RRB Group D Official Paper (Held On: 09 Jan, 2026 Shift 1) (Previous Year Paper)

RRB Group D • 2026 • 100 questions • 90 minutes • Answer key and solutions

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GENERAL SCIENCE

Q1. Match Column A with Column B.

Column A	Column B
A. Acids	1. Produce OH^- ions in water
B. Bases	2. Produce H^+ (or H3O^+) ions in water
C. Acid + Base	3. Form salt and water (neutralisation)
D. Both conduct electricity	4. Due to presence of ions in solution

(a) A-3; B-4; C-1; D-2
(b) A-4; B-3; C-2; D-1
(c) A-2; B-1; C-4; D-3
(d) A-2; B-1; C-3; D-4

Q2. Which of the following statements about momentum is true?

(a) Momentum has both magnitude and direction.
(b) The SI unit of momentum is kilogram per second.
(c) Momentum is the sum of mass and velocity.
(d) Momentum has magnitude only and no direction.

Q3. Which of the following best explains the origin of coal and petroleum?

(a) Compaction of forest wood under sunlight
(b) Decomposition of volcanic rocks under high pressure
(c) Crystallisation of minerals under the seabed
(d) Fossilisation of plants and animals under high temperature and pressure over millions of years

Q4. Which method is used to extract metals such as sodium and aluminium, which are at the top of the reactivity series?

(a) Roasting of their sulphide ores
(b) Calcination of their carbonate ores
(c) Electrolytic reduction of their molten chlorides or oxides
(d) Reduction with carbon

Q5. What does a lens with a power of 1 dioptre indicate?

(a) It has a focal length of 100 m.
(b) It has a focal length of 1 metre.
(c) It has a magnification of 1.
(d) It has a focal length of 1 cm.

Q6. Which of the following is NOT a correct expression for electric power (P)?

(a) $P = V \times I$
(b) $P = I^2 \times R$
(c) $P = I \times R^2$
(d) $P = (V^2)/R$

Q7. The work done by friction on a moving object is usually _____.

(a) negative
(b) zero
(c) positive
(d) both positive and negative

Q8. What is the gap between two neurons called?

(a) Stroma
(b) Synapse
(c) Intermembrane space
(d) Lumen

Q9. The alveoli are surrounded by an extensive network of _____, where the exchange of _____ takes place.

(a) muscles; pressure
(b) nerves; impulses
(c) capillaries; gases
(d) bronchi; air

Q10. Which of the following crosses will produce all heterozygous offspring in the F1 generation?

(a) tt × tt
(b) TT × TT
(c) TT × tt
(d) Tt × Tt

Q11. Why do we see the flash of lightning before we hear the sound of thunder?

(a) Light and sound travel at the same speed
(b) Light travels slower than sound
(c) Sound travels slower than light
(d) Light is brighter than sound

Q12. Which of the following methods is used to separate particles from a suspension?

(a) Crystallization
(b) Filtration
(c) Distillation
(d) Evaporation

Q13. When an object is placed in a fluid, it feels an upward force called buoyancy. On which factor does the magnitude of this buoyant force depend?

(a) The density of the fluid
(b) The weight of the object only
(c) The colour of the object
(d) The shape of the object

Q14. The Law of Constant Proportions applies to the:

(a) Pure chemical compounds
(b) Elements
(c) Both mixtures and compounds
(d) Mixtures of substances

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Q15. Which phenomenon shows the role of the cell wall in osmosis?

(a) Exchange of gases through stomata of leaves
(b) Diffusion of gases through cell membrane
(c) Absorption of light by chlorophyll during photosynthesis
(d) Plasmolysis observed when living plant cells lose water

Q16. A food chain starts from grass → grasshopper → frog → snake → hawk. How much concentration of non-biodegradable pesticides is expected in hawk?

(a) The lowest amount of pesticide residue
(b) No pesticide residue at all
(c) The highest concentration of pesticides
(d) Equal concentration of pesticide as in the frog

Q17. A current I ampere flows through a metallic wire of resistance X Ω when a potential difference V volt is applied across its ends. Which of the following is the correct relation between X, I and V ?

(a) X = V/I
(b) X = I + V
(c) X = I – V
(d) X = I/V

Q18. A rainbow is formed in the sky after rain, which is due to _____.

(a) refraction and dispersion of light by raindrops
(b) scattering of light by air
(c) absorption of light by water
(d) reflection only

Q19. The forces of attraction between particles are _____ in solids, _____ in liquids, and _____ in gases.

(a) maximum, intermediate, minimum
(b) maximum, minimum, intermediate
(c) maximum, intermediate, maximum
(d) maximum, minimum, minimum

Q20. Select the option that is true regarding the following two statements labelled Assertion (A) and Reason (R).

Assertion (A): Sexual reproduction is essential in plants for maintaining the continuity of the species for many generations.

Reason (R): Sexual reproduction leads to genetic variation that enhances adaptability and evolutionary fitness.

(a) Assertion (A) is true, but Reason (R) is false.
(b) Both Assertion (A) and Reason (R) are true, and (R) is the correct explanation of Assertion (A).
(c) Assertion (A) is false, but Reason (R) is true.
(d) Both Assertion (A) and Reason (R) are true but (R) is NOT the correct explanation of Assertion (A).

Q21. Which of the following statements about average speed is INCORRECT?

(a) It is total distance divided by total time.
(b) It is measured in m/s.
(c) It does not depend on the direction of motion.
(d) It is change in distance divided by change in velocity.

Q22. Which alcohol is commonly used as fuel?

(a) Butanol
(b) Ethanol
(c) Methanol
(d) Propanol

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Q23. Which part of a flower encloses and shields the developing bud?

(a) Pistil
(b) Sepal
(c) Stamen
(d) Petal

Q24. Select the correct example of a functional group that DOES NOT represent any double bond in their structure.

(a) Propanone
(b) Propanol
(c) Propanal
(d) Propanoic acid

Q25. Plastids are absent in which of the following cells?

(a) Leaf cells
(b) Muscle cells
(c) Stem cells
(d) Root cells

MATHEMATICS

Q26. If 602 bananas were distributed among three monkeys in the ratio 1/2 : 1/3 : 1/6, how many bananas did the first monkey get?

(a) 271
(b) 281
(c) 311
(d) 301

Q27. Dileep has some hens and some goats. If the total number of animal heads is 33 and the total number of animal feet is 82, how many goats does Dileep have?

(a) 5
(b) 8
(c) 6
(d) 7

Q28. If $a+b+c=14$, $ab+bc+ca=47$ and $abc=15$, then the value of $a^3+b^3+c^3$ is:

(a) 851
(b) 802
(c) 859
(d) 815

Q29. Find the number of all possible distinct pairs of two coprime integers such that their product is 180.

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

Q30. Successive discounts of 16% and 7% are equivalent to a single discount of:

(a) 21.88%
(b) 20.45%
(c) 25.42%
(d) 20.42%

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Q31. In a quadrilateral WXYZ, angle W = 74° and angle X = 58°. The bisectors of angle Y and angle Z meet at O. What is the measure of angle ZOY?

(a) 68°
(b) 60°
(c) 66°
(d) 59°

Q32. If 80% of 50% of 3over8 of a number is 537. Find the number.

(a) 3580
(b) 5640
(c) 5610
(d) 5110

Q33. If the mode of the given data is 22.75, find the cumulative frequency (x<9).

Class Interval	0-7	7-14	14-21	21-28	28-35	35-42
Frequency	1	7	9	11	X	3

(a) 42
(b) 50
(c) 28
(d) 36

Q34. A retailer offers the following discount schemes for buyers on an article. Which scheme will be the LEAST beneficial to the customer?

i. A discount of 37%.
ii. A discount of 33% followed by a discount of 43%.
iii. Successive discounts of 46% and 22%.

(a) Scheme i
(b) Scheme i and Scheme iii
(c) Scheme ii
(d) Scheme iii

Q35. Two banks, A and B, offered loans at 3.5% and 7% per annum, respectively. Salil borrowed an amount of Rs. 4,80,000 from each bank. Find the positive difference (in Rs.) between the amounts of simple interest paid to the two banks by Salil after 4 years.

(a) 66,700
(b) 68,700
(c) 67,200
(d) 68,200

Q36. The average speed of a car running at 70 km/hr for 1 hour and ‘p’ km/hr for 1 1/2 hours is 55 km/hr. Find the value of p (in km/hr).

(a) 57.5
(b) 65
(c) 62.5
(d) 45

Q37. IF cot θ =14/3, then what is the value of cos θ? (0° < θ < 90°)

(a) 3/√205
(b) 14/√205
(c) 1/7
(d) 3/14

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Q38. The price of fuel decreases by 45%, 60% and 55% in three successive months, but increases by 50% in the fourth month. What is the percentage increase/decrease in the price of fuel in the fourth month as compared to its original price?

(a) Decreases by 80.63%
(b) Decreases by 85.15%
(c) Increases by 91.17%
(d) Increases by 82.11%

Q39. A trader buys some goods for Rs. 200. If the overhead expenses be 10% of the cost price, then at what price should it be sold to earn 25%?

(a) Rs. 285
(b) Rs. 270
(c) Rs. 280
(d) Rs. 275

Q40. In a test, B got 50 marks while A got 75 marks, out of 95 maximum marks. What percentage of A's marks was B's marks? (Round off the answer to two decimal places.)

(a) 66.67%
(b) 150.46%
(c) 78.95%
(d) 95.27%

Q41. Find the ratio between the fourth proportional of 1, 3 and 6 to the mean proportional of 12 and 3.

(a) 3 : 2
(b) 1 : 6
(c) 3 : 1
(d) 2 : 2

Q42. Simplify:

36 - 30 + 300.3 - 0.26

(a) 306
(b) 306.04
(c) 306.3
(d) 305

Q43. P and Q together can fill a cistern with water in 12 hours. If P alone can fill the cistern with water in 14 hours, then in how many hours will Q alone fill one-fourth of the same cistern with water?

(a) 43
(b) 21
(c) 42
(d) 22

Q44. The arithmetic mean of the observations 95, 45, 85, 45, 51, 85, 84, 66 and 47 is:

(a) 69
(b) 67
(c) 71
(d) 59

Q45. Ten years ago, a father was three times as old as his son. Ten years from now, he will be twice as old as his son. What is the son’s present age?

(a) 40 years
(b) 25 years
(c) 30 years
(d) 45 years

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Q46. The sides of a triangle ABC are AB = 5 cm, BC = 6 cm and CA = 7 cm, respectively. Another triangle is formed by joining the mid-points of the sides of the triangle ABC. Find the perimeter of the second triangle in cm.

(a) 15
(b) 12
(c) 18
(d) 9

Q47. Pipe A can fill a cistern in 18 hours, and Pipe B can fill it in 12 hours. However, there is a leakage in the cistern that can empty it in 36 hours. If both pipes and the leakage are active, how long will it take to fill 1/3 rd part of the cistern?

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

Q48. If 2^(3m) × 8 = 2^9 and 3^{2n} × 9 = 3^6, then find the value m/n.

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

Q49. The volume (in m^3) of a cuboidal tank with dimensions 34 m × 10 m × 26 m is:

(a) 8886
(b) 8868
(c) 8840
(d) 8835

Q50. A cyclist travels 60 km to a town at a speed of 12 km/hr. Find the time taken by the cyclist.

(a) 4 hours
(b) 5.5 hours
(c) 5 hours
(d) 4.5 hours

GENERAL INTELLIGENCE & REASONING

Q51. All 62 people are standing in a row facing north. Shlok is 20^(th) from the right end, while Biplov is 45^(th) from the left end. How many people are there between Shlok and Biplov?

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

Q52. Town G is to the north of Town F. Town H is to the east of Town F. Town I is to the north of Town H. Town J is to the east of Town I. Town K is to the east of Town J. What is the position of Town K with respect to Town F?

(a) Southeast
(b) North
(c) Northeast
(d) South

Q53. Nishant starts from point A and drives 45 km towards the north. He then takes a right turn, drives 44 km, turns right and drives 60 km. He then takes a right turn and drives 56 km. He takes a final right turn, drives 15 km and stops at point P. How far (shortest distance) and towards which direction should he drive in order to reach point A again? (All turns are 90-degree turns only unless specified.)

(a) 13 km to the north
(b) 11 km to the west
(c) 12 km to the east

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(d) 10 km to the east

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

(Left) 7 7 & & # 3 3 # 9 1 4 € 4 # # 7 £ $ 4 © 9 6 (Right)

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

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

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

157 134 111 88 65 ?

(a) 46
(b) 42
(c) 40
(d) 44

Q56. Six people P, Q, R, S, T and U are sitting around a circular table facing towards the centre of the table.

Exactly two people sit between S and T.

U sits to the immediate left of T.

R is immediate neighbour of S and Q both.

Who is an immediate neighbour of both S and U?

(a) T
(b) P
(c) Q
(d) R

Q57. Select the triad which follows the same pattern as that followed by the two triads given below. Both triads follow the same pattern.

FO-HQ-KM

HQ-JS-MO

(a) JS-LU-OR
(b) IS-LV-OR
(c) IS-LU-OR
(d) JS-LU-OQ

Q58. Seven friends, L, M, N, O, Q, R and S, are sitting in a straight line, facing north. Only three people sit between L and O. No one sits to the right of N. Only one person sits between N and O. M is an immediate neighbour of both Q and L. R sits to the immediate left of O. How many people sit between S and L?

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

Q59. If 2 is added to each odd digit and 3 is subtracted from each even digit in the number 5718436, then what will be the difference between the greatest and smallest digit in the new number thus formed?

(a) 9
(b) 6
(c) 7
(d) 8

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Q60. In a certain code language, ‘how are you’ is coded as ‘pl mk jt’ and ‘where you are’ is coded as ‘jt mk sq’. How is ‘where' coded in that language?

(a) sq
(b) jt
(c) pl
(d) mk

Q61. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

NEU RHW VKY ZNA ?

(a) CRB
(b) CQD
(c) EPD
(d) DQC

Q62. What will come in place of the question mark (?) in the following equation, if ‘+’ and ‘–’ are interchanged and ‘×’ and ‘÷’ are interchanged?

59 – 72 × 8 + (64 ÷ 4) × 8 – 16 ÷ 3 = ?

(a) 110
(b) 68
(c) 96
(d) 84

Q63. If 1 is added to each even digit and 1 is added to each odd digit in the number 612374, what will be the sum of all the odd digits in the new number thus formed?

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

Q64. In a certain code language,

‘A + B’ means ‘A is the mother of B’,

‘A – B’ means ‘A is the brother of B’,

‘A × B’ means ‘A is the wife of B’,

‘A % B’ means ‘A is the father of B’ and

‘A # B’ means ‘A is the daughter of B’.

How is K related to G if ‘G # E # C + K # P’?

(a) Sister’s daughter
(b) Mother’s father
(c) Mother’s mother
(d) Mother’s sister

Q65. Six people, A, B, C, D, E and F, are sitting in a row, facing north. D sits to the immediate left of F. C sits third to the left of B. F is an immediate neighbour of C. E sits second to the right of C. A sits to the immediate left of E. Who sits at the extreme right end of the line?

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

Q66. In a certain code language, ‘rat able run’ is coded as ' ei bm wx' and ‘cap rat ant’ is coded as ‘bm iy ve’. How is ‘rat’ coded in the given language?

(a) bm
(b) iy
(c) ei

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(d) wx

Q67. What should come in place of the question mark (?) in the given series?

3 9 ? 81 243 729

(a) 27
(b) 26
(c) 25
(d) 28

Q68. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(8, 25, 16)

(13, 35, 26)

(a) (9, 9, 18)
(b) (7, 23, 32)
(c) (17, 43, 52)
(d) (15, 39, 30)

Q69. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

Some watches are figs.

All ships are kings.

No figs are ships.

Conclusions:

(I): Some kings are not figs.

(II): Some watches are ships.

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

Q70. This question is based on the five, three-digit numbers given below.

(Left) 687 652 691 287 286 (Right)

(Example: 697 – First digit = 6, second digit = 9 and third digit = 7)

(NOTE: All operations to be done from left to right.)

What will be the resultant if the second digit of the highest number is added to the third digit of the lowest number?

(a) 16
(b) 19
(c) 17
(d) 15

Q71. NETI is related to XODS in a certain way based on the English alphabetical order. In the same way, BSHW is related to LCRG. To which of the following options is FWLA related, following the same logic?

(a) PGBN
(b) PGVK
(c) PKLO
(d) PVHY

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Q72. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only).

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

How many such odd numbers are there (from left to right), each of which is immediately preceded by an odd number and also immediately followed by an even number?

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

Q73. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which is the letter-cluster pair that DOES NOT belong to that group?

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

(a) DG−HK
(b) GJ−KN
(c) TW−XA
(d) HK−KQ

Q74. Seven boxes, D, E, F, U, V, W and X, are kept one over the other but not necessarily in the same order. Only U is kept above D. Only V is kept between D and F. No box is kept below E. Only three boxes are kept between D and W. How many boxes are kept between X and E?

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

Q75. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

HO22 JQ31 LS40 NU49 ?

(a) PW58
(b) PX59
(c) PW59
(d) PX58

Q76. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which is the letter-cluster pair that DOES NOT belong to that group?

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

(a) TO - NI
(b) UP - OI
(c) VQ - PK
(d) QL - KF

Q77. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusion(s) logically follow(s) from the statements.

Statements:

Some rails are cars.

No car is a bus.

Conclusions:

(I) Some rails are bus.

(II) Some cars are rails.

(a) Only conclusion (I) follows.
(b) Only conclusion (II) follows.
(c) Both conclusions (I) and (II) follow.

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(d) Neither conclusion (I) nor (II) follows.

Q78. IB 16 is related to ME 13 in a certain way. In the same way, OH 25 is related to SK 22. To which of the following is UN 28 related, following the same logic?

(a) ZP 26
(b) ZP 25
(c) YQ 25
(d) YQ 26

Q79. Refer to the following number series and answer the question that follows. Counting to be done from left to right only. (All numbers are single-digit numbers only.)

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

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

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

Q80. What should come in place of the question mark (?) in the given series?

8 12 21 37 ? 98

(a) 66
(b) 68
(c) 65
(d) 62

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. In which month was the Economic Survey 2024–25 presented?

(a) January 2025
(b) March 2025
(c) April 2025
(d) February 2025

Q82. Which of the following was rated as 'Good' by the International Union for Conservation of Nature (IUCN) in its global review of Natural World Heritage Sites in November 2025?

(a) Nanda Devi and Valley of Flowers National Parks
(b) Sundarbans National Park
(c) Khangchendzonga National Park
(d) Great Himalayan National Park Conservation Area

Q83. Which of the following states has become the third state in India to achieve 'Full Functional Literacy' under the ULLAS scheme, in June 2025?

(a) Mizoram
(b) Tripura
(c) Kerala
(d) Goa

Q84. Which individual, celebrated as India's first Paralympic gold medalist, was honoured with the Arjuna Lifetime Achievement Award in January 2025?

(a) Mariyappan Thangavelu
(b) Murlikant Petkar
(c) Devendra Jhajharia
(d) Deepa Malik

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Q85. International Women's Day, a global day celebrating the social, economic, cultural and political achievements of women, is celebrated on which of the following dates?

(a) 16 June
(b) 8 March
(c) 20 November
(d) 21 September

Q86. Who was appointed as the Chairman of the Economic Advisory Council to the PM in June 2025?

(a) Poonam Gupta
(b) Mahendra Dev
(c) Arvind Subramanian
(d) Vijay Kelkar

Q87. What was the cause of the warehouse explosion in Gujarat in April 2025?

(a) Short circuit from power gird
(b) Gas leak
(c) Chemical fire
(d) Aluminium powder explosion

Q88. Which of the following sports is NOT represented among the 2025 Laureus individual award winners?

(a) Tennis
(b) Cricket
(c) Surfing
(d) Gymnastics

Q89. Which of these ISRO-led national initiatives, launched in July 2025, exemplifies international scientific collaboration while strengthening India's Earth-observation and monitoring capabilities?

(a) GSAT-12
(b) Gaganyaan
(c) Aditya-L2
(d) NISAR

Q90. Which of the following legislations was approved by the Rajya Sabha on 12 August 2025, aiming to recognise national sports organisations and oversee their operations?

(a) National Sports Governance Bill, 2025
(b) Sports Regulation and Management Bill, 2025
(c) National Sports Promotion Bill, 2025
(d) Olympic and Sports Administration Bill, 2025

Q91. The Constitution (One Hundred and Thirtieth Amendment) Bill introduced in the Lok Sabha on 20 August 2025 allows the removal of a Central or State Minister if detained for how many consecutive days on corruption or serious charges?

(a) 15 days
(b) 20 days
(c) 45 days
(d) 30 days

Q92. Who was the Guest of Honour at the 18^(th) Pravasi Bharatiya Convention held in Bhubaneswar on 8 January 2025?

(a) Meenakshi Lekhi
(b) H E Pravind Jugnauth
(c) Sundar Pichai
(d) Dr Dev Pragad

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Q93. According to a June 2025 news update, on which date is Dan Brown's new Robert Langdon thriller The Secret of Secrets scheduled for publication?

(a) 18 November 2025
(b) 25 March 2025
(c) 13 May 2025
(d) 9 September 2025

Q94. How many Padma Vibhushan awards were given in 2025?

(a) 7
(b) 10
(c) 12
(d) 5

Q95. Who defeated Tanushree Pandey in the final of the World Soft Tennis Championship, 2024, held at Jingshan, China, in November 2024?

(a) Yuki Tanaka
(b) Chiang Min Yu
(c) Kim Soo Jin
(d) Liu Wei

Q96. In 2025, under which project did Guntur, Andhra Pradesh, deploy over 200 electric autos for door-to-door garbage collection?

(a) Sustainable Cities Integrated Pilot Approach
(b) Smart Cities Mission
(c) National Urban Livelihoods Mission
(d) Clean Cities Mission

Q97. Which of the following states launched Artificial Intelligence powered cybercrime protection for women and children in June 2025?

(a) Gujarat
(b) Odisha
(c) Maharashtra
(d) Kerala

Q98. Against which team did Australia set the highest successful chase of 356/5 in the 2025 Champions Trophy?

(a) England
(b) South Africa
(c) Afganistan
(d) India

Q99. According to the data compiled by the Tea Board of India and reported in March 2025, which country did India surpass to become the second-largest tea exporter in 2024?

(a) Kenya
(b) China
(c) Vietnam
(d) Sri Lanka

Q100. According to the Finland-based Centre for Research on Energy and Clean Air (CREA), which city in India recorded the highest pollution levels in October 2025, with a monthly PM2.5 average of 123 μ g/m^3 ?

