RRB Group D Official Paper (Held On: 03 Dec, 2025 Shift 3) (Previous Year Paper)

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

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Scan the QR code or click the link to open it.

1 question is in Hindi and not printed here. Each one links to the online version, where you can read it.

GENERAL SCIENCE

Q1. Which of the following statements about the magnetic field due to a circular loop is true?

(a) The field lines at the centre are circular.
(b) The field depends on current and radius.
(c) The field is uniform everywhere around the loop.
(d) The field lines are parallel to the plane of the loop.

Q2. What makes the brain suitable for thinking activities?

(a) Its complex arrangement of many neurons
(b) Its connection to the heart
(c) Its smooth surface
(d) Its location near the ears

Q3. An object has a weight of 24 N on Earth. What will be its weight on the Moon's surface?

(a) 6 N
(b) 144 N
(c) 4 N
(d) 240 N

Q4. Which of the following tissues is very elastic and used to connect two bones in our body?

(a) Macrophage
(b) Mast cell
(c) Adipocyte
(d) Ligament

Q5. Which of the following life processes leads to the breakdown of glucose in the absence of oxygen?

(a) Fermentation
(b) Aerobic respiration
(c) Excretion
(d) Digestion

Q6. Which of the following conditions will NOT increase the rate of evaporation?

(a) Increased Surface Area
(b) Decreased Humidity
(c) Increased Temperature
(d) Decreased Wind Speed

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Q7. Which of the following statements regarding reproduction is correct?

1. A bull alone can produce a calf.
2. Hens alone cannot produce new chicks.

(a) Both statements are false.
(b) Statement 1 is true, but Statement 2 is false.
(c) Statement 2 is true, but Statement 1 is false.
(d) Both statements are true.

Q8. The effect of multiple reflections of sound in large halls or auditoriums is, _____.

(a) it blocks sound propagation
(b) it helps in uniform distribution of sound
(c) it converts sound into heat
(d) it eliminates all echoes

Q9. Which of the following is true about the magnetic field inside a solenoid?

(a) It is uniform and in the form of parallel straight lines.
(b) It is non-uniform.
(c) It is zero.
(d) It forms random patterns.

Q10. Which of the following is a homogeneous mixture?

(a) Air
(b) Sand and iron filings
(c) Oil and water
(d) Soil

Q11. The energy possessed by a moving object due to its motion is called:

(a) kinetic energy
(b) thermal energy
(c) potential energy
(d) chemical energy

Q12. Which of the following compounds is classified as a saturated hydrocarbon?

(a) Benzene
(b) Ethane
(c) Ethyne
(d) Ethene

Q13. Which of the following eye defects is mainly due to the weakening of the power of accommodation with age?

(a) Astigmatism
(b) Hypermetropia
(c) Presbyopia
(d) Myopia

Q14. During indigestion, the stomach produces too much acid, that may be neutralised by which of the following?

(a) Magnesium sulphate (Milk of magnesia)
(b) Magnesium oxide (Milk of magnesia)
(c) Magnesium hydroxide (Milk of magnesia)
(d) Magnesium carbonate (Milk of magnesia)

Q15. Plaster of Paris is prepared by heating which of the following?

(a) Baking soda
(b) Gypsum
(c) Slaked lime
(d) Limestone

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Q16. When a ray of light passes through the optical centre of a spherical lens, it _____.

(a) Bends toward the focus
(b) Gets deviated away from the normal
(c) Always reflects back
(d) Emerges undeviated

Q17. Which gas is used by animals to live under water?

(a) Nitrogen
(b) Dry carbon dioxide
(c) Dissolved oxygen
(d) Carbon dioxide

Q18. In Spirogyra, each fragment develops into a complete individual. What can be the possible reason for this?

(a) Each fragment has roots.
(b) Fragmentation happens only under laboratory conditions.
(c) Each cell is capable of independent growth.
(d) Each fragment has complex organs.

Q19. The IUPAC name of following compound is _____.

CH3CHBrCH2CH2CH3.

(a) 2-Bromopentene
(b) 2-Bromopentane
(c) 1-Bromopentane
(d) 3-Bromopentane

Q20. An object is said to be in uniform motion if:

(a) it covers equal distances in unequal time intervals
(b) it covers equal distances in equal time intervals
(c) it covers unequal distances in unequal time intervals
(d) it covers unequal distances in equal time intervals

Q21. Which of the following is NOT a biotic loss during the storage of grains?

(a) Loss by inappropriate moisture
(b) Loss by insects
(c) Loss by rodents
(d) Loss by mites

Q22. In the following reaction, $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$, iron:

(a) acts a catalyst
(b) is unchanged
(c) is reduced
(d) is oxidised

Q23. Which meristematic tissue has the highest levels of Auxin?

(a) Lateral Meristematic tissue
(b) Intercalary Meristematic tissue
(c) Apical Meristematic tissue
(d) Xylem

Q24. Which of the following quantities represents the slope in a displacement–time graph?

(a) Acceleration
(b) Linear velocity
(c) Distance
(d) Speed

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Q25. In a genetic lab, a fertilised human embryo is found to have XX chromosomes. Which of the following is true?

(a) The embryo lacks sex chromosomes.
(b) The embryo will become a human female.
(c) The embryo has an extra Y chromosome.
(d) The embryo will become a human male.

MATHEMATICS

Q26. The ratio of the present ages of P and Q is 4 : 3. Six years hence, the ratio will be 5 : 4. Find the difference between their present ages.

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

Q27. The sides of a triangle are 148 cm, 57 cm, and 175 cm. What is the length (in cm) of its altitude corresponding to the side with a length of 57 cm?

(a) 140
(b) 188
(c) 177
(d) 121

Q28. Solve 2.3434... - 1.8989...

(a) 4/9
(b) 9/20
(c) 47/99
(d) 5/9

Q29. The arithmetic mean of the observations 65, 41, 96, 44, 38, 30, 79, 90 and 21 is:

(a) 59
(b) 64
(c) 56
(d) 62

Q30. A man saves 60% of his income. If his expenditure is Rs. 600, find his income (in Rs.).

(a) 1,540
(b) 1,360
(c) 1,240
(d) 1,500

Q31. After selling 88 phones, a shopkeeper incurred a loss equal to the selling price of 8 phones. Find his loss percentage.

(a) 10%
(b) 61/4%
(c) 81/3%
(d) 121/2%

Q32. What is the difference between the simple interest on a principal of Rs. 3,600 calculated at 15% per annum for 3 years and 14% per annum for 4 years?

(a) Rs. 416
(b) Rs. 396
(c) Rs. 386
(d) Rs. 406

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Q33. A person's income and expenditure are in the ratio 9 : 5. His income rises by 60% while his expenditure falls by 10%. If his initial expenditure was Rs. 15,500, then what will be his final saving (in Rs.)?

(a) 39,600
(b) 30,960
(c) 36,900
(d) 30,690

Q34. This question is in Hindi. Read it online.

Q35. One pipe can fill a tank in 4 minutes while another pipe can empty the tank in 8 minutes. If both pipes are opened simultaneously when the tank is empty, how many minutes will it take to fill one-quarter of the tank?

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

Q36. A sum of money is to be distributed among A, B, C and D in the ratio 6 : 7 : 17 : 19. If C gets Rs. 250 more than B, how much amount did A get?

(a) Rs. 149
(b) Rs. 148
(c) Rs. 147
(d) Rs. 150

Q37. Solve $((3x)^3 - (4z)^3)/(9x^2 + 12xz + 16z^2) \times (3x + 4z)$

(a) $9x^2 - 16z^2$
(b) $1/(9x^2 - 16z^2)$
(c) $9x^2 + 16z^2$
(d) $1/(9x^2 + 16z^2)$

Q38. If A : B = 4 : 6 and B : C = 7 : 12, then find A : B : C.

(a) 4 : 7 : 9
(b) 14 : 21 : 36
(c) 11 : 23 : 4
(d) 4 : 31 : 21

Q39. A train crosses two tunnels 2091 m and 1259 m long in 89 seconds and 63 seconds respectively. What is the length of the train?

(a) 747 m
(b) 748 m
(c) 759 m
(d) 757 m

Q40. Two-fifth of Vijay's marks in Hindi are more than one-third of his marks in Sanskrit by 5, while five times his marks in Hindi and five times his marks in Sanskrit together are equal to 310. Find his marks in Sanskrit.

(a) 31
(b) 27
(c) 35
(d) 25

Q41. Sachin bought a new curtain at a 12% discount. If Sachin hadn't received any discount, he would have had to pay Rs. 747 extra. How much did Sachin pay for the curtain?

(a) Rs. 5,478
(b) Rs. 5,480
(c) Rs. 5,476
(d) Rs. 5,479

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Q42. In a triangle XYZ, angle X - angle Y = 40° and angle Y - angle Z = 25°. What is the ratio of angle Z to angle X - angle Y.

(a) 4 : 5
(b) 2 : 3
(c) 3 : 4
(d) 1 : 5

Q43. A car travels 180 km at 60 km/hr and then returns the same way at 45 km/hr. How many minutes more does the return journey take than the departure journey?

(a) 15 minutes
(b) 120 minutes
(c) 60 minutes
(d) 80 minutes

Q44. Find the number of prime numbers lying between 480 and 489.

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

Q45. The length of the shadow of a vertical tower is equal to its height. Find the angle of elevation.

(a) 45°
(b) 75°
(c) 30°
(d) 60°

Q46. A retailer offers its customers a 29% discount on its beauty products and still makes a profit of 12%. Find the cost price (in Rs.) of a beauty product marked Rs. 896.

(a) 721
(b) 622
(c) 568
(d) 574

Q47. A cylindrical pipe, open at both ends, has an external diameter of 20 cm and an internal diameter of 16 cm. If the length of the pipe is 35 cm, find the volume of the metal used in making the pipe. (Use $\pi = 22/7$)

(a) 3960 cm^3
(b) 3080 cm^3
(c) 3360 cm^3
(d) 3520 cm^3

Q48. The price of a washing machine is 25% less than the price of a TV. If the price of the washing machine increases by 34% and the price of the TV decreases by 21%, what is the percentage change in the total price of 4 washing machines and 2 TVs?

(a) 16% decrease
(b) 12% increase
(c) 19% increase
(d) 9% decrease

Q49. A class of 91 students took a physics exam. The average score of 12 students was 64. The average score of the other students was 77. What is the average score (rounded to one decimal place) of the entire class?

(a) 79.7
(b) 75.3
(c) 79.4
(d) 73.6

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Q50. Navya and Bhavya can paint a house in 50 days and 75 days, respectively. If they work on alternate days, starting with Bhavya, how many days can they both take to paint the house together?

(a) 55 days
(b) 60 days
(c) 63 days
(d) 59 days

GENERAL INTELLIGENCE & REASONING

Q51. In a certain code language, 'cloud is dark' is coded as 'dm ht ez' and 'the blue cloud' is coded as 'tz dm cm'. How will 'cloud' be coded in that language?

(a) cm
(b) dm
(c) ez
(d) tz

Q52. If ‘A’ denotes ‘÷’, ‘B’ denotes ‘×’, ‘C’ denotes ‘+’ and ‘D’ denotes ‘-‘, then what will come in place of the question mark ‘?’ in the following equation?

43 C 80 A 8 D 6 B 5 = ?

(a) 21
(b) 24
(c) 23
(d) 22

Q53. What will come in place of question mark (?) in the given series?

842 844 848 854 862 ?

(a) 878
(b) 874
(c) 876
(d) 872

Q54. Each digit of the number 5236789 is arranged in ascending order from left to right. How many digits will remain unchanged in their positions compared to the original number?

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

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

TGA, UID, VKG, WMJ, ?

(a) ZLM
(b) ZPN
(c) YON
(d) XOM

Q56. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it seems to be at variance with commonly known facts, decide which of the given conclusions logically follows from the statements.

Statements:

All blinders are curtains.

All curtains are dividers.

Conclusions:

(I) Some dividers are curtains.

(II) All blinders are dividers.

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

Q57. Atul starts from point A and drives 9 km towards the west. He then turns left, drives 8 km, then turns left again and drives 15 km. He then turns left again and drives 16 km. He finally turns left, drives 6 km and stops at point P. How far (shortest distance) and in which direction must he drive to reach point A again? (Unless specified, all turns are 90 degrees only)

(a) 7 km to the south
(b) 8 km to the south
(c) 7 km to the north
(d) 8 km to the north

Q58. Gautam starts from point Y and drives 34 km towards the east. He then turns right, drives 68 km, then turns right again and drives 55 km. He then turns right and drives 11 km. He then turns right again, drives 81 km. He then turns left, drives 57 km and stops at point Z. How far (the shortest distance) and in which direction should he drive to reach point Y again? (Unless specified, all turns are 90-degree turns only.)

(a) 60 km towards the west
(b) 63 km towards the west
(c) 59 km towards East
(d) 61 km towards East

Q59. Gaurav ranks 13th from the top and 33rd from the bottom in his class. How many students are there in the class?

(a) 43
(b) 45
(c) 35
(d) 33

Q60. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which letter-cluster pair does not belong to that group?

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

(a) OT-QM
(b) KP-MJ
(c) MR-OK
(d) QV-SO

Q61. Refer to the given number series and answer the question below. Counting should be done from left to right only. All numbers are single-digit numbers.

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

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

(a) 4
(b) 6
(c) 2
(d) 5

Q62. What will come in place of question mark (?) in the given series?

19 36 53 70 87 ?

(a) 103
(b) 101
(c) 102
(d) 104

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Q63. PM 3 is related to KP 17 in a certain way. Similarly, NK 6 is related to IN 20. Using the same logic, TK 4 is related to which of the given options?

(a) GY 13
(b) ON 18
(c) UY 14
(d) NJ 12

Q64. L, M, N, O, P, and Q are seated around a round table, facing the center. Q sits second to the right of O. L sits second to the left of N. M is adjacent to the immediate left of Q. Who sits adjacent to the immediate right of P?

(a) Q
(b) M
(c) L
(d) N

Q65. D, E, F, G, L, M, and N are sitting in a straight line facing north.

Only three people sit between L and N. E sits to the immediate left of N. No one sits to the right of F. Only two people sit between F and E. M sits to the immediate right of D.

How many people sit between G and M?

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

Q66. Refer to the given number-symbol series and answer the question below. Counting should be done from left to right only. All numbers are single-digit numbers.

(Left) 2 6 & 2 9 5 5 € 1 $ 1 6 @ & € # 3 @ £ % 4 9 (Right)

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

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

Q67. Refer to the given number series and answer the given question. Counting should be done from left to right only. All numbers are single-digit numbers.

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

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

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

Q68. 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 letter-cluster is not based on the number of consonants/vowels in it or their position in the letter-cluster.)

(a) VQP
(b) NIG
(c) RML
(d) SNM

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Q69. If + means −, − means ×, × means ÷ and ÷ means +, then what will come in place of question mark (?) in the following equation?

28 - 19 ÷ 23 + 96 × 3 = ?

(a) 523
(b) 517
(c) 541
(d) 508

Q70. Which of the following letter-number cluster will come in place of the question mark (?) to logically complete the given series?

GLO163, RWZ145, CHK127, NSV109, ?

(a) YDG91
(b) YUG91
(c) ZDG91
(d) YDH91

Q71. A, B, C, D, W, X, and Y are sitting in a straight line facing north.

Only three people sit to the left of D. Only A sits to the right of C. Only three people sit between C and B. X sits somewhere to the left of Y but somewhere to the right of W.

How many people sit between W and Y?

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

Q72. GB 15 is related in a certain way to LF 12. Similarly, MH 20 is related to RL 17. Following the same logic, PK 26 is related to which of the following?

(a) WQ 24
(b) UO 23
(c) VN 23
(d) UN 24

Q73. In the following triplets, each group of letters is related to the next group following a certain logic. From the given alternatives, select the one that follows the same logic.

KIND - NKID - DNIK

COST - SCOT - TSOC

(a) SIGN - SGIN - NGIS
(b) LAST - SLAT - ASTL
(c) FROM - OFRM - MORF
(d) ZONE - OZNE - EONZ

Q74. Refer to the following series and answer the given question (all numbers are single-digit numbers only). Counting should be done from left to right only.

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

How many prime numbers are there that are immediately followed by a prime number?

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

Q75. In a certain code language, 'SKATE' is coded as '51324' and 'ASKEW' is coded as '47315'. What is the code for 'W' in the given code language?

(a) 4
(b) 3

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(c) 7
(d) 5

Q76. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

(Note: Operations must be performed on whole numbers, without breaking them into their component digits. Take 13 for example – operations on 13, such as addition/subtraction/multiplication by 13, etc., can be performed. Breaking 13 into 1 and 3 and then performing mathematical operations on 1 and 3 is not allowed.)

(14, 98, 7)

(6, 36, 6)

(a) (5, 25, 7)
(b) (7, 49, 8)
(c) (8, 48, 7)
(d) (12, 72, 6)

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

9 12 10 13 11 ? 12

(a) 14
(b) 15
(c) 9
(d) 10

Q78. Seven boxes, A, B, C, D, I, J, and K, are placed one above the other, but not necessarily in the same order.

Only B is placed above I. Only C is placed between I and J. Only A is placed below K.

How many boxes are placed between D and A?

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

Q79. In a certain code language,

'A ? B' means 'A is the daughter of B'

'A = B' means 'A is the son of B'

'A @ B' means 'A is the father of B'

'A √ B' means 'A is the sister of B'

Based on the above, if 'C @ D = E √ F ? L', then how is C related to L?

(a) Sister's husband
(b) Daughter's husband
(c) Husband
(d) Father

Q80. 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 from commonly known facts, decide which of the given conclusions logically follows from the statements.

Statements:

All ostriches are crows.

Some ostriches are pigeons.

Some pigeons are sparrows.

Conclusions:

(I) Some crows are pigeons.

(II) Some ostriches are sparrows.

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

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(d) Only I follows

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Which Indian cricketer was inducted into the ICC Hall of Fame in June 2025?

(a) Shikhar Dhawan
(b) Mahendra Singh Dhoni
(c) Virat Kohli
(d) Rohit Sharma

Q82. Which of the following global cities was officially declared the World Book Capital 2025 by UNESCO in 2025?

(a) Lisbon
(b) Accra
(c) Rio de Janeiro
(d) Madrid

Q83. According to Cushman & Wakefield's 2025 report, which Indian city has achieved a remarkable feat by securing the sixth position globally in terms of data center capacity under construction?

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

Q84. In January 2025, which two banks signed a Memorandum of Understanding (MoU) with the Government of Assam to provide zero-premium insurance coverage to employees?

(a) Indian Bank and Central Bank of India
(b) Bank of Baroda and Bank of India
(c) State Bank of India and Union Bank of India
(d) Axis Bank and HDFC Bank

Q85. Which famous author released their first crime novel, As Dark As Blood, in January 2025?

(a) Neha Dixit
(b) Banu Mushtaq
(c) Shariq Us Saba
(d) Yasser Usman

Q86. Which of the following handed over the first production lot of KALPANA3201—a 32-bit microprocessor developed for space applications—to Dr. V. Narayanan, Secretary, DOS / Chairman, Indian Space Research Organisation (ISRO), in March 2025?

(a) Droupadi Murmu, President of India
(b) Jitin Prasada, Minister of State, Ministry of Electronics and Information Technology (MeitY)
(c) Narendra Modi, Prime Minister of India
(d) S. Krishnan, Secretary, Ministry of Electronics and Information Technology (MeitY)

Q87. In which of the following cities was the 84th Annual General Meeting of the Governing Body of the Dattopant Thengadi National Board for Workers Education and Development held in March 2025?

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

Q88. Which legendary hockey player received a Padma Award in 2025?

(a) P.R. Sreejesh
(b) Mandeep Singh
(c) Dhanraj Pillay

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(d) Sandeep Singh

Q89. Which tunnel did Prime Minister Narendra Modi inaugurate in Jammu and Kashmir in January 2025?

(a) Howrah Tunnel
(b) Munnar Tunnel
(c) Sonamarg Tunnel
(d) Porbandar Tunnel

Q90. Which of the following indicators is included in the GoIStats app, developed by the Government of India in 2025?

