqrt{(135 \times (135-87) \times (135-108) \times (135-75))} = \sqrt{(135 \times 48 \times 27 \times 60)}$.

Area = $\sqrt{(3240^2)} = 3240$ cm².

Altitude (h) on base 108: h = (2 × Area) ÷ base = (2 × 3240) ÷ 108 = 60 cm.

Therefore The correct answer is 60 cm.

Alternate Method

Given: Sides of triangle a = 87 cm, b = 108 cm, c = 75 cm.

Formula Used: Heron's Formula for Area = $\sqrt{[s(s - a)(s - b)(s - c)]}$ and Area = (1/2) × base × height.

=> Semi-perimeter s = (a + b + c) ÷ 2

=> s = (87 + 108 + 75) ÷ 2 = 135 cm

=> Area = $\sqrt{[135 \times (135 - 87) \times (135 - 108) \times (135 - 75)]}$

=> Area = $\sqrt{[135 \times 48 \times 27 \times 60]}$

=> Area = $\sqrt{[5 \times 27 \times 3 \times 16 \times 27 \times 5 \times 12]}$

=> Area = $\sqrt{[5^2 \times 27^2 \times 4^2 \times 6^2]}$

=> Area = $5 \times 27 \times 4 \times 6 = 3240$ cm²

=> Area = (1/2) × base × altitude

=> 3240 = (1/2) × 108 × altitude

=> 3240 = 54 × altitude

=> altitude = 3240 ÷ 54 = 60 cm

Therefore The correct answer is 60 cm.

Additional Information

Heron's Formula

Used to find the area of a triangle when all three sides (a, b, c) are known: Area = $\sqrt{[s(s-a)(s-b)(s-c)]}$, where s is the semi-perimeter.

Altitude of a Triangle

The perpendicular distance from a vertex to the opposite side. The length of the altitude can be found using h = (2 × Area) ÷ Base.

Inradius of a Triangle

The radius of the inscribed circle is given by r = Area ÷ s, where s is the semi-perimeter.

Q42. Answer: (a) Rs. 7018

Shortcut Trick

Total amount = Rs. 10,279

Sum of deductions = 67 + 33 + 13 = Rs. 113

Remaining amount = 10,279 − 113 = Rs. 10,166

Ratio after deduction (A : B : C) = 4 : 2 : 20 (Total units = 26)

Value of 1 unit = 10,166 ÷ 26 = Rs. 391

Difference (C − B) = (20 − 2) units + (13 − 33) = 18 × 391 − 20 = 7,038 − 20 = Rs. 7,018

Therefore The correct answer is Rs. 7018.

Alternate Method

Given: Total amount = Rs. 10,279; Deductions: A = Rs. 67, B = Rs. 33, C = Rs. 13; Ratio = 4 : 2 : 20.

Formula: New Share = Original Share − Deduction; Ratio sum × x = Total remaining amount.

=> Total remaining = 10,279 − (67 + 33 + 13) = 10,166

=> 4x + 2x + 20x = 10,166

=> 26x = 10,166

=> x = 10,166 ÷ 26 = 391

=> B's original share = 2 × 391 + 33 = 782 + 33 = Rs. 815

=> C's original share = 20 × 391 + 13 = 7,820 + 13 = Rs. 7,833

=> Difference = 7,833 − 815 = 7,018

Therefore The correct answer is Rs. 7018.

Additional Information

Ratio and Proportion

Ratio represents the comparison between two or more quantities. For a total S divided in ratio a:b:c, the value of one part is S / (a+b+c).

Deduction Method

When fixed amounts are subtracted from shares, subtract the total deduction from the grand total before applying the ratio distribution.

Q43. Answer: (c) 217/9

Shortcut Trick

Mean = (2 ÷ 3) × Mode = (2 ÷ 3) × 3 = 2.

Using the empirical formula: Mode = 3 × Median − 2 × Mean.

3 = 3 × Median − 2(2) => 3 = 3 × Median − 4 => Median = 7/3.

Product = 2 × (7/3) = 14/3.

Square = $(14/3)^2$ = 196/9 = 21 7/9.

Therefore The correct answer is 21 7/9.

Alternate Method

Given:

Mode = 3

Mode = (3/2) × Mean

Formula Used:

Empirical relationship: Mode = 3 × Median − 2 × Mean

Calculations:

=> 3 = (3/2) × Mean

=> Mean = (3 × 2) ÷ 3 = 2

=> Now, substitute values in the empirical formula:

=> 3 = 3 × Median − 2(2)

=> 3 = 3 × Median − 4

=> 7 = 3 × Median

=> Median = 7/3

=> Required value = $(\text{Median} \times \text{Mean})^2$

=> Result = $(7/3 \times 2)^2$

=> Result = $(14/3)^2$ = 196/9

=> Result = 21 7/9

Therefore The correct answer is 21 7/9.

Additional Information

Empirical Relationship

For a moderately skewed distribution, the relationship is approximately Mode = 3 × Median − 2 × Mean.

Symmetric Distribution

In a perfectly symmetrical distribution, the values of Mean, Median, and Mode are all equal (Mean = Median = Mode).

Positively Skewed Distribution

When the tail of the distribution is on the right side, it is called positively skewed, where Mean > Median > Mode.

Negatively Skewed Distribution

When the tail of the distribution is on the left side, it is called negatively skewed, where Mode > Median > Mean.

Q44. Answer: (c) 9

Shortcut Trick

Convert times to fractions: Pipe P = 75/2 minutes, Pipe Q = 45 minutes.

Let Total Capacity (LCM of 75 and 45) = 225 units.

Efficiency P = 225 ÷ (75/2) = 6 units/min; Efficiency Q = 225 ÷ 45 = 5 units/min.

Pipe P works for the full 30 minutes: 6 × 30 = 180 units.

Remaining work for Pipe Q = 225 − 180 = 45 units.

Time x = 45 ÷ 5 = 9 minutes.

Therefore The correct answer is 9 minutes.

Alternate Method

Given: Time P = 37.5 min = 75/2 min, Time Q = 45 min, Total time = 30 min.

Formula Used: Total Work = Time × Efficiency

Person	Days	Total Work	Efficiency
Pipe P	75/2	225	6
Pipe Q	45	5	

=> Let Pipe Q be closed after x minutes.

=> Work done by P in 30 mins + Work done by Q in x mins = 225

=> (6 × 30) + (5 × x) = 225

=> 180 + 5x = 225

=> 5x = 45

=> x = 9 minutes

Therefore The correct answer is 9 minutes.

Additional Information

Pipes and Cisterns Efficiency

Efficiency is inversely proportional to time. If a pipe fills a tank in T hours, its efficiency is 1/T per hour.

Inlet and Outlet Pipes

Inlet pipes have positive efficiency (filling), while outlet/leakage pipes have negative efficiency (emptying).

Combined Work Formula

If pipe A fills in x and pipe B fills in y, time to fill together is (x × y) ÷ (x + y).

Q45. Answer: (a) 11.2 m

Shortcut Trick

In a 30°−60°−90° triangle, the sides are in the ratio 1 : √3 : 2.

The side adjacent to 60° (base) is 1 unit, and the hypotenuse (ladder) is 2 units.

Given: 1 unit = 5.6 m

=> 2 units = 5.6 × 2 = 11.2 m

Therefore The correct answer is 11.2 m.

Alternate Method

Given:

Angle of elevation (θ) = 60°

Distance from wall (Base) = 5.6 m

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Formula Used:

cos(θ) = Base ÷ Hypotenuse

Calculations:

=> cos(60°) = 5.6 ÷ Length of ladder

=> 1/2 = 5.6 ÷ Length of ladder

=> Length of ladder = 5.6 × 2

=> Length of ladder = 11.2 m

Therefore The correct answer is 11.2 m.

Additional Information

Trigonometric Ratios

For a right-angled triangle, sin θ = Perpendicular/Hypotenuse, cos θ = Base/Hypotenuse, and tan θ = Perpendicular/Base.

Standard Values

Key values to remember: sin 60° = √3/2, cos 60° = 1/2, tan 60° = √3.

Pythagoras Theorem

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

Q46. Answer: (d) 31.82 metres

Shortcut Trick

Total Perimeter = 2 × Straight Length + 2 × π × Radius

400 = 2(100) + 2 × (22/7) × r

200 = (44/7) × r

r = 1400 ÷ 44 = 31.818...

Therefore The correct answer is 31.82 metres.

Alternate Method

Given:

Length of straight portions (L) = 100 m

Total Perimeter (P) = 400 m

Value of π = 22/7

Formula Used:

Perimeter of Track = (2 × Length of straight part) + (Circumference of a full circle formed by two semicircles)

Perimeter = 2L + 2πr

Calculations:

=> 400 = (2 × 100) + (2 × 22/7 × r)

=> 400 = 200 + (44/7) × r

=> 400 − 200 = (44/7) × r

=> 200 = (44/7) × r

=> r = (200 × 7) ÷ 44

=> r = 1400 ÷ 44

=> r = 31.818181...

=> r ≈ 31.82 m

Therefore The correct answer is 31.82 metres.

