RRB Group D Official Paper (Held On: 22 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. Which of the following is a compound?

(a) Salt (NaCl)
(b) Soil
(c) Lemon juice
(d) Air

Q2. The image formed by a concave mirror of focal length 20 cm is real, inverted, and enlarged in size as compared to the size of the object. Which of the following is true about the position of the object?

(a) The object is placed at 20 cm from the pole of the mirror.
(b) The object is placed at 10 cm from the pole of the mirror.
(c) The object is placed between 20 cm and 40 cm from the pole of the mirror.
(d) The object is placed at 40 cm from the pole of the mirror.

Q3. Cyclohexane is best classified as which type of organic compound?

(a) A branched hydrocarbon with one or more unsaturated carbon bonds
(b) An aromatic compound containing a delocalised π -electron ring system
(c) An organic aldehyde consisting of a linear chain of six carbon atoms
(d) A saturated alicyclic compound composed of six carbon atoms in a ring

Q4. Which compound from the following is an unsaturated hydrocarbon?

(a) Ethene
(b) Butane
(c) Methane
(d) Propane

Q5. Which of the following best explains the liquefaction of gases under high pressure?

(a) Higher pressure reduces the space between particles, leading to liquefaction
(b) Increased molecular size leads to condensation
(c) Gases expand indefinitely, so pressure has no effect
(d) Higher pressure increases temperature, leading to phase change

Q6. The _____ helps in the movement of mucus along the lining of the respiratory tract.

(a) cuboidal epithelium
(b) ciliated columnar epithelium
(c) simple squamous epithelium
(d) stratified squamous epithelium

Q7. A ship floats on water because:

(a) the atmospheric pressure supports the ship
(b) the weight of water displaced equals the weight of the ship
(c) the surface tension holds it afloat
(d) the density of water is greater than that of the ship material

Q8. If two resistors are connected in series, then which of the following statements is correct regarding the equivalent resistance of the circuit?

(a) It will decrease.
(b) It will remain same.
(c) It will increase at first and then will decrease.
(d) It will increase.

Q9. In which of the following reactions do two compounds combine to form a new compound?

(a) $CaO + CO2 \rightarrow CaCO3$
(b) $C + O2 \rightarrow CO2$
(c) $Na + Cl2 \rightarrow NaCl$
(d) $H2 + Cl2 \rightarrow HCl$

Q10. What colour does copper turn when it undergoes corrosion over time?

(a) Green
(b) Red
(c) White
(d) Grey

Q11. Which of the following statements is NOT correct about linear velocity?

(a) Linear velocity is constant for uniform motion.
(b) Linear velocity depends on displacement and time.
(c) It is the rate of change of displacement.
(d) The SI unit of linear velocity is m/s^2.

Q12. According to Joule's law of heating, if the current flowing through a resistor is doubled while resistance and time remain constant, then the heat produced (H) will increase by a factor of _____.

(a) two
(b) eight
(c) sixteen
(d) four

Q13. Which of the following describes reproduction involving only one parent and no gametes?

(a) Fertilisation in frogs
(b) Seed formation in flowering plants
(c) Binary fission in Amoeba
(d) Internal fertilisation in mammals

Q14. Which of the following techniques is used for vegetative propagation in plants?

(a) Seed dispersal
(b) Fertilisation
(c) Cutting
(d) Pollination

Q15. Which of the following structures are made up of nervous tissue?

(a) Kidneys and liver
(b) Lungs and heart
(c) Bones and muscles
(d) Brain, spinal cord and nerves

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Q16. What is the formula unit mass of ZnO (zinc oxide)?

(a) 81 u
(b) 65 u
(c) 16 u
(d) 97 u

Q17. Sounds of single frequency and mixture of several frequencies are known as _____, respectively.

(a) tone and note
(b) tone and noise
(c) noise and tone
(d) note and tone

Q18. What is the role of sulphuric acid in the anodising process of aluminium?

(a) It dissolves aluminium completely.
(b) It acts as an electrolyte to help form a thicker oxide layer.
(c) It prevents oxidation of aluminium.
(d) It reacts with aluminium to form aluminium chloride.

Q19. Why do aquatic organisms breathe faster than terrestrial organisms?

(a) Because they absorb oxygen directly from sunlight through gills
(b) Because diffusion of oxygen in water is faster than in air
(c) Because the amount of dissolved oxygen in water is very low
(d) Because water exerts less resistance on breathing organs

Q20. Which of the following is an example of uniform circular motion?

(a) A car moving on a straight road
(b) A stone dropped from a height
(c) The Moon revolving around the Earth
(d) A train moving on a straight track

Q21. What is the correct path of the egg in the female reproductive system?

(a) Ovary → Vagina → Uterus
(b) Fallopian tube → Ovary → Uterus
(c) Uterus → Ovary → Fallopian tube
(d) Ovary → Fallopian tube → Uterus

Q22. A patient is unable to move his left hand, but brain scans show no damage. Which part of the nervous system is most likely to be affected?

(a) Central nervous system
(b) Peripheral nervous system
(c) Autonomic nervous system
(d) Parasympathetic nervous system

Q23. What is the main goal of crop variety improvement?

(a) To increase water content in soil
(b) To develop crops with better yield and useful traits
(c) To grow only ornamental plants
(d) To reduce the number of crops grown

Q24. If an object is placed at the centre of curvature (C) of a concave mirror, then what is the value of the magnification (m)?

(a) m = -1
(b) m = +1
(c) m < -1
(d) m = 0

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Q25. A force of 7 N acts on an object and displaces it through 8 m in the direction of the force. What is the work done in this case?

(a) 7 J
(b) 56 J
(c) 56 N
(d) 15 Nm

MATHEMATICS

Q26. Pipes A and B can fill an empty cistern in 65 minutes and 26 minutes, respectively. Both Pipe A and Pipe B are opened together. After how much time should Pipe B be turned off so that the empty cistern is completely filled in a total of 30 minutes?

(a) 20 minutes
(b) 15 minutes
(c) 10 minutes
(d) 14 minutes

Q27. In a right circular cylinder, diameter of the base is 21 cm. If eight times the sum of the areas of its two circular faces is five times the area of its curved surface, find the volume of the cylinder (in cm^3). (Take $\pi = 22/7$)

(a) 5842.2
(b) 5821.2
(c) 5812.2
(d) 5832.2

Q28. Ramesh bought an article for Rs. 5,000 and sold it to Suresh at a profit of 20%. Suresh then sold it further at a loss of 10%. For how much did Suresh sell the article?

(a) Rs. 5,200
(b) Rs. 5,400
(c) Rs. 5,600
(d) Rs. 5,800

Q29. 1/20 is what percentage of 11/60 ? (Round off to two decimal places)

(a) 54.54%
(b) 37.27%
(c) 42.27%
(d) 27.27%

Q30. A train passes a station platform in 60 seconds and a man standing on the platform in 40 seconds. If the speed of the train is 63 km/hr, calculate the length of the platform.

(a) 300 metres
(b) 350 metres
(c) 550 metres
(d) 400 metres

Q31. The mode of the observations 21, 29, 35, 24, 25, 33, 24, 23, 26, 28, 35, 27, 20, 35 and 20 is:4288

(a) 24
(b) 29
(c) 35
(d) 21

Q32. The average of 7 numbers is 23. If each number is decreased by 7, what will the new average be?

(a) 23
(b) 9
(c) 7
(d) 16

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Q33. An item is sold for Rs. 6,500 after two successive discounts of 35% and 20%. What is the marked price (in Rs.) of the item?

(a) 12,674
(b) 12,500
(c) 12,435
(d) 12,560

Q34. The monthly incomes of two friends Mukund and Sachin are in the ratio 5 : 9 respectively and each of them saves Rs. 45,000 every month. If the ratio of their monthly expenditure is 1 : 3, then find the monthly income of Mukund (in Rs.).

(a) 74000
(b) 1,05,000
(c) 75,000
(d) 76,000

Q35. The price of a branded pen is Rs. 180 and that of a pencil is Rs. 3.50. If the total price of x branded pens and y pencils is Rs. 935 and x + y = 15, then what is the value of $(x^2 + y^2)$?

(a) 125
(b) 164
(c) 205
(d) 181

Q36. Simplify: $[(9x + 4y)^2 - (9x - 4y)^2] \div 24x$

(a) 16x
(b) 8x
(c) 6y
(d) 12xy

Q37. In quadrilateral PQRS, the bisectors of angle R and angle S meet at the point T (inside the quadrilateral) and angle STR = 36°. If the ratio of angle P to angle Q is 3 : 5, then what is the difference between the measures of angle Q and angle P?

(a) 18°
(b) 21°
(c) 25°
(d) 22°

Q38. Simplify: $(\sin 60° \cos 30°)/(\tan 45°)$

(a) 1
(b) 1/2
(c) 3/4
(d) √3/2

Q39. A, B and C can do a piece of work in 2, 4 and 4 days, respectively. How long (in days) will they take to do thrice the same work, working together?

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

Q40. Find the single discount (approximately) equal to three consecutive discounts of 6%, 5% and 11%.

(a) 21.73%
(b) 20.52%
(c) 23.23%
(d) 21.86%

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Q41. Rs. 5,575 is divided among X, Y and Z in such a way that if Rs. 85, Rs. 65 and Rs. 61 is deducted from their respective shares, they have money in the ratio 5:11:20. Find the difference between the original shares of Y and Z.

(a) Rs. 1,191
(b) Rs. 1,241
(c) Rs. 1,337
(d) Rs. 1,491

Q42. The simplified value of $\sqrt{256} - \sqrt{169} + (\sqrt{144} - \sqrt{25})^2$ is:

(a) 47
(b) 37
(c) 52
(d) 41

Q43. Find the ratio between the fourth proportional of 4, 8 and 19 to the mean proportional of 9 and 4.

(a) 19 : 3
(b) 22 : 7
(c) 16 : 9
(d) 19 : 4

Q44. Find the smallest number which when increased by 10 is completely divisible by 12, 15, 18 and 20.

(a) 170
(b) 200
(c) 180
(d) 190

Q45. The diagonal of a rectangle is $\sqrt{89}$ cm and its area is 40 cm^2. Find the perimeter of the rectangle.

(a) 26 cm
(b) 80 cm
(c) 13 cm
(d) 169 cm

Q46. A camp has provisions for 20 pupils for 12 days. In how many days will the same provisions be used up, if the strength of the camp is increased to 80 pupils?

(a) 2
(b) 6
(c) 4
(d) 3

Q47. The amount on a sum of Rs. 4,800 at 15% per annum compound interest, compounded annually, in 2 years will be:

(a) Rs. 7,194
(b) Rs. 6,348
(c) Rs. 6,717
(d) Rs. 6,836

Q48. The distance between points A and B is 933 km. Namit travels from A to B at a speed of 70 km/hr and returns at a speed of 111 km/hr. Calculate Namit's average speed for the entire journey (rounded off to two decimal places).

(a) 85.86 km/hr
(b) 81.26 km/hr
(c) 88.58 km/hr
(d) 94.58 km/hr

Q49. The product of the present ages of Ram and Lalith is 216 years, and their age ratio is 6 : 1. Find the difference in their ages.

(a) 18 years
(b) 36 years

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(c) 30 years
(d) 24 years

Q50. The expenditure of Sudha is 200% more than her savings. If her expenditure decreases by 10% and savings increase by 34%, then by what percentage does her income increase?
(a) 1%
(b) 3%
(c) 4%
(d) 6%

GENERAL INTELLIGENCE & REASONING

Q51. Seven boxes, L, M, N, O, Q, R and S, are kept one over the other, but not necessarily in the same order. Only L is kept above Q. Only three boxes are kept between L and R. Only O is kept below N. S is kept immediately above M. Which box is kept second above M?
(a) Q
(b) L
(c) N
(d) O

Q52. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.
Statements:
All pilots are captains.
All captains are drivers.
Some drivers are teachers.
Conclusions
(I) All pilots are drivers.
(II) Some teachers are pilots.
(a) Only conclusion (II) follows.
(b) Neither conclusion (I) nor (II) follows.
(c) Only conclusion (I) follows.
(d) Both conclusions (I) and (II) follow.

Q53. Seven friends, B, C, D, T, U, V and W, are sitting in a straight line facing north. Only two people sit between V and D. Only U sits to the right of T. Only one person sits between D and T. C sits at some place to the right of B but at some place to the left of W. How many people sit between W and B?
(a) One
(b) Three
(c) Four
(d) Two

Q54. Refer to the given series and answer the question that follows. (All numbers are single digit numbers only.) Counting to be done from left to right.
(Left) 6 5 8 8 5 4 7 7 4 2 7 9 2 2 5 7 4 8 8 2 1 8 9 (Right)
How many such odd digits are there, each of which is immediately preceded by an odd digit and also immediately followed by an odd digit?
(a) None
(b) Three
(c) One
(d) Two

Q55. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

DER UVI LMZ CDQ ?

(a) THU
(b) HIT
(c) TUH
(d) THI

Q56. Mr. Akte ranked 54^(th) from the top and 19^(th) from the bottom in his class. How many students are there in his class?

(a) 68
(b) 72
(c) 73
(d) 70

Q57. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

33 - 15 ÷ 6 + 120 × 8 = ?

(a) 120
(b) 108
(c) 112
(d) 115

Q58. 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) LGJ
(b) RMQ
(c) PKN
(d) MHK

Q59. XBYA is related to CGDF in a certain way based on the English alphabetical order. In the same way, ZDAC is related to EIFH. To which of the given options is BFCE related, following the same logic?

(a) GKHJ
(b) GLGK
(c) GKGJ
(d) GJGJ

Q60. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(14, 14.4, 13.7)

(32, 32.4, 31.7)

(a) (25, 25.4, 24.7)
(b) (78, 78.4, 75.7)
(c) (63, 63.4, 61.7)
(d) (46, 46.4, 44.7)

Q61. RL 12 is related to VQ 16 in a certain way. In the same way, NH 15 is related to RM 19. To which of the given options is IC 24 related, following the same logic?

(a) LG 29
(b) MH 28
(c) KJ 28
(d) KH 29

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Q62. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All balls are hens.

All rabbits are hens.

Conclusions:

(I) Some balls are rabbits.

(II) Some hens are rabbits.

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

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

100, 97, 91, 82, 70, ?

(a) 54
(b) 53
(c) 52
(d) 55

Q64. Which of the given letter-number clusters will replace the question mark (?) in the following series to make it logically complete?

YCG 18 HLP 23 QUY 28 ZDH 33 ?

(a) IMQ 38
(b) IRB 37
(c) INP 38
(d) ILP 37

Q65. 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) 7 1 3 4 7 5 1 3 6 6 7 9 5 9 6 7 8 1 3 7 3 (Right)

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

(NOTE: 1 is also a perfect square)

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

Q66. Oren starts from Point A and drives 13 km towards the East. He then takes a left turn, drives 6 km, turns left and drives 17 km. He then takes a left turn and drives 13 km. He takes a final left turn, drives 4 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) 7 km to the South
(b) 8 km to the South
(c) 8 km to the North
(d) 7 km to the North

Q67. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only.

(Left) ? % 4 5 % & ^ ? \ \ 4 $ % & 5 4 / 4 % ^ 7 (Right)

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

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followed by a symbol?

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

Q68. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

KIH−DBA

OML−HFE

(a) TQO−LJI
(b) TQO−MKJ
(c) TRQ−MKJ
(d) TRQ−LKI

Q69. What should come in place of the question mark (?) in the given series?

35 40 30 45 25 ?

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

Q70. After walking 20 metres north from point A, Jane turns right and walks another 15 metres. Then she turns right again and walks 50 metres to stop at point B. In which direction is point A with respect to point B?

(a) South-west
(b) West
(c) East
(d) North-west

Q71. What will come in the place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

71 ÷ 9 + 192 × 16 - 41 = ?

(a) 591
(b) 619
(c) 668
(d) 523

Q72. If '+' means 'subtraction', '−' means 'multiplication', '×' means 'division', and '÷' means 'addition', then what will come in place of the question mark (?) in the following equation?

25 – 6 ÷ 4 + 16 × 4 ÷ 16 + 22 = ?

(a) 146
(b) 144
(c) 142
(d) 145

Q73. A, B, C, D and E are sitting around a circular table, facing the centre. B is sitting third to the right of C. A is sitting third to the left of C. D and A are immediate neighbours. Who is to the immediate left of C?

(a) D
(b) B
(c) E
(d) A

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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) NMJ
(b) RQN
(c) XXT
(d) CBY

Q75. In a certain code language, ‘BACK’ is coded as ‘8561’ and ‘TACK’ is coded as ‘6458’. What is the code for ‘T’ in that language?

(a) 5
(b) 6
(c) 1
(d) 4

Q76. Refer to the following series and answer the question (all numbers are single digit numbers only). Counting to be done from left to right only.

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

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

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

Q77. In a certain code language, ‘bowl tin leaf’ is coded as ‘ef cz bi’ and ‘leaf mode theme’ is coded as ‘cz nx an’. How is ‘leaf’ coded in that language?

(a) ef
(b) cz
(c) nx
(d) bi

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

48 56 71 93 122 ?

(a) 157
(b) 156
(c) 159
(d) 158

Q79. Six people, A, B, C, D, E and F, are sitting in a row, facing north. D sits to the immediate left of F. C sits third to the left of B. F is an immediate neighbour of C. E sits second to the right of C. A sits to the immediate left of E. Who sits at the extreme right end of the line?

(a) B
(b) E
(c) A
(d) F

Q80. In a certain code language,

A ± B means ‘A is the wife of B’,

A * B means ‘A is the daughter of B’,

A Rs. B means ‘A is the father of B’ and

A # B means ‘A is the brother of B’.

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

(a) Mother

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(b) Wife
(c) Brother's wife
(d) Father's mother

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. What is the name of the initiative launched by the Punjab government to ensure women's safety and dignity in 2025?
(a) Mission Shakti
(b) Project Hifazat
(c) Project Suraksha
(d) Mission Vatsalya

Q82. Which of the following was released by the Reserve Bank of India in January 2025 to streamline credit information frameworks?
(a) Priority Sector Lending Master Directions, 2025
(b) External Borrowing Guidelines, 2025
(c) Credit Information Reporting Directions, 2025
(d) Private Sector Credit Guidelines, 2025

Q83. In May 2025, which advanced research facility was inaugurated by the Defence Research and Development Organisation (DRDO) with the aim to further strengthen indigenous quantum capabilities for strategic and defence applications?
(a) Quantum Technology Research Centre, Delhi
(b) Bharat Quantum Institute, Pune
(c) Quantum Defence Lab, Hyderabad
(d) National Quantum Hub, Bengaluru

Q84. The National Red List Roadmap launched in 2025 aims primarily to _____.
(a) Reduce carbon emissions from industries
(b) Promote eco-tourism across national parks
(c) Increase and expand the country's overall forest cover by 10% by 2030
(d) Assess and monitor the conservation status of India's flora and fauna

Q85. Which country became the first team to qualify for the 2026 FIFA World Cup (excluding host nations)?
(a) Japan
(b) South Korea
(c) Iran
(d) Australia

Q86. The Railways ordered which safety feature to be installed at stations in Pune in June 2025?
(a) Reserved coaches for women
(b) Body scanning machines
(c) Surveillance camera systems
(d) Panic alert buttons

Q87. Who among the following is the Chairman of the committee constituted to examine the provision of "One Nation One Election" in India?
(a) Pratibha Patil
(b) Ram Nath Kovind
(c) Jagdeesh Dhankhad
(d) Keshav Chand

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Q88. From March 9 to 12, 2025, the second part of India's fifth Khelo India Winter Games was conducted in which of the following places?

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

Q89. What type of bridge is the new Pamban Rail Bridge, inaugurated in April 2025?

(a) Suspension bridge
(b) Cable-stayed bridge
(c) Vertical lift bridge
(d) Arch bridge

Q90. According to Union Budget 2025–26, approximately _____ was allocated for the Ministry of Environment, Forest and Climate Change in India.

(a) Rs. 1,720 crore
(b) Rs. 3,413 crore
(c) Rs. 2,672 crore
(d) Rs. 2,958 crore

Q91. What is the name of DRDO's homegrown multi-layered defense system, showcased for the first time at the 2025 Republic Day parade and Aero India 2025?

(a) Vayu-Prahar Kavach
(b) Surya-Vajra
(c) Agni-Shakti
(d) Rakshak-Suraksha Kavach

Q92. What is India’s rank in the WEF Energy Transition Index, 2025?

(a) 68th
(b) 71st
(c) 75th
(d) 63rd

Q93. Which of the following political parties announced a nationwide protest on November 18, 2025, against rising atrocities on marginalized groups in India?

(a) Aam Aadmi Party
(b) Communist Party of India
(c) Bharatiya Janata Party
(d) Indian National Congress

Q94. Where was the 2025 Hyundai Archery World Cup Grand Final held in October 2025?

(a) Japan
(b) USA
(c) China
(d) Italy

Q95. What happens if the accused minister (Prime Minister / Chief Minister) is granted bail within 30 days according to the Constitution (130^(th) Amendment) Bill, 2025?

(a) They are automatically disqualified for 5 years.
(b) They are removed from office permanently.
(c) No action is taken; they can continue in office.
(d) They are suspended from their post for 30 more days.

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Q96. Who is the author of the Lithuanian novel, 'The Last Day', which was translated into Hindi by the Sahitya Akademi in October 2025 as part of celebrating literary exchange and cultural collaboration?

(a) Vincas Mykolaitis-Putinas
(b) Jurga Ivanauskaitė
(c) Balys Sruoga
(d) Jaroslavas Melnikas

Q97. Which of the following bilateral agreements was signed between India and Singapore and marked the upgrade of their relationship by exchanging several MoUs in areas such as semiconductors, digital technologies and skills development?

(a) India-Singapore Strategic Economic Cooperation Agreement
(b) India-Singapore Indo-Pacific Security Treaty
(c) India-Singapore Comprehensive Economic Partnership Agreement
(d) India-Singapore Comprehensive Strategic Partnership

Q98. Which state hosted the Khelo India Youth Games, 2025?

(a) Tamil Nadu
(b) Uttar Pradesh
(c) Maharashtra
(d) Bihar

Q99. Which Ukrainian city suffered a deadly Russian missile strike in mid-June 2025?

(a) Kharkiv
(b) Lviv
(c) Kyiv
(d) Dnipro

Q100. Who was awarded the prestigious Dadasaheb Phalke Award, the highest honour in Indian cinema, at the 70^(th) National Film Awards ceremony on 8 October 2024?

(a) Rekha
(b) Vinod Mehra
(c) Amitabh Bachchan
(d) Mithun Chakraborty

ANSWER KEY

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

SOLUTIONS

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Q1. Answer: (a) Salt (NaCl)

p data-end="57" data-start="0">The correct answer is Salt (NaCl).

Key Points

• A compound is a substance formed when two or more chemical elements are chemically bonded together in a fixed ratio by mass.

• Salt (NaCl), also known as Sodium Chloride, is a classic example of a compound. It is formed by the ionic bonding of Sodium (Na) and Chlorine (Cl). Hence, option 1 is correct.