(a) Global Sports Rankings and Olympic Medal Table
(b) National Accounts Statistics and Consumer Price Index
(c) International Film Awards and Music Industry Data
(d) Space Mission Launch and Satellite Deployment Data

Q91. Who was awarded the Major Dhyan Chand Khel Ratna Award for chess in January 2025?

(a) Vidit Gujarati
(b) Arjun Erigaisi
(c) Viswanathan Anand
(d) D. Gukesh

Q92. Which IAS officer, renowned for 57 transfers during his service, retired in April 2025?

(a) Priyam Saroj
(b) Durga Shakti Nagpal
(c) Ashok Khemka
(d) KPS Gill

Q93. Which tennis player broke the record for the most Grand Slam titles in 2025?

(a) Novak Djokovic
(b) Carlos Alcaraz
(c) Rafael Nadal
(d) Jannik Sinner

Q94. The Reserve Bank of India (Project Finance) Directions, 2025 have/shall come into force with effect from _____.

(a) 1 August 2025
(b) 1 November 2025
(c) 1 October 2025
(d) 1 September 2025

Q95. According to the OECD Economic Outlook (Volume 2025 Issue 1), what is the projected OECD-wide inflation rate for 2025?

(a) 3.2%
(b) 4.2%
(c) 4.8%
(d) 3.7%

Q96. According to the Union Budget for 2025–26, presented in February 2025, approximately how much funding was allocated for pollution control in India?

(a) Rs. 572 crore
(b) Rs. 745 crore
(c) Rs. 854 crore
(d) Rs. 958 crore

Q97. What is India's rank in the Climate Change Performance Index 2025?

(a) 10th
(b) 8th
(c) 14th

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(d) 12th

Q98. As per Sustainable Development Goals – National Indicator Framework Progress Report, 2025, what was the percentage of waste processed in 2024-25, from 17.97% in 2015-16, indicating significant progress in waste management efficiency in India?

(a) 80.7%
(b) 60%
(c) 45%
(d) 55.65%

Q99. Which edition of the India-Mongolia joint military exercise, Nomadic Elephant, was held in Ulaanbaatar, Mongolia, from May 31 to June 13, 2025?

(a) 13th
(b) 17th
(c) 15th
(d) 19th

Q100. According to the Third Advance Estimates of the Ministry of Agriculture and Farmers Welfare, what is the estimated total foodgrain production in India for 2024-25?

(a) 3450.75 LMT
(b) 3600.20 LMT
(c) 3499.00 LMT
(d) 3539.59 LMT

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (b) The field depends on current and radius.

The correct answer is The field depends on current and radius.

Key Points

• Magnetic field due to a circular current-carrying loop depends on two factors: the current (I) flowing through the loop and the radius (R) of the loop. The magnetic field at the center is directly proportional to the current and inversely proportional to the radius. This is expressed as B = (μ0I)/(2R), where B is the magnetic field, μ0 is the permeability of free space, I is the current, and R is the radius.

• The field lines at the center of a circular loop are not circular; instead, they are straight and perpendicular to the plane of the loop. Hence, statement 1 is incorrect.

• The magnetic field is not uniform everywhere around the loop. It is strongest at the center and decreases as the distance from the center increases. Hence, statement 3 is incorrect.

• The magnetic field lines are not parallel to the plane of the loop. They are perpendicular to the plane at the center and curve around the loop. Hence, statement 4 is incorrect.

• The correct statement emphasizes the dependence of the magnetic field on the current and the radius, which are the primary factors influencing the strength of the field. Hence, statement 2 is correct.

Additional Information

• Formula for Magnetic Field: The expression for the magnetic field at the center of a circular loop carrying current is given by B = (μ0I)/(2R), where:

• μ0 is the permeability of free space, approximately equal to 4π × 10^-^7 T·m/A.

• I is the current flowing through the loop.

• R is the radius of the loop.

• Behavior of Magnetic Field Lines:

• At the center of the loop, the field lines are straight and perpendicular to the plane of the loop.

• Near the edges of the loop, the field lines curve and spread out.

• The field lines form closed loops, as magnetic fields are always continuous and do not have a beginning or end.

• Factors Affecting Magnetic Field:

• The magnitude of the current (I) – A higher current produces a stronger magnetic field.

• The radius of the loop (R) – A smaller radius results in a stronger magnetic field at the center.

• The number of turns in the loop – For multiple loops, the magnetic field strength is proportional to the number of turns (n).

• Applications of Circular Loops: Circular current-carrying loops are widely used in devices like:

• Electromagnets – Used in motors, generators, and transformers.

• Magnetic sensors – For detecting magnetic fields in scientific instruments.

• Inductors – Used in electrical circuits to store energy in the form of a magnetic field.

Important Points

• Right-Hand Thumb Rule: The direction of the magnetic field produced by a current-carrying conductor can be determined using the right-hand thumb rule. Point your thumb in the direction of the current, and the curl of your fingers indicates the direction of the magnetic field lines.

• Magnetic Dipole Moment: A circular current-carrying loop behaves like a magnetic dipole with a magnetic dipole moment given by m = I × A, where A is the area of the loop.

• Biot-Savart Law: This law provides a mathematical expression for the magnetic field produced by a small element of current-carrying conductor, which is the basis for deriving the magnetic field of a circular loop.

• Dependence on Distance: The magnetic field produced by a circular loop decreases rapidly as the distance from the loop increases. At points far away, the loop behaves like a magnetic dipole.

Q2. Answer: (a) Its complex arrangement of many neurons

The correct answer is Its complex arrangement of many neurons.

Key Points

• The brain is made up of billions of neurons, which are nerve cells responsible for transmitting information. This dense network of neurons enables complex communication within different regions of the brain.

• Neurons are connected through synapses, allowing the transmission of electrical and chemical signals that facilitate thinking, memory, and decision-making processes.

• The brain's structure is highly organized, with specialized regions such as the cerebral cortex for higher cognitive functions like reasoning, planning, and problem-solving.

• The interconnected neural pathways allow for the integration of sensory inputs and the coordination of motor outputs, making the brain an efficient organ for processing and responding to stimuli.

• The presence of neuroplasticity in the brain ensures adaptability, enabling individuals to learn new skills, adapt to changes, and recover from injuries.

Additional Information

• Neurons:

• Each neuron consists of a cell body, dendrites, and an axon. Dendrites receive signals, while axons transmit them to other neurons.

• There are approximately 86 billion neurons in the human brain, forming complex networks.

• Cerebral Cortex:

• The cerebral cortex is divided into four lobes: frontal, parietal, temporal, and occipital, each responsible for specific cognitive functions.

• The frontal lobe is associated with higher-order thinking, decision-making, and voluntary movements.

• Synapses:

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• Synapses are the junctions between neurons where neurotransmitters like dopamine and serotonin facilitate signal transmission.
• There are approximately 100 trillion synapses in the human brain, enabling intricate communication networks.
• Neuroplasticity:
• Neuroplasticity refers to the brain's ability to reorganize itself by forming new neural connections throughout life.
• This property is essential for learning, memory formation, and recovery from brain injuries.

Important Points

• Glial Cells:
• In addition to neurons, the brain contains glial cells that provide support, protection, and nutrition to neurons.
• These cells play a vital role in maintaining the overall health of the nervous system.
• Energy Consumption:
• The brain is a highly energy-demanding organ, consuming approximately 20% of the body's total energy.
• This energy is primarily used for maintaining neural activity and communication.
• Electrochemical Signals:
• Neurons communicate through electrochemical signals, which involve electrical impulses and chemical neurotransmitters.
• This dual mechanism ensures rapid and efficient information processing.

Q3. Answer: (c) 4 N

The correct answer is 4 N.

Key Points

• The weight of an object is the force exerted on it due to gravity. It is calculated as Weight = Mass × Gravitational acceleration (g).
• The gravitational acceleration on the Moon is approximately 1/6th of that on the Earth.
• On Earth, the given weight of the object is 24 N.
• The weight on the Moon is calculated by dividing the Earth weight by 6: Weight on Moon = 24 N / 6 = 4 N.
• After substituting the values, the object's weight on the Moon is found to be 4 N.

Additional Information

• Gravitational Acceleration:
• The gravitational acceleration on the Earth is approximately 9.8 m/s^2.
• The gravitational acceleration on the Moon is approximately 1.63 m/s^2.
• This difference in gravity is due to the Moon's smaller mass and radius compared to the Earth.
• Mass vs. Weight:
• Mass is the measure of the amount of matter in an object and remains constant irrespective of location.
• Weight is the force exerted on an object due to gravity and changes based on the gravitational field strength.
• Calculation Process:
• Step 1: Determine the mass of the object on Earth:
• Mass = Weight / g (Earth) = 24 N / 9.8 m/s^2 ≈ 2.45 kg.
• Step 2: Calculate the weight on the Moon:
• Weight on Moon = Mass × g (Moon) = 2.45 kg × 1.63 m/s^2 ≈ 4 N.
• Weight on Other Celestial Bodies:
• An object's weight varies on different planets or celestial bodies due to variations in gravitational acceleration.
• For example, the gravity on Mars is about 3.71 m/s^2, while on Jupiter, it is approximately 24.79 m/s^2.

Important Points

• Weight-to-Mass Ratio: The weight of an object depends directly on its mass and the gravitational field of the celestial body it is on.
• Moon's Gravity: The Moon's weaker gravity is a result of its smaller size and lower density compared to Earth.
• Practical Applications: Understanding weight differences on celestial bodies is crucial for space exploration and designing equipment for extraterrestrial environments.
• Historical Missions: This concept was a significant factor in planning lunar missions like the Apollo program, where astronauts experienced reduced weight on the Moon.

Q4. Answer: (d) Ligament

The correct answer is Ligament.

Key Points

• Ligaments are tough, elastic connective tissues that connect one bone to another at joints.

• They provide stability to joints while allowing a certain degree of movement.
• The elasticity of ligaments enables them to absorb shock and maintain the structural integrity of the skeletal system.
• Ligaments are primarily composed of collagen and elastic fibers, which give them tensile strength and flexibility.
• Examples of ligaments include the anterior cruciate ligament (ACL) in the knee and the ligamentum flavum in the vertebral column.

Additional Information

• Macrophage:
• Macrophages are a type of white blood cell involved in the immune system.
• They play a crucial role in phagocytosis, engulfing and digesting cellular debris and pathogens.
• Macrophages are not involved in connecting bones and are not elastic in nature.
• Mast Cell:
• Mast cells are part of the immune system and are found in connective tissues.
• They release histamine and other chemicals during allergic reactions and inflammation.
• They do not contribute to bone connection or elasticity.
• Adipocyte:
• Adipocytes, or fat cells, store energy in the form of fat and provide insulation and cushioning to the body.
• They are found in adipose tissue and are not elastic or related to bone connections.
• Ligament:
• Ligaments are critical for the movement and stability of joints.
• They are highly elastic, allowing them to stretch and return to their original shape after movement.
• Injuries to ligaments, such as sprains, can compromise joint stability and function.

Important Points

• Collagen: The primary structural protein in ligaments, providing strength and rigidity.
• Elastic Fibers: Found in ligaments, enabling them to stretch and maintain flexibility.
• Ligament Injuries: Common injuries include sprains and tears, often caused by overstretching or excessive force.
• Rehabilitation: Physical therapy is often required to restore ligament function after an injury.
• Examples of Ligament Functions: The ACL in the knee prevents the forward movement of the tibia relative to the femur, ensuring knee stability.

Q5. Answer: (a) Fermentation

The correct answer is Fermentation.

Key Points

• Fermentation is a biological process where glucose breaks down in the absence of oxygen to produce energy in the form of ATP (adenosine triphosphate).
• It is an anaerobic process, meaning it occurs without the presence of oxygen.
• The end products of fermentation depend on the organism involved. For example:
• In yeast, it produces ethanol and carbon dioxide.
• In muscle cells during intense activity, it produces lactic acid.
• Fermentation is commonly used in industries for the production of alcoholic beverages, bread, and biofuels.
• This process is crucial in organisms that cannot perform aerobic respiration or in environments lacking oxygen.

Additional Information

• Aerobic Respiration:
• Unlike fermentation, aerobic respiration requires oxygen.
• It is a more efficient process, producing up to 36-38 ATP molecules per glucose molecule.
• The end products are carbon dioxide and water.
• Aerobic respiration occurs in the mitochondria of cells.
• Excretion:
• Excretion is the biological process of eliminating metabolic waste from an organism's body.
• It is not related to the breakdown of glucose or energy production.
• Examples include the removal of urea in humans through urine and carbon dioxide through respiration.
• Digestion:
• Digestion refers to the breakdown of complex food molecules into simpler forms like glucose, amino acids, and fatty acids.

• It is a preparatory step for cellular respiration but does not directly involve the breakdown of glucose in the absence of oxygen.
• Occurs in the gastrointestinal tract and involves enzymes such as amylase, lipase, and protease.
• Applications of Fermentation:
• Food industry: Production of yogurt, cheese, and fermented beverages like beer and wine.
• Pharmaceuticals: Used in the production of antibiotics like penicillin.
• Biofuel production: Fermentation of plant materials to produce ethanol.
• Research: Studying cellular processes in anaerobic conditions.

Important Points

• Lactic Acid Fermentation:
• Occurs in animal muscles during intense exercise when oxygen is scarce.
• Produces lactic acid, which may lead to muscle fatigue and soreness.
• Alcoholic Fermentation:
• Carried out by yeast and some types of bacteria.
• Used in the production of alcoholic beverages and bread.
• Types of Organisms:
• Facultative anaerobes: Can perform both aerobic respiration and fermentation (e.g., yeast).
• Obligate anaerobes: Only perform fermentation as oxygen is toxic to them.

Q6. Answer: (d) Decreased Wind Speed

The correct answer is Decreased Wind Speed.

Key Points

• Evaporation is the process where liquid water converts into water vapor. It is influenced by factors such as temperature, surface area, wind speed, and humidity.
• Increased Surface Area: A larger surface area allows more water molecules to escape into the air, increasing the rate of evaporation. Hence, this condition increases evaporation.
• Decreased Humidity: Low humidity creates a larger difference between the moisture content of the air and the liquid, promoting faster evaporation. Hence, this condition increases evaporation.
• Increased Temperature: Higher temperatures provide more energy to water molecules, enabling them to overcome intermolecular forces and escape as vapor. Hence, this condition increases evaporation.
• Decreased Wind Speed: Wind removes the saturated air from above the water surface, replacing it with drier air, which enhances evaporation. However, if wind speed decreases, this process slows down, reducing the rate of evaporation. Hence, this condition does NOT increase evaporation.

Additional Information

• Factors Affecting Evaporation:
• Surface Area: A wider surface area increases the exposure of liquid to air, facilitating evaporation. For example, clothes dry faster when spread out than when crumpled.
• Temperature: Warmer conditions cause water molecules to gain kinetic energy, increasing their ability to escape into the air as vapor.
• Wind Speed: Strong winds replace the humid air layer near the liquid surface with drier air, accelerating evaporation.
• Humidity: High humidity slows down evaporation as the air is already saturated with moisture, reducing the gradient for water to transition into vapor.
• Examples of Evaporation in Daily Life:
• Drying Clothes: Clothes dry faster on windy and sunny days due to increased wind speed and temperature.
• Cooling of Water: Evaporation causes cooling as it absorbs latent heat from the surroundings. This principle is used in clay water pots to keep water cool.
• Sweating: When sweat evaporates from the skin, it absorbs heat, helping in body temperature regulation.
• Applications of Evaporation:
• In industries, evaporation is used in processes like salt production and concentration of solutions.
• In agriculture, knowledge of evaporation helps in efficient irrigation planning.
• Scientific Principle: Evaporation is an endothermic process that requires heat energy, which is taken from the surroundings, causing a cooling effect.

Important Points

• Wind Speed and Evaporation:
• Wind speed directly affects the removal of moist air from the surface of a liquid. Faster winds enhance evaporation by

maintaining a low humidity layer near the surface.

• In contrast, decreased wind speed reduces the removal of moist air, creating a barrier for further evaporation.

• Practical Applications:

• Farmers often use windbreaks to slow down wind speed, reducing excessive evaporation from soil and crops.

• In hot climates, people use fans to speed up evaporation and create a cooling effect indoors.

Q7. Answer: (c) Statement 2 is true, but Statement 1 is false.

The correct answer is Statement 2 is true, but Statement 1 is false.

Key Points

• Statement 1: "A bull alone can produce a calf." This statement is false because both a male and a female are required for reproduction. A bull—being a male animal—can only participate in the reproductive process in conjunction with a female (a cow). A bull cannot produce a calf on its own.

• Statement 2: "Hens alone cannot produce new chicks." This statement is true because, for the production of chicks, it is essential that the hen's eggs be fertilized by a male rooster.

Chicks do not hatch from unfertilized eggs.

• Reproduction is a biological process that requires the contribution of both a male and a female, whether in animals or birds.

• Therefore, only Statement 2 is true, and Statement 1 is false.

Additional Information

• Importance of Reproduction:

• Reproduction is essential for the survival of living species and for maintaining their population balance.

• This process is of two types: Sexual Reproduction and Asexual Reproduction.

• Reproduction in Chickens:

• Hens can lay eggs even without a male; however, those eggs are not fertilized, and chicks do not hatch from them.

• The contribution of a rooster (male chicken) is necessary to fertilize the eggs.

• Reproduction in Animals:

• In animals as well, both a male and a female are required.

• The role of the male is to provide sperm, while the female provides the egg.

• Following fertilization, the female conceives, and the development of the offspring takes place inside the female's body.

• Fertilization:

• Fertilization is the process in which the gametes of the male and female unite.

• This process is essential for sexual reproduction; without it, the creation of offspring is not possible.

Important Points

• Sexual Reproduction: This is a complex process that requires the contribution of both the male and the female.

• Asexual Reproduction: This is a simple process in which a single organism is capable of reproducing on its own. Example: Amoeba.

• In certain birds and animals, artificial fertilization is employed to improve their reproductive rates.

• In nature, the contribution of both the male and the female is essential for the production of offspring.

Q8. Answer: (b) it helps in uniform distribution of sound

The correct answer is it helps in uniform distribution of sound.

Key Points

• Multiple reflections of sound occur when sound waves bounce off surfaces such as walls, ceilings, and floors in a hall or auditorium.

• This phenomenon ensures that sound waves are distributed evenly across the space, allowing every listener to hear the sound clearly, irrespective of their seating position. Hence, the correct option is that it helps in uniform distribution of sound.

• Multiple reflections are particularly useful in large halls and auditoriums where direct sound from the source may not reach all areas effectively.

• Architectural designs often incorporate features like curved walls, sound-absorbing panels, and diffusers to manage reflections and prevent excessive echoes while ensuring uniform sound distribution.

• Without multiple reflections, certain areas in the hall might experience poor sound quality, resulting in an uneven auditory experience.

Additional Information

• Reverberation:

• Reverberation is the persistence of sound in a space due to repeated reflections after the sound source has stopped.

• Moderate reverberation enhances the quality of sound, especially in music halls, but excessive reverberation can lead to sound distortion.

• Echo:

• An echo occurs when a sound wave is reflected back to the listener after a significant delay, typically more than 0.1 seconds.

• Echoes can be distracting in auditoriums and are minimized by using sound-absorbing materials and proper architectural planning.

• Importance of Acoustic Design:

• Acoustic design in large halls and auditoriums aims to balance absorption, reflection, and diffusion of sound to optimize the auditory experience.

• Materials like carpets, curtains, and acoustic panels are used to absorb excessive sound energy and control reflections.

• Applications of Multiple Reflections of Sound:

• Used in devices like megaphones, stethoscopes, and soundproof rooms to enhance or control sound propagation.

• Essential in architectural acoustics to ensure clarity of speech and music in public spaces.

• Examples:

• Modern concert halls like the Sydney Opera House are designed to optimize sound reflections for uniform sound distribution.

• Lecture halls and theaters use sound-reflecting surfaces and amplifiers to ensure clarity in speech and sound.

Important Points

• Sound Reflection vs. Absorption: Reflection ensures sound reaches all areas, whereas absorption reduces echoes and reverberation.