Additional Information

Area of the Athletic Track

The total area is the sum of the rectangular area and the area of the full circle: Area = (L × 2r) + πr².

Circumference of a Semicircle

The distance around the curved part of a semicircle is πr. The total perimeter of a closed semicircle is πr + 2r.

Standard Running Track

A standard 400m outdoor track usually has a radius of approximately 36.5 metres for the innermost lane.

Q47. Answer: (b) 90

Shortcut Trick

Total distance for one complete round = 4 × Side = 4 × 25 = 100 m.

Speed in m/s = 4 × (5/18) = 10/9 m/s.
Time = Distance ÷ Speed = 100 ÷ (10/9) = 10 × 9 = 90 seconds.
Therefore The correct answer is 90 seconds.
Alternate Method
Given:
Side of the square field = 25 m
Speed of the boy = 4 km/hr
Formula Used:
Perimeter of square = 4 × side
Time = Distance ÷ Speed
Conversion: 1 km/hr = 5/18 m/s
Calculations:
=> Total Distance = Perimeter = 4 × 25 = 100 m
=> Speed in m/s = 4 × (5/18) = 20/18 = 10/9 m/s
=> Time taken = 100 ÷ (10/9)
=> Time taken = 100 × (9/10)
=> Time taken = 10 × 9 = 90 seconds
Therefore The correct answer is 90 seconds.
Additional Information
Unit Conversion
To convert km/hr to m/s, multiply by 5/18. To convert m/s to km/hr, multiply by 18/5.
Square Properties
The distance covered in one complete round is the Perimeter (4a). The area is side² (a^2).
Basic Speed Formula
Speed = Distance ÷ Time | Distance = Speed × Time | Time = Distance ÷ Speed.

Q48. Answer: (c) 48

Shortcut Trick
Mean proportional (MP) formula: MP^2 = Product of numbers
=> $84^2 = X \times 147$
=> X = (84 × 84) ÷ 147
=> X = 48
Therefore The correct answer is 48.
Alternate Method
Given:
First term = X
Third term = 147
Mean Proportional = 84
Formula Used:
If b is the mean proportional between a and c, then $b^2 = ac$ or $b = \sqrt{(ac)}$.
Calculations:
=> $84 = \sqrt{(X \times 147)}$
=> 84 × 84 = X × 147
=> 7056 = X × 147
=> X = 7056 ÷ 147
=> X = 48
Therefore The correct answer is 48.
Additional Information
Third Proportional
If a and b are two numbers, then the third proportional c is given by the relation a:b :: b:c, which means $c = b^2/a$.
Fourth Proportional
If a, b, and c are three numbers, the fourth proportional d is such that a:b :: c:d, which means d = (b × c)/a.

Continued Proportion

Three numbers a, b, c are in continued proportion if a/b = b/c, meaning b is the geometric mean of a and c.

Q49. Answer: (b) Rs. 150

Shortcut Trick

Profit per unit = Selling Price − Cost Price

Profit per kg = 100 − 85 = Rs. 15

Total Profit = Quantity × Profit per unit

Total Profit = 10 × 15 = Rs. 150

Therefore The correct answer is Rs. 150.

Alternate Method

Given: Quantity = 10 kg, Cost Price (CP) = Rs. 85/kg, Selling Price (SP) = Rs. 100/kg.

Formulas: Total Profit = Total SP − Total CP | Total CP = Quantity × CP per unit | Total SP = Quantity × SP per unit

=> Total Cost Price = 10 × 85 = Rs. 850

=> Total Selling Price = 10 × 100 = Rs. 1000

=> Total Profit = 1000 − 850 = Rs. 150

Therefore The correct answer is Rs. 150.

Additional Information

Profit Percentage

It is the ratio of profit to cost price expressed as a percentage: Profit% = (Profit ÷ CP) × 100.

Net Gain and Loss

Profit occurs when SP > CP, while loss occurs when CP > SP. Loss = CP − SP.

Q50. Answer: (c) 26.83%

Shortcut Trick

Net discount in 'Buy x get y free' schemes is calculated as y ÷ (x + y) × 100.

Here, x = 30 and y = 11.

Discount % = 11 ÷ (30 + 11) × 100 = 11 ÷ 41 × 100.

Discount % = 1100 ÷ 41 = 26.829...

Rounding to two decimal places, we get 26.83%.

Therefore The correct answer is 26.83%.

Alternate Method

Given: Buy 30 items, get 11 items free.

Formulas: Discount % = (Discount ÷ MP) × 100 | Total Items = Paid Items + Free Items.

=> Let the Marked Price (MP) of 1 item be 1.

=> Total items given to customer = 30 + 11 = 41.

=> Total MP of 41 items = 41.

=> Customer pays for only 30 items, so Selling Price (SP) = 30.

=> Discount = MP − SP = 41 − 30 = 11.

=> Discount % = (11 ÷ 41) × 100 = 26.829...%.

Therefore The correct answer is 26.83%.

Additional Information

Marked Price & Discount

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

Free Goods Schemes

In "Buy A get B free", the effective discount rate is B ÷ (A + B) × 100. The shopkeeper bears the cost of (A+B) items but receives revenue for only A items.

Q51. Answer: (c) W

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

Only two people sit to the right of X.

Only two people sit between X and Q.

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Only two people sit between O and P.
P sits to the immediate left of X.
R sits to the immediate right of Y.
Now, the third position from the left end is W.
Hence, the correct answer is "Option 3".

Q52. Answer: (c) 109

The logic followed here is:
thus, "109" will replace the question mark in the given series.
Hence, the correct option is "Option 3".

Q53. Answer: (a) One

Given: A, B, C, D, E and F sit around a circular table facing the centre.
E sits third to the right of F.
B sits second to the left of E.
C sits second to the right of A.
D sits to the immediate right of C.
So, only one person sits between E and D.
Hence, the correct answer is "Option 1".

Q54. Answer: (a) TUQ−PQM

The logic followed here is:
For, NOK → JKG
For, EFB → ABX
Now, check the options using the same pattern:
Option 1) TUQ → PQM
Option 2) TTO → PQM
Option 3) TTO → OPL
Option 4) TUQ → OQL
Hence, the correct answer is Option 1.

Q55. Answer: (d) (30, 22, 19)

The logic followed here is:
Logic: Second Number = (First Number − Third Number) × 2.
For, (44, 52, 18)
=> 44 − 18 = 26
=> 26 × 2 = 52
For, (50, 56, 22)
=> 50 − 22 = 28
=> 28 × 2 = 56
Now, checking the options using the same pattern:
Option 1) (41, 82, 1)
=> 41 − 1 = 40
=> 40 × 2 = 80 ≠ 82
Option 2) (42, 78, 4)
=> 42 − 4 = 38
=> 38 × 2 = 76 ≠ 78
Option 3) (19, 14, 13)
=> 19 − 13 = 6
=> 6 × 2 = 12 ≠ 14
Option 4) (30, 22, 19)
=> 30 − 19 = 11
=> 11 × 2 = 22

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Hence, the correct answer is Option 4.

Q56. Answer: (c) BEE

The logic followed here is based on the alphabetical position pattern:
Option 1: TVW
Option 2: OQR
Option 3: BEE
Option 4: EGH
Thus, BEE does not follow the pattern.
Hence, the odd one out is Option 3.

Q57. Answer: (b) EA 26

The logic followed here is:
For, NK 16 → QN 12
For, PS 20 → SV 16
Now, apply the same to BX 30:
So, BX 30 → EA 26
Hence, the correct answer is Option 2.

Q58. Answer: (a) KOR

The logic followed here is:
So, 'KOR' will replace the question mark in the given series.
Hence, the correct answer is "Option 1"

Q59. Answer: (a) 276

The logic followed here is:
thus, "276" will replace the question mark in the given series.
Hence, the correct option is "Option 1".

Q60. Answer: (b) Five

Given: Seven boxes B, D, E, P, S, T and W are kept one over the other but not necessarily in the same order.
W is kept second from the bottom.
Only three boxes are kept between W and B.
P is kept at one of the positions below W.
Only D is kept between B and S.
E is kept at one of the positions above B.

Position	Box
7 (Top)	E
6	B
5	D
4	S
3	T
2	W
1 (Bottom)	P

Between P and E → B, D, S, T, W
Hence, the correct answer is Option 2.

Q61. Answer: (c) One

Given: (Left) 3 @ © 6 5 € € 3 3 8 € % 2 7 6 # 7 * £ € 9 $ (Right)
Now,
Symbols, which are immediately preceded by a number and also immediately followed by a number.

So, Needed pattern is: Number - Symbol - Number
(Left) 3 @ © 6 5 € € 3 3 8 € % 2 7 6 # 7 * £ € 9 $ (Right)
So, total valid symbols = 1
Hence, the correct answer is Option 3.

Q62. Answer: (c) 8

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:
=> 16 ÷ 4 − 8 × 3 + 28 = ?
=> 4 − 24 + 28 = ?
=> 32 − 24 = ?
=> 8
Hence, the correct option is "Option 3".

