RRB Group D Official Paper (Held On: 22 Dec, 2025 Shift 3) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. According to Bohr, electrons revolve:

(a) in fixed circular orbits called shells
(b) inside the nucleus of an atom
(c) only when energy is absorbed
(d) in elliptical orbits randomly

Q2. What can be the consequences of improper storage of grains?

(a) Better nutrition
(b) Stronger grains
(c) More fragrance
(d) Pest attack and spoilage

Q3. A wooden block weighs 49 N (thrust). If this block is placed on a table with a contact area of 0.02 m^2, what is the resulting pressure exerted on the table?

(a) 2450 Nm^(-2)
(b) 49 Pa
(c) 980 Nm^(-2)
(d) 612.5 Nm^(-2)

Q4. Which of the following pairs of frequency and time period is correctly related?

(a) 5 Hz and 5 s
(b) 2 Hz and 0.2 s
(c) 1 Hz and 2 s
(d) 10 Hz and 0.1 s

Q5. Which of the following is NOT an outcome of fertilisation?

(a) Zygote formation
(b) Placenta formation
(c) Egg formation
(d) Embryo formation

Q6. Which of the following generally forms the longest part of a neuron?

(a) Synapse
(b) Cell body
(c) Nerve ending
(d) Axon

Q7. Which of the following is NOT a type of connective tissue?

(a) Bone
(b) Blood
(c) Cartilage
(d) Epithelium

Q8. An object is placed anywhere along the principal axis of a concave lens. The image is always formed _____.

(a) beyond twice the focal length (2F)
(b) at twice the focal length (2F)
(c) between the focus (F) and the optical centre (O)
(d) at the focus (F)

Q9. The 'p' in pH stands for _____and it is used for measuring _____ concentration.

(a) Potenz; hydroxide ion
(b) Potenz; hydrogen ion
(c) Potential; hydroxide ion
(d) Potential; hydrogen ion

Q10. If the applied force is quadrupled, how must the acceleration of the object change, assuming its mass remains constant?

(a) The acceleration remains the same, but the duration of the change decreases.
(b) The acceleration increases by a factor of 4.
(c) The acceleration decreases by a factor of 4.
(d) The acceleration increases by a factor of 2.

Q11. A potential difference of V volt is applied across a resistor of R Ω, then a current of I ampere flows through it. Keeping the resistance the same, how should the value of potential difference be changed so that the current flowing through the resistance gets doubled? (Keep all the other parameters the same.)

(a) V volts
(b) V/2 volts
(c) V/4 volts
(d) 2V volts

Q12. What is the immediate result of the fusion between the male and female germ cells in plants?

(a) Seed coat
(b) Ovule
(c) Zygote
(d) Pollen tube

Q13. Some organisms show binary fission by division in any plane but some shows division in a definite orientation. Which of the following shows definite orientation of binary fission?

(a) Plasmodium
(b) Paramecium
(c) Amoeba
(d) Leishmania

Q14. Which of the following is NOT an olfactory indicator?

(a) Turmeric
(b) Vanilla extract
(c) Clove oil
(d) Onion

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Q15. Which statement about parallel connection of resistors is true?

(a) Each resistor carries the same current regardless of its resistance.
(b) The total current is the sum of the currents through individual resistors.
(c) The total current is the same as current through any branch.
(d) The total resistance increases when more resistors are added.

Q16. What happens to particles on heating a solid?

(a) They vibrate with more energy.
(b) They stop interacting completely.
(c) They break into other elements.
(d) They freeze and become static.

Q17. 2-methylpropane has the same molecular formula as that of which of the following?

(a) Butane
(b) Butene
(c) Pentane
(d) Pentene

Q18. Which of the following is true for saturated hydrocarbons?

(a) They have at least one triple bond between carbon-carbon atoms.
(b) They can have either double and triple bond between carbon-carbon atoms.
(c) They have only a single bond between carbon-carbon atoms.
(d) They have at least one double bond between carbon-carbon atoms.

Q19. A body undergoes a displacement of 10 m under the action of a constant force of 2.5 N, in the opposite direction to the direction of force. What will be the work done under the action of this force?

(a) −2.5 J
(b) −25 J
(c) +2.5 J
(d) +25 J

Q20. Which type of muscle is voluntary and shows light and dark bands?

(a) Cardiac muscle
(b) Striated muscle
(c) Smooth muscle
(d) Unstriated muscle

Q21. A convex lens forms a real image of an object placed at a distance of 30 cm from it. If the image is formed at 60 cm on the other side of the lens, the focal length of the lens is:

(a) 20 cm
(b) 15 cm
(c) 10 cm
(d) 30 cm

Q22. Select the correct statement about the properties of colloid.

(a) The components of a colloid solution are not dispersed phase.
(b) Dispersing medium is the component in which its phase is suspended.
(c) They can be separated from the mixture by the process of filtration.
(d) A colloid is a homogeneous mixture.

Q23. Match the following columns on Apparatus and Purpose.

Column A	Column B
A. Litmus paper	1. To detect acidic or basic nature
B. Watch-glass	2. To place drops of test solutions

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C. Test tube	3. To hold and mix solutions safely
D. Indicator solution	4. Shows colour change to identify acid or base

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

Q24. If a car moves 100 m in 5 seconds, its linear velocity is:
(a) 15 m/s
(b) 20 m/s
(c) 10 m/s
(d) 25 m/s

Q25. Which of the following statements about phloem is correct?
(a) Phloem transports minerals from roots to leaves.
(b) Phloem transports food from leaves to other parts.
(c) Phloem transports water upward only.
(d) Phloem is made entirely of dead cells.

MATHEMATICS

Q26. A regular polygon has 2n sides. What is the angle made between two adjacent sides (in degrees)?
(a) (1 - 1/n) × 180°
(b) (1 + 1/n) × 180°
(c) (1 + 1/n) × 90°
(d) (1 - 1/n) × 90°

Q27. In a test, B got 50 marks while A got 75 marks, out of 100 maximum marks. What percentage of A's marks was B's marks? (Round off the answer to two decimal places.)
(a) 66.67%
(b) 75.55%
(c) 150.19%
(d) 82.35%

Q28. If the mean proportional of P and 150 is 120, then find the value of P.5767
(a) 96
(b) 98
(c) 99
(d) 97

Q29. What price should Anjali mark on a shirt which cost her Rs. 7,000, so as to gain 17% after allowing successive discounts of 35% and 30%?
(a) Rs. 18,066
(b) Rs. 18,070
(c) Rs. 18,138
(d) Rs. 18,000

Q30. The mode of the observations 7, 5, 6, 3, 3, 7, 1, 7, 8, 7, 1, 4, 8, 8 and 4 is:
(a) 7
(b) 6
(c) 3
(d) 5

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Q31. A total profit of Rs. 14,200 is to be distributed amongst A, B and C such that A: B = 13 : 9 and B : C = 18 : 11. The share (in) of C in the profit is:

(a) 2,740
(b) 2,940
(c) 2,690
(d) 2,840

Q32. Raman's income is Rs. 43,000. He saves 26% of his income. If his income increases by 20% and 2 expenditure increases by 40%, then his savings will:

(a) increase by Rs. 4,131
(b) decrease by Rs. 4,128
(c) increase by Rs. 4,133
(d) decrease by Rs. 4,133

Q33. In a farm, there are chickens and rabbits, altogether, there are 20 animals. The total number of legs is 56. How many chickens are there in the farm?

(a) 6
(b) 12
(c) 8
(d) 14

Q34. Find the largest number which divides 62, 134 and 242 to leave the same reminder in each case.

(a) 34
(b) 36
(c) 38
(d) 32

Q35. A car travels 128 km in the first hour and 146 km in the second hour. What is the average speed (in km / hr) of the car for the whole journey?

(a) 137
(b) 133
(c) 145
(d) 131

Q36. A trader marks an item 40% above its cost price and gives a discount of 10%. Find his profit percentage.

(a) 24%
(b) 26%
(c) 30%
(d) 20%

Q37. If $\sec\theta + \tan\theta = 4 + \sqrt{15}$, then find the value of $\sec\theta - \tan\theta$.

(a) 10
(b) 15
(c) $4\sqrt{15}$
(d) $4-\sqrt{15}$

Q38. If 4 lines of a print, in a column of a book, contain 63 words, how many words will a column of 52 lines contain?

(a) 829
(b) 823
(c) 819
(d) 815

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Q39. The ratio of two friends' ages is 4: 5. Together, their ages add up to 36 years. What is the age of the older friend?

(a) 22 years
(b) 18 years
(c) 20 years
(d) 16 years

Q40. If the radius of a cylinder is halved and its height is doubled, then its volume will be _(————————).

(a) Doubled
(b) Halved
(c) Same
(d) Increased by four times

Q41. If $x + y = 12$ and $xy = 32$, find the value of $x^2 + y^2$.

(a) 76
(b) 88
(c) 80
(d) 85

Q42. If $\sqrt{72} + \sqrt{12} = a\sqrt{2} + b\sqrt{3}$, then what is the value of a - b ?

(a) 4
(b) 8
(c) 5
(d) 6

Q43. The monthly incomes of two friends Rupesh and Manjit, are in the ratio 5 : 9, respectively, and each of them saves Rs. 36,000 every month. If the ratio of their monthly expenditure is 2 : 4, find the monthly income of Rupesh (in Rs.).

(a) 1,79,000
(b) 2,52,000
(c) 1,81,000
(d) 1,80,000

Q44. Walking at 3/4 th of his normal speed from his home, Abhishek is 5 minutes late in reaching his office. The usual time taken by him to cover the distance between his home and his office is:

(a) 7 minutes
(b) 12 minutes
(c) 15 minutes
(d) 11 minutes

Q45. PQRS is a trapezium with PQ parallel to SR and angle QRS = 60°. With R as centre and RQ as radius, an arc QAB is drawn which intersects SR in B. A is an arbitrary point on the arc QAB. If PQ = QR = 14 cm and SB = 8 cm, then find the area (in cm^2, rounded off to the nearest integer) of the region PQABSP.

(Take $\pi = 22/7$, and $\sqrt{3} = 1.732$)

(a) 96
(b) 116
(c) 110
(d) 102

Q46. What is the difference between the average of prime numbers between 20 and 40 and the average of multiples of 2 between 10 and 30?

(a) 18
(b) 1
(c) 10
(d) 20

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Q47. A can complete one-sixth of a work in 13 days, B can complete 34% of the same work in 17 days, C can complete one-third of the work in 19 days and D can complete three-fourth of the work in 15 days. Who will be able to complete the work first?

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

Q48. P and Q together can fill a cistern with water in 12 hours. If P alone can fill the cistern with water in 48 hours, then in how many hours will Q alone fill one-fourth of the same cistern with water?

(a) 9
(b) 5
(c) 4
(d) 8

Q49. The amount on a sum of Rs. 2,000 at 15% per annum compound interest, compounded annually, in 2 years will be:

(a) Rs. 2,667
(b) Rs. 2,650
(c) Rs. 2,645
(d) Rs. 2,575

Q50. After allowing a discount of 9% on the marked price of an article, it is sold for Rs. 53,053. Find its marked price (in Rs.).

(a) 58,300
(b) 58,204
(c) 58,132
(d) 58,146

GENERAL INTELLIGENCE & REASONING

Q51. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

JLO−QSV

TVY−ACF

(a) NOQ−TVY
(b) NPS−UWZ
(c) NPS−TWY
(d) NOQ−UWZ

Q52. MHSD is related to HDPB in a certain way based on the English alphabetical order. In the same way, LNPB is related to GJMZ. To which of the given options is SMUT related, following the same logic?

(a) NIRQ
(b) MJQQ
(c) NIRR
(d) MJQR

Q53. In a row of 58 people facing the north, Jolly sits 19^(th) from the left end. If Bela sits 17^(th) to the right of Jolly, then what is Bela’s position from the right end of the line?

(a) 23rd
(b) 24th
(c) 20th
(d) 22nd

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Q54. If 1 is added to each even digit and 2 is subtracted from each odd digit in the number 73256, how many digits will appear more than once in the new number thus formed?

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

Q55. 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 seats are plates. All plates are chairs.

Conclusion (I): Some seats are chairs.

Conclusion (II): All chairs are plates.

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

Q56. Refer to the given series and answer the question that follows. All numbers are single-digit numbers only. Counting to be done from left to right.

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

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

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

Q57. Mohak starts from Point A and drives 12 km towards the south. He then takes a left turn, drives 11 km, turns left and drives 15 km. He then takes a left turn and drives 14 km. He takes a final left turn, drives 3 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) 4 km to the west
(b) 4 km to the east
(c) 3 km to the east
(d) 3 km to the west

Q58. In a certain code language GYSU is coded as 74 and MAKZ is coded as 53. What is the code for IHOW in that language?

(a) 57
(b) 51
(c) 59
(d) 60

Q59. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(14, 3, 42)

(12, 2, 24)

(a) (5, 8, 36)
(b) (13, 3, 39)
(c) (18, 2, 9)
(d) (15, 45, 3)

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

11 16 22 29 37 ?

(a) 46
(b) 44
(c) 43
(d) 45

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

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

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

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

Q62. In a certain code language,

A + B means 'A is the mother of B',

A – B means 'A is the brother of B',

A x 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 E related to T if 'T – L # Q # P x E'?

(a) Wife's brother
(b) Daughter's son
(c) Mother's father
(d) Daughter's husband

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

3 6 8 16 18 36 38 ?

(a) 40
(b) 84
(c) 76
(d) 56

Q64. Refer to the given number series and answer the question that follows. Counting to be done from left to right only. All numbers are single-digit numbers.

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

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

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

Q65. This question is based on the five, three-digit numbers given below.

(Left) 745 768 729 716 721 (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 second highest number is added to the third digit of the lowest number?

(a) 14

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(b) 13
(c) 10
(d) 12

Q66. Six friends — Edwin, Preeti, Sunita, Jacob, Victoria, and Sagar — are sitting around a circular table facing the centre. Edwin is an immediate neighbour of both Preeti and Sunita. Jacob is sitting third to the left of Sunita. Victoria is sitting second to the right of Jacob. Who is sitting second to the left of Edwin?

(a) Preeti
(b) Victoria
(c) Sunita
(d) Sagar

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

85 100 120 145 175 ?

(a) 210
(b) 205
(c) 215
(d) 195

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

BFL : EIO

KPI : NSL

(a) DJH : GMJ
(b) DBH : THY
(c) LQW : OTZ
(d) APH : BSJ

Q69. In a certain code language, ‘TUNE’ is coded as ‘5279’ and ‘WAIT’ is coded as ‘1428’. What is the code for ‘T’ in the given code language?

(a) 1
(b) 5
(c) 2
(d) 8

Q70. If ‘A’ stands for ‘×’, ‘B’ stands for ‘÷’, ‘C’ stands for ‘−’ and ‘D’ stands for ‘+’, then what will come in place of question mark (?) in the following equation?

27 B 3 D 5 A 10 C 12 D 15 C 27 = ?

(a) 32
(b) 34
(c) 36
(d) 35

Q71. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All helmets are nuts.

All helmets are bins.

Conclusions:

(I) Some nuts are bins.

(II) All bins are helmets.

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

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(c) Only conclusion (II) follows.
(d) Only conclusion (I) follows.

Q72. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which letter-cluster pair DOES NOT belong to that group?