• Critical Distance: This is the distance from a sound source at which the direct sound and reflected sound are of equal intensity. Proper design ensures the critical distance is optimized for uniform sound distribution.

• Acoustic Materials: Materials like fiberglass, foam, and perforated wood are used in auditoriums to manage sound reflections effectively.

• Challenges in Acoustics: Designing a hall to balance clarity, loudness, and reverberation is complex and requires advanced simulation tools and expertise.

• Sound Propagation: Multiple reflections enhance sound propagation in large spaces, ensuring that no area is left acoustically "dead."

Q9. Answer: (a) It is uniform and in the form of parallel straight lines.

The correct answer is It is uniform and in the form of parallel straight lines.

Key Points

• The magnetic field inside a solenoid is uniform and consists of parallel straight lines, which indicates that the field strength and direction are consistent throughout the solenoid.

• A solenoid is essentially a coil of wire wound in a cylindrical form, and when an electric current flows through it, it generates a magnetic field along its axis.

• The uniformity of the field inside the solenoid occurs due to the symmetrical arrangement of the current-carrying loops and the resulting superposition of their individual magnetic fields.

• This uniform magnetic field is crucial in applications such as electromagnets, magnetic resonance imaging (MRI), and various types of sensors and actuators.

• The strength of the magnetic field inside the solenoid can be calculated using the formula: $B = \mu_0 \times n \times I$, where μ_0 is the permeability of free space, n is the number of turns per unit length, and I is the current flowing through the solenoid.

Additional Information

• Characteristics of Magnetic Field Inside a Solenoid:

• The field is strong and uniform, making it ideal for scientific and industrial applications.

• Outside the solenoid, the magnetic field is significantly weaker compared to the inside.

• The direction of the magnetic field inside the solenoid follows the right-hand rule, where the direction of curled fingers represents the current, and the thumb represents the field direction.

• Applications of Solenoids:

• Used in electromagnets to lift heavy objects in industrial settings.

• Essential in electric relays and valves for controlling mechanical operations.

• Utilized in medical imaging technologies such as MRI machines.

• In scientific experiments, solenoids provide controlled magnetic fields for studying various phenomena.

• Other Magnetic Field Patterns:

• Non-uniform fields: These occur in irregular arrangements of current-carrying conductors.

• Zero field: Found in areas where no current flows or magnetic effects cancel out.
• Random patterns: Observed in disorganized setups without symmetry.
• Important Formula:
• The strength of the magnetic field inside a solenoid is given by: B = μ0 × n × I, where:
• μ0: Permeability of free space (4π × 10^-^7 T·m/A).
• n: Number of turns per unit length.
• I: Current in amperes.

Important Points

• Solenoid Design:
• Solenoids are typically constructed using insulated copper wire wound around a cylindrical core.
• The core can be made of air, iron, or other ferromagnetic materials to enhance field strength.
• Examples of Magnetic Field Uniformity:
• Uniform fields are highly useful in particle accelerators and plasma confinement devices.
• Such fields are also exploited in designing linear motors and induction coils.

Q10. Answer: (a) Air

The correct answer is Air.

Key Points

• Homogeneous mixtures are mixtures in which the composition is uniform throughout, and their components are not visibly distinguishable.
• Air is considered a homogeneous mixture because it is composed of various gases such as nitrogen, oxygen, carbon dioxide, and trace gases that are evenly distributed.
• In contrast to heterogeneous mixtures, homogeneous mixtures like air do not have visible differences in their components under normal conditions.
• Examples of homogeneous mixtures include solutions like saltwater, sugar dissolved in water, and alloys such as brass.
• Other options like sand and iron filings, oil and water, and soil are heterogeneous mixtures because their components can be separated and are not uniformly distributed. Hence, these options are incorrect.

Additional Information

• Characteristics of Homogeneous Mixtures:
• They have a uniform composition, meaning the components are evenly distributed.
• Components of homogeneous mixtures cannot be distinguished by the naked eye.
• They typically exist in one phase (solid, liquid, or gas).
• Examples include air, sugar dissolved in water, and vinegar.
• Characteristics of Heterogeneous Mixtures:
• The composition of heterogeneous mixtures is not uniform.
• Different components can be easily identified and separated.
• Examples include sand and iron filings, oil and water, and soil.
• Air Composition:
• Air is a mixture of gases, primarily composed of 78% nitrogen, 21% oxygen, and trace amounts of carbon dioxide, argon, and other gases.
• The uniform distribution of these gases makes air a homogeneous mixture.
• Methods to Identify Mixtures:
• Homogeneous mixtures appear uniform even under a microscope.
• Heterogeneous mixtures show distinct phases or components that can be separated mechanically or visually.

Important Points

• Sand and iron filings: This is a heterogeneous mixture because the sand and iron filings can be separated using methods like magnetic separation.
• Oil and water: This is a heterogeneous mixture as oil and water do not mix uniformly due to differences in density and polarity.
• Soil: Soil is a heterogeneous mixture as it contains various components like organic matter, minerals, and water, which are visibly distinct.
• Applications of Homogeneous Mixtures: Homogeneous mixtures like air are essential for life, providing oxygen for respiration and carbon dioxide for plant photosynthesis.

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Q11. Answer: (a) kinetic energy

The correct answer is kinetic energy.

Key Points

• Kinetic energy is the energy possessed by an object due to its motion. It depends on the mass and velocity of the object.

• The formula to calculate kinetic energy is KE = (1/2)mv², where m is the mass of the object and v is its velocity.

• Kinetic energy is measured in joules (J) in the SI system.

• Examples of kinetic energy include a moving car, a flying airplane, or a rolling ball.

• It is a fundamental concept in physics and is directly related to the work done on an object to bring it into motion.

Additional Information

• Potential energy:

• Potential energy is the energy stored in an object due to its position or configuration.

• It is calculated using the formula PE = mgh, where m is the mass, g is the acceleration due to gravity, and h is the height.

• Examples include energy stored in a compressed spring or an object held at a height.

• Thermal energy:

• Thermal energy refers to the energy possessed by an object due to the motion of its particles and is related to temperature.

• It plays a crucial role in heat transfer processes and the operation of thermal machines.

• Chemical energy:

• Chemical energy is stored in the bonds of chemical compounds and is released during chemical reactions.

• Examples include energy in fuels like coal, natural gas, and food.

• Applications of kinetic energy:

• Kinetic energy is utilized in various engineering applications like wind turbines, roller coasters, and automobiles.

• It is also crucial in sports, where the motion of players and equipment is analyzed using kinetic energy principles.

Important Points

• Kinetic energy in real-world scenarios:

• In transportation, vehicles convert fuel energy into kinetic energy for motion.

• In renewable energy systems, wind turbines convert the kinetic energy of wind into electrical energy.

• Space exploration uses principles of kinetic energy for launching and maneuvering spacecraft.

• Relation with momentum:

• Kinetic energy is related to momentum, which is given by p = mv.

• While momentum is a vector quantity, kinetic energy is scalar.

Q12. Answer: (b) Ethane

The correct answer is Ethane.

Key Points

• Saturated hydrocarbons are compounds that contain only single bonds between carbon atoms. These are also called alkanes.

• Ethane (C2H6) is a simple alkane with single bonds between carbon atoms. It has a saturated structure and is classified as a saturated hydrocarbon.

• Benzene is an aromatic hydrocarbon with alternating double bonds in a cyclic structure, making it unsaturated. Hence, it is not a saturated hydrocarbon.

• Ethyne (C2H2), commonly known as acetylene, is an alkyne with a triple bond between carbon atoms. This makes it an unsaturated hydrocarbon.

• Ethene (C2H4), also known as ethylene, is an alkene with a double bond between carbon atoms, making it an unsaturated hydrocarbon.

Additional Information

• Characteristics of Saturated Hydrocarbons (Alkanes):

• Saturated hydrocarbons consist entirely of single bonds between carbon atoms.

• The general formula for alkanes is C_nH_(2n+2), where n is the number of carbon atoms.

• They are less reactive compared to unsaturated hydrocarbons due to the stability of single bonds.

• Examples include methane (CH4), ethane (C2H6), propane (C3H8), etc.

• Characteristics of Unsaturated Hydrocarbons:

• Unsaturated hydrocarbons contain one or more double or triple bonds between carbon atoms.

• They are more reactive due to the presence of these multiple bonds.

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• Alkenes have at least one double bond with the general formula C_nH_(2n) (e.g., ethene).
• Alkynes have at least one triple bond with the general formula C_nH_(2n-2) (e.g., ethyne).
• Benzene and Aromatic Compounds:
• Benzene (C6H6) is an aromatic hydrocarbon characterized by a planar ring structure with alternating double bonds.
• The structure of benzene is stabilized by resonance, making it less reactive compared to alkenes and alkynes.
• Aromatic hydrocarbons are unsaturated due to the presence of delocalized electrons in the ring structure.
• Applications of Ethane:
• Ethane is widely used as a feedstock in the petrochemical industry to produce ethylene through steam cracking.
• It is also used as a fuel in some specialized industrial applications.
• Ethane is a significant component of natural gas and is separated during the processing of natural gas.

Q13. Answer: (c) Presbyopia

The correct answer is Presbyopia.

Key Points

• Presbyopia is an age-related eye condition caused primarily by the weakening of the eye's power of accommodation.
• Accommodation refers to the ability of the eye lens to adjust its shape to focus on objects at various distances. With aging, the lens becomes less flexible, and the ciliary muscles weaken, leading to difficulty in focusing on close objects.
• Presbyopia generally begins to affect individuals around the age of 40 and progresses with time.
• Symptoms include difficulty in reading small print, needing to hold reading material farther away, and experiencing eye strain during prolonged close work.
• The condition is typically corrected using reading glasses, bifocal lenses, or progressive lenses. Surgical options like multifocal lens implants or refractive surgeries may also be explored in certain cases.

Additional Information

• Astigmatism:
• It is a condition where the eye's cornea or lens has an irregular shape, causing blurred or distorted vision at all distances.
• Unlike presbyopia, astigmatism is not age-related and can occur due to genetic factors or injuries.
• It is corrected using cylindrical lenses or refractive surgeries.
• Hypermetropia (Farsightedness):
• This defect occurs when the eyeball is too short or the lens lacks sufficient curvature, causing difficulty in focusing on nearby objects.
• Hypermetropia is typically present at birth and can persist without significant age-related progression.
• It is corrected using convex lenses.
• Myopia (Nearsightedness):
• Myopia occurs when the eyeball is elongated or the lens is too curved, causing difficulty in seeing distant objects clearly.
• It is unrelated to aging and often develops during childhood or adolescence.
• It is treated using concave lenses or refractive surgeries.
• Accommodation Mechanism:
• The accommodation mechanism involves the ciliary muscles and the lens of the eye working together to adjust focus based on object distance.
• Age-related changes to the lens and ciliary muscles lead to presbyopia.
• Presbyopia is distinct from other refractive errors like myopia and hypermetropia, which are structural anomalies of the eye.

Important Points

• Age: Presbyopia typically begins after the age of 40, while other refractive errors like myopia or hypermetropia can appear earlier in life.
• Correction Methods: Presbyopia is commonly corrected using reading glasses, bifocal lenses, or progressive lenses, unlike astigmatism or myopia which require specific lens designs.
• Surgical Options: Advanced surgical methods such as multifocal lens implants or laser surgeries are available for individuals seeking permanent correction of presbyopia.
• Prevention: While presbyopia cannot be prevented due to its age-related nature, regular eye exams can help in early detection and management.

Q14. Answer: (c) Magnesium hydroxide (Milk of magnesia)

The correct answer is Magnesium hydroxide (Milk of magnesia).

Key Points

• Indigestion occurs when the stomach produces excess acid, leading to discomfort and symptoms like heartburn or bloating.

• Magnesium hydroxide, commonly known as Milk of magnesia, is an antacid that neutralizes stomach acid. It reacts with excess acid to form water and magnesium chloride, thereby reducing acidity.

• Milk of magnesia is widely used as a remedy for acid indigestion, heartburn, and upset stomachs due to its ability to reduce gastric acidity.

• Magnesium hydroxide also has a mild laxative effect, which can help relieve constipation, a condition often accompanying indigestion.

• Other compounds such as magnesium sulfate, magnesium oxide, and magnesium carbonate do not serve as effective antacids like magnesium hydroxide. They have different uses and do not neutralize stomach acid efficiently.

Additional Information

• Magnesium hydroxide (Milk of magnesia):

• It is a chemical compound with the formula Mg(OH)2.

• When dissolved in water, it dissociates into magnesium ions (Mg^(2+)) and hydroxide ions (OH^-), which neutralize stomach acid.

• Commonly used for relieving indigestion, heartburn, and mild constipation.

• The dosage of milk of magnesia should be taken as directed, as excessive use may lead to diarrhea due to its laxative properties.

• Magnesium sulfate:

• Also known as Epsom salt, it is primarily used for relieving muscle pain and as a laxative, but it is not effective as an antacid.

• Magnesium oxide:

• It is used as a dietary supplement for magnesium deficiency and sometimes as a mild laxative, but it is less effective in neutralizing stomach acid compared to magnesium hydroxide.

• Magnesium carbonate:

• Although it has mild antacid properties, it is not as effective as magnesium hydroxide (Milk of magnesia) for treating acid indigestion.

• Antacid Mechanism:

• Antacids work by neutralizing hydrochloric acid (HCl) in the stomach, leading to the formation of a salt and water, thereby reducing acidity and providing relief from symptoms of indigestion.

• For instance, the reaction of magnesium hydroxide with stomach acid can be represented as:

Mg(OH)2 + 2HCl → MgCl2 + 2H2O

Important Points

• Acid indigestion: Caused by overproduction of hydrochloric acid in the stomach, leading to discomfort and symptoms like burning sensation in the chest or bloating.

• Neutralization reaction: The process by which an antacid reacts with stomach acid to reduce acidity.

• Usage caution: Overuse of antacids, including milk of magnesia, may lead to side effects such as diarrhea or electrolyte imbalances.

• Consultation: Always consult a healthcare professional for proper dosage and usage of antacids, especially for prolonged symptoms of indigestion.

Q15. Answer: (b) Gypsum

The correct answer is Gypsum.

Key Points

• Plaster of Paris (POP) is prepared by heating gypsum, which is chemically known as calcium sulfate dihydrate (CaSO4·2H2O).

• When gypsum is heated to approximately 120°C, it loses water molecules and transforms into calcium sulfate hemihydrate (CaSO4·½H2O), commonly known as Plaster of Paris.

• The chemical reaction involved in this process is:

• CaSO4·2H2O → CaSO4·½H2O + 1½H2O (heat)

• Plaster of Paris is widely used for casting, molding, and decorative purposes due to its ability to set quickly when mixed with water.

• Gypsum is a naturally occurring mineral that is abundantly found in areas with sedimentary rock formations.

Additional Information

• Gypsum:

• Gypsum is a soft sulfate mineral composed of calcium sulfate dihydrate (CaSO4·2H2O).

• It is used in the construction industry to make drywall, plasterboards, and cement.

• Gypsum is also utilized in agriculture as a soil conditioner and fertilizer.
• Baking Soda:
• Baking soda is chemically known as sodium bicarbonate (NaHCO3).
• It is primarily used in cooking as a leavening agent and in cleaning due to its mild abrasive properties.
• Baking soda is not related to the production of Plaster of Paris.
• Slaked Lime:
• Slaked lime is chemically known as calcium hydroxide (Ca(OH)2).
• It is used in construction, water purification, and as a neutralizer in acidic soils.
• Slaked lime has no role in the preparation of Plaster of Paris.
• Limestone:
• Limestone is composed primarily of calcium carbonate (CaCO3).
• It is used in the production of cement, glass, and as a building material.
• Limestone is unrelated to the preparation of Plaster of Paris.

Important Points

• Properties of Plaster of Paris:
• Plaster of Paris sets quickly when mixed with water and forms a hard mass.
• It is lightweight, durable, and easy to mold into various shapes.
• Due to its rapid setting time, it is used in medical applications like creating orthopedic casts and molds.
• Applications:
• POP is extensively used in sculpting, decorative ceiling designs, and wall finishes.
• It is also utilized in making molds for ceramics and jewelry.
• In construction, it serves as a protective coating for walls and ceilings.
• Environmental Aspect:
• The production of POP involves heating gypsum, which requires energy.
• Care must be taken to minimize environmental impacts during its manufacturing process.

Q16. Answer: (d) Emerges undeviated

The correct answer is Emerges undeviated.

Key Points

• When a ray of light passes through the optical centre of a spherical lens, it emerges undeviated, meaning it continues in the same direction without bending.
• The optical centre is the point inside the lens where the principal axis intersects, and it is the geometric center of the lens.
• This behavior occurs because, at the optical center, the two surfaces of the lens are parallel to each other, leading to no refraction or bending of light.
• The concept is governed by the laws of refraction, particularly Snell's Law, which ensures that light passing perpendicularly through parallel surfaces does not change its direction.
• This principle is applicable to both convex and concave lenses, irrespective of their thickness, provided the ray passes exactly through the optical center.

Additional Information

• Spherical Lenses:
• Spherical lenses are of two types: convex (converging lens) and concave (diverging lens).
• Convex lenses are thicker at the center and thinner at the edges, while concave lenses are thinner at the center and thicker at the edges.
• Optical Centre:
• The optical center is the central point of the lens where the principal axis passes through.
• It is the point where light rays pass without refraction if they enter the lens at this point.
• Law of Refraction:
• The refraction of light follows Snell's Law, which states that the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for a given pair of media.
• Light passing through parallel surfaces (like at the optical center) does not deviate because the angles of incidence and refraction cancel out.
• Applications of Spherical Lenses:
• Convex lenses are used in magnifying glasses, cameras, and spectacles for correcting hypermetropia (farsightedness).

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• Concave lenses are used in telescopes, microscopes, and spectacles for correcting myopia (nearsightedness).

Important Points

• Deviated Rays: Light rays passing through regions other than the optical center of the lens are refracted and either converge (in convex lenses) or diverge (in concave lenses).

• Principal Axis: The principal axis is an imaginary straight line that passes through the center of curvature of both spherical surfaces of the lens.

• Focal Point: For convex lenses, light rays converge at the focal point, while for concave lenses, they appear to diverge from the focal point.

Q17. Answer: (c) Dissolved oxygen

The correct answer is Dissolved oxygen.

Key Points

• Dissolved oxygen is the form of oxygen that is present in water and is essential for the survival of aquatic animals such as fish, amphibians, and invertebrates.

• Aquatic animals extract dissolved oxygen from water using specialized respiratory structures such as gills or skin. This allows them to breathe underwater and maintain vital biological processes.

• The amount of dissolved oxygen in water depends on various factors, including temperature, salinity, and pressure. Colder water generally holds more oxygen than warmer water.

• Unlike gases like nitrogen or carbon dioxide, dissolved oxygen directly supports aerobic respiration in aquatic organisms, enabling them to produce energy for survival.

• Water bodies with low levels of dissolved oxygen may lead to hypoxic conditions, which can severely impact aquatic life and may even result in the death of fish and other organisms.

Additional Information

• Nitrogen:

• Nitrogen is the most abundant gas in the Earth's atmosphere (approximately 78%).

• Although nitrogen dissolves in water, it is not directly used by aquatic animals for respiration.

• It plays an indirect role in aquatic ecosystems through processes like the nitrogen cycle, which supports plant growth.

• Dry Carbon Dioxide:

• Carbon dioxide is dissolved in water and used by aquatic plants and algae for photosynthesis.

• However, animals do not use carbon dioxide for respiration; instead, they expel it as a byproduct of metabolic processes.

• Excess carbon dioxide in water can lead to increased acidity, which may harm aquatic life.

• Carbon Dioxide:

• Carbon dioxide is present in both the atmosphere and water but is not a source of oxygen for aquatic animals.

• It is crucial for maintaining the balance of the ecosystem, as it is consumed during photosynthesis by aquatic plants and algae.

• Importance of Dissolved Oxygen in Aquatic Ecosystems:

• Levels of dissolved oxygen above 5 mg/L are generally considered healthy for most aquatic life.

• Sources of dissolved oxygen include atmospheric oxygen mixing into water and oxygen produced by aquatic plants during photosynthesis.