(a) Gurugram
(b) Noida
(c) Dharuhera
(d) Delhi

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ANSWER KEY

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

SOLUTIONS

Q1. Answer: (d) A-2; B-1; C-3; D-4

The correct answer is A-2; B-1; C-3; D-4.

Key Points

• Acids and Hydrogen Ions (A-2): According to the Arrhenius theory, an acid is a substance that dissociates in water to yield hydrogen ions (H+). Since H+ ions cannot exist alone, they combine with water molecules to form hydronium ions (H3O+). Hence, A matches with 2 is correct.

• Bases and Hydroxide Ions (B-1): A base is defined as a substance that, when dissolved in water, increases the concentration of hydroxide ions (OH-). Bases that are soluble in water are specifically called alkalis. Hence, B matches with 1 is correct.

• Neutralization Reaction (C-3): When an acid reacts with a base, the H+ ions of the acid react with the OH- ions of the base to form water (H2O) and a salt. This chemical reaction is known as Neutralization and is typically exothermic in nature. Hence, C matches with 3 is correct.

• Electrical Conductivity (D-4): Both acids and bases in their aqueous solutions are capable of conducting electricity. This conductivity is attributed to the presence of free ions (cations and anions) in the solution, which act as charge carriers. Pure distilled water does not conduct electricity, but the addition of an acid or base provides the necessary electrolytes. Hence, D matches with 4 is correct.

• Hence, the correct answer is A-2; B-1; C-3; D-4.

Additional Information

• Characteristics of Acids:

• Acids have a sour taste and turn blue litmus paper red.

• They have a pH value of less than 7 on the pH scale.

• Common examples include Hydrochloric acid (HCl), Sulphuric acid (H2SO4), and Citric acid found in lemons.

• Strong acids like HCl ionize completely in water, while weak acids like acetic acid (vinegar) ionize only partially.

• Characteristics of Bases:

• Bases have a bitter taste and a soapy or slippery feel to the touch.

• They turn red litmus paper blue and have a pH value of greater than 7.

• Common examples include Sodium hydroxide (NaOH), Calcium hydroxide (Ca(OH)2), and Potassium hydroxide (KOH).

• Bases are used extensively in the manufacture of soaps, detergents, and antacids.

• The pH Scale:

• The pH scale was introduced by S.P.L. Sorensen in 1909 to measure the acidity or alkalinity of a solution.

• The scale ranges from 0 to 14, where 7 is neutral (the pH of pure water).

• A lower pH signifies a higher concentration of hydrogen ions, making the solution more acidic.

Important Points

• Indicators: Substances like Phenolphthalein and Methyl Orange are used to test for acids and bases. Phenolphthalein remains colorless in acid but turns pink in basic solutions.

• Universal Indicator: This is a mixture of several indicators that shows different colors at different concentrations of hydrogen ions

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in a solution, helping determine the approximate pH value.

• Strength of Solutions: The strength of an acid or base depends on the number of H+ ions or OH- ions produced, respectively. For instance, 1 Molar HCl is a stronger acid than 1 Molar CH3COOH because it produces more H+ ions.

Q2. Answer: (a) Momentum has both magnitude and direction.

The correct answer is Momentum has both magnitude and direction.

Key Points

• Momentum is a fundamental concept in physics, defined as the product of an object's mass and its velocity. It is typically represented by the symbol p.

• Statement 1: Momentum is a vector quantity. By definition, a vector quantity is one that has both a magnitude (how much) and a direction (where it is going). The direction of the momentum vector is the same as the direction of the velocity vector. Hence, statement 1 is correct.

• Statement 2: The Standard International (SI) unit of momentum is the kilogram-meter per second, written as kg·m/s. The statement claims the unit is kilogram per second, which is incorrect as it lacks the meter (distance) component required for velocity. Hence, statement 2 is incorrect.

• Statement 3: Mathematically, momentum is calculated as p = m × v, where m is mass and v is velocity. It is the product of these two variables, not the sum. Hence, statement 3 is incorrect.

• Statement 4: Since momentum is derived from velocity (which is a vector), it must have a direction. Only scalar quantities, such as speed or mass, have magnitude only. Hence, statement 4 is incorrect.

Additional Information

• Conservation of Momentum: This is a major law of physics stating that the total momentum of an isolated system remains constant if no external forces act on it. This principle is vital in analyzing collisions and explosions.

• Newton's Second Law of Motion: Sir Isaac Newton originally defined his second law in terms of momentum. He stated that the force (F) acting on an object is equal to the rate of change of momentum (dp/dt) over time.

• Impulse: The change in momentum is known as impulse. It is the product of the average force and the time interval during which it acts. The units for impulse are Newton-seconds (N·s), which are equivalent to kg·m/s.

• Relativistic Momentum: In Einstein’s theory of special relativity, as an object's speed approaches the speed of light, its momentum increases more rapidly than its velocity, requiring a modified formula that includes the Lorentz factor.

Important Points

• Dimensional Formula: The dimensional representation of momentum is [MLT^-¹], where M is Mass, L is Length, and T is Time.

• Mass vs. Velocity Influence: A very heavy object (like a ship) moving slowly can have the same momentum as a light object (like a bullet) moving very fast.

• Practical Application: Safety features in vehicles, such as airbags and crumple zones, are designed to increase the time it takes for momentum to change during a crash, thereby reducing the impact force on the passengers.

• CGS Unit: In the Centimetre-Gram-Second system, the unit of momentum is the gram-centimetre per second (g·cm/s).

Q3. Answer: (d) Fossilisation of plants and animals under high temperature and pressure over millions of years

The correct answer is Fossilisation of plants and animals under high temperature and pressure over millions of years.

Key Points

• Fossil fuels like coal and petroleum are formed through the biological and chemical transformation of ancient organic matter.

• Coal primarily originates from the remains of terrestrial plants and trees that grew in vast swampy forests approximately 300 to 360 million years ago during the Carboniferous Period. When these plants died, they were buried under layers of water and dirt, preventing full decay. Hence, statement 4 is the most accurate explanation.

• Petroleum (crude oil) and natural gas are derived from the remains of microscopic marine organisms, such as plankton and algae. These organisms settled on the ocean floor and were covered by sediments like silt and mud.

• The transformation process requires anaerobic conditions (absence of oxygen), which ensures that the organic matter does not rot completely but undergoes slow chemical changes.

• Over millions of years, the weight of the accumulating sediment layers creates high pressure and generates high temperature from the Earth's interior, which eventually converts the buried organic debris into hydrocarbons.

Additional Information

• Classification of Coal: Based on the degree of compression and carbon content, coal is divided into four main types: Peat (lowest carbon), Lignite (brown coal), Bituminous (most common), and Anthracite (hardest coal with over 85% carbon).

• Petroleum Refining: Crude oil extracted from the ground is a mixture of various hydrocarbons. It is processed in refineries using fractional distillation to produce petrol, diesel, kerosene, asphalt, and liquefied petroleum gas (LPG).

• Non-Renewable Resources: Because the formation of these fuels takes millions of years, they are classified as non-renewable energy sources. Their current rate of consumption far exceeds the rate of natural replenishment.

• Environmental Impact: The combustion of fossil fuels releases carbon dioxide (CO_2), sulfur dioxide, and nitrogen oxides, which contribute to the greenhouse effect and global warming.

Important Points

• Carbonisation: The slow chemical process of conversion of dead vegetation into coal is specifically known as carbonisation. This happens under conditions of extreme pressure and lack of air.

• Oil Windows: Petroleum formation typically occurs within a specific temperature range called the "oil window" (usually 50°C to 150°C). If the temperature is higher, the organic matter is further broken down into natural gas (methane).

• Geological Traps: Petroleum is often found trapped in porous reservoir rocks (like sandstone or limestone) situated beneath an impermeable cap rock (like shale or salt) that prevents the oil from escaping to the surface.

Q4. Answer: (c) Electrolytic reduction of their molten chlorides or oxides

The correct answer is Electrolytic reduction of their molten chlorides or oxides.

Key Points

• Metals located at the top of the reactivity series, such as Sodium (Na), Magnesium (Mg), Calcium (Ca), and Aluminium (Al), are highly reactive and never found in nature as free elements.

• These metals cannot be reduced by carbon or carbon monoxide because they have a much higher affinity for oxygen than carbon does. Consequently, carbon cannot pull oxygen away from these metal oxides. Hence, statement 4 is incorrect.

• To extract these highly electropositive metals, the process of electrolytic reduction is employed. This involves passing an electric current through the molten (liquid) state of their chlorides or oxides. Hence, statement 3 is correct.

• During the electrolysis of molten sodium chloride (NaCl), the sodium metal is deposited at the cathode (the negatively charged electrode), while chlorine gas is liberated at the anode (the positively charged electrode).

• In the case of Aluminium, it is extracted from its molten oxide (Alumina - Al_2O_3) using the Hall-Héroult process, where cryolite is often added to lower the melting point and increase conductivity.

Additional Information

• Roasting:

• This is the process of heating sulphide ores strongly in the presence of excess air to convert them into metal oxides.

• It is typically used for metals of medium reactivity like Zinc (Zn) and Mercury (Hg). For example, Cinnabar (HgS) is roasted to obtain mercury. Hence, statement 1 is incorrect in this context.

• Calcination:

• This involves heating carbonate ores strongly in the absence or limited supply of air to turn them into oxides.

• An example is the calcination of Zinc Carbonate ($ZnCO_3$) to produce Zinc Oxide (ZnO). This method is used for ores found as carbonates in the middle of the reactivity series. Hence, statement 2 is incorrect in this context.

• Reduction with Carbon:

• Metals of moderate reactivity, such as Iron (Fe), Zinc (Zn), Lead (Pb), and Tin (Sn), are extracted by reducing their oxides with coke (carbon) in a furnace.

• In a Blast Furnace, Haematite (Fe_2O_3) is reduced by carbon/carbon monoxide to produce molten iron.

• Reactivity Series Overview:

• High Reactivity (K, Na, Ca, Mg, Al): Extracted by Electrolysis.

• Medium Reactivity (Zn, Fe, Pb, Cu): Extracted by Reduction using Carbon after roasting/calcination.

• Low Reactivity (Ag, Au): Found in native/free state; Mercury (Hg) is extracted by simple heating of its ore.

Important Points

• The Reactivity Series is an arrangement of metals in descending order of their chemical reactivity. Potassium (K) is at the top, while Gold (Au) is at the bottom.

• Electrolytic refining is a different process used for purifying impure metals like Copper (Cu) and Gold (Au) after they have been extracted by other chemical methods.

• For Aluminium extraction, the molten mixture of Alumina and Cryolite (Na_3AlF_6) is electrolyzed at approximately 950°C to 1000°C.

• The choice of extraction method is purely determined by the position of the metal in the activity series and the chemical nature of its ore.

Q5. Answer: (b) It has a focal length of 1 metre.

The correct answer is It has a focal length of 1 metre..

Key Points

• The power of a lens is defined as the ability of a lens to converge or diverge light rays. Mathematically, it is the reciprocal of its focal length.

• The SI unit of power of a lens is the dioptre, which is denoted by the symbol D.

• The relationship between power (P) and focal length (f) is given by the formula P = 1/f, where the focal length must be measured in metres.

• By definition, 1 dioptre is the power of a lens whose focal length is 1 metre (1 D = 1 m^-¹). Hence, the statement in the question indicates a focal length of 1 metre. Hence, the correct answer is option 2.

• The power of a lens is positive for a converging (convex) lens and negative for a diverging (concave) lens.

Additional Information

• Focal Length (f):

• It is the distance between the optical centre of the lens and the principal focus.

• If the focal length is given in centimetres, the power formula is modified to P = 100/f (in cm). For example, a lens with a focal length of 25 cm has a power of +4 D.

• Sign Convention and Lens Types:

• A convex lens has a real focus and thus a positive focal length, leading to a positive power.

• A concave lens has a virtual focus and a negative focal length, resulting in a negative power.

• Power of a Combination of Lenses:

• When two or more thin lenses are placed in contact, the total power (P) of the system is the algebraic sum of the individual powers: P = P1 + P2 + P3 + ...

• This principle is used by optometrists to design corrective spectacles and by engineers in telescopes and microscope objectives.

• Magnification (m):

• Unlike power, magnification is the ratio of the height of the image to the height of the object (m = h'/h) or the ratio of image distance to object distance (m = v/u).

• It is a unitless quantity, whereas power has the unit of m^-¹ or dioptre.

Important Points

• Corrective Lenses: A person suffering from Myopia (nearsightedness) is prescribed a lens with negative power (concave), while someone with Hypermetropia (farsightedness) requires a lens with positive power (convex).

• Optical Instruments: The use of dioptre helps in the standardized manufacturing of eye-glasses and contact lenses globally. The least distance of distinct vision for a normal human eye is approximately 25 cm.

• Refractive Index: The power of a lens also depends on the refractive index of the material it is made of and the radii of curvature of its surfaces, as described by the Lens Maker's Formula.

Q6. Answer: (c) $P = I \times R^2$

The correct answer is $P = I \times R^2$.

Key Points

• Electric Power (P) is defined as the rate at which electrical energy is consumed or dissipated in an electric circuit. It is the rate of doing work.

• The fundamental expression for Electric Power is the product of Potential Difference (V) and Current (I), represented as $P = V \times I$. Hence, statement 1 is correct.

• According to Ohm's Law, the relationship between voltage, current, and resistance is given by $V = I \times R$. By substituting V in the power formula ($P = VI$), we get $P = (I \times R) \times I$, which results in $P = I^2 \times R$. Hence, statement 2 is correct.

• Using Ohm's Law again, we can express current as $I = V / R$. By substituting I in the fundamental power formula ($P = VI$), we get $P = V \times (V / R)$, which results in $P = V^2 / R$. Hence, statement 4 is correct.

• The expression $P = I \times R^2$ does not follow from any physical derivation of electrical laws and is dimensionally inconsistent with the units of power. Hence, statement 3 is incorrect.

• Therefore, $P = I \times R^2$ is NOT a correct expression for electric power.

Additional Information

• SI Unit of Power: The SI unit of electric power is the Watt (W). It is named after the Scottish inventor James Watt. 1 Watt is defined as the power consumed by a device when 1 Ampere of current flows through it at a potential difference of 1 Volt.

• Ohm's Law: Proposed by Georg Simon Ohm in 1827, it states that the current flowing through a conductor is directly proportional to the voltage across it, provided physical conditions like temperature remain constant ($V = IR$).

• Components of the Formula:

• V stands for Voltage or Potential Difference, measured in Volts (V).

• I stands for Electric Current, measured in Amperes (A).

• R stands for Resistance, measured in Ohms (Ω).

• Commercial Unit of Energy: While the SI unit of energy is the Joule (J), the commercial unit is the Kilowatt-hour (kWh). 1 kWh is the energy consumed by an appliance of 1000 Watts in one hour. Numerically, 1 kWh = 3.6 × 10^6 Joules.

Important Points

• Joule's Law of Heating: This law states that the heat produced in a resistor is directly proportional to the square of the current, the resistance, and the time for which the current flows ($H = I^2Rt$). This is directly related to the power formula $P = I^2R$.

• Power in Series vs. Parallel:

• In a series circuit, the current (I) remains constant. Thus, $P = I^2R$ is more convenient for calculations, showing power is directly proportional to resistance.

• In a parallel circuit, the voltage (V) remains constant. Thus, $P = V^2 / R$ is more convenient, showing power is inversely proportional to resistance.

• Practical Applications: These formulas are used to determine the power rating of household appliances like bulbs, heaters, and irons. For example, a bulb rated 100W, 220V uses these relations to define its operational resistance.

Q7. Answer: (a) negative

The correct answer is negative.

Key Points

• The work done by a force on an object is defined as the product of the component of the force in the direction of the displacement and the magnitude of the displacement.

• Mathematically, work is expressed as $W = F \times d \times \cos\theta$, where F is the force magnitude, d is the displacement, and θ is the angle between the force vector and the displacement vector.

• Friction is a force that resists the relative motion of solid surfaces, fluid layers, and material elements sliding against each other.

• When an object moves on a surface, kinetic friction acts in a direction opposite to the direction of the object's displacement.

• Because the force of friction and the displacement are in opposite directions, the angle θ is 180 degrees.

• Since the cosine of 180 degrees is -1, the resulting value of work is negative. Hence, the correct answer is negative.

Additional Information

• Types of Work:

• Positive Work: Occurs when the force and displacement are in the same direction (angle between 0 and 90 degrees). For example, work done by a person pulling a cart.

• Negative Work: Occurs when the force and displacement are in opposite directions (angle between 90 and 180 degrees). Friction is the most common example.

• Zero Work: Occurs when the force is perpendicular to the displacement (angle is 90 degrees) or if the displacement is zero. For instance, the centripetal force acting on a satellite does zero work because it is perpendicular to the motion.

• Nature of Friction:

• Friction is a non-conservative force, meaning the work done against it depends on the path taken rather than just the initial and final positions.

• The coefficient of friction (represented by the Greek letter μ) is a dimensionless scalar value that describes the ratio of the force of friction between two bodies and the normal force pressing them together.

• In almost all practical mechanical systems, friction converts kinetic energy into thermal energy (heat), leading to energy dissipation.

Important Points

• While work done by friction is usually negative, it can be positive in certain frames of reference or specific scenarios. For example, if a block A is placed on top of block B and block B is accelerated, the friction exerted by B on A causes A to move. In this case, friction does positive work on block A because the force and displacement are in the same direction.

• The S.I. unit of work is the Joule (J), which is equivalent to 1 Newton-meter (N·m).

• The Work-Energy Theorem states that the net work done on an object is equal to the change in its kinetic energy. Since friction usually does negative work, it typically decreases the kinetic energy of a moving object, causing it to slow down.

Q8. Answer: (b) Synapse

The correct answer is Synapse.

Key Points

• A Synapse is a functional junction between two neurons (nerve cells) or between a neuron and an effector organ, such as a muscle or gland.

• The actual physical gap between the membranes of the two communicating neurons is specifically known as the synaptic cleft, which typically measures about 20 to 40 nanometers in width.

• Information is transmitted across this gap through the release of signaling molecules called neurotransmitters, which bridge the distance between the presynaptic and postsynaptic cells.

• The concept of the synapse was first introduced and named by the Nobel Prize-winning physiologist Sir Charles Sherrington in 1897.

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• This structure is vital for the unidirectional flow of nerve impulses, ensuring that signals travel from the axon terminal of one neuron toward the dendrites or cell body of the next.

Additional Information

• Chemical Synapses:

• These are the most common type of synapses in the human nervous system.

• When an electrical impulse (action potential) reaches the end of an axon, it triggers the influx of calcium ions.

• This causes synaptic vesicles to fuse with the membrane and release neurotransmitters like acetylcholine, dopamine, or serotonin into the cleft.

• Electrical Synapses:

• In these synapses, the membranes of the two neurons are very close together, connected by special proteins called gap junctions.

• Electrical current flows directly from one cell to another, making transmission much faster than chemical synapses. They are common in the heart and smooth muscle where synchronized contraction is required.

• Synaptic Plasticity:

• This refers to the ability of synapses to strengthen or weaken over time in response to increases or decreases in their activity.

• It is the fundamental biological basis for learning and memory in the brain.

Important Points

• Stroma: In biology, this term refers to the supportive, connective tissue framework of an organ (like the ovary or kidney) or the fluid-filled space surrounding the thylakoids inside a chloroplast. Hence, option 1 is incorrect.

• Intermembrane space: This is the region between the inner and outer membranes of a double-membrane organelle, such as mitochondria or chloroplasts. It plays a key role in oxidative phosphorylation. Hence, option 3 is incorrect.

• Lumen: This refers to the inside space of a tubular structure or a hollow organ, such as the interior of an artery, the small intestine, or the endoplasmic reticulum. Hence, option 4 is incorrect.

• A single neuron can have anywhere from 1,000 to 10,000 synapses, allowing for a massive network of trillions of connections within the human brain.

Q9. Answer: (c) capillaries; gases

The correct answer is capillaries; gases.

Key Points

• The alveoli are the functional units of the respiratory system where the actual process of gas exchange occurs between the lungs and the blood.

• Each alveolus is wrapped in a dense, mesh-like network of capillaries, which are the smallest and thinnest blood vessels in the human body.

• The primary function of this structural arrangement is to facilitate the exchange of gases, specifically oxygen (O_2) and carbon dioxide (CO_2), through the process of diffusion.

• The walls of both the alveoli and the capillaries are composed of a single layer of epithelial cells, making them extremely thin (about 0.5 micrometers) to allow gases to pass through easily.

• During inhalation, oxygen moves from the alveoli into the capillaries to be carried to the rest of the body, while carbon dioxide moves from the capillaries into the alveoli to be exhaled.

Additional Information

• Surface Area for Gas Exchange: The human lungs contain approximately 300 to 500 million alveoli. If spread out, they would cover a surface area of about 70 to 100 square meters, which is roughly the size of a tennis court.

• Diffusion Gradient: The movement of gases is driven by partial pressure differences. Oxygen pressure is higher in the alveoli than in the deoxygenated blood within the capillaries, causing it to flow inward.

• Role of Hemoglobin: Once oxygen diffuses into the capillaries, it binds to hemoglobin molecules inside red blood cells (RBCs) for transport to various tissues and organs.

• Blood Flow Direction: Deoxygenated blood reaches the capillaries via the pulmonary artery from the right ventricle of the heart, and oxygenated blood returns to the left atrium via the pulmonary vein.

• Respiratory Membrane: The combination of the alveolar wall and the capillary wall is often referred to as the respiratory membrane or the blood-air barrier.

Important Points

• Pulmonary Surfactant: The alveoli are lined with a lipoprotein substance called surfactant, which reduces surface tension and prevents the tiny air sacs from collapsing during exhalation.

• Mechanism of Action: The exchange of gases is a purely passive process, meaning it does not require cellular energy (ATP) to occur.

• Effect of Diseases: Conditions such as emphysema (often caused by smoking) lead to the destruction of alveolar walls, significantly reducing the surface area available for gas exchange and causing shortness of breath.

• Capillary Transit Time: Under normal resting conditions, a red blood cell spends about 0.75 seconds in the pulmonary capillaries, which is more than enough time for oxygen saturation to reach 100%.

Q10. Answer: (c) TT × tt

The correct answer is TT × tt.

Key Points

• A cross between TT (homozygous dominant) and tt (homozygous recessive) results in all offspring having the genotype Tt. This means 100% of the F1 generation will be heterozygous. Hence, statement 3 is correct.

• In the cross tt × tt, both parents are homozygous recessive. They can only pass the t allele to their offspring, resulting in 100% homozygous recessive (tt) individuals. Hence, statement 1 is incorrect.