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

(a) GK−MQ
(b) KO−QU
(c) NR−TX
(d) TX−YF

Q73. Warner starts from Point A and drives 78 km towards the west. He then takes a right turn, drives 79 km, turns right and drives 80 km. He then takes a right turn and drives 90 km. He takes a final right turn, drives 2 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 south
(b) 10 km to the north
(c) 11 km to the north
(d) 12 km to the south

Q74. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

24 ÷ 5 + 18 × 6 − 17 = ?

(a) 134
(b) 136
(c) 130
(d) 132

Q75. Based on the English alphabetical order, three of the following four letter-clusters are alike in a certain way and thus form a group. Which letter-cluster DOES NOT belong to that group?

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

(a) UACG
(b) AGIM
(c) BHIM
(d) GMOS

Q76. In a row of 55 people facing north, Nalini sits 20^(th) from the right end. If Ranjit sits 18^(th) from the left end of the line, how many people sit between Nalini and Ranjit?

(a) 14
(b) 17
(c) 16
(d) 15

Q77. A, B, C, D, E and F are sitting around a circular table, facing the centre.

B sits second to the left of F. C is an immediate neighbour of A. B sits to the immediate right of A. D sits second to the left of E.

What is the position of E with respect to A?

(a) Second to the right
(b) Third to the left
(c) Immediate right
(d) Second to the left

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Q78. Eight people (A, B, C, D, P, Q, R and S) are sitting around a circular table facing towards the centre.

B is an immediate neighbour of both S and P.

C sits second to the right of P.

R is an immediate neighbour of both D and Q.

A sits second to the left of Q.

What is the position of Q with respect to C?

(a) Immediate left
(b) Second to the right
(c) Immediate right
(d) Second to the left

Q79. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

BZA 30 ZXY 41 XVW 52 VTU 63 ?

(a) TRS 74
(b) TYE 73
(c) TSR 74
(d) TQR 73

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

ZDF1, YGH3, XJJ9, WML27, ?1690

(a) VQM81
(b) WQM79
(c) WPM79
(d) VPN81

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. When did IndusInd Bank launch its 'Indus StartUp Banking' programme aimed at supporting early-stage startups?

(a) April 2025
(b) June 2025
(c) July 2025
(d) August 2025

Q82. What is the name of India’s first AI teacher introduced in 2024?

(a) Eva
(b) Iris
(c) Mira
(d) Sophia

Q83. In 2025, senators from which of the following nations introduced the 'India Shrimp Tariff Act'?

(a) Australia
(b) United Kingdom
(c) United States
(d) Canada

Q84. In 2025, which country tested a revolutionary hydrogen bomb that functions without traditional fissile materials like uranium or plutonium, using advanced fusion techniques such as magnesium hydride-based fusion?

(a) Russia
(b) The US
(c) China
(d) North Korea

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Q85. Where did DRDO successfully conduct the maiden flight-tests of the Integrated Air Defence Weapon System (IADWS) on 23 August 2025?

(a) Goa Coast
(b) Mumbai Coast
(c) Chennai Coast
(d) Odisha Coast

Q86. Under India's National Green Hydrogen Mission, what is the minimum annual green hydrogen production capacity targeted by 2030?

(a) 10 million metric tonnes (MMT) per year
(b) 8 million metric tonnes (MMT) per year
(c) 5 million metric tonnes (MMT) per year
(d) 2 million metric tonnes (MMT) per year

Q87. Which female athlete became the second woman in history to win the Laureus World Sportswoman of the Year four times by April 2025?

(a) Serena Williams
(b) Naomi Osaka
(c) Simone Biles
(d) Rebeca Andrade

Q88. Which athlete clocked 58.11 seconds to win gold in women's 400 m hurdles at the 2025 National Games?

(a) Vithya Ramraj
(b) Aishwarya Mishra
(c) Anjali Devi
(d) Revathi Veeramani

Q89. Who captained India in the ICC Women's Cricket World Cup, 2025, in November 2025?

(a) Jhulan Goswami
(b) Harmanpreet Kaur
(c) Mithali Raj
(d) Smriti Mandhana

Q90. Who became the Chairperson of the 23^(rd) Law Commission of India in April 2025?

(a) Professor DP Verma
(b) Hitesh Jain
(c) Justice Dinesh Maheshwari
(d) Justice Ritu Raj Awasthi

Q91. The Population Census, 2027, will include which major new component for the first time since 1931?

(a) Religion-wise urban census
(b) Income-based classification
(c) Caste-based enumeration
(d) Occupation-based mapping

Q92. According to the NITI Aayog press release (July 2025) on the second edition of the NER District SDG Index 2023–24, how are districts classified based on their SDG scores?

(a) Achiever 95–100; Front Runner 60–94; Performer 45–59; Aspirant <45
(b) Achiever 100; Front Runner 65–99; Performer 50–65; Aspirant <50
(c) Achiever 100; Front Runner 70–99; Performer 55–69; Aspirant <55
(d) Achiever 90–100; Front Runner 70–89; Performer 50–69; Aspirant <50

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Q93. In July 2025, which state government directed all department heads to ensure strict compliance with the Prevention of Sexual Harassment (POSH) Act, 2013 at workplaces to strengthen women's safety?

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

Q94. Which two countries initialed a peace agreement draft on 19 June 2025, aimed at ending conflict in eastern DR Congo?

(a) DR Congo and South Sudan
(b) DR Congo and Burundi
(c) DR Congo and Uganda
(d) DR Congo and Rwanda

Q95. Which stance did the Reserve Bank of India adopt after the April 2025 repo rate cut?

(a) Withdrawn
(b) Accommodative
(c) Neutral
(d) Restrictive

Q96. Which of the following states won the highest number of medals overall (gold, silver, bronze combined) in National-Games 2025?

(a) Uttarakhand
(b) Punjab
(c) Maharashtra
(d) Tamil Nadu

Q97. Which Union Minister inaugurated the Startup Mahakumbh 2025 and referred to his visit as "an experience of a lifetime"?

(a) Piyush Goyal
(b) Dharmendra Pradhan
(c) Ashwini Vaishnaw
(d) Rajeev Chandrasekhar

Q98. In 2025, Netaji Subhas Chandra Bose Jayanti, also celebrated as Parakram Diwas, falls on which date?

(a) 23 January
(b) 21 February
(c) 19 April
(d) 17 March

Q99. Which legendary surfer received the Lifetime Achievement Award at Laureus 2025?

(a) Stephanie Gilmore
(b) Mick Fanning
(c) Kelly Slater
(d) Tom Carroll

Q100. As per the Sustainable Development Goals — National Indicator Framework Progress Report 2025, published in June 2025, the rise in internet subscriptions in the year 2024–25 primarily supports which of the following SDGs in India?

(a) SDG 1
(b) SDG 6
(c) SDG 13
(d) SDG 9

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ANSWER KEY

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

SOLUTIONS

Q1. Answer: (a) in fixed circular orbits called shells

The correct answer is in fixed circular orbits called shells.

Key Points

• In 1913, Niels Bohr proposed a model for the atom that modified Rutherford's earlier model to explain why atoms are stable and why they emit specific frequencies of light.

• According to Bohr's theory, electrons revolve around the nucleus in certain discrete orbits. These orbits are circular and have a fixed radius and fixed energy associated with them.

• These discrete orbits are known as stationary states, energy levels, or shells. Hence, statement 1 is correct.

• Bohr postulated that while an electron is revolving in these fixed orbits, it does not radiate energy, which prevents it from spiraling into the nucleus.

• Electrons do not exist inside the nucleus; the nucleus is composed of protons and neutrons, while electrons occupy the space around it. Hence, statement 2 is incorrect.

• Electrons revolve continuously in these orbits; they absorb energy only to jump to a higher energy level (excitation) and emit energy when falling to a lower level. They do not require constant absorption of energy just to maintain their revolution. Hence, statement 3 is incorrect.

• Bohr's model specifically described circular orbits. The concept of elliptical orbits was later introduced by Arnold Sommerfeld to explain the fine structure of spectral lines. Hence, statement 4 is incorrect.

Additional Information

• Designation of Shells: The energy levels or shells are represented by the letters K, L, M, N or by the principal quantum number n = 1, 2, 3, 4. The K-shell (n=1) is the one closest to the nucleus and possesses the lowest energy.

• Bohr-Bury Scheme: This scheme determines the distribution of electrons in different shells. The maximum number of electrons that can be accommodated in any shell is given by the formula $2n^2$. For instance, the M-shell (n=3) can hold a maximum of 18 electrons.

• Stability of the Atom: Bohr's model solved the primary flaw of Rutherford's atomic model, which suggested that accelerating electrons should continuously lose energy and eventually collapse into the nucleus. Bohr's stationary orbit concept ensured atomic stability.

• Quantization of Energy: A fundamental aspect of Bohr's model is that the angular momentum of an electron is quantized. It can only be an integral multiple of $h/2\pi$, where h is Planck's constant.

Important Points

• Hydrogen Spectrum: Bohr's model was highly successful in explaining the line spectra of the hydrogen atom and hydrogen-like ions (such as He+ or Li2+). It predicted the wavelengths of light emitted during electron transitions between shells.

• Valence Electrons: The electrons present in the outermost shell of an atom are called valence electrons. These electrons determine the chemical properties and valency of the element.

• Limitations of the Bohr Model: While a major milestone, the model could not explain the Zeeman effect (splitting of spectral lines in a magnetic field) or the Stark effect (splitting in an electric field). It also failed to account for the wave-particle duality of matter and the Heisenberg Uncertainty Principle.

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Q2. Answer: (d) Pest attack and spoilage

The correct answer is Pest attack and spoilage.

Key Points

• Improper storage of food grains leads to significant biotic and abiotic degradation. The primary consequence is pest attack, where insects like weevils, grain borers, and beetles infest the stock, leading to weight loss and hollow grains.

• Spoilage occurs due to the growth of microorganisms. When grains are stored with high moisture content (typically above 14%), they become a breeding ground for fungi and bacteria, which cause rotting and foul odors. Hence, the correct answer is Pest attack and spoilage.

• Grains lose their germination capacity if stored in damp conditions. High humidity and temperature damage the embryo of the seeds, making them unfit for future agricultural use as sowing seeds.

• Contamination by rodents like rats and mice is a major risk. They not only consume the grains but also contaminate the entire lot with excreta, urine, and hair, spreading diseases such as Salmonellosis and Leptospirosis.

• Improper storage results in the loss of market value. Factors like discoloration, loss of weight, and degradation in quality make the produce less desirable for consumers and wholesalers, leading to financial losses for farmers.

Additional Information

• Factors Affecting Storage:

• Biotic Factors: These include living organisms such as insects, rodents, fungi, mites, and bacteria that actively consume or spoil the grains.

• Abiotic Factors: These are non-living components like moisture (humidity) and temperature. For safe storage, moisture content should ideally be reduced to below 10-12% by sundrying.

• Prevention and Management:

• Cleaning: Before storage, grains must be thoroughly cleaned to remove chaff, dirt, and stones which can harbor pests.

• Fumigation: Using chemical vapors like Aluminum Phosphide in airtight storage helps kill insects and their larvae without damaging the grain.

• Proper Drying: Grains are first dried in the sun and then in the shade to ensure all internal moisture is removed before bagging.

• Storage Structures:

• In India, the Food Corporation of India (FCI) manages large-scale storage using Granaries and Silos.

• Traditional storage methods include Kothis, Bukhari, and Gunnies (jute bags), though these are more susceptible to moisture ingress and pest attack compared to modern metal silos.

• Chemical Hazards: Improper storage can lead to the production of Mycotoxins, such as Aflatoxins produced by the fungus Aspergillus flavus. These toxins are carcinogenic and highly dangerous if the spoiled grain is consumed by humans or livestock.

Important Points

• Grains stored improperly do not provide better nutrition (Option 1 is incorrect) as the vitamins and proteins degrade over time due to enzymatic activity.

• They do not become stronger grains (Option 2 is incorrect); instead, they become brittle and easily crushed during milling.

• There is no increase in fragrance (Option 3 is incorrect); in fact, spoilage leads to a musty or rancid smell due to the breakdown of lipids and fungal growth.

• The Government of India regulates grain storage through the Essential Commodities Act, 1955, to prevent hoarding and ensure proper storage conditions for food security.

Q3. Answer: (a) 2450 Nm^(-2)

The correct answer is 2450 Nm^{-2}.

Key Points

• Pressure is defined as the physical force exerted per unit area. In this context, the thrust acting on the block is the same as its weight.

• The formula used to calculate pressure is Pressure = Thrust / Area (or P = F / A).

• Given in the problem:

• Thrust (Force) = 49 N

• Contact Area = 0.02 m^2

• Substituting the values into the formula: Pressure = 49 / 0.02.

• To solve the calculation: 49 / (2/100) = (49 × 100) / 2 = 4900 / 2 = 2450.

• The resulting pressure exerted by the wooden block on the table is 2450 Nm^{-2} (also known as 2450 Pascals).

Additional Information

• Pressure (P):

• It is a scalar quantity because it relates to the magnitude of the force acting perpendicular to a surface.
• The SI unit of pressure is the Pascal (Pa), named after the French mathematician and physicist Blaise Pascal.
• 1 Pascal is equivalent to 1 Newton per square metre (1 N/m² or 1 Nm^-²).
• Relationship between Area and Pressure:
• For a constant force, pressure is inversely proportional to the area of contact.
• If the area is smaller, the pressure exerted is larger (e.g., why a sharp knife cuts better than a blunt one).
• If the area is larger, the pressure exerted is smaller (e.g., why heavy trucks have more wheels and wider tyres).
• Thrust:
• Thrust is the total force acting perpendicularly on a surface. It is measured in Newtons (N).
• While thrust depends only on the force applied, pressure depends on both the thrust and the surface area.

Important Points

• The concept of pressure is widely applied in fluid mechanics (liquids and gases) as well as solid mechanics.
• Other units of pressure include the Atmosphere (atm), Bar, and Torr. 1 atm is approximately 101,325 Pa.
• In fluids, pressure increases with depth due to the weight of the fluid column above a point, a principle discovered by Pascal.
• The calculation of pressure is essential in engineering fields to ensure that structures can withstand the thrust exerted by machinery, buildings, or water in dams.

Q4. Answer: (d) 10 Hz and 0.1 s

The correct answer is 10 Hz and 0.1 s.

Key Points

• Frequency is defined as the number of cycles or oscillations that occur in a unit of time, specifically in one second. It is denoted by the symbol f or nu (ν).
• Time Period is the total time taken to complete one single oscillation or vibration. It is denoted by the symbol T and is measured in seconds.
• The mathematical relationship between these two physical quantities is that they are the reciprocal of each other, expressed by the formula T = 1 / f or f = 1 / T.
• In Option 4, the frequency is 10 Hz and the time period is 0.1 s. Calculating using the formula, 1 / 10 = 0.1. Hence, statement 4 is correct.
• In Option 1, for a frequency of 5 Hz, the time period should be 1 / 5 = 0.2 s, but 5 s is given. Hence, statement 1 is incorrect.
• In Option 2, for a frequency of 2 Hz, the time period should be 1 / 2 = 0.5 s, but 0.2 s is given. Hence, statement 2 is incorrect.
• In Option 3, for a frequency of 1 Hz, the time period should be 1 / 1 = 1 s, but 2 s is given. Hence, statement 3 is incorrect.