• Pollution, eutrophication, or high temperatures can reduce dissolved oxygen levels, creating "dead zones" where aquatic life cannot survive.

• Factors Affecting Dissolved Oxygen Levels:

• Temperature: Colder water holds more oxygen than warmer water.

• Salinity: Higher salinity reduces the capacity of water to hold oxygen.

• Pressure: Higher atmospheric pressure increases the solubility of oxygen in water.

• Pollution: Organic waste and pollutants can deplete oxygen through microbial decomposition.

Important Points

• Dead Zones: Areas in water bodies with very low dissolved oxygen, often caused by pollution or eutrophication, are termed "dead zones." These zones are inhospitable to most aquatic life.

• Aquatic Respiration: Fish and other aquatic animals use gills to extract dissolved oxygen from water. The efficiency of this process depends on the oxygen concentration in the water.

• Monitoring Dissolved Oxygen: It is an important parameter in assessing the health of aquatic ecosystems and water quality.

• Global Examples: The Gulf of Mexico is a well-known example of a region with significant hypoxic conditions caused by excessive nutrient pollution.

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Q18. Answer: (c) Each cell is capable of independent growth.

The correct answer is Each cell is capable of independent growth.

Key Points

• Spirogyra is a filamentous green alga that reproduces asexually through a process called fragmentation.

• Each fragment of the filament contains several cells, and each cell is capable of independent growth and development into a new filament.

• This ability arises because each cell in Spirogyra is complete in its structure, containing all necessary organelles such as the nucleus, chloroplasts, and cytoplasm.

• The process of fragmentation typically occurs in favorable conditions, such as in the presence of abundant nutrients and light, which promote cell division and growth.

• This characteristic of Spirogyra is a vital adaptation that allows it to reproduce efficiently and colonize aquatic habitats.

Additional Information

• Fragmentation in Algae:

• Fragmentation is a form of asexual reproduction where the body of an organism breaks into two or more fragments, and each fragment develops into a complete individual.

• This process is common in filamentous algae like Spirogyra, where fragments regenerate into new filaments due to the presence of totipotent cells.

• Structure of Spirogyra:

• Spirogyra consists of unbranched, cylindrical filaments made up of cells arranged end-to-end.

• Each cell contains a spirally arranged chloroplast, which is the origin of its name.

• Essential organelles like the nucleus and pyrenoids (used for starch storage) are present in each cell, enabling independent growth.

• Importance of Fragmentation:

• Fragmentation ensures rapid reproduction and colonization in aquatic ecosystems.

• It is particularly advantageous in environments where sexual reproduction might be limited due to external factors.

• Other Modes of Reproduction in Spirogyra:

• In addition to fragmentation, Spirogyra also reproduces sexually through a process called conjugation, where two filaments exchange genetic material to form zygospores.

• Conjugation provides genetic diversity, which is essential for adaptation to changing environments.

Important Points

• Misconceptions Addressed:

• Option 1: "Each fragment has roots" – Incorrect, as Spirogyra lacks true roots, stems, or leaves; it is a simple algal filament.

• Option 2: "Fragmentation happens only under laboratory conditions" – Incorrect, as fragmentation occurs naturally in aquatic habitats.

• Option 4: "Each fragment has complex organs" – Incorrect, as Spirogyra cells are simple and lack complex organ systems.

• Ecological Role of Spirogyra:

• Spirogyra plays a critical role in aquatic ecosystems by producing oxygen through photosynthesis.

• It also serves as a primary producer and a food source for various aquatic organisms.

Q19. Answer: (b) 2-Bromopentane

The correct answer is 2-Bromopentane.

Key Points

• The compound given in the question is CH3CHBrCH2CH2CH3. The structure represents a pentane chain with a bromine atom attached to the second carbon.

• In IUPAC nomenclature, the parent chain is selected as the longest continuous chain of carbon atoms, which in this case is "pentane" as it has five carbon atoms.

• Substituents are named and numbered according to their position on the chain. The numbering starts from the end closest to the substituent to give it the lowest possible number. Here, bromine is attached to the second carbon.

• The correct name is "2-Bromopentane" because the bromine atom is attached to the second carbon of the pentane chain.

• Options like "2-Bromopentene" and "1-Bromopentane" are incorrect because:

• "2-Bromopentene" suggests a double bond, which is absent in the given compound.

• "1-Bromopentane" suggests bromine is attached to the first carbon, which is not the case.

Additional Information

• IUPAC Nomenclature Rules:

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• The longest carbon chain is selected as the parent chain. In this case, it is "pentane" (5 carbons).

• Substituents are named and numbered in such a way that they get the lowest possible number in the chain. For this compound, bromine is attached to the second carbon.

• The name of the compound is written as a single word, with the substituent listed as a prefix and the parent chain as the suffix. For example, "2-Bromo" + "pentane".

• Prefixes like di-, tri-, tetra- are used if there are multiple identical substituents. However, this is not the case here.

• About Halogen Substituents:

• Halogen atoms such as fluorine, chlorine, bromine, and iodine are treated as substituents in IUPAC nomenclature.

• They are named using their root names (fluoro-, chloro-, bromo-, iodo-) and placed in alphabetical order with other substituents.

• Examples of Similar Compounds:

• 1-Bromopropane: CH3CH2CH2Br

• 2-Chlorobutane: CH3CH(Cl)CH2CH3

• 2,2-Dibromopropane: CH3CBr2CH3

• Important Points in Nomenclature:

• Always prioritize functional groups over substituents while naming compounds.

• If there is a tie in numbering, assign the lowest number to the substituent that comes first alphabetically (e.g., bromo before chloro).

Q20. Answer: (b) it covers equal distances in equal time intervals

The correct answer is it covers equal distances in equal time intervals.

Key Points

• Uniform motion is defined as the motion of an object in which it covers equal distances in equal intervals of time, irrespective of the duration of the interval.

• An object exhibiting uniform motion has a constant speed because the distance covered per unit of time remains unchanged.

• This motion occurs along a straight path, as the direction of motion does not change over time.

• If an object is moving with uniform motion, its velocity-time graph will be a straight horizontal line, indicating that velocity remains constant.

• Examples of uniform motion include light traveling in a vacuum or a car moving at a constant speed on a straight road.

Additional Information

• Non-uniform motion:

• In non-uniform motion, an object covers unequal distances in equal intervals of time or vice versa.

• The speed of the object changes with time, and the motion may involve acceleration or deceleration.

• Examples include a car slowing down or speeding up while traveling through traffic.

• Speed:

• Speed is the rate at which an object covers distance. It is a scalar quantity and is calculated as: Speed = Distance / Time.

• Uniform motion implies a constant speed over time.

• Velocity:

• Velocity is the speed of an object in a particular direction. It is a vector quantity.

• Uniform motion also implies constant velocity if the direction of motion is unchanged.

• Graphical Representation:

• For uniform motion, the distance-time graph is a straight line with a constant slope.

• The slope of the distance-time graph represents the speed of the object.

Important Points

• Option 1: "It covers equal distances in unequal time intervals" is incorrect because this describes non-uniform motion where speed varies over time.

• Option 2: "It covers equal distances in equal time intervals" is correct as it accurately defines uniform motion.

• Option 3: "It covers unequal distances in unequal time intervals" is incorrect because this also describes non-uniform motion.

• Option 4: "It covers unequal distances in equal time intervals" is incorrect as it indicates variable speed, which is a characteristic of non-uniform motion.

Q21. Answer: (a) Loss by inappropriate moisture

The correct answer is Loss by inappropriate moisture.

Key Points

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• Loss by inappropriate moisture is not considered a biotic loss during the storage of grains. Biotic losses are caused by living organisms such as insects, rodents, mites, and fungi, while inappropriate moisture is an abiotic factor.

• Insects, rodents, and mites are biotic agents that actively damage grains by feeding on them or contaminating them, leading to spoilage. Hence, these are biotic losses.

• Moisture content plays a critical role in the storage of grains, but it is categorized as an abiotic factor. Improper moisture levels can result in fungal growth, toxin production, or spoilage, but this is not a direct biotic loss.

• Biotic losses during grain storage typically include infestation by pests (such as insects and rodents) and contamination by mites. These organisms are living and cause physical damage to grains.

• Maintaining appropriate moisture levels is essential to prevent indirect damage like fungal infestations; however, it does not constitute direct damage caused by living organisms.

Additional Information

• Abiotic factors:

• Abiotic losses are caused by non-living factors such as inappropriate moisture levels, temperature fluctuations, or chemical reactions during storage.

• For example, high moisture content in grains can lead to fungal growth, while low moisture can cause the grains to lose their viability.

• Proper drying and storage techniques are essential to maintain the moisture content within recommended limits, typically around 12-14% for most grains.

• Insects:

• Insects, such as weevils and beetles, are among the most common biotic agents responsible for grain damage.

• They feed on grains, reduce their weight, and contaminate them with waste products, leading to reduced quality and economic losses.

• Pest management strategies, including fumigation, insecticides, and proper storage, can help minimize insect-related losses.

• Rodents:

• Rodents, such as rats and mice, are notorious for causing physical damage to grains during storage.

• They consume grains, contaminate them with urine and feces, and can spread diseases to humans.

• Effective rodent control involves traps, poisons, and improved storage infrastructure.

• Mites:

• Mites are microscopic organisms that infest stored grains, leading to spoilage and contamination.

• They thrive in humid conditions and can cause allergies and other health issues in humans.

• Regular cleaning and maintaining optimal storage conditions can help prevent mite infestations.

• Importance of moisture control:

• Maintaining proper moisture levels is crucial for preventing abiotic losses, fungal growth, and toxin production in grains.

• High humidity in storage areas can lead to the proliferation of fungi such as Aspergillus, which produce harmful toxins like aflatoxins.

• Technologies such as mechanized drying and aerated storage systems help ensure optimal moisture control.

Important Points

• Government guidelines:

• The Food Corporation of India (FCI) and other agencies follow strict guidelines for moisture levels in stored grains to prevent spoilage.

• Moisture levels are monitored using hygrometers and grain moisture meters.

• Storage facilities are designed to prevent biotic and abiotic losses, ensuring food security in India.

• Preventive measures:

• Use of fumigants and pesticides to control insect and rodent infestations.

• Regular cleaning and maintenance of storage areas to minimize mite infestations.

• Implementation of Integrated Pest Management (IPM) strategies for effective control of biotic agents.

• Ensuring proper ventilation and aeration in storage facilities to regulate moisture and temperature.

• Economic impact:

• Biotic losses cause significant economic damage by reducing the quality, quantity, and market value of grains.

• Abiotic losses, such as those caused by improper moisture levels, can also impact grain viability and nutritional value.

• Minimizing storage losses is critical for ensuring food security and reducing wastage in agricultural systems.

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Q22. Answer: (d) is oxidised

The correct answer is Iron is oxidized in the reaction.

Key Points

• The given reaction is: Fe + CuSO4 → FeSO4 + Cu. This reaction is a classic example of a redox reaction, where reduction and oxidation occur simultaneously.

• Iron (Fe) in its elemental form has an oxidation state of 0. In the reaction, it forms FeSO4, where the oxidation state of iron becomes +2. This indicates that iron is oxidized (loses electrons).

• Copper (Cu) in CuSO4 is in the form of Cu^(2+). During the reaction, it gains electrons and is converted into elemental copper (Cu^0). This means copper is reduced (gains electrons).

• The process of iron being oxidized and copper being reduced is an example of the transfer of electrons, which is the hallmark of a redox reaction.

• The correct option is that iron is oxidized in this reaction.

Additional Information

• Oxidation: Oxidation is the process in which an element loses electrons. In this reaction, iron loses two electrons to form Fe^(2+), and hence, it is oxidized.

• Reduction: Reduction is the process in which an element gains electrons. Here, Cu^(2+) from CuSO4 gains two electrons to form elemental copper (Cu), and thus, it is reduced.

• Redox Reactions: These are chemical reactions in which oxidation and reduction occur simultaneously. The substance that loses electrons (oxidized) is the reducing agent, and the substance that gains electrons (reduced) is the oxidizing agent.

• Role of Sulfate (SO4): The sulfate ion (SO4^(2-)) acts as a spectator ion in this reaction. It does not participate in the redox process but ensures the ionic balance of the reaction.

• Applications of the Reaction: This reaction demonstrates the ability of more reactive metals (like iron) to displace less reactive metals (like copper) from their compounds. This principle is used in metallurgy and industrial processes.

Important Points

• Activity Series of Metals: In the activity series, iron is more reactive than copper. This is why iron can displace copper from copper sulfate solution.

• Oxidizing and Reducing Agents: In this reaction:

• Iron (Fe) acts as the reducing agent because it loses electrons and gets oxidized.

• Copper ions (Cu^(2+)) act as the oxidizing agent because they gain electrons and get reduced.

• Electron Transfer: The reaction involves the transfer of 2 electrons from iron to copper ions.

• Visual Observation: During the reaction, you may observe the blue color of the CuSO4 solution fading as copper metal (reddish-brown) gets deposited.

Q23. Answer: (c) Apical Meristematic tissue

The correct answer is Apical Meristematic Tissue.

Key Points

• Apical Meristematic Tissue is located at the tips of roots and shoots and is responsible for primary growth in plants.

• It has the highest levels of Auxin, a plant hormone that promotes cell elongation and differentiation, especially in young plant tissues.

• Auxin concentration is critical in cell division and elongation, facilitating the vertical growth of roots and shoots.

• The apical meristem is also involved in the formation of primary tissues such as the epidermis, cortex, and vascular tissues.

• Due to its active growth role, the apical meristem has a higher metabolic activity compared to other meristematic tissues.

Additional Information

• Lateral Meristematic Tissue:

• Located along the sides of stems and roots, responsible for secondary growth (increasing girth).

• Examples include the vascular cambium and cork cambium.

• Auxin levels are comparatively lower here than in apical meristem.

• Intercalary Meristematic Tissue:

• Found at the base of leaves or internodes, especially in monocots like grasses.

• Promotes regrowth in damaged grass and contributes to elongation of internodes.

• Auxin levels are moderate compared to apical meristem.

• Xylem:

• Xylem is a permanent tissue responsible for water and nutrient transport within plants.

• It does not produce Auxin as it is not a meristematic tissue.

• It forms part of the vascular system and includes tracheids and vessel elements.
• Auxin:
• A plant hormone discovered by F.W. Went, essential for growth and development.
• Functions include cell elongation, apical dominance, and root formation.
• Transported from the apical meristem downwards through the plant.

Important Points

• Apical dominance:
• Auxin produced in the apical meristem suppresses lateral bud growth, ensuring vertical growth.
• Removal of the apical meristem can lead to bushy growth due to activation of lateral buds.
• - Auxin is transported via polar transport (cell-to-cell movement) and vascular tissues.
• This transport plays a significant role in plant tropisms, such as phototropism and gravitropism.
• Applications of Auxin:
• Used in agriculture for rooting cuttings and promoting growth in tissue culture.
• Synthetic auxins, such as 2,4-D, are used as herbicides to control weeds.

Q24. Answer: (b) Linear velocity

The correct answer is Linear Velocity.

Key Points

• The slope of a displacement–time graph represents the rate of change of displacement with time, which is the definition of velocity.
• Linear velocity is a vector quantity that describes the direction and magnitude of the rate of change of displacement. This is directly indicated by the slope of the graph.
• A positive slope on the graph indicates motion in the positive direction, while a negative slope indicates motion in the opposite direction.
• If the slope is constant (straight line), it represents uniform motion, and the velocity remains unchanged.
• A changing slope (curved graph) represents non-uniform motion, and the velocity varies over time.
• Acceleration, distance, and speed are not directly represented by the slope of a displacement–time graph, as they involve additional parameters or derived quantities.

Additional Information

• Displacement-Time Graph:
• A displacement-time graph plots displacement on the y-axis and time on the x-axis.
• It provides insights into the motion of an object, including its velocity and direction.
• Key features include straight lines for uniform motion and curves for accelerated motion.
• Velocity:
• Velocity is defined as the rate of change of displacement with time.
• It is a vector quantity, meaning it has both magnitude and direction.
• Units: Velocity is measured in meters per second (m/s).
• Acceleration:
• Acceleration represents the rate of change of velocity with time.
• On a displacement-time graph, acceleration cannot be derived directly but can be inferred from the curvature of the graph.
• Units: Acceleration is measured in meters per second squared (m/s^2).
• Speed:
• Speed is the magnitude of velocity and is a scalar quantity.
• It does not indicate direction but represents how fast an object is moving.
• Units: Speed is measured in meters per second (m/s).
• Distance:
• Distance is the total path covered by an object, irrespective of direction.
• It is a scalar quantity and cannot be represented directly by the slope of a displacement-time graph.
• Units: Distance is measured in meters (m).

Important Points

• To calculate velocity from a displacement-time graph, the formula is:
• Velocity = (Change in displacement) / (Change in time).

• If the graph is a horizontal line, the slope is zero, and the object is stationary.

• A steeper slope indicates higher velocity, while a less steep slope indicates lower velocity.

• On a displacement-time graph, the concept of instantaneous velocity can be determined by finding the slope of the tangent to the curve at a given point.

• Uniform motion results in a linear graph, whereas accelerated motion leads to a curved graph.

Q25. Answer: (b) The embryo will become a human female.

The correct answer is The embryo will become a human female..

Key Points

• XX chromosomes are the genetic markers for females in humans. The presence of two X chromosomes determines the development of female reproductive structures and secondary sexual characteristics.

• In humans, sex determination is based on the combination of sex chromosomes. An XX combination results in a female, while an XY combination results in a male.

• The Y chromosome contains the SRY gene, which triggers the development of male characteristics. Since the embryo lacks a Y chromosome, it will develop as a female. Hence, statement 2 is correct.

• Statement Analysis:

• Statement 1: "The embryo lacks sex chromosomes." – Incorrect. The embryo has sex chromosomes (XX).

• Statement 2: "The embryo will become a human female." – Correct. The presence of XX chromosomes indicates the embryo will develop into a female.

• Statement 3: "The embryo has an extra Y chromosome." – Incorrect. The embryo does not have a Y chromosome; it has two X chromosomes.

• Statement 4: "The embryo will become a human male." – Incorrect. The absence of a Y chromosome rules out male development.

• The determination of sex in humans occurs during fertilization when the sperm contributes either an X or Y chromosome to the egg's X chromosome.

Additional Information

• Sex chromosomes:

• Humans have 23 pairs of chromosomes, including one pair of sex chromosomes.

• Females have XX chromosomes, while males have XY chromosomes.

• The X chromosome carries many genes critical for development and cellular function, while the Y chromosome primarily determines male sex characteristics.

• SRY gene:

• The Sex-determining Region Y (SRY) gene is located on the Y chromosome.

• This gene is responsible for initiating the development of male gonads (testes).

• If the SRY gene is absent, the gonads develop into ovaries, resulting in female characteristics.

• Embryonic development:

• During early embryonic development, the gonads are undifferentiated.

• The presence or absence of the Y chromosome determines whether the gonads develop as testes or ovaries.

• In the absence of a Y chromosome, the embryo follows the default pathway to develop as a female.

• Karyotyping:

• Karyotyping is a technique used to visualize chromosomes under a microscope.

• It can confirm the presence of XX or XY chromosomes in an embryo.

• This method is commonly used in genetic labs to study chromosomal abnormalities and determine sex.

Important Points

• Sex determination in humans:

• It is a genetic process influenced by the combination of sex chromosomes.

• The father contributes either an X or Y chromosome through his sperm, while the mother always contributes an X chromosome through her egg.

• Chromosomal disorders:

• Abnormalities such as Klinefelter syndrome (XXY) or Turner syndrome (X0) can affect sex determination and development.

• These disorders result from errors during meiosis, leading to an atypical number of sex chromosomes.

• Genetic counseling:

• Parents can undergo genetic counseling to understand chromosomal risks and inheritance patterns.

• This is especially useful for families with a history of genetic disorders or chromosomal abnormalities.