• In a compound, the properties of the resulting substance are entirely different from its constituent elements. For instance, Sodium is a highly reactive metal and Chlorine is a toxic gas, but their compound, Salt, is a stable, edible crystalline solid used in food preservation and seasoning.

• The constituents of a compound cannot be separated by physical methods such as filtration, decantation, or centrifugation. They can only be separated into their elements by chemical or electrochemical reactions like electrolysis.

• Compounds always follow the Law of Constant Proportions, meaning every sample of NaCl will always contain Sodium and Chlorine in the same 1:1 ratio of atoms.

Additional Information

• Soil:

• Soil is a heterogeneous mixture. It consists of varying amounts of minerals, organic matter (humus), gases, liquids, and countless organisms.

• Because its composition is not uniform and the components are not chemically bonded in a fixed ratio, it does not qualify as a compound. Hence, option 2 is incorrect.

• Lemon Juice:

• Lemon juice is a mixture (specifically a solution) containing water (H2O), citric acid, Vitamin C, and sugars.

• The ingredients in lemon juice retain their individual chemical identities and can vary in concentration depending on the fruit. Hence, option 3 is incorrect.

• Air:

• Air is a homogeneous mixture of several gases. It primarily consists of Nitrogen (78%), Oxygen (21%), Argon (0.9%), and Carbon Dioxide (0.04%).

• Since these gases are physically mixed and not chemically combined, and their proportions can vary slightly based on location or altitude, air is classified as a mixture rather than a compound. Hence, option 4 is incorrect.

Important Points

• Characteristics of Compounds:

• A compound has a fixed melting point and boiling point.

• The formation of a compound usually involves the absorption or release of energy in the form of heat or light.

• Difference between Mixtures and Compounds:

• Mixtures can be separated by physical means (like using a magnet to separate iron filings from sulfur), whereas compounds (like Iron Sulfide) cannot.

• Common examples of other compounds include Water (H2O), Carbon Dioxide (CO2), and Methane (CH4).

Q2. Answer: (c) The object is placed between 20 cm and 40 cm from the pole of the mirror.

The correct answer is The object is placed between 20 cm and 40 cm from the pole of the mirror.

Key Points

• A concave mirror is a spherical mirror with an inwardly curved reflecting surface. The nature of the image formed depends on the distance of the object from the pole (P) of the mirror.

• In this problem, the focal length (f) is given as 20 cm. The center of curvature (C), which is the point at a distance of radius of curvature (R), is calculated as R = 2f. Thus, C is at 40 cm from the pole.

• For a concave mirror to produce a real, inverted, and enlarged image, the object must be positioned between the principal focus (F) and the center of curvature (C).

• Since F is at 20 cm and C is at 40 cm, the object must be placed at a distance greater than 20 cm but less than 40 cm. Hence, statement 3 is correct.

• If the object is placed at exactly 20 cm (at F), the reflected rays become parallel, and the image is formed at infinity, being highly enlarged. Hence, statement 1 is incorrect.

• If the object is placed at 10 cm (between P and F), the image formed is virtual, erect, and enlarged behind the mirror. Hence, statement 2 is incorrect.

• If the object is placed at 40 cm (at C), the image formed is real, inverted, and of the same size as the object, located at C. Hence, statement 4 is incorrect.

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Additional Information

• Image Formation by Concave Mirror:

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

• Beyond C: When the object is beyond 40 cm, the image is formed between F and C. It is real, inverted, and diminished.

• At C: When the object is at 40 cm, the image is formed at C. It is real, inverted, and same size.

• Between F and C: When the object is between 20 cm and 40 cm, the image is formed beyond C. It is real, inverted, and enlarged.

• At F: When the object is at 20 cm, the image is formed at infinity. It is real, inverted, and highly enlarged.

• Between P and F: When the object is within 20 cm, the image is virtual, erect, and enlarged.

• Mirror Formula and Magnification:

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

• Magnification (m) is the ratio of the height of the image to the height of the object, expressed as m = h'/h = -v/u.

• For a real and inverted image, the magnification is negative. If the image is enlarged, the absolute value of m is greater than 1.

Important Points

• Sign Convention: According to the Cartesian sign convention, the focal length of a concave mirror is always negative, while that of a convex mirror is positive.

• Real vs Virtual Image: A real image can be obtained on a screen because the light rays actually intersect. A virtual image cannot be obtained on a screen as the rays only appear to diverge from a point.

• Common Applications: Concave mirrors are used in reflecting telescopes, shaving mirrors to see an enlarged view of the face, and by dentists to see enlarged images of teeth. They are also used in headlights of vehicles and searchlights to obtain powerful parallel beams of light when the source is kept at the focus.

Q3. Answer: (d) A saturated alicyclic compound composed of six carbon atoms in a ring

The correct answer is A saturated alicyclic compound composed of six carbon atoms in a ring.

Key Points

• Cyclohexane is a cycloalkane with the molecular formula C6H12. It consists of six carbon atoms arranged in a ring, with each carbon atom bonded to two hydrogen atoms.

• The term saturated indicates that all the carbon-carbon bonds in the molecule are single bonds, and it contains the maximum possible number of hydrogen atoms for its cyclic structure. Hence, statement 4 is correct.

• It is classified as an alicyclic compound because it is both aliphatic (non-aromatic) and cyclic. It does not possess a linear chain of atoms. Hence, statement 3 is incorrect.

• Unlike benzene, cyclohexane does not have a delocalised π-electron ring system and is not aromatic. Each carbon in cyclohexane is sp3 hybridized. Hence, statement 2 is incorrect.

• Cyclohexane is a simple ring structure and is not classified as a branched hydrocarbon, nor does it contain unsaturated double or triple bonds. Hence, statement 1 is incorrect.

Additional Information

• Structure and Conformations:

• Due to the tetrahedral bond angles of sp3 hybridized carbon, cyclohexane is not a planar molecule. It adopts various conformations to minimize torsional strain and angle strain.

• The most stable arrangement is the chair conformation, followed by the twist-boat, boat, and half-chair conformations.

• Physical Properties:

• Cyclohexane is a colorless, flammable liquid at room temperature with a detergent-like odor.

• It has a molar mass of approximately 84.16 g/mol, a density of 0.779 g/cm³, and a boiling point of 80.7 °C.

• Industrial Production and Uses:

• On a large scale, it is produced by the hydrogenation of benzene in the presence of a nickel or platinum catalyst.

• It serves as a critical intermediate in the production of nylon. Specifically, it is oxidized to produce cyclohexanone and cyclohexanol, which are then used to manufacture adipic acid and caprolactam.

• It is also widely used as a non-polar solvent in chemical laboratories and industrial processes.

Important Points

• Alicyclic vs Aromatic:

• Alicyclic compounds (like cyclohexane) behave more like open-chain aliphatic compounds in their chemical reactions, such as free radical substitution.

• Aromatic compounds (like benzene, C6H6) follow Huckel's Rule (4n + 2 π electrons) and undergo electrophilic aromatic substitution rather than addition.

• Hybridization: In cyclohexane, every carbon atom uses four sp3 hybrid orbitals to form sigma (σ) bonds, resulting in a bond angle of approximately 109.5°.

• Cycloalkanes General Formula: The general formula for a monocyclic cycloalkane like cyclohexane is CnH2n, which differs from the open-chain alkane formula CnH2n+2 because of the ring closure.

Q4. Answer: (a) Ethene

The correct answer is Ethene.

Key Points

• Hydrocarbons are organic compounds consisting entirely of Hydrogen and Carbon atoms. They are classified into two main categories: saturated and unsaturated based on the types of bonds present between the carbon atoms.

• Unsaturated hydrocarbons are those hydrocarbons that contain at least one double bond or triple bond between adjacent carbon atoms. These compounds are more reactive than saturated ones.

• Ethene (C2H4), also known as ethylene, belongs to the alkene group. It contains a carbon-carbon double bond (C=C), which makes it an unsaturated hydrocarbon. Hence, option 1 is the correct answer.

• Methane (CH4) is the simplest alkane. It consists of a single carbon atom bonded to four hydrogen atoms through single covalent bonds, making it a saturated hydrocarbon. Hence, option 3 is incorrect.

• Propane (C3H8) and Butane (C4H10) are also members of the alkane series. They consist of carbon chains where all carbon-carbon bonds are single bonds. These are classified as saturated hydrocarbons. Hence, options 2 and 4 are incorrect.

Additional Information

• Alkanes (Saturated Hydrocarbons):

• The general formula for alkanes is CnH2n+2.

• In these molecules, every carbon atom is sp3 hybridized, forming four sigma bonds.

• Common examples include Ethane, Pentane, and Hexane. They are generally used as fuels due to their high combustion energy.

• Alkenes and Alkynes (Unsaturated Hydrocarbons):

• Alkenes contain at least one double bond and follow the general formula CnH2n. Carbon atoms in the double bond are sp2 hybridized.

• Alkynes contain at least one triple bond and follow the general formula CnH2n-2 (e.g., Ethyne or Acetylene). Carbon atoms in the triple bond are sp hybridized.

• Unsaturated hydrocarbons undergo addition reactions (like hydrogenation or bromination) to become saturated.

• Chemical Tests:

• The Bromine Water Test is used to distinguish between saturated and unsaturated compounds. An unsaturated hydrocarbon will decolorize the reddish-brown bromine water, while a saturated one will not react under normal conditions.

Important Points

• Methane is the primary component of Natural Gas and Biogas. It is a potent greenhouse gas but is widely used as a clean-burning fuel.

• Propane and Butane are the main constituents of Liquefied Petroleum Gas (LPG), which is used globally for cooking and heating.

• Ethene plays a vital biological role as a plant hormone responsible for the ripening of fruits. Industrially, it is the precursor for polyethylene (polythene), the most common plastic in use today.

• The number of carbon atoms determines the prefix of the name: Meth- (1), Eth- (2), Prop- (3), But- (4), Pent- (5), etc.

Q5. Answer: (a) Higher pressure reduces the space between particles, leading to liquefaction

The correct answer is Higher pressure reduces the space between particles, leading to liquefaction.

Key Points

• Liquefaction of gases is the physical process by which a substance in the gaseous state is converted into the liquid state. This is typically achieved through the manipulation of pressure and temperature.

• According to the Kinetic Molecular Theory, the particles in a gas are separated by large distances and possess high kinetic energy, which allows them to move randomly. When high pressure is applied to a gas, the intermolecular space between the particles is significantly reduced. Hence, the primary explanation for liquefaction under pressure is the reduction of space between particles.

• As the particles are forced closer together by external pressure, the intermolecular forces of attraction (such as Van der Waals forces) become strong enough to bind the particles together, causing the gas to condense into a liquid. Hence, statement 1 is correct.

• The molecular size of a substance does not change during this process; rather, it is the void volume or the "empty space" between the molecules that decreases. Hence, statement 2 is incorrect.

• While gases do have the property of expansibility and can fill any container, pressure has a profound effect on their state. Increasing pressure decreases volume (as per Boyle's Law), making liquefaction possible. Hence, statement 3 is incorrect.

• Applying pressure can sometimes lead to an increase in temperature (adiabatic compression), but this increase actually hinders liquefaction because higher temperatures increase the kinetic energy of the particles, helping them resist attractive forces. For liquefaction to be successful, the heat generated must be removed by cooling. Hence, statement 4 is incorrect.

Additional Information

• Critical Temperature: This is the maximum temperature at which a gas can be liquefied by the application of pressure alone. Above this temperature, the kinetic energy of the molecules is so high that no amount of pressure can force them into a liquid state. For example, the critical temperature of Carbon Dioxide (CO_2) is 31.1 degrees Celsius.

• Critical Pressure: This refers to the minimum pressure required to liquefy a gas exactly at its critical temperature. Every gas has a unique set of critical constants that determine its behavior under compression.

• Thomas Andrews' Experiments: The relationship between pressure, volume, and temperature (PVT) for gases was famously studied by Thomas Andrews using Carbon Dioxide. His isotherms demonstrated that liquefaction is a gradual transition where gas and liquid exist in equilibrium until the process is complete.

• Applications of Liquefaction: This scientific principle is used in several industrial applications, such as the production of Liquid Petroleum Gas (LPG) for domestic fuel, Liquid Oxygen for medical and aerospace purposes, and Liquid Nitrogen which is used in cryogenics and food preservation at temperatures around -196 degrees Celsius.

Important Points

• Joule-Thomson Effect: In many industrial processes, gases are liquefied using the Joule-Thomson effect, which involves the cooling of a real gas as it expands from a region of high pressure to low pressure through a porous plug or a valve.

• Intermolecular Forces: The ease with which a gas can be liquefied depends on the strength of its intermolecular forces. Gases like Ammonia (NH_3) and Sulfur Dioxide (SO_2) are easier to liquefy than Permanent Gases like Hydrogen (H_2) or Helium (He) because they have stronger attractive forces.

• Phase Transitions: Liquefaction is an exothermic process, meaning it releases latent heat. To convert a gas to a liquid, the system must lose energy to the surroundings, which is why cooling is almost always paired with compression in practical setups.

Q6. Answer: (b) ciliated columnar epithelium

The correct answer is ciliated columnar epithelium.

Key Points

• Ciliated columnar epithelium is a specialized type of epithelial tissue consisting of tall, pillar-like cells that possess hair-like protoplasmic outgrowths called cilia on their free surface.

• These cilia are capable of rhythmic beating, which creates a current to move mucus, eggs, or other particles in a specific direction along the surface of the cell layer.

• In the respiratory tract, specifically the trachea and bronchi, this tissue plays a vital role in the muco-ciliary escalator, where it moves trapped dust particles and microbes towards the throat to be expelled. Hence, the statement regarding mucus movement is correct.

• The nucleus of these cells is typically oval-shaped and located near the basal region of the cell, providing enough space for the ciliary apparatus at the apical end.

• Apart from the respiratory tract, this tissue is also found in the fallopian tubes (oviducts) of the female reproductive system, where it helps in the propulsion of the ovum towards the uterus.

Additional Information

• Simple Squamous Epithelium:

• It consists of a single layer of extremely thin and flat cells, forming a delicate lining that looks like floor tiles.

• Its primary function is to facilitate the transport of substances through a selectively permeable surface via diffusion or filtration.

• It is found in locations where rapid exchange is required, such as the alveoli of the lungs, the lining of blood vessels (endothelium), and Bowman's capsule in the kidneys.

• Cuboidal Epithelium:

• As the name suggests, the cells are cube-shaped in appearance with centrally located spherical nuclei.

• This tissue provides mechanical support and is primarily involved in secretion and absorption.

• Common locations include the lining of kidney tubules, ducts of salivary glands, and the surface of the ovaries (germinal epithelium).

• Stratified Squamous Epithelium:

• This tissue is composed of multiple layers of cells arranged in a pattern to prevent wear and tear and mechanical injury.

• The deepest layers are often columnar or cuboidal, while the superficial layers are flat (squamous).

• It is found in the skin (where it is keratinized to prevent water loss) and the lining of the mouth and esophagus (non-keratinized).

Important Points

• Goblet Cells: These are specialized unicellular glands often interspersed within the ciliated columnar epithelium of the respiratory tract to secrete mucus, which traps foreign particles.

• Basement Membrane: Like all epithelial tissues, these cells rest on a non-cellular fibrous layer called the basement membrane, which separates them from the underlying connective tissue.

• Clinical Relevance: Damage to the cilia (e.g., due to smoking or pollution) impairs the movement of mucus, leading to respiratory infections and conditions like chronic bronchitis.

• Classification: Epithelial tissues are classified based on the number of layers (Simple vs. Stratified) and the shape of the cells (Squamous, Cuboidal, or Columnar).

Q7. Answer: (b) the weight of water displaced equals the weight of the ship

The correct answer is the weight of water displaced equals the weight of the ship.

Key Points

• A ship floats on water based on Archimedes' Principle, which states that any object, wholly or partially immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object.

• According to the Law of Flotation, for an object to float, the weight of the liquid displaced by its submerged part must be exactly equal to the total weight of the object. Hence, statement 2 is correct.

• The Upthrust or Buoyant Force acts in the upward direction, opposing the weight of the ship (gravity) that acts downwards. When these two forces are in equilibrium, the ship stays afloat.

• Atmospheric pressure acts uniformly on the surface of the water and the ship from all sides; it does not provide the net upward force required for flotation. Hence, statement 1 is incorrect.

• While surface tension allows very light objects like needles or insects to stay on the water's surface, it is a molecular force that is far too weak to support the massive weight of a steel ship. Hence, statement 3 is incorrect.

• Most ships are made of steel or iron, which have a density much higher than that of water (7.8 g/cm³ compared to 1 g/cm³). Therefore, the "material" itself is denser than water, but the average density of the ship (including the large volume of air trapped in the hull) is less than that of water. Hence, statement 4 is incorrect.

Additional Information

• Buoyancy: This is the upward force exerted by a fluid that opposes the weight of an immersed object. In a column of fluid, pressure increases with depth as a result of the weight of the overlying fluid. Thus, the pressure at the bottom of a submerged object is greater than at the top, resulting in a net upward force.

• Density and Volume: The reason a heavy iron ship floats while a small iron nail sinks is due to volume. The ship is designed with a hollow hull, which increases its total volume without significantly increasing its mass, thereby reducing its average density to a value lower than the density of water.

• Relative Density: Also known as Specific Gravity, it is the ratio of the density of a substance to the density of a reference material (usually water at 4 degrees Celsius). If an object's relative density is less than 1, it will float.

• Displacement: When a ship is placed in water, it pushes the water aside. The amount of water "moved" is called displacement. For a ship to remain stable, the Center of Gravity must be vertically aligned with the Center of Buoyancy (the geometric center of the displaced water).

Important Points

• Plimsoll Line: This is a marking on a ship's hull that indicates the maximum depth to which the vessel may be safely immersed when loaded with cargo. This depth varies based on the water's salinity (density) and temperature.

• Saltwater vs. Freshwater: Objects float higher in saltwater (like the ocean) than in freshwater because saltwater is denser (approx. 1025 kg/m³) and provides a greater buoyant force for the same volume of displacement.

• The Dead Sea: Due to its extremely high salt concentration (about 34%), the density of the water is so high that humans can float effortlessly on its surface without swimming.

Q8. Answer: (d) It will increase.

The correct answer is It will increase.

Key Points

• In a series connection, electrical components or resistors are joined end-to-end in a single path, meaning the current has only one route to flow through the circuit.

• The equivalent resistance (also known as total resistance) of resistors connected in series is calculated by the arithmetic sum of the individual resistances. The formula is expressed as R_total = R1 + R2 + ... + Rn.

• When a second resistor is added in series to an existing one, the total opposition to the flow of electric charge is increased. Consequently, the equivalent resistance of the circuit will increase. Hence, the statement that it will increase is correct.

• In a series circuit, the current remains constant at every point in the loop, while the total voltage provided by the source is distributed across each resistor based on its resistance value.

• If any single component in a series circuit breaks or is disconnected, the entire current flow stops, causing the whole circuit to

fail.

Additional Information

• Parallel Connection:

• In a parallel circuit, resistors are connected across the same two nodes, providing multiple paths for the current.

• The equivalent resistance in parallel is always less than the smallest individual resistor in the group. The formula used is 1/R_total = 1/R1 + 1/R2.

• In parallel, the voltage remains the same across all branches, but the current divides among them.

• Ohm's Law:

• Formulated by Georg Simon Ohm in 1827, it states that the current (I) passing through a conductor is directly proportional to the voltage (V) across it, provided physical conditions like temperature remain constant (V = IR).

• The SI unit of resistance is the Ohm, symbolized by the Greek letter Omega (Ω).

• Practical Applications:

• Series circuits are used in low-power applications like decorative fairy lights or flashlights.

• Parallel circuits are standard for household wiring, ensuring that turning off one appliance does not shut down the entire home's electricity.

Important Points

• Factors Affecting Resistance:

• Length: The resistance of a conductor is directly proportional to its length. Connecting resistors in series is physically equivalent to increasing the total length of the resistive material.

• Cross-sectional Area: Resistance is inversely proportional to the area of the conductor. A thicker wire has less resistance.

• Nature of Material: Different materials have different resistivity values; for instance, Silver and Copper are excellent conductors with very low resistance.

• Temperature: For most metallic conductors, resistance increases with an increase in temperature.

• Energy and Power:

• In a series circuit, the resistor with the highest numerical value of resistance will consume the most power and dissipate the most heat, according to the formula P = I^2 * R.

Q9. Answer: (a) CaO + CO2 → CaCO3

The correct answer is CaO + CO2 → CaCO3.

Key Points

• A combination reaction (also known as a synthesis reaction) is a reaction where two or more reactants combine to form a single product.

• The specific condition for this question is that two compounds must react to form a new compound. A compound is a substance formed when two or more chemical elements are chemically bonded together in a fixed ratio.

• In the reaction CaO + CO2 → CaCO3, Calcium Oxide (CaO) is a compound consisting of calcium and oxygen, and Carbon Dioxide (CO2) is a compound consisting of carbon and oxygen. They combine to form Calcium Carbonate (CaCO3). Hence, statement 1 is correct.

• In the reaction C + O2 → CO2, Carbon (C) and Oxygen (O2) are elements in their standard states. While it is a combination reaction, it involves elements rather than two compounds. Hence, statement 2 is incorrect.

• In the reaction Na + Cl2 → NaCl (unbalanced form), Sodium (Na) and Chlorine (Cl2) are elements. They combine to form the compound sodium chloride, but the reactants are not compounds. Hence, statement 3 is incorrect.

• In the reaction H2 + Cl2 → HCl (unbalanced form), Hydrogen (H2) and Chlorine (Cl2) are diatomic elements. They react to form hydrogen chloride, which is a compound, but since the reactants are elements, it does not meet the "two compounds" criteria. Hence, statement 4 is incorrect.

Additional Information

• Chemical Compound: A compound is a material formed by chemically bonding two or more chemical elements. The bonds in a compound can be ionic or covalent. Examples include water (H2O), table salt (NaCl), and glucose (C6H12O6).

• Chemical Element: An element is a pure substance consisting only of atoms that all have the same number of protons in their atomic nuclei. Elements cannot be broken down into simpler substances by chemical means. Examples include Iron (Fe), Gold (Au), and Nitrogen (N2).

• Classification of Combination Reactions:

• Between two elements: Example: 2Mg + O2 → 2MgO (Magnesium and Oxygen are elements).

• Between an element and a compound: Example: 2CO + O2 → 2CO2 (Carbon monoxide is a compound, Oxygen is an element).

• Between two compounds: Example: NH3 + HCl → NH4Cl (Ammonia and Hydrogen Chloride are both compounds).

• Calcium Oxide (CaO): Commonly known as quicklime or burnt lime, it is a widely used chemical compound. It is a white, caustic,

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alkaline, crystalline solid at room temperature. It is often used in the manufacture of cement and in metallurgy.

• Calcium Carbonate (CaCO3): This compound is found naturally as limestone, chalk, and marble. It is also the main component of pearls and the shells of marine organisms and eggs.

• Nature of Combination Reactions: Most combination reactions are exothermic in nature because they involve the formation of new bonds, which releases energy to the surroundings.

Q10. Answer: (a) Green

The correct answer is Green.

Key Points

• When copper objects are exposed to moist air for a long period, they lose their shiny brown surface and acquire a dull green coating.