Additional Information

• SI Units: The Standard International (SI) unit for frequency is Hertz (Hz), which is equivalent to 1 cycle per second. The unit is named after the German physicist Heinrich Rudolf Hertz.
• Inverse Proportion: Frequency and time period are inversely proportional. As the frequency of a wave increases, the time taken for a single cycle decreases proportionately.
• Human Hearing Range: The audible frequency range for a healthy human ear is typically between 20 Hz and 20,000 Hz (20 kHz). Frequencies below this are infrasonic, and those above are ultrasonic.
• Wave Propagation: While wavelength and speed of a wave can change when moving through different media (like air to water), the frequency of the wave generally remains constant as it depends on the source of vibration.
• Applications: Understanding these calculations is vital in electronics, signal processing, and acoustics to determine how many data bits or sound pulses are transmitted per numerical value of time.

Important Points

• Angular Frequency: In rotational motion or Simple Harmonic Motion (SHM), angular frequency (ω) is used. It is calculated as 2π times the frequency (f), and its unit is radians per second.
• Oscillation: An oscillation is the to-and-fro motion of an object about a mean position. The time it takes to go from one extreme to another and back is the time period.
• Numerical Fact: If a device has a frequency of 50 Hz (standard for AC power supply in India), the time period for one cycle of current is 1 / 50 = 0.02 seconds.
• Dimensional Formula: The dimensional formula for frequency is [M0 L0 T-1], representing the inverse of time.

Q5. Answer: (c) Egg formation

The correct answer is Egg formation.

Key Points

• Fertilisation is the biological process where a male gamete (sperm) fuses with a female gamete (egg or ovum) to form a new

individual. This process typically occurs in the fallopian tube in humans.

• Zygote formation is the immediate result of the fusion of the sperm and the egg. The zygote is a single diploid cell that contains the genetic material from both parents. Hence, statement 1 is an outcome of fertilisation.

• Embryo formation follows the creation of the zygote. The zygote undergoes rapid cell division (cleavage) and differentiation to become an embryo. This developmental stage eventually leads to the formation of a fetus. Hence, statement 4 is an outcome of fertilisation.

• Placenta formation occurs after the embryo implants itself into the uterine wall. The placenta is a specialized organ that facilitates the exchange of nutrients, oxygen, and waste products between the mother and the developing fetus. Hence, statement 2 is an outcome of fertilisation.

• Egg formation, also known as oogenesis, is the process of creating a female gamete. This process happens in the ovaries before fertilisation can even take place. Since an egg must already exist for fertilisation to occur, its formation cannot be an "outcome" of the fertilisation process itself. Hence, statement 3 is NOT an outcome of fertilisation.

Additional Information

• Oogenesis: This is the process of formation of mature female gametes. It starts during the fetal development stage in females, where millions of oogonia are formed in each fetal ovary. No more oogonia are added after birth. These cells enter meiosis I but remain suspended until puberty.

• The Zygote: This is the vital link that ensures continuity of species between organisms of one generation and the next. In all sexually reproducing organisms, including humans, the zygote is diploid (2n), formed by the union of two haploid (n) gametes.

• Implantation: About 6 to 9 days after fertilisation, the developing blastocyst (a stage of the embryo) attaches itself to the endometrium of the uterus. This successful attachment is what triggers the subsequent formation of the placenta and the continuation of pregnancy.

• Internal vs. External Fertilisation:

• Internal Fertilisation: Occurs inside the female body (e.g., mammals, birds, reptiles). It provides better protection for the developing zygote.

• External Fertilisation: Occurs outside the body, usually in aquatic environments (e.g., fish, frogs). Large numbers of gametes are released to increase the chances of survival.

Important Points

• Gestation Period: The time duration between fertilisation and the birth (parturition) of the offspring. In humans, this lasts approximately 280 days or 9 months.

• Cleavage: This refers to the series of mitotic divisions the zygote undergoes as it moves through the isthmus of the oviduct towards the uterus, forming 2, 4, 8, and 16 daughter cells called blastomeres.

• Acrosome Reaction: For fertilisation to be successful, the sperm must release enzymes from its acrosome to penetrate the zona pellucida layer of the egg.

• Polyspermy Prevention: Once one sperm enters the egg, the egg membrane undergoes chemical changes to block the entry of additional sperm, ensuring the zygote remains diploid.

Q6. Answer: (d) Axon

The correct answer is Axon.

Key Points

• A neuron is the fundamental structural and functional unit of the nervous system, responsible for transmitting information throughout the body.

• The Axon, also referred to as a nerve fiber, is a long, slender projection of a nerve cell that typically conducts electrical impulses known as action potentials away from the nerve cell body.

• It generally forms the longest part of a neuron. In the human body, some axons can be remarkably long; for example, the axons of the sciatic nerve run from the base of the spinal cord to the big toe of each foot, reaching lengths of 1 meter or more.

• The primary function of the axon is to transmit information to different neurons, muscles, and glands. The speed of transmission is often increased by an insulating layer called the myelin sheath.

• The point where the axon joins the cell body is called the axon hillock, which is the site where summation of signals occurs before an impulse is propagated. Hence, the correct answer is Axon.

Additional Information

• Cell Body (Soma):

• The cell body is the spherical part of the neuron that contains the nucleus and other organelles like mitochondria and ribosomes.

• It serves as the metabolic center of the neuron, responsible for protein synthesis and energy production.

• It integrates the synaptic inputs received from the dendrites.

• Synapse:

• A synapse is a specialized junction or gap between two neurons or between a neuron and an effector cell (like a muscle).

• It is the site where chemical neurotransmitters are released from the presynaptic neuron to excite or inhibit the postsynaptic cell.
• The width of a synaptic cleft is extremely small, typically measuring about 20 to 40 nanometers.
• Nerve Ending:
• Also known as axon terminals or telodendria, these are the distal ends of the axon branches.
• They contain synaptic vesicles that store neurotransmitters like acetylcholine or dopamine.
• When an electrical signal reaches the nerve ending, it triggers the release of these chemicals into the synapse.
• Dendrites:
• These are short, highly branched cytoplasmic extensions that project from the cell body.
• Their main function is to receive incoming signals from other neurons and carry them towards the cell body.

Important Points

• Direction of Impulse: In a typical neuron, the nerve impulse travels in a unidirectional manner: from the dendrites to the cell body, then along the axon, and finally to the nerve endings.
• Myelination: Many axons are covered by a myelin sheath, which is composed of fats and proteins. In the Peripheral Nervous System (PNS), this is formed by Schwann cells, while in the Central Nervous System (CNS), it is formed by oligodendrocytes.
• Nodes of Ranvier: These are periodic gaps in the myelin sheath where the axon membrane is exposed. They facilitate saltatory conduction, allowing the impulse to "jump" and travel much faster.
• Types of Neurons: Based on function, they are classified into Sensory neurons (carry signals to the CNS), Motor neurons (carry signals from the CNS to muscles), and Interneurons (connect neurons within the CNS).

Q7. Answer: (d) Epithelium

The correct answer is Epithelium.

Key Points

• Connective tissue is one of the four primary types of animal tissue that binds, supports, and protects other tissues and organs in the body. It is characterized by the presence of an extracellular matrix.
• Bone is a highly mineralized and hard connective tissue that forms the skeleton. It provides structural support and protection to vital organs. Hence, Bone is a type of connective tissue.
• Blood is a unique fluid connective tissue that circulates throughout the body. It consists of plasma (the liquid matrix) and cellular components like Red Blood Cells (RBCs) and White Blood Cells (WBCs). Hence, Blood is a type of connective tissue.
• Cartilage is a flexible, semi-rigid connective tissue found in areas such as the joints, nose, and ears. It reduces friction between bones and provides a framework for certain structures. Hence, Cartilage is a type of connective tissue.
• Epithelium (or epithelial tissue) consists of tightly packed cells arranged in layers. Its primary functions are protection, secretion, and absorption, and it lacks the extensive extracellular matrix found in connective tissues. Hence, Epithelium is NOT a type of connective tissue and is the correct answer.

Additional Information

• Types of Connective Tissue:
• Loose Connective Tissue: Includes Areolar tissue and Adipose tissue (which stores fat).
• Dense Connective Tissue: Includes tendons (connecting muscle to bone) and ligaments (connecting bone to bone).
• Specialized Connective Tissue: Includes Bone, Cartilage, and Blood.
• Epithelial Tissue Classification:
• It is classified based on cell shape into Squamous (flat), Cuboidal (cube-like), and Columnar (tall and narrow).
• It covers the external surfaces of the body (skin) and lines internal cavities and organs.
• The cells are resting on a non-cellular basement membrane.
• Main Tissue Categories:
• There are four main types of tissues in animals: Epithelial, Connective, Muscular, and Nervous.
• Each tissue type has a specific origin; for example, connective tissue generally originates from the mesoderm.

Important Points

• Matrix Composition: In Bone, the matrix is hardened by Calcium and Phosphorus salts, whereas in Blood, the matrix (plasma) is liquid and lacks fibers under normal conditions.
• Cell Types: Specific cells are associated with different connective tissues, such as Osteocytes in bones and Chondrocytes in cartilage.
• Functional Difference: While connective tissues act as the body's glue and support system, epithelial tissues act as the body's lining and defensive barrier.
• Regeneration: Epithelial tissue has a very high capacity for regeneration compared to specialized connective tissues like cartilage, which heals slowly due to a lack of blood vessels (avascularity).

Q8. Answer: (c) between the focus (F) and the optical centre (O)

p data-end="75" data-start="0">The correct answer is between the focus (F) and the optical centre (O).

Key Points

• A concave lens is known as a diverging lens because it bends incident light rays away from the principal axis. Due to this property, the refracted rays never actually meet on the other side of the lens.

• When an object is placed anywhere between infinity and the optical centre (O) of a concave lens, the image is always formed on the same side of the lens as the object. This image is characterized by being virtual, erect, and diminished.

• Regardless of the specific object distance (u), the virtual intersection of the refracted rays (when extended backwards) always occurs within the focal length. Therefore, the image is always formed between the focus (F) and the optical centre (O). Hence, option 3 is the correct answer.

• If the object is at infinity, the image is formed at the focus (F) and is highly diminished (point-sized). As the object moves closer to the lens, the image moves from the focus towards the optical centre, but remains smaller than the object. Hence, option 4 is only a special case for an object at infinity.

• Positions such as beyond twice the focal length (2F) or at 2F are common image locations for convex lenses, but they are impossible for real objects placed before a concave lens. Hence, options 1 and 2 are incorrect.

Additional Information

• Lens Formula: The relationship between the focal length (f), the image distance (v), and the object distance (u) is expressed as 1/f = 1/v - 1/u. For a concave lens, f is always negative.

• Magnification (m): This is the ratio of the height of the image to the height of the object, given by m = v/u. For a concave lens, the magnification is always positive (since the image is erect) and less than 1 (since the image is diminished).

• Applications in Vision: Concave lenses are primarily used to correct Myopia (nearsightedness). In a myopic eye, the image of a distant object is formed in front of the retina; a concave lens diverges the light before it enters the eye, allowing the image to form exactly on the retina.

• Practical Uses: Beyond eyewear, these lenses are used in peepholes in doors to provide a wide-angle view of people outside, in flashlights to spread the light beam, and in telescopes or binoculars to produce upright images.

Important Points

• Ray Tracing Rules: To determine the image position, two rules are vital: 1) A ray parallel to the principal axis appears to diverge from the principal focus. 2) A ray passing through the optical centre (O) passes through without any deviation.

• Cartesian Sign Convention: For a concave lens, according to the New Cartesian Sign Convention, the object distance (u) is negative, the image distance (v) is negative, and the focal length (f) is negative.

• Image Consistency: Unlike the convex lens, which can form both real and virtual images depending on the object's position, the concave lens is consistent in forming only virtual images for any real object position on the principal axis.

Q9. Answer: (b) Potenz; hydrogen ion

The correct answer is Potenz; hydrogen ion.

Key Points

• The term pH was first introduced by the Danish biochemist S.P.L. Sorensen in the year 1909 to express the acidity or alkalinity of a solution.

• In the notation pH, the letter ‘p’ stands for ‘potenz’, which is a German word meaning ‘power’.

• The pH scale is used for measuring the hydrogen ion (H+) concentration in a solution. It provides a numerical value that represents the activity of these ions.

• The scale allows us to determine the strength of acids and bases based on the concentration of hydronium ions produced in water.

• The value of pH is inversely proportional to the hydrogen ion concentration; therefore, a high concentration of hydrogen ions results in a low pH value.

Additional Information

• The pH Scale Range:

• The pH scale typically ranges from 0 to 14.

• A pH of 7 represents a neutral solution, such as pure water, where the concentration of hydrogen ions and hydroxide ions are equal.

• Solutions with a pH less than 7 are acidic. The lower the pH value (closer to 0), the stronger the acid.

• Solutions with a pH greater than 7 are basic or alkaline. The higher the pH value (closer to 14), the stronger the base.

• Mathematical Definition:

• pH is defined as the negative logarithm (to the base 10) of the hydrogen ion concentration in moles per litre.

• As it is a logarithmic scale, a change of one pH unit represents a tenfold change in hydrogen ion concentration.

• Common pH Values:

• Gastric Juice in the human stomach has a pH of approximately 1.2, which is highly acidic to aid digestion.

• Lemon juice has a pH of about 2.2.

• Human blood is slightly alkaline with a pH of approximately 7.4.

• Milk of Magnesia, used as an antacid, has a pH of about 10.

• Sodium Hydroxide solution (1M) has a pH of nearly 14.

• Importance in Biology:

• Most physiological processes in the human body occur within a narrow pH range of 7.0 to 7.8.

• Acid rain occurs when the pH of rain water falls below 5.6, which can be harmful to aquatic life and ecosystems.

Q10. Answer: (b) The acceleration increases by a factor of 4.

The correct answer is The acceleration increases by a factor of 4.

Key Points

• The relationship between force, mass, and acceleration is governed by Newton's Second Law of Motion, which states that the acceleration of an object is directly proportional to the net force acting on it.

• Mathematically, this is represented by the formula F = ma, where F is the applied force, m is the mass of the object, and a is the acceleration produced.

• In the given scenario, the mass (m) remains constant. This implies a linear relationship where the acceleration is directly proportional to the force (a prop. to F).

• If the applied force is quadrupled (multiplied by 4), the equation becomes 4F = m * (new acceleration). To maintain equality, the acceleration must also be multiplied by 4. Hence, the statement that the acceleration increases by a factor of 4 is correct.

• Options suggesting the acceleration remains the same, decreases, or increases only by a factor of 2 violate the fundamental direct proportionality established in classical mechanics.

Additional Information

• Newton's Second Law of Motion:

• This law defines Force quantitatively. It states that the rate of change of momentum of an object is proportional to the applied force in the direction of the force.

• The SI unit of force is the Newton (N). One Newton is defined as the force needed to provide a mass of 1 kilogram with an acceleration of 1 meter per second squared (m/s^2).

• Concept of Mass:

• Mass is a measure of the amount of matter in an object and is also a measure of its inertia (resistance to acceleration).

• In the SI system, mass is measured in kilograms (kg). Unlike weight, mass remains constant regardless of the object's location in the universe (excluding relativistic speeds).