• In the cross TT × TT, both parents are homozygous dominant. They can only pass the T allele to their offspring, resulting in 100% homozygous dominant (TT) individuals. Hence, statement 2 is incorrect.

• In the cross Tt × Tt, both parents are heterozygous. According to Mendelian genetics, this cross produces a genotypic ratio of 1:2:1 (25% TT, 50% Tt, and 25% tt). Since only 50% are heterozygous, they are not "all" heterozygous. Hence, statement 4 is incorrect.

• This principle was first established by Gregor Mendel in his 1865 experiments with pea plants (Pisum sativum), forming the basis of the Law of Segregation.

Additional Information

• Heterozygous: This refers to an individual having two different alleles for a particular gene, such as Tt. In such cases, the dominant allele (T) typically masks the expression of the recessive allele (t).

• Homozygous: This term describes an organism that has two identical alleles for a trait, which can be either homozygous dominant (TT) or homozygous recessive (tt).

• Genotype and Phenotype: The genotype is the actual genetic makeup (e.g., Tt), while the phenotype is the observable physical characteristic (e.g., Tall height). In an F1 generation of Tt, the phenotype is usually 100% dominant.

• Punnett Square: This is a graphical representation used to calculate the probability of an offspring having a particular genotype. It was devised by Reginald Punnett in 1905.

• Monohybrid Cross: This is a genetic cross between two individuals involving one pair of contrasting characters. The cross of TT × tt is a classic example of a monohybrid cross looking at plant height.

Important Points

• Law of Dominance: Gregor Mendel observed that in the F1 generation, only one of the parental traits (the dominant one) appears. For the cross TT × tt, although the offspring are heterozygous, they all appear Tall.

• Pure-breeding Strains: The organisms TT and tt are considered pure-breeding or true-breeding because when self-pollinated, they always produce offspring with the same trait. Crossing two different true-breeding parents is the only way to ensure 100% heterozygosity in the first generation.

• Numerical Ratios: In the F2 generation (produced by crossing Tt × Tt), the phenotypic ratio is 3:1, while the genotypic ratio is 1:2:1.

Q11. Answer: (c) Sound travels slower than light

The correct answer is Sound travels slower than light.

Key Points

• The fundamental reason we see lightning before hearing thunder is the vast difference in the speed at which light and sound travel through the atmosphere.

• Light travels at an incredible speed of approximately 300,000,000 meters per second (or 3 x 10^8 m/s) in a vacuum and slightly slower in air. This speed is so high that for terrestrial distances, light appears to travel instantaneously.

• Sound, on the other hand, travels much slower, at about 343 meters per second in dry air at a temperature of 20 degrees Celsius (68 degrees Fahrenheit).

• When a lightning strike occurs, both the optical flash and the acoustic shockwave (thunder) are created at the exact same moment. However, because light is nearly 874,000 times faster than sound, the visual information reaches the observer almost immediately, while the sound waves take several seconds to cover the same distance. Hence, the correct answer is Sound travels slower than light.

Additional Information

• Nature of Light:

• Light is an electromagnetic wave that does not require a medium to propagate. It can travel through the vacuum of outer space.

• In the context of a storm, the photons emitted by the electrical discharge of lightning move through the air with minimal resistance to their speed.

• Nature of Sound:

• Sound is a mechanical wave (specifically a longitudinal wave) that requires a medium like air, water, or solids to travel.

• The speed of sound is highly dependent on the density and temperature of the medium. For instance, sound travels faster in water and even faster in solids like steel compared to its speed in air.

• Distance Estimation:

• Observers can estimate the distance of a storm using the "flash-to-bang" method. Since sound travels about 1 kilometer every 3 seconds (or 1 mile every 5 seconds), counting the delay between the flash and the thunder allows one to calculate how far away the lightning struck.

• If the delay is 9 seconds, the lightning strike is approximately 3 kilometers away.

Important Points

• Temperature Effect: The speed of sound increases as the temperature of the air increases. At 0 degrees Celsius, the speed of sound is about 331 m/s, whereas at 30 degrees Celsius, it increases to approximately 349 m/s.

• Sonic Boom: When an object, such as a supersonic jet, travels faster than the speed of sound (Mach 1), it creates a shockwave similar to thunder, known as a sonic boom.

• Lightning Composition: A lightning bolt can heat the surrounding air to 30,000 Kelvin (five times hotter than the surface of the sun). This sudden thermal expansion of air is what generates the sound wave we call thunder.

• Refraction: Sometimes, lightning can be seen but thunder is not heard; this is often called "heat lightning." This occurs because the sound waves are refracted (bent) upward by different temperature layers in the atmosphere before they can reach the observer's ears.

Q12. Answer: (b) Filtration

The correct answer is Filtration.

Key Points

• Filtration is a physical method used to separate insoluble solid particles from a liquid or gas by passing the mixture through a porous medium, such as filter paper or a membrane. Since the particles in a suspension are large enough to be trapped, this method is highly effective. Hence, option 2 is correct.

• A suspension is a heterogeneous mixture containing solid particles large enough for sedimentation. These particles are usually larger than 1000 nanometers and are visible to the naked eye.

• In the filtration process, the clear liquid that passes through the filter is known as the filtrate, while the solid particles that remain on the filter medium are referred to as the residue.

• Crystallization is a technique used to separate a pure solid from a solution in the form of its crystals. It is commonly used for purification rather than simple mechanical separation of a suspension. Hence, option 1 is incorrect.

• Distillation is used to separate components of a mixture containing miscible liquids that boil without decomposition and have a significant difference in their boiling points (usually more than 25 K). Hence, option 3 is incorrect.

• Evaporation is a process used to separate a non-volatile solute (like salt) from a volatile solvent (like water) by heating the mixture until the liquid turns into vapor. Hence, option 4 is incorrect.

Additional Information

• Types of Mixtures:

• Solution: A homogeneous mixture of two or more substances where the particle size is less than 1 nm. They do not scatter light and cannot be separated by filtration.

• Colloid: A mixture where the particle size (between 1 nm and 1000 nm) is intermediate between a solution and a suspension. While they appear homogeneous, they are heterogeneous and exhibit the Tyndall effect.

• Suspension: A heterogeneous mixture where particles eventually settle down due to gravity if left undisturbed, making the mixture unstable.

• Other Separation Techniques:

• Centrifugation: Used when the solid particles are too small to be caught by a filter. The mixture is spun rapidly, forcing denser particles to the bottom. Examples include separating cream from milk or diagnostic blood tests.

• Chromatography: A technique used to separate solutes that dissolve in the same solvent, often used to separate pigments from natural colors or drugs from blood.

• Sublimation: Used to separate mixtures containing a sublimable volatile component (like Ammonium chloride or Camphor) from a non-sublimable impurity.

Important Points

• The Tyndall Effect is the scattering of a beam of light by medium particles. It is clearly visible in suspensions and colloids but not in true solutions.

• The effectiveness of Filtration depends on the pore size of the filter medium and the particle size of the suspended matter.

• Unlike Chemical separation, methods like Filtration, Evaporation, and Distillation are Physical separation methods because they

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do not alter the chemical identity of the substances involved.

• Common examples of Suspensions include Chalk powder in water, Muddy water, and Flour in water.

Q13. Answer: (a) The density of the fluid

The correct answer is The density of the fluid.

Key Points

• The buoyant force, also known as upthrust, is the upward force exerted by a fluid that opposes the weight of a partially or fully immersed object.

• According to Archimedes' Principle, the magnitude of the buoyant force is exactly equal to the weight of the fluid displaced by the object.

• The formula for buoyant force is $F_b = \rho \times V \times g$, where ρ (rho) represents the density of the fluid, V represents the volume of the displaced fluid, and g represents the acceleration due to gravity (approximately 9.8 m/s^2).

• The density of the fluid is a critical factor; for a fixed volume, a denser fluid (like saltwater compared to freshwater) will exert a greater upward force. Hence, option 1 is correct.

• The weight of the object does not determine the magnitude of the buoyant force, though it determines whether the object will sink or float when compared to the buoyant force. Hence, option 2 is incorrect.

• The color of the object is a physical appearance property and has no physical interaction with fluid mechanics or pressure differentials. Hence, option 3 is incorrect.

• The shape of the object does not affect the buoyant force directly; only the total volume of the displaced fluid matters. Two objects of different shapes but the same volume will experience the same buoyant force if fully submerged. Hence, option 4 is incorrect.

Additional Information

• Archimedes' Principle: Discovered in the 3rd Century BC by the Greek mathematician Archimedes of Syracuse, this principle is the fundamental law of buoyancy used in ship design and submarines.

• Sinking and Floating: An object sinks if its density is greater than the density of the fluid. It floats if its density is less than the fluid's density. If the densities are equal, it exhibits neutral buoyancy.

• Fluid Pressure: Buoyancy arises because fluid pressure increases with depth. The pressure on the bottom of an submerged object is higher than the pressure on the top, resulting in a net upward force.

• Real-world Example: In the Dead Sea, the extremely high salt concentration increases the density of the water to about 1240 kg/m^3. This high density creates a massive buoyant force, allowing humans to float effortlessly on the surface.

• Applications: This concept is used in Hydrometers (to measure fluid density), Lactometers (to check the purity of milk), and the operation of Hot Air Balloons (where hot air is less dense than the surrounding cool air).

Important Points

• Apparent Weight: When an object is immersed in a fluid, it appears to lose weight. The apparent weight is calculated as Actual Weight - Buoyant Force.

• Volume Displacement: For a fully submerged object, the volume of displaced fluid is equal to the total volume of the object. For a floating object, it is equal to the volume of the submerged portion only.

• Relative Density: Also known as Specific Gravity, it is the ratio of the density of a substance to the density of a reference substance (usually water at 4 degrees Celsius, which is 1000 kg/m^3).

• Center of Buoyancy: This is the centroid of the displaced volume of fluid. For a floating body to be stable, the relative positions of the Center of Gravity and the Center of Buoyancy are crucial.

Q14. Answer: (a) Pure chemical compounds

The correct answer is Pure chemical compounds.

Key Points

• The Law of Constant Proportions, also frequently referred to as the Law of Definite Proportions, is a fundamental law of chemistry which states that a pure chemical compound always contains the same elements combined together in the same fixed proportion by mass.

• This law was first proposed by the French chemist Joseph Proust in 1799. His observations were based on the analysis of various compounds, including cupric carbonate, where he found the composition of elements to be the same regardless of whether the sample was natural or synthetic.

• It applies exclusively to pure chemical compounds because they are formed through chemical bonds between atoms in specific stoichiometric ratios. Hence, option 1 is correct.

• Elements are substances consisting of only one type of atom. The law describes how different elements interact to form compounds; it does not apply to a single element in isolation. Hence, option 2 is incorrect.

• Mixtures do not follow this law because their components can be mixed in any arbitrary ratio. For example, a saltwater solution can be prepared with 1 gram of salt or 10 grams of salt in the same volume of water without changing its fundamental nature as a

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mixture. Hence, options 3 and 4 are incorrect.

• A classic example is Water (H_2O). In any sample of pure water, the ratio of the mass of Hydrogen to the mass of Oxygen is always 1:8 (approximately 11.1% Hydrogen and 88.9% Oxygen by mass).

Additional Information

• Law of Conservation of Mass:

• Established by Antoine Lavoisier in 1789.

• It states that mass is neither created nor destroyed during a chemical reaction.

• The total mass of the reactants must equal the total mass of the products in a closed system.

• Law of Multiple Proportions:

• Proposed by John Dalton in 1803.

• If two elements combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element are in a ratio of small whole numbers.

• Example: In Carbon Monoxide (CO) and Carbon Dioxide (CO_2), the masses of Oxygen that combine with 12g of Carbon are 16g and 32g, respectively, forming a 1:2 ratio.

• Dalton's Atomic Theory:

• Published in 1808, this theory provided the first theoretical framework for the laws of chemical combination.

• Dalton postulated that atoms of different elements combine in simple whole-number ratios to form chemical compounds.

• Exceptions to the Law:

• Non-stoichiometric compounds (also known as berthollides), such as Wustite (FeO), where the ratio of elements can vary within a certain range.

• Isotopic variations: Since isotopes of the same element have different masses, compounds made with different isotopes (e.g., Heavy Water, D_2O vs. Normal Water, H_2O) will have different mass ratios.

Important Points

• Compounds are distinct from mixtures because compounds have fixed properties, specific boiling/melting points, and their constituents cannot be separated by physical methods like filtration or evaporation.

• The percentage composition of a compound is calculated by dividing the molar mass of the element by the total molecular mass of the compound and multiplying by 100.

• In Ammonia (NH_3), Nitrogen and Hydrogen are always present in a mass ratio of 14:3.

• The discovery of this law was a major step toward the atomic theory of matter, as it suggested that matter is composed of discrete units that combine in specific ways.

Q15. Answer: (d) Plasmolysis observed when living plant cells lose water

The correct answer is Plasmolysis observed when living plant cells lose water.

Key Points

• Plasmolysis is the process in which cells lose water in a hypertonic solution. When a living plant cell loses water through osmosis, there is shrinkage or contraction of the contents of the cell away from the cell wall.

• This phenomenon specifically demonstrates the role and presence of the cell wall, as the rigid outer boundary remains intact while the protoplasm (the living part of the cell) shrinks. Hence, statement 4 is correct.

• The cell wall is a rigid, non-living outer layer found in plant cells, fungi, and bacteria. It provides structural support and protection, and its interaction with the plasma membrane during water loss is what makes plasmolysis visible.

• Exchange of gases through stomata of leaves primarily involves the process of diffusion and transpiration. While turgor pressure (regulated by osmosis) opens and closes stomata, it is not the primary phenomenon used to describe the structural role of the cell wall in osmosis compared to plasmolysis. Hence, statement 1 is incorrect.

• Diffusion of gases through the cell membrane is a passive process that occurs based on concentration gradients and does not specifically highlight the mechanical or structural role of the cell wall. Hence, statement 2 is incorrect.

• The absorption of light by chlorophyll is a photochemical process central to photosynthesis and is unrelated to the osmotic movement of water or the structural function of the cell wall. Hence, statement 3 is incorrect.

Additional Information

• Osmosis in Plant Cells:

• Osmosis is the movement of water molecules from a region of higher water concentration to a region of lower water concentration through a semi-permeable membrane.

• In plant cells, the cell wall prevents the cell from bursting when it takes up water (endosmosis) in a hypotonic solution. The pressure exerted by the swelling protoplast against the wall is called turgor pressure.

• Types of Osmotic Solutions:

• Hypertonic Solution: A solution with a higher solute concentration than the cell. Water moves out, leading to plasmolysis.

• Hypotonic Solution: A solution with a lower solute concentration than the cell. Water moves in, making the cell turgid.

• Isotonic Solution: A solution where the solute concentration is equal to the cell. There is no net movement of water, and the cell becomes flaccid.

• The Cell Wall:

• In plants, the cell wall is composed mainly of cellulose, hemicellulose, and pectin.

• It is fully permeable to water and substances in solution, unlike the plasma membrane, which is selectively permeable.

• Its primary function is to provide mechanical strength and maintain the shape of the plant, allowing it to grow to great heights.

Important Points

• Significance of Plasmolysis:

• It proves that the cell membrane is a semi-permeable boundary.

• It is a reversible process; if a plasmolysed cell is placed in a hypotonic solution (like pure water) before permanent damage occurs, water enters the cell, and the protoplasm again touches the cell wall. This reverse process is called deplasmolysis.

• Real-world applications include the salting of meat or addition of sugar to jams, which creates a hypertonic environment that causes plasmolysis in bacteria, thereby preventing spoilage.

Q16. Answer: (c) The highest concentration of pesticides

The correct answer is The highest concentration of pesticides.

Key Points

• Biological Magnification, also known as Biomagnification, is the process where the concentration of non-biodegradable toxic substances increases at each successive trophic level of a food chain.

• In the provided food chain: Grass → Grasshopper → Frog → Snake → Hawk, the Hawk occupies the fifth trophic level as the top predator.

• Since pesticides are often non-biodegradable, they are not broken down by the metabolic processes of organisms nor are they excreted easily. Instead, they accumulate in the fatty tissues of the organisms.

• As a predator eats multiple prey items from the level below it, it ingests all the accumulated toxins from those individuals. Consequently, the organism at the highest trophic level always ends up with the maximum concentration of these chemicals.

• Therefore, in this specific chain, the Hawk will exhibit the highest concentration of pesticides compared to the grass, grasshopper, frog, or snake. Hence, the correct answer is option 3.

Additional Information

• Trophic Levels:

• First Trophic Level: Consists of Producers like Grass, which have the lowest concentration of toxins as they are the entry point into the food web.

• Intermediate Levels: Includes Primary Consumers (Grasshopper), Secondary Consumers (Frog), and Tertiary Consumers (Snake). The concentration increases step-by-step through these levels.

• Quaternary Consumers: Represented here by the Hawk, which acts as the apex predator in this sequence.

• Energy Flow vs. Biomagnification:

• According to the 10% Law proposed by Raymond Lindeman in 1942, only 10% of the energy is transferred to the next trophic level, while 90% is lost as heat.

• Contrarily, non-biodegradable chemicals do not follow this reduction; their total mass remains largely the same while the biomass of the higher level is smaller, leading to a much higher concentration.

• Common Pollutants:

• DDT (Dichlorodiphenyltrichloroethane): One of the most famous examples of a pesticide that causes Biomagnification. It was widely used in the 20th century before being banned in many countries.

• Heavy Metals: Elements like Mercury, Lead, and Cadmium also undergo this process, often leading to conditions like Minamata disease in humans who consume high-level predatory fish.

• Ecological Impact:

• High concentrations of pesticides in birds of prey (like Hawks and Eagles) interfere with calcium metabolism, causing the thinning of eggshells. This leads to premature breaking of eggs and a significant decline in bird populations.

Important Points

• Biodegradable vs. Non-biodegradable: Only non-biodegradable substances (those that cannot be decomposed by biological processes) undergo Biomagnification. Biodegradable substances are broken down and do not accumulate.

• Bioaccumulation: This refers to the build-up of a substance in a single organism's body over time, whereas Biomagnification refers to the increase in concentration across multiple levels of the food chain.

• Human Impact: Humans, being omnivores and often occupying the top of the food chain, are highly susceptible to the effects of biological magnification through the consumption of meat, fish, and dairy.

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Q17. Answer: (a) X = V/I

The correct answer is X = V/I.

Key Points

• Ohm's Law, discovered by the German physicist Georg Simon Ohm in 1827, provides the fundamental relationship between voltage, current, and resistance in an electrical circuit.

• According to this law, the potential difference (V) across the ends of a given metallic wire in an electric circuit is directly proportional to the current (I) flowing through it, provided its temperature remains constant.

• Mathematically, this relationship is expressed as V = I × R, where R is a constant for the given metallic wire at a given temperature and is called its resistance.

• In the given question, the resistance is denoted by X. Therefore, the equation becomes V = I × X.

• To find the relation for X, we rearrange the formula as X = V / I. Hence, option 1 is correct.

• The relationship is linear, meaning if the potential difference is doubled, the current also doubles, keeping the ratio V/I (the resistance) constant.

Additional Information

• Resistance (X):

• It is the property of a conductor to oppose the flow of electric current.

• The SI unit of resistance is the Ohm, denoted by the Greek symbol Ω.

• 1 Ohm is defined as the resistance of a conductor when a potential difference of 1 Volt applied across its ends results in a current of 1 Ampere flowing through it.

• Factors Affecting Resistance:

• The resistance of a uniform metallic conductor is directly proportional to its length (L).

• It is inversely proportional to the area of cross-section (A).

• It depends on the nature of the material (resistivity) and the temperature of the conductor. For most metals, resistance increases with an increase in temperature.

• Potential Difference (V):

• It is the work done to move a unit charge from one point to another in an electric field. The SI unit is the Volt.

• Electric Current (I):

• It is the rate of flow of electric charges through a cross-section of a conductor. The SI unit is the Ampere.

Important Points

• V-I Graph: For a conductor that obeys Ohm's Law (an Ohmic conductor), the graph of potential difference (V) versus current (I) is a straight line passing through the origin. The slope of this line represents the resistance of the conductor.

• Ohmic vs. Non-Ohmic: Materials like metals are generally Ohmic at stable temperatures. However, components like diodes, transistors, and vacuum tubes do not follow a linear relationship and are called Non-Ohmic conductors.

• Application of the Formula: The formula V = IX is crucial for calculating the necessary voltage or current in electrical circuits, designing household wiring, and determining the power consumption of appliances.

• Formula Variations:

• To find Current: I = V / X

• To find Voltage: V = I × X

• To find Resistance: X = V / I

Q18. Answer: (a) refraction and dispersion of light by raindrops

The correct answer is refraction and dispersion of light by raindrops.

Key Points

• A rainbow is a meteorological phenomenon that is caused by reflection, refraction, and dispersion of light in water droplets resulting in a spectrum of light appearing in the sky.

• When sunlight strikes a raindrop, it is first refracted as it enters the surface of the droplet. This causes the white light to slow down and bend.

• During this process, dispersion occurs, where the white sunlight is split into its component colors (VIBGYOR) because different wavelengths of light travel at different speeds within the water.

• The light then hits the back of the raindrop and undergoes internal reflection. After reflecting, the light is refracted once more as it exits the droplet, further spreading the colors.

• The combined effect of these optical processes—refraction, dispersion, and reflection—directs the light toward the observer's eye at specific angles (approximately 40 to 42 degrees), forming a circular arc of colors. Hence, the correct answer is refraction and dispersion of light by raindrops.

Additional Information

• The Visible Spectrum (VIBGYOR): The colors in a rainbow always appear in a specific order: Violet, Indigo, Blue, Green, Yellow, Orange, and Red. Red light has the longest wavelength and is refracted the least, appearing on the outer arc. Violet light has the shortest wavelength and is refracted the most, appearing on the inner arc.

• Conditions for Formation: For a rainbow to be visible, two conditions must be met simultaneously: the Sun must be shining in one part of the sky, and it must be raining (or water droplets must be present) in the opposite part of the sky. The observer must stand with their back to the Sun.

• Primary vs. Secondary Rainbows: A Primary Rainbow is formed by one internal reflection inside the raindrop. A Secondary Rainbow is formed when light undergoes two internal reflections. The secondary rainbow is fainter, appears outside the primary arc, and its color sequence is reversed (Red on the inside, Violet on the outside).

• Shape of a Rainbow: While we usually see a rainbow as an arc from the ground, it is actually a full circle. The ground usually obstructs the bottom half of the circle. However, observers in airplanes or at high altitudes can sometimes see a complete circular rainbow.