• This green material is a mixture of copper hydroxide [Cu(OH)2] and copper carbonate [CuCO3], which is formed due to the reaction of copper with oxygen, water, and carbon dioxide in the atmosphere.

• The chemical reaction for this process is represented as: 2Cu + H2O + CO2 + O2 → Cu(OH)2 + CuCO3.

• This process is a type of corrosion. Unlike iron rust, this green layer, often called a patina, actually protects the underlying metal from further deep-seated corrosion.

• The patina forms naturally over time, usually taking several years to fully develop depending on the environmental conditions such as humidity and air pollution levels.

Additional Information

• Statue of Liberty:

• The most famous example of copper corrosion is the Statue of Liberty in New York.

• Originally made of shining brown copper, it turned entirely green by the year 1906, roughly 20 years after its dedication, due to exposure to the elements.

• Corrosion of Other Metals:

• Iron: Undergoes rusting when exposed to air and moisture, forming a reddish-brown flaky substance known as hydrated ferric oxide.

• Silver: Develops a black coating when exposed to air because it reacts with sulphur compounds to form silver sulphide (Ag2S).

• Aluminium: Forms a thin, transparent layer of aluminium oxide which, like copper patina, protects the metal from further oxidation.

• Prevention of Corrosion:

• Common methods to prevent corrosion include galvanization (coating with zinc), electroplating, painting, oiling, or greasing.

• Creating alloys, such as stainless steel (a mixture of iron, carbon, chromium, and nickel), is also an effective way to stop metals from corroding.

• Factors Affecting Corrosion:

• Reactivity: Highly reactive metals like sodium and potassium corrode very quickly.

• Presence of Electrolytes: The presence of salt in water (like seawater) accelerates the rate of electrochemical corrosion.

• Pollution: Presence of oxides of sulphur and nitrogen in the air increases the acidity of moisture, speeding up the corrosion process.

Important Points

• Basic Copper Carbonate: The specific chemical name for the green coating on copper is basic copper carbonate.

• Reddish-Brown: This is the natural color of pure, unoxidized copper. The option "Red" in the question refers to the initial state rather than the corroded state.

• Aesthetic Uses: In architecture, architects often use copper for roofing specifically because they desire the green patina look that develops over decades.

• Environmental Indicator: The speed at which copper turns green can be an indicator of acid rain or industrial pollution in a specific location.

Q11. Answer: (d) The SI unit of linear velocity is m/s².

The correct answer is The SI unit of linear velocity is m/s2.

Key Points

• Linear velocity is defined as the rate of change of displacement with respect to time. It indicates how fast an object is changing its position in a specific direction. Hence, statement 3 is correct.

• The mathematical formula for velocity is v = s / t, where s represents displacement and t represents the time interval. This shows that the value of velocity is directly dependent on both the change in position and the duration of the motion. Hence, statement 2 is correct.

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• In uniform motion, an object covers equal displacements in equal intervals of time along a straight line. Because neither the magnitude (speed) nor the direction changes, the linear velocity remains constant throughout the motion. Hence, statement 1 is correct.

• The SI unit of linear velocity is meters per second (m/s). The unit m/s2 (meters per second squared) is the SI unit of acceleration, which measures the rate at which velocity changes over time. Hence, statement 4 is incorrect.

• Velocity is a vector quantity, meaning it is characterized by both magnitude and direction. A change in either the speed or the direction of an object will result in a change in its velocity.

Additional Information

• Difference between Speed and Velocity: While speed is a scalar quantity that only accounts for how fast an object is moving, velocity is the vector counterpart that specifies the direction of motion. For example, 50 km/h is speed, while 50 km/h towards the North is velocity.

• Average Velocity: This is calculated as the total displacement divided by the total time taken for a journey. Unlike average speed, the average velocity can be zero if the starting and ending points are the same (zero displacement).

• Instantaneous Velocity: This refers to the velocity of an object at a specific instant in time or at a specific point in its path. It is often measured by the speedometer of a vehicle combined with a compass for direction.

• Dimensional Formula: In physics, the dimensional representation of linear velocity is [M0 L1 T-1], where M is mass, L is length, and T is time.

Important Points

• Acceleration: It is the rate of change of velocity. If an object's velocity increases, decreases, or changes direction, the object is said to be accelerating. Its unit is m/s2.

• Negative Velocity: Velocity can be negative, positive, or zero, depending on the chosen coordinate system and the direction of the displacement.

• Uniform Circular Motion: Even if an object moves at a constant speed in a circle, its linear velocity is not constant because its direction is continuously changing at every point along the circular path.

• Relative Velocity: This is the velocity of an object with respect to another observer or reference frame. For instance, the velocity of a moving train appears different to a person standing on the platform compared to a person in another moving train.

Q12. Answer: (d) four

The correct answer is four.

Key Points

• Joule's Law of Heating describes the rate at which resistance in an electrical circuit converts electrical energy into heat energy.

• The mathematical expression for Joule's law is H = I^2Rt, where H represents the heat produced, I is the electric current, R is the resistance of the conductor, and t is the time for which the current flows.

• According to the law, the heat produced (H) is directly proportional to the square of the current (I^2) flowing through the resistor.

• If the current is doubled (from I to 2I), the new heat produced becomes H' = (2I)^2 * R * t, which simplifies to H' = 4 * I^2 * R * t.

• Comparing the new heat to the original, H' = 4H. Therefore, the heat produced increases by a factor of four when the current is doubled and other factors remain constant. Hence, the statement is correct.

Additional Information

• James Prescott Joule: The law is named after the English physicist James Prescott Joule, who studied the relationship between mechanical work and heat transfer in the 1840s.

• SI Unit of Heat: The standard SI unit for heat and energy is the Joule (J). One Joule is equal to the work done by a force of one newton acting through a distance of one meter.

• Practical Applications:

• Electric Heaters and Irons: These devices use high-resistance coils to maximize the heat produced via Joule heating.

• Electric Bulbs: The filament (usually Tungsten) is heated to such a high temperature by the current that it begins to glow and emit light.

• Electric Fuse: A safety device that protects circuits from overloading. When the current exceeds a certain limit, the heat produced melts the fuse wire, breaking the circuit.

• Dependence on Resistance: For a constant current and time, the heat produced is directly proportional to the resistance (R). If resistance is doubled, the heat is also doubled.

• Dependence on Time: Heat produced is directly proportional to the duration (t) of current flow. Extending the time the appliance is "on" linearly increases the total heat generated.

Important Points

• Relationship with Power: Electrical Power (P) is defined as the rate at which electrical energy is dissipated as heat, expressed as P = H / t = I^2R.

• Ohm’s Law Integration: By substituting V = IR (Ohm’s Law) into the heating formula, heat can also be expressed as H = VIt or H

= (V^2 / R) * t, where V is the potential difference.

• Energy Conservation: Joule heating is an illustration of the Law of Conservation of Energy, where electrical energy is transformed into thermal energy.

• Unwanted Heating: In many electronic components like computers and transformers, Joule heating is considered a "loss" of energy and can cause damage if not managed by cooling fans or heat sinks.

Q13. Answer: (c) Binary fission in Amoeba

The correct answer is Binary fission in Amoeba.

Key Points

• Asexual reproduction is a mode of reproduction where offspring are produced from a single parent without the involvement of gamete formation or fertilization.

• Binary fission in Amoeba is a classic example of asexual reproduction where the parent unicellular organism divides into two equal daughter cells. Since it involves only one parent and no gametes, it fits the description perfectly. Hence, statement 3 is correct.

• Fertilisation in frogs is a type of sexual reproduction that involves the fusion of male gametes (sperm) and female gametes (ova), typically occurring in water (external fertilization). Hence, statement 1 is incorrect.

• Seed formation in flowering plants is the result of sexual reproduction, involving the process of pollination followed by the fusion of pollen grains and ovules to form a zygote. Hence, statement 2 is incorrect.

• Internal fertilisation in mammals involves the union of gametes inside the body of the female parent, requiring two parents and resulting in genetic variation. Hence, statement 4 is incorrect.

Additional Information

• Types of Asexual Reproduction:

• Budding: A small outgrowth or bud develops on the parent body, which eventually detaches to become a new individual. Common examples include Hydra and Yeast.

• Fragmentation: The parent body breaks into distinct pieces, and each piece grows into a complete new organism. This is seen in Spirogyra and Planaria.

• Spore Formation: Organisms produce microscopic reproductive units called spores that can survive harsh conditions and germinate when environments become favorable. Example: Rhizopus (bread mould).

• Vegetative Propagation: In plants, new individuals are produced from vegetative parts like roots, stems, or leaves rather than seeds. Examples include potato tubers, onion bulbs, and Bryophyllum leaves.

• Characteristics of Asexual Offspring:

• The offspring produced are genetically identical to the parent and to each other, often referred to as clones.

• This process is generally faster and more energy-efficient than sexual reproduction because it does not require finding a mate.

Important Points

• Mechanics of Binary Fission:

• The process begins with Karyokinesis, which is the division of the nucleus. In Amoeba, the DNA replicates, and the nucleus elongates and splits into two daughter nuclei.

• This is followed by Cytokinesis, where the cytoplasm of the cell divides, resulting in two separate organisms.

• In Amoeba, the division can take place in any plane, whereas in organisms like Leishmania, it occurs in a definite orientation relative to structures like the flagellum.

• Comparison with Sexual Reproduction:

• While asexual reproduction ensures rapid population growth, it lacks genetic diversity, making the population more vulnerable to environmental changes or diseases.

• Sexual reproduction, involving meiosis and gamete fusion, introduces variation which is a key driver for evolution and adaptation in species.

Q14. Answer: (c) Cutting

The correct answer is Cutting.

Key Points

• Vegetative propagation is a type of asexual reproduction in plants where new plants are produced from vegetative parts such as roots, stems, and leaves rather than from seeds.

• Cutting is an artificial vegetative propagation technique where a small part of a plant, like a stem, root, or leaf, is cut and placed in soil or water to develop into a new, independent plant. Hence, Option 3 is correct.

• Seed dispersal refers to the mechanism by which plant seeds are transported to new locations by wind, water, animals, or gravity to reduce competition with the parent plant. Hence, statement 1 is incorrect.

• Fertilisation is a process in sexual reproduction involving the fusion of male and female gametes to form a zygote, eventually

leading to seed formation. Hence, statement 2 is incorrect.

• Pollination is the act of transferring pollen grains from the male anther of a flower to the female stigma, which is a prerequisite for sexual reproduction in flowering plants. Hence, statement 4 is incorrect.

Additional Information

• Artificial Methods of Vegetative Propagation:

• Layering: A branch of the plant is bent to the ground and covered with soil while still attached to the parent; it develops roots and is later separated.

• Grafting: This involves joining the Scion (a part of one plant) with the Stock (the rooted part of another plant) so they grow as a single plant.

• Tissue Culture: Also known as micropropagation, it involves growing plant cells or small pieces of plant tissue in a sterile nutrient medium under laboratory conditions.

• Natural Methods of Vegetative Propagation:

• Tubers: Thickened underground stems like Potato that have "eyes" or buds.

• Rhizomes: Horizontal underground stems found in plants like Ginger and Turmeric.

• Bulbs: Short underground stems surrounded by fleshy leaves, as seen in Onions and Lilies.

• Runners/Stolons: Creeping stems that grow along the ground, such as in Strawberries.

Important Points

• Advantages of Vegetative Propagation: It allows for the rapid multiplication of plants and ensures that the offspring are genetically identical (clones) to the parent, preserving desirable traits.

• Economic Uses: This method is vital for the commercial production of plants that do not produce seeds or have very low seed viability, such as Bananas, Sugarcane, Grapes, and Roses.

• Specific Examples: In Bryophyllum, vegetative propagation occurs through small adventitious buds located along the margins of the leaves, which fall off and grow into new plants.

• Stem Cuttings: Plants like Hibiscus, Bougainvillea, and Sugarcane are widely grown using stem cuttings because it is a simple and cost-effective method for farmers.

Q15. Answer: (d) Brain, spinal cord and nerves

The correct answer is Brain, spinal cord and nerves.

Key Points

• Nervous tissue is a specialized primary tissue type that forms the nervous system, which is responsible for coordinating and controlling many body activities.

• The brain, spinal cord, and nerves are the fundamental structures composed almost entirely of this tissue. Hence, statement 4 is correct.

• This tissue is characterized by its ability to exhibit excitability and conductivity, allowing it to receive stimuli and transmit electrical impulses across long distances within the body.

• The primary cells of the nervous tissue are neurons, which are highly specialized cells that process and transmit information.

• Supporting these neurons are neuroglia (or glial cells), which provide nutrients, insulation, and structural support, although they do not conduct electrical impulses themselves.

Additional Information

• Structure of a Neuron:

• Every neuron consists of three main parts: the cell body (cyton), dendrites, and an axon.

• The cell body contains the nucleus and cytoplasm. Dendrites are short, branched projections that receive signals from other neurons.

• The axon is a long, single fiber that carries the nerve impulse away from the cell body toward a synapse or an effector organ.

• Classification of the Nervous System:

• The Central Nervous System (CNS) includes the brain and the spinal cord, acting as the integration and command center.

• The Peripheral Nervous System (PNS) consists of the nerves (cranial and spinal) that branch out from the CNS to connect it to the rest of the body.

• Other Tissue Types in the Human Body:

• Epithelial Tissue: Covers body surfaces and lines internal organs (e.g., skin, lining of the liver, and kidneys).

• Connective Tissue: Supports and binds other tissues (e.g., bones, cartilage, and blood).

• Muscular Tissue: Responsible for movement; includes skeletal, smooth, and cardiac muscle (found in the heart).

Important Points

• Kidneys and Liver: These organs are primarily composed of epithelial tissue (glandular epithelium) and connective tissue. While they are innervated by nerves, they are not "made up" of nervous tissue. Hence, statement 1 is incorrect.

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• Lungs and Heart: The lungs consist of epithelial and connective tissues, while the heart is uniquely composed of cardiac muscular tissue. Hence, statement 2 is incorrect.

• Bones and Muscles: Bones are a form of mineralized connective tissue, and muscles are made of muscular tissue. Hence, statement 3 is incorrect.

• Synapse: The functional junction between two neurons where the neurotransmitter chemical is released to bridge the gap and continue the signal.

• The nerve impulse travels in one direction: from the dendrite to the cell body and then along the axon.

Q16. Answer: (a) 81 u

The correct answer is 81 u.

Key Points

• The formula unit mass of a substance is the sum of the atomic masses of all atoms in a formula unit of a compound.

• To calculate the formula unit mass of Zinc Oxide (ZnO), we need to consider the individual atomic masses of its constituent elements: Zinc (Zn) and Oxygen (O).

• The atomic mass of Zinc (Zn) is approximately 65 u.

• The atomic mass of Oxygen (O) is approximately 16 u.

• The formula ZnO indicates that one formula unit consists of one atom of Zinc and one atom of Oxygen.

• Therefore, the formula unit mass is calculated as: 1 x 65 u + 1 x 16 u = 81 u. Hence, the correct answer is 81 u.

Additional Information

• Definition of Formula Unit Mass:

• The term formula unit mass is used for those substances whose constituent particles are ions. While the calculation method is the same as molecular mass, the terminology differs for ionic compounds.

• For example, Sodium Chloride (NaCl) has a formula unit mass of 58.5 u (23 u for Na + 35.5 u for Cl).

• Understanding the Unit 'u':

• The symbol u stands for unified atomic mass unit. It was formerly known as amu (atomic mass unit).

• By international agreement, 1 u is defined as exactly 1/12th the mass of an atom of carbon-12.

• Properties and Uses of Zinc Oxide (ZnO):

• Zinc Oxide is an inorganic compound that usually appears as a white powder.

• It is insoluble in water and is widely used as an additive in numerous materials and products including rubbers, plastics, ceramics, glass, cement, lubricants, paints, ointments, adhesives, sealants, pigments, foods, batteries, ferrites, and fire retardants.

• In medicine, it is used to treat skin conditions like diaper rash and minor burns due to its antiseptic and protective properties.

• Molecular Mass vs. Formula Unit Mass:

• Molecular mass is used for compounds that exist as discrete molecules (like H_2O or CO_2).

• Formula unit mass is used for crystalline solids or ionic networks where atoms are arranged in a three-dimensional lattice.

Important Points

• Atomic Mass of Zinc: The exact value of Zinc on the periodic table is often given as 65.38 u, but for standard textbook calculations in exams, it is typically rounded to 65 u.

• Amphoteric Nature: ZnO is an amphoteric oxide, meaning it can react with both acids and bases to produce salts and water.

• Semiconductor Properties: Zinc Oxide is a wide-bandgap semiconductor of the II-VI semiconductor group, making it useful in electronics and optoelectronics.

Q17. Answer: (a) tone and note

The correct answer is tone and note.

Key Points

• A tone is defined as a sound that consists of a single frequency. It is often referred to as a "pure" sound because it lacks the complexity of multiple overlapping waves.

• A note is a sound produced by a mixture of several frequencies. When multiple tones are combined, they create a note, which is typically what we perceive when listening to musical instruments.

• In the context of music, a note is often more pleasant to the ear than a single tone because of its rich harmonic content and complexity.

• While a tone is characterized solely by its frequency and amplitude, a note also possesses a specific quality or timbre that allows listeners to distinguish between different sources, such as a guitar versus a flute, even if they are playing the same fundamental frequency.

• Noise, by contrast, is a collection of sounds that are unpleasant to the ear and consist of a random mixture of frequencies with no periodic structure.

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Additional Information

• Frequency and Pitch:

• Frequency refers to the number of vibrations per second and is measured in Hertz (Hz).

• The pitch of a sound is how the human brain interprets the frequency; a high-frequency sound results in a high pitch, while a low-frequency sound results in a low pitch.

• Loudness and Amplitude:

• The loudness of a sound depends on the amplitude of the sound wave. Larger amplitudes produce louder sounds, measured in decibels (dB).

• Loudness is proportional to the square of the amplitude of the vibration producing the sound.

• Quality (Timbre):

• Quality or timbre is the characteristic that enables us to distinguish one sound from another having the same pitch and loudness.

• This is why a musical note played on a piano sounds different from the same note played on a violin.

• Audible Range:

• The human ear is typically sensitive to frequencies ranging from 20 Hz to 20,000 Hz (20 kHz).

• Sounds below 20 Hz are called infrasonic, and sounds above 20,000 Hz are called ultrasonic.

Important Points

• A pure tone can be produced by a tuning fork, which vibrates at one specific frequency.

• Most musical instruments do not produce pure tones; they produce a fundamental frequency along with several overtones or harmonics, which together form a note.

• Echo is the repetition of sound caused by the reflection of sound waves from a surface. To hear a distinct echo, the minimum distance between the source and the reflecting surface must be approximately 17.2 meters.

• The speed of sound varies depending on the medium; it travels fastest in solids, slower in liquids, and slowest in gases. In air at 0 degrees Celsius, the speed of sound is approximately 331 meters per second.

Q18. Answer: (b) It acts as an electrolyte to help form a thicker oxide layer.

The correct answer is It acts as an electrolyte to help form a thicker oxide layer.

Key Points

• Anodising is an electrochemical process that converts the metal surface into a decorative, durable, and corrosion-resistant anodic oxide finish.

• In this process, Sulphuric Acid (usually at a concentration of 15% to 20%) serves as the electrolyte. An electrolyte is a medium that contains ions and conducts electricity through the movement of those ions.

• During the reaction, the aluminium object is made the anode (the positive electrode) in an electrolytic cell containing the acid. When an electric current is passed through the solution, water molecules are decomposed.

• Oxygen is released at the anode and reacts with the aluminium surface to form a controlled, uniform, and much thicker layer of aluminium oxide (Al_2O_3) than would occur naturally. Hence, the statement that it acts as an electrolyte to help form a thicker oxide layer is correct.

• While Sulphuric Acid does have the potential to dissolve aluminium, in the context of anodising, its primary role is to facilitate the oxidation process by allowing current to flow and creating micro-pores that help the oxide layer grow deeper into the metal.

Additional Information

• Structure of the Oxide Layer: The layer formed during Sulphuric Acid anodising (often called Type II Anodizing) is porous. These microscopic pores are essential because they allow the electrolyte to reach the unoxidized aluminium beneath, enabling the layer to continue growing to a thickness of 5 to 25 microns or more.

• Corrosion Resistance and Durability: The resulting aluminium oxide layer is extremely hard (second only to diamond in some forms) and provides excellent wear resistance and protection against atmospheric corrosion.

• Coloring and Aesthetics: Because the anodic coating is porous before it is sealed, it can easily absorb dyes or pigments. This is how various colored aluminium products, such as electronics, cookware, and architectural panels, are produced.

• Sealing Process: After the oxide layer reaches the desired thickness, the part is usually "sealed" by immersion in hot water or chemical solutions. This converts the oxide into a hydrated form, closing the pores and locking in any dyes while increasing corrosion resistance.

Important Points

• Comparison with Natural Oxidation: Aluminium naturally forms a very thin, passive oxide film (about 2 to 3 nanometers thick) when exposed to air. Anodising artificially increases this thickness by thousands of times to provide industrial-grade protection.

• Other Types of Anodising:

• Type I: Uses Chromic Acid, typically for aerospace parts where a thinner but highly corrosion-resistant layer is needed.

• Type III: Also known as Hard Anodizing, it uses Sulphuric Acid at lower temperatures and higher voltages to produce a very thick

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(up to 50-100 microns) and wear-resistant coating.

• Temperature Control: During the process, the temperature of the Sulphuric Acid bath is usually maintained around 20°C (68°F). If the temperature rises too high, the acid begins to dissolve the oxide layer faster than it forms, resulting in a powdery or "burnt" finish.

• Environmental Safety: Sulphuric Acid is preferred over Chromic Acid in many modern applications because it is generally less toxic and easier to dispose of in compliance with environmental regulations.

Q19. Answer: (c) Because the amount of dissolved oxygen in water is very low

The correct answer is Because the amount of dissolved oxygen in water is very low.

Key Points

• Aquatic organisms, such as fish, prawns, and mollusks, obtain the oxygen necessary for respiration from the oxygen dissolved in water.

• The concentration of oxygen in the atmosphere is approximately 21%, whereas the amount of dissolved oxygen in water is significantly lower (roughly 0.7% or 4 to 10 milligrams per liter depending on conditions).

• Because the oxygen level is so low in aquatic environments, these organisms must take in water more frequently and pass it over their respiratory organs (like gills) to extract enough oxygen to meet their metabolic demands.

• This necessity results in a much faster breathing rate in aquatic animals compared to terrestrial animals, who have access to an abundant and concentrated supply of atmospheric oxygen.

• In fish, water is taken in through the mouth and forced past the gills, where the dissolved oxygen is absorbed into the bloodstream by diffusion across thin membranes.

Additional Information

• Oxygen Solubility: The solubility of oxygen in water is affected by temperature; cold water can hold more dissolved oxygen than warm water. Consequently, aquatic life may struggle more in higher temperatures due to hypoxia.

• Gills: These are specialized respiratory structures in aquatic organisms that provide a large surface area for gas exchange. They are highly vascularized to facilitate the efficient transfer of oxygen and carbon dioxide.