• Acceleration Details:

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

• It is defined as the rate of change of velocity over time. If the force acts in the direction of motion, the object speeds up; if it acts opposite, the object slows down (deceleration).

Important Points

• Direct Proportionality: When mass is held constant, any change in the magnitude of the force results in an identical proportional change in the acceleration. For example, doubling the force doubles the acceleration; tripling the force triples the acceleration.

• Inverse Proportionality: If the force were held constant instead, the acceleration would be inversely proportional to the mass. In that case, quadrupling the mass would lead to the acceleration decreasing by a factor of 4.

• Practical Application: This principle is used in engineering and automotive design. To achieve higher acceleration in vehicles, manufacturers either increase the engine's force (torque/thrust) or decrease the vehicle's mass (weight reduction).

• Net Force: It is important to note that F in the equation refers to the net force (the vector sum of all external forces like friction, air resistance, and applied force). If there is no net force, there is no acceleration, which aligns with Newton's First Law.

Q11. Answer: (d) 2V volts

The correct answer is 2V volts.

Key Points

• The relationship between potential difference, current, and resistance is governed by Ohm's Law, which was proposed by the German physicist Georg Simon Ohm in 1827.

• According to Ohm's Law, the current (I) flowing through a conductor is directly proportional to the potential difference (V) applied across its ends, provided the physical conditions like temperature remain constant. Mathematically, it is expressed as $V = I \times R$.

• In the given scenario, the initial state is represented by the equation $V = I \times R$. Here, V is the potential difference in volts, I is the

current in amperes, and R is the resistance in Ohms (Ω).

• The question states that the resistance (R) is kept constant, and we want the new current (let's call it I') to be double the original current, meaning I' = 2I.

• To find the new potential difference (V'), we apply the formula: V' = I' × R. Substituting the value of I', we get V' = (2I) × R, which can be rewritten as V' = 2 × (I × R).

• Since V = I × R, substituting this back into the equation gives V' = 2V. Therefore, the value of the potential difference must be changed to 2V volts to double the current while keeping the resistance the same.

Additional Information

• Potential Difference (V):

• It is defined as the amount of work done in moving a unit positive charge from one point to another in an electric circuit.

• The SI unit of potential difference is the Volt (V), named after Alessandro Volta. 1 Volt is equal to 1 Joule per Coulomb.

• Electric Current (I):

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

• The SI unit of current is the Ampere (A). A current of 1 Ampere constitutes the flow of 1 Coulomb of charge per second.

• Electrical Resistance (R):

• It is the property of a conductor to oppose the flow of charges through it.

• The SI unit of resistance is the Ohm (Ω). Resistance depends on the length of the conductor, its area of cross-section, the nature of the material, and the temperature.

• Ohmic and Non-Ohmic Conductors:

• Conductors that strictly follow Ohm's Law (where the V-I graph is a straight line passing through the origin) are called Ohmic conductors (e.g., metals like copper and silver).

• Devices that do not maintain a linear relationship between V and I are called non-Ohmic (e.g., diodes, transistors, and LEDs).

Important Points

• Factors Affecting Resistance: If the length of a wire is doubled, its resistance also doubles. Conversely, if the area of cross-section is doubled, the resistance is halved.

• Temperature Dependence: For most metallic conductors, resistance increases with an increase in temperature. This is why Ohm's Law specifies that temperature must remain constant for the proportionality to hold.

• Numerical Application: If the potential difference is kept constant and the resistance is doubled, the current will become half (I/2) because current is inversely proportional to resistance when V is constant.

Q12. Answer: (c) Zygote

The correct answer is Zygote.

Key Points

• The process of fusion between the male germ cell (sperm/pollen) and the female germ cell (egg/ovum) is known as fertilization or syngamy.

• The immediate result of this fusion in plants is the formation of a single-celled diploid structure called a Zygote. Hence, statement 3 is correct.

• In Angiosperms (flowering plants), one male gamete fuses with the egg cell to form the zygote, which eventually develops into the embryo.

• The zygote carries genetic material from both parents, ensuring the continuity of the species and providing genetic variation.

• This fusion typically occurs inside the embryo sac, which is located within the ovule of the flower.

Additional Information

• Pollen Tube:

• The pollen tube is a tubular structure produced by the pollen grain after it lands on the stigma.

• Its primary function is to transport the male gametes from the pollen grain to the ovule for fertilization. It is a precursor to fusion, not a result of it. Hence, statement 4 is incorrect.

• Ovule:

• The ovule is the structure within the ovary of a seed plant that contains the female germ cell.

• After successful fertilization, the entire ovule matures into a seed. It is the site where the zygote is formed, not the result of the fusion itself. Hence, statement 2 is incorrect.

• Seed Coat:

• The seed coat (or testa) is the protective outer layer of a seed.

• It develops from the integuments (outer layers) of the ovule post-fertilization. It is a later stage of development intended to protect the embryo. Hence, statement 1 is incorrect.

Important Points

• Double Fertilization: This is a unique characteristic of angiosperms. While one male gamete fuses with the egg to form a zygote (2n), the second male gamete fuses with two polar nuclei to form the Primary Endosperm Nucleus (PEN), which is triploid (3n).

• Post-Fertilization Changes:

• The Zygote develops into the Embryo.

• The Endosperm (3n) provides nutrition to the developing embryo.

• The Ovary ripens and develops into the Fruit.

• The Ovule transforms into the Seed.

• Location: In flowering plants, the male gametes are carried by pollination (via wind, water, or animals) to the stigma, where the journey toward the embryo sac begins.

Q13. Answer: (d) Leishmania

The correct answer is Leishmania.

Key Points

• Binary fission is a common method of asexual reproduction in single-celled organisms where a parent cell splits into two identical daughter cells.

• In Amoeba, the division can take place in any plane. Since Amoeba does not have a fixed shape and constantly changes its form using pseudopodia, the cytokinesis (cytoplasm division) is not restricted to a specific axis.

• Organisms like Leishmania show binary fission in a definite orientation. Leishmania is a protozoan characterized by a whip-like structure called a flagellum at one end of its body.

• In Leishmania, binary fission occurs in a longitudinal plane relative to the flagellum. This specific orientation ensures that the complex cellular structures are properly replicated and shared between the two new cells.

• Paramecium, another ciliated protozoan, also exhibits a definite orientation for division, but it undergoes transverse binary fission, where the cell divides along its horizontal axis.

Additional Information

• Leishmania:

• It is the causative agent of Kala-azar (Visceral Leishmaniasis).

• The parasite is transmitted to humans through the bite of an infected female sandfly.

• It primarily affects the immune system, leading to the enlargement of the liver and spleen.

• Plasmodium:

• Unlike binary fission, Plasmodium reproduces via multiple fission.

• In this process, the parent cell divides into many daughter cells simultaneously.

• It is the malarial parasite responsible for causing Malaria in humans.

• Paramecium:

• It is a slipper-shaped ciliate found in freshwater.

• It possesses two types of nuclei: a macronucleus (for metabolic functions) and a micronucleus (for reproduction).

• Its transverse binary fission involves the constriction of the cell membrane across the middle.

Important Points

• Reproductive Strategy: In single-celled organisms, cell division itself is the mode of reproduction, creating new individuals that are genetically identical (clones) to the parent.

• Kala-azar: It is also known as Black Fever. It is a severe tropical disease that can be fatal if not treated. India, specifically states like Bihar and West Bengal, has historically been a significant region for its prevalence.

• Types of Fission:

• Simple Binary Fission: Division in any plane (e.g., Amoeba).

• Longitudinal Binary Fission: Division along the vertical axis (e.g., Leishmania, Euglena).

• Transverse Binary Fission: Division along the horizontal axis (e.g., Paramecium, Planaria).

• Nuclear Division: In all forms of fission, karyokinesis (nuclear division) always precedes cytokinesis (cytoplasmic division) to ensure both offspring receive genetic material.

Q14. Answer: (a) Turmeric

The correct answer is Turmeric.

Key Points

• Olfactory indicators are substances whose smell or odor changes depending on whether they are mixed with an acidic or a basic solution.

• Turmeric is a natural indicator that undergoes a color change rather than an odor change. It remains yellow in acidic solutions but turns reddish-brown in basic solutions. Hence, statement 1 is correct as it is NOT an olfactory indicator.

• Vanilla extract is a well-known olfactory indicator. Its characteristic pleasant smell disappears when it is added to a base (like Sodium Hydroxide), but the smell persists in acidic conditions. Hence, statement 2 is incorrect.

• Clove oil acts as an olfactory indicator because its distinctive pungent odor cannot be detected in a basic medium, while it remains detectable in an acidic medium. Hence, statement 3 is incorrect.

• Onion is also an olfactory indicator. The smell of onion is destroyed in a basic solution, which is why it can be used to distinguish between acids and bases by visually impaired students. Hence, statement 4 is incorrect.

Additional Information

• Indicators: These are substances that help in identifying the acidic or basic nature of a solution. They are broadly classified into Natural, Synthetic, and Olfactory indicators.

• Natural Indicators:

• Litmus: Extracted from Lichens. It turns red in acid and blue in base.

• Red Cabbage: Its extract remains red in acid but turns green in base.

• Turmeric: Commonly used in kitchens; it is yellow in neutral/acidic media and reddish-brown in basic media (e.g., when soap is applied to a turmeric stain).

• Synthetic Indicators:

• Phenolphthalein: It remains colorless in acidic solutions but turns pink in basic solutions.

• Methyl Orange: It turns red in acidic solutions and yellow in basic solutions.

• Universal Indicator:

• It is a mixture of several indicators that shows different colors at different concentrations of hydrogen ions in a solution.

• It is used to measure the pH value of a solution on a scale of 0 to 14.

Important Points

• Acids are substances that taste sour and turn blue litmus red. They release H+ ions in aqueous solutions. Examples include Hydrochloric acid (HCl) and Sulfuric acid (H_2SO_4).

• Bases are substances that taste bitter, feel soapy to touch, and turn red litmus blue. They release OH- ions in aqueous solutions. Examples include Sodium Hydroxide (NaOH) and Calcium Hydroxide ($Ca(OH)_2$).

• Olfactory Indicators are particularly important in inclusive education as they allow visually challenged students to perform acid-base titrations and experiments in chemistry laboratories.

Q15. Answer: (b) The total current is the sum of the currents through individual resistors.

The correct answer is The total current is the sum of the currents through individual resistors.

Key Points

• In a parallel connection, all the resistors are connected between the same two common points or nodes. This ensures that the potential difference (Voltage) across each individual resistor remains the same.

• According to Kirchhoff's Current Law (KCL), the total current entering a junction must be equal to the sum of the currents leaving that junction. In a parallel circuit, the total current (I) provided by the source divides among the various branches.

• The mathematical expression for total current in a parallel circuit is $I = I1 + I2 + I3 + ... + In$. Hence, statement 2 is correct.

• In a parallel circuit, the current through each resistor is determined by Ohm's Law ($I = V/R$). Since the voltage (V) is constant, the current is inversely proportional to the resistance (R). This means resistors with different values will carry different currents. Hence, statement 1 is incorrect.

• The total current is the aggregate of all branch currents, meaning it cannot be the same as the current through a single branch unless there is only one resistor in the circuit. Hence, statement 3 is incorrect.

• Adding more resistors in parallel provides additional paths for the electric current to flow. This reduces the overall opposition to the current, meaning the equivalent resistance decreases as more resistors are added. Hence, statement 4 is incorrect.

Additional Information

• Equivalent Resistance (Req): The reciprocal of the equivalent resistance of a parallel combination is equal to the sum of the reciprocals of the individual resistances. The formula is $1/Req = 1/R1 + 1/R2 + 1/R3 + ... + 1/Rn$.

• Smallest Resistance Rule: One of the unique features of parallel circuits is that the total equivalent resistance is always smaller than the smallest individual resistance present in the parallel network.

• Domestic Wiring: In most households, electrical appliances are connected in parallel. This ensures that every device receives the full supply voltage (usually 220V to 240V depending on the country) and can be operated independently using its own switch.

• Fault Tolerance: Parallel circuits are highly reliable for complex systems. If one resistor or appliance in a parallel branch burns out or is disconnected, the other branches remain unaffected and continue to operate normally because their circuits are still complete.

Important Points

• Comparison with Series Circuits: In a series circuit, the current remains the same through all components, while the total voltage is the sum of the individual voltage drops across the resistors. This is the exact opposite of a parallel circuit.

• Power Dissipation: The total power (P) consumed by a parallel circuit is the sum of the power dissipated by each individual resistor. Since P = V^2 / R, the resistor with the lowest resistance will dissipate the highest power in a parallel connection.

• Current Division Rule: For two resistors (R1 and R2) in parallel, the current through R1 is calculated as I1 = I * (R2 / (R1 + R2)), where I is the total current. This highlights how current distribution is dependent on the ratio of resistances.

Q16. Answer: (a) They vibrate with more energy.

The correct answer is They vibrate with more energy.

Key Points

• When a solid is heated, the thermal energy provided is absorbed by the constituent particles (atoms, molecules, or ions). This increase in energy directly translates to an increase in the kinetic energy of the particles.

• In a solid state, particles are packed closely together in a fixed, regular lattice structure and are held by strong intermolecular forces. Because of this rigid arrangement, the particles do not move from one location to another but instead vibrate around their mean positions.

• As the temperature rises, the amplitude and frequency of these vibrations increase. This means the particles vibrate with more energy and intensity as they gain heat. Hence, the statement that they vibrate with more energy is correct.

• The idea that particles stop interacting completely is false, as intermolecular attractions still exist until the substance reaches a gaseous state or undergoes a chemical change. Hence, statement 2 is incorrect.

• Heating a solid typically causes physical changes (like melting) rather than nuclear or chemical decomposition into different elements under standard conditions. Hence, statement 3 is incorrect.

• Freezing is the process of losing energy, not gaining it; heating causes particles to become more active, not static. Hence, statement 4 is incorrect.

Additional Information

• Kinetic Theory of Matter: This theory states that all matter is composed of tiny particles that are in constant motion. The amount of motion is proportional to the temperature of the substance, measured in Kelvin.

• Melting Point: When a solid is heated to a specific temperature, the vibrations become so violent that the particles overcome the attractive forces holding them in the lattice. This transition from a solid to a liquid is known as melting or fusion.

• Thermal Expansion: As particles in a solid vibrate more vigorously due to heating, they push each other further apart. This results in an increase in the volume of the material, a phenomenon known as thermal expansion. This is a critical factor in engineering and construction, such as in the design of railway tracks and bridges.

• Specific Heat Capacity: This is the amount of heat energy required to raise the temperature of 1 kilogram of a substance by 1 degree Celsius. Different solids have different capacities for absorbing energy based on their atomic structure.

• Latent Heat of Fusion: During the actual process of melting, the temperature of the solid does not rise even though heat is being added. This energy is used exclusively to break the bonds between particles and is referred to as latent heat.

Important Points

• Vibrational Motion: In solids, the particles are restricted to vibrational motion. In liquids, they exhibit translational and rotational motion, and in gases, they move randomly at high velocities.

• Absolute Zero: According to thermodynamics, at a temperature of 0 Kelvin (-273.15 degrees Celsius), particle motion (vibration) reaches its theoretical minimum, though it never truly becomes zero due to quantum mechanical effects.