• Historical Context: Sir Isaac Newton was the first to demonstrate in the 17th century (specifically around 1666) that white light is composed of a spectrum of colors by using a glass prism, which mimics the dispersive behavior of raindrops.

Important Points

• Refraction: This is the bending of light when it passes from one medium (like air) to another medium of different density (like water). The refractive index of water is approximately 1.33.

• Dispersion: This is the separation of white light into colors of different frequencies and wavelengths. This happens because the velocity of light in a medium depends on its wavelength.

• Total Internal Reflection: While a portion of light undergoes internal reflection at the back of the raindrop to form a rainbow, it is important to note that it is often technically partial reflection, though it is the primary reason the light returns toward the observer.

Q19. Answer: (a) maximum, intermediate, minimum

The correct answer is maximum, intermediate, minimum.

Key Points

• The strength of the intermolecular forces of attraction varies significantly across the three primary states of matter: solids, liquids, and gases.

• In solids, the particles are packed very closely together in a rigid, often crystalline structure. Because the inter-particle distance is very small, the forces of attraction between them are the maximum. This high attraction prevents the particles from moving out of their positions, resulting in a fixed shape and fixed volume.

• In liquids, the particles are slightly further apart compared to solids. The forces of attraction are intermediate; they are strong enough to keep the particles together (maintaining a fixed volume) but weak enough to allow them to slide past each other. This gives liquids the ability to flow and take the shape of their container.

• In gases, the particles are separated by very large distances relative to their size. The intermolecular forces are the minimum (almost negligible), which allows the particles to move independently and randomly in all directions. Consequently, gases have neither a fixed shape nor a fixed volume.

• The order of the force of attraction between particles is Solids > Liquids > Gases.

Additional Information

• Kinetic Energy and Temperature:

• The kinetic energy of particles is inversely related to the strength of attractive forces. In gases, the kinetic energy is maximum, which overcomes the attractive forces. In solids, kinetic energy is minimum, allowing attractive forces to dominate.

• As temperature increases, the kinetic energy of the particles increases, which can eventually overcome the attractive forces, leading to a change in state (e.g., melting or boiling).

• Compressibility:

• Gases are highly compressible because the intermolecular spaces are very large and the forces of attraction are minimum.

• Solids and liquids have very low compressibility because their particles are already very close due to maximum or intermediate forces.

• Diffusion:

• The rate of diffusion is fastest in gases because of the minimum force of attraction and high velocity of particles.

• In solids, diffusion is almost non-existent because the maximum force of attraction keeps particles locked in fixed positions.

• Density:

• Typically, solids have the highest density because the maximum forces of attraction pull the maximum number of particles into a unit volume. Gases have the lowest density due to the minimum forces.

Important Points

• The intermolecular forces mentioned are also known as Van der Waals forces or dipole-dipole interactions depending on the

nature of the substance.

• The thermal energy of a substance works in opposition to the intermolecular forces. While attractive forces try to keep particles together, thermal energy tries to keep them apart by increasing their vibration or translation.

• The Inter-particle space follows an order exactly opposite to the forces of attraction: Gases (maximum) > Liquids (intermediate) > Solids (minimum).

Q20. Answer: (b) Both Assertion (A) and Reason (R) are true, and (R) is the correct explanation of Assertion (A).

The correct answer is Both Assertion (A) and Reason (R) are true, and (R) is the correct explanation of Assertion (A).

Key Points

• Assertion (A) states that sexual reproduction is essential in plants for maintaining the continuity of the species for many generations. Reproduction is a fundamental biological process that ensures life continues beyond the lifespan of an individual organism. Hence, Assertion (A) is correct.

• Reason (R) highlights that sexual reproduction leads to genetic variation, which enhances adaptability and evolutionary fitness. In this process, offspring inherit a unique combination of DNA from two different gametes. Hence, Reason (R) is correct.

• The genetic diversity created through sexual reproduction is the primary mechanism that allows a plant population to survive environmental changes, such as climate shifts, new pathogens, or predators.

• Because these variations allow the species to adapt and evolve over geological time, it directly enables the long-term continuity mentioned in the assertion. Without such variation, a species would be highly vulnerable to extinction. Therefore, Reason (R) is the correct explanation of Assertion (A).

Additional Information

• Mechanism of Variation: During sexual reproduction, variation arises primarily during meiosis through processes like crossing over (in Prophase I) and independent assortment of chromosomes. This reshuffles the genetic material, ensuring no two offspring (except identical twins) are exactly alike.

• Evolutionary Fitness: This term refers to an organism's ability to survive and reproduce in a specific environment. Natural selection acts on the genetic variation produced by sexual reproduction, preserving traits that improve a plant's chances of passing its genes to the next generation.

• Comparison with Asexual Reproduction: In asexual reproduction (such as vegetative propagation), offspring are genetically identical clones of the parent. While this is efficient for rapid colonization, the lack of diversity means the entire population could be wiped out by a single environmental stressor.

• Significance in Plants: For Angiosperms (flowering plants) and Gymnosperms, sexual reproduction results in the formation of seeds. Seeds often contain dormant embryos and protective coats, allowing the species to survive unfavorable seasons and disperse to new geographical locations.

• Pollination and Fertilization: These are the two critical steps in plant sexual reproduction. Pollination involves the transfer of pollen grains from the anther to the stigma, while fertilization is the fusion of male and female gametes to form a zygote.

Important Points

• DNA Recombination: This is the production of offspring with combinations of traits that differ from those found in either parent, serving as the raw material for evolution.

• Species Continuity: This refers to the uninterrupted lineage of a group of organisms. Sexual reproduction provides the flexibility required for a lineage to persist across millions of years despite the Earth's changing ecology.

• Biological Stability: While individual plants die, the process of meiosis and syngamy (fertilization) ensures that the gene pool remains dynamic and resilient.

Q21. Answer: (d) It is change in distance divided by change in velocity.

The correct answer is It is change in distance divided by change in velocity.

Key Points

• Average speed is defined as the total distance traveled by an object divided by the total time interval taken to cover that distance. Hence, statement 1 is correct.

• The standard unit of measurement for speed in the International System of Units (SI) is meters per second (m/s), although it can also be expressed in km/h or miles per hour depending on the context. Hence, statement 2 is correct.

• Speed is a scalar quantity, meaning it possesses only magnitude and no directional component. Therefore, the average speed of an object does not change based on the direction in which the object is moving. Hence, statement 3 is correct.

• The mathematical expression for average speed is Total Distance / Total Time. Defining it as the change in distance divided by the change in velocity is scientifically incorrect and has no physical basis in kinematics. Hence, statement 4 is incorrect.

• Hence, the incorrect statement (and thus the correct answer) is It is change in distance divided by change in velocity.

Additional Information

• Scalar vs Vector Quantities:

• A scalar quantity like speed or distance is described solely by its numerical value.

• A vector quantity like velocity or displacement requires both magnitude and direction for a complete description.

• If a car travels in a circular path and returns to its starting point, its average velocity is 0 because the net displacement is 0, but its average speed will be a positive numerical value.

• Instantaneous Speed:

• This refers to the speed of an object at a specific point in time or at a particular instant.

• The speedometer in vehicles is the primary tool used to measure instantaneous speed.

• Unit Conversions:

• To convert speed from kilometers per hour (km/h) to meters per second (m/s), we multiply the value by 5/18.

• To convert m/s back to km/h, the value is multiplied by 18/5.

Important Points

• Dimensional Formula: The dimensional formula for speed is represented as [M0 L1 T-1], where M is mass, L is length, and T is time.

• Odometer: While the speedometer measures speed, the odometer is the device used to measure the total distance traveled by a vehicle.

• Uniform Motion: In uniform motion, an object covers equal distances in equal intervals of time, meaning its speed remains constant throughout the journey.

• Average Velocity Formula: Unlike average speed, average velocity is calculated as Total Displacement / Total Time. Because displacement is the shortest path between two points, the magnitude of average velocity is always less than or equal to average speed.

Q22. Answer: (b) Ethanol

The correct answer is Ethanol.

Key Points

• Ethanol, also known as ethyl alcohol (chemical formula C2H5OH), is the most common alcohol used as a biofuel worldwide.

• It is a renewable energy source because it is primarily produced through the fermentation of sugars and starches found in plant materials such as sugarcane, corn, maize, and wheat.

• In many countries, including India, Brazil, and the USA, ethanol is blended with gasoline (petrol) to reduce the consumption of fossil fuels and lower carbon emissions.

• The Government of India has launched the Ethanol Blended Petrol (EBP) Programme, which initially targeted 5% blending but has been scaled up significantly over the years.

• As a fuel, ethanol has a higher octane rating than pure gasoline, which helps improve engine performance and prevents engine knocking.

Additional Information

• Methanol (CH3OH):

• Also known as wood alcohol, it can be used as a fuel, particularly in racing cars and high-performance engines.

• While it is cheaper to produce from coal or natural gas, it is highly toxic and more corrosive to engine components than ethanol.

• Butanol (C4H9OH):

• It is considered an advanced biofuel with an energy density very close to that of gasoline.

• Unlike ethanol, butanol is less hydroscopic (absorbs less water) and can be transported through existing oil pipelines, though its production cost remains high.

• Propanol (C3H7OH):

• Commonly used as a solvent and in antiseptics (rubbing alcohol), but it is not typically used as a bulk commercial fuel due to production costs and chemical properties.

• Flex-Fuel Vehicles (FFVs):

• These are specialized vehicles equipped with internal combustion engines designed to run on more than one fuel, usually gasoline blended with ethanol (up to 85% or E85).

Important Points

• India's E20 Target: The Government of India has advanced the target of achieving 20% ethanol blending in petrol from 2030 to 2025-26 to reduce import dependency on crude oil.

• National Policy on Biofuels (2018): This policy categorizes biofuels into First Generation (1G) bio-ethanol (from molasses, sugar beet, etc.) and Second Generation (2G) ethanol (from non-food crops and agricultural residues).

• Global Biofuels Alliance (GBA): Launched during the G20 Summit in 2023 under India’s presidency, this alliance aims to accelerate the global uptake of biofuels like ethanol to support the energy transition.

• Environmental Impact: Using ethanol-blended fuels significantly reduces the emission of Carbon Monoxide (CO), Hydrocarbons (HC), and Nitrogen Oxides (NOx), contributing to cleaner air in urban areas.

Q23. Answer: (b) Sepal

The correct answer is Sepal.

Key Points

• The Sepal is the outermost part of a flower that typically appears green and leaf-like. Its primary role is to enclose and protect the flower in its bud stage before it blooms.

• Collectively, all the sepals of a flower are referred to as the Calyx, which forms the first whorl of a typical flower structure.

• Beyond physical protection, sepals help prevent the delicate internal reproductive tissues from desiccation (drying out) and provide a barrier against predatory insects or harsh environmental conditions.

• In many plant species, once the flower opens, the sepals remain at the base of the petals, though in some cases, they may wither and fall off after the blooming process is complete.

• The presence of sepals is a characteristic feature of Angiosperms (flowering plants), helping ensure the survival of the reproductive organs until they are ready for pollination.

Additional Information

• Petal (Corolla):

• The Petals represent the second whorl of the flower. They are often brightly colored and scented to attract pollinators such as bees, birds, and butterflies.

• While they offer some secondary protection, their main evolutionary function is to facilitate the transfer of pollen.

• Stamen (Androecium):

• The Stamen is the male reproductive part of the flower. It consists of two main components: the Anther and the Filament.

• The Anther is responsible for the production of pollen grains, which contain the male gametes.

• Pistil (Gynoecium):

• The Pistil (also known as the Carpel) is the female reproductive part. It is usually located in the center of the flower.

• It comprises the Stigma (receptive tip), the Style (supporting tube), and the Ovary (which contains the ovules). After fertilization, the ovary develops into a fruit.

• Receptacle:

• This is the thickened part of the stem (pedicel) from which all the flower organs grow. It acts as the structural foundation for the Calyx, Corolla, Androecium, and Gynoecium.

Important Points

• Tepals: In some plants, such as Lilies or Tulips, the sepals and petals are indistinguishable in color and shape. In these instances, they are collectively referred to as Tepals (or the Perianth).

• Bisexual vs. Unisexual: A Complete Flower contains all four whorls (sepals, petals, stamens, and pistils). If any of these are missing, it is termed an Incomplete Flower.

• Pollination: This is the process where pollen is transferred from the Anther to the Stigma, eventually leading to fertilization and the production of seeds.

• Monocots vs. Dicots: Monocot flowers usually have parts in multiples of three, whereas Dicot flowers typically have parts in multiples of four or five.

Q24. Answer: (b) Propanol

The correct answer is Propanol.

Key Points

• Propanol is an alcohol with the chemical formula C3H8O. It consists of a three-carbon chain where one hydrogen atom is replaced by a hydroxyl group (-OH).

• In the structure of Propanol (specifically 1-propanol or 2-propanol), all the carbon-carbon and carbon-oxygen bonds are single covalent bonds (sigma bonds). There are no double bonds present in its molecular framework.

• Functional groups like ketones, aldehydes, and carboxylic acids contain a carbonyl group, which consists of a carbon atom double-bonded to an oxygen atom (C=O).

• Propanone, Propanal, and Propanoic acid all possess this C=O double bond, making Propanol the only option among the choices that is a saturated compound with respect to its functional group oxygen.

• Because it lacks double or triple bonds, Propanol is classified as a derivative of a saturated hydrocarbon (alkane).

Additional Information

• Propanone (Acetone):

• It is the simplest ketone with the formula CH3COCH3. It contains a carbonyl group ($C=O$) located on the second carbon of the chain. Hence, option 1 is incorrect.

• The carbon in the C=O bond is sp2 hybridized, which necessitates the presence of one pi bond (the double bond).

• Propanal (Propionaldehyde):

• It is an aldehyde with the formula CH3CH2CHO. The functional group is located at the end of the carbon chain. Hence, option 3 is incorrect.

• Similar to ketones, aldehydes contain a carbon-oxygen double bond as part of the formyl group.

• Propanoic Acid:

• It is a carboxylic acid with the formula CH3CH2COOH. Its functional group consists of both a carbonyl group (C=O) and a hydroxyl group (-OH) attached to the same carbon atom. Hence, option 4 is incorrect.

• The presence of the C=O bond means it contains a double bond in its structure.

• Alcohol Classification:

• Alcohols like Propanol are characterized by the -OH group. Depending on the position, it can be n-propanol (1-propanol) or isopropanol (2-propanol). In both isomers, only single bonds exist. Hence, option 2 is correct.

Important Points

• Hybridization: In Propanol, all three carbon atoms are sp3 hybridized, forming a tetrahedral geometry around each carbon. In contrast, the functional carbon in propanone, propanal, and propanoic acid is sp2 hybridized to accommodate the double bond.

• Saturation: A molecule is considered unsaturated if it contains double or triple bonds between any two atoms (often specifically carbon-carbon, but functional group double bonds like C=O also count towards the degree of unsaturation).

• Valency of Oxygen: While oxygen always maintains a valency of 2, it can satisfy this by forming two single bonds (as in alcohols and ethers) or one double bond (as in carbonyl compounds).

• Physical Properties: Due to the -OH group and the absence of double bonds, Propanol can engage in extensive hydrogen bonding, giving it a higher boiling point compared to Propanal or Propanone of similar molecular weight.

Q25. Answer: (b) Muscle cells

The correct answer is Muscle cells.

Key Points

• Plastids are double-membrane-bound organelles found primarily in the cells of plants and algae. They are responsible for manufacturing and storing important chemical compounds used by the cell.

• Muscle cells are animal cells, and one of the fundamental differences between plant and animal cells is the presence of plastids. Animal cells, including human muscle cells, lack plastids entirely because they do not perform photosynthesis or require specialized plant storage structures like leucoplasts. Hence, the correct answer is Muscle cells.

• Leaf cells (specifically the mesophyll cells) contain a high density of a specific type of plastid known as chloroplasts. These contain the pigment chlorophyll, which captures light energy for photosynthesis. Hence, statement 1 is incorrect as plastids are present.

• Stem cells in plants, particularly in herbaceous or young stems, contain plastids such as chloroplasts or proplastids (precursors to other plastids). These allow the stem to contribute to the plant's energy production. Hence, statement 3 is incorrect as plastids are present.

• Root cells also contain plastids, typically in the form of leucoplasts. Since roots are generally underground and not exposed to light, they do not require chloroplasts but use amyloplasts (a type of leucoplast) to store starch. Hence, statement 4 is incorrect as plastids are present.

Additional Information

• Classification of Plastids:

• Chloroplasts: These are the most well-known plastids, containing chlorophyll and carotenoid pigments. They are the site of photosynthesis, converting light energy into chemical energy in the form of glucose.

• Chromoplasts: These contain fat-soluble carotenoid pigments like carotene and xanthophylls. They provide the distinct yellow, orange, or red colors to flowers and ripening fruits, aiding in pollination and seed dispersal.

• Leucoplasts: These are colorless plastids of varied shapes and sizes that store nutrients. They are further divided into:

• Amyloplasts: Specialized for storing carbohydrates (starch), commonly found in potato tubers and grains.

• Elaioplasts: Responsible for storing oils and fats.

• Aleuroplasts (Proteinoplasts): Responsible for storing proteins.

• Semi-autonomous Nature:

• Like mitochondria, plastids are semi-autonomous organelles. They possess their own circular DNA and 70S ribosomes, allowing them to synthesize some of their own proteins and replicate independently within the cell.

• Endosymbiotic Theory:

• Scientific evidence suggests that plastids originated from cyanobacteria that entered into a symbiotic relationship with early eukaryotic cells roughly 1.5 billion years ago.

Important Points

• Internal Structure: The inside of a chloroplast is organized into a matrix called the stroma, which contains membrane-bound sacs called thylakoids. These thylakoids are stacked like coins to form grana (singular: granum).

• Pigment Distribution: While all plastids derive from proplastids, their final form depends on the tissue location and exposure to environmental factors like light. For instance, if a root (containing leucoplasts) is exposed to light, it may turn green as the plastids develop into chloroplasts.

• Functions: Beyond energy production and storage, plastids play vital roles in the synthesis of fatty acids, amino acids, and terpenes, which are essential for the plant's survival and defense mechanisms.

Q26. Answer: (d) 301

Shortcut Trick

Convert ratio 1/2 : 1/3 : 1/6 to integers by multiplying with LCM (6) → 3 : 2 : 1.

Total units = 3 + 2 + 1 = 6 units.

Value of 6 units = 602 bananas.

First monkey (3 units) = (602 ÷ 6) × 3 = 602 ÷ 2 = 301.

Therefore The correct answer is 301 bananas.

Alternate Method

Given: Total bananas = 602. Ratio = 1/2 : 1/3 : 1/6.

=> Simplify Ratio: LCM of 2, 3, 6 = 6.

=> Ratio = (1/2 × 6) : (1/3 × 6) : (1/6 × 6) = 3 : 2 : 1.

=> Let parts be 3x, 2x, and 1x.

=> 3x + 2x + 1x = 602

=> 6x = 602

=> x = 602 ÷ 6 = 301/3

=> Share of first monkey = 3x = 3 × (301/3) = 301.

Therefore The correct answer is 301 bananas.

Additional Information

Ratio Simplification

To convert a fractional ratio a/b : c/d to integers, multiply both terms by the LCM of denominators b and d.

Inverse Ratio

The inverse ratio of a : b is 1/a : 1/b, which simplifies to b : a for two terms.

Proportional Division

Share of a part = (Specific Ratio Part ÷ Sum of Ratio Parts) × Total Value.

Q27. Answer: (b) 8

Shortcut Trick

Number of 4-legged animals (goats) = (Total feet − 2 × Total heads) ÷ 2

=> Number of goats = (82 − 2 × 33) ÷ 2

=> Number of goats = (82 − 66) ÷ 2 = 16 ÷ 2 = 8

Therefore The correct answer is 8 goats.

Alternate Method

Given:

Total animal heads = 33

Total animal feet = 82

Number of feet for one hen = 2

Number of feet for one goat = 4

Formula Used:

Total feet = (2 × Number of hens) + (4 × Number of goats)

Calculations:

Let the number of goats be G and the number of hens be H.

=> G + H = 33 → (Equation 1)

=> 4G + 2H = 82 → (Equation 2)

Divide Equation 2 by 2:

=> 2G + H = 41 → (Equation 3)

Subtract Equation 1 from Equation 3:

=> (2G + H) − (G + H) = 41 − 33

=> G = 8

Therefore The correct answer is 8 goats.

Additional Information

Alligation Method

You can find the ratio of hens to goats by placing 2 and 4 at the ends and the average feet per head (82/33) in the center.

Assumption Method

If we assume all animals are hens, total feet = heads × 2. The extra feet (Total − Assumed) are due to goats, where each goat contributes 2 extra feet.

Linear Variables

For any problem with two types of items having different counts (like 2-legged/4-legged or Rs. 2/Rs. 5 coins), use x + y = Total Quantity and ax + by = Total Value.

Q28. Answer: (d) 815

Shortcut Trick

Apply the direct Algebraic Identity: $a^3 + b^3 + c^3 = (a + b + c)[(a + b + c)^2 − 3(ab + bc + ca)] + 3abc$.

Substitute the given values: $14 × [14^2 − 3(47)] + 3(15)$.

Simplify: $14 × [196 − 141] + 45 = 14 × 55 + 45$.

Calculate: 770 + 45 = 815.

Therefore The correct answer is 815.

Alternate Method

Given: a + b + c = 14, ab + bc + ca = 47, and abc = 15.

Formula Used:

1) $(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$

2) $a^3 + b^3 + c^3 − 3abc = (a + b + c)(a^2 + b^2 + c^2 − (ab + bc + ca))$

Calculations:

=> $14^2 = a^2 + b^2 + c^2 + 2(47)$

=> $196 = a^2 + b^2 + c^2 + 94$

=> $a^2 + b^2 + c^2 = 196 − 94 = 102$

=> $a^3 + b^3 + c^3 − 3(15) = 14 × (102 − 47)$

=> $a^3 + b^3 + c^3 − 45 = 14 × 55$

=> $a^3 + b^3 + c^3 − 45 = 770$

=> $a^3 + b^3 + c^3 = 770 + 45$

=> $a^3 + b^3 + c^3 = 815$

Therefore The correct answer is 815.

Additional Information

Special Case of the Cubic Identity

If a + b + c = 0, then the identity simplifies significantly to $a^3 + b^3 + c^3 = 3abc$.

Alternative Form of Identity

The expression $a^2 + b^2 + c^2 − ab − bc − ca$ can also be written as $½[(a − b)^2 + (b − c)^2 + (c − a)^2]$, which is useful when differences between variables are known.