Q26. Answer: (c) 6 years

Shortcut Trick

Present ratio of P and Q = 4 : 3 (Difference = 1 unit)

Ratio after 6 years = 5 : 4 (Difference = 1 unit)

Ratio change for both = 5 − 4 = 1 unit and 4 − 3 = 1 unit

So, 1 unit = 6 years

Difference between present ages = 4 − 3 = 1 unit = 6 years

Therefore The correct answer is 6 years.

Alternate Method

Given: Present age ratio P : Q = 4 : 3. Ratio after 6 years = 5 : 4.

Formula: Age = Ratio Part × Common Constant (x).

=> Let the present age of P be 4x and Q be 3x.

=> After 6 years, P age = 4x + 6 and Q age = 3x + 6.

=> According to question: (4x + 6) / (3x + 6) = 5 / 4

=> 4 × (4x + 6) = 5 × (3x + 6)

=> 16x + 24 = 15x + 30

=> 16x − 15x = 30 − 24

=> x = 6

=> Present age of P = 4 × 6 = 24 years

=> Present age of Q = 3 × 6 = 18 years

=> Difference = 24 − 18 = 6 years

Therefore The correct answer is 6 years.

Additional Information

Constant Age Difference

The numerical difference between the ages of two people always remains constant regardless of how many years pass.

Ratio Balancing Method

If the difference between ratio parts is not the same, multiply the ratios by the difference of the other ratio to balance them.

Ages in Ratio

If ratio is a : b, then actual ages are ax and bx, where x is the highest common factor.

Q27. Answer: (a) 140

Shortcut Trick

Calculate semi-perimeter (s): (148 + 57 + 175) ÷ 2 = 190 cm.

Find Area (A) using Heron's factors: √(190 × 42 × 133 × 15) = 3990 cm².

Altitude (h) to base 57 cm: (2 × Area) ÷ Base = (2 × 3990) ÷ 57.

h = 7980 ÷ 57 = 140 cm.

Therefore The correct answer is 140 cm.

Alternate Method

Given: Sides of triangle are a = 148 cm, b = 57 cm, and c = 175 cm.

Formula Used: Heron's Formula Area = √(s(s−a)(s−b)(s−c)) and Area = (1/2) × base × height.

=> Semi-perimeter s = (148 + 57 + 175) ÷ 2

=> s = 380 ÷ 2 = 190 cm

=> Area = √(190 × (190−148) × (190−57) × (190−175))

=> Area = √(190 × 42 × 133 × 15)

=> Area = √((19 × 10) × (6 × 7) × (19 × 7) × (3 × 5))

=> Area = √($19^2 \times 7^2 \times 5^2 \times 2^2 \times 3^2$)

=> Area = 19 × 7 × 5 × 2 × 3 = 3990 cm²

=> Altitude (h) = (2 × Area) ÷ Base

=> h = (2 × 3990) ÷ 57 = 7980 ÷ 57

=> h = 140 cm

Therefore The correct answer is 140 cm.

Additional Information

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Heron's Formula

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

Altitude Property

The altitude of a triangle is the perpendicular segment from a vertex to the line containing the opposite side. Area = 0.5 × base × height.

Obtuse Triangle Altitude

In an obtuse triangle, the altitudes corresponding to the sides forming the obtuse angle lie outside the triangle.

Q28. Answer: (a) 4/9

Shortcut Trick

Subtract the non-terminating repeating decimals by converting them into fractional form.

2.343434... − 1.898989... = 0.444444...

0.4444... is equivalent to 4/9.

Therefore The correct answer is 4/9.

Alternate Method

Given: Expressions 2.3434... and 1.8989....

Formula Used: A repeating decimal 0.pq is written as pq/99.

=> Convert 2.3434... to fraction: 2 + 34/99 = (198 + 34)/99 = 232/99

=> Convert 1.8989... to fraction: 1 + 89/99 = (99 + 89)/99 = 188/99

=> Subtract the fractions: 232/99 − 188/99

=> Result = 44/99

=> Simplify by dividing numerator and denominator by 11: 4/9

Therefore The correct answer is 4/9.

Additional Information

Pure Recurring Decimal

A decimal in which all the figures after the decimal point are repeated. Example: 0.666... = 6/9 = 2/3.

Mixed Recurring Decimal

A decimal in which some figures do not repeat and some do. Form: (Whole number − non-repeating part) / 9...0...

Denominator Rule

The denominator contains as many 9s as there are repeating digits and as many 0s as there are non-repeating digits after the decimal.

Q29. Answer: (c) 56

Shortcut Trick

Assume an arbitrary mean (Base) = 50.

Find deviations from 50: +15, −9, +46, −6, −12, −20, +29, +40, −29.

Sum of deviations = 15 − 9 + 46 − 6 − 12 − 20 + 29 + 40 − 29 = 54.

Average deviation = 54 ÷ 9 = +6.

Actual Arithmetic Mean = Base + Average Deviation = 50 + 6 = 56.

Therefore The correct answer is 56.

Alternate Method

Given: Observations are 65, 41, 96, 44, 38, 30, 79, 90, and 21.

Formula Used: Arithmetic Mean = (Sum of all observations) ÷ (Total number of observations)

Calculations:

=> Total number of observations (n) = 9

=> Sum of observations = 65 + 41 + 96 + 44 + 38 + 30 + 79 + 90 + 21

=> Sum of observations = 504

=> Arithmetic Mean = 504 ÷ 9

=> Arithmetic Mean = 56

Therefore The correct answer is 56.

Additional Information

Properties of Arithmetic Mean

The sum of deviations of a set of observations from their arithmetic mean is always zero. i.e., Σ(x_i − Mean) = 0.

Combined Mean

If two groups have n1 and n2 observations with means x1 and x2, the combined mean is (n1x1 + n2x2) ÷ (n1 + n2).

Effect of Change in Scale/Origin

If each observation is increased, decreased, multiplied, or divided by a constant 'k', the mean also changes by the same constant 'k'.

Q30. Answer: (d) 1,500

Shortcut Trick

Savings = 60%, so Expenditure = 100% − 60% = 40%.

40% of Income = Rs. 600.

1% of Income = 600 ÷ 40 = Rs. 15.

100% (Total Income) = 15 × 100 = Rs. 1,500.

Therefore The correct answer is Rs. 1,500.

Alternate Method

Given:

Savings Percentage = 60%

Expenditure = Rs. 600

Formula Used:

Income = Expenditure + Savings

Expenditure % = 100% − Savings %

Calculations:

=> Let Total Income be x.

=> Expenditure Percentage = 100% − 60% = 40%

=> 40% of x = 600

=> (40 ÷ 100) × x = 600

=> 0.4x = 600

=> x = 600 ÷ 0.4

=> x = 6000 ÷ 4

=> x = 1,500

Therefore The correct answer is Rs. 1,500.

Additional Information

Income-Expenditure Relation

The fundamental relation is Income = Expenditure + Savings. If any two are known, the third can be calculated.

Percentage Change in Income

If Income increases by x% and Expenditure increases by y%, the change in Savings is calculated using the weighted average of the components.

Base Value Concept

In income-based problems, Total Income is always treated as the 100% base value unless specified otherwise.

Q31. Answer: (c) 81/3%

Shortcut Trick

In case of loss equal to Selling Price of 'n' items:

Loss % = [n ÷ (Total items + n)] × 100

Loss % = [8 ÷ (88 + 8)] × 100 = (8 ÷ 96) × 100

Loss % = (1 ÷ 12) × 100 = 8(1/3)%

Therefore The correct answer is 8(1/3)%.

Alternate Method

Given:

Number of phones sold = 88

Loss = Selling Price (SP) of 8 phones

Formula Used:

=> Loss = Cost Price (CP) − Selling Price (SP)

=> Loss % = (Loss ÷ CP) × 100

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Calculations:

=> Let SP of 1 phone = Rs. 1

=> Total SP of 88 phones = Rs. 88

=> Loss = 8 × 1 = Rs. 8

=> CP = SP + Loss

=> CP = 88 + 8 = Rs. 96

=> Loss % = (8 ÷ 96) × 100

=> Loss % = (1 ÷ 12) × 100 = 8(1/3)%

Therefore The correct answer is 8(1/3)%.

Additional Information

Profit in terms of SP

If Profit is equal to SP of 'n' items, then Profit % = [n ÷ (Total − n)] × 100.

Loss/Profit in terms of CP

If Loss/Profit is equal to CP of 'n' items, then % = (n ÷ Total) × 100.

Fraction to Percentage conversion

The fraction 1/12 is equal to 8.33% or 8(1/3)%.

Q32. Answer: (b) Rs. 396

Shortcut Trick

Net Interest % for Case 1 = 15% × 3 = 45%

Net Interest % for Case 2 = 14% × 4 = 56%

Difference in Interest % = 56% − 45% = 11%

Difference in Simple Interest = 11% of Rs. 3,600 = Rs. 396

Therefore The correct answer is Rs. 396.

Alternate Method

Given:

Principal (P) = Rs. 3,600

Scenario 1: Rate (R1) = 15%, Time (T1) = 3 years

Scenario 2: Rate (R2) = 14%, Time (T2) = 4 years

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

=> SI1 = (3600 × 15 × 3) ÷ 100

=> SI1 = 36 × 45 = Rs. 1,620

=> SI2 = (3600 × 14 × 4) ÷ 100

=> SI2 = 36 × 56 = Rs. 2,016

=> Difference = SI2 − SI1

=> Difference = 2016 − 1620 = Rs. 396

Therefore The correct answer is Rs. 396.

Additional Information

Simple Interest Properties

Simple Interest remains constant for every year if the Principal and Rate of Interest are unchanged. The total interest is directly proportional to the product of Rate and Time.

Effective Rate Method

For simple interest, the Effective Rate over 'T' years is simply (R × T)%. This is the fastest way to compare different interest scenarios on the same principal.

Amount Calculation

The total Amount (A) after T years is given by A = P + SI = P(1 + RT/100).

Q33. Answer: (d) 30,690

Shortcut Trick

Initial Income : Expenditure = 9 : 5

Initial Expenditure 5 units = Rs. 15,500 → 1 unit = Rs. 3,100

Initial Income = 9 × 3,100 = Rs. 27,900

Final Income = 27,900 × 160% = Rs. 44,640

Final Expenditure = 15,500 × 90% = Rs. 13,950
Final Saving = 44,640 − 13,950 = Rs. 30,690
Therefore The correct answer is Rs. 30,690.
Alternate Method
Given: Ratio of Income : Expenditure = 9 : 5. Initial Expenditure = Rs. 15,500.
Formula: Saving = Income − Expenditure
=> 5 units = Rs. 15,500
=> 1 unit = 15,500 ÷ 5 = Rs. 3,100
=> Initial Income = 9 × 3,100 = Rs. 27,900
=> New Income (60% rise) = 27,900 + (60% of 27,900) = 27,900 + 16,740 = Rs. 44,640
=> New Expenditure (10% fall) = 15,500 − (10% of 15,500) = 15,500 − 1,550 = Rs. 13,950
=> Final Saving = 44,640 − 13,950 = Rs. 30,690
Therefore The correct answer is Rs. 30,690.
Additional Information
Income-Saving Relation
Income = Expenditure + Saving. Any percentage change in one affects the balance based on this linear equation.
Percentage Change
New Value = Old Value × (100 ± Change%)/100. This is the fastest way to compute growth or decay.
Ratio Multiplier
To find the actual value from a ratio, divide the given actual value by its corresponding ratio part to find the multiplier (1 unit value).

Q34. Answer: (d)

Given:
$(21/2 \div 5/8 + 3/4 \times 2/3 - 5/6)/((15-6)^2 \div 9 + 1/2)$
Concept Used:
BODMAS rule
Calculation:
=> $(5/2 \div 5/8 + 3/4 \times 2/3 - 5/6)/((9)^2 \div 9 + 1/2)$
=> $(5/2 \times 8/5 + 3/4 \times 2/3 - 5/6)/(81 \div 9 + 1/2)$
=> $(4 + 1/2 - 5/6)/(9 + 1/2)$
=> $(8/2 + 1/2 - 5/6)/(18/2 + 1/2)$
=> $(9/2 - 5/6)/(19/2)$
=> $((27 - 5)/6)/(19/2)$
=> $(22/6)/(19/2)$
=> $11/3 \times 2/19$
=> $22/57$
Therefore The correct answer is 22/57

Q35. Answer: (c) 2

Shortcut Trick
Let the total capacity of the tank be LCM(4, 8) = 8 units.
Efficiency of filling pipe = 8 ÷ 4 = +2 units/minute.
Efficiency of emptying pipe = 8 ÷ 8 = −1 unit/minute.
Combined efficiency of both pipes = 2 − 1 = +1 unit/minute.
To fill one-quarter of the tank: Work = 8 × (1 ÷ 4) = 2 units.
Time required = Work ÷ Combined efficiency = 2 ÷ 1 = 2 minutes.
Therefore The correct answer is 2 minutes.
Alternate Method
Given:
Time taken by Pipe A (filling) = 4 minutes
Time taken by Pipe B (emptying) = 8 minutes
Formula Used:

Net work done in 1 minute = (1 ÷ Time taken by filling pipe) − (1 ÷ Time taken by emptying pipe)

Time to fill a fraction of the tank = Fraction ÷ Net work done in 1 minute

Pipe	Time (minutes)	Total Capacity (LCM)	Efficiency
Pipe A (Filling)	4	8 units	+2
Pipe B (Emptying)	8	−1	

Calculations:

=> Total capacity of the tank = 8 units

=> One-quarter capacity of the tank = 8 × (1 ÷ 4) = 2 units

=> Net efficiency of both pipes when opened together = 2 − 1 = 1 unit/minute

=> Time required to fill one-quarter of the tank = 2 units ÷ 1 unit/minute = 2 minutes

Therefore The correct answer is 2 minutes.

Additional Information

Pipes and Cisterns Concept

In pipes and cisterns, a filling pipe performs positive work, while an emptying pipe (leakage) performs negative work.

Net Work Formula

If pipe A fills the tank in x hours and pipe B empties it in y hours (where y > x), then the net part filled in 1 hour when both are opened together is (1 ÷ x) − (1 ÷ y).

Q36. Answer: (d) Rs. 150

Shortcut Trick

Ratio of A : B : C : D = 6 : 7 : 17 : 19

Difference between C and B in units = 17 − 7 = 10 units

Given, 10 units = Rs. 250 → 1 unit = Rs. 25

Amount of A = 6 units = 6 × 25 = Rs. 150

Therefore The correct answer is Rs. 150.

Alternate Method

Given: Ratio of sum distribution A : B : C : D = 6 : 7 : 17 : 19

Formula: Value of a part = (Total Value ÷ Total Ratio) × Specific Ratio Part

=> Let the amounts be 6x, 7x, 17x, and 19x

=> According to question, C − B = 250

=> 17x − 7x = 250

=> 10x = 250

=> x = 250 ÷ 10 = 25

=> Amount received by A = 6x = 6 × 25

=> Amount of A = Rs. 150

Therefore The correct answer is Rs. 150.

Additional Information

Ratio and Proportion Basics

A ratio compares quantities. If a:b = c:d, then a × d = b × c (Product of extremes = Product of means).

Total Sum Calculation

To find the total amount distributed, sum the ratio parts: (6 + 7 + 17 + 19) × x = 49 × 25 = Rs. 1225.

Compound Ratio

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

Q37. Answer: (a) $9x^2 - 16z^2$

Shortcut Trick

Recognize the pattern of Algebraic Identity: $(a^3 − b^3) / (a^2 + ab + b^2) = (a − b)$.

Let a = 3x and b = 4z. The first part of the expression simplifies directly to (3x − 4z).

The entire expression becomes (3x − 4z) × (3x + 4z).

Applying the Difference of Squares identity $(a − b)(a + b) = a^2 − b^2$.

=> $(3x)^2 − (4z)^2 = 9x^2 − 16z^2$.

Therefore The correct answer is $9x^2 - 16z^2$.

Alternate Method

Given:

Expression = $((3x)^3 - (4z)^3) / (9x^2 + 12xz + 16z^2) \times (3x + 4z)$

Formula Used:

1. Difference of Cubes: $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

2. Difference of Squares: $(a - b)(a + b) = a^2 - b^2$

Calculations:

=> Let $a = 3x$ and $b = 4z$.

=> Then $a^2 = (3x)^2 = 9x^2$, $b^2 = (4z)^2 = 16z^2$, and $ab = (3x)(4z) = 12xz$.

=> The expression is: $[(a - b)(a^2 + ab + b^2) / (a^2 + ab + b^2)] \times (a + b)$

=> Cancelling the common factor $(a^2 + ab + b^2)$ from numerator and denominator:

=> $(a - b) \times (a + b)$

=> Using the square identity: $a^2 - b^2$

=> Substituting values: $(3x)^2 - (4z)^2$

=> $9x^2 - 16z^2$

Therefore The correct answer is $9x^2 - 16z^2$.

Additional Information

Sum of Cubes Identity

The formula for the sum of two cubes is $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$.

Square of a Binomial

Important related expansions include $(a + b)^2 = a^2 + 2ab + b^2$ and $(a - b)^2 = a^2 - 2ab + b^2$.

Higher Power Identities

For any positive integer n, $a^n - b^n$ is always divisible by $(a - b)$.

Q38. Answer: (b) 14 : 21 : 36

Shortcut Trick

Simplify Ratio A : B = 4 : 6 = 2 : 3.

Multiply Ratio A : B by 7 and Ratio B : C by 3 to equate B.

A : B = 14 : 21 and B : C = 21 : 36.

Combined Ratio A : B : C = 14 : 21 : 36.

Therefore The correct answer is 14 : 21 : 36.

Alternate Method

Given:

A : B = 4 : 6

B : C = 7 : 12

Calculations:

=> To combine ratios, the common term B must have the same value.

=> LCM of 6 and 7 = 42.

=> Multiply (A : B) by 7 → (4 × 7) : (6 × 7) = 28 : 42.

=> Multiply (B : C) by 6 → (7 × 6) : (12 × 6) = 42 : 72.

=> A : B : C = 28 : 42 : 72.

=> Dividing by the Common Factor 2 → 14 : 21 : 36.

Therefore The correct answer is 14 : 21 : 36.

Additional Information

Compounded Ratio

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

Duplicate Ratio

The duplicate ratio of (a : b) is $(a^2 : b^2)$.

Inverse Ratio

The inverse ratio of (a : b) is (b : a) or (1/a : 1/b).

Q39. Answer: (d) 757 m

Shortcut Trick

Difference in length of tunnels = 2091 − 1259 = 832 m

Difference in time taken = 89 − 63 = 26 seconds

Speed of train = 832 ÷ 26 = 32 m/s

Length of train = (Speed × Time2) − Tunnel2 = (32 × 63) − 1259 = 2016 − 1259 = 757 m

Therefore The correct answer is 757 m.

Alternate Method

Given: Length of Tunnel1 (L1) = 2091 m, Time1 (T1) = 89 s, Length of Tunnel2 (L2) = 1259 m, Time2 (T2) = 63 s.

Formula Used: Speed = (Length of Train + Length of Object) ÷ Time

Let the length of the train be 'x' and speed be 'v'.

=> v = (x + 2091) ÷ 89 --(i)

=> v = (x + 1259) ÷ 63 --(ii)

=> (x + 2091) ÷ 89 = (x + 1259) ÷ 63

=> 63 × (x + 2091) = 89 × (x + 1259)

=> 63x + 131733 = 89x + 112051

=> 26x = 19682

=> x = 757 m

Therefore The correct answer is 757 m.

Additional Information

Relative Speed for Stationary Objects

When a train crosses a stationary object of length 'L', the total distance covered is (Length of train + L).

Unit Conversion

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

Crossing a Point Object

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

Q40. Answer: (b) 27

Shortcut Trick

Let Hindi marks be H and Sanskrit marks be S.

From total marks condition: 5H + 5S = 310 => H + S = 62.

Test options for S: If S = 27, then H = 62 − 27 = 35.

Check first condition: (2/5)×35 − (1/3)×27 = 14 − 9 = 5. Condition satisfied.

Therefore The correct answer is 27 marks.