• States of Matter: The transition from solid to liquid to gas is driven by the balance between thermal energy (which promotes motion) and intermolecular forces (which promote order).

Q17. Answer: (a) Butane

The correct answer is Butane.

Key Points

• 2-methylpropane, also commonly known as isobutane, has the molecular formula C4H10. It consists of a three-carbon chain with a methyl group (-CH3) attached to the second carbon atom.

• Butane is a straight-chain alkane that also possesses the molecular formula C4H10. It consists of four carbon atoms linked in a continuous row.

• Because both 2-methylpropane and Butane share the same molecular formula (C4H10) but differ in the arrangement of their atoms, they are referred to as structural isomers (specifically chain isomers). Hence, the first option is correct.

• Butene has the molecular formula C4H8. It is an alkene, meaning it contains at least one carbon-carbon double bond, which reduces the number of hydrogen atoms compared to an alkane. Hence, the second statement is incorrect.

• Pentane is an alkane with five carbon atoms, resulting in the molecular formula C5H12. Since it has more carbon atoms than 2-methylpropane, their formulas do not match. Hence, the third statement is incorrect.

• Pentene is an alkene with five carbon atoms and one double bond, giving it the molecular formula C5H10. Hence, the fourth statement is incorrect.

Additional Information

• General Formula of Alkanes: All saturated hydrocarbons (alkanes) follow the general chemical formula CnH2n+2, where n represents the number of carbon atoms. For n=4, the formula is C4H(2*4+2), which equals C4H10.

• Concept of Isomerism: Isomers are molecules that have the same molecular formula but different chemical structures. Chain isomerism occurs when there is a difference in the atomic arrangement of the carbon skeleton.

• Physical Properties: While isomers share the same formula, their physical properties often differ. For instance, Butane has a boiling point of approximately -0.5 degrees Celsius, whereas 2-methylpropane has a lower boiling point of about -11.7 degrees Celsius due to its more spherical shape and reduced surface area.

• Industrial Uses: Both Butane and Isobutane are extracted from natural gas or petroleum refinery streams. They are widely used as fuel in LPG (Liquefied Petroleum Gas), as refrigerants, and as propellants in aerosol sprays.

Important Points

• IUPAC Nomenclature: The International Union of Pure and Applied Chemistry (IUPAC) rules dictate that for 2-methylpropane, the longest continuous chain is 3 carbons (propane), and the methyl branch is at position 2.

• Saturation: Alkanes like Butane and 2-methylpropane are saturated, meaning they contain only single bonds between carbon atoms. Alkenes (like butene) and Alkynes are unsaturated.

• Homologous Series: Compounds like Butane and Pentane belong to the same homologous series, where each successive member differs by a -CH2- unit and a molecular mass of 14 units.

Q18. Answer: (c) They have only a single bond between carbon-carbon atoms.

The correct answer is They have only a single bond between carbon-carbon atoms.

Key Points

• Saturated hydrocarbons are organic compounds composed entirely of carbon and hydrogen atoms where all carbon-carbon atoms are linked by single covalent bonds.

• These compounds are commonly known as Alkanes. Because every carbon atom is bonded to the maximum possible number of hydrogen atoms, they are considered "saturated." Hence, statement 3 is correct.

• Hydrocarbons that contain at least one triple bond between carbon atoms are called Alkynes. These are classified as unsaturated hydrocarbons. Hence, statement 1 is incorrect.

• Hydrocarbons having at least one double bond are known as Alkenes. Like alkynes, they are also unsaturated because they can undergo addition reactions to accommodate more hydrogen. Hence, statement 4 is incorrect.

• Compounds that contain either double or triple bonds are broadly grouped as unsaturated hydrocarbons, distinguishing them clearly from saturated ones. Hence, statement 2 is incorrect.

Additional Information

• Alkanes (Saturated):

• The general formula for open-chain alkanes is CnH2n+2, where n is the number of carbon atoms.

• Common examples include Methane (CH4), Ethane (C2H6), Propane (C3H8), and Butane (C4H10).

• They are also called paraffins (Latin: parum affinis = little affinity) because they are relatively unreactive under normal conditions.

• Unsaturated Hydrocarbons:

• Alkenes: Contain at least one C=C double bond. Their general formula is CnH2n. An example is Ethene (C2H4).

• Alkynes: Contain at least one carbon-carbon triple bond. Their general formula is CnH2n-2. An example is Ethyne (C2H2), also known as acetylene.

• These compounds are more chemically reactive than saturated hydrocarbons due to the presence of pi bonds.

• Cyclic Hydrocarbons:

• Hydrocarbons can also form ring structures. Cycloalkanes are saturated cyclic hydrocarbons (e.g., Cyclohexane), while Aromatic hydrocarbons like Benzene (C6H6) possess unique stability and unsaturated ring systems.

Important Points

• Hybridization: In saturated hydrocarbons (alkanes), each carbon atom undergoes sp3 hybridization, resulting in a tetrahedral geometry with a bond angle of approximately 109.5 degrees.

• Physical State: At room temperature, the first four alkanes (C1 to C4) are gases, C5 to C17 are liquids, and those with 18 or more carbon atoms are solids.

• Combustion: Saturated hydrocarbons typically undergo complete combustion in the presence of sufficient oxygen, producing a non-sooty blue flame, carbon dioxide, and water.

• Applications: They are primarily used as fuels (Natural gas, Petrol, Diesel) and lubricants due to their chemical stability and energy content.

Q19. Answer: (b) −25 J

The correct answer is -25 J.

Key Points

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

• The mathematical expression for work is W = Fs cos θ, where F represents the constant force applied, s is the displacement, and θ is the angle between the force vector and the displacement vector.

• In the given problem, the magnitude of the constant force is 2.5 N and the displacement is 10 m.

• The problem states that the displacement occurs in the opposite direction to the direction of the force. This implies that the angle (θ) between the force and the displacement is 180 degrees.

• The value of cos(180°) is -1. Therefore, substituting these values into the formula: Work = 2.5 N × 10 m × (-1).

• The resulting calculation gives -25 Joules (J). The negative sign indicates that the force is acting in a direction opposite to the motion of the body.

Additional Information

• Types of Work:

• Positive Work: If the force and displacement are in the same direction (angle θ = 0°), the work done is positive. An example is an object falling freely under gravity.

• Negative Work: If the force and displacement are in opposite directions (angle θ = 180°), the work done is negative. A classic example is the force of friction acting on a moving car.

• Zero Work: Work is zero if the force is perpendicular to the displacement (angle θ = 90°) or if either the force or displacement is zero. For example, a person carrying a box on their head and walking on a horizontal road does zero work against gravity.

• Units and Nature:

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

• In the CGS system, the unit of work is the erg. The relationship between the two is 1 Joule = 10^7 ergs.

• Work is a scalar quantity, meaning it has magnitude but no direction, even though it is derived from two vector quantities (force and displacement).

• Dimensional Formula:

• The dimensional formula for work is $[ML^2T^{-2}]$. This is derived from the dimensions of force $[MLT^{-2}]$ multiplied by the dimension of displacement [L].

• Work-Energy Theorem:

• According to this theorem, the net work done on a body is equal to the change in its kinetic energy. This principle is fundamental in classical mechanics for solving problems involving variable forces and complex motions.

Important Points

• It is important to note that the negative sign in work does not represent a direction in space but rather indicates that energy is being removed from the system or that work is being done against a particular force.

• For a constant force, the path taken between two points does not change the amount of work done, provided the force is conservative (like gravity or electrostatic force).

• When multiple forces act on a body, the total work done is the algebraic sum of the work done by each individual force.

Q20. Answer: (b) Striated muscle

The correct answer is Striated muscle.

Key Points

• Striated muscles, also commonly referred to as skeletal muscles, are primarily attached to the bones by tendons and are responsible for the locomotion and movement of the body.

• These muscles are characterized by the presence of alternating light and dark bands or striations when viewed under a microscope. These bands are formed due to the highly organized arrangement of contractile proteins, namely Actin (light bands) and Myosin (dark bands).

• Striated muscles are voluntary in nature, meaning their movement and contraction are under the conscious control of the individual. This control is mediated by the somatic nervous system.

• The cells (fibers) of striated muscles are long, cylindrical, and unbranched. A unique feature of these fibers is that they are multinucleated, containing many nuclei located at the periphery of the cell.

• They facilitate activities such as walking, running, writing, and maintaining posture. Because they tire easily, they require rest after periods of intense physical activity.

Additional Information

• Cardiac Muscle:

• These are specialized muscles found exclusively in the heart wall (myocardium).

• Like skeletal muscles, they show striations; however, they are involuntary, meaning they are not controlled by conscious thought.

• The cells are cylindrical, branched, and usually uninucleated. They possess intercalated discs that allow for rapid electrical communication between cells, ensuring the heart beats as a synchronized unit.

• Smooth Muscle (Unstriated Muscle):

• These are also known as unstriated or visceral muscles because they lack the visible striations found in skeletal and cardiac muscles.

• They are involuntary and are controlled by the autonomic nervous system.

• Their cells are spindle-shaped (tapered at both ends) and contain a single, centrally located nucleus.

• They are located in the walls of hollow internal organs such as the alimentary canal (for peristalsis), blood vessels, urinary bladder, and uterus.

• Key Protein Filaments:

• Actin: Known as the thin filament, it constitutes the I-band (Isotropic band) or the light band of the muscle fiber.

• Myosin: Known as the thick filament, it constitutes the A-band (Anisotropic band) or the dark band. The interaction between these two proteins according to the Sliding Filament Theory leads to muscle contraction.

• Sarcomere:

• This is the functional unit of contraction in a striated muscle fiber. It is the segment of a myofibril located between two successive Z-lines.

Important Points

• Nervous System Control: Voluntary muscles (Striated) are connected to the Central Nervous System (CNS) via motor neurons, whereas involuntary muscles (Smooth and Cardiac) are regulated by the sympathetic and parasympathetic divisions of the autonomic nervous system.

• Metabolic Adaptations: Striated muscles have a high demand for ATP and contain myoglobin, an oxygen-storing protein. Fibers rich in myoglobin are called Red fibers (slow-twitch), while those with less myoglobin are White fibers (fast-twitch).

• Location Summary: Striated is for limbs/body wall, Smooth is for internal organ systems, and Cardiac is strictly for the circulatory pump (heart).

Q21. Answer: (a) 20 cm

The correct answer is 20 cm.

Key Points

• To find the focal length of the lens, we use the Lens Formula, which is expressed as 1/f = 1/v - 1/u.

• According to the New Cartesian Sign Convention, the object distance (u) is always taken as negative because the object is placed to the left of the lens. Therefore, u = -30 cm.

• Since the lens forms a real image on the other side of the lens, the image distance (v) is positive. Therefore, v = +60 cm.

• Substituting the values into the formula: 1/f = 1/60 - 1/(-30). This simplifies to 1/f = 1/60 + 1/30.

• Finding a common denominator, we get 1/f = (1 + 2) / 60, which results in 1/f = 3/60.

• By taking the reciprocal, we find the focal length (f) = 60 / 3 = 20 cm. Hence, the calculation shows the focal length is 20 cm.

• The positive sign of the focal length confirms that the lens used is a convex lens, as they have positive focal lengths.

• Hence, the correct answer is 20 cm.

Additional Information

• Convex Lens (Converging Lens):

• A convex lens is thicker at the center than at the edges. It converges parallel rays of light passing through it.

• It can form both real and virtual images depending on the position of the object relative to the optical center and the principal focus.

• When the object is placed beyond the focal point (F), the image formed is real and inverted.

• Sign Convention for Lenses:

• All distances are measured from the optical center of the lens.

• Distances measured in the direction of incident light are positive, while those measured against the direction of incident light are negative.

• The focal length of a convex lens is always positive, whereas for a concave lens, it is always negative.

• Magnification (m):

• Magnification is defined as the ratio of the height of the image to the height of the object, or the ratio of image distance (v) to object distance (u).

• Formula: m = v / u. In this specific case, m = 60 / (-30) = -2.

• A negative magnification indicates that the image is real and inverted. The numerical value 2 indicates that the image is magnified (twice the size of the object).

Important Points

• Power of a Lens: The power (P) of a lens is the reciprocal of its focal length measured in meters. The SI unit of power is the Dioptre (D). For this lens, the focal length is 0.2 meters, so the power would be P = 1 / 0.2 = +5 D.

• Nature of Image: Since the image distance is positive and the image is formed on the side opposite to the object, the image is real. All real images formed by a single lens are inverted.

• Object at 2F: If an object is placed at 2f (twice the focal length), the image is formed at 2f on the other side. In this problem, 2f would be 40 cm. Since the object is at 30 cm (between f and 2f), the image is formed beyond 2f (which 60 cm is).

Q22. Answer: (b) Dispersing medium is the component in which its phase is suspended.

The correct answer is Dispersing medium is the component in which its phase is suspended.

Key Points

• A colloid is a mixture where one substance consisting of microscopically dispersed insoluble particles is suspended throughout another substance. It consists of two parts: the dispersed phase and the dispersing medium.

• The dispersing medium is the continuous medium (like a solvent) in which the dispersed phase (the colloidal particles) is distributed or suspended. Hence, statement 2 is correct.

• The components of a colloidal solution definitely include the dispersed phase, which represents the solute-like component. Hence, statement 1 is incorrect.

• Colloidal particles are small enough to pass through standard filter paper; therefore, they cannot be separated from the mixture by the process of filtration. They require special techniques like centrifugation for separation. Hence, statement 3 is incorrect.

• Although a colloid often appears uniform to the naked eye, it is actually a heterogeneous mixture because the particles remain distinct and do not truly dissolve at the molecular level. Hence, statement 4 is incorrect.

Additional Information

• Types of Colloids: Colloids are classified based on the state of the dispersed phase and the dispersing medium. Common types include Aerosols (liquid/solid in gas), Foams (gas in liquid), Emulsions (liquid in liquid), and Sols (solid in liquid).

• Tyndall Effect: This is the phenomenon where colloidal particles scatter a beam of visible light, making the path of the beam visible. This effect is not seen in true solutions because the particles are too small.

• Stability: Colloids are quite stable; the particles do not settle down when left undisturbed, unlike a suspension where particles eventually precipitate.

• Examples: Common everyday examples of colloids include Milk, Butter, Fog, Whipped Cream, and Paint. In milk, fat globules are the dispersed phase and water is the dispersing medium.

Important Points

• Particle Size: The size of particles in a colloid typically ranges between 1 nanometre (nm) and 1000 nanometres (nm). This intermediate size is what gives colloids their unique properties compared to true solutions (less than 1 nm) and suspensions (greater than 1000 nm).

• Brownian Motion: Colloidal particles often exhibit a random, zig-zag motion known as Brownian Motion. This motion is caused by the constant bombardment of the particles by the molecules of the dispersing medium, which helps keep the colloid stable and prevents settling.

• Centrifugation: Because filtration is ineffective, centrifugation (spinning the mixture at high speeds) is the primary physical method used to separate the dispersed phase from the dispersing medium in many colloids.

Q23. Answer: (b) A-1; B-2; C-3; D-4

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

Key Points

• Litmus paper (A - 1):

• Litmus paper is the most common natural indicator used in laboratories to detect the acidic or basic nature of a substance.

• It is extracted from lichens and is available as red or blue strips. Blue litmus turns red under acidic conditions, while red litmus turns blue under alkaline (basic) conditions. Hence, the match A-1 is correct.