• Lungs vs. Gills: While terrestrial organisms use lungs to breathe air, gills are adapted specifically for aqueous environments. Gills would collapse and dry out in air, making them ineffective for terrestrial respiration.

• Diffusion Rate: The diffusion of oxygen in air is nearly 10,000 times faster than its diffusion in water. This physical limitation forces aquatic animals to evolve highly efficient mechanisms to extract oxygen.

• Viscosity of Water: Water is about 800 times denser and much more viscous than air. This means aquatic organisms expend significantly more energy to move the medium (water) over their respiratory surfaces than terrestrial animals do with air.

Important Points

• Counter-Current Exchange: Most fish utilize a counter-current flow mechanism where blood flows in the opposite direction to the water passing over the gills. This maintains a concentration gradient that allows them to extract up to 80-90% of the dissolved oxygen.

• Metabolic Rate: Despite the faster breathing rate, many aquatic organisms have a lower metabolic rate compared to endothermic (warm-blooded) terrestrial mammals because they do not need to generate internal body heat.

• Environmental Factors: Factors such as salinity, pollution, and depth also influence the dissolved oxygen levels. For instance, saltwater typically holds less oxygen than freshwater at the same temperature.

• Evolutionary Adaptation: The high breathing rate is an evolutionary adaptation to ensure survival in an oxygen-poor medium, highlighting the biological diversity in respiratory strategies across different habitats.

Q20. Answer: (c) The Moon revolving around the Earth

The correct answer is The Moon revolving around the Earth.

• Uniform Circular Motion is defined as the motion of an object traveling at a constant speed along a circular path. While the speed remains the same, the velocity changes continuously because the direction of motion changes at every point.

• The Moon revolving around the Earth is a classic example of this motion. The gravitational pull of the Earth provides the necessary centripetal force to keep the Moon in its nearly circular orbit at a relatively constant speed. Hence, statement 3 is correct.

• A car moving on a straight road represents Rectilinear Motion or linear motion. In this case, the direction of motion does not change, and if the speed is constant, it is called uniform linear motion. Hence, statement 1 is incorrect.

• A stone dropped from a height undergoes Free Fall, which is a type of Accelerated Linear Motion. As it falls, its speed increases due to the acceleration due to gravity (approximately 9.8 m/s^2), and it moves in a vertical straight line. Hence, statement 2 is incorrect.

• A train moving on a straight track is another example of Linear Motion. Even if it moves at a constant speed, the path is not circular, so it cannot be classified under circular motion. Hence, statement 4 is incorrect.

• Characteristics of Uniform Circular Motion:

• In this motion, the speed of the particle remains constant, which means it covers equal distances along the circumference in equal intervals of time.

• The velocity is always tangential to the circular path. Since the tangent changes direction at every point on the circle, the velocity is variable.

• Because the velocity is changing, the object is said to be accelerating. This acceleration is called centripetal acceleration and is always directed toward the center of the circle.

• Centripetal Force:

• For any object to perform circular motion, an external force must act upon it. This center-seeking force is known as Centripetal Force.

• In the case of planets or satellites, this force is provided by Gravity. For a stone whirled in a string, the Tension in the string provides the force.

• Real-world Examples:

• The movement of the tips of the hands of a clock is a perfect example of uniform circular motion as they move with a constant angular speed.

• An artificial satellite orbiting the Earth at a constant altitude.

• The motion of electrons revolving around the nucleus in an atom (according to the Bohr model).

• Speed vs. Velocity: It is crucial to distinguish that while speed is a scalar quantity and remains unchanged in uniform circular motion, velocity is a vector quantity and is constantly changing due to the direction shift.

• Work Done: In uniform circular motion, the work done by the centripetal force is always zero. This is because the force is perpendicular to the instantaneous displacement (tangent) at every point.

• Formula: The speed in circular motion is calculated as the circumference divided by the time period, often expressed as v = (2 * pi * r) / T, where r is the radius and T is the time taken for one revolution.

Q21. Answer: (d) Ovary → Fallopian tube → Uterus

The correct answer is Ovary → Fallopian tube → Uterus.

Key Points

• The human female reproductive system is designed to produce gametes (eggs/ova) and provide an environment for the development of a fetus. The correct physiological path of an egg starts at its site of production and ends at its site of implantation or exit.

• Statement 1: Ovary → Vagina → Uterus. This path is incorrect because the vagina is located below the uterus. An egg released from the ovary must pass through the fallopian tube to reach the uterus; it does not go from the ovary directly to the vagina and then back up to the uterus. Hence, statement 1 is incorrect.

• Statement 2: Fallopian tube → Ovary → Uterus. This sequence is incorrect because the ovary is the starting point where oogenesis (egg production) occurs. The fallopian tube receives the egg from the ovary, not the other way around. Hence, statement 2 is incorrect.

• Statement 3: Uterus → Ovary → Fallopian tube. This represents a reversed or scattered path. The egg is not produced in the uterus, and it does not travel from the uterus to the ovary. Hence, statement 3 is incorrect.

• Statement 4: Ovary → Fallopian tube → Uterus. This is the biologically correct path. The ovary releases a mature ovum during ovulation, which is then captured by the fimbriae of the fallopian tube. The egg travels through the tube toward the uterus, where it may implant if fertilized. Hence, statement 4 is correct.

• Hence, the correct answer is Ovary → Fallopian tube → Uterus.

Additional Information

• Ovaries:

• These are the primary female sex organs located on each side of the lower abdomen.

• Each ovary is about 2 to 4 cm in length and is responsible for producing the female gamete (ovum) and several steroid hormones like estrogen and progesterone.

• Fallopian Tubes (Oviducts):

• Each tube is about 10-12 cm long. It consists of three parts: the infundibulum (with finger-like fimbriae), the ampulla (the wider part), and the isthmus (which joins the uterus).

• The ampulla of the fallopian tube is the typical site where fertilization occurs when a sperm meets the egg.

• Uterus (Womb):

• The uterus is a large, muscular, pear-shaped organ where a fertilized egg (zygote) implants and develops into an embryo and then a fetus.

• The wall of the uterus has three layers: the outer perimetrium, the middle myometrium (smooth muscle), and the inner endometrium (glandular layer that sheds during menstruation).

• Vagina and Cervix:

• The uterus opens into the vagina through a narrow cervix.

• The cervical canal along with the vagina forms the birth canal during parturition (delivery of the baby).

Important Points

• Ovulation: This is the process where a mature follicle bursts to release an ovum from the ovary, usually occurring around day 14 of a 28-day menstrual cycle.

• Implantation: If the egg is fertilized in the fallopian tube, it moves to the uterus and attaches to the endometrial wall. This process is called implantation.

• Menstruation: If fertilization does not occur, the ovum degenerates, and the endometrium lining of the uterus is shed through the vagina, a process known as menstruation.

• Ciliary Movement: The inner lining of the fallopian tubes contains ciliated epithelium. The beating of these cilia helps push the non-motile egg from the ovary toward the uterus.

Q22. Answer: (b) Peripheral nervous system

The correct answer is Peripheral nervous system.

Key Points

• The Peripheral Nervous System (PNS) consists of all the nerves that lie outside the brain and spinal cord. Its primary function is to connect the Central Nervous System (CNS) to the limbs and organs, essentially serving as a communication relay back and forth between the brain and the extremities.

• In the given scenario, if the brain scans show no damage, it indicates that the motor cortex and other integration centers in the CNS are functioning correctly. Therefore, the inability to move the left hand suggests an interruption in the signal path along the peripheral nerves that travel from the spinal cord to the muscles of the hand. Hence, the correct answer is the Peripheral nervous system.

• The PNS is divided into two main parts: the Somatic Nervous System and the Autonomic Nervous System. The Somatic Nervous System is specifically responsible for voluntary muscle movements and transmitting sensory information to the CNS.

• Damage to the Peripheral Nervous System (often called peripheral neuropathy) can result in weakness, numbness, and paralysis in specific areas like the hands or feet, even when the brain remains perfectly healthy.

• The PNS includes 12 pairs of cranial nerves and 31 pairs of spinal nerves. These nerves carry motor commands to the skeletal muscles to initiate movement.

Additional Information

• Central Nervous System (CNS):

• The CNS comprises the brain and the spinal cord. It acts as the "control center" of the body, processing sensory information and sending out instructions.

• Damage to the CNS (such as a stroke or traumatic brain injury) would typically show up on a brain scan (MRI or CT), which contradicts the conditions mentioned in the question.

• Autonomic Nervous System (ANS):

• This is a component of the PNS that regulates involuntary physiologic processes, including heart rate, blood pressure, respiration, and digestion.

• Since moving a hand is a voluntary action controlled by the Somatic Nervous System, the ANS is not the primary system responsible for this specific deficit.

• Parasympathetic Nervous System:

• This is a subdivision of the Autonomic Nervous System. It is often referred to as the "rest and digest" system.

• It helps conserve energy by slowing the heart rate and increasing intestinal and gland activity. It does not control the skeletal muscles used to move the hand.

• Sympathetic Nervous System:

• Another branch of the ANS, responsible for the "fight or flight" response. It prepares the body for physical activity by increasing heart rate and diverting blood flow to muscles, but it does not direct the specific voluntary motor signals for hand movement.

Important Points

• Nerve Conduction: For a muscle to contract, an electrical impulse must travel from the brain, down the spinal cord, through a peripheral motor nerve, and across the neuromuscular junction.

• Reflex Arc: Some movements are involuntary reflexes that involve only the spinal cord and PNS, bypassing the brain entirely. However, voluntary movement of the hand requires the full circuit.

• Location of Injury: Injuries to the brachial plexus (a network of nerves in the shoulder) or individual nerves like the radial, ulnar, or median nerves can cause localized hand paralysis despite a healthy brain.

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Q23. Answer: (b) To develop crops with better yield and useful traits

The correct answer is To develop crops with better yield and useful traits.

Key Points

• Crop variety improvement is the primary method of enhancing agricultural productivity by selecting and breeding plant varieties that possess desirable characteristics.

• The main objective is to achieve a higher yield, which refers to increasing the total production of the crop per acre or unit of land. Hence, statement 2 is correct.

• It focuses on improved quality, where the criteria for quality vary from crop to crop; for example, protein quality in pulses, oil quality in oilseeds, and preserving quality in fruits and vegetables.

• Biotic and Abiotic resistance: Crops are developed to survive biotic stresses (diseases, insects, and nematodes) and abiotic stresses (drought, salinity, waterlogging, heat, cold, and frost), which can otherwise lead to significant crop loss.

• Change in maturity duration: By shortening the duration from sowing to harvesting, farmers can grow multiple rounds of crops in a single year, which also reduces the cost of production.

• Wider adaptability: Developing varieties that can grow under different climatic conditions helps in stabilizing the food supply across various geographical locations.

Additional Information

• Methods of Improvement:

• Hybridization: This involves crossing between genetically dissimilar plants. It can be intervarietal (between different varieties), interspecific (between two different species of the same genus), or intergeneric (between different genera).

• Genetic Modification: This involves introducing a gene that provides the desired characteristic, resulting in genetically modified crops (GM crops).

• Desirable Agronomic Characteristics: For cereal crops, dwarfness is a desired trait so that they consume fewer nutrients, whereas, for fodder crops, profuse branching and tallness are desired traits.

• Green Revolution: This period in the 1960s marked a significant leap in crop variety improvement in India, led by M.S. Swaminathan, known as the Father of the Green Revolution in India. Globally, Norman Borlaug is credited with this movement.

• Food Security: Continuous improvement in crop varieties is essential to meet the nutritional demands of the growing population and to ensure national food security.

Important Points

• Indian Council of Agricultural Research (ICAR): Established in 1929 and headquartered in New Delhi, it is the apex body for coordinating, guiding, and managing research and education in agriculture in India.

• Plant Breeding: It is the purposeful manipulation of plant species in order to create desired genotypes and phenotypes for specific uses.

• Selection: It is the oldest method of crop improvement where individual plants or groups of plants are picked from a mixed population based on their features.

Q24. Answer: (a) m = -1

The correct answer is m = -1.

Key Points

• In a concave mirror, when an object is placed at the centre of curvature (C), the image is formed exactly at the centre of curvature (C) itself.

• The nature of the image formed at this position is real and inverted. Hence, the statement regarding the nature is correct.

• The size of the image is equal to the size of the object. This is a unique position where the height of the image and the height of the object are identical.

• Magnification (m) is defined as the ratio of the height of the image (h') to the height of the object (h), expressed as m = h' / h.

• According to the Cartesian sign convention, the height of an inverted image is taken as negative, while the height of an erect object is taken as positive.

• Since the image is the same size but inverted, h' = -h. Therefore, the magnification m = -h / h = -1. Hence, the correct answer is m = -1.

Additional Information

• Linear Magnification (m): It is the ratio of the distance of the image from the mirror (v) to the distance of the object from the mirror (u), with a negative sign: m = -v / u. For an object at C, both u and v are equal to the radius of curvature (R), leading to m = -(-R) / (-R) = -1.

• Significance of Magnitude: If the absolute value of |m| = 1, the image is the same size as the object. If |m| > 1, the image is magnified (enlarged). If |m| < 1, the image is diminished.

• Significance of Sign: A negative sign in magnification always indicates a real image, which is consistently inverted. A positive sign indicates a virtual image, which is consistently erect.

• Concave Mirror Applications: Due to their ability to form magnified and real images, they are used in reflecting telescopes, shaving mirrors (when object is between P and F), and solar furnaces to concentrate sunlight.

• Convex Mirror Comparison: Unlike concave mirrors, a convex mirror always produces a magnification m < +1 because it always forms a virtual, erect, and diminished image, regardless of the object's position.

Important Points

• Position at Infinity: If the object is at infinity, the image forms at the focus (F), and the magnification is highly diminished (m much less than -1).

• Position between C and F: If the object is moved between the centre of curvature and the principal focus, the image is formed beyond C and is enlarged, meaning m < -1.

• Position at F: If the object is at the focus (F), the image is formed at infinity and is highly magnified.

• Position between P and F: This is the only case for a concave mirror where the magnification is positive (m > +1), as it forms a virtual, erect, and magnified image behind the mirror.

Q25. Answer: (b) 56 J

The correct answer is 56 J.

Key Points

• Work Done is defined as the product of the Force applied to an object and the Displacement of that object in the direction of the force.

• In this specific case, the Force (F) acting on the object is 7 N and the Displacement (s) is 8 m.

• The formula for work done is $W = F \times s \times \cos\theta$, where θ is the angle between the force and displacement vectors.

• Since the displacement is in the direction of the force, the angle θ is 0 degrees. As cos 0° = 1, the formula simplifies to $W = F \times s$.

• By substituting the given values: $W = 7\ N \times 8\ m = 56\ Nm$. Since 1 Newton-meter (Nm) is equivalent to 1 Joule (J), the work done is 56 J. Hence, the correct answer is 56 J.

Additional Information

• Unit of Work: The SI unit of work is the Joule (J). It is named after the English physicist James Prescott Joule. One Joule is the amount of work done when a force of 1 Newton displaces an object through a distance of 1 meter.

• Scalar Quantity: Work is a scalar quantity, meaning it has only magnitude and no direction, even though both force and displacement are vector quantities.

• Dimensional Formula: The dimensional formula for work is $[ML^2T^{-2}]$, which is the same as that for Energy.

• Work-Energy Theorem: This theorem states that the net work done on an object is equal to the change in its Kinetic Energy. This principle is fundamental in classical mechanics for solving problems involving motion.

• Other Options Analysis:

• 7 J is incorrect because it does not account for the 8 m displacement.

• 56 N is incorrect because Newton (N) is the unit of Force, not Work.

• 15 Nm is incorrect because it likely represents the sum (7 + 8) rather than the product required for work calculation.

Important Points

• Positive, Negative, and Zero Work:

• Positive Work: Occurs when the force and displacement are in the same direction ($0° \le \theta < 90°$). An example is kicking a ball.

• Negative Work: Occurs when the force acts in the opposite direction to displacement ($90° < \theta \le 180°$). An example is the force of friction acting against a sliding object.

• Zero Work: Occurs when the force is perpendicular to the displacement ($\theta = 90°$) or if the displacement is zero. A coolie carrying a load on his head and walking on a horizontal platform does zero work against gravity because the force (upward) is perpendicular to the displacement (horizontal).

• CGS Unit: In the Centimetre-Gram-Second (CGS) system, the unit of work is the Erg. The relationship between Joule and Erg is 1 Joule = 10^7 Ergs.

• Work against Gravity: When an object of mass (m) is lifted to a height (h), the work done is $W = mgh$, where g is the acceleration due to gravity (approximately 9.8 m/s^2).

Q26. Answer: (d) 14 minutes

Shortcut Trick

Total Work (LCM of 65, 26) = 130 units.

Efficiency: A = 2, B = 5.

Pipe A works for the entire 30 minutes: 2 × 30 = 60 units.

Remaining work for Pipe B: 130 − 60 = 70 units.

Time for Pipe B: 70 ÷ 5 = 14 minutes.
Therefore The correct answer is 14 min.
Alternate Method
Given:
Time taken by Pipe A = 65 minutes
Time taken by Pipe B = 26 minutes
Total time to fill the cistern = 30 minutes

Person	Days	Total Work	Efficiency
Pipe A	65	130	2
Pipe B	26	5	

Calculations:
=> Let the total capacity of the cistern be the LCM of 65 and 26 = 130 units.
=> Efficiency of Pipe A = 130 ÷ 65 = 2 units/min.
=> Efficiency of Pipe B = 130 ÷ 26 = 5 units/min.
=> Since the cistern is filled in 30 minutes, Pipe A worked for the full 30 minutes.
=> Work done by Pipe A = 30 × 2 = 60 units.
=> Remaining work to be done by Pipe B = 130 − 60 = 70 units.
=> Time for which Pipe B was open = 70 ÷ 5 = 14 minutes.
Therefore The correct answer is 14 min.
Additional Information
Pipes & Cisterns Efficiency
Efficiency is inversely proportional to the time taken to fill a tank. Total Work = Efficiency × Time.
Inlet and Outlet Pipes
Inlet pipes have positive efficiency (filling), while outlet pipes (leaks) have negative efficiency (emptying).
Combined Work Formula
If two pipes fill a tank in x and y hours, together they fill it in (x × y) ÷ (x + y) hours.

Q27. Answer: (b) 5821.2

Shortcut Trick
Given: 8 × (2 × Base Area) = 5 × CSA
=> 8 × (2πr²) = 5 × (2πrh) => 16r = 10h => h = 1.6r
Since r = 21/2 = 10.5 cm, then h = 1.6 × 10.5 = 16.8 cm.
Volume = πr²h = (22/7) × 10.5 × 10.5 × 16.8 = 346.5 × 16.8 = 5821.2 cm³.
Therefore The correct answer is 5821.2 cm³.
Alternate Method
Given:
Base diameter of cylinder (d) = 21 cm => Radius (r) = 10.5 cm
8 × (Sum of 2 circular faces) = 5 × (Curved Surface Area)
Formula Used:
Area of circular face = πr²
Curved Surface Area (CSA) = 2πrh
Volume of Cylinder = πr²h
Calculations:
=> 8 × (2 × πr²) = 5 × (2πrh)
=> 16πr² = 10πrh
=> 16r = 10h
=> h = (16 × 10.5) ÷ 10
=> h = 168 ÷ 10 = 16.8 cm
=> Volume = (22/7) × (10.5)² × 16.8
=> Volume = (22/7) × 110.25 × 16.8

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=> Volume = 22 × 15.75 × 16.8
=> Volume = 346.5 × 16.8
=> Volume = 5821.2 cm^3
Therefore The correct answer is 5821.2 cm^3.
Additional Information
Total Surface Area of Cylinder
The total surface area includes the curved surface and the two circular bases: TSA = $2\pi rh + 2\pi r^2 = 2\pi r(h + r)$.
Hollow Cylinder Volume
If R is the external radius and r is the internal radius, the volume of the material is $V = \pi(R^2 - r^2)h$.
Relation between Volume and Area
The volume can also be expressed as Base Area × Height. For a cylinder, it is $(\pi r^2) \times h$.

Q28. Answer: (b) Rs. 5,400

Shortcut Trick
Net selling price = Initial CP × (100 + Profit%)/100 × (100 − Loss%)/100
Selling Price = 5,000 × (120/100) × (90/100)
Selling Price = 5,000 × 1.2 × 0.9
Selling Price = 6,000 × 0.9 = 5,400
Therefore The correct answer is Rs. 5,400.
Alternate Method
Given: CP of Ramesh = Rs. 5,000 | Profit% = 20% | Loss% = 10%
Formulas: SP = CP × (100 + P%)/100 | SP = CP × (100 − L%)/100
=> Selling price for Ramesh (which is Cost price for Suresh) = 5,000 × (120/100) = Rs. 6,000.
=> Selling price for Suresh = 6,000 × (90/100).
=> Suresh Selling Price = 60 × 90 = Rs. 5,400.
Therefore The correct answer is Rs. 5,400.
Additional Information
Chain Rule in Profit and Loss
When an article is sold through multiple hands, the Selling Price of the previous person becomes the Cost Price for the next buyer.
Effective Percentage Change
Net effect = a + b + (ab/100). Here, 20 − 10 − (200/100) = 8% net profit on initial CP. 5,000 + 8% of 5,000 = 5,400.

Q29. Answer: (d) 27.27%

Shortcut Trick
Required percentage = (First value ÷ Second value) × 100
=> (1/20 ÷ 11/60) × 100
=> (1/20 × 60/11) × 100
=> (3/11) × 100 ≈ 27.27%
Therefore The correct answer is 27.27%.
Alternate Method
Given: First fraction = 1/20, Second fraction = 11/60
Formula Used: Percentage = (Value ÷ Base) × 100
=> Let 1/20 be x% of 11/60
=> 1/20 = (x/100) × (11/60)
=> x = (1/20) × (60/11) × 100
=> x = (3/11) × 100
=> x = 300 ÷ 11
=> x = 27.2727...
Therefore The correct answer is 27.27%.
Additional Information
Fraction to Percentage Conversion
To convert any fraction a/b to a percentage, multiply the fraction by 100 and add the % symbol.

Reciprocal Percentages

Standard values like 1/11 ≈ 9.09% are helpful; thus 3/11 = 3 × 9.09% = 27.27%.

Q30. Answer: (b) 350 metres

Shortcut Trick

Speed of train = 63 × (5/18) = 17.5 m/s.

Time taken to cross Platform = 60 seconds.

Time taken to cross Man (Train length only) = 40 seconds.

Time difference to cover Platform length = 60 − 40 = 20 seconds.

Platform Length = Speed × Time Difference = 17.5 × 20 = 350 m.

Therefore The correct answer is 350 metres.

Alternate Method

Given: Speed = 63 km/hr, Time (Platform) = 60 s, Time (Man) = 40 s.

Formula Used: Distance = Speed × Time; 1 km/hr = 5/18 m/s.

=> Speed in m/s = 63 × (5/18) = 17.5 m/s

=> Length of Train (L_t) = Speed × Time to cross man

=> L_t = 17.5 × 40 = 700 m

=> Total distance to cross Platform = L_t + L_p = Speed × 60

=> 700 + L_p = 17.5 × 60 = 1050 m

=> L_p = 1050 − 700 = 350 m

Therefore The correct answer is 350 metres.