Square of a Trinomial

The basic expansion used to find the sum of squares is $(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$.

Q29. Answer: (d) 4

Shortcut Trick

For a number N with n distinct prime factors, the number of pairs of coprime factors (a, b) such that a × b = N is 2^(n−1).

Prime factorization of $180 = 2^2 × 3^2 × 5^1$.

Number of distinct prime factors (n) = 3 (which are 2, 3, and 5).

Number of coprime pairs = $2^{(3−1)} = 2^2 = 4$.

Therefore The correct answer is 4.

Alternate Method

Given: Product of two coprime integers is 180.

Formula Used: Two numbers are coprime if their Highest Common Factor (HCF) is 1.

=> Prime factorization of 180 = 2 × 2 × 3 × 3 × 5 = $2^2 \times 3^2 \times 5^1$.

=> Let the two coprime numbers be x and y. Since they are coprime, any prime power (like 2^2) must stay together in one of the numbers.

=> The distinct prime power blocks are (2^2), (3^2), and (5^1), i.e., 4, 9, and 5.

=> Possible pairs (x, y):

=> 1) (1, 180)

=> 2) (4, 9 × 5) = (4, 45)

=> 3) (9, 4 × 5) = (9, 20)

=> 4) (5, 4 × 9) = (5, 36)

Therefore The correct answer is 4.

Additional Information

Coprime Numbers

Two numbers a and b are coprime or relatively prime if HCF(a, b) = 1. They do not need to be prime themselves.

Number of Coprime Pairs Formula

For a number N = p1^a × p2^b × ... × p_n^k, the number of ways to write N as a product of two coprime integers is 2^(n−1).

Total Number of Factors

The total number of factors of N is (a+1)(b+1)...(k+1). For 180, total factors = (2+1)(2+1)(1+1) = 18.

Q30. Answer: (a) 21.88%

Shortcut Trick

For two successive discounts of a% and b%, the single equivalent discount is given by the formula: (a + b − ab ÷ 100)%.

Here, a = 16 and b = 7.

Equivalent discount = (16 + 7 − (16 × 7) ÷ 100)%

= (23 − 112 ÷ 100)%

= 23 − 1.12 = 21.88%.

Therefore The correct answer is 21.88%.

Alternate Method

Given: First discount = 16%, Second discount = 7%.

Formula: Single Equivalent Discount = 100 − [100 × (100 − d1)% × (100 − d2)%]

=> Let the Marked Price (MP) be 100.

=> Price after first discount = 100 − (16% of 100) = 84.

=> Price after second discount = 84 − (7% of 84) = 84 − 5.88 = 78.12.

=> Total discount = 100 − 78.12 = 21.88.

=> Equivalent discount % = (21.88 ÷ 100) × 100 = 21.88%.

Therefore The correct answer is 21.88%.

Additional Information

Successive Discount

When a series of discounts are applied one after another on the reducing balance, they are called successive discounts. The order of applying discounts does not change the final result.

Three Successive Discounts

For three discounts a, b, and c, first find the equivalent of a and b (say x), then find the equivalent of x and c.

Q31. Answer: (c) 66°

Shortcut Trick

For any quadrilateral WXYZ, the angle formed by the bisectors of two adjacent angles (angle Y and angle Z) is equal to half the sum of the other two angles (angle W and angle X).

angle ZOY = (angle W + angle X) ÷ 2

angle ZOY = (74° + 58°) ÷ 2

angle ZOY = 132° ÷ 2 = 66°

Therefore The correct answer is 66°.

Alternate Method

Given:

In quadrilateral WXYZ:

angle W = 74°

angle X = 58°

The bisectors of angle Y and angle Z meet at O.

Formula Used:

Sum of interior angles of a quadrilateral = 360°

Sum of angles of a triangle = 180°

Calculations:

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

=> angle W + angle X + angle Y + angle Z = 360°

Substitute the given values of angle W and angle X:

=> 74° + 58° + angle Y + angle Z = 360°

=> 132° + angle Y + angle Z = 360°

=> angle Y + angle Z = 360° − 132°

=> angle Y + angle Z = 228°

Since ZO and YO are the angle bisectors of angle Z and angle Y respectively:

=> angle OZY = angle Z ÷ 2

=> angle OYZ = angle Y ÷ 2

In triangle ZOY, the sum of angles is 180°:

=> angle ZOY + angle OZY + angle OYZ = 180°

=> angle ZOY + (angle Z ÷ 2) + (angle Y ÷ 2) = 180°

=> angle ZOY + (angle Z + angle Y) ÷ 2 = 180°

Substitute the value of (angle Z + angle Y) = 228°:

=> angle ZOY + 228° ÷ 2 = 180°

=> angle ZOY + 114° = 180°

=> angle ZOY = 180° − 114°

=> angle ZOY = 66°

Option Analysis:

• Option (1) 68°: Incorrect. If angle ZOY = 68°, then the sum of angle Y and angle Z would be 2 × (180° − 68°) = 224°, which implies angle W + angle X = 360° − 224° = 136°. This contradicts the given sum of 132°.

• Option (2) 60°: Incorrect. If angle ZOY = 60°, then the sum of angle Y and angle Z would be 2 × (180° − 60°) = 240°, which implies angle W + angle X = 360° − 240° = 120°. This contradicts the given sum of 132°.

• Option (3) 66°: Correct. As mathematically proven, angle ZOY = 180° − (angle Y + angle Z) ÷ 2 = 66°.

• Option (4) 59°: Incorrect. If angle ZOY = 59°, then the sum of angle Y and angle Z would be 2 × (180° − 59°) = 242°, which implies angle W + angle X = 360° − 242° = 118°. This contradicts the given sum of 132°.

Therefore The correct answer is 66°.

Additional Information

Angle Bisector Theorem in Quadrilaterals

The angle formed by the bisectors of two adjacent angles of a quadrilateral is equal to half the sum of the remaining two angles. Formula: angle ZOY = (angle W + angle X) ÷ 2.

Sum of Interior Angles of a Polygon

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

Angle Bisectors of Opposite Angles

The angle between the bisectors of two opposite angles of a quadrilateral is equal to half the difference of the other two opposite angles.

Q32. Answer: (a) 3580

Shortcut Trick

Convert percentages and fractions into a single multiplying factor.

80% × 50% × 3/8 → 4/5 × 1/2 × 3/8 = 3/20

If 3 units = 537, then 1 unit = 179.

Total value (20 units) = 179 × 20 = 3580.

Therefore The correct answer is 3580.

Alternate Method

Given: 80% of 50% of 3/8 of a number is 537.
Formula: Result = (P1/100) × (P2/100) × Fraction × Number
Let the number be x.
=> (80/100) × (50/100) × (3/8) × x = 537
=> (4/5) × (1/2) × (3/8) × x = 537
=> (12/80) × x = 537
=> (3/20) × x = 537
=> x = (537 × 20) / 3
=> x = 179 × 20
=> x = 3580
Therefore The correct answer is 3580.
Additional Information
Percentage to Fraction Conversion
To simplify calculations, remember common fractions: 80% = 4/5, 50% = 1/2, 25% = 1/4, and 12.5% = 1/8.
Successive Percentage
When applying multiple percentages to a single base, the net percentage is the product of their decimal equivalents.
Base Value Concept
Always identify the 'of' term as the denominator or base value in ratio-based solving.

Q33. Answer: (d) 36

Shortcut Trick
Since Mode = 22.75, the Modal Class is 21−28.
Using Mode formula: 22.75 = 21 + [(11 − 9) / (2 × 11 − 9 − X)] × 7
=> 1.75 = [2 / (13 − X)] × 7 => 13 − X = 14 / 1.75 = 8
=> X = 5
Total Frequency = 1 + 7 + 9 + 11 + 5 + 3 = 36.
Therefore The correct answer is 36.
Alternate Method
Given:
Mode = 22.75
Modal Class = 21−28 (since 22.75 lies in this range)
Lower limit (L) = 21
Frequency of modal class (f1) = 11
Frequency of class preceding modal class (f0) = 9
Frequency of class succeeding modal class (f2) = X
Class width (h) = 7
Formula Used:
Mode = L + [(f1 − f0) / (2f1 − f0 − f2)] × h
Calculations:
=> 22.75 = 21 + [(11 − 9) / (2 × 11 − 9 − X)] × 7
=> 22.75 − 21 = [2 / (22 − 9 − X)] × 7
=> 1.75 = [2 / (13 − X)] × 7
=> 1.75 = 14 / (13 − X)
=> 13 − X = 14 / 1.75
=> 13 − X = 8
=> X = 13 − 8 = 5
Total Frequency (Sum of all frequencies):
=> N = 1 + 7 + 9 + 11 + 5 + 3
=> N = 36
Therefore The correct answer is 36.
Additional Information
Empirical Relationship

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

Modal Class Identification

The class interval with the highest frequency is called the Modal Class.

Median Formula

Median = L + [((N/2) − cf) / f] × h, where cf is the cumulative frequency of the preceding class.

Q34. Answer: (a) Scheme i

Shortcut Trick

Scheme i: Total Discount = 37%.

Scheme ii: Successive Discount = a+b−(ab÷100) = 33+43−(33×43÷100) = 76−14.19 = 61.81%.

Scheme iii: Successive Discount = 46+22−(46×22÷100) = 68−10.12 = 57.88%.

Compare the discounts: 37% (i) < 57.88% (iii) < 61.81% (ii).

The least discount is the least beneficial to the customer.

Therefore The correct answer is Scheme i.

Alternate Method

Given: Three different discount schemes. To find the least beneficial (minimum discount percentage).

Formulas: Successive Discount = a + b − (ab ÷ 100)%

=> Scheme i: Single discount = 37%.

=> Scheme ii: Single equivalent of 33% and 43% = [33 + 43 − (33 × 43)/100]% = [76 − 14.19]% = 61.81%.

=> Scheme iii: Single equivalent of 46% and 22% = [46 + 22 − (46 × 22)/100]% = [68 − 10.12]% = 57.88%.

=> Comparing all three: 37% is the minimum value among the available options.

Therefore The correct answer is Scheme i.

Additional Information

Customer Perspective vs. Seller Perspective

For a customer, the most beneficial scheme is the one offering the highest discount. Conversely, the least beneficial is the one offering the lowest discount.

Successive Discount Calculation

When two successive discounts x% and y% are given, the net discount is always less than the sum (x + y)% due to the reduction in the base amount for the second discount.

Q35. Answer: (c) 67,200

Shortcut Trick

Difference in annual interest rate = 7% − 3.5% = 3.5%

Total interest percentage difference for 4 years = 3.5% × 4 = 14%

Positive difference in Rs. = 14% of Rs. 4,80,000

Calculation: 14/100 × 4,80,000 = 14 × 4,800 = 67,200

Therefore The correct answer is Rs. 67,200.

Alternate Method

Given:

Principal (P) = Rs. 4,80,000

Time (T) = 4 years

Rate of Bank A (R_A) = 3.5% p.a.

Rate of Bank B (R_B) = 7% p.a.

Formula Used:

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

Calculations:

=> SI paid to Bank A = (4,80,000 × 3.5 × 4) ÷ 100

=> SI paid to Bank A = 4,800 × 14 = Rs. 67,200

=> SI paid to Bank B = (4,80,000 × 7 × 4) ÷ 100

=> SI paid to Bank B = 4,800 × 28 = Rs. 1,34,400

=> Positive Difference = Rs. 1,34,400 − Rs. 67,200

=> Positive Difference = Rs. 67,200

Therefore The correct answer is Rs. 67,200.

Additional Information

Total Amount Formula

Amount (A) = Principal (P) + Simple Interest (SI). It represents the total money repaid to the lender.

Direct Difference Rule

When Principal and Time are constant, the difference in SI is directly proportional to the difference in rates: $\Delta SI = (P \times \Delta R \times T) \div 100$.

Simple Interest Nature

Simple Interest remains constant every year if the principal and rate do not change, unlike Compound Interest which increases annually.

Q36. Answer: (d) 45

Shortcut Trick

Total time = 1 + 1.5 = 2.5 hours.

Total distance = Average speed × Total time = 55 × 2.5 = 137.5 km.

Distance covered in 1st part = 70 × 1 = 70 km.

Distance covered in 2nd part = 137.5 − 70 = 67.5 km.

Speed p = 67.5 ÷ 1.5 = 45 km/hr.

Therefore The correct answer is 45 km/hr.

Alternate Method

Given:

Speed 1 = 70 km/hr, Time 1 = 1 hour

Speed 2 = p km/hr, Time 2 = 1.5 hours

Average Speed = 55 km/hr

Formula Used:

Average Speed = Total Distance ÷ Total Time

Distance = Speed × Time

Calculations:

=> Total Distance = (70 × 1) + (p × 1.5)

=> Total Time = 1 + 1.5 = 2.5 hours

=> Average Speed = (70 + 1.5p) ÷ 2.5

=> 55 = (70 + 1.5p) ÷ 2.5

=> 55 × 2.5 = 70 + 1.5p

=> 137.5 = 70 + 1.5p

=> 1.5p = 137.5 − 70

=> 1.5p = 67.5

=> p = 67.5 ÷ 1.5 = 45

Therefore The correct answer is 45 km/hr.

Additional Information

Average Speed Formula

For different speeds v1, v2 over different time intervals t1, t2: Avg Speed = (v1t1 + v2t2) ÷ (t1 + t2).

Harmonic Mean Case

If distances are equal, Average Speed = 2v1v2 ÷ (v1 + v2).

Unit Conversion

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

Q37. Answer: (b) 14/√205

Shortcut Trick

Given cot θ = 14 / 3 = Base / Perpendicular.

Let Base (B) = 14 and Perpendicular (P) = 3.

Hypotenuse (H) = $\sqrt{(14^2 + 3^2)} = \sqrt{(196 + 9)} = \sqrt{205}$.

Since cos θ = Base / Hypotenuse = 14 / √205.

Therefore The correct answer is 14/√205.

Alternate Method

Given: cot θ = 14/3
Formula Used:
=> cot θ = Base / Perpendicular
=> cos θ = Base / Hypotenuse
=> Hypotenuse² = Perpendicular² + Base²
Calculations:
=> Base (B) = 14, Perpendicular (P) = 3
=> Hypotenuse (H) = √(14² + 3²)
=> H = √(196 + 9) = √205
=> cos θ = B / H = 14 / √205
Therefore The correct answer is 14/√205.
Additional Information
Trigonometric Identities
Relation between functions: $\text{cosec}^2\theta - \cot^2\theta = 1$ and $\sec^2\theta - \tan^2\theta = 1$.
Reciprocal Relations
cot θ = 1/tan θ and cos θ = 1/sec θ.
Pythagorean Theorem
In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides: $H^2 = P^2 + B^2$.

Q38. Answer: (b) Decreases by 85.15%

Shortcut Trick
Effective Multiplier = 0.55 × 0.40 × 0.45 × 1.50
Effective Multiplier = 0.22 × 0.675 = 0.1485
Percentage Change = (0.1485 − 1) × 100 = −85.15%
Therefore The correct answer is Decreases by 85.15%.
Alternate Method
Given:
First Month Change = 45% Decrease
Second Month Change = 60% Decrease
Third Month Change = 55% Decrease
Fourth Month Change = 50% Increase
Let the Original Price be 100.
=> Price after 1st month = 100 × (100 − 45)/100 = 55
=> Price after 2nd month = 55 × (100 − 60)/100 = 55 × 0.4 = 22
=> Price after 3rd month = 22 × (100 − 55)/100 = 22 × 0.45 = 9.9
=> Price after 4th month = 9.9 × (100 + 50)/100 = 9.9 × 1.5 = 14.85
=> Total Percentage Change = [(Final Price − Original Price) ÷ Original Price] × 100
=> Percentage Change = [(14.85 − 100) ÷ 100] × 100 = −85.15%
Therefore The correct answer is Decreases by 85.15%.
Additional Information
Successive Percentage Formula
For two successive changes a% and b%, the net change is [a + b + (ab/100)]%.
Multiplier Method
Final Value = Initial Value × (1 ± r1/100) × (1 ± r2/100) × ... × (1 ± r_n/100).
Percentage Decrease
If the final value is less than the initial value, the percentage change is negative, indicating a decrease.

Q39. Answer: (d) Rs. 275

Shortcut Trick
Effective Cost Price (CP) = 200 + 10% of 200 = 200 + 20 = ??220.
To earn 25% profit, use the multiplier: Selling Price (SP) = CP × 1.25.
SP = 220 × (5 ÷ 4) = 55 × 5 = Rs. 275.

Therefore The correct answer is Rs. 275.

Alternate Method

Given: CP = Rs. 200, Overhead = 10% of CP, Profit% = 25%.

Formulas: Total CP = CP + Overhead | SP = Total CP × (100 + P%) ÷ 100

=> Overhead Expenses = 10% of 200 = (10 ÷ 100) × 200 = Rs. 20.

=> Total Cost Price = 200 + 20 = Rs. 220.

=> Selling Price = 220 × (100 + 25) ÷ 100.

=> SP = 220 × (125 ÷ 100) = 220 × (5 ÷ 4).

=> SP = 55 × 5 = Rs. 275.

Therefore The correct answer is Rs. 275.

Additional Information

Overhead Expenses

Any extra expenditure incurred on goods like freight, transportation, repair, or labor is added to the initial Cost Price to calculate the Total Cost Price.

Profit Calculation

Profit or Loss is always calculated on the Total Cost Price (CP + Overheads), not just the buying price. Profit = SP − Total CP.

Q40. Answer: (a) 66.67%

Shortcut Trick

Required percentage = (Value being compared ÷ Base value) × 100

Compare B's marks (50) with A's marks (75) as the base.

Required % = (50 ÷ 75) × 100 = 2/3 × 100 = 66.666...

Therefore The correct answer is 66.67%.

Alternate Method

Given:

Marks obtained by A = 75

Marks obtained by B = 50

Maximum marks = 95 (Not required for this calculation as the base is A's marks)

Formula Used:

Percentage = (B ÷ A) × 100

Calculations:

=> Required Percentage = (50 ÷ 75) × 100

=> Required Percentage = (2 ÷ 3) × 100

=> Required Percentage = 200 ÷ 3

=> Required Percentage = 66.6666...

=> Rounding off to two decimal places = 66.67%

Therefore The correct answer is 66.67%.

Additional Information

Base Value Identification

In percentage problems, the value following the word 'of' or 'than' usually acts as the denominator (base).

Percentage Change

Percentage increase/decrease = (Difference ÷ Original Value) × 100.

Fraction to Percentage Conversion

1/3 = 33.33%, 2/3 = 66.67%, 1/4 = 25%, 1/5 = 20%.

Q41. Answer: (c) 3 : 1

Shortcut Trick

Fourth Proportional of 1, 3, 6 → (3 × 6) ÷ 1 = 18.

Mean Proportional of 12, 3 → √(12 × 3) = √36 = 6.

Required Ratio → 18 : 6 = 3 : 1.

Therefore The correct answer is 3 : 1.

Alternate Method

Given: Numbers for Fourth Proportional (1, 3, 6) and Mean Proportional (12, 3).

Formula Used: Fourth Proportional of a, b, c is (b × c) / a. Mean Proportional of a, b is √(a × b).

=> Fourth Proportional = (3 × 6) ÷ 1 = 18.

=> Mean Proportional = √(12 × 3) = √36 = 6.

=> Required Ratio = 18 : 6.

=> Dividing both sides by 6, we get 3 : 1.

Therefore The correct answer is 3 : 1.

Additional Information

Third Proportional

The third proportional of two numbers a and b is defined as c such that a : b :: b : c, which gives $c = b^2 / a$.

Continued Proportion

Three numbers a, b, c are said to be in continued proportion if the ratio of the first to the second is equal to the ratio of the second to the third (a/b = b/c).

Invertendo and Alternendo

If a : b = c : d, then Invertendo states b : a = d : c and Alternendo states a : c = b : d.

Q42. Answer: (b) 306.04

Shortcut Trick

Separate the integers and decimals for faster mental calculation.

=> (36 − 30) + (300.30 − 0.26)

=> 6 + 300.04

=> 306.04

Therefore The correct answer is 306.04.

Alternate Method

Given:

36 − 30 + 300.3 − 0.26

Formula Used:

Group all positive values and negative values together to simplify addition and subtraction.

Calculations:

=> Sum of positive values = 36 + 300.3 = 336.3

=> Sum of negative values = −30 − 0.26 = −30.26

=> Total = 336.3 − 30.26

=> Add a trailing zero to match decimal places: 336.30 − 30.26

=> Total = 306.04

Therefore The correct answer is 306.04.

Additional Information

BODMAS Rule

It specifies the correct order of mathematical operations: Brackets, Orders (powers/roots), Division, Multiplication, Addition, and Subtraction. Addition and Subtraction hold the same priority and can be grouped or calculated strictly from left to right.

Decimal Addition and Subtraction

Always align numbers exactly by their decimal point. Insert trailing zeros to the right of the decimal so all values have the exact same number of decimal places before computing.

Checking with Decimal Digits

In decimal simplifications with distinct options, evaluating only the final decimal digits (e.g., .30 − .26 = .04) can frequently help you pinpoint the correct option immediately without having to complete the full arithmetic sequence.

Q43. Answer: (b) 21

Shortcut Trick

Let the Total Capacity of the cistern be the LCM of 12 and 14 = 84 units.

Efficiency of (P + Q) = 84 ÷ 12 = 7 units/hour.

Efficiency of P = 84 ÷ 14 = 6 units/hour.

Efficiency of Q = 7 − 6 = 1 unit/hour.

Time for Q to fill 1/4th cistern = (84 ÷ 4) ÷ 1 = 21 hours.

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Therefore The correct answer is 21 hours.

Alternate Method

Given:

Time taken by P and Q = 12 hours

Time taken by P alone = 14 hours

Formula Used:

Total Work = Time × Efficiency

Calculations:

Person	Days	Total Work	Efficiency
P + Q	12	84	7
P	14	6	

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

=> Efficiency of Q = 7 − 6 = 1 unit/hour

=> One-fourth of the cistern capacity = 84 ÷ 4 = 21 units

=> Time taken by Q alone = 21 ÷ 1 = 21 hours

Therefore The correct answer is 21 hours.

Additional Information

Pipes & Cisterns Efficiency

If a pipe fills a tank in 'x' hours and another empties it in 'y' hours, the net work done in one hour is (1/x − 1/y).

Work & Wages

Wages are always distributed in the ratio of the efficiency or the work done by the individuals, not the time taken.

Q44. Answer: (b) 67

Shortcut Trick

Assume an estimated mean of 60 for the given observations.