• Watch-glass (B - 2):

• A watch-glass is a circular concave piece of glass used in chemistry for various purposes such as evaporating a liquid or holding small samples.

• In the context of testing pH, it is frequently used to place drops of test solutions before adding an indicator or touching it with litmus paper to observe reactions. Hence, the match B-2 is correct.

• Test tube (C - 3):

• A test tube is a standard piece of laboratory glassware consisting of a finger-like length of glass or clear plastic tubing, open at the top and closed at the bottom.

• Its primary function is to hold, mix, or heat small quantities of solid or liquid solutions safely during an experiment. Hence, the match C-3 is correct.

• Indicator solution (D - 4):

• An indicator solution is a chemical substance that shows a distinct colour change when it comes into contact with an acid or a base.

• Common examples include Phenolphthalein, which remains colourless in acid but turns pink in base, and Methyl Orange. Hence, the match D-4 is correct.

Additional Information

• Acids and Bases:

• Acids are substances that have a sour taste and release Hydrogen ions (H+) in aqueous solutions. Their pH value is always less than 7.

• Bases are substances that are bitter to taste, soapy to touch, and release Hydroxyl ions (OH-). Their pH value is greater than 7.

• Natural Indicators:

• Apart from litmus, other natural indicators include turmeric (which turns red in base), China rose, and red cabbage juice.

• These are used to identify the chemical nature of household substances without using synthetic chemicals.

• Synthetic Indicators and pH Scale:

• Methyl orange and phenolphthalein are synthetic indicators used for precise titrations in a laboratory.

• The pH scale was developed by S.P.L. Sorensen in 1909 to measure the strength of acidity or alkalinity on a scale of 0 to 14.

• Laboratory Apparatus Maintenance:

• Test tubes are often made of borosilicate glass (like Pyrex) to withstand high temperatures and minimize thermal expansion.

• Watch-glasses must be thoroughly cleaned and dried to avoid contamination of the test solutions during qualitative analysis.

Important Points

• Safety Protocols: When using a test tube for heating, always use a test tube holder and point the mouth of the tube away from yourself and others to prevent injury from spurting liquids.

• Universal Indicator: This is a mixture of indicators that shows different colours at different pH values across the entire pH scale, providing a more accurate measurement than simple litmus paper.

• Neutralization: When an acid and a base react in a test tube, they form salt and water, a process known as neutralization, which often releases heat (exothermic).

Q24. Answer: (b) 20 m/s

The correct answer is 20 m/s.

Key Points

• Linear Velocity is defined as the rate of change of the displacement of an object with respect to time. It is a vector quantity, meaning it possesses both magnitude and direction.

• The mathematical formula for calculating velocity is Velocity (v) = Displacement (s) / Time (t). In the context of a car moving in a straight line, the distance covered represents the magnitude of displacement.

• In this specific problem, the displacement is given as 100 meters and the time interval is 5 seconds. By applying the formula: 100 / 5, we obtain a value of 20.

• The SI unit for velocity is meters per second (m/s). Therefore, the linear velocity of the car is 20 m/s. Hence, the correct answer is 20 m/s.

• Linear velocity differs from angular velocity, as the former refers to motion along a straight path, while the latter refers to the rate of change of angular displacement during circular motion.

Additional Information

• Difference between Speed and Velocity:

• Speed is a scalar quantity that refers to "how fast an object is moving," calculating the total distance covered over time.

• Velocity is a vector quantity that considers the direction of motion and uses displacement (the shortest distance between start and end points) instead of total distance.

• Types of Velocity:

• Uniform Velocity: When an object covers equal displacements in equal intervals of time, it is said to be moving with uniform velocity.

• Non-uniform (Variable) Velocity: When either the speed or the direction of an object changes over time, its velocity is considered non-uniform.

• Instantaneous Velocity: This refers to the velocity of an object at a specific point in time or at a specific point in its path.

• Unit Conversions: In many physics problems, velocity may be given in kilometers per hour (km/h). To convert km/h to m/s, you multiply the value by 5/18. Conversely, to convert m/s to km/h, you multiply by 18/5. For example, 20 m/s is equivalent to 72 km/h.

• Acceleration: The rate at which the velocity of an object changes is called acceleration. If the car in the question was increasing its speed from 0 to 20 m/s over those 5 seconds, it would be experiencing linear acceleration, measured in m/s^2.

Important Points

• The magnitude of velocity is equal to the speed only when the object moves in a straight line without changing direction.

• If an object returns to its starting position after moving 100 meters (e.g., moves 50m forward and 50m back), its total displacement would be 0, and therefore its average velocity would also be 0 m/s, despite having a non-zero average speed.

• In Newton's First Law of Motion, an object will maintain a constant velocity (including a velocity of zero) unless acted upon by an external unbalanced force.

Q25. Answer: (b) Phloem transports food from leaves to other parts.

The correct answer is Phloem transports food from leaves to other parts.

Key Points

• Phloem is a complex permanent tissue in vascular plants responsible for the transport of organic nutrients, particularly sucrose, produced during photosynthesis.

• Statement 1: Phloem transports minerals from roots to leaves. This is incorrect because the transport of water and minerals from the roots to the leaves is the primary function of the Xylem tissue. Hence, statement 1 is incorrect.

• Statement 2: Phloem transports food from leaves to other parts. This is the fundamental role of phloem, often referred to as translocation. It carries synthesized food from the source (leaves) to the sink (roots, fruits, and growing tips). Hence, statement 2 is correct.

• Statement 3: Phloem transports water upward only. This is incorrect. While phloem contains some water to facilitate the flow of solutes, the transport of water is primarily handled by the Xylem in a unidirectional (upward) flow. Phloem transport is bidirectional (both upward and downward). Hence, statement 3 is incorrect.

• Statement 4: Phloem is made entirely of dead cells. This is incorrect. Most components of the phloem, such as sieve tube elements, companion cells, and phloem parenchyma, are living cells. Only the phloem fibres (bast fibres) are dead cells at maturity. Hence, statement 4 is incorrect.

Additional Information

• Components of Phloem:

• Sieve Tubes: These are long, tube-like structures arranged longitudinally. They are living cells but lack a nucleus at maturity to allow for efficient flow of nutrients.

• Companion Cells: These are specialized parenchymatous cells closely associated with sieve tubes. They possess a nucleus and help maintain the pressure gradient in the sieve tubes.

• Phloem Parenchyma: These are living cells that store food and other substances like resins and latex.

• Phloem Fibres: Also known as bast fibres, these provide mechanical strength to the plant. These are the only dead components of the phloem.

• Direction of Transport: Unlike Xylem, which moves substances unidirectionally from roots to shoots, Phloem moves nutrients multidirectionally. This allows the plant to send food to storage organs (like roots) and later mobilize it for budding or growth in spring.

• Mechanism of Translocation: The movement of food in the phloem occurs via the Pressure Flow Hypothesis (or Munch Hypothesis). It involves the active loading of sucrose into sieve tubes, which creates a hypertonic environment, drawing water in and creating hydrostatic pressure that pushes the sap toward areas of lower pressure (sinks).

Important Points

• Xylem vs. Phloem: While Xylem is responsible for the conduction of water and minerals and consists mostly of dead cells (tracheids and vessels), Phloem conducts organic solutes and consists mostly of living cells.

• Economic Importance: Some phloem fibres, such as those from jute, flax, and hemp, are commercially used to make ropes and fabrics due to their strength.

• Vascular Bundles: Together, xylem and phloem constitute the vascular bundles of the plant, which are the main transport systems in higher plants.

Q26. Answer: (a) (1 - 1/n) × 180°

Shortcut Trick

For any regular polygon with N sides, the exterior angle is 360° ÷ N.

The interior angle (angle between adjacent sides) is 180° − Exterior angle.

Given N = 2n, Exterior angle = 360° ÷ 2n = 180° ÷ n.

Interior angle = 180° − (180° ÷ n) = 180° × (1 − 1/n).

Therefore The correct answer is (1 − (1/n)) × 180°.
Alternate Method
Given: Number of sides (N) = 2n.
Formula Used: Each interior angle of a regular polygon = [(N − 2) × 180°] ÷ N.
=> N = 2n
=> Interior angle = [(2n − 2) × 180°] ÷ 2n
=> Interior angle = [2(n − 1) × 180°] ÷ 2n
=> Interior angle = [(n − 1) × 180°] ÷ n
=> Interior angle = (n/n − 1/n) × 180°
=> Interior angle = (1 − 1/n) × 180°
Therefore The correct answer is (1 − (1/n)) × 180°.
Additional Information

Q27. Answer: (a) 66.67%

Shortcut Trick
Required percentage = (Marks of B ÷ Marks of A) × 100
Required percentage = (50 ÷ 75) × 100
Required percentage = (2 ÷ 3) × 100 ≈ 66.67%
Therefore The correct answer is 66.67%.
Alternate Method
Given:
Marks obtained by B = 50
Marks obtained by A = 75
Formula Used:
Percentage = (Value ÷ Base Value) × 100
Calculations:
=> Required % = (50 ÷ 75) × 100
=> Required % = 0.66666... × 100
=> Required % = 66.666...
=> Required % ≈ 66.67%
Therefore The correct answer is 66.67%.
Additional Information
Percentage Base Rule
The value following the word 'than' or 'of' in a comparison is usually taken as the denominator (base value).
Fraction to Percentage Conversion
Standard fractions like 1/3 = 33.33% and 2/3 = 66.67% are frequently used in competitive exams for faster calculation.

Q28. Answer: (a) 96

Shortcut Trick
For two numbers P and Q, the Mean Proportional is √(P × Q).
Given Mean Proportional = 120 and one number = 150.
=> 120^2 = P × 150
=> 14400 = P × 150
=> P = 1440 ÷ 15 = 96.
Therefore The correct answer is 96.
Alternate Method
Given:
First number = P
Second number = 150
Mean Proportional (M.P.) = 120
Formula Used:
Mean Proportional = √(First number × Second number)

Calculations:
=> 120 = √(P × 150)
Squaring both sides:
=> $(120)^2 = P \times 150$
=> 14400 = P × 150
=> P = 14400 ÷ 150
=> P = 96
Therefore The correct answer is 96.
Additional Information
Mean Proportional
The mean proportional between two numbers a and b is x if a/x = x/b, which gives x = √(ab).
Third Proportional
If a : b :: b : c, then c is called the third proportional to a and b, calculated as $c = b^2/a$.
Fourth Proportional
If a : b :: c : d, then d is the fourth proportional to a, b, and c, calculated as d = (b × c)/a.

Q29. Answer: (d) Rs. 18,000

Shortcut Trick
Effective discount = a + b − (a × b) ÷ 100 = 35 + 30 − (35 × 30) ÷ 100 = 65 − 10.5 = 54.5%.
Ratio of Marked Price (MP) to Cost Price (CP): MP ÷ CP = (100 + Gain%) ÷ (100 − Discount%).
MP ÷ 7,000 = (100 + 17) ÷ (100 − 54.5) = 117 ÷ 45.5.
MP = (7,000 × 117) ÷ 45.5 = (7,000 × 1170) ÷ 455.
MP = 18.02 × 1,000 ≈ Rs. 18,000.
Therefore The correct answer is Rs. 18,000.
Alternate Method
Given: CP = Rs. 7,000, Gain = 17%, Successive Discounts = 35% and 30%.
Formulas: SP = CP × (100 + P%) ÷ 100 | MP = SP × 100 ÷ (100 − D%) | Successive Discount = a + b − ab ÷ 100.
Steps:
=> Calculate Selling Price (SP): SP = 7,000 × (117 ÷ 100) = 70 × 117 = Rs. 8,190.
=> Calculate Single Equivalent Discount: 35 + 30 − (35 × 30 ÷ 100) = 65 − 10.5 = 54.5%.
=> Use SP and Discount to find MP: MP × (100 − 54.5) ÷ 100 = 8,190.
=> MP × 45.5 ÷ 100 = 8,190 => MP = (8,190 × 100) ÷ 45.5.
=> MP = 819,000 ÷ 45.5 = Rs. 18,000.
Therefore The correct answer is Rs. 18,000.
Additional Information
Relationship between MP and CP
When both discount percentage and profit percentage are known, the direct relation is MP/CP = (100 + P%)/(100 - D%).
Successive Discounts
Two successive discounts of x% and y% are equivalent to a single discount of [x + y − (xy/100)]%.

Q30. Answer: (a) 7

Shortcut Trick
Mode is the observation that appears most frequently in the data set.
Count the occurrences of each unique number:
Value 1 appears 2 times; Value 3 appears 2 times; Value 4 appears 2 times; Value 5 appears 1 time; Value 6 appears 1 time.
Value 7 appears 4 times; Value 8 appears 3 times.
Since 7 has the highest frequency, it is the mode.
Therefore The correct answer is 7.
Alternate Method
Given: Observations = 7, 5, 6, 3, 3, 7, 1, 7, 8, 7, 1, 4, 8, 8, 4
Step 1: Arrange data in Ascending Order: 1, 1, 3, 3, 4, 4, 5, 6, 7, 7, 7, 7, 8, 8, 8
=> Frequency of 1 = 2

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=> Frequency of 3 = 2
=> Frequency of 4 = 2
=> Frequency of 5 = 1
=> Frequency of 6 = 1
=> Frequency of 7 = 4
=> Frequency of 8 = 3
=> Highest Frequency = 4 (for the number 7)
Therefore The correct answer is 7.
Additional Information
Empirical Formula
The relationship between central tendencies is given by: Mode = 3 × Median − 2 × Mean.
Bimodal and Multimodal
If two observations have the same maximum frequency, the data set is Bimodal. If more than two, it is Multimodal.
Median for Discrete Data
For n observations, if n is odd, Median = ((n+1)/2)^(th) term. If n is even, Median = Average of (n/2)^(th) and (n/2 + 1)^(th) terms.

Q31. Answer: (d) 2,840

Shortcut Trick
Combine the ratios: A : B = 13 : 9 and B : C = 18 : 11.
To equalize B, multiply A : B by 2 → A : B : C = 26 : 18 : 11.
Total units = 26 + 18 + 11 = 55 units.
Value of 55 units = Rs. 14,200 → 1 unit = 14,200 ÷ 55 = 2840 ÷ 11.
Share of C = 11 units = (2840 ÷ 11) × 11 = Rs. 2,840.
Therefore The correct answer is Rs. 2,840.
Alternate Method
Given:
Total profit = Rs. 14,200
Ratio A : B = 13 : 9
Ratio B : C = 18 : 11
Calculations:
=> To find the combined ratio, we make the term for B common.
=> A : B = (13 × 2) : (9 × 2) = 26 : 18
=> B : C = 18 : 11
=> Combined Ratio A : B : C = 26 : 18 : 11
=> Sum of ratio parts = 26 + 18 + 11 = 55
=> Share of C = (Ratio of C ÷ Total Ratio) × Total Profit
=> Share of C = (11 ÷ 55) × 14,200
=> Share of C = (1 ÷ 5) × 14,200
=> Share of C = Rs. 2,840
Therefore The correct answer is Rs. 2,840.
Additional Information
Ratio Balancing
When two ratios share a common variable, multiply the terms to make the common variable's value identical in both ratios before combining.
Profit Distribution in Partnership
Profit is distributed based on the Ratio of Investment × Time. If time is equal, profit ratio = capital ratio.
Compound Ratio
The compound ratio of a : b and c : d is found by multiplying corresponding terms: (ac) : (bd).