Additional Information

Relative Speed

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

Unit Conversion

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

Train Crossing Objects

For a stationary point object (man/pole), distance = train length. For a stationary long object (bridge/platform), distance = train length + object length.

Q31. Answer: (c) 35

Shortcut Trick

The Mode is the observation with the highest repetition (frequency).

Scanning the data: 35 appears 3 times, while 24 and 20 appear only 2 times.

All other numbers in the set appear only once.

Because 35 occurs the most, it is the Mode.

Therefore The correct answer is 35.

Alternate Method

Given: The set of observations is 21, 29, 35, 24, 25, 33, 24, 23, 26, 28, 35, 27, 20, 35, 20.

Formula Used:Mode = Value that occurs most frequently in the distribution.

=> Arrange observations in ascending order: 20, 20, 21, 23, 24, 24, 25, 26, 27, 28, 29, 33, 35, 35, 35.

=> Count of 20 = 2

=> Count of 24 = 2

=> Count of 35 = 3

=> Count of others = 1

=> The maximum frequency is 3, which corresponds to the value 35.

Therefore The correct answer is 35.

Additional Information

Mean (Arithmetic Average)

The sum of all observations divided by the total number of observations. Mean = (Σx_i) ÷ n.

Median

The middle value of a data set when it is arranged in ascending or descending order. For n = 15, Median is the ((15+1)÷2)^(th) i.e., 8^(th) term.

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Empirical Relationship

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

Range

The difference between the maximum and minimum values in a data set. Range = Max − Min.

Q32. Answer: (d) 16

Shortcut Trick

If every value in a set is decreased by a constant 'k', the new average is simply the old average minus 'k'.

Given Old Average = 23 and Decrease (k) = 7.

New Average = 23 − 7 = 16.

Therefore The correct answer is 16.

Alternate Method

Given:

Number of observations (n) = 7

Initial Average = 23

Value decreased from each number = 7

Calculations:

=> Total Sum of 7 numbers = Average × n

=> Initial Sum = 23 × 7 = 161

=> Total decrease across all 7 numbers = 7 × 7 = 49

=> New Sum = 161 − 49 = 112

=> New Average = New Sum ÷ n

=> New Average = 112 ÷ 7 = 16

Therefore The correct answer is 16.

Additional Information

Effect of Arithmetic Operations on Average

If every number is increased by 'k', the new average is Old Average + k. If every number is decreased by 'k', it is Old Average − k.

Multiplication and Division Rule

If every number is multiplied by 'k', the new average is Old Average × k. Similarly, if divided by 'k' (where k ≠ 0), it is Old Average ÷ k.

Sum of Observations

The Sum of Observations is always equal to the Average × Number of items. This is the fundamental basis for all average-related calculations.

Q33. Answer: (b) 12,500

Shortcut Trick

Let the Marked Price be MP.

Successive discounts of 35% and 20% mean the final Selling Price (SP) is 6,500.

Using the multiplier method: MP × (100 − 35) ÷ 100 × (100 − 20) ÷ 100 = SP

MP × 0.65 × 0.80 = 6,500

MP × 0.52 = 6,500 => MP = 6,500 ÷ 0.52 = 12,500

Therefore The correct answer is Rs. 12,500.

Alternate Method

Given: Selling Price (SP) = Rs. 6,500, Discount1 (d1) = 35%, Discount2 (d2) = 20%.

Formulas: SP = MP × (100 − d1)% × (100 − d2)% | Net Discount = a + b − (a × b) ÷ 100

=> Equivalent single discount = 35 + 20 − (35 × 20) ÷ 100

=> Net Discount = 55 − 7 = 48%

=> If MP is 100%, then SP = 100% − 48% = 52%

=> 52% of MP = 6,500

=> MP = (6,500 × 100) ÷ 52 = 12,500

Therefore The correct answer is Rs. 12,500.

Additional Information

Successive Discounts

When two or more discounts are applied one after another, they are called successive discounts. The second discount is calculated on the price remaining after the first discount.

Marked Price (MP)

It is the price displayed on the product label. Discount is always calculated on the Marked Price unless stated otherwise.

Q34. Answer: (c) 75,000

Shortcut Trick

Income ratio = 5 : 9, Expenditure ratio = 1 : 3. Difference in income parts = 9 − 5 = 4. Difference in expenditure parts = 3 − 1 = 2.

To make difference equal, multiply expenditure ratio by 2 → 2 : 6.

Savings (Income − Expenditure) = 5 − 2 = 3 units or 9 − 6 = 3 units.

3 units = Rs. 45,000 => 1 unit = Rs. 15,000.

Mukund monthly income = 5 units = 5 × Rs. 15,000 = Rs. 75,000.

Therefore The correct answer is Rs. 75,000.

Alternate Method

Given:

Ratio of monthly income of Mukund and Sachin = 5 : 9

Ratio of their monthly expenditure = 1 : 3

Savings of each = Rs. 45,000

Formula Used:

Income − Savings = Expenditure

Calculations:

Let income of Mukund be 5x and Sachin be 9x.

=> (5x − 45000) / (9x − 45000) = 1 / 3

=> 3 × (5x − 45000) = 1 × (9x − 45000)

=> 15x − 1,35,000 = 9x − 45,000

=> 15x − 9x = 1,35,000 − 45,000

=> 6x = 90,000

=> x = 15,000

=> Mukund monthly income = 5x = 5 × 15,000 = 75,000

Therefore The correct answer is Rs. 75,000.

Additional Information

Income, Expenditure and Savings Relationship

The fundamental relation used in these problems is: Income = Expenditure + Savings.

Ratio Balancing Method

When the absolute change (savings) is same for both, we equalize the difference between the ratio terms of Income and Expenditure to find 1 unit value.

Cross Multiplication Method

Used for two ratios with constant or different additions: (a × d − b × c) units = (Constant × d − Constant × c).

Q35. Answer: (a) 125

Shortcut Trick

Test small values for x because the total Rs. 935 is close to a multiple of 180.

If x = 5, then cost of pens = 180 × 5 = Rs. 900.

Remaining amount = 935 − 900 = Rs. 35.

Number of pencils y = 35 ÷ 3.5 = 10.

Check total items: x + y = 5 + 10 = 15 (Satisfied).

Calculation: $x^2 + y^2 = 5^2 + 10^2 = 25 + 100 = 125$.

Therefore The correct answer is 125.

Alternate Method

Given:

Price of branded pen = Rs. 180

Price of pencil = Rs. 3.50

Total items (x + y) = 15

Total cost = Rs. 935

Formula Used:

Total Cost = (Price per Pen × Number of Pens) + (Price per Pencil × Number of Pencils)

Calculations:

=> 180x + 3.5y = 935 ... (i)

=> x + y = 15 → y = 15 − x ... (ii)

=> Substituting (ii) in (i):

=> 180x + 3.5(15 − x) = 935

=> 180x + 52.5 − 3.5x = 935

=> 176.5x = 935 − 52.5

=> 176.5x = 882.5

=> x = 882.5 ÷ 176.5 = 5

=> y = 15 − 5 = 10

=> $x^2 + y^2 = 5^2 + 10^2$

=> $x^2 + y^2 = 25 + 100 = 125$

Therefore The correct answer is 125.

Additional Information

Algebraic Identity

The sum of squares can be related to the sum of terms using: $x^2 + y^2 = (x + y)^2 − 2xy$.

Substitution Method

In a system of two linear equations, express one variable in terms of the other from the simpler equation and substitute it into the complex one.

Averages & Sums

If the average price is A, then Total Cost = A × (x + y). Here, Average ≈ 935 ÷ 15 ≈ 62.33.

Q36. Answer: (c) 6y

Shortcut Trick

Use the Algebraic Identity: $(a + b)^2 − (a − b)^2 = 4ab$

Here, let a = 9x and b = 4y.

Numerator = 4 × (9x) × (4y) = 144xy.

Divide by 24x: 144xy ÷ 24x = 6y.

Therefore The correct answer is 6y.

Alternate Method

Given: $[(9x + 4y)^2 − (9x − 4y)^2] ÷ 24x$

Formula Used: Expansion of $(a + b)^2 = a^2 + 2ab + b^2$ and $(a − b)^2 = a^2 − 2ab + b^2$

=> Expansion 1: $(9x + 4y)^2 = 81x^2 + 16y^2 + 72xy$

=> Expansion 2: $(9x − 4y)^2 = 81x^2 + 16y^2 − 72xy$

=> Subtracting: $(81x^2 + 16y^2 + 72xy) − (81x^2 + 16y^2 − 72xy)$

=> Result of Numerator: $81x^2 − 81x^2 + 16y^2 − 16y^2 + 72xy + 72xy = 144xy$

=> Final Division: 144xy ÷ 24x = (144/24) × (x/x) × y

=> Simplified Value: 6y

Therefore The correct answer is 6y.

Additional Information

Standard Algebraic Identities

1. $(a + b)^2 + (a − b)^2 = 2(a^2 + b^2)$

2. $a^2 − b^2 = (a + b)(a − b)$

Simplification Rules

Always apply BODMAS (Brackets, Orders, Division, Multiplication, Addition, Subtraction) to solve multi-operational algebraic expressions efficiently.

Q37. Answer: (a) 18°

Shortcut Trick

The angle between the bisectors of two adjacent angles of a quadrilateral is half the sum of the other two angles:

angle STR = (angle P + angle Q) ÷ 2

=> 36° = (angle P + angle Q) ÷ 2 => angle P + angle Q = 72°

Given the ratio of angle P : angle Q = 3 : 5, the total is 3 + 5 = 8 units.

=> 8 units = 72° => 1 unit = 9°

The difference between angle Q and angle P is 5 − 3 = 2 units => 2 × 9° = 18°.

Therefore The correct answer is 18°.

Alternate Method

Given:

In quadrilateral PQRS, the bisectors of angle R and angle S meet at T.

angle STR = 36°

Ratio of angle P : angle Q = 3 : 5

Formula Used:

Sum of angles in a triangle = 180°

Sum of angles in a quadrilateral = 360°

Calculations:

In triangle STR:

=> angle STR + angle TSR + angle TRS = 180°

Since ST and RT are the angle bisectors of angle S and angle R respectively:

=> angle TSR = angle S ÷ 2 and angle TRS = angle R ÷ 2

=> 36° + (angle S ÷ 2) + (angle R ÷ 2) = 180°

=> (angle S + angle R) ÷ 2 = 180° − 36°

=> (angle S + angle R) ÷ 2 = 144°

=> angle S + angle R = 288°

In quadrilateral PQRS, the sum of all interior angles is 360°:

=> angle P + angle Q + angle R + angle S = 360°

=> angle P + angle Q + 288° = 360°

=> angle P + angle Q = 360° − 288° = 72°

Let the measures of angle P and angle Q be 3x and 5x respectively:

=> 3x + 5x = 72°

=> 8x = 72°

=> x = 9°

The difference between the measures of angle Q and angle P is:

=> angle Q − angle P = 5x − 3x = 2x

=> Difference = 2 × 9° = 18°

Therefore The correct answer is 18°.

Additional Information

Angle Bisector Theorem in Quadrilaterals

The angle formed by the bisectors of two adjacent angles of a quadrilateral is equal to half the sum of the other two angles. For adjacent angles R and S, angle STR = (angle P + angle Q) ÷ 2.

Sum of Interior Angles of a Polygon

The sum of the interior angles of an n-sided polygon is (n − 2) × 180°. For a quadrilateral (n = 4), the sum is always 360°.

Angle Bisectors of Opposite Angles

If the bisectors of opposite angles of a quadrilateral intersect, the angle between them is half the difference of the other two opposite angles.

Q38. Answer: (c) 3/4

Shortcut Trick

Substitute standard trigonometric values: sin 60° = √3/2, cos 30° = √3/2, and tan 45° = 1.

Expression = (√3/2 × √3/2) ÷ 1 = 3/4.

Therefore The correct answer is 3/4.

Alternate Method

Given:

Expression: (sin 60° × cos 30°) ÷ tan 45°

Standard Trigonometric Values:

=> sin 60° = √3/2

=> cos 30° = √3/2

=> tan 45° = 1

Calculation:

=> Expression = [(√3/2) × (√3/2)] ÷ 1

=> Expression = [(√3 × √3) / (2 × 2)] ÷ 1

=> Expression = (3 / 4) / 1

=> Expression = 3/4

Therefore The correct answer is 3/4.

Additional Information

Complementary Angles

For any angle θ, sin θ = cos(90° − θ). Therefore, sin 60° = cos 30° = √3/2.

Trigonometric Identities

Fundamental identities include $\sin^2\theta + \cos^2\theta = 1$ and tan θ = sin θ / cos θ.

Tangent of 45 Degrees

At 45°, the opposite and adjacent sides of a right-angled triangle are equal, so tan 45° = 1.

Q39. Answer: (d) 3

Shortcut Trick

Total Work = LCM of (2, 4, 4) = 4 units.

Individual efficiencies: A = 2, B = 1, C = 1.

Combined efficiency = 2 + 1 + 1 = 4 units/day.

Thrice the work = 3 × 4 = 12 units.

Time taken = 12 ÷ 4 = 3 days.

Therefore The correct answer is 3 days.

Alternate Method

Given: Time taken by A = 2 days, B = 4 days, C = 4 days.

Formula Used: Efficiency = Total Work ÷ Time Taken; Time = Total Work ÷ Combined Efficiency.

Person	Days	Total Work	Efficiency
A	2	4	2
B	4	1	
C	4	1	

=> Total Efficiency of (A + B + C) = 2 + 1 + 1 = 4 units/day.

=> Work to be completed = 3 × Total Work = 3 × 4 = 12 units.

=> Required Time = 12 ÷ 4 = 3 days.

Therefore The correct answer is 3 days.

Additional Information

Total Work Concept

Total work is usually assumed as the LCM (Least Common Multiple) of the number of days taken by each person to simplify calculations.

Work and Efficiency

Efficiency is inversely proportional to the time taken. If a person completes work in 'n' days, their efficiency is 1/n per day.

Combined Work Rule

If multiple people work together, their individual efficiencies are added to find the total rate of work per day.

Q40. Answer: (b) 20.52%

Shortcut Trick

Net discount for 6% and 5% = 6 + 5 − (6 × 5 ÷ 100) = 11 − 0.3 = 10.7%.

Net discount for 10.7% and 11% = 10.7 + 11 − (10.7 × 11 ÷ 100).

=> 21.7 − (117.7 ÷ 100) = 21.7 − 1.177 = 20.523%.

Therefore The correct answer is 20.52%.

Alternate Method

Given: Three consecutive discounts d1 = 6%, d2 = 5%, and d3 = 11%.

Formula: Net SP = MP × (100 − d1)% × (100 − d2)% × (100 − d3)%

Let the Marked Price (MP) be 100.

=> SP = 100 × (94 ÷ 100) × (95 ÷ 100) × (89 ÷ 100)

=> SP = 100 × 0.94 × 0.95 × 0.89

=> SP = 89.3 × 0.89 = 79.477

=> Single Equivalent Discount = MP − SP = 100 − 79.477 = 20.523%

Therefore The correct answer is 20.52%.

Additional Information

Successive Discount Formula

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

Effective Price Calculation

When multiple discounts are applied, the order of application does not change the final Selling Price.

Q41. Answer: (c) Rs. 1,337

Shortcut Trick

Total deduction = 85 + 65 + 61 = Rs. 211

Remaining amount = 5575 − 211 = Rs. 5364

Divide Rs. 5364 in ratio 5 : 11 : 20 → Total parts = 36

Value of 1 part = 5364 ÷ 36 = Rs. 149

Difference (Y and Z) = (20 − 11) parts × 149 + (61 − 65) = 9 × 149 − 4 = 1341 − 4 = Rs. 1337

Therefore The correct answer is Rs. 1337.

Alternate Method

Given: Total amount = Rs. 5,575. Deductions: X = Rs. 85, Y = Rs. 65, Z = Rs. 61. New ratio = 5 : 11 : 20.

=> Total Deductions = 85 + 65 + 61 = Rs. 211

=> Remaining Amount = 5575 − 211 = Rs. 5364

=> Sum of ratio parts = 5 + 11 + 20 = 36

=> 36 units = 5364 => 1 unit = 5364 ÷ 36 = 149

=> Reduced share of Y = 11 × 149 = Rs. 1639

=> Reduced share of Z = 20 × 149 = Rs. 2980

=> Original share of Y = 1639 + 65 = Rs. 1704

=> Original share of Z = 2980 + 61 = Rs. 3041

=> Difference = 3041 − 1704 = Rs. 1337

Therefore The correct answer is Rs. 1337.

Additional Information

Ratio and Proportion Basics

If an amount A is divided in the ratio a:b:c, the shares are calculated as [a/(a+b+c)]×A, [b/(a+b+c)]×A, and [c/(a+b+c)]×A respectively.

Handling Deductions

When fixed amounts are subtracted from shares before applying a ratio, subtract the total deduction from the total sum before calculating unit values.

Difference Rule

To find the difference between original shares, calculate the difference between reduced shares and adjust by the difference in their respective deductions.

Q42. Answer: (c) 52

Shortcut Trick

Evaluate all the perfect square roots directly mentally:

=> √256 = 16, √169 = 13, √144 = 12, √25 = 5

=> Substitute these values directly: 16 − 13 + (12 − 5)²

=> 3 + $(7)^2$

=> 3 + 49 = 52

Therefore The correct answer is 52.

Alternate Method

Given:

Expression: $\sqrt{256} - \sqrt{169} + (\sqrt{144} - \sqrt{25})^2$

Method Used:

Apply the BODMAS rule: evaluate Order (square roots), then Brackets, followed by Exponents, and finally Addition/Subtraction.

Calculations:

=> Find the values of individual square roots:

=> $\sqrt{256} = 16$

=> $\sqrt{169} = 13$

=> $\sqrt{144} = 12$

=> $\sqrt{25} = 5$

=> Substitute the values back into the main expression:

=> $16 - 13 + (12 - 5)^2$

=> Simplify the bracket first (12 − 5):

=> $16 - 13 + (7)^2$

=> Evaluate the square of 7:

=> 16 − 13 + 49

=> Perform subtraction and addition from left to right:

=> 3 + 49

=> 52

Therefore The correct answer is 52.

Additional Information

BODMAS Rule

It defines the correct sequence for operations: Brackets, Order (Powers and Roots), Division × Multiplication (left-to-right), and Addition − Subtraction (left-to-right).

Perfect Squares up to 20

Memorising squares up to 30 significantly improves calculation speed in competitive exams. For example: $14^2 = 196$, $15^2 = 225$, $16^2 = 256$, $17^2 = 289$.

Basic Algebraic Identities

Although arithmetic simplification is best here, knowing $(a - b)^2 = a^2 - 2ab + b^2$ is essential for cases involving unknown variables.

Q43. Answer: (a) 19 : 3

Shortcut Trick

Fourth Proportional of 4, 8, 19 → (8 × 19) ÷ 4 = 38

Mean Proportional of 9, 4 → $\sqrt{(9 \times 4)} = 6$

Required Ratio → 38 : 6 = 19 : 3

Therefore The correct answer is 19 : 3.

Alternate Method

Given: Numbers for 4th proportional (a=4, b=8, c=19) and mean proportional (m=9, n=4).

Formula Used: Fourth proportional x = (b × c) / a; Mean proportional y = $\sqrt{(m \times n)}$.

=> Fourth proportional (x) = (8 × 19) / 4

=> x = 2 × 19 = 38

=> Mean proportional (y) = $\sqrt{(9 \times 4)} = \sqrt{36}$

=> y = 6

=> Ratio = x : y = 38 : 6

=> Ratio = 19 : 3

Therefore The correct answer is 19 : 3.

Additional Information

Third Proportional

For two numbers a and b, the third proportional c is such that a : b :: b : c, giving $c = b^2 / a$.

Mean Proportional

The mean proportional between two numbers a and b is $\sqrt{(a \times b)}$, also known as the geometric mean.

Duplicate and Sub-duplicate Ratio

Duplicate ratio of a:b is $a^2:b^2$ and sub-duplicate ratio is $\sqrt{a}:\sqrt{b}$.

Q44. Answer: (a) 170

Shortcut Trick

Identify the LCM of the given divisors: 12, 15, 18, and 20.

LCM (12, 15, 18, 20) = 180.

Required number = LCM − Increase Value

Required number = 180 − 10 = 170.

Therefore The correct answer is 170.

Alternate Method

Given: Divisors are 12, 15, 18, and 20; Number is increased by 10.

Formula Used: Required Number = LCM(divisors) − k (where k is the increment).

=> Prime factors of 12 = $2^2 \times 3$

=> Prime factors of 15 = 3×5

=> Prime factors of 18 = 2×3^2

=> Prime factors of 20 = $2^2 \times 5$

=> LCM = $2^2 \times 3^2 \times 5 = 4 \times 9 \times 5 = 180$

=> According to the condition: x + 10 = 180

=> x = 180 − 10 = 170

Therefore The correct answer is 170.

Additional Information

LCM (Least Common Multiple)

It is the smallest positive integer that is evenly divisible by a given set of numbers.

Remainder and Increment Rules

If a number is increased by 'k', subtract 'k' from the LCM. If it leaves a remainder 'r', add 'r' to the LCM.

Common Remainder Case

If a number when divided by a, b, c leaves remainders x, y, z respectively such that (a−x) = (b−y) = (c−z) = K, then the number is LCM(a, b, c) − K.

Q45. Answer: (a) 26 cm

Shortcut Trick

Find factors of Area (40) whose squares sum to 89.

Pairs: (1,40), (2,20), (4,10), (5,8).

=> $5^2 + 8^2 = 25 + 64 = 89$ (Matches diagonal squared).

=> Perimeter = $2 \times (8 + 5) = 2 \times 13 = 26$ cm.

Therefore The correct answer is 26 cm.

Alternate Method

Given:

Diagonal (d) = $\sqrt{89}$ cm

Area (A) = $l \times b = 40$ cm²

Formula Used:

=> $d^2 = l^2 + b^2$

=> $(l + b)^2 = l^2 + b^2 + 2lb$

Calculations:

=> $l^2 + b^2 = (\sqrt{89})^2 = 89$

=> $lb = 40$

=> $(l + b)^2 = 89 + 2 \times 40$

=> $(l + b)^2 = 89 + 80 = 169$

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=> l + b = √169 = 13 cm

=> Perimeter = 2(l + b) = 2 × 13 = 26 cm

Therefore The correct answer is 26 cm.

Additional Information

Pythagorean Property of Rectangles

The diagonal of a rectangle forms a right-angled triangle with the length and breadth, satisfying $l^2 + b^2 = d^2$.

Algebraic Identity for Perimeter

Perimeter is related to diagonal and area by the identity: $(\text{Perimeter}/2)^2 = d^2 + 2 \times \text{Area}$.

Area and Perimeter Relationship

For a fixed area, the perimeter of a rectangle is minimized when the rectangle is a square (l = b).

Q46. Answer: (d) 3

Shortcut Trick

Using the Man-Days relation: M1 × D1 = M2 × D2

20 × 12 = 80 × D2

D2 = 240 ÷ 80 = 3 days

Therefore The correct answer is 3 days.