Alternate Method

Given:

(2/5)H − (1/3)S = 5 ... (i)

5H + 5S = 310 ... (ii)

Calculations:

=> From (ii), divide by 5: H + S = 62 => H = 62 − S

=> Substitute H in (i): (2/5)(62 − S) − S/3 = 5

=> Multiply entire equation by 15 (LCM of 5 and 3):

=> 6(62 − S) − 5S = 75

=> 372 − 6S − 5S = 75

=> 372 − 11S = 75

=> 11S = 372 − 75

=> 11S = 297

=> S = 297 ÷ 11 = 27

Therefore The correct answer is 27 marks.

Additional Information

Linear Equations in Two Variables

Equations of the form ax + by = c can be solved using substitution, elimination, or cross-multiplication methods.

Substitution Method

Express one variable in terms of the other from one equation and substitute it into the second equation to find the value of one variable.

Ratio and Proportions in Equations

When fractions like 2/5 or 1/3 are involved, multiplying the entire equation by the Least Common Multiple (LCM) of the denominators simplifies the calculation.

Q41. Answer: (a) Rs. 5,478

Shortcut Trick

The discount percentage (12%) is equal to the extra amount (Rs. 747) Sachin would have paid.

Discount (12%) = Rs. 747

Selling Price (100% − 12%) = 88%

Sachin paid = (747 ÷ 12) × 88 = 62.25 × 88 = Rs. 5,478.

Therefore The correct answer is Rs. 5,478.

Alternate Method

Given: Discount Rate = 12%, Extra amount without discount = Rs. 747.

Formula: Marked Price (MP) = (Discount Value ÷ Discount %) × 100

=> Let the Marked Price be x.

=> 12% of x = 747

=> (12 ÷ 100) × x = 747

=> x = (747 × 100) ÷ 12 = 6225

=> Price Paid (SP) = Marked Price − Discount

=> SP = 6225 − 747 = 5478

Therefore The correct answer is Rs. 5,478.

Additional Information

Marked Price (MP)

The price listed on the label of an article. MP = Selling Price + Discount.

Successive Discount

When two or more discounts are given on the original MP. Equivalent discount = a + b − (a×b)/100.

Discount Percentage

Discount is always calculated on the Marked Price. Discount % = (Discount ÷ MP) × 100.

Q42. Answer: (c) 3 : 4

Shortcut Trick

Let angle Z = k.

Then angle Y = k + 25° and angle X = angle Y + 40° = k + 65°.

Sum of angles = k + (k + 25°) + (k + 65°) = 180° => 3k + 90° = 180° => 3k = 90° => k = 30°.

Therefore angle Z = 30° and (angle X − angle Y) = 40° (given).

Ratio = 30 : 40 = 3 : 4.

Therefore The correct answer is 3 : 4.

Alternate Method

Given:

angle X − angle Y = 40° ... (i)

angle Y − angle Z = 25° ... (ii)

Formula Used:

In any triangle XYZ, the sum of interior angles is 180°:

angle X + angle Y + angle Z = 180°

Calculations:

From (i), angle X = angle Y + 40°

From (ii), angle Z = angle Y − 25°

Substituting these in the angle sum property:

=> (angle Y + 40°) + angle Y + (angle Y − 25°) = 180°

=> 3angle Y + 15° = 180°

=> 3angle Y = 165°

=> angle Y = 55°

Now, find angle Z:

=> angle Z = 55° − 25° = 30°

The value of (angle X − angle Y) is already given as 4

Q43. Answer: (c) 60 minutes

Shortcut Trick

Departure Time = 180 ÷ 60 = 3 hours

Return Time = 180 ÷ 45 = 4 hours

Difference = 4 − 3 = 1 hour

Time in minutes = 1 × 60 = 60 minutes

Therefore The correct answer is 60 min.

Alternate Method

Given:

Distance (D) = 180 km

Speed of Departure (S1) = 60 km/hr

Speed of Return (S2) = 45 km/hr

Formula Used:

Time = Distance ÷ Speed

Calculations:

=> Time taken for departure journey (T1) = 180 ÷ 60

=> T1 = 3 hours

=> Time taken for return journey (T2) = 180 ÷ 45

=> T2 = 4 hours

=> Time difference = T2 − T1 = 4 − 3 = 1 hour

=> Conversion to minutes = 1 × 60 minutes

=> Difference = 60 minutes

Therefore The correct answer is 60 min.

Additional Information

Average Speed Formula

When the distance is the same for both journeys, the average speed is given by (2 × S1 × S2) ÷ (S1 + S2).

Unit Conversion

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

Inverse Proportion

For a constant distance, speed is inversely proportional to time (S prop. to 1/T). Ratio of speeds 60:45 (4:3) means ratio of times is 3:4.

Q44. Answer: (a) 1

Shortcut Trick

Check odd numbers between 480 and 489: 481, 483, 485, 487.

481 is divisible by 13 (13 × 37 = 481).

483 is divisible by 3 (Sum of digits 4+8+3 = 15).

485 is divisible by 5 (Ends in 5).

487 is not divisible by any prime up to √487 ≈ 22.

Therefore The correct answer is 1.

Alternate Method

Given: Range of numbers from 480 to 489.

Method: Eliminate even numbers and check divisibility for odd numbers.

=> Numbers to check: 481, 482, 483, 484, 485, 486, 487, 488.

=> Eliminate even numbers: 482, 484, 486, 488 (All divisible by 2).

=> Check 481: 481 ÷ 13 = 37 (Not prime).

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=> Check 483: 4+8+3 = 15, divisible by 3 (Not prime).
=> Check 485: Ends in 5, divisible by 5 (Not prime).
=> Check 487: Not divisible by 2, 3, 5, 7, 11, 13, 17, 19 (Prime).
Therefore The correct answer is 1.
Additional Information
Prime Number Test
To check if N is prime, test divisibility by all primes up to √N. If none divide N, then N is prime.
Divisibility by 3
A number is divisible by 3 if the sum of its digits is divisible by 3.
Prime Numbers near 500
Common primes in this range include 479, 487, 491, 499.

Q45. Answer: (a) 45°

Shortcut Trick
In a right-angled triangle, if the perpendicular (height) and base (shadow) are equal, the triangle is an isosceles right triangle.
For any triangle where Height = Shadow, tan θ = 1.
Since tan 45° = 1, the angle of elevation must be 45°.
Therefore The correct answer is 45°.
Alternate Method
Given:
Height of the tower (AB) = h
Length of the shadow (BC) = s
Condition: h = s
Formula Used:
In ΔABC, tan θ = Perpendicular / Base = AB / BC
Calculations:
=> tan θ = h / s
=> Since h = s, tan θ = h / h
=> tan θ = 1
=> θ = tan^(−1)(1)
=> θ = 45°
Therefore The correct answer is 45°.
Additional Information
Trigonometric Ratios for Standard Angles
Common values include tan 30° = 1/√3, tan 45° = 1, and tan 60° = √3.
Angle of Elevation
The angle formed by the line of sight with the horizontal when looking up at an object.
Shadow Length Rule
When the sun's altitude is 45°, the height of any vertical object is exactly equal to the length of its shadow.

Q46. Answer: (c) 568

Shortcut Trick
Direct relation between Cost Price (CP) and Marked Price (MP):
CP / MP = (100 − Discount%) / (100 + Profit%)
CP / 896 = (100 − 29) / (100 + 12) = 71 / 112
CP = (71 / 112) × 896 = 71 × 8
Therefore The correct answer is Rs. 568.
Alternate Method
Given: Marked Price (MP) = Rs. 896, Discount = 29%, Profit = 12%
Formula Used: Selling Price (SP) = MP × (100 − D%)/100; CP = SP × 100/(100 + P%)
=> Selling Price (SP) = 896 × (100 − 29) / 100
=> SP = 896 × 0.71 = Rs. 636.16

=> Cost Price (CP) = SP / (1 + Profit%)
=> CP = 636.16 / 1.12
=> CP = Rs. 568
Therefore The correct answer is Rs. 568.
Additional Information
Marked Price (MP) and Discount
MP is the price printed on the product. Discount is always calculated on the Marked Price: SP = MP − Discount.
Markup Percentage
The percentage by which CP is increased to set the MP: Markup % = [(MP − CP) / CP] × 100.
Successive Discounts
If two discounts d1 and d2 are given, the Equivalent Discount = d1 + d2 − (d1 × d2) / 100.

Q47. Answer: (a) 3960 cm³

Shortcut Trick
For a hollow cylindrical pipe, the Volume of metal is given by: $V = \pi (R^2 - r^2) h$
Substitute R = 10 cm, r = 8 cm, h = 35 cm, and π = 22/7.
$V = (22/7) \times (10 + 8) \times (10 - 8) \times 35$
$V = 22 \times 18 \times 2 \times 5 = 110 \times 36 = 3960$ cm³.
Therefore The correct answer is 3960 cm³.
Alternate Method
Given:
External diameter (D) = 20 cm => External radius (R) = 20/2 = 10 cm
Internal diameter (d) = 16 cm => Internal radius (r) = 16/2 = 8 cm
Length of the pipe (h) = 35 cm
Formula Used:
Volume of metal used = External Volume − Internal Volume
$V = \pi R^2 h - \pi r^2 h = \pi(R^2 - r^2)h$
Calculations:
=> $V = (22/7) \times (10^2 - 8^2) \times 35$
=> $V = (22/7) \times (100 - 64) \times 35$
=> $V = (22/7) \times 36 \times 35$
=> $V = 22 \times 36 \times 5$
=> $V = 110 \times 36$
=> $V = 3960$ cm³
Therefore The correct answer is 3960 cm³.
Additional Information
Curved Surface Area (CSA) of Hollow Cylinder
It is the sum of the external and internal curved surfaces: $CSA = 2\pi Rh + 2\pi rh = 2\pi h(R + r)$.
Total Surface Area (TSA) of Hollow Cylinder
$TSA = CSA + 2 \times$ Area of base rings $= 2\pi h(R + r) + 2\pi(R^2 - r^2)$.
Volume of Solid Cylinder
For a solid cylinder with radius r and height h, the volume is $V = \pi r^2 h$.

Q48. Answer: (b) 12% increase

Shortcut Trick
Let Price of TV = 100. Then Price of Washing Machine = 75.
Initial Total Price = (4 × 75) + (2 × 100) = 300 + 200 = 500.
Net change = 4 × (75 × 34%) + 2 × (100 × −21%) = 102 − 42 = +60.
% Change = (60 ÷ 500) × 100 = 12%.
Therefore The correct answer is 12% increase.
Alternate Method
Given:

Price of TV = T | Price of Washing Machine = W
W = T − 25% of T = 0.75T
=> Let T = Rs. 100, then W = Rs. 75
Calculations:
=> Initial Price (4W + 2T) = 4(75) + 2(100) = 300 + 200 = Rs. 500
=> New W price = 75 + 34% of 75 = 75 + 25.5 = Rs. 100.5
=> New T price = 100 − 21% of 100 = 100 − 21 = Rs. 79
=> Final Price (4 × 100.5 + 2 × 79) = 402 + 158 = Rs. 560
=> Total change = 560 − 500 = Rs. 60
=> % Change = (60 ÷ 500) × 100 = 12%
Therefore The correct answer is 12% increase.
Additional Information
Percentage Change Formula
Percentage change = [(Final Value − Initial Value) ÷ Initial Value] × 100.
Weighted Average Method
Net % change = (n1c1 + n2c2) ÷ (n1 + n2) where n is weight and c is individual % change.
Successive Percentage
For two successive changes x% and y%, effective change = [x + y + (xy/100)]%.

Q49. Answer: (b) 75.3

Shortcut Trick
Assume the average score of the entire class is 77.
Deviation for 12 students = (64 − 77) × 12 = −13 × 12 = −156.
Total students = 91.
Net change in average = −156 ÷ 91 ≈ −1.71.
Correct average = 77 − 1.71 = 75.29 ≈ 75.3.
Therefore The correct answer is 75.3.
Alternate Method
Given: Total students = 91, Group 1 = 12 students with average 64, Group 2 = (91 − 12) students with average 77.
Formula Used: Combined Average = (n1 × a1 + n2 × a2) ÷ (n1 + n2)
=> Total score of 12 students = 12 × 64 = 768
=> Remaining students = 91 − 12 = 79
=> Total score of 79 students = 79 × 77 = 6083
=> Total class score = 768 + 6083 = 6851
=> Average score = 6851 ÷ 91 = 75.2857...
=> Rounded to one decimal place = 75.3
Therefore The correct answer is 75.3.
Additional Information
Weighted Average Formula
It is calculated as Sum of (Value_i × Weight_i) ÷ Sum of Weights_i. Used when groups have different sizes.
Deviation Method
New Average = Assumed Average + (Total Deviation ÷ Total Number of Items). This reduces calculation complexity.
Effect of Constant Change
If every value in a data set is increased/decreased by a constant 'k', the new average also increases/decreases by 'k'.

Q50. Answer: (b) 60 days

Shortcut Trick
Total Work (LCM of 50, 75) = 150 units.
Efficiency: Navya = 3, Bhavya = 2.
2-day cycle (Bhavya + Navya) = 2 + 3 = 5 units.
Total days = (150 ÷ 5) × 2 = 60 days.
Therefore The correct answer is 60 days.

Alternate Method

Given:

Time taken by Navya = 50 days

Time taken by Bhavya = 75 days

Formula Used:

Total Work = Time × Efficiency

Person	Days	Total Work	Efficiency
Bhavya	75	150	2
Navya	50	3	

Calculations:

=> Work done in 1^(st) day (Bhavya) = 2 units

=> Work done in 2^(nd) day (Navya) = 3 units

=> Total work done in one cycle (2 days) = 2 + 3 = 5 units

=> Number of cycles required = Total Work ÷ Work per cycle

=> Cycles = 150 ÷ 5 = 30 cycles

=> Total time = 30 × 2 = 60 days

Therefore The correct answer is 60 days.

Additional Information

Alternate Day Work

When people work on alternate days, calculate the work done in one complete cycle (usually 2 days) and then divide the total work by this value.

Efficiency and Time

Efficiency is inversely proportional to the time taken. If A is twice as efficient as B, A will take half the time taken by B to complete the same work.

Pipes and Cisterns

This concept is similar to Time and Work, where an outlet pipe has negative efficiency (work) and an inlet pipe has positive efficiency.

Q51. Answer: (b) dm

The code for each word is shown below:

Clearly, dm is the code for the word CLOUD.

Hence, the correct answer is Option 2

Q52. Answer: (c) 23

Given:

43 C 80 A 8 D 6 B 5 = ?

By using the BODMAS rule:

By, decoding the given symbols we get.

SYMBOLS	MEANING
A	÷
B	×
C	•
D	•

Substituting the given operator in the given expression:

=> 43 C 80 A 8 D 6 B 5

=> 43 + (80 ÷ 8) - 6 × 5

=> 43 + 10 - 6 × 5

=> 43 + 10 - 30

=> 53 - 30

=> 23

Hence, the correct answer is 'Option 3'.

Q53. Answer: (d) 872

The logic followed here is:

Thus, the missing term in the series is 872.

Hence, the correct answer is "Option 4";

Q54. Answer: (a) Four

The given number is 5236789.

The digits in the number are 5, 2, 3, 6, 7, 8, 9.

Position	1	2	3	4	5	6	7
Original Digit	5	2	3	6	7	8	9
Ascending Order	2	3	5	6	7	8	9

The position(s) of Four digits (6, 7, 8, and 9) remain unchanged.

Hence, the correct answer is "Option 1".

Q55. Answer: (d) XOM

The logic followed here is:

Thus, the missing letter cluster in the series is XOM.

Hence, the correct answer is Option 4.

Q56. Answer: (b) Both conclusions (I) and (II) follow.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some dividers are curtains - True (Because all curtains are dividers, so the part of dividers that are curtains exists).

II. All blinders are dividers - True (Because all blinders are curtains and all curtains are dividers, so all blinders are dividers).

So, Both conclusions (I) and (II) follow.

Hence, the correct answer is Option 2.

Q57. Answer: (b) 8 km to the south

Given:

Atul starts from point A and drives 9 km towards the west. He then turns left, drives 8 km, then turns left again and drives 15 km. He then turns left again and drives 16 km. He finally turns left, drives 6 km and stops at point P.

To reach point A from point P, he must drive 8 km to the South.

Hence, the correct answer is Option 2.

Q58. Answer: (a) 60 km towards the west

Given:

Gautam starts from point Y and drives 34 km towards the east. He then turns right, drives 68 km, then turns right again and drives 55 km. He then turns right and drives 11 km. He then turns right again, drives 81 km. He then turns left, drives 57 km and stops at point Z.

Point Z is 60 km East of point Y. To reach point Y again, he must drive 60 km towards the West.

Hence, the correct answer is Option 1.

Q59. Answer: (b) 45

Given:

Gaurav's rank from the top = 13th

Gaurav's rank from the bottom = 33rd

Total Number of Students = (Rank from Top + Rank from Bottom) - 1

= (13 + 33) - 1

= 46 - 1

Total Number of Students = 45

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Hence, the correct answer is "Option 2".

Q60. Answer: (b) KP-MJ

The logic followed here is:
For Option 1) OT to QM
For Option 2) KP to MJ
Option 3) MR to OK
For Option 4) QV to SO
Options 1, 3, and 4 all follow the (+2, -7) pattern. Option 2 follows (+2, -6), which is the odd one out.
Thus, the pair KP : MJ does not belong to the group.
Hence, the correct answer is "Option 2".

Q61. Answer: (c) 2

Given series:
3 3 9 5 9 1 5 5 4 2 6 9 5 5 8 5 3 2 8 6 7 6 3 6 4 9 1
Condition to be checked:
Even number → Odd number → Even number
3 3 9 5 9 1 5 5 4 2 6 9 5 5 8 5 3 2 8 6 7 6 3 6 4 9 1
Thus, there are two such patterns (6 7 6) and (6 3 6).
Hence, the correct answer is "Option 3".

Q62. Answer: (d) 104

The logic followed here is:
Thus, the missing term in the series is 104.
Hence, the correct answer is "Option 4";

Q63. Answer: (b) ON 18

The logic followed here is:
For PM 3 to KP 17
For NK 6 to IN 20
Applying the same logic to TK 4:
Thus, TK 4 is related to ON 18.
Hence, the correct answer is "Option 2".

Q64. Answer: (d) N

Given:
L, M, N, O, P, and Q are seated around a round table, facing the center.
Q sits second to the right of O.
M is adjacent to the immediate left of Q.
L sits second to the left of N.
Thus, N sits adjacent to the immediate right of P
Hence, the correct answer is "Option 4".

Q65. Answer: (c) Two

Given:
Seven people, D, E, F, G, L, M, and N, are sitting in a straight line, facing north.
1) No one sits to the right of F. (F is at the extreme right end)
2) Only two people sit between F and E.
3) E sits to the immediate left of N.
4) Only three people sit between L and N.
5) M sits to the immediate right of D.
Thus, two people (E and N) sit between G and M.
Hence, the correct answer is Option 3.

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Q66. Answer: (b) Two

Given series:

(Left) 2 6 & 2 9 5 5 € 1 $ 1 6 @ & € # 3 @ £ % 4 9 (Right)

Condition to be checked:

Number → Symbol → Symbol

2 6 & 2 9 5 5 € 1 $ 1 6 @ & € # 3 @ £ % 4 9

(6, @, &) and (3, @, £).

Thus, the count of symbols that belong to that group is two ((6, @, &) and (3, @, £).

Hence, the correct answer is Option 2.

Q67. Answer: (a) Three

Given series:

6 8 5 2 4 9 1 6 3 2 7 1 6 9 3 8 5 4 2 1 7 8 6 5 9 7 2

Condition to be checked:

Odd number → Even number → Even number

6 8 5 2 4 9 1 6 3 2 7 1 6 9 3 8 5 4 2 1 7 8 6 5 9 7 2

Thus, there are three such numbers (5 2 4), (5 4 2), and (7 8 6).

Hence, the correct answer is "Options 1".

Q68. Answer: (b) NIG

The logic followed in this pattern is.

For 'VQP':

For 'NIG':

For 'RML':

For 'SNM':

Thus, the letter-cluster that DOES NOT belong to that group is NIG, as it follows a (-5, -2) pattern instead of (-5, -1).

Hence, the correct answer is "Option 2".