Q32. Answer: (b) decrease by Rs. 4,128

Shortcut Trick
Let Income = 100, Savings = 26, Expenditure = 74.

New Income = 100 + 20% = 120.
New Expenditure = 74 + 40% = 74 + 29.6 = 103.6.
New Savings = 120 − 103.6 = 16.4.
Change in Savings = 16.4 − 26 = −9.6 units. (Decrease)
Since 100 units = Rs. 43,000, 1 unit = Rs. 430. Change = 9.6 × 430 = Rs. 4,128.
Therefore The correct answer is decrease by Rs. 4,128.
Alternate Method
Given: Initial Income = Rs. 43,000 | Savings % = 26%.
Formula Used: Income = Expenditure + Savings
=> Initial Savings = 26% of 43,000 = 0.26 × 43,000 = Rs. 11,180.
=> Initial Expenditure = 43,000 − 11,180 = Rs. 31,820.
=> New Income = 43,000 × 1.20 = Rs. 51,600.
=> New Expenditure = 31,820 × 1.40 = Rs. 44,548.
=> New Savings = 51,600 − 44,548 = Rs. 7,052.
=> Change in Savings = 11,180 − 7,052 = Rs. 4,128 decrease.
Therefore The correct answer is decrease by Rs. 4,128.
Additional Information
Percentage Change in Savings
Percentage change is calculated as [(New Value − Old Value) ÷ Old Value] × 100.
Base Change Property
If income and expenditure change by different percentages, savings will change based on their weighted relative proportions.
Income-Expenditure Identity
Always remember: Income = Expenditure + Savings. Any increase in Income must be balanced by the sum of increases in Expenditure and Savings.

Q33. Answer: (b) 12

Shortcut Trick
Assume all 20 animals are rabbits (4 legs each).
Hypothetical total legs = 20 × 4 = 80.
Difference from actual legs = 80 − 56 = 24.
Each chicken has 2 fewer legs than a rabbit (4 − 2 = 2).
Number of chickens = 24 ÷ 2 = 12.
Therefore The correct answer is 12.
Alternate Method
Given:
Total animals = 20
Total legs = 56
Let the number of chickens be x and rabbits be (20 − x).
=> Total legs = (Number of chickens × 2) + (Number of rabbits × 4)
=> 56 = 2x + 4(20 − x)
=> 56 = 2x + 80 − 4x
=> 56 = 80 − 2x
=> 2x = 80 − 56
=> 2x = 24
=> x = 24 ÷ 2
=> x = 12
Therefore The correct answer is 12.
Additional Information
Direct Formula for 4-legged animals
Number of 4-legged animals (Rabbits) = (Total Legs − 2 × Total Heads) ÷ 2. Here, Rabbits = (56 − 40) ÷ 2 = 8.
Alligation Method
Average legs per animal = 56 ÷ 20 = 2.8. Ratio of Chickens to Rabbits = (4 − 2.8) : (2.8 − 2) = 1.2 : 0.8 = 3 : 2.

Linear Equations in Two Variables

Solve by simultaneous equations: x + y = Total Animals and Ax + By = Total Legs, where A and B are the number of legs of each species.

Q34. Answer: (b) 36

Shortcut Trick

To find the largest number leaving the same remainder, find the HCF of the differences between the numbers.

Differences: (134 − 62) = 72 and (242 − 134) = 108.

HCF of 72 and 108 = 36.

Therefore The correct answer is 36.

Alternate Method

Given: Numbers are 62, 134, and 242.

Formula: Required Number = HCF(|a−b|, |b−c|, |c−a|)

=> Difference 1 = 134 − 62 = 72

=> Difference 2 = 242 − 134 = 108

=> Difference 3 = 242 − 62 = 180

=> HCF(72, 108, 180):

=> $72 = 2^3 \times 3^2$

=> $108 = 2^2 \times 3^3$

=> $180 = 2^2 \times 3^2 \times 5$

=> HCF = $2^2 \times 3^2 = 4 \times 9 = 36$

Therefore The correct answer is 36.

Additional Information

HCF with Same Remainder

The greatest number which when divides x, y, and z leaving the same remainder 'r' in each case is given by HCF of (x−y), (y−z), and (z−x).

HCF with Different Remainders

The greatest number which divides x, y, and z leaving remainders a, b, and c is HCF of (x−a), (y−b), and (z−c).

LCM Concept

LCM is the smallest number which is exactly divisible by all the given numbers.

Q35. Answer: (a) 137

Shortcut Trick

Average Speed for equal time intervals = Arithmetic Mean of individual speeds.

Given Time = 1 hour each, so Speed 1 = 128 kmph and Speed 2 = 146 kmph.

Average Speed = (128 + 146) ÷ 2 = 274 ÷ 2 = 137 kmph.

Therefore The correct answer is 137 km/hr.

Alternate Method

Given:

Distance1 = 128 km, Time1 = 1 hr

Distance2 = 146 km, Time2 = 1 hr

Formula Used:

Average Speed = Total Distance ÷ Total Time

Calculations:

=> Total Distance = 128 + 146 = 274 km

=> Total Time = 1 + 1 = 2 hours

=> Average Speed = 274 ÷ 2

=> Average Speed = 137 km/hr

Therefore The correct answer is 137 km/hr.

Additional Information

Average Speed (Equal Distance)

If a car covers equal distances at speeds u and v, the average speed is 2uv ÷ (u + v).

Relative Speed

When two bodies move in the same direction, relative speed is the difference (s1 − s2). In opposite directions, it is the sum (s1 + s2).

Unit Conversion

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

Q36. Answer: (b) 26%

Shortcut Trick

Net Profit% = Markup% + Discount% + (Markup × Discount) ÷ 100

Here, Markup = +40% and Discount = −10%.

Net Profit% = 40 − 10 + (40 × −10) ÷ 100

Net Profit% = 30 − 4 = 26%.

Therefore The correct answer is 26%.

Alternate Method

Given: Markup Percentage = 40%, Discount Percentage = 10%.

Formulas: MP = CP × (100 + Markup%) ÷ 100 | SP = MP × (100 − Discount%) ÷ 100 | Profit% = (SP − CP) ÷ CP × 100.

=> Let Cost Price (CP) be 100.

=> Marked Price (MP) = 100 + 40% of 100 = 140.

=> Selling Price (SP) = 140 − 10% of 140 = 140 − 14 = 126.

=> Profit = SP − CP = 126 − 100 = 26.

=> Profit Percentage = (26 ÷ 100) × 100 = 26%.

Therefore The correct answer is 26%.

Additional Information

Marked Price & Discount

The Marked Price (MP) is the price listed on the label, and Discount is always calculated on the MP to arrive at the Selling Price (SP).

Successive Percentage Change

Profit can be seen as a successive change of markup (increase) and discount (decrease): a + b + (ab ÷ 100).

Q37. Answer: (d) 4-√15

Shortcut Trick

For any trigonometric identity involving secθ and tanθ, we know that $\sec^2\theta - \tan^2\theta = 1$.

This implies (secθ + tanθ)(secθ − tanθ) = 1.

If secθ + tanθ = x, then secθ − tanθ = 1/x.

Given secθ + tanθ = 4 + √15, then secθ − tanθ = 1/(4 + √15).

By rationalization, 1/(4 + √15) = (4 − √15) / (4^2 − (√15)²) = (4 − √15) / (16 − 15) = 4 − √15.

Therefore The correct answer is 4 − √15.

Alternate Method

Given: secθ + tanθ = 4 + √15

Formula Used: $\sec^2\theta - \tan^2\theta = 1$

=> Let secθ + tanθ = A = 4 + √15

=> secθ − tanθ = 1/A

=> secθ − tanθ = 1 / (4 + √15)

=> Multiply numerator and denominator by the conjugate (4 − √15):

=> secθ − tanθ = (4 − √15) / [(4 + √15)(4 − √15)]

=> secθ − tanθ = (4 − √15) / (4^2 − (√15)²)

=> secθ − tanθ = (4 − √15) / (16 − 15)

=> secθ − tanθ = 4 − √15

Therefore The correct answer is 4 − √15.

Additional Information

Trigonometric Identities

Standard identities include $\sin^2\theta + \cos^2\theta = 1$, $1 + \tan^2\theta = \sec^2\theta$, and $1 + \cot^2\theta = \text{cosec}^2\theta$.

Reciprocal Property

If cosecθ + cotθ = x, then cosecθ − cotθ = 1/x, which is useful for solving similar Cosecant-Cotangent problems.

Rationalization Technique

When the denominator is of the form (a + √b), multiplying by (a − √b) removes the radical by using the difference of squares property ($a^2 - b$).

Q38. Answer: (c) 819

Shortcut Trick

Apply Unitary Method directly.

Words per line = 63 ÷ 4

Total words for 52 lines = (63 ÷ 4) × 52 = 63 × 13

Calculation: 60 × 13 + 3 × 13 = 780 + 39 = 819

Therefore The correct answer is 819 words.

Alternate Method

Given:

Number of lines (L1) = 4 lines

Number of words (W1) = 63 words

Target lines (L2) = 52 lines

Formula Used:

Direct Proportion: W1/L1 = W2/L2

Calculations:

=> Let the required number of words be x.

=> 4 : 63 = 52 : x

=> 4 × x = 63 × 52

=> x = (63 × 52) ÷ 4

=> x = 63 × 13

=> x = 819

Therefore The correct answer is 819 words.

Additional Information

Direct Proportion

When one quantity increases, the other increases at the same rate. Formula: x1/y1 = x2/y2.

Unitary Method

Finding the value of a single unit first (Value ÷ Quantity) and then multiplying by the desired number of units.

Chain Rule

Used for comparison of multiple variables: (M1×D1×H1)/W1 = (M2×D2×H2)/W2.

Q39. Answer: (c) 20 years

Shortcut Trick

Sum of ratios = 4 + 5 = 9 units.

Total age given = 36 years.

Therefore 9 units = 36 years → 1 unit = 4 years.

Age of older friend (5 units) = 5 × 4 = 20 years.

Therefore The correct answer is 20 years.

Alternate Method

Given:

Ratio of ages = 4 : 5

Total Sum of ages = 36 years

Let the ages be 4x and 5x.

=> 4x + 5x = 36

=> 9x = 36

=> x = 36 ÷ 9

=> x = 4

Age of the older friend = 5x

=> 5 × 4 = 20 years

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Therefore The correct answer is 20 years.

Additional Information

Ratio and Proportion Basics

If a total quantity S is divided in the ratio a : b, the parts are [a/(a+b)] × S and [b/(a+b)] × S.

Age Problems Properties

The difference between ages remains constant throughout time, whereas the ratio of ages changes every year.

Direct Proportion

When the sum is constant, an increase in one ratio part leads to a proportional decrease in the other part to maintain the total.

Q40. Answer: (b) Halved

Shortcut Trick

The volume of a cylinder depends on the square of the radius and the height (V prop. to r^2h).

Effect of halving the radius: $(1/2)^2 = 1/4$

Effect of doubling the height: $2/1 = 2$

Combined effect on volume: $1/4 \times 2 = 1/2$

Therefore The correct answer is Halved.

Alternate Method

Given:

Initial radius = r | Initial height = h

New radius (r1) = r/2 | New height (h1) = 2h

Formula:

Volume of a cylinder (V) = πr^2h

Calculations:

=> Initial Volume (V) = πr^2h

=> New Volume (V1) = $\pi \times (r/2)^2 \times (2h)$

=> V1 = $\pi \times (r^2/4) \times 2h$

=> V1 = $\pi \times r^2 \times (2/4)h$

=> V1 = $(1/2) \times \pi r^2h$

=> V1 = V / 2

Therefore The correct answer is Halved.

Additional Information

Curved Surface Area (CSA) of Cylinder

The area of the side surface is given by the formula $2\pi rh$.

Total Surface Area (TSA) of Cylinder

The sum of the areas of the curved surface and the two circular bases: $2\pi rh + 2\pi r^2$.

Volume of a Cone

A cone with the same radius and height as a cylinder has 1/3^(rd) of its volume: $(1/3)\pi r^2h$.

Volume of a Sphere

The volume of a sphere with radius r is given by $(4/3)\pi r^3$.

Q41. Answer: (c) 80

Shortcut Trick

Given Sum (x + y) = 12 and Product (xy) = 32.

Direct formula for $x^2 + y^2 = (Sum)^2 - 2(Product)$

=> $12^2 - 2 \times 32$

=> 144 − 64 = 80

Therefore The correct answer is 80.

Alternate Method

Given:

x + y = 12

xy = 32

Formula Used:

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

Calculations:

$\Rightarrow (x + y)^2 = 12^2$

$\Rightarrow x^2 + y^2 + 2xy = 144$

$\Rightarrow x^2 + y^2 + 2(32) = 144$

$\Rightarrow x^2 + y^2 + 64 = 144$

$\Rightarrow x^2 + y^2 = 144 - 64$

$\Rightarrow x^2 + y^2 = 80$

Therefore The correct answer is 80.

Additional Information

Algebraic Square Identities

The difference of squares is given by $(x - y)^2 = x^2 + y^2 - 2xy$.

Relationship between Identities

$(x + y)^2 - (x - y)^2 = 4xy$. This is useful when the difference of the numbers is required.

Sum and Difference of Cubes

$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$ and $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$.

Q42. Answer: (a) 4

Shortcut Trick

Express the surds in their simplest form by factoring out perfect squares:

$\sqrt{72} = \sqrt{(36 \times 2)} = 6\sqrt{2}$

$\sqrt{12} = \sqrt{(4 \times 3)} = 2\sqrt{3}$

Compare $6\sqrt{2} + 2\sqrt{3}$ with $a\sqrt{2} + b\sqrt{3} \Rightarrow a = 6, b = 2$.

Calculate $a - b = 6 - 2 = 4$.

Therefore The correct answer is 4.

Alternate Method

Given:

$\sqrt{72} + \sqrt{12} = a\sqrt{2} + b\sqrt{3}$

Calculations:

$\Rightarrow$ Prime factorise the numbers inside the square roots to extract perfect squares.

$\Rightarrow \sqrt{(2 \times 2 \times 2 \times 3 \times 3)} + \sqrt{(2 \times 2 \times 3)} = a\sqrt{2} + b\sqrt{3}$

$\Rightarrow \sqrt{(6^2 \times 2)} + \sqrt{(2^2 \times 3)} = a\sqrt{2} + b\sqrt{3}$

$\Rightarrow 6\sqrt{2} + 2\sqrt{3} = a\sqrt{2} + b\sqrt{3}$

$\Rightarrow$ By comparing the corresponding coefficients of the like surds on both sides, we get:

$\Rightarrow a = 6$ and $b = 2$

$\Rightarrow$ Now substitute the values into the required expression:

$\Rightarrow a - b = 6 - 2$

$\Rightarrow a - b = 4$

Therefore The correct answer is 4.

Additional Information

Properties of Surds

The multiplication rule of surds $\sqrt{(ab)} = \sqrt{a} \times \sqrt{b}$ allows extracting perfect squares from under the radical sign to simplify expressions.

Like and Unlike Surds

Surds having the same irrational factor are called like surds (e.g., $2\sqrt{3}$ and $5\sqrt{3}$). They can be added or subtracted directly by simply combining their coefficients.