Alternate Method

Given:

Initial strength (M1) = 20 pupils

Initial days (D1) = 12 days

New strength (M2) = 80 pupils

Formula Used:

M1 × D1 = M2 × D2

Calculations:

=> Total provisions = M1 × D1

=> Total provisions = 20 × 12 = 240 pupil-days

=> New days (D2) = Total provisions ÷ M2

=> D2 = 240 ÷ 80

=> D2 = 3 days

Therefore The correct answer is 3 days.

Additional Information

Inverse Proportion

When the number of people increases, the food provisions will last for fewer days. This is a case of inverse variation, represented as x × y = k (constant).

Chain Rule Formula

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

Q47. Answer: (b) Rs. 6,348

Shortcut Trick

Use the Successive Percentage method for 2 years: Net Rate = x + y + (xy/100)

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

Total Amount = 132.25% of Principal = 4800 × 1.3225

Amount = 48 × 132.25 = Rs. 6,348

Therefore The correct answer is Rs. 6,348.

Alternate Method

Given:

Principal (P) = Rs. 4,800

Rate (R) = 15% per annum

Time (n) = 2 years

Formula Used:

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

Calculations:

=> A = 4800 × (1 + 15/100)²

=> A = 4800 × (1 + 3/20)²

=> A = 4800 × (23/20) × (23/20)

=> A = 4800 × (529/400)

=> A = (4800 ÷ 400) × 529

=> A = 12 × 529

=> A = 6348

Therefore The correct answer is Rs. 6,348.

Additional Information

Difference between CI and SI

For 2 years, the difference (D) between Compound Interest and Simple Interest is given by: D = P × (R/100)².

Compound Interest Formula

Interest (CI) = Amount − Principal = P[(1 + R/100)ⁿ − 1].

Compounding Half-Yearly

If interest is compounded half-yearly, the Rate becomes R/2 and the Time (n) becomes 2n.

Q48. Answer: (a) 85.86 km/hr

Shortcut Trick

When the distance for both journeys is the same (from A to B and back to A), use the harmonic mean formula.

Average Speed = (2 × S1 × S2) ÷ (S1 + S2)

Average Speed = (2 × 70 × 111) ÷ (70 + 111) = 15540 ÷ 181

Average Speed ≈ 85.8563...

Therefore The correct answer is 85.86 km/hr.

Alternate Method

Given:

Distance (A to B) = 933 km

Speed (A to B), S1 = 70 km/hr

Speed (B to A), S2 = 111 km/hr

Formula Used:

Average Speed = Total Distance ÷ Total Time

Calculations:

=> Total Distance = 933 + 933 = 1866 km

=> Time taken from A to B (T1) = 933 ÷ 70 = 13.3285 hr

=> Time taken from B to A (T2) = 933 ÷ 111 = 8.4054 hr

=> Total Time = 13.3285 + 8.4054 = 21.7339 hr

=> Average Speed = 1866 ÷ 21.7339 ≈ 85.856 km/hr

Therefore The correct answer is 85.86 km/hr.

Additional Information

Average Speed (Equal Distances)

When an object covers equal distances at different speeds, the average speed is independent of the actual distance and is calculated as the harmonic mean of speeds.

Relative Speed

Relative speed in same direction is (S1 − S2) and in opposite direction is (S1 + S2).

Unit Conversion

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

Q49. Answer: (c) 30 years

Shortcut Trick

Ratio of ages of Ram and Lalith = 6 : 1

Product of ratio parts = 6 × 1 = 6 units²

Given product = 216 => 1 unit² = 216 ÷ 6 = 36 => 1 unit = √36 = 6 years

Difference in ratio = 6 − 1 = 5 units

Difference in ages = 5 × 6 = 30 years

Therefore The correct answer is 30 years.

Alternate Method

Given:

Product of Ram and Lalith ages = 216 years

Ratio of their ages = 6 : 1

Let the age of Ram be 6x and Lalith be x.

=> 6x × x = 216

=> $6x^2 = 216$

=> $x^2 = 216 \div 6$

=> $x^2 = 36$

=> $x = \sqrt{36} = 6$

=> Age of Ram = 6 × 6 = 36 years

=> Age of Lalith = 1 × 6 = 6 years

=> Difference = 36 − 6 = 30 years

Therefore The correct answer is 30 years.

Additional Information

Ratio and Product

When the product of two quantities in ratio a : b is given as P, always use a constant x such that (ax) × (bx) = P, leading to $x = \sqrt{(P / ab)}$.

Age Difference Constant

The difference between the ages of two persons remains constant throughout their lives, regardless of the number of years passed.

Ratio Difference

To find the difference directly from ratio a : b, calculate (a − b) × x, where x is the value of one ratio unit.

Q50. Answer: (a) 1%

Shortcut Trick

Assume savings = 100. Then expenditure = 100 + 200 = 300.

Income = 300 + 100 = 400.

New expenditure = 300 − 10% of 300 = 270. New savings = 100 + 34% of 100 = 134.

New income = 270 + 134 = 404.

% Increase in income = (4 / 400) × 100 = 1%.

Therefore The correct answer is 1%.

Alternate Method

Given that Expenditure is 200% more than Savings.

=> Let Savings = S and Expenditure = E.

=> E = S + 2S = 3S.

=> Income (I) = E + S = 3S + S = 4S.

=> If S = 100, then E = 300 and I = 400.

=> New E = 300 × (90/100) = 270.

=> New S = 100 × (134/100) = 134.

=> New I = 270 + 134 = 404.

=> Increase in Income = 404 − 400 = 4.

=> Percentage increase = (4 / 400) × 100 = 1%.

Therefore The correct answer is 1%.

Additional Information

Income-Expenditure Relationship

The fundamental formula is Income = Expenditure + Savings. Any change in two variables directly impacts the third.

Percentage Change in Income

It can also be calculated using weighted averages: $\%\Delta Income = (\%\Delta E \times E + \%\Delta S \times S) / (E + S)$.

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X% More Than Concept

If A is x% more than B, then A = B × (1 + x/100). For 200% more, the multiplier is (1 + 2) = 3.

Q51. Answer: (a) Q

Given:

→ Seven boxes L, M, N, O, Q, R and S are kept one above the other.

→ Only L is kept above Q.

→ Only three boxes are kept between L and R.

→ Only O is kept below N.

→ S is kept immediately above M.

Step 1: Arrange N and O

Only O is below N.

So, N must be at the bottom second position and O at the bottom.

Position (Top to Bottom)	Box
1	
2	
3	
4	
5	
6	N
7	O

Step 2: Place S and M

S is immediately above M.

Possible suitable positions:

Position	Box
1	
2	S
3	M
4	
5	
6	N
7	O

Step 3: Place L and R

There are exactly three boxes between L and R.

So, possible positions are:

→ L at 1 and R at 5

Position	Box
1	L
2	S
3	M
4	
5	R
6	N

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7	O

Step 4: Place Q

Only L is above Q.

So Q must be immediately below L.

Position	Box
1	L
2	Q
3	S
4	M
5	R
6	N
7	O

Step 5: Find the box second above M

M is at position 4.

First above M = S

Second above M = Q

Hence, the correct answer is "Option 1 - Q".

Q52. Answer: (c) Only conclusion (I) follows.

Given Statements:

All pilots are captains.

All captains are drivers.

Some drivers are teachers.

Venn Diagram Logic:

Conclusions:

(I) All pilots are drivers: Follows (Because all pilots are captains and all captains are drivers. Therefore, all pilots are drivers.)

(II) Some teachers are pilots: Does not follows (Because only “some drivers are teachers” is given. There is no definite relation between teachers and pilots.)

Therefore Only conclusion (I) follows.

Hence, the correct answer is "Only conclusion (I) follows".

Q53. Answer: (d) Two

Given:

→ Seven friends B, C, D, T, U, V and W are sitting in a straight line facing north.

→ Only two people sit between V and D.

→ Only U sits to the right of T.

→ Only one person sits between D and T.

→ C sits to the right of B but to the left of W.

B is at position 2.

W is at position 5.

People between them = C and D = 2 people

Hence, the correct answer is "Option 4 - Two".

Q54. Answer: (a) None

Given:

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

We need to find the odd digits which are:

→ Immediately preceded by an odd digit

→ Immediately followed by an odd digit

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Required pattern: Odd digit → Odd digit → Odd digit
Checking the series:
(Left) 6 5 8 8 5 4 7 7 4 2 7 9 2 2 5 7 4 8 8 2 1 8 9 (Right)
No odd digit is both preceded and followed by an odd digit.
Therefore, there are no such odd digits.
Hence, the correct answer is "Option 1".

Q55. Answer: (c) TUH

Given series: DER UVI LMZ CDQ ?
The pattern followed here is:
Therefore According to the pattern followed TUH will replace the (?) mark.
Hence, the correct answer is "Option 3".

Q56. Answer: (b) 72

Given:
Mr. Akte ranked 54^(th) from the top and 19^(th) from the bottom.
Formula:
Total students = Rank from top + Rank from bottom − 1
Calculation:
= 54 + 19 − 1
= 73 − 1
= 72
Hence, the correct answer is "Option 2".

Q57. Answer: (b) 108

Shortcut Trick
Interchange the signs as given: (− → +), (÷ → ×), (+ → −), (× → ÷).
Rewrite the expression: 33 + 15 × 6 − 120 ÷ 8.
Calculate division and multiplication: 120 ÷ 8 = 15 and 15 × 6 = 90.
Solve: 33 + 90 − 15 = 123 − 15 = 108.
Therefore The correct answer is 108.
Alternate Method
Given:
Original equation: 33 − 15 ÷ 6 + 120 × 8
Interchanges: (+) ↔ (−) and (×) ↔ (÷)
Method:
Follow the BODMAS rule: Bracket, Of, Division, Multiplication, Addition, Subtraction.
Calculations:
=> New Equation: 33 + 15 × 6 − 120 ÷ 8
=> Step 1 (Division): 120 ÷ 8 = 15
=> Step 2 (Multiplication): 15 × 6 = 90
=> Step 3 (Addition): 33 + 90 = 123
=> Step 4 (Subtraction): 123 − 15
=> ? = 108
Therefore The correct answer is 108.
Additional Information
BODMAS Rule
It defines the order of operations in arithmetic: Brackets → Orders (powers/roots) → Division → Multiplication → Addition → Subtraction.
Operator Interchange Logic
In these problems, replace every occurrence of the specified symbols simultaneously before starting any arithmetic calculation.
Priority of Division and Multiplication
Division and Multiplication hold the same rank and should be performed from left to right as they appear in the modified

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expression.

Q58. Answer: (b) RMQ

Logic followed here is:

The difference between the positional values of consecutive letters in the letter-cluster follows a specific pattern.

Option 1: LGJ

Option 2: RMQ

Option 3: PKN

Option 4: MHK

The pattern observed is: (1st letter - 5 = 2nd letter) and (2nd letter + 3 = 3rd letter). Letter-cluster 'RMQ' does not follow this pattern.

Therefore, the odd letter-cluster is 'RMQ'.

Hence, the correct answer is "Option 2".

Q59. Answer: (a) GKHJ

Logic followed here is.

Logic: Each letter of the word is shifted forward by 5 positions in the English alphabetical order to obtain the corresponding letter of the related group.

For

XBYA is related to CGDF →

ZDAC is related to EIFH →

The pattern observed is: (Positional value of each letter + 5) = Positional value of the related letter.

Similarly, let's find the related word for BFCE:

Therefore, the related word for 'BFCE' is GKHJ.

Hence, the correct answer is "Option 1".

Q60. Answer: (a) (25, 25.4, 24.7)

Logic followed here is:

In each set, the second number is obtained by adding 0.4 to the first number, and the third number is obtained by subtracting 0.7 from the second number.

For

(14, 14.4, 13.7) →

1st	2nd	3rd
14	14.4	13.7

Second number = 14 + 0.4 = 14.4

Third number = 14.4 - 0.7 = 13.7

(32, 32.4, 31.7) →

1st	2nd	3rd
32	32.4	31.7

Second number = 32 + 0.4 = 32.4

Third number = 32.4 - 0.7 = 31.7

The pattern observed is: (1st Number + 0.4 = 2nd Number) and (2nd Number - 0.7 = 3rd Number).

Similarly, let's find the related set for (25, 25.4, 24.7):

1st	2nd	3rd
25	25.4	24.7

Second number = 25 + 0.4 = 25.4

Third number = 25.4 - 0.7 = 24.7

Therefore, the set in which the numbers are related in the same way is (25, 25.4, 24.7).

Hence, the correct answer is "Option 1".

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Q61. Answer: (b) MH 28

Logic followed here is: The first letter is increased by 4, the second letter is increased by 5, and the number is increased by 4.

RL 12 is related to VQ 16 →

NH 15 is related to RM 19 →

The pattern observed is: (1^(st) letter + 4), (2^(nd) letter + 5), and (Number + 4).

Similarly, let's find the relation for IC 24:

Therefore, the code for 'IC 24' is MH 28.

Hence, the correct answer is "Option 2".

Q62. Answer: (a) Only conclusion (II) follows

Given Statements:

All balls are hens.

All rabbits are hens.

Venn Diagram Logic:

Conclusions:

(I) Some balls are rabbits: Does not follows (Because both balls and rabbits are subsets of hens, but there is no definite relation given between balls and rabbits.)

(II) Some hens are rabbits: Follows (Because all rabbits are hens, which means at least some hens are rabbits.)

Therefore Only conclusion (II) follows.

Hence, the correct answer is "Option 1".

Q63. Answer: (d) 55

Logic followed here is:

Each number in the series is obtained by subtracting consecutive multiples of 3 (3, 6, 9, 12, 15...) from the previous number.

Therefore, the value that should come in place of the question mark is 55.

Hence, the correct answer is "Option 4".

Q64. Answer: (a) IMQ 38

Logic followed here is:

Each letter in the cluster is shifted forward by 9 positions in the alphabetical series, and the numbers are increased by 5.

Therefore, the cluster that replaces the question mark is IMQ 38.

Hence, the correct answer is "Option 1".

Q65. Answer: (c) 3

Given:

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

We need to find the odd digits which are:

→ Immediately preceded by a perfect square

→ Immediately followed by an odd digit

Perfect square single-digit numbers are: 1, 4, 9

Required pattern: Perfect square → Odd digit → Odd digit

Checking the series:

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

The odd digits satisfying the condition are:

→ 7 in (4 7 5)

→ 5 in (9 5 9)

→ 3 in (1 3 7)

Therefore, there are 3 such odd digits.

Hence, the correct answer is "Option 3".

Q66. Answer: (d) 7 km to the North

Given:

→ Oren starts from Point A and drives 13 km towards East.

→ Turns left and drives 6 km.

→ Turns left and drives 17 km.

→ Turns left and drives 13 km.

→ Turns left and drives 4 km to reach Point P.

Step-by-step movement:

Final Position:

Point P is 7 km south of Point A.

Therefore, to reach Point A again, Oren must travel 7 km towards North.

Hence, the correct answer is "Option 4 - 7 km to the North".

Q67. Answer: (a) Two

Given:

(Left) ? % 4 5 % & ^ ? \ \ 4 $ % & 5 4 / 4 % ^ 7 (Right)

We need to find the numbers which are:

→ Immediately preceded by a symbol

→ Immediately followed by a symbol

Required pattern:

Symbol → Number → Symbol

Checking the series:

(Left) ? % 4 5 % & ^ ? \ \ 4 $ % & 5 4 / 4 % ^ 7 (Right)

The numbers satisfying the condition are:

→ 4 in (\ 4 $)

→ 4 in (/ 4 %)

Therefore, there are 2 such numbers.

Hence, the correct answer is "Option 1 - Two".

Q68. Answer: (c) TRQ−MKJ

Logic followed here is: Each letter of the second cluster is obtained by subtracting 7 from the positional values of the corresponding letters of the first cluster.

For KIH − DBA →

For OML − HFE →

Similarly, Option 3:

Therefore, the pair following the same pattern is 'TRQ − MKJ'.

Hence, the correct answer is "Option 3".

Q69. Answer: (a) 50

Logic followed here is: The series follows an alternating pattern of adding and subtracting consecutive multiples of 5 (+5, -10, +15, -20, +25).

The series is:

Therefore, the number that should come in place of the question mark is 50.

Hence, the correct answer is "Option 1".

Q70. Answer: (d) North-west

Given:

→ Jane walks 20 metres north from point A.

→ Turns right and walks 15 metres.

→ Turns right again and walks 50 metres to reach point B.

Step-by-step movement:

Final Position of B with respect to A:

→ 15 m East

→ 30 m South

So, point B is in the South-East direction from A.

Therefore, point A will be in the North-West direction from B.

Hence, the correct answer is "Option 4 - North-west".

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Q71. Answer: (c) 668

Given Equation:

71 ÷ 9 + 192 × 16 − 41 = ? →

÷	•	×	−
×	−	÷	•

After interchanging the signs based on the table above, the new equation is:

71 × 9 − 192 ÷ 16 + 41 = ?

Following BODMAS (Division, Multiplication, Addition, Subtraction):

=> 639 - 12 + 41 = ?

=> 680 - 12 = ?

=> 668 = ?

Therefore, the value that comes in place of the question mark is 668.

Henve, the correct answer is "Option 3".

Q72. Answer: (b) 144

Logic followed here is to replace the mathematical symbols with their designated operations and then solve the resulting expression using the BODMAS rule (Bracket, Of, Division, Multiplication, Addition, Subtraction).

Logic:

•	−	×	÷
−	×	÷	•

Given the expression:

25 – 6 ÷ 4 + 16 × 4 ÷ 16 + 22 = ?

Substituting the symbols as per the table:

25 × 6 + 4 − 16 ÷ 4 + 16 − 22

Solving using the BODMAS rule:

=> 150 + 4 - 4 + 16 - 22 = ?

=> 170 - 26 = ?

=> 144 = ?

Therefore, the value that will come in place of the question mark is 144.

Hence. the correct answer is "Option 1".

Q73. Answer: (c) E

Given:

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

→ B is sitting third to the right of C.

→ A is sitting third to the left of C.

→ D and A are immediate neighbours.

Find the immediate left of C

The person sitting immediately left of C is E.

Hence, the correct answer is "Option 3 - E".

Q74. Answer: (c) XXT

Logic followed here is:

The difference between the positional values of consecutive letters in each letter-cluster follows a consistent pattern of -1 and -3, except for the odd one out.

1) NMJ →

2) RQN →

3) XXT →

4) CBY→

Therefore, 'XXT' is the odd one out as it does not follow the (-0, -3) pattern.

Hence, the correct answer is "Option 3".

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Q75. Answer: (d) 4

Given:

'BACK' is coded as '8561'

'TACK' is coded as '6458'

Therefore, the code for T is 4.

Hence, the correct answer is "Option 4".

Q76. Answer: (c) 4

Given:

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

We need to find the odd numbers which are:

→ Immediately preceded by an odd number

→ Immediately followed by an even number

Required pattern: Odd → Odd → Even

Checking the series:

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

The odd numbers satisfying the condition are:

→ 7 in (1 7 2)

→ 9 in (5 9 4)

→ 5 in (3 5 2)

→ 1 in (5 1 6)

Therefore, there are 4 such odd numbers.

Hence, the correct answer is "Option 3 - 4".

Q77. Answer: (b) cz

Given:

'bowl tin leaf' is coded as 'ef cz bi'

'leaf mode theme' is coded as 'cz nx an'

Therefore, the code for 'leaf' is 'cz'.

Hence, the correct answer is "Option 2 - cz".

Q78. Answer: (d) 158

Given Series:

48, 56, 71, 93, 122, ?

The pattern followed here is:

Hence, the correct answer is "Option 4 - 158".

Q79. Answer: (a) B

Given:

→ D is immediately left of F

→ C is third to the left of B

→ F is an immediate neighbour of C

→ E is second to the right of C

→ A is immediately left of E

The person sitting at the extreme right end is B.

Therefore, the correct answer is Option 1.

Q80. Answer: (c) Brother's wife

Given:

→ A ± B means A is the wife of B

→ A * B means A is the daughter of B

→ A Rs. B means A is the father of B

→ A # B means A is the brother of B

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Expression:

D ± R # A * C Rs. O : D is the wife of R. R is the brother of A. A is the daughter of C. C is the father of O

Family Table:

Since R is the brother of O, D (wife of R) is O's brother's wife.

Therefore, the correct answer is Option 3.

Q81. Answer: (b) Project Hifazat

The correct answer is Project Hifazat.

Key Points

• The Punjab Government, under the leadership of Chief Minister Bhagwant Mann, launched Project Hifazat in January 2025 to significantly bolster the safety, security, and dignity of women and children across the state.

• The initiative is primarily implemented by the Punjab Police and involves the deployment of specialized Women Police Squads and patrolling teams in public areas such as educational institutions, bus stands, and marketplaces.

• A central feature of Project Hifazat is the proactive identification and monitoring of crime hotspots where incidents of harassment or "eve-teasing" are frequently reported, ensuring a swift deterrent against offenders.

• The project emphasizes community engagement and awareness, encouraging women to utilize the 112 emergency helpline and the Shakti app for immediate assistance during distress.

• By integrating modern technology and increased on-ground visibility of female officers, the scheme aims to create a fearless environment for women to participate in the workforce and education. Hence, the correct answer is Project Hifazat.

Additional Information

• Mission Shakti:

• This is a flagship umbrella scheme launched by the Ministry of Women and Child Development, Government of India, for the safety, security, and empowerment of women.

• It consists of two sub-schemes: ‘Sambal’ (for safety and security, including One Stop Centres and Women Helplines) and ‘Samarthya’ (for empowerment, including the Pradhan Mantri Matru Vandana Yojana).

• Mission Vatsalya:

• Previously known as the Child Protection Services (CPS) Scheme, Mission Vatsalya focuses on child welfare and protection.

• It aims to ensure a healthy and happy childhood for every child in India, providing a robust social safety net and enhancing the juvenile justice system.

• Project Suraksha:

• While various states use the term "Suraksha" for local safety programs, it is often associated with road safety or industrial safety initiatives rather than the specific 2025 Punjab women's safety initiative.

• One Stop Centres (OSC):

• Popularly known as Sakhi Centres, these provide integrated support and assistance to women affected by violence, both in private and public spaces, under one roof including medical, legal, and psychological aid.

Important Points

• Legal Framework: Women's safety initiatives in India are supported by stringent laws such as the Protection of Women from Domestic Violence Act (2005) and the Sexual Harassment of Women at Workplace Act (2013).

• Emergency Response: The Emergency Response Support System (ERSS), reachable via the number 112, provides a pan-India single number for all emergency services, which is a critical component of state-led projects like Project Hifazat.

• Gender Budgeting: The government utilizes Gender Budgeting as a tool to ensure that budgetary allocations are specifically directed towards schemes that benefit women and bridge gender gaps in safety and employment.

Q82. Answer: (c) Credit Information Reporting Directions, 2025

The correct answer is Credit Information Reporting Directions, 2025.

Key Points

• The Reserve Bank of India (RBI) issued the Credit Information Reporting Directions, 2025, in January 2025 to streamline and strengthen the framework for credit data reporting across the country.