Q63. Answer: (c) Two

The logic followed here is:
Given number: 1245367
Logic:
Add 1 to each odd digit
Subtract 2 from each even digit
Original number: 1 2 4 5 3 6 7

Digit	Type	Operation	New Digit
1	Odd	1 + 1	2
2	Even	2 − 2	0
4	Even	4 − 2	2
5	Odd	5 + 1	6
3	Odd	3 + 1	4
6	Even	6 − 2	4
7	Odd	7 + 1	8

New number: 2 0 2 6 4 4 8

Digit	Frequency
2	2
4	2

Digits appearing more than once = 2, 4
Total such digits = 2
Hence, the correct answer is Option 3.

Q64. Answer: (a) 16 km to the east

The logic followed here is:
Given:
Mr. Z starts at Point A (0, 0)
13 km South
15 km East (left from South)
27 km North

31 km West

14 km South

So To reach Point A again from P: Move 16 km East

Hence, the correct answer is Option 1.

Q65. Answer: (c) Six

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

Now,

Odd numbers, which are immediately preceded by an odd number and also immediately followed by an odd number.

So, Needed pattern is: Odd - Odd - Odd

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

So, total valid odd numbers = 6

Hence, the correct answer is Option 3.

Q66. Answer: (b) 1

Given: (Left) % * 7 % € % 2 # € $ € © 9 5 6 # 9 & 6 % 7 & (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) % * 7 % € % 2 # € $ € © 9 5 6 # 9 & 6 % 7 & (Right)

So, total valid numbers = 1

Hence, the correct answer is Option 2.

Q67. Answer: (b) 10

The logic followed here is:

Given number: 6325894

Original number: 6 3 2 5 8 9 4

Digits arranged in ascending order: 2 3 4 5 6 8 9

Position	Original Digit	New Digit	Position Same?
1st	6	2	No
2nd	3	3	Yes
3rd	2	4	No
4th	5	5	Yes
5th	8	6	No
6th	9	8	No
7th	4	9	No

Digits with unchanged positions = 3, 5

Lowest digit in the original number = 2

Sum = (3 + 5) + 2 = 10

Hence, the correct answer is Option 2.

Q68. Answer: (a) Only conclusion (II) follows

Given Statements:

No Judges are Accountants.

Some Accountants are Nurses.

All Nurses are Librarians.

The least possible Venn diagram for the given statement is:

Conclusions:

I. No Judges are Nurses → Does not follow (The statements only say that Judges are not Accountants. It is possible that some Judges may be Nurses who are not Accountants.)

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II. Some Accountants are Librarians → Follows (Since some Accountants are Nurses and all Nurses are Librarians, those Accountants who are Nurses must also be Librarians.)

So, only conclusion II follows.

Hence, the correct answer is Option 1.

Q69. Answer: (c) ap

Given:

'door win king' is coded as 'ab ap ly'

'win key mom' is coded as 'dw tc ap'

So, win = ap

Hence, the correct answer is Option 3.

Q70. Answer: (c) 552

Shortcut Trick

The differences between the terms are consecutive odd numbers: 3, 5, 7, 9.

Next odd number in the sequence after 9 is 11.

Required number = 541 + 11 = 552.

Therefore The correct answer is 552.

Alternate Method

Given series: 517, 520, 525, 532, 541, ?

Pattern: Addition of consecutive odd numbers to the previous term.

517 +3 → 520 +5 → 525 +7 → 532 +9 → 541 +11 → 552

Pattern explanation: The difference between consecutive terms follows the sequence of odd numbers: 3, 5, 7, 9, 11, ...

=> 517 + 3 = 520

=> 520 + 5 = 525

=> 525 + 7 = 532

=> 532 + 9 = 541

=> 541 + 11 = 552

Therefore The correct answer is 552.

Additional Information

Odd Number Series

A sequence where terms are generated by adding consecutive odd integers (1, 3, 5, 7, ...) to previous terms.

Prime Number Series

A common variation where the differences are consecutive prime numbers (2, 3, 5, 7, 11, ...).

Double Difference Series

In these series, the difference of the differences (second-level difference) remains constant or follows a specific pattern.

Q71. Answer: (c) Mother's mother

Family Chart:

Symbol → + | # | & | %

Meaning → Mother | Wife | Brother | Father

Given: I # J % B & L + M

It means: I is the wife of J, J is the father of B, B is the brother of L, and L is the mother of M.

Thus, I is the Mother's mother of M.

Hence, the correct answer is Option 3.

Q72. Answer: (a) JMQ47

The logic followed here is:

So, 'JMQ47' will replace the question mark in the given series.

Hence, the correct answer is "Option 1"

Q73. Answer: (c) Neither conclusion (I) nor (II) follows

Given Statements:

Some machines are anchors.

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Some anchors are wheels.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some machines are wheels → Does not follow (No definite relationship is established between Machines and Wheels. Their overlap is only a possibility, not a certainty.)

II. All wheels are anchors → Does not follow (The statement says only "Some anchors are wheels". This does not mean that all wheels are anchors.)

So, neither conclusion I nor conclusion II follows.

Hence, the correct answer is Option 3.

Q74. Answer: (a) TXT

The logic followed here is based on the alphabetical position pattern:

Option 1: TXT

Option 2: HLG

Option 3: KOJ

Option 4: EID

Thus, TXT does not follow the pattern.

Hence, the odd one out is Option 1.

Q75. Answer: (d) 4

Given:

'LAVS' → '3812'

'VALE' → '1342'

So, E = 4

Hence, the correct answer is Option 4.

Q76. Answer: (d) One

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

Now,

Odd digits, which are immediately preceded by an even digit and also immediately followed by an odd digit.

So, Needed pattern is: Even - Odd - Odd

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

So, total valid odd digits = 1

Hence, the correct answer is Option 4.

Q77. Answer: (d) 17

The logic followed here is:

Logic: Total number of students = (Position of a person from the top + Position of the same person from the bottom) − 1

Given:

Rank from Top = 6

Rank from Bottom = 12

Total students = 6 + 12 − 1

Total students = 18 − 1

Total students = 17

Hence, the correct answer is Option 4.

Q78. Answer: (a) F

Given: A, B, C, E, F, P and Q sit around a circular table facing the centre.

A sits fourth to the left of C.

P sits fourth to the right of B.

Only two people sit between C and B when counted from the left of C.

E is not an immediate neighbour of P or B.

F is not an immediate neighbour of P.

So, F sits third to the right of Q.

Hence, the correct answer is "Option 1".

Q79. Answer: (b) KG 13

The logic followed here is:

For, LR 9 → PT 3

For, TS 13 → XU 7

Now, apply the same to GE 19:

So, GE 19 → KG 13

Hence, the correct answer is Option 2.

Q80. Answer: (c) 7 km towards south

The logic followed here is:

Given:

Point M is taken as origin (0, 0)

8 km East

5 km South

3 km East

7 km South

11 km West

5 km North

So, 7 km South of Point M.

Hence, the correct answer is Option 3.

Q81. Answer: (a) ICICI Prudential Life Insurance

The correct answer is ICICI Prudential Life Insurance.

Key Points

• SBM Bank India entered into a strategic bancassurance partnership with ICICI Prudential Life Insurance to provide its customers with a comprehensive range of life insurance products.

• Through this partnership, SBM Bank India aims to offer its private banking and retail customers a diverse portfolio of insurance solutions, including wealth management, retirement, and protection plans.

• This collaboration leverages SBM Bank's extensive distribution network and ICICI Prudential's digital-first approach to provide seamless financial services.

• The primary objective of this tie-up is to enhance financial security and provide long-term savings options to the bank's growing client base across India.

• The agreement signifies a major step for SBM Bank India in becoming a one-stop destination for all financial and insurance needs of its customers.

Additional Information

• Bancassurance:

• It is an arrangement between a bank and an insurance company that allows the insurance company to sell its products to the bank's client base.

• This partnership benefits the bank through commission-based income and provides the insurance company with a wide distribution channel.

• SBM Bank India:

• It is the first bank in India to receive a Universal Banking License from the Reserve Bank of India (RBI) to operate as a Wholly Owned Subsidiary (WOS) of a foreign bank.

• The bank is headquartered in Mumbai and is a subsidiary of SBM Holdings, which is based in Mauritius.

• The bank focuses on corporate banking, retail banking, and wealth management with a strong emphasis on technology-driven solutions.

• ICICI Prudential Life Insurance:

• It is a joint venture between ICICI Bank Limited and Prudential Corporation Holdings Limited.

• The company began operations in December 2000 and was the first private sector life insurance company to be listed on the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE).

• It offers a wide range of products including Term Insurance, Health Insurance, and Unit Linked Insurance Plans (ULIPs).

• Regulatory Framework:

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• The Insurance Regulatory and Development Authority of India (IRDAI) governs the guidelines for bancassurance to ensure that consumer interests are protected and mis-selling is prevented.

Important Points

• Financial Inclusion: Such partnerships are vital for increasing insurance penetration in India, especially among the middle-class and affluent segments served by private banks.

• Digital Integration: Both entities emphasize digital ecosystems, allowing customers to purchase and manage policies via mobile banking and internet banking platforms.

• SBM Bank's Presence: As of 2024-2025, the bank has been expanding its footprint in metropolitan cities and through Neo-banking partnerships to reach a wider demographic.