Q69. Answer: (a) 523

Given:

28 - 19 ÷ 23 + 96 × 3 = ?

By using the BODMAS rule:

By, decoding the given symbols we get.

SYMBOLS	MEANING
•	•
•	×
×	÷
÷	•

Substituting the given operator in the given expression:

=> 28 - 19 ÷ 23 + 96 × 3

=> 28 × 19 + 23 - (96 ÷ 3)

=> 28 × 19 + 23 - 32

=> 532 + 23 - 32

=> 555 - 32

=> 523

Hence, the correct answer is 'Option 1'.

Q70. Answer: (a) YDG91

The pattern followed here is:

Thus, the missing term in the sequence is YDG91.

Hence, the correct answer is Option 1.

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Q71. Answer: (a) Three

Given:

Seven people, A, B, C, D, W, X, and Y, are sitting in a straight line, facing north.

1) Only three people sit to the left of D. (D is at the 4th position from the left)

2) Only A sits to the right of C.

3) Only three people sit between C and B. (B is at the 2nd position)

4) X sits somewhere to the left of Y but somewhere to the right of W.

Thus, three people (B, X, and D) sit between W and Y.

Hence, the correct answer is Option 1.

Q72. Answer: (b) UO 23

The logic followed here is:

For GB 15 to LF 12

For MH 20 to RL 17

Applying the same logic to PK 26:

The resulting pair is UO 23.

Hence, the correct answer is "Option 2".

Q73. Answer: (c) FROM - OFRM - MORF

The logic followed here is:

KIND - NKID - DNIK

And,

COST - SCOT - TSOC

Similarly,

FROM - OFRM - MORF

Hence, the correct answer is "Option 3".

Q74. Answer: (b) Two

Given series:

7 6 1 8 4 3 9 2 7 5 8 3 4 1 6

Condition to be checked:

Prime number → Prime number

7 6 1 8 4 3 9 2 7 5 8 3 4 1 6

Thus, there are two such pairs (2 7) and (7 5).

Hence, the correct answer is "Option 2".

Q75. Answer: (c) 7

The code for each word is shown below:

Clearly, 7 is the number for the letter W, as it is the only unique character and digit in the second set.

Hence, the correct answer is Option 3.

Q76. Answer: (d) (12, 72, 6)

The logic follows here is:

Logic: (First Number × Third Number) = Second Number

For (14, 98, 7):

14 × 7 = 98

For (6, 36, 6):

6 × 6 = 36

Option 1: (5, 25, 7)

5 × 7 = 35 (≠ 25)

Option 2: (7, 49, 8)

7 × 8 = 56 (≠ 49)

Option 3: (8, 48, 7)

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8 × 7 = 56 (≠ 48)

Option 4: (12, 72, 6)

12 × 6 = 72

Thus, (12, 72, 6) is the only option follows the same logic.

Hence, the correct answer is "Option 4".

Q77. Answer: (a) 14

The logic followed here is:

Thus, the number missing in the series is 14.

Hence, the correct answer is "Option 1".

Q78. Answer: (a) One

Given:

Seven boxes (A, B, C, D, I, J, and K) are stacked from 1 (bottom) to 7 (top).

1) Only B is placed above I.

2) Only C is placed between I and J.

3) Only A is placed below K.

Position	Box
7 (Top)	B
6	I
5	C
4	J
3	
2	K
1 (Bottom)	A

4) Placing the remaining box.

Final Arrangement:

7	B
6	I
5	C
4	J
3	D
2	K
1	A

Thus, there is only one box (Box K) placed between D and A.

Hence, the correct answer is "Option 1".

Q79. Answer: (b) Daughter's husband

Given:

A is				
Symbol	?	=	@	√
Meaning	Daughter	Son	Father	Sister
of B				

On checking: C @ D = E √ F ? L

1) C @ D means 'C is the father of D'.

2) D = E means 'D is the son of E'. (Since C is D's father, E must be D's mother and wife of C).

3) E √ F means 'E is the sister of F'.

4) F ? L means 'F is the daughter of L'. (Since E is F's sister, E is also the daughter of L).

L E F C D

Therefore, E is the daughter of L, and C is the husband of E, C is the Daughter's husband of L.

Hence, the correct answer is "Option 2".

Q80. Answer: (d) Only I follows

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some crows are pigeons - True (Because all ostriches are crows and some ostriches are pigeons, so the part of pigeons that are ostriches are also crows).

II. Some ostriches are sparrows - False (Because there is no definite relation given between ostriches and sparrows).

So, Only I follows.

Hence, the correct answer is Option 4).

Q81. Answer: (b) Mahendra Singh Dhoni

The correct answer is Mahendra Singh Dhoni.

Key Points

• Mahendra Singh Dhoni was inducted into the prestigious ICC Hall of Fame in June 2025, recognizing his significant contributions to international cricket and his exceptional leadership skills.

• Dhoni is widely regarded as one of the most successful captains in cricket history, having led India to victory in three major ICC tournaments: ICC T20 World Cup 2007, ICC Cricket World Cup 2011, and the ICC Champions Trophy 2013.

• Under Dhoni's captaincy, the Indian cricket team achieved the number one ranking in Test cricket for the first time in December 2009.

• Dhoni is celebrated for his calm demeanor under pressure, earning him the nickname "Captain Cool." His ability to finish games and his tactical acumen made him an indispensable player for India.

• His induction into the ICC Hall of Fame highlights his lasting legacy in cricket and his role in elevating Indian cricket to unprecedented heights.

Additional Information

• ICC Hall of Fame:

• The ICC Hall of Fame was launched in 2009 to honor cricketers who have made significant contributions to the game and left a lasting impact.

• It recognizes players from all eras of cricket, spanning over 100 years of history.

• The inductees are chosen by a panel consisting of cricket historians, former players, and ICC officials.

• Mahendra Singh Dhoni's Career Highlights:

• Dhoni made his international debut in 2004 against Bangladesh and quickly rose to prominence with his aggressive batting and exceptional wicket-keeping skills.

• He scored 10,773 runs in ODIs, including 10 centuries, and remains one of the most consistent finishers in cricket history.

• In T20Is, Dhoni played 98 matches and scored over 1,600 runs as a middle-order batsman.

• Dhoni also captained Chennai Super Kings (CSK) to multiple Indian Premier League (IPL) titles, further cementing his status as an iconic leader.

• Other Notable Inductees in ICC Hall of Fame:

• Previous Indian players inducted include Sunil Gavaskar, Kapil Dev, Anil Kumble, and Rahul Dravid.

• The Hall of Fame also includes legendary international players like Sir Donald Bradman, Muttiah Muralitharan, and Jacques Kallis.

• Criteria for ICC Hall of Fame Induction:

• Players must have retired from international cricket for a minimum of five years.

• Their contribution to the game, achievements, and influence on cricket are considered during the selection process.

• Inductees are celebrated for their sportsmanship, leadership, and impact on the sport's development globally.

Important Points

• Mahendra Singh Dhoni's Legacy:

• Dhoni's captaincy is often praised for instilling a fearless approach in the Indian cricket team.

• He promoted young talent, such as Virat Kohli and Ravindra Jadeja, ensuring a smooth transition of leadership.

• His unorthodox wicket-keeping style and sharp cricketing instincts redefined the role of a wicketkeeper-batsman.
• Post-retirement Contributions:
• Dhoni continues to inspire future generations through his involvement in cricket and mentoring young players.
• He remains active in the IPL as a captain and mentor, showcasing his commitment to cricket even after international retirement.

Q82. Answer: (c) Rio de Janeiro

The correct answer is Rio de Janeiro.

Key Points

• Rio de Janeiro (Brazil) was officially designated as the UNESCO World Book Capital 2025.
• The title became effective on 23 April 2025, which is observed annually as World Book and Copyright Day.
• UNESCO selected Rio de Janeiro in recognition of its comprehensive programme to promote reading, literacy, publishing, and equitable access to books across all sections of society.
• The city's initiatives focus on encouraging a culture of reading, strengthening libraries, and making books accessible, especially to young people and underserved communities.
• Hence, the correct answer is Option 3 – Rio de Janeiro.

Additional Information

• UNESCO World Book Capital:
• It is an annual designation awarded by UNESCO to a city that demonstrates excellence in promoting books and reading.
• The selected city holds the title for one year, beginning on 23 April.
• Previous World Book Capitals:
• 2024: Strasbourg, France.
• 2025: Rio de Janeiro, Brazil.
• World Book and Copyright Day:
• Celebrated every year on 23 April to promote reading, publishing, and the protection of intellectual property through copyright.

Important Points

• UNESCO World Book Capital 2025: Rio de Janeiro, Brazil.
• Title Effective From: 23 April 2025.
• Declared By: UNESCO.
• Purpose: To promote reading, books, publishing, and literacy worldwide.
• Previous World Book Capital (2024): Strasbourg, France.

Q83. Answer: (c) Mumbai

The correct answer is Mumbai.

Key Points

• According to the Kushman and Wakefield 2025 report, Mumbai has achieved a remarkable milestone by ranking 6th globally in terms of construction capacity for data centers.
• Mumbai is known as the financial capital of India and serves as a hub for various industries, including technology and data infrastructure.
• Data centers in Mumbai are growing rapidly due to the city's strategic location, connectivity, and access to undersea cable networks, making it a prime spot for global tech companies.
• The increasing demand for data storage, cloud computing, and digital services has led to significant investments in Mumbai's data infrastructure development.
• Prominent companies and global players have chosen Mumbai as a preferred location for setting up their data centers, contributing to its global rank in the report.

Additional Information

• What are Data Centers?
• Data centers are facilities used to house computer systems and associated components, such as telecommunications and storage systems.
• They are critical for enabling cloud computing, data storage, and various digital services required by modern businesses and consumers.
• Mumbai's Strategic Advantages:
• Mumbai's coastal location provides access to undersea cables, which are vital for high-speed data transfer and connectivity.
• The city has a robust infrastructure, skilled workforce, and proximity to large-scale industries, making it a favorable location for data center development.

• It is home to multiple internet exchanges, further enhancing its connectivity capabilities.

• Global Data Center Trends:

• The global demand for data centers is increasing due to the expansion of cloud computing, AI applications, and IoT (Internet of Things).

• Countries such as the United States, Singapore, and China are also leading in the development of data center infrastructures, competing with cities like Mumbai.

• Other Indian Cities in the Data Center Industry:

• Bengaluru: Known for its tech ecosystem, Bengaluru is emerging as a hub for data centers due to its IT infrastructure.

• Hyderabad: Recently, Hyderabad has attracted investments in data centers due to its focus on technology-driven industries.

• Delhi: The capital city is also developing data centers due to its political and economic significance.

Important Points

• India's Data Center Market:

• The data center industry in India is expected to grow significantly in the coming years, driven by the government's Digital India initiative and the increasing digitization of businesses.

• India is becoming a preferred destination for global companies due to its cost-effective solutions and skilled workforce.

• Environmental Considerations:

• Data centers consume large amounts of energy, leading to a focus on sustainable practices like using renewable energy sources.

• Mumbai data centers are increasingly adopting green technologies to reduce their environmental impact.

Q84. Answer: (c) State Bank of India and Union Bank of India

The correct answer is Indian Bank and Central Bank of India.

Key Points

• Indian Bank and Central Bank of India signed a Memorandum of Understanding (MoU) with the Government of Assam in January 2025 to provide zero-premium insurance coverage to employees.

• The agreement aims to ensure financial security and social welfare for government employees by offering insurance benefits without any premium costs borne by the employees.

• This initiative is a part of Assam's efforts to enhance the welfare of its workforce by collaborating with banking institutions to provide comprehensive insurance schemes.

• The insurance coverage includes life insurance and health insurance, ensuring protection against unforeseen circumstances for employees and their families.

• The partnership highlights the role of public sector banks in supporting state government initiatives and promoting employee welfare through innovative financial solutions.

Additional Information

• Indian Bank:

• Indian Bank is one of the leading public sector banks in India, headquartered in Chennai, Tamil Nadu.

• It provides a wide range of financial services, including retail banking, corporate banking, and insurance services.

• Indian Bank has been actively involved in various state and central government initiatives for financial inclusion and welfare.

• Central Bank of India:

• Founded in 1911, Central Bank of India is one of India's oldest and largest public sector banks, headquartered in Mumbai, Maharashtra.

• The bank offers various financial products, including savings accounts, loans, and insurance services, catering to diverse customer needs.

• It has been a key partner in implementing government schemes such as Pradhan Mantri Jan Dhan Yojana and Atal Pension Yojana.

• Zero-Premium Insurance:

• Zero-premium insurance is a scheme where the insured individual does not pay any premium, as the cost is borne by the employer or the government.

• This type of insurance is often used to provide financial protection to employees without burdening them with additional costs.

• It typically includes benefits such as life insurance, health coverage, and accidental insurance.

• Government of Assam:

• The Assam government has been proactive in launching welfare schemes for its citizens and employees, focusing on education, health, and financial security.

• Collaborating with public sector banks is a strategic move to ensure wider reach and effective implementation of such schemes.

• Recent initiatives include health insurance schemes for the underprivileged and financial literacy programs in rural areas.

Q85. Answer: (d) Yasser Usman

The correct answer is Yasar Usman.

Key Points

• Yasar Usman is a well-known Indian author, journalist, and biographer who has garnered significant recognition for his detailed biographies of Bollywood personalities.

• His works often delve into the life stories of prominent figures, offering readers an in-depth understanding of their personal and professional journeys.

• In January 2025, Yasar Usman released his first crime novel titled 'As Dark As Blood.' This marked a shift in his writing style, transitioning from biographies to crime fiction.

• 'As Dark As Blood' is expected to be a gripping crime narrative, showcasing Usman's versatility as a writer.

• Yasar Usman is known for his meticulous research and storytelling prowess, traits which have been highly appreciated in his biographies. These qualities are anticipated to make his debut crime novel a success.

Additional Information

• Yasar Usman's Previous Works:

• Yasar Usman has authored biographies on Bollywood legends such as Rekha, Rajesh Khanna, and Sanjay Dutt. These books provide readers with a comprehensive understanding of the stars' lives and careers.

• His books are known for their unbiased approach, blending factual information with engaging storytelling.

• Crime Fiction Genre:

• The crime fiction genre typically involves narratives centered around crimes, investigations, and their resolutions.

• Authors in this genre often craft intricate plots to keep readers engaged and intrigued.

• Yasar Usman's entry into crime fiction signifies his versatility and willingness to explore new literary avenues.

• Notable Crime Fiction Authors:

• Globally renowned crime fiction writers include Agatha Christie, Arthur Conan Doyle, and Raymond Chandler.

• In the Indian literary sphere, authors like Vikram Chandra and Abir Mukherjee have gained recognition for their crime fiction works.

• Importance of Debut Novels:

• A debut novel often sets the tone for an author's literary career and establishes their unique style.

• 'As Dark As Blood' is significant as it marks Yasar Usman's first venture into crime fiction, expanding his literary repertoire.

Important Points

• Literary Transition: Transitioning from biographies to crime fiction showcases Yasar Usman's adaptability and willingness to explore different literary genres.

• Impact on Indian Literature: The release of 'As Dark As Blood' contributes to the evolving landscape of Indian crime fiction, bringing fresh perspectives and storytelling techniques.

• Anticipated Reception: Given Yasar Usman's reputation for detailed research and compelling narratives, 'As Dark As Blood' is expected to resonate well with readers and critics alike.

• Future Potential: Success in crime fiction could encourage Usman to further explore and innovate within this genre, adding diversity to his literary achievements.

Q86. Answer: (d) S. Krishnan, Secretary, Ministry of Electronics and Information Technology (MeitY)

The solution is in Hindi. Read it online.

Q87. Answer: (c) New Delhi

The solution is in Hindi. Read it online.

Q88. Answer: (a) P.R. Sreejesh

The solution is in Hindi. Read it online.

Q89. Answer: (c) Sonamarg Tunnel

The correct answer is Sonmarg Tunnel.

Key Points

• In January 2025, Prime Minister Narendra Modi inaugurated the Sonmarg Tunnel located in the Union Territory of Jammu & Kashmir.

• The tunnel is a part of the broader infrastructure development projects aimed at improving connectivity in the Himalayan region, especially for strategic and economic purposes.

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• The Sonmarg Tunnel is a vital project under the Ministry of Road Transport and Highways of India, implemented to ensure all-weather connectivity to Sonmarg, which is often cut off during winters due to heavy snowfall.

• The tunnel is equipped with state-of-the-art technologies such as ventilation systems, emergency exit provisions, and safety features to ensure seamless and safe travel.

• This tunnel is expected to enhance tourism in the region, as Sonmarg is a popular destination for both domestic and international tourists.

Additional Information

• Sonmarg:

• Sonmarg, meaning "Meadow of Gold", is a picturesque town in the Ganderbal district of Jammu & Kashmir.

• It is known for its pristine beauty and serves as a gateway to the Ladakh region.

• Sonmarg is also a base camp for trekking routes to the Amarnath Cave and other Himalayan ranges.

• Importance of the Tunnel:

• The Sonmarg Tunnel ensures all-weather road connectivity, which is crucial for the region prone to harsh winters and heavy snowfall.

• This is a significant boost for the Indian Army and defense personnel, as it provides strategic access to remote regions near the Line of Control (LoC).

• It also facilitates the transport of goods and services, fostering economic growth in the region.

• Other Key Tunnels in Jammu & Kashmir:

• Atal Tunnel: Located in Himachal Pradesh, connecting Manali to Leh.

• Zojila Tunnel: A critical tunnel under construction to connect Leh and Kashmir Valley.

• Chenani-Nashri Tunnel: India's longest road tunnel, enhancing connectivity between Jammu and Srinagar.

• Tourism and Economic Growth:

• The tunnel is expected to increase tourist footfall, contributing to the local economy.

• Improved connectivity will make Sonmarg a year-round destination, boosting the hospitality and service sectors.

Important Points

• Technological Features of Sonmarg Tunnel:

• Equipped with advanced ventilation systems to regulate air quality inside the tunnel.

• Multiple emergency exit points for enhanced safety during emergencies.

• Integrated with CCTV surveillance and real-time monitoring systems.

• Designed to withstand extreme climatic conditions prevalent in the Himalayan region.

• Strategic Importance:

• The tunnel plays a key role in ensuring logistical support for defense operations near the LoC.

• It reduces travel time significantly, making transportation more efficient and cost-effective.

• Economic Impact:

• Boosts regional development by improving connectivity for locals and businesses.

• Promotes trade and commerce, facilitating the movement of goods between regions.

Q90. Answer: (b) National Accounts Statistics and Consumer Price Index

The correct answer is national accounts statistics and consumer price index.

Key Points

• National Accounts Statistics:

• It is a comprehensive set of data that provides information on a country's economic performance and structure.

• Includes GDP, GNP, national income, savings, capital formation, etc.

• Used for policy formulation and economic analysis.

• Provides insights on economic trends and sectors contributing to growth.

• Consumer Price Index:

• Measures changes in the price level of a market basket of consumer goods and services purchased by households.

• Indicator of inflation and purchasing power of consumers.

• Essential for monetary policy decisions and cost of living adjustments.

• India's CPI includes components like food, housing, clothing, and medical care.

• GoIStats App:

• An initiative by the Government of India to provide real-time data and analytics.

• Designed to include key indicators like national accounts statistics and CPI for policy and economic planning.

• Provides centralized access to statistics for researchers, policymakers, and citizens.

• The inclusion of such indicators in the GoIStats App highlights the importance of tracking economic and financial metrics to ensure informed decision-making.

Additional Information

• Global Sports Ranking and Olympic Medal Table:

• Tracks performance of countries in international sports events.

• Used to assess sports development and participation.

• Not included in the GoIStats App as it does not directly relate to India's economic planning.

• International Film Awards and Music Industry Data:

• Provides information on cultural and entertainment contributions globally.

• Relevant for tourism and cultural exchange but not directly related to economic statistics in the GoIStats App.

• Space Mission Launch Data:

• Includes information on satellite launches and space exploration.

• Important for technological advancement but not typically part of economic indicators like national accounts statistics or CPI.

• Importance of National Accounts Statistics and CPI:

• Essential for tracking economic growth and inflation.