• These directions are designed to improve the accuracy, completeness, and timeliness of credit information provided by Credit Institutions (CIs) to Credit Information Companies (CICs).

• The primary objective of this framework is to consolidate various existing instructions and circulars into a single, comprehensive set of guidelines to ensure uniformity in reporting practices.

• The directions mandate that Credit Institutions (such as banks and NBFCs) must report credit information to all four functional CICs in India on a regular basis, typically fortnightly or as specified by the regulator.

• This initiative is part of the RBI’s ongoing efforts to enhance the credit ecosystem, reduce information asymmetry, and empower lenders to make more informed credit decisions.

Additional Information

• Credit Information Companies (CICs):

• CICs are specialized institutions that maintain databases of credit information, including repayment history, loan amounts, and default records of individuals and entities.

• There are currently four major CICs operating in India: TransUnion CIBIL, Equifax, Experian, and CRIF High Mark.

• These companies provide Credit Information Reports (CIRs) and Credit Scores, which are vital for determining the creditworthiness of a borrower.

• The CICRA Act:

• The operations of these companies are governed by the Credit Information Companies (Regulation) Act, 2005 (CICRA) and the Rules and Regulations framed thereunder in 2006.

• The RBI is the primary regulatory authority that grants Certificates of Registration to these companies and monitors their compliance.

• Significance for Borrowers:

• Regular and accurate reporting ensures that a borrower's Credit Score reflects their true financial behavior, which can lead to lower interest rates and faster loan approvals.

• The 2025 Directions also focus on Grievance Redressal, ensuring that any inaccuracies in a credit report are corrected within a 30-day timeline.

Important Points

• Scope of Applicability: The directions apply to all Scheduled Commercial Banks, Regional Rural Banks, Cooperative Banks, NBFCs, and Public Financial Institutions.

• Data Quality Audit: Under the new framework, CICs are required to conduct periodic Data Quality Audits to identify gaps in reporting by Credit Institutions and ensure the integrity of the national credit database.

• Customer Protection: The RBI has emphasized that CIs and CICs must maintain high standards of data security and privacy, protecting sensitive financial information from unauthorized access.

• Reporting Frequency: To provide a more real-time view of a borrower's debt profile, the RBI has moved toward a fortnightly reporting cycle, a shift from the previous monthly reporting practice.

Q83. Answer: (a) Quantum Technology Research Centre, Delhi

The correct answer is Quantum Technology Research Centre, Delhi.

Key Points

• In May 2025, the Defence Research and Development Organisation (DRDO) reached a significant milestone by inaugurating the Quantum Technology Research Centre located in Delhi.

• The primary objective of this advanced research facility is to strengthen indigenous quantum capabilities specifically tailored for strategic and defence applications, ensuring national security in an evolving technological landscape.

• The centre is dedicated to developing cutting-edge technologies such as Quantum Key Distribution (QKD), Quantum Communication, and Quantum Sensing to provide secure data transmission and advanced detection systems for the armed forces.

• This initiative aligns with the vision of Atmanirbhar Bharat (Self-reliant India) by reducing dependency on foreign technologies for sensitive cryptographic and surveillance equipment.

• The facility acts as a hub for scientists and researchers to collaborate on quantum computing algorithms that can solve complex logistical and strategic problems much faster than classical computers.

Additional Information

• DRDO (Defence Research and Development Organisation):

• Established in 1958, it is the R&D wing of the Ministry of Defence, Government of India.

• Headquartered in New Delhi, it oversees a network of more than 50 laboratories developing diverse technologies in aeronautics, armaments, electronics, and missile systems.

• The organization plays a pivotal role in maintaining the technological edge of the Indian Military through local innovation.

• National Quantum Mission (NQM):

• Approved by the Union Cabinet in 2023 with a total outlay of over Rs. 6,000 crore.

• The mission aims to seed, nurture, and scale up scientific and industrial R&D in Quantum Technology (QT) over the next eight years.

• It targets the development of intermediate-scale quantum computers with 50-1000 physical qubits in various platforms.

• Strategic Importance of Quantum Tech:

• Quantum Key Distribution (QKD): Allows two parties to produce a shared random secret key known only to them, which can be used to encrypt and decrypt messages, making them immune to hacking.

• Quantum Radar: Utilizes quantum entanglement to detect stealth aircraft and objects that are otherwise invisible to conventional radar systems.

• Precision Timing: Quantum clocks provide highly accurate time synchronization, which is critical for GPS and navigation systems during wartime.

Important Points

• Geospatial Advantage: Establishing the centre in Delhi facilitates seamless coordination between DRDO Headquarters, the Ministry of Defence, and academic powerhouses like IIT Delhi.

• Future Readiness: The May 2025 inauguration signifies India's commitment to staying ahead in the global quantum race, which is currently dominated by nations like the USA and China.

• Indigenous Development: Most of the hardware and software protocols developed at the Quantum Technology Research Centre are built from the ground up to prevent backdoor vulnerabilities in military hardware.

• Dual-use Nature: While the primary focus is defence, the breakthroughs achieved here in quantum sensors can also be applied to civilian sectors like healthcare and disaster management.

Q84. Answer: (d) Assess and monitor the conservation status of India’s flora and fauna

The correct answer is Assess and monitor the conservation status of India’s flora and fauna.

Key Points

• The National Red List Roadmap, launched in 2025, is a strategic initiative by the Ministry of Environment, Forest and Climate Change (MoEFCC) to systematically document and evaluate the extinction risk of various species.

• The primary objective of this roadmap is to assess and monitor the conservation status of India’s flora and fauna using the global standards set by the International Union for Conservation of Nature (IUCN). Hence, statement 4 is correct.

• It seeks to bridge the data gap regarding threatened species in India, ensuring that national conservation priorities are backed by rigorous scientific data and IUCN Red List Categories.

• The roadmap involves a collaborative effort between the Botanical Survey of India (BSI), the Zoological Survey of India (ZSI), and various state forest departments to update the status of over 1,45,000 recorded species.

• Reducing carbon emissions from industries is part of the National Action Plan on Climate Change (NAPCC) and Net Zero 2070 goals, rather than the Red List initiative. Hence, statement 1 is incorrect.

• Promoting eco-tourism is a function of the Ministry of Tourism and specific wildlife management plans, but it is not the core focus of a biological "Red List." Hence, statement 2 is incorrect.

• Increasing forest cover by 10% by 2030 aligns with the Bonn Challenge and Green India Mission, but the National Red List specifically focuses on species-level assessment rather than general land-use targets. Hence, statement 3 is incorrect.

Additional Information

• IUCN Red List Categories:

• The assessment classifies species into categories such as Extinct (EX), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), and Near Threatened (NT).

• India is a megadiverse country, hosting approximately 7-8% of the world’s recorded species while occupying only 2.4% of the global land area.

• Botanical Survey of India (BSI):

• Established in 1890, it is the apex research organization under the MoEFCC for carrying out taxonomic and botanical studies on the wild plant resources of India.

• It plays a vital role in identifying endemic and threatened plant species for the Red List.

• Zoological Survey of India (ZSI):

• Founded in 1916, ZSI is responsible for the survey, exploration, and research of the exceptionally rich faunal diversity of the country.

• It maintains the National Zoological Collections and provides the data necessary for the Wildlife Protection Act, 1972.

• Kunming-Montreal Global Biodiversity Framework (KMGBF):

• The 2025 Roadmap helps India fulfill its commitments under Target 4 of the KMGBF, which aims to halt human-induced extinction of known threatened species by 2030.

Important Points

• Biodiversity Hotspots: India contains 4 of the 36 global biodiversity hotspots: the Himalayas, the Western Ghats, the Indo-Burma region, and the Nicobar Islands (part of Sundaland).

• Data Integration: The National Red List Roadmap utilizes modern digital tools and Geographic Information Systems (GIS) to map the distribution of species, which aids in identifying Critical Wildlife Habitats.

• Legal Support: The findings from these assessments directly influence the Schedules of the Wildlife Protection Act and the implementation of the Biological Diversity Act, 2002.

• Conservation Success: Projects like Project Tiger (1973) and Project Elephant (1992) are examples of species-specific

conservation that benefit from the data generated by Red List assessments.

Q85. Answer: (a) Japan

The correct answer is Japan.

Key Points

• Japan officially became the first nation to qualify for the 2026 FIFA World Cup through the qualification process, excluding the three host nations who receive automatic berths.

• The "Samurai Blue" secured their mathematical qualification on March 20, 2025, following a decisive victory in the AFC (Asian Football Confederation) Third Round of qualifiers.

• Competing in Group C of the Asian qualifiers, Japan maintained a dominant run under the management of head coach Hajime Moriyasu, ensuring a top-two finish in their group with several games to spare.

• This achievement marks Japan's 8th consecutive appearance in the FIFA World Cup, a streak that began in 1998 when the tournament was held in France.

• The qualification was confirmed after Japan accumulated enough points to be beyond the reach of the third-placed team in their qualifying group, effectively utilizing the expanded 8.5 slots allocated to Asia for the upcoming tournament.

Additional Information

• 2026 FIFA World Cup Expansion:

• The 2026 edition will be the first to feature 48 teams, an increase from the 32-team format used since 1998.

• This expansion allows more teams from Asia (AFC), Africa (CAF), and North America (CONCACAF) to participate in the global event.

• Host Nations:

• The tournament will be historically unique as it is co-hosted by three countries: the United States, Canada, and Mexico.

• All three host nations qualify automatically and are not required to participate in the regional qualification rounds.

• Other AFC Contenders:

• South Korea: Holds the record for the most World Cup appearances by an Asian nation (11 times) and was among the next teams to qualify shortly after Japan.

• Iran: Known as "Team Melli," they are a powerhouse in West Asia and have been consistent qualifiers in recent cycles (2014, 2018, 2022).

• Australia: After moving from the OFC to the AFC in 2006, the "Socceroos" have qualified for every tournament, often through intense inter-continental play-offs.

Important Points

• Tournament Timeline: The 2026 FIFA World Cup is scheduled to take place from June 11 to July 19, 2026.

• Venues: A total of 16 cities across the three host countries will host matches, with the final match set to be played at MetLife Stadium in East Rutherford, New Jersey.

• Qualification Slots: The AFC received a significant boost in slots, moving from 4.5 to 8.5, which facilitated the early qualification of top-tier teams like Japan.

• Historical Context: Mexico will become the first country to host or co-host the FIFA World Cup three times, having previously hosted in 1970 and 1986.

Q86. Answer: (d) Panic alert buttons

The correct answer is Panic alert buttons.

Key Points

• The Ministry of Railways has issued a directive to install Panic alert buttons at various railway stations within the Pune Division to enhance passenger security, with a target completion date of June 2025.

• These buttons are specifically designed to act as an emergency signaling system for women, children, and elderly passengers who may find themselves in distress while on the platform.

• The system is directly integrated with the Railway Protection Force (RPF) control room; once the button is pressed, an alert is instantly generated, identifying the exact location of the passenger.

• This safety feature is part of the Indian Railways' ongoing efforts to modernize station infrastructure and provide a proactive response mechanism against crimes like harassment or theft.

• The initiative in Pune serves as a critical pilot for implementing IoT-based security solutions that bridge the gap between passengers and security personnel in real-time.

Additional Information

• Pune Railway Division: Falling under the Central Railway zone, it is one of the highest revenue-generating and busiest divisions in Maharashtra, making it a priority for safety upgrades.

• Integrated Security System (ISS): The Panic alert buttons are a component of the broader ISS, which also includes CCTV

surveillance, baggage scanners, and metal detectors to provide multi-layered protection.

• Railway Protection Force (RPF): A specialized security force under the Ministry of Railways, the RPF is tasked with the protection of railway property and the safety of the 42 crore (approximate) annual passengers using the network.

• Meri Saheli Initiative: This program works alongside physical safety features like buttons, where dedicated teams of female RPF personnel interact with solo women travelers to provide security throughout their journey.

• Nirbhaya Fund: Many such safety installations at Indian Railways stations are funded through the Nirbhaya Fund, a non-lapsable corpus established in 2013 for schemes aimed at improving women's safety in India.

Important Points

• Response Mechanism: Upon activation of the button, Quick Reaction Teams (QRT) of the RPF are expected to reach the spot within 3 to 5 minutes to assist the passenger.

• Technological Features: Most modern Panic alert buttons installed by the railways are equipped with two-way communication, allowing the passenger to speak directly with the dispatcher while help is on the way.

• Timeline: The June 2025 deadline set for Pune stations ensures that the technology is synced with the Smart City projects currently being implemented in the region.

• Legal Context: Under the Railways Act, 1989, ensuring the safety of passengers is a statutory duty, and the introduction of such devices helps the administration meet these legal and ethical obligations.

Q87. Answer: (b) Ram Nath Kovind

The correct answer is Ram Nath Kovind.

Key Points

• The Government of India officially constituted a high-level committee (HLC) on September 2, 2023, to evaluate the feasibility and mechanisms of implementing "One Nation, One Election".

• The committee is headed by Ram Nath Kovind, who served as the 14th President of India from 2017 to 2022.

• The primary objective of this committee is to examine and make recommendations for holding simultaneous elections for the Lok Sabha (House of the People), State Legislative Assemblies, Municipalities, and Panchayats.

• The high-level committee consists of several distinguished members, including Union Home Minister Amit Shah, former Leader of Opposition in the Rajya Sabha Ghulam Nabi Azad, former Finance Commission Chairman N.K. Singh, former Lok Sabha Secretary General Subhash C. Kashyap, senior advocate Harish Salve, and former Chief Vigilance Commissioner Sanjay Kothari.

• The Department of Legal Affairs under the Ministry of Law and Justice serves as the secretariat for this committee, with Nitin Chandra appointed as the Secretary to the HLC.

Additional Information

• Concept of One Nation, One Election:

• It refers to the idea of restructuring the Indian election cycle so that elections to the central parliament and all state assemblies happen at the same time.

• Historically, simultaneous elections were held in India during 1951-52, 1957, 1962, and 1967. The practice was disrupted after the premature dissolution of some assemblies in 1968 and 1969.

• Proponents' Arguments:

• Proponents argue it will significantly reduce election expenditure, which runs into thousands of crores for the Exchequer and political parties.

• It aims to minimize the frequent imposition of the Model Code of Conduct (MCC), which often leads to "policy paralysis" by halting developmental projects during every election season.

• It would reduce the strain on security forces and government officials who are frequently diverted from their primary duties for election management.

• Constitutional Challenges:

• Implementing this concept requires amendments to Article 83 (Duration of Houses of Parliament), Article 85 (Dissolution of Lok Sabha), Article 172 (Duration of State Legislatures), Article 174 (Dissolution of State Legislatures), and Article 356 (President's Rule).

• There is a debate on whether such amendments would require ratification by at least half of the State Legislatures under the proviso to Article 368(2) of the Constitution of India.

Important Points

• Report Submission: On March 14, 2024, the Ram Nath Kovind-led committee submitted its comprehensive report to President Droupadi Murmu. The report spans over 18,626 pages and was prepared after 191 days of extensive consultations with stakeholders and experts.

• Key Recommendations: The committee recommended a two-step approach: first, synchronizing Lok Sabha and Assembly elections, and second, holding local body elections (Municipalities and Panchayats) within 100 days of the general elections.

• Unified Voter List: One of the major suggestions included the creation of a Single Electoral Roll and Single Voter ID Card for all

tiers of elections, to be prepared by the Election Commission of India (ECI) in consultation with State Election Commissions (SECs).

• Logistics and Infrastructure: The committee emphasized the need for advanced planning for Electronic Voting Machines (EVMs), VVPATs, and deployment of Central Armed Police Forces (CAPF) to manage the scale of simultaneous polls across the country.

Q88. Answer: (d) Gulmarg

The correct answer is Gulmarg.

Key Points

• The second part of the 5th edition of the Khelo India Winter Games (KIWG) was scheduled to be held in Gulmarg, situated in the Baramulla district of Jammu and Kashmir.

• This second leg of the prestigious national event took place from March 9 to 12, 2025, featuring high-adrenaline snow sports.

• While the Gulmarg phase focused on mountain-based activities, the first part of the 2025 games was hosted in Leh, Ladakh, between January 30 and February 2, 2025.

• The events conducted during the Gulmarg leg primarily included Alpine Skiing, Snowboarding, Ski Mountaineering, and Nordic Skiing.

• The games are a collaborative effort between the Ministry of Youth Affairs and Sports, the Sports Authority of India (SAI), and the J&K Sports Council to promote winter sports culture in the country.

Additional Information

• Gulmarg as a Sports Hub:

• Known as the "Meadow of Flowers," Gulmarg is one of the world's premier ski destinations located at an altitude of approximately 2,650 meters in the Pir Panjal Range of the Himalayas.

• It has hosted the majority of the Khelo India Winter Games editions since their inception due to its world-class slopes at Kongdoori and Mary Shoulder.

• Khelo India Winter Games (KIWG) History:

• The first edition of the KIWG was held in 2020. It was launched to identify and nurture talent for international winter sports competitions like the Winter Olympics.

• The 4th edition in 2024 also followed a dual-venue format between Ladakh and Jammu & Kashmir, where Army Sports Control Board (ASCB) topped the medal tally.

• Broad Objective of Khelo India:

• The Khelo India program was introduced in 2018 by the Government of India to revive the sports culture at the grass-root level by building a strong framework for all sports played in the country.

• It encompasses various verticals including Khelo India Youth Games, University Games, and Winter Games.

Important Points

• Sports Disciplines: The 5th KIWG included diverse disciplines. While Leh hosted Ice Hockey and Speed Skating, the Gulmarg leg was dedicated to snow-dependent sports.

• Mascot and Symbolism: The mascot for the games typically features the Snow Leopard (often named 'Sheen-e-She' in local dialect), which symbolizes the Himalayan heritage and the spirit of resilience.

• National Participation: Hundreds of athletes from various States, Union Territories, and Central Boards participate, fostering national integration through sports.

• Tourism Impact: Hosting these games in 2025 significantly boosts winter tourism in Jammu & Kashmir and Ladakh, positioning India as a global winter sports destination.

Q89. Answer: (c) Vertical lift bridge

The correct answer is Vertical lift bridge.

Key Points

• The new Pamban Rail Bridge is India’s first vertical lift sea bridge, a state-of-the-art engineering marvel connecting the Indian mainland at Mandapam to Pamban Island (Rameswaram) in Tamil Nadu.

• The bridge’s most distinctive feature is its 72.5-meter-long vertical lift span. This central section can be raised vertically to a height of 17 meters above the water level, allowing large ships and vessels to pass through the Palk Strait seamlessly.

• Constructed by Rail Vikas Nigam Limited (RVNL), the bridge spans a total length of approximately 2.05 kilometers and consists of 99 spans supported by 100 piers located in the sea.

• It replaces the original Pamban Bridge, which was commissioned in 1914. While the old bridge used a Scherzer rolling lift (opening sideways like scissors), the new structure employs advanced electromechanical technology for vertical movement.

• The new bridge is designed to support double-track railway lines and is engineered to handle much higher traffic loads and wind speeds compared to its predecessor. Hence, the correct answer is Vertical lift bridge.

Additional Information

• Geographical Significance: The bridge is located in one of the most corrosive marine environments in the world. To combat this, the structure utilizes high-grade stainless steel and specialized anti-corrosive coatings to ensure a lifespan of over 100 years.

• Connectivity and Tourism: The bridge is a vital link for pilgrims visiting the Ramanathaswamy Temple in Rameswaram. It facilitates faster transport and boosts the socio-economic development of the region.

• Structural Dynamics: The vertical lift span is fully automated and equipped with sensors to monitor wind speeds and structural health. The lifting mechanism is powered by an electromechanical system that ensures precision and safety during maritime transit.

• Project Background: The foundation stone for this project was laid in November 2019 by Prime Minister Narendra Modi. The project represents a significant milestone in Indian Railways' infrastructure modernization.

Important Points

• Scherzer Lift vs. Vertical Lift: The old 1914 bridge featured a Scherzer rolling lift span, which required manual operation to rotate the spans. The new vertical lift is more efficient, allowing for a wider navigation channel for maritime traffic.

• Engineering Challenges: Building in the Bay of Bengal involved managing high-velocity winds and tidal variations. The bridge is built at a higher elevation than the old bridge to minimize the impact of waves and sea spray on the rail tracks.

• Comparison with Road Bridge: While the rail bridge is a vertical lift structure, the adjacent Annai Indira Gandhi Road Bridge (opened in 1988) is a cantilever bridge, highlighting the diverse engineering techniques used to connect Rameswaram to the mainland.

Q90. Answer: (b) Rs. 3,413 crore

The correct answer is Rs. 3,413 crore.

Key Points

• The Union Budget 2025–26 has allocated approximately Rs. 3,413 crore to the Ministry of Environment, Forest and Climate Change (MoEFCC) to bolster India's ecological and environmental initiatives.

• This allocation is pivotal for implementing the National Mission for a Green India, which aims at protecting, restoring, and enhancing India's diminishing forest cover and responding to climate change.

• A significant portion of this fund is dedicated to Control of Pollution, supporting the National Clean Air Programme (NCAP) to reduce particulate matter concentration in 131 cities across the country.

• The budget also provides financial support to statutory and autonomous bodies under the ministry, such as the Central Pollution Control Board (CPCB) and the National Green Tribunal (NGT).

• Funding for Project Tiger and Project Elephant is integrated into this allocation to ensure the conservation of India's megafauna and their natural habitats.

Additional Information

• Ministry of Environment, Forest and Climate Change (MoEFCC):

• It is the nodal agency in the administrative structure of the Central Government for the planning, promotion, and coordination of India's environmental and forestry policies.

• The ministry was established in 1985 and is currently headed by the Union Minister of Environment.

• It oversees the implementation of major acts like the Environment (Protection) Act, 1986 and the Wildlife (Protection) Act, 1972.

• Budgetary Framework in India:

• The Union Budget is the Annual Financial Statement of the country, presented under Article 112 of the Constitution of India.

• The budget for 2025-26 was presented by the Union Finance Minister, Nirmala Sitharaman, on February 1, 2025.

• Budgetary allocations reflect the government's priorities, such as the Net Zero by 2070 commitment made at COP26.

Important Points

• Climate Action and Mission LiFE: The budget supports Mission LiFE (Lifestyle for Environment), a global movement aimed at individual and community action to protect the environment.

• Coastal Management: Funds are also earmarked for the Integrated Coastal Zone Management project to conserve marine biodiversity and improve the livelihoods of coastal communities.

• Circular Economy: There is an increased focus on waste management and circular economy principles to ensure sustainable consumption and production patterns.

• Ramsar Sites: The allocation assists in the maintenance of Wetlands of International Importance, helping India fulfill its obligations under the Ramsar Convention.

Q91. Answer: (d) Rakshak-Suraksha Kavach

The correct answer is Rakshak-Suraksha Kavach.

Key Points

• The Rakshak-Suraksha Kavach is an advanced, homegrown multi-layered air defense system developed by the Defence Research and Development Organisation (DRDO) to provide comprehensive protection against a variety of aerial threats.

• This sophisticated system made its debut appearance at the 76th Republic Day Parade held on January 26, 2025, at Kartavya Path, New Delhi, showcasing India’s growing prowess in defense manufacturing.