Q82. Answer: (d) Shakti 2025

The correct answer is Shakti 2025.

Key Points

• The bilateral military exercise named Shakti 2025 was conducted between the Indian Army and the French Army.

• The exercise took place over a period of two weeks, starting from 18 June and concluding on 1 July 2025.

• The venue for this edition of the drill was Camp Larzac, which is a prominent military training facility located in France.

• The primary focus of Exercise Shakti is to enhance interoperability between the two armed forces and to share combat experience and best practices in the domain of counter-terrorism and sub-conventional operations.

• The drill involves high-intensity training, including joint planning, tactical maneuvers, and neutralization of threat scenarios, typically under a United Nations mandate.

Additional Information

• History and Frequency: Exercise Shakti is a biennial training event that alternates between India and France. The first edition of this exercise was held in 2011.

• Indo-French Defense Cooperation: India and France share a deep Strategic Partnership established in 1998. Defense cooperation is one of the strongest pillars of this relationship, involving technology transfer, joint production, and regular military dialogues.

• Other Bilateral Exercises:

• Exercise Varuna: A bilateral Naval exercise that highlights the maritime cooperation between the Indian Navy and the French Navy.

• Exercise Garuda: A bilateral Air Force exercise involving the Indian Air Force (IAF) and the French Air and Space Force.

• Exercise Desert Knight: A complex air exercise often involving multi-national participation but rooted in Indo-French cooperation.

• Significance of Camp Larzac: Located in Southern France, Camp Larzac provides a diverse and challenging geographical terrain suitable for simulating various operational environments, making it an ideal location for infantry-based drills.

• Equipment and Participation: During these exercises, both nations often deploy their latest military hardware. The Indian Army typically sends a contingent from one of its Infantry Regiments (such as the Rajput Regiment or Gorkha Rifles) to participate alongside French counterparts.

Important Points

• Strategic Objectives: The Shakti 2025 exercise serves to strengthen the diplomatic ties between New Delhi and Paris, ensuring both nations can respond effectively to global security challenges.

• Joint Operations: Such exercises allow for the development of Joint Command structures, where officers from both countries work together to execute mission-critical tasks.

• 2024 Edition: For context, the 7th edition of Exercise Shakti was held in May 2024 at the Umroi Joint Training Node in Meghalaya, India, showcasing the alternating nature of the hosting responsibilities.

Q83. Answer: (c) Pakistan

The correct answer is Pakistan.

Key Points

• The Asia Cup is a premier continental cricket tournament organized by the Asian Cricket Council (ACC), featuring top teams from the Asian region.

• In the specific scenario described for September 2025, the Indian cricket team refused to participate in the trophy presentation involving the Home Minister of Pakistan, highlighting the persistent diplomatic and political tensions between the two neighboring nations.

• The President of the Asian Cricket Council (a position held by Jay Shah as of the mid-2020s) typically presides over such ceremonies alongside high-ranking officials of the host country to honor the winners.

• Due to security concerns and geopolitical conflicts, India has often pushed for a hybrid model for tournaments hosted by Pakistan, ensuring that matches involving the Indian team are held at neutral venues like Sri Lanka or the UAE.

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• The refusal to accept the trophy from a senior member of the Pakistan government, such as the Home Minister, aligns with the BCCI and the Indian Government policy of maintaining minimal official engagement with Pakistan in sporting contexts.

Additional Information

• Asian Cricket Council (ACC):

• Founded in 1983 to promote and develop cricket in Asia, it is currently headquartered in Colombo, Sri Lanka.

• The ACC Asia Cup is the only continental championship in cricket and the winning team is crowned the Champion of Asia.

• India-Pakistan Sporting Ties:

• Bilateral cricket between the BCCI and the PCB has been suspended since the 2012-13 season.

• Matches are now limited to ICC and ACC events, where venues and protocols are often the subject of intense administrative negotiations.

Q84. Answer: (a) Kamle

The correct answer is Kamle.

Key Points

• In January 2025, a state-of-the-art Khelo India multipurpose hall was officially inaugurated in the Kamle district of Arunachal Pradesh.

• The infrastructure was established at Raga, which is the administrative headquarters of the Kamle district, to promote indoor sports activities among the local youth.

• The construction of this facility was funded under the Khelo India Scheme, a flagship national program of the Ministry of Youth Affairs and Sports, Government of India.

• The hall is designed to accommodate various sports such as badminton, table tennis, and wrestling, providing a dedicated space for athletes to train regardless of weather conditions.

• The inauguration reflects the government's focus on the North Eastern Region to identify and nurture grassroots talent in sports through the creation of modern infrastructure in remote areas.

Additional Information

• Kamle District:

• Kamle was inaugurated as the 22nd district of Arunachal Pradesh in December 2017.

• It was carved out of the existing Lower Subansiri and Upper Subansiri districts to improve administrative efficiency.

• The district is inhabited primarily by the Nyishi community and the Galo tribe.

• Khelo India Scheme:

• Launched in 2018, the Khelo India - National Programme for Development of Sports aims to revive the sports culture in India at the grassroots level.

• It provides an annual financial assistance of Rs. 5 lakh per annum for 8 years to talented players identified in priority sports disciplines.

• The scheme has several components, including State Level Khelo India Centres and Sports Infrastructure Utilization.

• Sports in Arunachal Pradesh:

• The state government has been proactive in branding Arunachal Pradesh as a sports hub, focusing on disciplines like weightlifting, archery, and karate.

• Major sports infrastructure include the Sangay Lhaden Sports Academy located in Itanagar, which is also a Khelo India State Centre of Excellence (KISCE).

Important Points

• Geographic Significance: The establishment of such facilities in Kamle is significant due to its difficult mountainous terrain, where outdoor sports activities are often hindered by heavy rainfall and geographic barriers.

• Talent Identification: The Khelo India initiative in the Northeast has been instrumental in bringing athletes from the region into the national spotlight, contributing significantly to India's medal tally in international events.

• Governance: The project completion in 2025 aligns with the state's vision of "Vision 2030" for sports, aiming to provide high-quality training facilities in every district of Arunachal Pradesh.

Q85. Answer: (d) Ground-level ozone

The correct answer is Ground-level ozone.

Key Points

• In a comprehensive analysis released in July 2025, the Centre for Science and Environment (CSE) reported that Ground-level ozone has emerged as a significant threat to air quality during the summer of 2025 across India's mega cities.

• The report highlighted that cities which historically had cleaner summer air, such as Bengaluru, Mumbai, and Chennai, saw frequent breaches of the 8-hour ozone standard.

• The phenomenon was particularly severe in 2025 due to intense and prolonged heatwaves, which provided the ideal conditions—high solar radiation and temperatures—for ozone formation.

• Unlike primary pollutants like PM2.5, Ground-level ozone is a secondary pollutant. It is not emitted directly but is formed through complex chemical reactions between Nitrogen oxides (NOx) and Volatile Organic Compounds (VOCs) in the presence of sunlight.

• The CSE study noted that even Kolkata and Hyderabad experienced "ozone blindness," where despite visible clarity in the air, the invisible ozone levels were dangerously high, often exceeding the 100 µg/m³ threshold for several hours a day.

Additional Information

• Nature of Ground-level Ozone:

• Commonly referred to as "Bad Ozone" or Tropospheric Ozone, it exists in the lower atmosphere (from the ground up to 10-15 kilometers).

• This is distinct from the "Good Ozone" found in the Stratosphere, which protects the Earth from harmful Ultraviolet (UV) radiation.

• Precursors and Sources:

• The chemical precursors, NOx and VOCs, originate from vehicular exhaust, industrial emissions, power plants, and even chemical solvents.

• In the summer of 2025, the increase in air conditioning usage and electricity demand contributed to higher precursor emissions from fossil fuel combustion.

• Health and Environmental Impacts:

• Exposure to Ground-level ozone causes respiratory inflammation, aggravates asthma, and can lead to chronic obstructive pulmonary disease (COPD).

• Environmentally, it acts as a potent greenhouse gas and inhibits plant growth, reducing crop yields for essential grains like wheat and rice.

• Regulatory Standards in India:

• The National Ambient Air Quality Standards (NAAQS) set by the Central Pollution Control Board (CPCB) define the limit for ozone at 100 µg/m³ for an 8-hour average and 180 µg/m³ for a 1-hour average.

• Monitoring ozone is technically challenging compared to Particulate Matter, requiring sophisticated UV-photometry equipment at Continuous Ambient Air Quality Monitoring Stations (CAAQMS).

Important Points

• Geographical Spread: The 2025 report underscored that ozone is no longer just a Delhi-NCR problem; coastal cities like Mumbai and Chennai are now highly vulnerable due to rising urban heat island effects.

• Diurnal Patterns: Ozone levels typically peak during the afternoon (between 1:00 PM and 4:00 PM) when the sun is at its zenith, and dissipate during the night as there is no sunlight to catalyze the reaction.

• Policy Recommendation: The Centre for Science and Environment (CSE) advocated for a multi-pollutant control strategy, emphasizing that reducing PM2.5 alone is insufficient if NOx and VOC emissions from the transport sector are not strictly curtailed.