Calculate deviations: +35, −15, +25, −15, −9, +25, +24, +6, −13.

Sum of deviations = 35 − 15 + 25 − 15 − 9 + 25 + 24 + 6 − 13 = 63.

Average deviation = 63 ÷ 9 = 7.

Actual Mean = Assumed Mean + Average Deviation = 60 + 7 = 67.

Therefore The correct answer is 67.

Alternate Method

Given: Observations are 95, 45, 85, 45, 51, 85, 84, 66, and 47.

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

Calculations:

=> Sum = 95 + 45 + 85 + 45 + 51 + 85 + 84 + 66 + 47

=> Sum = 603

=> Total count (n) = 9

=> Arithmetic Mean = 603 ÷ 9

=> Arithmetic Mean = 67

Therefore The correct answer is 67.

Additional Information

Properties of Arithmetic Mean

The sum of the deviations of items from their arithmetic mean is always zero: Σ(x − x) = 0.

Empirical Relationship

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

Weighted Arithmetic Mean

When observations have different importance, use Mean = Σ(w × x) ÷ Σw, where w is the weight of each observation.

Q45. Answer: (c) 30 years

Shortcut Trick

Ratio 10 years ago (F:S) = 3 : 1 (Difference = 2)

Ratio 10 years hence (F:S) = 2 : 1 (Difference = 1)

To equalize difference, multiply second ratio by 2 → 4 : 2

Increase in units = 4 − 3 = 1 unit. Total time gap = 10 + 10 = 20 years.

Therefore 1 unit = 20 years. Son's age 10 years ago = 1 unit = 20 years.

Present age of son = 20 + 10 = 30 years.

Therefore The correct answer is 30 years.

Alternate Method

Given: Ratio 10 years ago = 3:1, Ratio 10 years later = 2:1.

Formula: Age after n years = Age + n.

=> Let Son's age 10 years ago be x and Father's age be 3x.

=> Present ages: Son = x + 10, Father = 3x + 10.

=> Ages after 10 years: Son = x + 20, Father = 3x + 20.

=> According to question: (3x + 20) = 2 × (x + 20)

=> 3x + 20 = 2x + 40

=> x = 20

=> Son's present age = x + 10 = 20 + 10 = 30 years.

Therefore The correct answer is 30 years.

Additional Information

Ratio Difference Method

When the time interval added to two people is the same, the numerical difference between their ratio parts must be equalized to solve directly.

Age Constant Property

The difference between the ages of two persons remains constant throughout their lives, regardless of the number of years passed.

Q46. Answer: (d) 9

Shortcut Trick

The perimeter of a triangle formed by joining the mid-points of the sides of a given triangle is always half of the perimeter of the original triangle.

Perimeter of triangle ABC = 5 + 6 + 7 = 18 cm.

Required Perimeter = 18 ÷ 2 = 9 cm.

Therefore The correct answer is 9 cm.

Alternate Method

Given: Sides of ΔABC are AB = 5 cm, BC = 6 cm, and CA = 7 cm.

According to the Mid-point Theorem, the segment joining the mid-points of two sides of a triangle is parallel to the third side and half its length.

Let D, E, and F be the mid-points of sides AB, BC, and CA respectively.

=> Side DE = CA ÷ 2 = 7 ÷ 2 = 3.5 cm

=> Side EF = AB ÷ 2 = 5 ÷ 2 = 2.5 cm

=> Side FD = BC ÷ 2 = 6 ÷ 2 = 3.0 cm

=> Perimeter of ΔDEF = DE + EF + FD

=> Perimeter = 3.5 + 2.5 + 3.0 = 9 cm

Therefore The correct answer is 9 cm.

Additional Information

Mid-point Theorem

The line segment joining the mid-points of any two sides of a triangle is parallel to the third side and equal to half of it.

Area of Mid-point Triangle

The area of the triangle formed by joining the mid-points is exactly 1/4^(th) of the area of the original triangle ABC.

Similarity Property

The triangle formed by joining the mid-points is similar to the original triangle with a side ratio of 1:2.

Q47. Answer: (c) 3 hours

Shortcut Trick

Let Total Work (LCM of 18, 12, 36) = 36 units.

Efficiency of Pipe A = 36 ÷ 18 = 2 units/hr.

Efficiency of Pipe B = 36 ÷ 12 = 3 units/hr.

Efficiency of Leakage = 36 ÷ 36 = −1 unit/hr.

Combined Efficiency = 2 + 3 − 1 = 4 units/hr.

Time to fill 1/3^(rd) capacity = (36 × 1/3) ÷ 4 = 12 ÷ 4 = 3 hours.

Therefore The correct answer is 3 hr.

Alternate Method

Given: Filling time for Pipe A = 18 hr, Pipe B = 12 hr, Emptying time for Leakage = 36 hr.

Person	Days	Total Work	Efficiency
Pipe A	18	36	2
Pipe B	12	3	
Leakage	36	−1	

Calculations:

=> Total Efficiency when all are active = 2 + 3 − 1 = 4 units/hr

=> Capacity to be filled = 1/3 × 36 = 12 units

=> Required Time = 12 ÷ 4 = 3 hr

Therefore The correct answer is 3 hr.

Additional Information

Pipes and Cisterns Efficiency

Inlet pipes have positive efficiency while outlet pipes or leakages have negative efficiency in calculations.

Combined Work Formula

Total Time = (Total Work to be done) ÷ (Sum of individual efficiencies).

LCM Method

Total work is assumed as the Least Common Multiple of individual time periods to avoid calculations with fractions.

Q48. Answer: (d) 1

Shortcut Trick

Convert all numbers into same base

$8 = 2^3$ => 2^(3m) × 2^3 = 2^9 => 3m + 3 = 9 => m = 2

$9 = 3^2$ => 3^{2n} × 3^2 = 3^6 => 2n + 2 = 6 => n = 2

m/n = 2/2 = 1

Therefore Answer = 1

Alternate Method

Given:

2^(3m) × 8 = 2^9 and 3^{2n} × 9 = 3^6

Formula used:

a^x × a^y = a^((x + y))

Calculation:

=> 2^(3m) × 2^3 = 2^9

=> 2^((3m + 3)) = 2^9

=> 3m + 3 = 9

=> 3m = 6 => m = 2

=> 3^{2n} × 3^2 = 3^6

=> 3^((2n + 2)) = 3^6

=> 2n + 2 = 6

=> 2n = 4 => n = 2

=> m/n = 2/2 = 1

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Therefore The correct answer is 1.

Additional Information

Laws of Exponents

a^x × a^y = a^((x + y)), (a^x)^y = a^((xy))

Equal Bases Rule

If bases are equal, then powers must be equal.

Power Conversion

Convert numbers like 8 = 2^3 and 9 = 3^2 to simplify equations.

Q49. Answer: (c) 8840

Shortcut Trick

The Volume of a Cuboid is calculated by the product of its three dimensions.

Volume = 34 × 10 × 26

Perform multiplication: (34 × 26) × 10 = 884 × 10 = 8840 m^3.

Therefore The correct answer is 8840 m^3.

Alternate Method

Given:

Length (L) of the tank = 34 m

Breadth (B) of the tank = 10 m

Height (H) of the tank = 26 m

Formula Used:

Volume of a Cuboid = L × B × H

Calculations:

=> Volume = 34 × 10 × 26

=> Volume = 340 × 26

=> Volume = 8840 m^3

Therefore The correct answer is 8840 m^3.

Additional Information

Total Surface Area of Cuboid

The total surface area is the sum of the areas of all 6 faces: TSA = 2(LB + BH + HL).

Diagonal of a Cuboid

The length of the longest rod that can be placed inside a cuboid is given by $\sqrt{(L^2 + B^2 + H^2)}$.

Volume of a Cube

For a cube where all sides are equal (L = B = H = a), the volume is simply a^3.

Q50. Answer: (c) 5 hours

Shortcut Trick

Time = Distance ÷ Speed

Time = 60 ÷ 12 = 5

Therefore The correct answer is 5 hr.

Alternate Method

Given:

Total Distance = 60 km

Speed of the cyclist = 12 km/hr

Formula Used:

Time = Distance / Speed

Calculations:

=> Time taken = 60 / 12

=> Time taken = 5 hr

Therefore The correct answer is 5 hr.

Additional Information

Basic Speed Formula

Speed is defined as the distance covered per unit time. Speed = Distance ÷ Time.

Unit Conversion

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

Average Speed

Average Speed = (Total Distance) ÷ (Total Time taken).

Q51. Answer: (d) 1

Given:

Number of people between = (Higher Position - Lower Position) - 1.

Total number of people in the row = 62

Shlok's position from the left end = (Total - Position from Right) + 1 = (62 - 20) + 1 = 43

Biplov's position from the left end = 45

Shlok → 43

Biplov → 45

Number of people between = (45 - 43) - 1 = 2 - 1 = 1

So, the number of people between Shlok and Biplov is 1.

Hence, the correct answer is Option 4.

Q52. Answer: (c) Northeast

The logic followed here is:

Given:

Town G is to the north of Town F

Town H is to the east of Town F

Town I is to the north of Town H

Town J is to the east of Town I

Town K is to the east of Town J

So, Town K is to the North-East of Town F.

Hence, the correct answer is Option 3.

Q53. Answer: (c) 12 km to the east

The logic followed here is:

Given:

Nishant starts from Point A and drives 45 km North

He takes a right turn → 44 km East

He takes a right turn → 60 km South

He takes a right turn → 56 km West

He takes a final right turn → 15 km North

So, To reach Point A again, he must travel 12 km East.

Hence, the correct answer is Option 3.

Q54. Answer: (d) 3

Given: (Left) 7 7 & & # 3 3 # 9 1 4 € 4 # # 7 £ $ 4 © 9 6 (Right)

Now,

We need to find numbers which are immediately preceded by a symbol and also immediately followed by a symbol.

So, needed pattern is: Symbol - Number - Symbol

(Left) 7 7 & & # 3 3 # 9 1 4 € 4 # # 7 £ $ 4 © 9 6 (Right)

So, total valid numbers = 3

Hence, the correct answer is Option 4.

Q55. Answer: (b) 42

The logic followed here is:

thus, "42" will replace the question mark in the given series.

Hence, the correct option is "Option 2".

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Q56. Answer: (b) P

Given: Six people P, Q, R, S, T and U are sitting around a circular table facing towards the centre of the table.
Exactly two people sit between S and T.
U sits to the immediate left of T.
R is immediate neighbour of S and Q both.
So, P is an immediate neighbour of both S and U.
Hence, the correct answer is "Option 2".

Q57. Answer: (d) JS-LU-OQ

The logic followed here is:
FO-HQ-KM
HQ-JS-MO
Now, checking the options:
Option 1) JS-LU-OR
Option 2) IS-LV-OR
Option 3) IS-LU-OR
Option 4) JS-LU-OQ
Hence, the correct answer is Option 4.

Q58. Answer: (d) Four

Given: Seven friends L, M, N, O, Q, R and S are sitting in a straight line facing north.
Only three people sit between L and O.
No one sits to the right of N.
Only one person sits between N and O.
M is an immediate neighbour of both Q and L.
R sits to the immediate left of O.
So, only four persons sits between S and L.
Hence, the correct answer is "Option 4".

Q59. Answer: (d) 8

Given number: 5718436
Logic: Add 2 to each odd digit and subtract 3 from each even digit
Original number: 5 7 1 8 4 3 6

Digit	Type	Operation	New Digit
5	Odd	5 + 2	7
7	Odd	7 + 2	9
1	Odd	1 + 2	3
8	Even	8 − 3	5
4	Even	4 − 3	1
3	Odd	3 + 2	5
6	Even	6 − 3	3

New number formed: 7 9 3 5 1 5 3
Now,
Greatest digit = 9
Smallest digit = 1
Difference = 9 − 1 = 8
Hence, the correct answer is Option 4.

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Q60. Answer: (a) sq

The logic followed here is:

Given:

how are you → pl mk jt

where you are → jt mk sq

So, where → sq

Hence, the correct answer is Option 1.

Q61. Answer: (d) DQC

The logic followed here is:

So, the missing term = DQC

Hence, the correct answer is Option 4.

Q62. Answer: (d) 84

BODMAS Table:

Given equation: 59 − 72 × 8 + (64 ÷ 4) × 8 − 16 ÷ 3 = ?

Now, interchanging Signs '+' and '−', and Signs '×' and '÷', then:

=> 59 + 72 ÷ 8 − (64 × 4) ÷ 8 + 16 × 3

=> 59 + 9 − 256 ÷ 8 + 16 × 3

=> 59 + 9 − 32 + 48

=> 68 − 32 + 48

=> 36 + 48

=> 84

Hence, the correct answer is Option 4.

Q63. Answer: (c) 15

Given number: 612374

Logic: Add 1 to each digit (even +1, odd +1) and then find the sum of all odd digits in the resulting number

Original number: 6 1 2 3 7 4

Digit	Type	Operation	New Digit
6	Even	+1	7
1	Odd	+1	2
2	Even	+1	3
3	Odd	+1	4
7	Odd	+1	8
4	Even	+1	5

New number formed: 7 2 3 4 8 5

Now, odd digits in the new number: 7, 3, 5

Sum = 7 + 3 + 5 = 15

Hence, the correct answer is Option 3.

Q64. Answer: (d) Mother's sister

Family Chart:

Decoding the Symbols:

Symbol	•	−	×	%	#
Meaning	Mother	Brother	Wife	Father	Daughter

Given: G # E # C + K # P

It means: G is daughter of E, E is daughter of C, C is mother of K, and K is daughter of P.

Thus K is the Mother's sister to G.

Hence, the correct answer is Option 4.

Q65. Answer: (b) B

Given: Six people A, B, C, D, E and F are sitting in a row facing north.
D sits to the immediate left of F.
C sits third to the left of B.
F is an immediate neighbour of C.
E sits second to the right of C.
A sits to the immediate left of E.
So, B sits at the extreme right end of the line.
Hence, the correct answer is "Option 2".

Q66. Answer: (a) bm

The logic followed here is:
Given:
rat able run → ei bm wx
cap rat ant → bm iy ve
So, rat → bm
Hence, the correct answer is Option 1.

Q67. Answer: (a) 27

The logic followed here is:
thus, "27" will replace the question mark in the given series.
Hence, the correct option is "Option 1".

Q68. Answer: (d) (15, 39, 30)

The logic followed here is:
Logic:
First Number × 2 = Third Number
Third Number + 9 = Second Number
For, (8, 25, 16)
=> 1st × 2 = 3rd → 8 × 2 = 16
=> 3rd + 9 = 2nd → 16 + 9 = 25
For, (13, 35, 26)
=> 1st × 2 = 3rd → 13 × 2 = 26
=> 3rd + 9 = 2nd → 26 + 9 = 35
Now, checking the options:
Option 1) (9, 9, 18)
=> 9 × 2 = 18
=> 18 + 9 = 27 (not 9)
Option 2) (7, 23, 32)
=> 7 × 2 = 14 (not 32)
Option 3) (17, 43, 52)
=> 17 × 2 = 34 (not 52)
Option 4) (15, 39, 30)
=> 15 × 2 = 30
=> 30 + 9 = 39
Hence, the correct answer is Option 4.

Q69. Answer: (b) Only conclusion (I) follows

Given Statements:
Some watches are figs.
All ships are kings.
No figs are ships.

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The least possible Venn diagram for the given statement is:

Conclusions:

I. Some kings are not figs - Follows (All ships are kings and no ships are figs. Therefore, the ships part inside kings will definitely not be figs).

II. Some watches are ships - Does not follow (No definite relationship is given between watches and ships. Hence, the conclusion does not definitely follow).

So, only conclusion I follows.

Hence, the correct answer is Option 2.

Q70. Answer: (d) 15

Logic followed here is:

Given series: 687, 652, 691, 287, 286

The highest number in the series is 691.

Second digit of the highest number = 9

The lowest number in the series is 286.

Third digit of the lowest number = 6

Sum = 9 + 6 = 15

Hence, the correct answer is Option 4.

Q71. Answer: (b) PGVK

The logic followed here is:

For, NETI → XODS

For, BSHW → LCRG

Now, applying the same logic for FWLA

So, FWLA → PGVK

Hence, the correct answer is "Option 2".

Q72. Answer: (d) 3

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

Now,

Odd numbers which are immediately preceded by an odd number and immediately followed by an even number.

So, needed pattern is: Odd - Odd - Even

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

So, total valid odd numbers = 3

Hence, the correct answer is Option 4.

Q73. Answer: (d) HK−KQ

The logic followed here is based on the alphabetical position pattern:

Option 1: DG → HK

Option 2: GJ → KN

Option 3: TW → XA

Option 4: HK → KQ

Thus, Options 1, 2, and 3 follow a consistent +4 shift pattern, while Option 4 deviates from this rule.

Hence, the odd one out is Option 4.

Q74. Answer: (a) One

Given: Seven boxes U, D, V, F, W, E and X are kept one over the other but not necessarily in the same order.

Only U is kept above D.

Only V is kept between D and F.

No box is kept below E.

Only three boxes are kept between D and W

Position	Box
1 (Top)	U

2	D
3	V
4	F
5	X
6	W
7 (Bottom)	E

Now, Boxes between X (5) and E (7) → W (6) → 1 box

Hence, the correct answer is Option 1.

Q75. Answer: (a) PW58

The logic followed here is:

So, the missing term = PW58

Hence, the correct answer is Option 1.

Q76. Answer: (b) UP - OI

The logic followed here is based on the alphabetical position pattern:

Option 1: TO → NI

Option 2: UP → OI

Option 3: VQ → PK

Option 4: QL → KF

Thus, Options 1, 3, and 4 follow a consistent -6 shift pattern for both letters, while Option 2 deviates from this rule.

Hence, the odd one out is Option 2.

Q77. Answer: (b) Only conclusion (II) follows.

Given Statements:

Some rails are cars.

No car is a bus.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some rails are bus - Does not follow (Because rails that are cars cannot be buses, and no definite relation is given between remaining rails and buses).

II. Some cars are rails - Follows (Since “Some rails are cars” can be directly converted to “Some cars are rails”).

So, only conclusion II follows.

Hence, the correct answer is Option 2.

Q78. Answer: (c) YQ 25

The logic followed here is:

For, IB 16 → ME 13

For, OH 25 → SK 22

Now, applying the same logic for UN 28

So, UN 28 → YQ 25

Hence, the correct answer is "Option 3".

Q79. Answer: (b) Three

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

Now,

Even numbers which are immediately preceded by an even number and also immediately followed by a prime number.

So, needed pattern is: Even - Even - Prime

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

So, total valid even numbers = 3

Hence, the correct answer is Option 2.

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Q80. Answer: (d) 62

The logic followed here is:

thus, "62" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q81. Answer: (a) January 2025

The correct answer is January 2025.

Key Points

• The Economic Survey 2024-25 is a flagship annual document of the Ministry of Finance, Government of India. It is traditionally presented in Parliament during the Budget Session, usually on January 31st, which falls in the month of January 2025.

• It is presented by the Union Finance Minister (currently Nirmala Sitharaman) in both the Lok Sabha and the Rajya Sabha. The presentation occurs exactly one day before the Union Budget is introduced.

• The document is prepared by the Economics Division of the Department of Economic Affairs (DEA) under the comprehensive guidance of the Chief Economic Advisor (CEA), currently V. Anantha Nageswaran.

• The Economic Survey serves as an official report card of the Indian Economy for the preceding financial year, detailing the performance of various sectors and the overall macroeconomic health of the nation.

• Since the Union Budget 2025-26 is scheduled for February 1, 2025, the preceding Economic Survey for the fiscal year 2024-25 is presented in January 2025 to provide the necessary context for the upcoming budget's proposals.

Additional Information

• Historical Context of the Survey:

• The first Economic Survey of India was presented in the year 1950-51.

• Up until 1964, the survey was presented along with the Union Budget. However, from 1964 onwards, it was decoupled and presented a day earlier to allow for a better understanding of the budget's background.

• Growth Projections and GDP:

• The survey provides GDP growth projections for the upcoming fiscal year. For 2024-25, it analyzes factors like inflation, fiscal deficit, and current account deficit.

• It helps the Government of India and the Reserve Bank of India (RBI) in formulating monetary and fiscal policies based on the data of the National Statistical Office (NSO).

• Key Sectoral Analysis:

• The document provides detailed chapters on the Agricultural Sector, Industrial Sector, and Services Sector.

• It also focuses on Foreign Exchange Reserves, Export-Import (EXIM) trends, and Sustainable Development Goals (SDGs).

Important Points

• Constitutional Status: While the Union Budget is a constitutional requirement under Article 112 (referred to as the Annual Financial Statement), the Economic Survey is not mandated by the Constitution of India. It is a settled convention that has become an integral part of the budget process.

• Interim Budget Exception: In an Election Year (such as 2024), the government may present an Interim Budget in February and a full budget along with the Economic Survey later in the year after the new government is formed. However, for a regular cycle like 2024-25 leading into 2025-26, the January presentation remains standard.

• Significance for Stakeholders: The survey is highly anticipated by economists, investors, and policymakers as it highlights the reforms needed and the challenges facing the Indian economy in the global context.

Q82. Answer: (c) Khangchendzonga National Park

The correct answer is Khangchendzonga National Park.

Key Points

• In the global review conducted by the International Union for Conservation of Nature (IUCN) in November 2025, Khangchendzonga National Park was rated as 'Good'. This rating signifies that the site's World Heritage values are well-protected and the management system is highly effective.

• The IUCN World Heritage Outlook is a flagship report released every three years that tracks whether the conservation of natural World Heritage sites is sufficient to protect them in the long term.

• Khangchendzonga National Park, situated in the heart of the Himalayas in Sikkim, is India’s first and only 'Mixed' World Heritage Site, recognized for both its natural and cultural significance since 2016.

• The 'Good' rating highlights the park's success in maintaining its unique high-altitude ecosystem and protecting rare species despite the challenges posed by climate change. Hence, the correct answer is Khangchendzonga National Park.

Additional Information

• Khangchendzonga National Park (KNP):

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• Located in the state of Sikkim, it includes a unique diversity of plains, valleys, lakes, glaciers, and spectacular snow-capped mountains covered with ancient forests.

• It is home to Mount Khangchendzonga, the third-highest peak in the world.

• The park provides a habitat for several endangered species, including the Snow Leopard, Red Panda, Himalayan Black Bear, and the Tibetan Wolf.

• Sundarbans National Park:

• Located in West Bengal, it is the world's largest mangrove forest.

• It is often categorized under 'Significant Concern' by the IUCN due to the rising sea levels and the high frequency of cyclones in the region.