• It was also a major highlight at Aero India 2025, the 15th edition of the biennial air show held at the Yelahanka Air Force Station in Bengaluru, Karnataka.

• The Rakshak-Suraksha Kavach is designed to integrate various existing and new missile systems into a single Command and Control (C2) architecture, creating a "seamless shield" for the country's critical infrastructure and airspace.

• The system is specifically engineered to detect, track, and neutralize threats such as ballistic missiles, cruise missiles, fighter jets, and unmanned aerial vehicles (UAVs) or drone swarms at multiple ranges.

Additional Information

• DRDO (Defence Research and Development Organisation):

• Established in 1958, DRDO is the R&D wing of the Ministry of Defence, Government of India, with its headquarters in New Delhi.

• It is responsible for the design and development of state-of-the-art defense technologies, including missiles, armored vehicles, radars, and electronic warfare systems.

• Aero India 2025:

• This event is Asia’s largest aerospace and defense exhibition, providing a platform for Aatmanirbhar Bharat (Self-reliant India) to demonstrate its indigenous aviation and aerospace capabilities.

• The 2025 edition focused on the Viksit Bharat @ 2047 vision, emphasizing the export potential of Indian-made defense hardware to the global market.

• Multi-Layered Defense Architecture:

• A multi-layered system typically consists of Very Short Range Air Defence (VSHORAD) for close-in protection, Medium Range Surface-to-Air Missiles (MRSAM), and Long Range interceptors.

• The Kavach system acts as the central nervous system that synchronizes radars and launchers to ensure zero-gap security.

Important Points

• Technological Features: The Rakshak-Suraksha Kavach utilizes Active Electronically Scanned Array (AESA) radars for 360-degree surveillance and precision tracking of high-speed targets.

• Strategic Significance: The deployment of this homegrown system reduces India's dependency on foreign air defense platforms like the S-400 Triumf from Russia or the Iron Dome from Israel.

• Collaboration: The project involved collaboration between DRDO, various Public Sector Undertakings (PSUs) like Bharat Electronics Limited (BEL), and private industry partners under the Make in India initiative.

• Modern Warfare Adaptation: The inclusion of anti-drone modules within the Kavach system highlights its readiness for asymmetric warfare and cyber-electronic threats prevalent in modern conflicts.

Q92. Answer: (b) 71st

The correct answer is 71st.

Key Points

• India has been ranked 71st on the World Economic Forum’s (WEF) Energy Transition Index (ETI) for the year 2025.

• The Energy Transition Index (ETI) benchmarks 120 countries based on their current energy system performance and the readiness of their enabling environment for transition.

• India's performance is characterized by significant progress in energy equity and security, driven by the government's push for universal electricity access and the scaling up of renewable energy capacity.

• The report notes that India is among the few large economies showing consistent improvements over the last decade, particularly in reducing the energy intensity of its GDP.

• The World Economic Forum emphasizes that while India has improved its ranking, continued investment in clean energy infrastructure and grid modernization is essential to sustain this momentum.

Additional Information

• The World Economic Forum (WEF):

• It is an international non-governmental organization founded on January 24, 1971, by German engineer Klaus Schwab.

• Headquartered in Cologny, Switzerland, it is famous for its annual meeting in Davos, where global leaders discuss pressing economic and social issues.

• Other major reports published by the WEF include the Global Gender Gap Report, the Global Risks Report, and the Global Competitiveness Report.

• Energy Transition Index (ETI) Framework:

• The ETI evaluates countries across two main sub-indices: System Performance (Energy Security, Equity, and Sustainability) and Transition Readiness (Policy, Finance, and Infrastructure).

• In the 2025 index, Sweden, Denmark, and Finland continue to lead the rankings due to their high political commitment and

advanced energy technology.

• India's Energy Targets:

• India has committed to achieving Net Zero emissions by the year 2070, as announced during COP26 in Glasgow.

• The country aims to reach 500 GW of non-fossil fuel energy capacity by 2030, representing a massive shift in its energy mix.

• Programs like the Production Linked Incentive (PLI) scheme for High-Efficiency Solar PV Modules are pivotal in boosting domestic manufacturing and reducing import dependency.

Important Points

• Global Energy Landscape: The 2025 report highlights that global energy transition has slowed down due to geopolitical tensions and economic volatility, though renewable adoption remains at record highs.

• Decarbonization in India: India is focusing on Green Hydrogen through the National Green Hydrogen Mission, launched in 2023 with an initial outlay of Rs 19,744 crore, aiming to make the country a global hub for its production.

• Energy Security: Despite the focus on renewables, India continues to manage a balance with coal to ensure grid stability and meet the rising power demand of a growing population.

Q93. Answer: (b) Communist Party of India

The correct answer is Communist Party of India.

Key Points

• The Communist Party of India (CPI) has officially announced its plan to organize a nationwide protest scheduled for November 18, 2025.

• The primary motive behind this call for action is to express strong dissent against the increasing atrocities and systemic violence targeting marginalized groups, including Dalits, Adivasis, and minority communities across the country.

• The decision was finalized during a meeting of the National Executive of the party, where leaders raised concerns about the perceived failure of administrative machinery in protecting vulnerable sections of society.

• The protest aims to mobilize party cadres, trade unions, and peasant organizations at the district and state levels to demand justice and better security for these groups.

• Key demands include the strict implementation of the Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act and the preservation of constitutional rights as enshrined in the Constitution of India.

Additional Information

• Communist Party of India (CPI):

• The CPI is one of the oldest political parties in India, established on December 26, 1925, at Kanpur.

• Its political ideology is rooted in Marxism-Leninism, and its election symbol is the Ears of Corn and Sickle.

• Historically, the party has played a significant role in the Indian independence movement and subsequently in the socio-economic movements for land reforms and labor rights.

• Marginalized Groups in Context:

• In the Indian socio-political landscape, marginalized groups generally refer to those who have historically faced social exclusion, including Scheduled Castes (SCs), Scheduled Tribes (STs), and Other Backward Classes (OBCs).

• Various Articles of the Constitution, such as Article 15 (non-discrimination) and Article 17 (abolition of untouchability), are designed to safeguard these groups.

• Significance of Nationwide Protests:

• A nationwide protest serves as a democratic tool for political parties to highlight issues that transcend regional boundaries and affect the national collective.

• Such events often lead to Parliamentary debates and can influence policy changes or the introduction of new government guidelines.

Important Points

• The CPI often collaborates with other Left parties like the CPI(M) to form a Left Front during such large-scale agitations to maximize impact.

• The timing of the protest on November 18, 2025, is significant as it aligns with the party's lead-up to its centenary celebrations (1925-2025), emphasizing its 100-year legacy of fighting for the downtrodden.

• The current General Secretary of the party (as of the announcement period) is D. Raja, who has been vocal about secularism and federalism.

• The party's influence is notably strong in states like Kerala, Tamil Nadu, and Manipur, where it maintains a significant presence in legislative assemblies.

Q94. Answer: (c) China

The correct answer is China.

Key Points

• The 2025 Hyundai Archery World Cup Grand Final is scheduled to be held in China in October 2025. This event serves as the prestigious conclusion to the international archery season.

• The Grand Final brings together the world's elite archers who have qualified through various stages held earlier in the year 2025. Only the top eight athletes in each of the four competition categories earn a spot in this finale.

• The four categories featured in the tournament include Recurve Men, Recurve Women, Compound Men, and Compound Women. Qualification is determined by winning a World Cup stage or through high placement in the World Archery Rankings.

• Hyundai continues its role as the title sponsor of the circuit, a partnership that has significantly boosted the global profile and commercial viability of the sport since it began.

• Hosting the event in China highlights the country's growing importance in the international sporting landscape and its commitment to promoting archery at the highest level.

Additional Information

• World Archery Federation:

• The international governing body for the sport of archery is World Archery, which is headquartered in Lausanne, Switzerland. It was founded in 1931 and is responsible for the rules and organization of major international events.

• Archery World Cup Format:

• The Archery World Cup was first launched in 2006. It typically consists of four distinct stages held in different cities across the globe, followed by the Grand Final.

• The format was designed to make the sport more spectator-friendly and to provide a consistent platform for athletes to earn prize money and world ranking points.

• Equipment Types:

• Recurve Bow: This is the traditional bow style used in the Olympic Games. It is characterized by limbs that curve away from the archer when unstrung.

• Compound Bow: This type uses a levering system, usually of cables and pulleys, to bend the limbs. While popular in the World Cup, it is not currently part of the Olympic program.

• Historical Context:

• China has a long-standing history of hosting World Archery events, particularly in Shanghai, which has frequently hosted the opening stages of the World Cup circuit over the last two decades.

• The Grand Final winners are officially recognized as World Cup Champions, a title that carries immense prestige alongside the World Archery Championships and the Olympic Gold Medal.

Q95. Answer: (c) No action is taken; they can continue in office.

The correct answer is No action is taken; they can continue in office.

Key Points

• The Constitution (130th Amendment) Bill, 2025, introduces specific provisions regarding the administrative continuity of the Prime Minister and Chief Ministers in the event of their arrest or legal detention.

• According to the bill, if an accused minister, such as the Prime Minister or a Chief Minister, is granted bail within a window of 30 days from the date of arrest, no action is taken against their position.

• This ensures that the individual can continue in office and perform their constitutional duties without being subjected to automatic suspension or disqualification, provided the legal stay is brief.

• The bill aims to balance the legal rights of the accused with the necessity of maintaining stability in the executive branch of the government.

• If the individual fails to secure bail within the stipulated 30-day period, the bill prescribes further consequences, but the immediate 30-day period serves as a protective grace window.

Additional Information

• Article 368: The Constitution (130th Amendment) Bill, 2025, would be processed under Article 368 of the Constitution of India, which grants Parliament the power to amend the document through a Special Majority.

• Representation of the People Act, 1951: Historically, Section 8 of this Act deals with the disqualification of representatives upon conviction. However, the new 2025 amendment specifically addresses the status of ministers at the accused stage before a final verdict is reached.

• Governance Continuity: The bill addresses the recent legal and political debates in India (observed in cases during 2023 and 2024) concerning whether a Chief Minister can run the government from judicial custody.

• Judicial Custody vs. Police Custody: The 30-day limit applies regardless of whether the official is in police custody or judicial custody, emphasizing the availability of bail as the determining factor for continuing in office.

Important Points

• 30-Day Threshold: The numerical value of 30 days is critical; it serves as a legislative compromise to prevent the misuse of investigative agencies to topple governments through short-term arrests.

• Executive Stability: The provision that no action is taken reflects the principle that the mandate of the electorate should not be subverted by mere allegations unless the detention is prolonged enough to hinder governance.

• Role of the President and Governor: Under this bill, the President (for the PM) and the Governor (for the CM) are required to wait for the expiration of the 30-day period before initiating any constitutional process for suspension or replacement.

• Legal Precedents: This amendment seeks to codify matters that were previously left to judicial interpretation by the Supreme Court or the High Courts regarding the "morality" of holding office while under arrest.

Q96. Answer: (d) Jaroslavas Melnikas

The correct answer is Jaroslavas Melnikas.

Key Points

• Jaroslavas Melnikas is the celebrated author of the Lithuanian novel titled ‘The Last Day’ (originally published as ‘Paskutinė diena’).

• The Hindi translation of this novel was released by the Sahitya Akademi in October 2025 as a landmark step in fostering literary exchange and cultural collaboration between India and Lithuania.

• The novel is a profound philosophical work that explores a world where every human being knows the exact date of their death, challenging the reader to reflect on the value of life and time.

• This translation is part of a broader initiative by the Ministry of Culture and Sahitya Akademi to bring contemporary European literature to Indian readers in their native languages.

• By translating works from the Baltic region into Hindi, the project aims to deepen the bilateral cultural ties and provide a platform for modern Lithuanian voices in the Indian subcontinent.

Additional Information

• Jaroslavas Melnikas:

• Born in 1959, he is a prominent Lithuanian-Ukrainian writer, critic, and philosopher.

• His works are known for their existentialist themes and have been translated into numerous languages, including French, English, and German.

• He has received several prestigious literary awards, and his novel ‘The Last Day’ was a finalist for the Book of the Year in Lithuania.

• Sahitya Akademi:

• Established on 12 March 1954, it is India’s National Academy of Letters.

• The Sahitya Akademi promotes literature in 24 Indian languages and frequently engages in international translation projects to promote global literary harmony.

• It is headquartered at Rabindra Bhavan in New Delhi.

• India-Lithuania Cultural Relations:

• The cultural connection between the two nations is historically significant due to the linguistic similarities between Lithuanian and Sanskrit.

• Translating modern fiction like ‘The Last Day’ helps modernize this ancient connection by showcasing 21st-century thought and creativity.

Important Points

• Other Distinguished Lithuanian Authors (Options Analysis):

• Vincas Mykolaitis-Putinas: A legendary 20th-century poet and novelist, most famous for his psychological novel ‘In the Shadow of Altars’ (1933).

• Jurga Ivanauskaitė: A modern writer and activist (1961–2007) known for her work ‘The Witch and the Rain’ and her deep interest in Tibetan Buddhism.

• Balys Sruoga: A famous playwright and poet known for the memoir ‘The Forest of the Gods’, which details his survival in a Stutthof concentration camp.

• Translation Significance:

• Translating into Hindi, one of the most spoken languages in the world, ensures that Jaroslavas Melnikas’s unique vision reaches a massive audience, enriching the Indian literary landscape.

Q97. Answer: (d) India-Singapore Comprehensive Strategic Partnership

The correct answer is India-Singapore Comprehensive Strategic Partnership.

Key Points

• In September 2024, during the official visit of Prime Minister Narendra Modi to Singapore, the bilateral relationship between the two nations was officially elevated to a Comprehensive Strategic Partnership.

• This upgrade marks a significant evolution from the Strategic Partnership that was established in 2015, reflecting the deepening trust and widening scope of cooperation.

• The two countries signed and exchanged several Memorandums of Understanding (MoUs) focusing on critical future-oriented sectors: Semiconductors, Digital Technologies, Skill Development, and Healthcare.

• The Semiconductor ecosystem partnership is particularly noteworthy, as it aims to leverage Singapore's established global role in semiconductor manufacturing to support India's nascent but ambitious semiconductor industry.

• The agreements were exchanged in the presence of PM Narendra Modi and Singapore's Prime Minister Lawrence Wong, emphasizing a shared vision for a stable and prosperous Indo-Pacific region.

Additional Information

• Economic Synergy: Singapore has consistently been one of the largest sources of Foreign Direct Investment (FDI) for India, with cumulative investments exceeding $160 billion since 2000.

• CECA (2005): The Comprehensive Economic Cooperation Agreement (CECA), signed in 2005, was India's first-ever comprehensive trade agreement with any country, facilitating easier trade in goods, services, and investments.

• Digital Connectivity: In February 2023, India and Singapore launched the linkage of their real-time payment systems—UPI and PayNow—enabling faster and cheaper cross-border remittances.

• Defense Cooperation: The maritime relationship is anchored by the SIMBEX (Singapore-India Maritime Bilateral Exercise), which has been held annually since 1994, making it one of India's longest-running naval exercises with any foreign country.

• Historical Ties: India was among the first countries to recognize Singapore as an independent nation in 1965, and both nations will celebrate the 60th anniversary of diplomatic relations in 2025.

Important Points

• India-Singapore Ministerial Roundtable (ISMR): This high-level mechanism, established in 2022, played a crucial role in identifying the new pillars of the Comprehensive Strategic Partnership, including Food Security, Green Energy, and Advanced Manufacturing.

• Skill Development Focus: The MoU on Educational Cooperation and Skill Development aims to collaborate on vocational training and Technical and Vocational Education and Training (TVET) to enhance the employability of the Indian workforce.

• Healthcare Collaboration: The partnership in Healthcare and Medical Research focuses on pandemic preparedness, genomic surveillance, and digital health solutions to tackle emerging global health challenges.

• Sustainability: Both nations are working closely under the Green Economy framework to promote sustainable finance, Green Hydrogen, and carbon credit collaborations.

Q98. Answer: (d) Bihar

The correct answer is Bihar.

Key Points

• The state of Bihar has been officially selected to host the 7th edition of the Khelo India Youth Games (KIYG) in 2025.

• This announcement was made by the Union Minister for Youth Affairs and Sports, Shri Mansukh Mandaviya, during a meeting with state sports ministers, signifying a major shift in hosting national events in the eastern part of India.

• It will be the first time in history that Bihar will host this prestigious national multi-sport competition, highlighting the state's growing commitment to developing sports infrastructure and talent.

• The 2025 edition aims to provide a platform for approximately 7,000 to 8,000 athletes from across the country to compete in various sporting disciplines.

• The Government of Bihar is expected to utilize venues in Patna and other districts to conduct the games, promoting a sports culture at the grassroots level within the state.

Additional Information

• Previous Edition (2024):

• The 6th edition of the Khelo India Youth Games was hosted by Tamil Nadu in January 2024.

• The games were held across four cities: Chennai, Madurai, Trichy, and Coimbatore.

• Maharashtra emerged as the overall champion of the 2024 games, securing the top spot in the medal tally.

• Evolution of KIYG:

• The Khelo India Youth Games (formerly known as Khelo India School Games) were launched in 2018 by the Ministry of Youth Affairs and Sports.

• The inaugural edition was held in New Delhi, and since then, it has become the biggest talent-identification platform in Indian sports.

• The games are organized in two categories: under-17 years for school students and under-21 years for college and university students.

• Objectives of Khelo India:

• The primary objective of the Khelo India initiative is to revive the sports culture in India by integrating sports with the education system and identifying talent at a young age.

• Selected athletes receive an annual financial assistance of Rs. 5 lakh for a period of 8 years to prepare for international

competitions, including the Olympics.

Important Points

• Maharashtra and Haryana have been the most successful states in the history of the Khelo India Youth Games, often alternating for the top position in the medal table.

• In the 2024 edition, Silambam (a traditional martial art of Tamil Nadu) was featured as a demo sport for the first time.

• The hosting of the 2025 games in Bihar is part of the "Sports for All" vision, ensuring that states with untapped potential get the opportunity to upgrade their facilities and showcase local talent.

• The Ministry of Youth Affairs and Sports uses a Target Olympic Podium Scheme (TOPS) in conjunction with Khelo India to ensure the best young athletes receive world-class training and exposure.

Q99. Answer: (d) Dnipro

The correct answer is Dnipro.

Key Points

• In mid-June 2025, the city of Dnipro in central Ukraine was the site of a devastating Russian missile strike that targeted both civilian infrastructure and residential complexes.

• The attack involved the use of high-precision cruise missiles, which struck a multi-story apartment building and a nearby humanitarian distribution center, resulting in a high number of casualties.

• Local authorities in the Dnipropetrovsk Oblast confirmed that the strike occurred during the night, catching many residents asleep and complicating search and rescue efforts led by the State Emergency Service of Ukraine.

• The Ukrainian Air Force reported that while several incoming projectiles were neutralized by air defense systems, the volume of the mid-June barrage was designed to overwhelm local defenses.

• This specific event in 2025 highlighted the ongoing vulnerability of cities located along the Dnieper River, which serve as critical nodes for both military logistics and civilian refuge.

Additional Information

• Dnipro:

• It is the fourth-largest city in Ukraine and acts as the administrative center of the Dnipropetrovsk Oblast.

• Due to its strategic location on the Dnieper River, it has remained a primary target for Russian forces throughout the conflict that escalated in February 2022.

• The city is a major industrial hub, known historically for its aerospace and metallurgical industries.

• Kharkiv:

• Located in northeastern Ukraine, just 40 kilometers from the Russian border, it is the country's second-largest city.

• While it faces daily shelling, the specific deadly strike of mid-June 2025 mentioned in the context of this report was centered on Dnipro.

• Kyiv:

• The capital city of Ukraine, which is heavily fortified with advanced Western-made surface-to-air missile (SAM) systems like the Patriot.

• Although frequently targeted by Geran-2 drones and hypersonic missiles, its defense success rate is generally higher than that of regional hubs.

• Lviv:

• Situated in western Ukraine near the border with Poland, Lviv serves as a gateway for Western military aid and humanitarian support.

• Strikes in Lviv are less frequent compared to eastern cities but usually target electrical substations and transportation infrastructure.

Important Points

• International Response: The mid-June 2025 attack drew immediate condemnation from the United Nations (UN) and the European Union (EU), prompting calls for increased air defense transfers to Ukraine.

• Casualty Data: Reports indicated that over 20 civilians lost their lives, and more than 50 were injured, making it one of the most lethal single-strike incidents of the summer 2025 campaign.

• Infrastructure Impact: The damage to the energy grid in Dnipro caused temporary blackouts affecting approximately 100,000 households, necessitating urgent repairs by Ukrenergo engineers.

Q100. Answer: (d) Mithun Chakraborty

The correct answer is Mithun Chakraborty.

Key Points

• Veteran actor Mithun Chakraborty was honored with the Dadasaheb Phalke Award, the highest recognition in Indian cinema, during the 70th National Film Awards ceremony held on 8 October 2024.

• The award was presented by the President of India, Droupadi Murmu, at Vigyan Bhawan in New Delhi. Mithun Chakraborty is the 54th recipient of this prestigious award for his massive contribution to the film industry.

• The announcement of his selection was made earlier on September 30, 2024, by the Union Minister for Information and Broadcasting, Ashwini Vaishnaw.

• The selection was finalized by a distinguished jury consisting of five members: Asha Parekh, Khushbu Sundar, and Vipul Amrutlal Shah, among others.

• Mithun Chakraborty made his acting debut in the 1976 film Mrigayaa, directed by Mrinal Sen, for which he won his first National Film Award for Best Actor. Hence, the correct answer is Mithun Chakraborty.

Additional Information

• Dadasaheb Phalke Award:

• Instituted in 1969, the award commemorates Dhandiraj Govind Phalke, popularly known as the Father of Indian Cinema, who directed India's first full-length feature film, Raja Harishchandra, in 1913.

• The award is presented annually at the National Film Awards ceremony by the Directorate of Film Festivals, an organization set up by the Ministry of Information and Broadcasting.

• The first recipient of this award was Devika Rani, known as the "First Lady of Indian Cinema," who was honored at the 17th National Film Awards.

• The award comprises a Swarna Kamal (Golden Lotus) medallion, a shawl, and a cash prize of Rs. 15 lakh (which was increased from Rs. 10 lakh recently).

• Previous Honorees:

• Before Mithun Chakraborty, the 53rd Dadasaheb Phalke Award was conferred upon veteran actress Waheeda Rehman for the year 2021.

• Other notable recipients mentioned in the options include Amitabh Bachchan, who received the honor in 2018.

Important Points

• Career and Achievements:

• Mithun Chakraborty has won three National Film Awards in his career: Best Actor for Mrigayaa (1976), Best Actor for Tahader Katha (1992), and Best Supporting Actor for Swami Vivekananda (1998).

• He is globally renowned for his role in the 1982 blockbuster Disco Dancer, which gained him a massive fan following in countries like the Soviet Union and Africa.

• In April 2024, he was also conferred with the Padma Bhushan, India's third-highest civilian award, by the Government of India.

• Known affectionately as Mithun Da, he has acted in more than 350 films across various languages including Hindi, Bengali, Odia, Bhojpuri, and Tamil.

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