Q86. Answer: (b) Quantum Security Integrated Processor (QSIP)

The correct answer is Quantum Security Integrated Processor (QSIP).

Key Points

• In November 2025, Prime Minister Narendra Modi unveiled the Quantum Security Integrated Processor (QSIP), marking a historic achievement in India's indigenous technological capabilities.

• The QSIP is India's first fully locally designed and developed quantum-secure semiconductor chip, aimed at protecting the nation's digital sovereignty.

• This innovation is a cornerstone of the National Quantum Mission (NQM), which was initiated to position India as a global leader in Quantum Technology (QT).

• The chip is specifically engineered to provide hardware-level encryption that is resistant to the immense processing power of future quantum computers, which threaten to break existing RSA and ECC encryption standards.

• The development of QSIP aligns with the Atmanirbhar Bharat initiative, reducing India's reliance on foreign-made cryptographic modules and ensuring secure communication for defense and government sectors.

Additional Information

• National Quantum Mission (NQM):

• The Union Cabinet approved the NQM in April 2023 with a total financial outlay of Rs. 6,003.65 crore for the period 2023-24 to 2030-31.

• The mission aims to develop intermediate-scale quantum computers with 50-1000 physical qubits in various platforms like superconducting and photonic technology.

• It also focuses on Quantum Communications, specifically Quantum Key Distribution (QKD) over long distances, including satellite-based secure communications.

• Post-Quantum Cryptography (PQC):

• PQC refers to mathematical algorithms that are thought to be secure against a cryptanalytic attack by a quantum computer.

• The QSIP chip integrates these PQC standards to ensure that data remains protected even as quantum computing power scales globally.

• Strategic Applications:

• The chip is designed for use in critical infrastructure such as power grids, banking systems, and strategic defense networks.

• It facilitates Quantum Random Number Generation (QRNG), which provides a higher level of entropy compared to classical pseudo-random generators, making encryption keys nearly impossible to predict.

Important Points

• Semiconductor Mission connection: The production of the QSIP chip is part of the broader India Semiconductor Mission (ISM), which seeks to build a vibrant semiconductor and display ecosystem in the country.

• Global Standing: With the launch of QSIP, India joins an elite group of nations—including the USA, China, and France—that possess high-end quantum-secure hardware technology.

• Cybersecurity Landscape: As quantum computers can solve complex mathematical problems in seconds that would take classical computers thousands of years, the QSIP serves as a vital shield against "harvest now, decrypt later" strategies used by cyber-adversaries.

• Collaborative Effort: The design of the chip involved collaboration between the Department of Science and Technology (DST), premier institutes like IITs, and defense research laboratories.

Q87. Answer: (d) Tajikistan, Kyrgyzstan, Uzbekistan

The correct answer is Tajikistan, Kyrgyzstan, Uzbekistan.

Key Points

• The Khujand Treaty was officially signed in March 2025 by the nations of Tajikistan, Kyrgyzstan, and Uzbekistan to settle long-standing territorial and border delimitation disputes.

• The treaty takes its name from Khujand, the second-largest city in Tajikistan and a major administrative center in the Fergana Valley, which served as the venue for the high-level diplomatic summit.

• The primary objective of the agreement is to finalize the demarcation of nearly 1,000 kilometers of contested borders that have been a source of recurring conflict since the dissolution of the Soviet Union in 1991.

• The signing involved the respective Heads of State, emphasizing a shift toward Central Asian solidarity and regional economic cooperation rather than military confrontation.

• The Khujand Treaty specifically addresses the management of enclaves and exclaves, ensuring that residents in these isolated territories have guaranteed transit rights and access to essential resources.

Additional Information

• The Fergana Valley:

• This region is shared by Uzbekistan, Kyrgyzstan, and Tajikistan and is the most densely populated area in Central Asia.

• Due to its fertile soil and strategic location, it has been the epicenter of ethnic tensions and border skirmishes over land rights and irrigation water.

• Historical Context:

• The borders in this region were originally drawn during the Stalinist era of the Soviet Union without regard for ethnic distributions, leading to the creation of complex enclaves such as Vorukh (Tajik enclave in Kyrgyzstan) and Sokh (Uzbek enclave in Kyrgyzstan).

• Significance of the Agreement:

• Settling these disputes is a prerequisite for major infrastructure projects, including the China-Kyrgyzstan-Uzbekistan (CKU) railway, which aims to enhance trade routes between East Asia and Europe.

• The 2025 treaty builds upon the momentum of the 2023 bilateral agreement between Bishkek and Tashkent, which successfully resolved their mutual border issues.

• Regional Impact:

• By resolving these issues, the three countries aim to reduce the influence of external security actors and strengthen the role of the Consultative Meetings of Central Asian Heads of State as a primary forum for conflict resolution.

• It also minimizes the risk of water-sharing conflicts, which are expected to intensify in the Amu Darya and Syr Darya basins due to climate change.

Q88. Answer: (a) Gyanesh Kumar

The correct answer is Gyanesh Kumar.

Key Points

• Gyanesh Kumar took charge as the Chief Election Commissioner (CEC) of India on 19 February 2025.

• His appointment and subsequent elevation to the top post were conducted under the new provisions of The Chief Election Commissioner and other Election Commissioners (Appointment, Conditions of Service and Term of Office) Act, 2023.

• He succeeded Rajiv Kumar, who demitted the office of Chief Election Commissioner on 18 February 2025 after the completion of his tenure.

• Prior to becoming the CEC, Gyanesh Kumar had been serving as an Election Commissioner since March 2024.

• He is a retired 1988-batch Indian Administrative Service (IAS) officer of the Kerala cadre and has previously served as the Secretary in the Ministry of Cooperation and the Ministry of Utpal Kumar Singh.

Additional Information

• The 2023 Appointment Act:

• This Act replaced the Election Commission (Conditions of Service of Election Commissioners and Transaction of Business) Act, 1991.

• It established a new mechanism for the appointment of the CEC and ECs, following a Supreme Court ruling in the Anoop Baranwal v. Union of India case.

• The Selection Committee under this Act consists of the Prime Minister (as Chairperson), a Union Cabinet Minister, and the Leader of the Opposition in the Lok Sabha.

• Structure of the Election Commission:

• The Election Commission of India (ECI) is a multi-member body consisting of one Chief Election Commissioner and two Election Commissioners.

• They are appointed by the President of India based on the recommendations of the Selection Committee.

• The tenure for these positions is six years or until the appointee reaches the age of 65 years, whichever occurs earlier.

• Constitutional Provisions:

• Article 324 of the Constitution of India provides for the establishment, powers, and functions of the Election Commission.

• It mandates the commission to superintend, direct, and control the preparation of electoral rolls and the conduct of all elections to Parliament, State Legislatures, and the offices of President and Vice-President.

Important Points

• Sukhbir Singh Sandhu: Along with Gyanesh Kumar, Sukhbir Singh Sandhu (a 1988-batch IAS officer of the Uttarakhand cadre) was among the first Election Commissioners appointed under the 2023 Act in March 2024.

• Independence of the Office: To ensure impartiality, the CEC can only be removed from office in the same manner and on the same grounds as a Judge of the Supreme Court of India.

• Search Committee: Before the Selection Committee meets, a Search Committee headed by the Minister of Law and Justice prepares a panel of five persons for consideration.

• Rank and Salary: The Chief Election Commissioner and the two Election Commissioners enjoy the same status and receive a salary and perks equivalent to those of a Judge of the Supreme Court.

• Historical Context: Originally, the Commission had only a Chief Election Commissioner. It became a multi-member body for the first time in 1989, and then permanently from 1 October 1993.

Q89. Answer: (a) Reserve Bank of India (RBI)

The correct answer is Reserve Bank of India (RBI).

Key Points

• During the first half of the financial year 2024-25 (FY25), the Reserve Bank of India (RBI) significantly intensified its regulatory oversight by imposing a total monetary penalty of Rs. 54.78 crore.

• The enforcement action targeted 353 regulated entities, including Public Sector Banks, Private Sector Banks, Foreign Banks, Co-operative Banks, and Non-Banking Financial Companies (NBFCs).

• The primary reasons for these penalties included non-compliance with Know Your Customer (KYC) guidelines, lapses in Credit Information Companies (CIC) reporting, and violations of the Fair Practices Code.

• Compared to the previous year, the RBI has shown a stricter stance towards governance issues and risk management frameworks within the Indian banking ecosystem.

• These measures are exercised under the powers conferred to the central bank by the Banking Regulation Act, 1949, and the Reserve Bank of India Act, 1934, to ensure financial stability.

Additional Information

• Reserve Bank of India (RBI):

• Established on April 1, 1935, following the recommendations of the Hilton Young Commission.

• It serves as the Central Bank of India, managing monetary policy, foreign exchange, and the issuance of currency notes.

• Securities and Exchange Board of India (SEBI):

• Established in 1988 and granted statutory status in 1992, it regulates the stock markets and commodity markets in India.

• National Payments Corporation of India (NPCI):

• Founded in 2008, it is an umbrella organization for all retail payments in India, managing systems like UPI and RuPay.