• Great Himalayan National Park Conservation Area (GHNPCA):

• Located in Kullu, Himachal Pradesh, it was inscribed on the World Heritage List in 2014.

• It is characterized by high alpine peaks, alpine meadows, and riverine forests.

• Nanda Devi and Valley of Flowers National Parks:

• Located in Uttarakhand, these parks are renowned for their meadows of endemic alpine flowers and outstanding natural beauty.

• Nanda Devi National Park was inscribed in 1988, and the Valley of Flowers was added to the site in 2005.

Important Points

• The IUCN uses four categories to rate sites: Good, Good with Some Concern, Significant Concern, and Critical.

• The International Union for Conservation of Nature (IUCN) was established in 1948 and is headquartered in Gland, Switzerland. It serves as the official advisory body on nature to the UNESCO World Heritage Committee.

• As of 2025, the major threats identified for Indian natural heritage sites include invasive species, climate change, and infrastructure development.

Q83. Answer: (b) Tripura

The correct answer is Tripura.

Key Points

• In June 2025, the state of Tripura officially declared itself as the third state in India to achieve Full Functional Literacy under the ULLAS (Understanding Lifelong Learning for All in Society) initiative.

• The ULLAS scheme, also known as the New India Literacy Programme (NILP), is a centrally sponsored initiative aimed at empowering non-literates aged 15 years and above.

• The declaration came after the successful conduct of the Foundational Literacy and Numeracy Assessment Test (FLNAT), which verified the literacy skills of thousands of learners across the state's districts.

• This achievement places Tripura alongside other leading regions like Mizoram and the Union Territory of Ladakh, which were early achievers in reaching full functional literacy status under this framework.

• The success of the program in Tripura is attributed to the coordinated efforts of the State Literacy Mission Authority and the active participation of Volunteer Teachers (VTPs).

Additional Information

• The ULLAS Scheme:

• The Understanding Lifelong Learning for All in Society (ULLAS) was approved by the Government of India for implementation during the period FY 2022-2027.

• It is designed to align with the recommendations of the National Education Policy (NEP) 2020 to achieve 100% literacy in India.

• The scheme has five major components: Foundational Literacy and Numeracy, Critical Life Skills (including financial and digital literacy), Vocational Skills Development, Basic Education, and Continuing Education.

• Implementation and Technology:

• The scheme is implemented through volunteerism, encouraging students and citizens to provide social service as teachers for non-literate members of society.

• The ULLAS Mobile App serves as a digital platform for the registration of learners and volunteers, providing access to various teaching-learning materials (TLM).

• The National Institute of Open Schooling (NIOS) and the National Council of Educational Research and Training (NCERT) provide the academic support and assessment frameworks for the learners.

• Financial Allocation and Targets:

• The total financial outlay for ULLAS-NILP is Rs. 1037.90 crore, with the Central Government contributing Rs. 700 crore and the States contributing Rs. 337.90 crore.

• The scheme targets approximately 5 crore non-literates across the country, focusing on marginalized groups and regions with low literacy rates.

Important Points

• Functional Literacy: Unlike traditional literacy, functional literacy refers to the ability of an individual to engage in all those activities in which literacy is required for effective functioning of their group and community.

• FLNAT: The Foundational Literacy and Numeracy Assessment Test is a nationwide test conducted twice a year (usually in March and September) to certify the learners under the ULLAS program.

• Geographical Milestone: Tripura, located in Northeast India, has consistently maintained high literacy rankings, and this achievement under ULLAS reinforces its status as an educational hub in the region.

• Ministry of Education: The Department of School Education and Literacy under the Union Ministry of Education is the nodal agency responsible for the monitoring and evaluation of the scheme nationwide.

Q84. Answer: (b) Murlikant Petkar

The correct answer is Murlikant Petkar.

Key Points

• Murlikant Petkar was conferred with the prestigious Arjuna Lifetime Achievement Award in January 2025 in recognition of his pioneering contributions to Indian sports.

• He holds the distinction of being India's first Paralympic gold medalist, a feat he achieved more than five decades ago.

• His historic gold medal was won at the 1972 Summer Paralympics held in Heidelberg, West Germany.

• He competed in the 50m Freestyle swimming event, where he set a World Record at the time with a finish of 37.33 seconds.

• The award presented in 2025 serves to honor his legacy as the person who put India on the Paralympic map long before the nation became a regular contender for medals in the event.

Additional Information

• Military Career and Injury:

• Before becoming an athlete, Petkar was a soldier in the Indian Army, serving in the Corps of Electronics and Mechanical Engineers (EME).

• He sustained severe injuries, including nine bullet wounds, during the 1965 Indo-Pak War in the Sialkot sector, which led to him becoming paraplegic.

• Multifaceted Athlete:

• Petkar was a versatile sportsman; he initially represented India in Table Tennis at the 1968 Tel Aviv Paralympics.

• Apart from swimming, he has also competed internationally in Javelin Throw, Precision Javelin Throw, and Shot Put.

• National Honors:

• He was awarded the Padma Shri, India's fourth-highest civilian award, in 2018 by the Government of India.

• His life story was the inspiration for the 2024 biographical film titled "Chandu Champion", directed by Kabir Khan and starring Kartik Aaryan.

• Evolution of Awards:

• The Arjuna Award is usually given for outstanding performance over the previous four years, but the Lifetime Achievement category recognizes legends whose impact spans decades.

Important Points

• Devendra Jhajharia: He is another legendary para-athlete who won two gold medals in Javelin Throw (2004 Athens and 2016 Rio) and served as a major inspiration for the current generation.

• Mariyappan Thangavelu: He won the gold medal in the Men's High Jump T42 category at the 2016 Rio Paralympics.

• Deepa Malik: She was the first Indian woman to win a Paralympic medal, securing a silver in Shot Put at the 2016 Rio Games.

• Significance of 1972: Petkar's gold in 1972 was India's only individual Olympic or Paralympic gold until Abhinav Bindra won gold in 2008 and Devendra Jhajharia won in 2004.

Q85. Answer: (b) 8 March

The correct answer is 8 March.

Key Points

• International Women’s Day (IWD) is celebrated annually on 8 March to recognize the social, economic, cultural, and political achievements of women worldwide.

• The day also marks a call to action for accelerating gender parity and raising awareness about women's equality.

• The first National Woman's Day was observed in the United States on February 28, 1909, organized by the Socialist Party of America.

• The idea to make the day international was proposed by Clara Zetkin at the International Conference of Working Women in Copenhagen in 1910.

• As a result of the Copenhagen initiative, International Women’s Day was honored for the first time in Austria, Denmark, Germany, and Switzerland on 19 March 1911.

• The date of 8 March became fixed after women in Russia gained the right to vote following a strike for "Bread and Peace" in 1917, which began on 8 March (Gregorian calendar).

• The United Nations began celebrating International Women's Day in 1975, which was designated as International Women's Year.

Additional Information

• 16 June:

• This date is observed as the International Day of the African Child.

• It commemorates the 1976 Soweto Uprising in South Africa, where thousands of black school children protested against the poor quality of their education and demanded the right to be taught in their own language.

• It is also celebrated as Youth Day in South Africa to honor the students who lost their lives during the protest.

• 20 November:

• This date is recognized as World Children's Day (or Universal Children's Day).

• It marks the anniversary of the date in 1959 when the UN General Assembly adopted the Declaration of the Rights of the Child.

• It is also the date in 1989 when the UN General Assembly adopted the Convention on the Rights of the Child.

• 21 September:

• This date is observed as the International Day of Peace (World Peace Day).

• Established in 1981 by the United Nations, it is dedicated to world peace and specifically the absence of war and violence.

• The United Nations Peace Bell is rung at UN Headquarters in New York City to inaugurate the day.

• IWD Symbolism and Colors:

• The official colors of International Women's Day are Purple, Green, and White.

• Purple signifies justice and dignity; Green symbolizes hope; and White represents purity (though purity is a controversial concept, it was originally used by the Women's Social and Political Union in the UK).

Important Points

• In 1977, the United Nations General Assembly invited member states to proclaim March 8 as the UN Day for women's rights and world peace.

• Each year, the United Nations assigns a specific theme to the day. For example, the theme for 2024 was 'Invest in women: Accelerate progress'.

• International Women's Day is an official holiday in many countries, including Afghanistan, Armenia, Azerbaijan, Belarus, Cambodia, Cuba, Georgia, Laos, Mongolia, Montenegro, Russia, Tajikistan, Turkmenistan, Uganda, Ukraine, Uzbekistan, Vietnam, and Zambia.

Q86. Answer: (b) Mahendra Dev

The correct answer is Mahendra Dev.

Key Points

• Mahendra Dev was appointed as the Chairman of the Economic Advisory Council to the Prime Minister (EAC-PM) in June 2025.

• The Economic Advisory Council to the Prime Minister (EAC-PM) is an independent body constituted to provide expert advice on economic and related issues to the Prime Minister of India.

• Prior to this prestigious appointment, Mahendra Dev served as the Director and Vice-Chancellor of the Indira Gandhi Institute of Development Research (IGIDR) in Mumbai.

• He has also served as the Chairman of the Commission for Agricultural Costs and Prices (CACP), which is under the Ministry of Agriculture.

• His expertise spans development economics, agricultural policy, and poverty alleviation, making him a critical figure in shaping India's macroeconomic strategy for the mid-2020s.

Additional Information

• Economic Advisory Council to the Prime Minister (EAC-PM):

• It is a non-constitutional, non-permanent, and non-statutory body.

• The Council is tasked with analyzing any issue, economic or otherwise, referred to it by the Prime Minister.

• It maintains its secretariat within the NITI Aayog for administrative and logistical support.

• Other Economists in the Options:

• Poonam Gupta: She is the first female Director General of the National Council of Applied Economic Research (NCAER) and has been a member of the EAC-PM.

• Arvind Subramanian: A world-renowned economist who served as the Chief Economic Adviser (CEA) to the Government of India from 2014 to 2018.

• Vijay Kelkar: A veteran economist and civil servant who served as the Chairman of the 13th Finance Commission and is known for the Kelkar Committee reports on tax reforms and PPP models.

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Important Points

• The Chairman of the EAC-PM usually holds a rank equivalent to a Cabinet Minister in the Union Government.

• The EAC-PM has been instrumental in publishing major reports such as the Competitiveness Roadmap for India@100 and the State of Inequality in India Report.

• The council typically consists of full-time members and part-time members who are experts from academia and the private sector.

• The terms of reference for the EAC-PM include addressing macroeconomic issues, inflation, employment, and financial sector stability.

Q87. Answer: (d) Aluminium powder explosion

The correct answer is Aluminium powder explosion.

Key Points

• The tragic warehouse incident occurred in April 2025 in the state of Gujarat, which is a major industrial and chemical hub in India.

• Preliminary investigations and forensic reports identified that the root cause of the blast was an Aluminium powder explosion, categorized as a high-intensity dust explosion.

• Aluminium powder is extremely combustible and reactive; when it is finely divided, it has a very high surface-area-to-volume ratio, making it prone to rapid oxidation and ignition if suspended in the air.

• The explosion likely occurred due to the accumulation of metallic dust in a confined space, where a small spark or heat source triggered a primary explosion, followed by a more devastating secondary explosion as settled dust was lofted into the atmosphere.

• Industrial safety experts noted that Gujarat hosts numerous units involved in pigment manufacturing, pyrotechnics, and metallurgy, where such hazardous materials are commonly stored. Hence, the correct answer is Aluminium powder explosion.

Additional Information

• Properties of Aluminium Powder:

• It is a silvery-white powder used extensively in paints, explosives, rocket fuel, and solar cell manufacturing.

• In its powder form, aluminium reacts with oxygen and water (releasing hydrogen gas), which can create a pressurized and highly flammable environment in sealed containers.

• Combustible Dust Hazards:

• A dust explosion requires five elements: fuel (dust), dispersion, confinement, oxidizer (oxygen), and an ignition source.

• Unlike liquid fires, metal fires (Class D) cannot be extinguished with water, as water can exacerbate the reaction by producing hydrogen.

• Industrial Landscape of Gujarat:

• Gujarat contributes significantly to India's industrial output, particularly in the chemical and petrochemical sectors.

• Major industrial zones like Vapi, Ankleshwar, and Dahej are strictly monitored under the Factories Act, 1948, to prevent such catastrophic failures.

• Regulatory Framework:

• The Petroleum and Explosives Safety Organization (PESO) is the nodal agency in India for regulating hazardous substances under the Explosives Act, 1884.

• Companies are required to maintain a Material Safety Data Sheet (MSDS) for all reactive chemicals to ensure workers are aware of storage protocols and emergency response steps.

Important Points

• Prevention and Mitigation:

• Warehouses dealing with Aluminium powder must utilize explosion-proof lighting and non-sparking tools to minimize ignition risks.

• Effective ventilation systems and dust extraction units are mandatory to keep the concentration of airborne particles below the Lower Explosive Limit (LEL).

• Regular safety audits and mock drills are emphasized by the National Disaster Management Authority (NDMA) to improve resilience against industrial disasters in high-risk zones.

Q88. Answer: (b) Cricket

The correct answer is Cricket.

Key Points

• The Laureus World Sports Awards are considered the most prestigious honors in the international sporting calendar, often referred to as the "Oscars of Sports." They celebrate the greatest sporting achievements of the previous calendar year.

• Gymnastics: This sport was represented by Simone Biles, who won the Laureus World Sportswoman of the Year award in 2025 (following her record-breaking performance at the 2024 Paris Olympics). Gymnastics has a strong history of representation in

individual categories due to the global impact of its stars. Hence, Gymnastics is represented.

• Tennis: In the 2025 cycle, Tennis featured prominently with athletes like Novak Djokovic or Carlos Alcaraz being recognized in the World Sportsman of the Year or Breakthrough of the Year categories. Tennis is a staple at the Laureus awards, with legends like Roger Federer holding record wins. Hence, Tennis is represented.

• Surfing: This sport is typically represented in the Laureus World Action Sportsperson of the Year category. In the 2025 awards, top surfers like Caroline Marks or John John Florence were acknowledged for their achievements in the World Surf League and Olympic stages. Hence, Surfing is represented.

• Cricket: Despite the high popularity of the T20 World Cup and other major tournaments in 2024, Cricket was not represented among the individual award winners for the 2025 Laureus ceremony. While cricket teams sometimes appear in the Team of the Year nominations, individual cricketers rarely win against global individual sport stars like those in athletics, tennis, or gymnastics. Hence, the correct answer is Cricket.

Additional Information

• History and Foundation: The Laureus World Sports Awards were established in 1999 by founding patrons Daimler and Richemont. The inaugural ceremony was held in May 2000 in Monte Carlo, where Tiger Woods and Marion Jones were the first major winners.

• The Selection Process: The awards involve a two-step process. First, a Nominations Panel of over 1,000 sports journalists from over 70 countries selects a shortlist. Then, the members of the Laureus World Sports Academy—a group of over 70 living sporting legends—vote by secret ballot to select the winners.

• Major Categories: The core individual awards include World Sportsman of the Year, World Sportswoman of the Year, World Breakthrough of the Year, World Comeback of the Year, and World Action Sportsperson of the Year. There is also a Sport for Good award, which recognizes organizations using sport to improve lives.

• Laureus Sport for Good: Beyond the glitz of the awards, the Laureus Sport for Good Foundation supports more than 160 projects in over 40 countries. The foundation uses the power of sport to end violence, discrimination, and disadvantage for young people around the globe.

• Notable Figures: Roger Federer holds the record for the most Laureus awards won by a single athlete, with six trophies (five for Sportsman of the Year and one for Comeback of the Year). Usain Bolt and Novak Djokovic are also among the most decorated athletes in the history of the event.

Important Points

• 2025 Ceremony Context: The 2025 awards celebrated achievements from the 2024 calendar year, which was dominated by the Paris Olympic Games. This resulted in a heavy concentration of winners from Olympic disciplines such as Athletics, Swimming, and Gymnastics.

• Individual vs. Team Recognition: While Cricket stars like Virat Kohli or Pat Cummins may be icons, the Laureus individual categories are historically dominated by sports with a singular global tour (like Tennis or Golf) or Olympic importance. Cricket is more frequently considered for the Team of the Year award rather than individual honors.

Q89. Answer: (d) NISAR

The correct answer is NISAR.

Key Points

• NISAR (NASA-ISRO Synthetic Aperture Radar) is a joint Earth-observation mission between the National Aeronautics and Space Administration (NASA) of the United States and the Indian Space Research Organisation (ISRO).

• Scheduled for launch in 2025 (specifically targeted around July 2025 as per mission updates), this initiative stands as a premier example of international scientific collaboration in space exploration.

• The mission aims to provide a detailed view of Earth using Synthetic Aperture Radar (SAR) technology, which can observe the planet's surface in all weather conditions, day and night.

• It is the first satellite mission to use two different radar frequencies: the L-band (provided by NASA) and the S-band (provided by ISRO), allowing for high-resolution mapping of ecosystems and ice mass.

• The satellite will map the entire globe every 12 days, providing spatially and temporally consistent data for understanding changes in Earth’s ecosystems, ice sheets, and natural hazards.

Additional Information

• Mission Objectives and Applications:

• The primary goal of NISAR is to measure Earth’s changing ecosystems, dynamic surfaces, and ice masses, offering insights into biomass, natural hazards, and groundwater.

• It will monitor crustal deformation caused by earthquakes, volcanoes, and landslides, helping in disaster management and risk assessment.

• The data will assist in tracking sea level rise and the rate of glacier melting in the Arctic and Antarctic regions.

• Technical Contributions:

• ISRO is responsible for providing the S-band radar, the spacecraft bus, and the launch services using the GSLV Mark II

(Geosynchronous Satellite Launch Vehicle).

• NASA provides the L-band SAR, a high-rate communication subsystem for science data, GPS receivers, and a solid-state recorder.

• The L-band SAR has a wavelength of about 24 centimeters, while the S-band SAR has a wavelength of about 10 centimeters, making them ideal for different types of surface penetration and sensitivity.

• Other Mentioned Initiatives:

• Gaganyaan: India's first human spaceflight mission, which aims to demonstrate indigenous capability by sending a crew of three members to an orbit of 400 km for a 3-day mission.

• Aditya-L1/L2: Aditya-L1 was launched in September 2023 as India's first dedicated mission to study the Sun from the Lagrange point 1. Aditya-L2 is a conceptualized follow-up mission.

• GSAT-12: A communication satellite launched by ISRO in July 2011 to provide services like tele-education, tele-medicine, and Village Resource Centres.

• Global Impact:

• The NISAR mission data will be open-access, supporting the global scientific community in climate change research and sustainable agriculture.

• It represents a strategic partnership signed in 2014, showcasing the growing Indo-US space cooperation.

Q90. Answer: (a) National Sports Governance Bill, 2025

The correct answer is National Sports Governance Bill, 2025.

Key Points

• The National Sports Governance Bill, 2025 was approved by the Rajya Sabha on 12 August 2025. This legislation marks a significant shift in how sports are administered in the country by providing a statutory framework for the recognition and regulation of sports bodies.

• The primary objective of the bill is to recognize national sports organisations (NSOs) and oversee their operations to ensure they adhere to principles of transparency and accountability.

• Under this Act, the Central Government is empowered to grant recognition to National Sports Federations (NSFs) and the Indian Olympic Association (IOA), provided they comply with the prescribed governance standards. Hence, the bill aims to streamline the functioning of these bodies.

• The bill introduces a National Sports Regulatory Board, which will act as an apex body to monitor the compliance of various sports organizations with the new National Sports Code.

• It emphasizes athlete-centric administration, ensuring that the interests of sportspersons are prioritized over administrative bureaucracy in National Sports Organisations.

Additional Information

• Regulatory Framework: Before this bill, sports governance was largely guided by the National Sports Development Code of India, 2011. The 2025 Bill codifies many of these guidelines into law, making them legally binding on all recognized sports entities.

• Dispute Resolution: The bill proposes the establishment of a National Sports Dispute Resolution and Appellate Tribunal. This body will handle grievances related to selection disputes, disciplinary actions, and anti-doping violations, providing an alternative to traditional civil courts.

• International Alignment: One of the key features of the legislation is to align Indian sports governance with the Olympic Charter and the guidelines of International Sports Federations. This is crucial for avoiding suspensions from international bodies like the International Olympic Committee (IOC).

• Promotion of Integrity: The bill contains specific provisions to combat match-fixing, age fraud, and sexual harassment in sports. It mandates the creation of Internal Complaints Committees in every sports organization as per the POSH Act.

Important Points

• Tenure and Age Limits: To prevent the monopolization of power, the bill enforces strict tenure limits and an age cap of 70 years for office bearers of sports federations, similar to the Lodha Committee recommendations for cricket.

• Gender Representation: A mandatory requirement of at least 30% representation of women in the executive committees of all recognized National Sports Federations has been introduced to promote gender equality in sports management.

• Financial Accountability: Any sports organization receiving government grants or financial assistance will be subject to audit by the Comptroller and Auditor General (CAG) of India to ensure the proper utilization of public funds.

• Athlete Commissions: The legislation mandates that every National Sports Organisation must have an Athletes' Commission, where active or recently retired athletes have a voice in the decision-making process.

Q91. Answer: (d) 30 days

The correct answer is 30 days.

Key Points

• The Constitution (One Hundred and Thirtieth Amendment) Bill was introduced in the Lok Sabha on 20 August 2025. This landmark legislation aims to address legal ambiguities regarding the continuation of high-ranking officials in office while under judicial or police custody.

• According to the provisions of the bill, any Central Minister or State Minister who is detained for a period of 30 consecutive days or more must be removed from their position. This rule applies specifically when the detention is related to corruption or other serious criminal charges.

• The bill seeks to establish a mandatory timeframe to ensure that the governance of the country or a state is not hampered by the physical absence or legal entanglements of a member of the Council of Ministers.

• The threshold of 30 days was determined to allow for a reasonable period for legal recourse or bail applications, while ensuring that prolonged judicial custody does not lead to a vacuum in administrative leadership.

• Prior to this amendment, there was no specific constitutional provision that mandated the automatic removal of a minister solely based on detention; removal was largely dependent on the discretion of the Prime Minister or Chief Minister, or upon conviction under the Representation of the People Act.

Additional Information

• Constitutional Provisions for Ministers:

• At the Union level, Article 75 of the Constitution of India states that ministers are appointed by the President on the advice of the Prime Minister and hold office during the pleasure of the President.

• At the State level, Article 164 contains similar provisions, where ministers hold office during the pleasure of the Governor. The 130th Amendment Bill adds a specific condition to these articles regarding detention.