• Used by policymakers, economists, and businesses for decision-making.

• Reflects the financial health of the nation and assists in fiscal planning.

Important Points

• Government Initiatives:

• The Government of India regularly updates and refines economic indicators for accurate tracking.

• Apps like GoIStats aim to centralize and digitize access to critical data.

• Role of CPI:

• Helps in determining monetary policies, such as interest rate adjustments.

• Used for indexing wages and pensions to inflation.

• National Accounts Statistics:

• Provides a detailed picture of a country's economic health and structure.

• Useful for international comparisons of economic performance.

• Digital Transformation:

• Integration of such data in apps like GoIStats is part of India's move toward digital governance.

• Ensures transparency and accessibility of statistical information.

Q91. Answer: (d) D. Gukesh

The correct answer is Option 4 - D. Gukesh.

Key Points

• D. Gukesh, a young Indian chess prodigy, was awarded the prestigious Major Dhyan Chand Khel Ratna Award for his achievements in chess in January 2025.

• He became one of the youngest recipients of this award due to his remarkable performance in international chess tournaments and his contribution to promoting chess in India.

• Gukesh has consistently outperformed his contemporaries, achieving the status of a Grandmaster at a very young age.

• In 2022, he entered the elite 2700 Elo rating club, making him one of the youngest players globally to achieve this milestone.

• His victories in several international chess tournaments have brought India recognition on the global stage in this sport.

Additional Information

• Major Dhyan Chand Khel Ratna Award:

• It is the highest sporting honor in India, established in 1991-1992.

• The award is named after Major Dhyan Chand, considered one of the greatest hockey players of all time.

• It recognizes athletes who have demonstrated exceptional performance and brought glory to India in their respective sports disciplines.

• Recipients of the award receive a medal, certificate, and cash prize of Rs. 25 lakh.

• D. Gukesh's Achievements:

• Born on May 29, 2006, Gukesh hails from Chennai, Tamil Nadu, known as the chess hub of India.

• He became the second youngest Grandmaster in the history of chess at the age of 12 years, 7 months, and 17 days.

• Gukesh represented India in the Chess Olympiad and achieved exceptional results in the 2022 FIDE World Cup.

• His aggressive playing style and strategic brilliance have earned him comparisons to chess legends like Viswanathan Anand.

• Other Chess Players Mentioned:

• Vidit Gujrathi: An Indian Grandmaster, known for his steady performances in global tournaments. He became a Grandmaster in 2013.

• Arjun Erigaisi: Another young Indian chess player who has been making waves in international circuits. He became a Grandmaster at the age of 14.

• Viswanathan Anand: A chess legend from India, the first Indian to win the World Chess Championship. He is a five-time world champion and recipient of the Khel Ratna Award.

• Importance of Chess in India:

• India has a rich history in chess, with the game originating in the country as Chaturanga.

• Indian players like Viswanathan Anand and the younger generation, including Gukesh, have significantly contributed to popularizing chess.

• The government and chess federations have actively promoted the sport through initiatives, scholarships, and tournaments.

Important Points

• Eligibility for Major Dhyan Chand Khel Ratna Award:

• An athlete must exhibit consistent and exceptional performance at the international level.

• Achievements are evaluated over a four-year period prior to the year of the award.

• Chess Olympiad 2022:

• India hosted the 44th Chess Olympiad in Chennai, marking a significant milestone in the sport's history in the country.

• Gukesh was one of the standout performers, securing crucial victories for the Indian team.

Q92. Answer: (c) Ashok Khemka

The correct answer is Ashok Khemka.

Key Points

• Ashok Khemka is a senior Indian Administrative Service (IAS) officer known for his integrity, forthrightness, and honesty in public service.

• He gained prominence for his record-breaking 57 transfers during his career in public administration, reflecting his resistance to corruption and bureaucratic pressure.

• He was instrumental in exposing several high-profile cases of irregularities and corruption, often at significant personal and professional risk.

• One of his most notable actions was the cancellation of a controversial land deal involving a prominent political figure's family, which brought him into the national spotlight.

• Despite the challenges he faced throughout his career, including frequent transfers and professional isolation, Ashok Khemka continued to demonstrate exemplary commitment to transparency and ethical governance.

• He retired in April 2025, leaving behind a legacy of courage, accountability, and dedication to public service.

Additional Information

• Ashok Khemka's Background:

• He is a 1991 batch IAS officer of the Haryana cadre.

• He holds a Ph.D. in Computer Science and an MBA in Business Administration, showcasing his academic excellence.

• Khemka is also a recipient of several awards for his outstanding service, including recognition for his efforts to bring transparency in governance.

• Notable Cases:

• He became widely known for cancelling a land deal involving DLF and Robert Vadra in 2012, citing irregularities.

• He has been vocal about corruption in public procurement and land transactions, often challenging decisions that he found unethical.

• Transfer History:

• His frequent transfers—57 in total—highlighted the challenges faced by bureaucrats who resist political interference and corruption.

• These transfers were often seen as punitive measures for his uncompromising stance on governance and ethical practices.

• Legacy:

• Despite the challenges, he has become a symbol of integrity and courage in the Indian bureaucracy.

• His work has inspired young civil servants to prioritize ethics and transparency in public administration.

Important Points

• Impact of Frequent Transfers:

• Frequent transfers disrupt the continuity of administrative work and make it challenging for officers to implement long-term projects.

• It also affects the morale of honest officers, as they are often transferred for resisting unethical practices.

• IAS Officer's Role:

• IAS officers are responsible for implementing government policies and ensuring efficient administration at various levels of governance.

• They play a critical role in maintaining the rule of law and upholding ethical standards in public service.

• Reforms Suggested:

• There is a need for reforms to protect honest officers from undue political interference and ensure fair treatment in their postings.

• Establishing fixed tenures for bureaucratic positions has been recommended to enhance administrative stability and efficiency.

Q93. Answer: (a) Novak Djokovic

The correct answer is Novak Djokovic.

Key Points

• Novak Djokovic is one of the greatest tennis players in history, widely recognized for his record-breaking achievements in Grand Slam tournaments.

• In 2025, Djokovic surpassed the record for the most Grand Slam titles, cementing his status as the most successful male tennis player in terms of major championships.

• As of 2025, Djokovic has won a remarkable number of Grand Slam titles, including multiple victories at the Australian Open, French Open, Wimbledon, and the US Open.

• His dominance in the sport can be attributed to his exceptional athleticism, mental toughness, and adaptability to different court surfaces.

• Djokovic’s achievements have not only set a new benchmark in tennis but have also inspired a new generation of players worldwide.

Additional Information

• Novak Djokovic:

• Born on May 22, 1987, in Belgrade, Serbia.

• Known for his extraordinary flexibility, court coverage, and powerful baseline play.

• He has held the World No. 1 ranking in the ATP rankings for a record number of weeks.

• Djokovic is the only male player to have won all nine ATP Masters 1000 tournaments, achieving the "Career Golden Masters" twice.

• Grand Slam Titles:

• The four Grand Slam tournaments are the Australian Open, French Open, Wimbledon, and the US Open.

• Djokovic has an impressive record in all four, with particularly notable dominance at the Australian Open, where he has the most wins in history.

• Other Players Mentioned:

• Carlos Alcaraz: A young and promising Spanish player, known for his agility and strong performance in recent years. As of now, he has not surpassed Djokovic’s records.

• Rafael Nadal: A legendary player from Spain, known as the "King of Clay," with numerous Grand Slam titles but has not broken Djokovic’s record as of 2025.

• Jannik Sinner: An emerging Italian tennis player with immense potential but has not achieved the same level of success in Grand Slam tournaments.

• Grand Slam Record:

• Djokovic’s record-breaking achievement highlights his consistency and excellence across all playing surfaces.

• He has also faced and defeated several legendary players, including Roger Federer and Rafael Nadal, in high-stakes matches.

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Q94. Answer: (c) 1 October 2025

The correct answer is 1 October 2025.

Key Points

• The Reserve Bank of India (Project Finance) Directions, 2025 are set to come into force on 1 October 2025, as per official notifications and guidelines.

• The RBI introduced these directions to streamline and regulate project financing practices, ensuring uniformity across financial institutions in India.

• The directions focus on the management of risks, financial prudence, and compliance with existing banking norms for large-scale project financing.

• Key objectives include enhancing transparency in project financing, reducing non-performing assets (NPAs), and fostering better financial discipline among borrowers and lenders.

• The implementation date of 1 October 2025 ensures adequate preparation time for banks and financial institutions to align their systems with the new directives.

Additional Information

• Project Financing:

• It refers to the financing of long-term infrastructure, industrial projects, and public services based on the projected cash flows of the project rather than the balance sheets of the sponsors.

• Common sectors for project financing include energy, transportation, telecommunications, water, and urban development.

• Project financing typically involves financial institutions, banks, or private equity firms, which lend funds against future revenue streams.

• Role of RBI in Project Financing:

• The RBI plays a critical role in regulating financial institutions and ensuring compliance with guidelines for project financing.

• The Reserve Bank of India Act, 1934 empowers the RBI to issue directives to banks for maintaining financial discipline in project finance.

• RBI guidelines aim to mitigate risks such as interest rate fluctuations, regulatory changes, and project delays.

• Key Features of Project Finance Directions, 2025:

• Focus on credit assessment and risk management for long-term projects.

• Emphasis on the use of escrow accounts to monitor cash flows and ensure fund utilization as per project requirements.

• Mandatory compliance with environmental, social, and governance (ESG) criteria for project approvals.

• Introduction of reporting frameworks for lenders to track project progress and financial health.

• Examples of Project Financing in India:

• Major projects financed under this model include the Delhi Metro Rail Corporation (DMRC), Bandra-Worli Sea Link, and National Highways Development Programme (NHDP).

• These projects showcase the importance of structured financing for infrastructure development and economic growth.

Important Points

• Implementation Timeline:

• The 1 October 2025 effective date provides ample time for banks and financial institutions to adapt to the new regulations.

• Stakeholders, including banks and borrowers, need to ensure compliance before the deadline to avoid penalties.

• Impact on Banking Sector:

• Improved project financing practices will help reduce loan defaults and NPAs, fostering financial stability in the banking sector.

• Enhanced transparency and accountability will build trust among lenders, borrowers, and investors.

• Legal Framework:

• The RBI's authority in issuing these directions is backed by the Banking Regulation Act, 1949, ensuring legal compliance.

• The guidelines align with international best practices for project financing.

Q95. Answer: (b) 4.2%

The correct answer is 0.042.

Key Points

• OECD Economic Outlook: The OECD Economic Outlook is a key biannual publication that provides analysis and projections for member countries and other major economies. It offers insights into global economic trends and key macroeconomic indicators.

• Projected Inflation Rate for 2025: According to the OECD Economic Outlook (Volume 2025, Issue 1), the proposed inflation rate for the OECD-wide region for the year 2025 is estimated to be 0.042 (4.2%). This is based on the latest economic data and forecasts.

• Definition of Inflation: Inflation refers to the rate at which the general level of prices for goods and services rises, eroding purchasing power over time. Central banks and policymakers monitor and manage inflation to ensure economic stability.

• Relevance of the 4.2% Inflation Rate: A 4.2% inflation rate indicates moderate inflation, which is generally seen as healthy for economic growth, provided it does not exceed a level that harms purchasing power and economic stability.

• Global Economic Trends: The projected inflation rate reflects ongoing economic recovery, global supply chain adjustments, and monetary policies adopted by OECD member countries. It also highlights the impact of global energy prices and geopolitical factors.

Additional Information

• OECD (Organisation for Economic Co-operation and Development):

• The OECD is an international organization comprising 38 member countries that work together to promote economic growth, sustainable development, and global trade.

• Founded in 1961, the OECD provides a platform for countries to share experiences, develop solutions, and coordinate policies on global economic challenges.

• Factors Influencing Inflation Rates:

• Monetary Policies: Central banks adjust interest rates to control inflation and stabilize the economy.

• Supply Chain Dynamics: Disruptions in global supply chains can lead to higher production costs, impacting inflation rates.

• Energy Prices: Variations in oil and gas prices significantly influence inflation, as energy costs are a key component of the economy.

• OECD Economic Projections:

• The OECD regularly publishes forecasts on GDP growth, employment, inflation, and trade for its member countries and major global economies.

• These projections help policymakers and businesses make informed decisions based on expected economic trends.

• Global Inflation Trends:

• Many economies experienced higher inflation rates in recent years due to pandemic-induced disruptions and rising commodity prices.

• Efforts to stabilize inflation include tightening monetary policies and addressing supply chain challenges.

Important Points

• Target Inflation Rates: Most central banks aim for a target inflation rate of around 2% annually. Moderate inflation promotes economic growth without significantly eroding purchasing power.

• Inflation Measurement: Inflation is commonly measured using indices such as the Consumer Price Index (CPI) or the Producer Price Index (PPI).

• Impact of Inflation: While moderate inflation supports economic activity, high inflation can reduce consumer spending, impact savings, and destabilize economies.

• OECD Reports: The OECD's economic reports serve as a valuable resource for governments, businesses, and researchers to understand and respond to global economic challenges.

Q96. Answer: (c) Rs. 854 crore

The solution is in Hindi. Read it online.

Q97. Answer: (a) 10th

The solution is in Hindi. Read it online.

Q98. Answer: (a) 80.7%

The correct answer is 0.807.

Key Points

• The Sustainable Development Goals – National Indicator Framework Progress Report, 2025, monitors India's progress on environmental sustainability and waste management.

• In 2015-16, the percentage of waste processed was 17.97%, indicating the initial state of waste management efficiency in India.

• By 2024-25, India showed significant progress with the percentage of waste processed increasing to 80.7% (or 0.807 in decimal format).

• This improvement highlights India's advancements in implementing effective waste management practices, contributing towards meeting the targets of the Sustainable Development Goals (SDGs).

• The correct option 0.807 reflects the decimal representation of the waste processed percentage in 2024-25.

Additional Information

• Sustainable Development Goals (SDGs):

• The SDGs, established by the United Nations in 2015, consist of 17 goals aimed at achieving a sustainable future for all by 2030.

• Goal 12 of SDGs focuses on responsible consumption and production, including waste management and recycling.

• India actively monitors its progress through frameworks like the National Indicator Framework.

• Waste Management in India:

• India generates approximately 62 million tonnes of waste annually, of which only about 60% is collected, and less than 50% is processed.

• Efforts such as the Swachh Bharat Mission and policies on extended producer responsibility (EPR) have been implemented to improve waste processing rates.

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• Technological advancements, public-private partnerships, and awareness campaigns play a critical role in enhancing waste management.
• National Indicator Framework:
• The National Indicator Framework is India's mechanism to track progress against the SDGs.
• It includes indicators specific to waste management, recycling, and sustainable urban development.
• The framework helps policymakers assess the effectiveness of programs and initiatives aimed at achieving sustainability targets.
• Waste Processing Technologies:
• Modern waste processing includes methods like composting, recycling, waste-to-energy conversion, and landfill gas recovery.
• India has been investing in integrated waste management systems to achieve higher efficiency in processing waste.
• Waste-to-energy plants convert non-recyclable waste into electricity, contributing to both waste reduction and energy generation.

Important Points

• Swachh Bharat Mission: Launched in 2014, this initiative aims at achieving universal sanitation and a garbage-free India.
• Extended Producer Responsibility (EPR): Indian policies mandate producers to manage post-consumer waste, especially for plastics and electronics.
• Waste-to-Energy (WTE): India has set up several WTE plants to process municipal solid waste and generate energy.
• Challenges: Despite progress, challenges like informal recycling, lack of infrastructure, and low public awareness persist.

Q99. Answer: (b) 17th

The correct answer is 17th edition.

Key Points

• Nomadic Elephant is a bilateral military exercise conducted between India and Mongolia to enhance defense cooperation and strengthen mutual relations.
• The 17th edition of this joint military exercise was held from 31 May to 13 June 2025 in Ulaanbaatar, Mongolia.
• The exercise focuses on counter-terrorism operations and promotes interoperability between the armed forces of both nations.
• Participating troops engage in drills for combat readiness, including training in operating under challenging environments and exchanging best practices.
• The exercise is part of India’s efforts to strengthen ties with Mongolia as part of its "Act East Policy", emphasizing strategic partnerships in the Asia-Pacific region.

Additional Information

• Mongolia-India Relations:
• Mongolia and India share historical ties dating back to the spread of Buddhism from India to Mongolia.
• India refers to Mongolia as its "spiritual neighbor" and has strengthened cooperation in areas like defense, trade, and cultural exchanges.
• Defense Cooperation:
• India provides defense training and equipment to Mongolia under bilateral agreements.
• Joint exercises like "Nomadic Elephant" focus on enhancing capabilities for peacekeeping operations, disaster management, and counter-terrorism.
• Act East Policy:
• India’s Act East Policy aims to establish closer relations with Southeast and East Asian countries.
• Strengthening ties with Mongolia aligns with India's strategic interests in the region.
• History of Nomadic Elephant:
• The first edition of Nomadic Elephant was conducted in 2004 as part of defense cooperation.
• It has evolved over the years into a significant platform for military collaboration between the two nations.

Important Points

• Strategic Importance:
• Mongolia is strategically located between Russia and China, making it significant for regional geopolitics.
• India's engagement with Mongolia reflects its broader strategy of enhancing ties with countries in the Asia-Pacific region.
• International Cooperation:
• Nomadic Elephant is part of India’s broader commitment to global peace and stability through international military collaboration.
• Training Aspects:
• Troops participating in Nomadic Elephant undergo training in areas like urban warfare, reconnaissance, and operating in diverse terrains.

Q100. Answer: (d) 3539.59 LMT

The correct answer is 3539.59 LMT.

Key Points

• According to the Ministry of Agriculture and Farmers Welfare, the third advance estimates for the year 2024-25 forecast India's total food grain production to be 3539.59 LMT (Lakh Metric Tonnes).

• This estimate includes the production of major food grains such as rice, wheat, pulses, and coarse cereals.

• The increase in food grain production is attributed to the implementation of advanced agricultural practices, favorable weather conditions, and government initiatives like PM Kisan Samman Nidhi, and subsidies on fertilizers and seeds.

• Rice and wheat continue to be the leading contributors to the total production, reflecting India's agricultural focus on these staple crops.

• The projection highlights India’s effort toward achieving self-sufficiency in food production, ensuring food security for its growing population.

Additional Information

• Breakdown of Food Grain Production Estimates:

• Rice: Estimated production is around 1300 LMT, making it the most cultivated crop in India.

• Wheat: Accounts for a production of approximately 1120 LMT, majorly grown in states like Punjab, Haryana, and Uttar Pradesh.

• Pulses: Estimated at 270 LMT, with significant production from Madhya Pradesh and Maharashtra.

• Coarse cereals: Includes crops like maize and barley, with a projected output of 849 LMT.

• Government Initiatives Supporting Agriculture:

• Pradhan Mantri Fasal Bima Yojana (PMFBY): Provides crop insurance to farmers to safeguard against natural calamities.

• Pradhan Mantri Krishi Sinchayee Yojana (PMKSY): Aims to improve irrigation coverage and water use efficiency.

• Soil Health Card Scheme: Helps farmers understand the nutrient status of their soil and improve crop productivity.

• Factors Contributing to Increased Production:

• Technological Advancements: Adoption of hybrid seeds, mechanized farming, and precision agriculture.

• Favorable Monsoon: Consistent rainfall in key agricultural regions supported higher yields.

• Government Subsidies: Subsidized fertilizers, seeds, and power supply for irrigation contributed significantly.

• Global Context: India continues to be a major producer of cereals and pulses, contributing significantly to global food security. India ranks among the top producers of rice, wheat, and pulses globally.

Important Points

• India's Agricultural Dependency: Nearly 58% of the Indian population relies on agriculture as its primary source of livelihood.

• Significance of Food Grain Estimates: These estimates help policymakers plan for procurement, storage, and distribution, ensuring food security and price stability.

• Challenges: Despite the rise in production, challenges like water scarcity, land degradation, and climate change pose long-term risks to agricultural sustainability.

• Future Outlook: Efforts are underway to promote sustainable practices such as organic farming and climate-resilient agriculture to ensure continued growth in the sector.

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