Q90. Answer: (c) Masaki Kashiwara

The correct answer is Masaki Kashiwara.

Key Points

• The 2025 Abel Prize has been awarded to the Japanese mathematician Masaki Kashiwara for his groundbreaking and transformative contributions to algebraic analysis and representation theory.

• Masaki Kashiwara is renowned for his work in creating the foundations of microlocal analysis alongside his mentor Mikio Sato, which allows for the study of linear differential equations using methods from algebraic geometry and complex analysis.

• He is credited with the development of D-module theory, a sophisticated mathematical framework that provides a deep connection between analysis and algebra, enabling researchers to solve complex problems in theoretical physics and mathematics.

• One of his most significant achievements in representation theory is the introduction of crystal bases. This concept revolutionized the study of quantum groups and their representations, providing a combinatorial way to understand these complex structures.

• The prize recognizes his lifetime of work at the Research Institute for Mathematical Sciences (RIMS) at Kyoto University, where he has influenced generations of mathematicians worldwide.

Additional Information

• The Abel Prize:

• It is an international award presented annually by the Norwegian Academy of Science and Letters to one or more outstanding mathematicians.

• Established by the Government of Norway in 2002, it is named after the famous Norwegian mathematician Niels Henrik Abel, marking the 200th anniversary of his birth.

• The prize is often referred to as the "Nobel Prize of Mathematics" because there is no Nobel category for the field of mathematics.

• The award ceremony traditionally takes place in Oslo, where the laureate receives a monetary prize of 7.5 million Norwegian kroner (approximately USD 700,000).

• Other Options Context:

• Terence Tao: A world-renowned Australian-American mathematician and Fields Medal winner (2006), known for his work in harmonic analysis and number theory, but he is not the recipient of the 2025 Abel Prize.

• Joel Mokyr and Philippe Aghion: These are distinguished economists rather than pure mathematicians, specializing in economic history and growth theory respectively.

Important Points

• Significance of Algebraic Analysis: This field, pioneered by the Sato School in Japan, treats differential equations as algebraic objects. This approach has led to major breakthroughs in soliton theory and integrable systems.

• Global Recognition: Before winning the Abel Prize in 2025, Masaki Kashiwara received several other prestigious honors, including the Kyoto Prize in Basic Sciences (2018) and the Chern Medal (2018), which is awarded every four years at the International Congress of Mathematicians (ICM).

• Impact on Physics: Kashiwara's theories, particularly in the realm of representation theory and D-modules, are extensively used in string theory and conformal field theory, bridging the gap between abstract pure mathematics and theoretical physics.

• Selection Process: The winner is selected by an international Abel Committee consisting of five leading mathematicians appointed by the Norwegian Academy of Science and Letters.

Q91. Answer: (a) Ministry of Electronics and Information Technology

The correct answer is Ministry of Electronics and Information Technology.

Key Points

• The Ministry of Electronics and Information Technology (MeitY) launched the Aadhaar Good Governance Portal to simplify and streamline the process for various government entities seeking permission for Aadhaar authentication.

• The portal is designed to provide a single-window interface for government Departments and Ministries, allowing them to submit and track their applications for utilizing Aadhaar services in their respective governance frameworks.

• This initiative is a significant step toward achieving Ease of Living for citizens by ensuring that Aadhaar-based services are more accessible and processed through a more efficient, transparent administrative system.

• The primary objective of the portal is to reduce the turnaround time for approvals and to ensure that the use of Aadhaar for good governance is promoted across various Central and State government schemes.

• By digitizing the application workflow, the portal supports the vision of "Minimum Government, Maximum Governance," helping agencies comply with the Aadhaar (Authentication and Offline Verification) Rules, 2021.

Additional Information

• Unique Identification Authority of India (UIDAI):

• The UIDAI is a statutory authority established under the Aadhaar (Targeted Delivery of Financial and Other Subsidies, Benefits and Services) Act, 2016.

• It operates under the jurisdiction of the Ministry of Electronics and Information Technology (MeitY) and is responsible for Aadhaar enrolment and authentication.

• Aadhaar Authentication:

• It is a process where the Aadhaar number, along with other attributes (biometric or demographic), is submitted to the Central Identities Data Repository (CIDR) for verification.

• This process enables contactless and paperless delivery of services, significantly reducing leakages in welfare programs.

• Significance in Governance:

• Aadhaar is a cornerstone of the JAM (Jan Dhan-Aadhaar-Mobile) trinity, which has revolutionized the Direct Benefit Transfer (DBT) mechanism in India.

• As of recent data, over 1.3 billion Aadhaar numbers have been generated, making it the world's largest biometric ID system.

• Role of MeitY:

• The Ministry of Electronics and Information Technology is responsible for IT policy, strategy, and the promotion of electronics hardware manufacturing and IT-enabled services.

• It oversees various digital initiatives like Digital India, UMANG, and DigiLocker to foster a digitally empowered society.

Q92. Answer: (a) 8th

The correct answer is 8th.

Key Points

• The Indian Space Research Organisation (ISRO) unveiled the latest version of its indigenous structural analysis software, FEAST (Finite Element Analysis of Structures), during the 8th edition of the National Finite Element Developers' Meeting (NFEDM).

• The event was held in February 2025 at the Vikram Sarabhai Space Centre (VSSC) located in Thiruvananthapuram, Kerala.

• The 8th NFEDM brought together experts, researchers, and developers from across the country to discuss advancements in computational mechanics and structural engineering.

• The release of the latest FEAST version is a significant milestone in India's pursuit of Atmanirbhar Bharat (Self-reliant India) in the domain of sophisticated engineering software.

• The software is designed to provide a robust and cost-effective alternative to expensive foreign-made Finite Element Analysis (FEA) tools, reducing dependency on international licenses.

Additional Information

• About FEAST Software:

• FEAST stands for Finite Element Analysis of Structures. It is a comprehensive software package developed by VSSC/ISRO for linear and non-linear structural analysis.

• It is used to analyze the structural integrity of rockets, satellites, and launch vehicles, ensuring they can withstand the extreme forces experienced during space missions.

• The software supports a wide range of applications, including static, dynamic, thermal, and buckling analysis of complex structures.

• It is available in various versions, such as Academic (for students), Premium (for small-scale industries), and Professional (for large enterprises).

• National Finite Element Developers' Meeting (NFEDM):

• The NFEDM is a biennial or periodic national-level platform initiated to foster collaboration among Indian developers of structural analysis tools.

• It aims to create a unified ecosystem for Finite Element Method (FEM) development in India, encouraging the use of indigenous technologies in aerospace, defense, and civil engineering.

• Vikram Sarabhai Space Centre (VSSC):

• Located in Thiruvananthapuram, VSSC is the lead center of ISRO responsible for the design and development of launch vehicle technology.

• It was named after Dr. Vikram Sarabhai, the father of the Indian space program, and has been instrumental in developing the SLV-3, ASLV, PSLV, GSLV, and LVM3.

Important Points

• Technological Significance: The development of FEAST by ISRO scientists highlights India's capability to produce high-end Computer-Aided Engineering (CAE) software that meets global standards.

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• Date and Timeline: The 8th NFEDM took place in February 2025, marking several years of continuous evolution since the initial versions of the software were conceptualized.

• Economic Impact: By utilizing indigenous software, Indian industries and academic institutions can save millions in foreign exchange that would otherwise be spent on proprietary software like ANSYS or NASTRAN.

• User Base: Beyond ISRO, the software is being increasingly adopted by the Indian Navy, defense labs (DRDO), and several IITs and NITs for research and development purposes.

Q93. Answer: (d) Nico Young

p data-end="57" data-start="0">The correct answer is Nico Young.

Key Points

• Nico Young is a prominent American long-distance runner who rose to fame competing for Northern Arizona University (NAU). In 2024, he transitioned to a professional career by signing with Adidas.

• The athlete has been instrumental in redefining American distance running benchmarks. The time of 12:45.27 represents an elite performance in the men's 5,000 m, a distance that requires 12.5 laps of a standard 400 m outdoor track.

• Born on July 27, 2002, in Camarillo, California, Nico Young became the first collegiate athlete to break the 13-minute barrier in the 5,000 m, setting an NCAA record of 12:57.14 earlier in 2024 before pushing toward the national record.

• His training base in Flagstaff, Arizona, which sits at an elevation of approximately 7,000 feet, is widely credited for his exceptional cardiovascular endurance and ability to compete against the world's best East African runners.

• At the 2024 U.S. Olympic Team Trials held in Eugene, Oregon, Nico Young demonstrated his elite status by qualifying for the Paris 2024 Olympic Games in both the 5,000 m and 10,000 m events.

Additional Information

• Grant Fisher:

• Prior to recent surges in times, Grant Fisher held the American outdoor record for the 5,000 m with a time of 12:46.96, set in September 2022 at the Diamond League final in Zurich.

• Fisher is a Stanford University alumnus and a Tokyo 2020 Olympian who has consistently lowered the U.S. records across multiple distances.

• Yared Nuguse:

• Yared Nuguse is primarily celebrated as a middle-distance specialist. He holds the American record in the mile with a time of 3:43.97 and the 3,000 m indoors.