• Corruption and Serious Charges:

• The bill targets offenses under the Prevention of Corruption Act, 1988, and other serious charges involving moral turpitude or threats to national security. The aim is to uphold the integrity of the executive branch.

• Difference between Detention and Conviction:

• Under the Representation of the People Act, 1951, a legislator is disqualified only upon conviction with a sentence of two years or more. However, the 2025 Amendment focuses on the detention stage (pre-trial or during trial) to prevent "governance from jail."

• Legislative Process:

• Being a Constitution Amendment Bill, it requires a special majority in both Houses of Parliament (Lok Sabha and Rajya Sabha) as per Article 368. This means a majority of the total membership of each House and a majority of not less than two-thirds of the members present and voting.

• Impact on Public Accountability:

• This amendment is seen as a step toward Zero Tolerance for corruption in public life. It ensures that individuals holding constitutional posts are held to a higher standard of accountability and transparency.

Q92. Answer: (d) Dr Dev Pragad

The correct answer is Dr Dev Pragad.

Key Points

• The 18th Pravasi Bharatiya Divas (PBD) Convention was held from 8th to 10th January 2025 in Bhubaneswar, Odisha.

• Dr Dev Pragad, the Chief Executive Officer (CEO) of the global media company Newsweek, served as the Guest of Honour for the convention.

• The theme for the 2025 convention was "Pravasi Bharatiya: Trusted Partners for India’s Progress in Amrit Kaal," emphasizing the role of the Indian diaspora in the nation's development.

• The event was officially inaugurated by Prime Minister Narendra Modi on January 9, 2025, which is the main day of the celebrations.

• The convention serves as a platform for the Government of India to engage with the Overseas Indian community and address their concerns while celebrating their achievements. Hence, the correct answer is Dr Dev Pragad.

Additional Information

• Significance of January 9:

• Pravasi Bharatiya Divas is celebrated on 9 January to mark the return of Mahatma Gandhi, the greatest 'Pravasi', from South Africa to India (specifically Mumbai) in the year 1915.

• The formal celebration of PBD began in 2003 under the administration of then-Prime Minister Atal Bihari Vajpayee.

• Evolution of the Convention:

• Since 2015, the format of PBD was changed to be celebrated once every two years (biennial) instead of every year.

• The 17th Pravasi Bharatiya Divas was held in Indore, Madhya Pradesh, in 2023, where Dr. Mohamed Irfaan Ali, the President of Guyana, was the Chief Guest.

• Pravasi Bharatiya Samman Awards:

• This is the highest honour conferred on Non-Resident Indians (NRIs), Persons of Indian Origin (PIOs), or an organization

established by them.

• The awards are traditionally conferred by the President of India (currently Droupadi Murmu) during the valedictory session of the convention.

• Ministry Involvement:

• The Ministry of External Affairs is the nodal agency for organizing this event, often in partnership with a host State Government and industry bodies like FICCI or CII.

Important Points

• Other Distinguished Guests in 2025:

• While Dr Dev Pragad was the Guest of Honour, the Chief Guest for the 18th PBD was H.E. Pravind Kumar Jugnauth, the former Prime Minister of Mauritius.

• The Youth Pravasi Bharatiya Divas, held on the first day (8 January), usually features a prominent young leader from the diaspora as a special guest.

• Focus Areas:

• The 2025 convention in Bhubaneswar specifically highlighted Odisha's potential in technology, tourism, and sports infrastructure, encouraging the Indian diaspora to invest in the state.

• The concept of Amrit Kaal refers to the 25-year period leading up to the centenary of India's independence in 2047, during which the diaspora is expected to play a crucial role in making India a Viksit Bharat (Developed India).

Q93. Answer: (d) 9 September 2025

The correct answer is 9 September 2025.

Key Points

• In an announcement made in June 2025, it was revealed that the world-renowned author Dan Brown is set to release a new installment in his famous Robert Langdon series.

• The title of the upcoming thriller is The Secret of Secrets, which marks the sixth book featuring the iconic professor of symbology.

• The official publication date for this highly anticipated novel is scheduled for 9 September 2025. Hence, the correct date is 9 September 2025.

• The release is expected to be a global event, handled by major publishing houses such as Doubleday in the United States and Transworld in the United Kingdom.

• Fans have been waiting for this release since the previous book in the series, Origin, which was published in 2017.

Additional Information

• Dan Brown's Literary Career:

• Dan Brown is an American author born on 22 June 1964, in Exeter, New Hampshire.

• He became a global phenomenon with the publication of The Da Vinci Code in 2003, which has sold over 80 million copies worldwide.

• His works are known for their blend of cryptography, keys, symbols, and conspiracy theories involving historical and religious organizations.

• The Robert Langdon Series:

• The series began with Angels & Demons (published in 2000), followed by the record-breaking The Da Vinci Code.

• Subsequent titles include The Lost Symbol (2009), Inferno (2013), and Origin (2017).

• The character Robert Langdon is a professor at Harvard University specializing in religious symbology and iconology.

• Impact and Adaptations:

• Brown's novels have been translated into more than 56 languages and have sold more than 250 million copies as of recent estimates.

• Several of his books have been adapted into major motion pictures starring Tom Hanks, directed by Ron Howard.

• His writing style often involves a 24-hour time frame and a fast-paced narrative that takes place in historically rich locations like Rome, Paris, and Washington, D.C.

Important Points

• The upcoming book, The Secret of Secrets, is rumored to delve into the mysteries of ancient manuscripts and modern technological enigmas.

• Publication of a Robert Langdon thriller typically leads to a significant surge in "literary tourism" to the cities and landmarks mentioned in the plot.

• Collectors and bibliophiles often look for the First Edition copies which are released on the primary publication date of 9 September 2025.

• The book will be available in multiple formats including hardcover, ebook, and audiobook simultaneously on the release day.

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Q94. Answer: (a) 7

The correct answer is 7.

Key Points

• The Ministry of Home Affairs announced the Padma Awards for the year 2025 on the eve of India's 76th Republic Day (January 25, 2025).

• For the year 2025, the President of India approved a total of 132 Padma Awards to be conferred upon distinguished individuals across various fields.

• The total count of awards includes 7 Padma Vibhushan, which is the second-highest civilian award in the country, followed by 11 Padma Bhushan and 114 Padma Shri awards.

• The Padma Vibhushan is awarded for exceptional and distinguished service in any field, including service rendered by Government servants (excluding doctors and scientists).

• Among the 132 awardees, 30 are women, and the list also features 8 persons from the category of Foreigners/NRI/PIO/OCI and 9 Posthumous awardees.

Additional Information

• History of the Awards: The Padma Awards were instituted in the year 1954. They are one of the highest civilian honors of India, announced annually on the occasion of Republic Day.

• Categories:

• Padma Vibhushan: For exceptional and distinguished service.

• Padma Bhushan: For distinguished service of a high order.

• Padma Shri: For distinguished service in any field such as Art, Social Work, Public Affairs, Science and Engineering, Trade and Industry, Medicine, Literature and Education, Sports, and Civil Service.

• Selection Process: The nominations are considered by the Padma Awards Committee, which is constituted by the Prime Minister every year. The committee is headed by the Cabinet Secretary.

• Presentation: The awards are presented by the President of India at a formal ceremony held at Rashtrapati Bhavan, typically in the months of March or April.

Important Points

• Maximum Limit: According to the guidelines, the total number of awards given in a single year (excluding posthumous awards and those given to foreigners) should not exceed 120.

• Bharat Ratna: This is the highest civilian award in India. While Padma Awards recognize "distinguished service," the Bharat Ratna is awarded for the "highest degree of national service."

• Interruptions: The awards have been announced every year since their inception, except for short interruptions during the years 1978, 1979, and from 1993 to 1997.

• Field of Recognition: The 2025 list highlights a significant emphasis on Social Work and Science and Engineering, reflecting the nation's current developmental priorities and cultural heritage.

Q95. Answer: (b) Chiang Min Yu

The correct answer is Chiang Min Yu.

Key Points

• The final of the 17th World Soft Tennis Championship, held in November 2024, saw a historic clash in the Girls' Singles (Under-15) category.

• Chiang Min Yu, representing Chinese Taipei, defeated India's Tanushree Pandey to claim the Gold Medal in the championship.

• The prestigious tournament was hosted in Jingshan, located in the Hubei Province of China, which is recognized as a major hub for the sport.

• By reaching the final and securing the Silver Medal, Tanushree Pandey became the first Indian girl to ever reach the final of a World Soft Tennis Championship, marking a significant milestone for Indian sports.

• The victory of Chiang Min Yu further solidified the dominance of Chinese Taipei in international soft tennis competitions, a sport where they have traditionally been very strong.

Additional Information

• Soft Tennis Overview:

• Soft Tennis is a racket sport that originated in Japan in the late 19th century. It differs from regular lawn tennis primarily by the use of soft rubber balls that are inflated with air.

• The sport is governed globally by the International Soft Tennis Federation (ISTF) and is included in major multi-sport events like the Asian Games.

• 17th World Soft Tennis Championship:

• The 2024 edition in Jingshan featured participants from over 30 countries, including powerhouses like Japan, South Korea, and

China.

• The event included various categories such as Singles, Doubles, and Team events for both seniors and juniors (Under-15, Under-18, and Under-21).

• Jingshan, China:

• The city of Jingshan is often referred to as the "Tennis City of China". It has hosted several international tournaments and possesses state-of-the-art tennis facilities to promote the growth of the sport in the region.

• India's Progress in Soft Tennis:

• The Amateur Soft Tennis Federation of India (ASTFI) is the national governing body responsible for selecting players for international stages.

• The success of players like Tanushree Pandey in 2024 highlights the rising popularity and competitive level of the sport in India, particularly at the grassroots and junior levels.

Important Points

• Technical Differences: In soft tennis, the rackets are usually lighter and the strings have lower tension compared to lawn tennis to accommodate the lighter rubber ball.

• Medal Tally 2024: India finished the 17th World Soft Tennis Championship with a total of six medals, including one Silver (by Tanushree Pandey) and five Bronze medals, marking one of their most successful outings in the tournament's history.

• Key Competitors: Apart from Chiang Min Yu, other top players in the tournament hailed from South Korea and Japan, nations that have historically shared the majority of gold medals in world championships.

Q96. Answer: (a) Sustainable Cities Integrated Pilot Approach

The correct answer is Sustainable Cities Integrated Pilot Approach.

Key Points

• In 2025, the Guntur Municipal Corporation (GMC) in Andhra Pradesh initiated a major environmental drive by deploying over 200 electric autos for municipal services.

• The primary function of these e-autos is to facilitate door-to-door garbage collection across the city, ensuring a more efficient and eco-friendly waste management system. Hence, the statement regarding Guntur's deployment under this specific project is correct.

• This initiative was implemented under the Sustainable Cities Integrated Pilot Approach (SCIPA), which is a collaborative project aimed at integrating sustainability into urban planning.

• The project is supported by the United Nations Industrial Development Organization (UNIDO) and the Global Environment Facility (GEF) in partnership with India's Ministry of Housing and Urban Affairs (MoHUA).

• The deployment of electric vehicles (EVs) helps in reducing the carbon footprint of the urban local body and aligns with the national goal of transitioning to clean energy.

Additional Information

• Sustainable Cities Integrated Pilot Approach (SCIPA):

• This project focuses on low-carbon urban development and integrated waste management solutions.

• It targets specific pilot cities in India, including Guntur and Vijayawada in Andhra Pradesh, to demonstrate sustainable models that can be replicated nationwide.

• Key components include composting, recycling, and the use of electric mobility to minimize environmental degradation.

• Guntur Municipal Corporation (GMC):

• Guntur is a major city in Andhra Pradesh known for its proactive stance in the Swachh Bharat Mission.

• The GMC has been focusing on achieving a higher rank in the Swachh Survekshan index by adopting modern technologies for solid waste management.

• The 200+ e-autos are equipped with GPS tracking to monitor the real-time movement and efficiency of garbage collection.

• Significance of Electric Mobility in Waste Management:

• Traditional diesel or petrol vehicles used for waste collection contribute significantly to air pollution and noise pollution in residential areas.

• The shift to electric autos reduces operational costs for the municipality due to lower maintenance and fuel expenses.

• It supports India's commitment to the Paris Agreement by promoting decarbonization in the transport sector.

Important Points

• Global Collaboration: The involvement of UNIDO and GEF provides technical expertise and funding to help Indian cities implement climate-resilient infrastructure.

• Year of Implementation: The scale-up of this project in Guntur reached a milestone in 2025, marking it as a leader in sustainable urban transport within the state.

• Impact on Livelihoods: The project also aims to provide better working conditions for sanitation workers by providing modern,

easy-to-operate electric vehicles.

Q97. Answer: (c) Maharashtra

The correct answer is Maharashtra.

Key Points

• In June 2025, the state of Maharashtra officially launched an advanced Artificial Intelligence (AI) powered system specifically engineered for the cybercrime protection of women and children.

• The initiative is designed to address the rising instances of digital harassment, cyberstalking, and the spread of deepfakes, providing a safer digital environment for vulnerable demographics.

• The AI framework utilizes predictive analytics and natural language processing to monitor and flag suspicious activities on social media and messaging platforms in real-time.

• This system is integrated with the Maharashtra State Cyber Cell, enabling automated First Information Report (FIR) drafting and faster triage of cases involving minors and women.

• The project is part of the Maharashtra Cyber Security Project Phase II, which aims to make the state a global hub for cybersecurity excellence and digital forensics.

Additional Information

• National Cyber Crime Reporting Portal:

• The Government of India maintains a centralized portal (www.cybercrime.gov.in) where citizens can report cybercrimes, with a special focus on crimes against women and children.

• The National Helpline Number 1930 serves as an immediate response mechanism for reporting financial cyber frauds.

• Legal Framework in India:

• The Information Technology Act, 2000, particularly Section 66E (violation of privacy) and Section 67 (publishing obscene material), provides the legal basis for prosecuting cyber offenders.

• The transition to the Bharatiya Nyaya Sanhita (BNS) has further strengthened provisions related to organized cybercrime and digital safety.

• I4C (Indian Cyber Crime Coordination Centre):

• Established by the Ministry of Home Affairs (MHA), I4C acts as a nodal agency to coordinate between Law Enforcement Agencies (LEAs) of different States and Union Territories.

• It focuses on identifying cybercrime trends and enhancing capacity building for police officers across India.

• AI in Law Enforcement:

• Modern policing increasingly uses Machine Learning (ML) for sentiment analysis and automated threat detection to prevent online grooming and exploitation.

Important Points

• Data Privacy Standards: The AI system launched in Maharashtra is built to comply with the Digital Personal Data Protection (DPDP) Act, 2023, ensuring that the personal data of victims is handled with the highest degree of confidentiality.

• Digital Forensics: Maharashtra has established dedicated cyber police stations in all 36 districts and 34 police commissionerates to handle technical investigations.

• Awareness Campaigns: Complementing the AI tool, the state conducts the Cyber Safe Girl campaign and Cyber Literacy workshops in schools to educate youth about safe internet practices and the risks of oversharing.

• Global Context: The use of Artificial Intelligence for protection aligns with the Budapest Convention on Cybercrime, emphasizing international cooperation to mitigate transnational digital threats.

Q98. Answer: (a) England

The correct answer is England.

Key Points

• In the ICC Champions Trophy 2025, Australia created a new record for the highest successful run chase in the history of the tournament by chasing down a target of 356.

• The record-breaking feat was achieved against England, who had posted a massive total of 355 runs in their allotted overs.

• Australia reached the target in the final overs, finishing at 356/5. This performance highlighted the aggressive batting depth of the Australian squad during the 2025 edition held in Pakistan.

• Prior to this, the record for the highest chase in the Champions Trophy was significantly lower, making this 350-plus chase a landmark event in One Day International (ODI) cricket history.

• The match was a crucial encounter that showcased the high-scoring nature of the pitches prepared for the 2025 event, specifically at venues like Lahore and Rawalpindi.

Additional Information

• ICC Champions Trophy 2025:

• The 2025 tournament was the 9th edition of the ICC Champions Trophy, an ODI cricket tournament contested by the top eight men's national teams.

• The event returned to the cricket calendar after an eight-year gap, with the previous edition having taken place in 2017 in England and Wales.

• The host country for the 2025 edition was Pakistan, marking the return of a major ICC multi-team event to the nation.

• Australia's Legacy in ICC Events:

• Australia is one of the most successful teams in ICC history, having won the Champions Trophy twice consecutively in 2006 and 2009.

• Their ability to chase high totals is a testament to their power-hitting capabilities and tactical approach to the middle overs of an ODI innings.

• England's Recent ODI Form:

• Despite setting a target of 355, England faced challenges in their bowling department, which struggled to contain the Australian batsmen on a flat track.

• England has been a pioneer of high-scoring ODI cricket since 2015, but this match proved that defensive bowling remains a challenge against elite opposition.

Important Points

• Statistical Highlights:

• The successful chase of 356/5 stands as a testament to the evolving nature of white-ball cricket where totals above 350 are no longer considered safe.

• Key contributors in the Australian lineup included top-order batters who maintained a strike rate of over 100 throughout the chase.

• Format and Qualification:

• The qualification for the 2025 Champions Trophy was based on the 2023 ICC Cricket World Cup group stage standings, ensuring only the most elite teams participated.

• The tournament format consisted of two groups of four teams, followed by semi-finals and a final.

• Historical Context:

• Before the 2025 record, the highest chase in a Champions Trophy was 297 runs, achieved by Sri Lanka against England in 2013. Australia's effort against England in 2025 broke this long-standing record by a massive margin.

Q99. Answer: (d) Sri Lanka

The correct answer is Sri Lanka.

Key Points

• According to the data compiled by the Tea Board of India and released in March 2025, India has emerged as the second-largest tea exporter in the world for the calendar year 2024.

• India achieved this milestone by surpassing Sri Lanka, which had long held a dominant position in the global tea export market.

• Indian tea exports in 2024 surged to approximately 245 million kg, showing a robust growth compared to the previous year's figures.

• The growth is primarily driven by a significant increase in shipments to traditional markets like Russia, the CIS countries, and Iran, as well as expansion into new territories in the Middle East.

• While Kenya continues to maintain its position as the world's largest tea exporter, India's rise to the second spot highlights the increasing global demand for Indian Orthodox and CTC (Crush, Tear, Curl) tea varieties.

Additional Information

• Tea Board of India:

• It is a statutory body established under the Tea Act, 1953, and it started functioning in April 1954.

• The board functions under the administrative control of the Ministry of Commerce and Industry, Government of India.

• It is headquartered in Kolkata and is responsible for the promotion of tea cultivation, processing, and domestic and international trade.

• Tea Production in India:

• India is the second-largest producer of tea in the world, with China holding the top position.

• The state of Assam is the largest producer of tea in India, followed by West Bengal (notably the Darjeeling and Dooars regions) and Tamil Nadu.

• Darjeeling Tea was the first Indian product to receive the Geographical Indication (GI) tag in 2004-2005.

• Export Destinations and Varieties:

• The major importers of Indian tea include Russia, the United Arab Emirates (UAE), Iran, the USA, and the UK.

• India primarily exports two types of tea: CTC, which is widely consumed for its strength, and Orthodox tea, which is preferred in

international markets for its aroma and flavor.

• Global Context:

• In 2024, Sri Lanka faced various production challenges and economic shifts that impacted its export volumes, allowing India to increase its market share.

• Tea remains one of the most important agro-based industries in India, providing direct employment to over 1.2 million workers, a large percentage of whom are women.

Important Points

• The Tea Board consists of 31 members, including the Chairman, and represents various stakeholders such as owners, workers, and consumers.

• Climatic Requirements: Tea cultivation requires a hot and humid climate with temperatures ranging between 20°C to 30°C and an annual rainfall of 150-300 cm.

• Soil requirements involve well-drained deep loamy soil with a rich organic content. It is typically grown on sloping terrain to prevent waterlogging, which is harmful to the roots.

Q100. Answer: (c) Dharuhera

The correct answer is Dharuhera.

Key Points

• According to the analysis by the Finland-based Centre for Research on Energy and Clean Air (CREA), Dharuhera in Haryana emerged as the most polluted city in India during October 2024/2025.

• The city recorded a monthly average PM2.5 concentration of 123 micrograms per cubic meter (µg/m³), which is significantly higher than the National Ambient Air Quality Standards (NAAQS) daily limit of 60 µg/m³.

• Dharuhera is a major industrial hub located in the Rewari district of Haryana, positioned within the National Capital Region (NCR), making it highly susceptible to regional pollution trends.

• The report highlights that the air quality in the NCR deteriorated rapidly during this period due to a combination of industrial emissions, vehicular pollution, and unfavorable meteorological conditions typical of the onset of winter.

• While Delhi often remains the focus of pollution discourse, this data indicates that surrounding industrial towns like Dharuhera frequently record even higher concentrations of fine particulate matter.

Additional Information

• Centre for Research on Energy and Clean Air (CREA): It is an independent research organization headquartered in Helsinki, Finland. It tracks air pollution trends and energy transitions globally to provide data-driven insights for policy changes.

• PM2.5 (Particulate Matter 2.5): These are fine inhalable particles with diameters that are generally 2.5 micrometers and smaller. Due to their tiny size, they can bypass the nose and throat and penetrate deep into the lungs and even enter the bloodstream, posing severe health risks like respiratory and cardiovascular diseases.

• Comparison with Delhi: In the same period, Delhi recorded a monthly PM2.5 average of approximately 105 to 110 µg/m³. Although extremely high, it was lower than the levels recorded in Dharuhera.

• Causes of Pollution in NCR: The primary drivers during October and November include stubble burning in the neighboring states of Punjab and Haryana, biomass burning for heating, construction dust, and thermal power plant emissions.

• National Ambient Air Quality Standards (NAAQS): These standards are notified by the Central Pollution Control Board (CPCB) under the Air (Prevention and Control of Pollution) Act, 1981. For PM2.5, the annual average limit is 40 µg/m³, while the 24-hour limit is 60 µg/m³.

Important Points

• Graded Response Action Plan (GRAP): To combat rising pollution in the Delhi-NCR region, the Commission for Air Quality Management (CAQM) implements GRAP, which consists of four stages based on the Air Quality Index (AQI) levels (Poor, Very Poor, Severe, and Severe Plus).

• Industrial Impact: Dharuhera houses numerous manufacturing units and auto-component industries. The concentration of heavy machinery and logistical movement contributes to localized nitrogen dioxide (NO2) and particulate matter spikes.

• Geographical Factors: During October, the "withdrawal of the monsoon" leads to low wind speeds and temperature inversion, which traps pollutants near the ground, preventing their dispersion and leading to the "smog" effect across the Indo-Gangetic Plain.

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