• He represents On Athletics Club (OAC) and is known for his tactical racing and powerful "kick" in the final 400 meters.

• Cole Hocker:

• Cole Hocker is a standout 1,500 m runner who won the 2024 U.S. Olympic Trials in that event with a meet record of 3:30.59.

• His versatility allows him to compete at a high level in the 5,000 m, often utilizing his speed developed in shorter races to out-sprint opponents.

• The 5,000 m Event:

• The 5,000 m (approximately 3.1 miles) is a standard Olympic distance. The world record is held by Joshua Cheptegei of Uganda with a time of 12:35.36 set in 2020.

• Modern advancements in footwear technology, often called "super spikes," and the use of Wavelight technology (pacing lights on the track) have contributed to significantly faster times in the 2020s.

Important Points

• Professional Transition: Nico Young's decision to turn professional in June 2024 followed one of the most successful collegiate seasons in history, including multiple NCAA Division I titles.

• Olympic Qualification: The United States long-distance squad for the Paris 2024 games is considered one of the strongest in history, with athletes like Young and Fisher both capable of challenging for podium spots.

• Record Progression: The American record for the 5,000 m has seen a rapid progression; it took over 13 years to break the 12:54 mark set by Bernard Lagat in 2011, but multiple athletes have since surpassed it.

Q94. Answer: (b) Panchkula

The correct answer is Panchkula.

Key Points

• The 115th Executive Council Meeting of the All-India Council of Mayors (AICM) was held in the city of Panchkula, located in the state of Haryana.

• The meeting took place over two days, specifically on 15-16 June 2025, and was attended by Mayors and municipal representatives from various parts of India.

• The event was hosted by the Panchkula Municipal Corporation, with Mayor Kulbhushan Goyal leading the local arrangements for the national-level gathering.

• The primary agenda of the executive council was to deliberate on the financial health of municipal bodies and to push for greater administrative powers for the office of the Mayor in India.

• Key discussions during the session focused on urban infrastructure, the integration of AI in city management, and enhancing revenue generation through localized Property Tax reforms.

Additional Information

• All India Council of Mayors (AICM):

• The AICM is an apex representative body for Municipal Corporations in India, established to provide a unified platform for urban local governance.

• It acts as an intermediary between the Union Government and the various Urban Local Bodies (ULBs) to resolve policy bottlenecks and advocate for decentralization.

• Urban Local Governance in India:

• Urban governance is governed by the 74th Constitutional Amendment Act, 1992, which added Part IX-A and the Twelfth Schedule to the Constitution of India.

• The Act mandates the creation of three types of municipalities: Nagar Panchayats, Municipal Councils, and Municipal Corporations based on the population size and area.

• Panchkula City:

• Panchkula is a well-planned city in Haryana and is a part of the Chandigarh Capital Region (CCR) or Tricity.

• It serves as the headquarters of various Haryana State Government departments and is known for its high urban planning standards and green cover.

Important Points

• Issues of Municipal Autonomy: One of the recurring themes in AICM meetings is the demand for a uniform five-year term for Mayors across all states and the introduction of directly elected Mayors to ensure stability in urban planning.

• Sustainability Goals: The 115th meeting emphasized the role of cities in achieving India's Net Zero targets and the effective implementation of the Swachh Bharat Mission 2.0 and AMRUT (Atal Mission for Rejuvenation and Urban Transformation).

• Resource Mobilization: The council recommended that Urban Local Bodies should explore Municipal Bonds as a way to fund large-scale infrastructure projects instead of relying solely on state grants.

Q95. Answer: (c) South Korea

The correct answer is South Korea.

Key Points

• The 26th edition of the Asian Athletics Championships is scheduled to be held in Gumi, South Korea, in 2025.

• The decision to award the hosting rights to Gumi was made by the Asian Athletics Association (AAA) during its council meeting held in 2023.

• South Korea will be hosting this prestigious continental event for the third time, having previously organized it in Seoul in 1975 and Incheon in 2005.

• The city of Gumi, located in the Gyeongsangbuk-do province, won the bid against Xiamen, China, which was also a strong contender for the 2025 event.

• The championships serve as a major platform for athletes from across Asia to compete in various track and field disciplines and earn World Athletics ranking points.

• Hence, the correct answer is South Korea.

Additional Information

• Asian Athletics Association (AAA):

• The AAA is the governing body for the sport of athletics in Asia and is one of the six continental associations of World Athletics.

• It was founded in 1973 and is currently headquartered in Singapore.

• The association is responsible for organizing the Asian Athletics Championships, Asian Indoor Athletics Championships, and other age-group competitions.

• History of the Championships:

• The inaugural Asian Athletics Championships took place in 1973 in Marikina, Philippines.

• Since its inception, the event has been held biennially (every two years), with some exceptions due to global health or scheduling issues.

• The 25th edition of the championships was held in Bangkok, Thailand, in July 2023, marking the 50th anniversary of the AAA.

• Performance Trends:

• Countries like China, Japan, and India have historically dominated the medal tables in these championships.

• India hosted the event in 1989 (New Delhi), 2013 (Pune), and 2017 (Bhubaneswar).

Important Points

• Qualification for Global Events:

• The Asian Athletics Championships are crucial for athletes as gold medalists in individual events often gain direct qualification for the World Athletics Championships.

• The event features nearly 45 different disciplines, including sprints, middle and long-distance running, hurdles, relays, jumps, and throws.

• Host City Features (Gumi):

• Gumi is known as an industrial hub and is expected to utilize the Gumi Civic Stadium as the primary venue for the 2025 games.

• The city anticipates hosting over 1,200 athletes and officials from approximately 45 member nations of the AAA.

Q96. Answer: (a) 52%

The correct answer is 52%.

Key Points

• According to the survey report titled "Climate Change in the Indian Mind, 2025", which was conducted by the Yale Program on Climate Change Communication in collaboration with CVoter, approximately 52% of Indians reported experiencing severe air pollution in the past 12 months.

• The comprehensive survey was conducted over a period spanning from December 5, 2024, to February 18, 2025, capturing public sentiment across various demographics in India.

• The data highlights that a majority of the population is now physically witnessing the detrimental effects of environmental degradation, particularly in urban and industrial corridors where smog and particulate matter levels often exceed safety limits.

• The survey indicates that personal experience with climate-related hazards is becoming a primary driver of public concern, with air pollution being one of the most visible and frequently cited issues.

• In addition to air quality, the report found that a significant portion of respondents also observed extreme weather events, including heatwaves and erratic rainfall, which further underscores the vulnerability of the Indian population to global warming.

Additional Information

• Yale Program on Climate Change Communication (YPCCC):

• Based at Yale University, this program conducts scientific research on public climate change knowledge, attitudes, and policy support.

• Their work often utilizes the "Global Warming's Six Americas" framework to segment the public into groups like Alarmed, Concerned, and Disengaged.

• CVoter (Centre for Voting Opinion & Trends in Election Research):

• An international polling agency headquartered in India, CVoter provided the field data and survey methodology for the 2025 report.

• The survey involved a nationally representative sample of thousands of Indian adults to ensure the findings reflected the diversity of the country.

• Climate Change Awareness in India:

• The 2025 study revealed that roughly 82% of Indians believe that global warming is happening, a significant increase from previous decades.

• About 73% of respondents noted that they have observed changes in local rainfall patterns over the past 10 years.

• There is strong public support in India for government-led climate action and a transition toward renewable energy sources like solar and wind power.

Important Points

• Air Quality Index (AQI) Context: India frequently tops global lists for the most polluted cities, with PM2.5 levels often reaching "Hazardous" categories during the winter months due to stubble burning, vehicular emissions, and industrial discharge.

• Health Impact: Severe air pollution in India is linked to chronic respiratory diseases, cardiovascular issues, and an estimated 1.6 million premature deaths annually.

• Social Segmentation: The report categorized a large segment of Indians (approximately 70%) as either "Alarmed" or "Concerned" about climate change, indicating a high level of psychological readiness for environmental policy changes.

• Economic Vulnerability: As a developing nation with a large agrarian economy, India faces unique challenges as air pollution and global warming directly impact crop yields and labor productivity.

Q97. Answer: (b) Constitutional roles like Prime Minister and Chief Ministers

The correct answer is Constitutional roles like Prime Minister and Chief Ministers.

Key Points

• The Constitutional Amendment Bill introduced in August 2025 focuses on maintaining the sanctity and operational efficiency of high-ranking executive offices in India.

• It specifically stipulates that individuals who are in jail or under judicial custody are prohibited from holding or continuing in

Constitutional roles such as the Prime Minister and Chief Ministers of states.

• The primary objective of this legislative change is to ensure that the governance of the Union or a State is not conducted from a prison cell, which is considered a violation of constitutional morality and administrative protocols.

• This bill addresses a previous legal ambiguity where individuals could technically remain in power while being detained, provided they had not yet been formally convicted by a court of law.

• By targeting these specific roles, the bill ensures that the Head of Government at both the Central and State levels remains available for cabinet meetings, official duties, and public accountability. Hence, the correct answer is Constitutional roles like Prime Minister and Chief Ministers.

Additional Information

• Representation of the People Act, 1951:

• Prior to the August 2025 bill, disqualification was largely governed by Section 8 of this Act.

• It mandates that a person convicted of an offense and sentenced to imprisonment for not less than two years shall be disqualified from the date of such conviction.

• The new bill extends the scope of disqualification to include the period of custody or jail time prior to conviction for specific Constitutional offices.

• Relevant Constitutional Articles:

• Article 75 deals with the appointment of the Prime Minister by the President and the principle of collective responsibility to the Lok Sabha.

• Article 164 outlines the appointment of Chief Ministers by the Governor and their responsibility to the State Legislative Assembly.

• These articles emphasize that the Council of Ministers must be able to function effectively, a task deemed impossible if the leader is in judicial detention.

• Judicial Precedents:

• In the Lily Thomas vs. Union of India (2013) case, the Supreme Court of India ruled that any Member of Parliament or State Legislature convicted of a crime with a sentence of two years or more would be disqualified immediately.

• The August 2025 amendment seeks to go a step further by addressing the status of an "accused" leader currently in jail to prevent administrative vacuums.

Important Points

• Integrity of Public Office: The bill reinforces the idea that public office is a public trust, and holding such a high-profile position while in jail undermines the integrity and dignity of the institution.

• Governance Challenges: Legal experts have noted that a Chief Minister or Prime Minister in custody cannot access classified documents, chair Cabinet meetings, or meet foreign dignitaries, thus hindering the Sovereignty and Security of the state.

• Future Impact: This amendment is expected to significantly influence the political landscape of India, as it forces political parties to reconsider leadership choices if a candidate faces imminent arrest or judicial remand.

Q98. Answer: (c) New Delhi

The correct answer is New Delhi.

Key Points

• The 24th edition of the World Sustainable Development Summit (WSDS), which is the flagship annual event of The Energy and Resources Institute (TERI), is scheduled to be held in New Delhi in February 2025.

• The summit serves as a premier international platform that brings together Nobel laureates, political leaders, and decision-makers from across the globe to deliberate on sustainable development and climate change solutions.

• The 2025 edition focuses on accelerating action toward achieving the Sustainable Development Goals (SDGs) and addressing the specific challenges faced by the Global South in the context of climate resilience.

• By hosting the event in New Delhi, India continues to position itself as a central player in global environmental diplomacy and sustainable policy-making.

• The summit aims to create a "Call to Action" for governments and businesses to integrate environmental sustainability into their core economic frameworks.

Additional Information

• TERI (The Energy and Resources Institute):

• It is a leading research institute based in New Delhi, established in 1974.

• Initially founded as the Tata Energy Research Institute, it was renamed in 2003. It specializes in energy, environment, and sustainable development research.

• Transition of the Summit:

• The event was previously known as the Delhi Sustainable Development Summit (DSDS), which was first established in 2001.

• In 2016, it was transitioned to the World Sustainable Development Summit (WSDS) to reflect its expanding international scope

and significance.

• Global Participation:

• The summit typically witnesses participation from high-ranking officials of the United Nations, various Heads of State, and ministers from over 50 countries.

• It acts as a Track-Two diplomacy channel, facilitating informal discussions that support formal negotiations under the United Nations Framework Convention on Climate Change (UNFCCC).

• Key Themes:

• Recent editions have emphasized the Paris Agreement, the circular economy, green hydrogen, and just energy transitions.

• The summit highlights India's leadership in initiatives like the International Solar Alliance (ISA) and the Coalition for Disaster Resilient Infrastructure (CDRI).

Important Points

• The summit plays a critical role in highlighting the vulnerabilities of developing nations to extreme weather events and the need for climate finance from developed economies.

• WSDS is one of the few platforms originating in the Global South that successfully influences the global sustainability agenda and policy frameworks.

• The Director General of TERI is currently Dr. Vibha Dhawan, who oversees the strategic implementation of the summit and other research initiatives.

Q99. Answer: (a) Gulmarg

The correct answer is Gulmarg.

Key Points

• The Khelo India Winter Games 2025 is the fifth edition of this national-level multisport event, designed to promote winter sports culture and identify athletic talent across India.

• The second phase of the 2025 games was hosted in Gulmarg, situated in the Baramulla district of Jammu and Kashmir. This region is world-renowned for its snow-covered slopes and high-altitude terrain.

• While the first phase of the event took place in Leh, Ladakh, focusing on ice-based sports like Ice Hockey and Ice Skating, the Gulmarg phase was dedicated to snow-based disciplines.

• The event is organized by the Ministry of Youth Affairs and Sports in collaboration with the Sports Authority of India (SAI) and the Jammu & Kashmir Sports Council.

• Key sports held during the Gulmarg phase included Alpine Skiing, Nordic Skiing, and Snowboarding, utilizing the specialized infrastructure of the Gulmarg Gondola and surrounding ridges.

Additional Information

• History of Khelo India Winter Games: The inaugural edition of the Winter Games was held in 2020. Since then, Gulmarg and Leh have remained the primary venues due to their unique geographical advantages.

• Significance of Gulmarg: Known as the "Heartland of Winter Sports in India," Gulmarg sits at an elevation of approximately 2,650 meters. It features the Gulmarg Gondola, which is one of the highest cable cars in the world, facilitating international-standard skiing competitions.

• Objectives: The primary goal of the Khelo India initiative is to strengthen the sports ecosystem at the grassroots level and prepare Indian athletes for international competitions like the Winter Olympics.

• Economic and Tourism Impact: Beyond sports, these games significantly boost tourism in Jammu and Kashmir. The influx of athletes, coaches, and spectators from across the country highlights the region as a safe and premier destination for global winter tourism.

• Mascot and Identity: Recent editions of the games have used the Snow Leopard (often referred to as ‘Sheen-e-She’ or Shan) as the mascot to raise awareness about Himalayan wildlife conservation and the spirit of resilience in high altitudes.

Important Points

• Participation: The 2025 games saw participation from various Indian States, Union Territories, and institutional teams like the Services Sports Control Board (SSCB) and the Army Marksmanship Unit.

• Infrastructure Development: Under the Khelo India scheme, the government has provided financial assistance to upgrade facilities in Gulmarg, including specialized grooming machines for snow slopes and safety equipment for athletes.

• Talent Identification: Top-performing athletes from the Khelo India Winter Games are often selected for specialized training camps funded by the National Sports Development Fund.

Q100. Answer: (d) BioPharma, BioIndustrial, BioAgri, and BioServices

The correct answer is BioPharma, BioIndustrial, BioAgri, and BioServices.

Key Points

• The India BioEconomy Report (IBER) 2025, as highlighted by GS Krishnan, the President of the Association of Biotechnology

Led Enterprises (ABLE), outlines the massive growth potential of India's biotechnology sector.

• The report identifies four major sectors that constitute the backbone of the Indian bioeconomy: BioPharma, BioIndustrial, BioAgri, and BioServices.

• The BioPharma sector remains the largest contributor, driven by India's strengths in vaccine manufacturing, diagnostics, and therapeutics.

• BioIndustrial applications focus on sustainable solutions, including the production of bio-fuels, industrial enzymes, and bio-plastics to meet environmental goals.

• The BioAgri segment emphasizes genetically modified (GM) seeds, bio-fertilizers, and bio-pesticides to enhance agricultural yield and food security.

• BioServices involves Contract Research Organizations (CROs) and Contract Development and Manufacturing Organizations (CDMOs), providing clinical trial and research services to global partners.

Additional Information

• Economic Targets: The Indian bioeconomy is projected to reach a valuation of $150 billion by 2025 and aims for a long-term goal of $300 billion by 2030.

• Global Standing: India is currently ranked among the top 12 biotechnology destinations in the world and holds the 3rd position in the Asia-Pacific region.

• BioPharma Dominance: Within the bioeconomy, BioPharma accounts for nearly 49% to 50% of the total share, largely due to India's role as the "Pharmacy of the World."

• Startup Ecosystem: The number of biotech startups in India has grown exponentially, surpassing 6,000 enterprises, supported by government initiatives like Startup India.

• Bio-Services Growth: This sector is growing rapidly as global pharmaceutical companies outsource R&D and clinical trials to India due to cost-efficiency and a highly skilled workforce.

Important Points

• Regulatory Support: The Department of Biotechnology (DBT) and the Biotechnology Industry Research Assistance Council (BIRAC) are instrumental in providing funding and infrastructure to the industry.

• Bio-IT and Data: While not a primary pillar like the four mentioned, Bio-IT and Bioinformatics are emerging as critical enablers for drug discovery and personalized medicine.

• Sustainability: The BioIndustrial sector is aligned with India's Net Zero targets, specifically through the Ethanol Blending Programme and the development of Second-Generation (2G) Bio-refineries.

• Geographic Hubs: Major biotechnology clusters have been established in Bengaluru, Hyderabad, Pune, and the National Capital Region (NCR) to foster innovation.

• Yearly Performance: In the year 2023, the bioeconomy was valued at approximately $137 billion, showing a robust year-on-year growth exceeding 10%.

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