Equating Irrational Expressions

If $p\sqrt{x} + q\sqrt{y} = a\sqrt{x} + b\sqrt{y}$, where $\sqrt{x}$ and $\sqrt{y}$ are distinctly different prime surds, then we can equate their coefficients directly, meaning $p = a$ and $q = b$.

Q43. Answer: (d) 1,80,000

Shortcut Trick

Income ratio = 5 : 9 | Expenditure ratio = 2 : 4 (Simplified to 1 : 2)

Cross-multiplication method: (5 × 2) − (9 × 1) units = Rs. 36,000 × (2 − 1)

1 unit = Rs. 36,000

Rupesh's income (5 units) = 5 × Rs. 36,000 = Rs. 1,80,000

Therefore The correct answer is Rs. 1,80,000.

Alternate Method

Given: Ratio of Income = 5 : 9, Ratio of Expenditure = 2 : 4, Savings = Rs. 36,000 each.

Formula: Income − Savings = Expenditure

=> Let Rupesh's income be 5x and Manjit's income be 9x.

=> (5x − 36,000) / (9x − 36,000) = 2 / 4

=> (5x − 36,000) / (9x − 36,000) = 1 / 2

=> 2(5x − 36,000) = 1(9x − 36,000)

=> 10x − 72,000 = 9x − 36,000

=> 10x − 9x = 72,000 − 36,000

=> x = 36,000

=> Rupesh's monthly income = 5 × 36,000 = Rs. 1,80,000

Therefore The correct answer is Rs. 1,80,000.

Additional Information

Income-Expenditure Relationship

The fundamental relation is Income = Expenditure + Savings. When savings are equal, the difference between the ratio parts of income and expenditure can often be balanced.

Ratio Balancing Method

If the difference between income ratio parts (9−5=4) and expenditure ratio parts (4−2=2) is not same, multiply ratios by constants to make the saving units (Income − Expenditure) equal for both individuals.

Q44. Answer: (c) 15 minutes

Shortcut Trick

When distance is constant, speed is inversely proportional to time.

Speed ratio (Usual : New) = 4 : 3

Time ratio (Usual : New) = 3 : 4

Difference in time units = 4 − 3 = 1 unit → 5 minutes.

Usual time = 3 units = 3 × 5 = 15 minutes.

Therefore The correct answer is 15 min.

Alternate Method

Given:

New speed = 3/4 × Usual speed

Time delay = 5 minutes

Formula: Distance = Speed × Time

=> Let usual speed be S and usual time be T.

=> Distance (D) = S × T

=> New speed = 3/4 S

=> New time = T + 5

=> Since Distance is same: S × T = (3/4 S) × (T + 5)

=> T = 3/4 (T + 5)

=> 4T = 3T + 15

=> T = 15 minutes

Therefore The correct answer is 15 min.

Additional Information

Inverse Proportion Rule

If speed becomes a/b of its original value, the time taken becomes b/a of the original time.

Late/Early Concept

Usual Time = (Late time × a) ÷ (b − a) where new speed is a/b of usual speed.

Average Speed

For same distance, Average Speed = (2 × S1 × S2) ÷ (S1 + S2).

Q45. Answer: (b) 116

Shortcut Trick

Total base SR = SB + BR = 8 + 14 = 22 cm (since BR = radius RQ = 14 cm).

Height h of the trapezium = QR × sin 60° = 14 × (√3/2) = 7√3 cm.

Area of Trapezium PQRS = 1/2 × (14 + 22) × 7√3 ≈ 218.23 cm².

Area of Sector QRB = (60/360) × (22/7) × 14² ≈ 102.67 cm².

Required Area PQABSP = 218.23 − 102.67 = 115.56 ≈ 116 cm².

Therefore The correct answer is 116 cm².

Alternate Method

Given: PQ = 14 cm, QR = 14 cm, SB = 8 cm, angle QRS = 60°.

Formula Used: Area of Trapezium = 1/2 × (Sum of parallel sides) × Height; Area of Sector = (θ/360) × πr².

=> Radius RB = RQ = 14 cm (since B is on the arc with centre R).

=> Side SR = SB + BR = 8 + 14 = 22 cm.

=> Height of trapezium = QR × sin 60° = 14 × (√3/2) = 7 × 1.732 = 12.124 cm.

=> Area of Trapezium PQRS = 1/2 × (14 + 22) × 12.124 = 18 × 12.124 = 218.232 cm².

=> Area of Sector QRB = (60/360) × (22/7) × 14 × 14 = (1/6) × 22 × 28 = 308/3 = 102.667 cm².

=> Area of region PQABSP = Area(PQRS) − Area(Sector QRB) = 218.232 − 102.667 = 115.565 cm².

=> Rounding to the nearest integer, we get 116 cm².

Therefore The correct answer is 116 cm².

Additional Information

Area of a Trapezium

The area of a trapezium is calculated as 1/2 × (a + b) × h, where 'a' and 'b' are the lengths of the parallel sides and 'h' is the perpendicular distance between them.

Area of a Circular Sector

The area of a sector of a circle with radius 'r' and central angle 'θ' is given by the formula (θ/360) × πr².

Trigonometric Height

In any trapezium, the height can be found using the non-parallel side (c) and the angle it makes with the base (α) as h = c × sin(α).

Q46. Answer: (c) 10

Shortcut Trick

Prime numbers between 20 and 40 are 23, 29, 31, and 37. Their average is 120 ÷ 4 = 30.

Multiples of 2 form an Arithmetic Progression. Average of 10, 12, ..., 30 = (First + Last) ÷ 2 = (10 + 30) ÷ 2 = 20.

Required Difference = 30 − 20 = 10.

Therefore The correct answer is 10.

Alternate Method

Given:

Range 1: Prime numbers between 20 and 40.

Range 2: Multiples of 2 between 10 and 30.

Formula Used:

Average = Sum of observations ÷ Number of observations

For an Arithmetic Progression (AP), Average = (a + l) ÷ 2, where a = first term and l = last term.

Calculations:

=> Prime numbers between 20 and 40 = 23, 29, 31, 37

=> Sum = 23 + 29 + 31 + 37 = 120

=> Average1 = 120 ÷ 4 = 30

=> Multiples of 2 between 10 and 30 = 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

=> Average2 = (10 + 30) ÷ 2 = 40 ÷ 2 = 20

=> Difference = Average1 − Average2 = 30 − 20 = 10

Therefore The correct answer is 10.

Additional Information

Average of AP

The average of any Arithmetic Progression is the mean of the first and the last term: (a + l) ÷ 2.

Prime Number Property

A prime number has exactly two distinct factors: 1 and itself. Note that 1 is neither prime nor composite, and 2 is the only even prime number.

Sum of First n Even Numbers

The sum of the first n consecutive even numbers is given by the formula n × (n + 1).

Q47. Answer: (b) D

Shortcut Trick

Compare the total time taken by each person to complete 100% of the work.

A: 13 × 6 = 78 days

B: (17 ÷ 34) × 100 = 50 days

C: 19 × 3 = 57 days

D: (15 ÷ 3) × 4 = 20 days

The person with the minimum number of days completes the work first.

Therefore The correct answer is D.

Alternate Method

Given:

Work done by A = 1/6 in 13 days

Work done by B = 34% in 17 days

Work done by C = 1/3 in 19 days

Work done by D = 3/4 in 15 days

Formula Used:

Total time = (Time taken) ÷ (Part of work completed)

Calculations:

Person	Days for partial work	Work Part	Total Days (100% work)
A	13	1/6	13 × 6 = 78 days
B	17	34/100	17 × (100/34) = 50 days
C	19	1/3	19 × 3 = 57 days
D	15	3/4	15 × (4/3) = 20 days

=> Total days for A = 78 days

=> Total days for B = 50 days

=> Total days for C = 57 days

=> Total days for D = 20 days

=> Comparing all: 20 < 50 < 57 < 78

Therefore The correct answer is D.

Additional Information

Efficiency and Time Relationship

Efficiency is inversely proportional to the time taken to complete a work. The person who takes the least time is the most efficient.

Work from Part to Whole

If a person completes 1/x part of work in 't' days, the total time taken for the full work is (t × x) days.

Percentage to Fraction Conversion

For calculations involving percentages like 34%, always convert to fractions (34/100) or use the unitary method: (17 ÷ 34) × 100.

Q48. Answer: (c) 4

Shortcut Trick

Total Capacity (LCM of 12 and 48) = 48 units

Efficiency of P + Q = 48 ÷ 12 = 4 units/hour

Efficiency of P = 48 ÷ 48 = 1 unit/hour

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Efficiency of Q = 4 − 1 = 3 units/hour

Time for Q to fill one-fourth of the cistern = (48 ÷ 4) ÷ 3 = 4 hours

Therefore The correct answer is 4 hours.

Alternate Method

Given:

Time taken by P and Q together = 12 hours

Time taken by P alone = 48 hours

Formula Used:

Total Work = LCM of individual times

Efficiency = Total Work ÷ Time

Person	Days	Total Work	Efficiency
P + Q	12	48	4
P	48	1	

Calculations:

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

=> Efficiency of Q = 4 − 1 = 3 units/hour

=> One-fourth of the cistern capacity = 48 ÷ 4 = 12 units

=> Time taken by Q alone to fill 12 units = 12 ÷ 3 = 4 hours

Therefore The correct answer is 4 hours.

Additional Information

Pipes and Cisterns Efficiency Rule

If an inlet pipe fills a tank in X hours and another inlet pipe fills it in Y hours, their combined 1-hour work is (1/X + 1/Y). For outlet pipes, the efficiency is taken as negative.

Fraction of Work Formula

Time required to complete a fraction F of work = (F × Total Work) ÷ Efficiency of the individual or group performing the work.

Q49. Answer: (c) Rs. 2,645

Shortcut Trick

Net effective rate for 2 years at 15% = 15 + 15 + (15 × 15)/100 = 32.25%.

Total Amount = Principal + 32.25% of Principal.

Amount = 2000 + (32.25/100) × 2000 = 2000 + 645 = Rs. 2,645.

Therefore The correct answer is Rs. 2,645.

Alternate Method

Given:

Principal (P) = Rs. 2,000

Rate of Interest (R) = 15% per annum

Time (n) = 2 years

Formula Used:

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

Calculations:

=> $A = 2000 \times (1 + 15/100)^2$

=> $A = 2000 \times (1 + 3/20)^2$

=> $A = 2000 \times (23/20)^2$

=> $A = 2000 \times (529/400)$

=> $A = 5 \times 529$

=> A = Rs. 2,645

Therefore The correct answer is Rs. 2,645.

Additional Information

Successive Percentage Change

For two successive changes of x% and y%, the net effective change is given by the formula: x + y + (xy/100)%.

Difference between CI and SI

For a period of 2 years, the difference between Compound Interest and Simple Interest is: CI − SI = $P(R/100)^2$.

Compound Interest Calculation

Compound Interest is calculated using the formula: CI = A − P = $P[(1 + R/100)^n - 1]$.

Q50. Answer: (a) 58,300

Shortcut Trick

Given Discount% = 9%, which means Selling Price (SP) is 91% of Marked Price (MP).

Using unitary method: 91 units = 53,053.

1 unit = 53,053 ÷ 91 = 583.

Marked Price (100 units) = 583 × 100 = 58,300.

Therefore The correct answer is Rs. 58,300.

Alternate Method

Given: Selling Price (SP) = Rs. 53,053, Discount (D%) = 9%.

Formula: MP = [SP × 100] ÷ [100 − Discount%]

=> MP = [53,053 × 100] ÷ [100 − 9]

=> MP = [53,053 × 100] ÷ 91

=> MP = 583 × 100

=> MP = 58,300

Therefore The correct answer is Rs. 58,300.

Additional Information

Marked Price & Discount

The Marked Price (MP) is the price printed on an article. Discount is always calculated on the MP. Selling Price = MP − Discount.

Discount Percentage

Discount% = (Discount ÷ MP) × 100. It represents the reduction offered on the tag price.

Q51. Answer: (b) NPS−UWZ

Logic followed here is: Each letter in the second group is obtained by adding 7 to the positional value of the corresponding letter in the first group.

For

JLO is related to QSV →

TVY is related to ACF →

Option 2) NPS - UWZ:

Therefore, the pair that follows the same pattern is NPS-UWZ.

Hence, the correct answer is "Option 2".

Q52. Answer: (c) NIRR

Logic followed here is.

Logic: The letters of the first word are shifted backwards by decreasing values (-5, -4, -3, -2) based on their positional values in the English alphabet to obtain the corresponding letters of the related word.

For

MHSD is related to HDPB →

LNPB is related to GJMZ →

The pattern observed is: The letters are shifted by -5, -4, -3, and -2 respectively.

Similarly, let's find the related word for SMUT:

Therefore, the word related to 'SMUT' is 'NIRR'.

Hence, the correct answer is "Option 3".

Q53. Answer: (a) 23rd

Given:

→ Total people = 58

→ Jolly sits 19^(th) from the left end

→ Bela sits 17^(th) to the right of Jolly

Step 1: Find Bela's position from the left

Bela's position from left = 19 + 17 = 36

Step 2: Find Bela's position from the right

Position from right = Total people − Position from left + 1

= 58 − 36 + 1

= 23

Therefore, Bela is 23^(rd) from the right end.

Hence, the correct answer is Option 1.

Q54. Answer: (b) One

Given Number: 73256

Rule:

→ Add 1 to each even digit

→ Subtract 2 from each odd digit

Step 1: Apply the operation

Digit	Operation	New Digit
7	7 − 2	5
3	3 − 2	1
2	2 + 1	3
5	5 − 2	3
6	6 + 1	7

New Number: 51337

Digit 3 appears more than once.

Therefore, only one digit appears more than once.

Hence, the correct answer is Option 2.

Q55. Answer: (b) Only conclusion (I) follows.

Given Statements:

Some seats are plates.

All plates are chairs.

Conclusions:

(I) Some seats are chairs: Follows (because some seats are plates and all plates are chairs.)

(II) All chairs are plates: Does not follows (because only plates are chairs is given, not all chairs are plates.

Therefore, only conclusion (I) follows.

Hence, the correct answer is Option 2.

Q56. Answer: (b) Four

Given Series:

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

Required pattern:

Even → Even → Odd

Checking the series:

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

Even digits satisfying the condition:

→ 8 in (2 8 1)

→ 4 in (6 4 3)

→ 2 in (8 2 1)

→ 8 in (2 8 7)

Therefore, there are 4 such even digits.

Hence, the correct answer is "Option 2".

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Q57. Answer: (c) 3 km to the east

Given:

→ Mohak starts from Point A

→ 12 km south

→ Left turn, 11 km

→ Left turn, 15 km

→ Left turn, 14 km

→ Left turn, 3 km to Point P

Vertical movement:

→ South = 12 + 3 = 15 km

→ North = 15 km

Vertical position becomes 0.

Horizontal movement:

→ East = 11 km

→ West = 14 km

Net movement = 3 km west.

So, Point P is 3 km west of Point A.

To reach Point A again, Mohak should travel 3 km towards the east.

Hence, the correct answer is Option 3.

Q58. Answer: (a) 57

Logic followed here is: The code for a word is determined by summing the positional values of its letters and then adding a (+2) to the sum.

For

GYSU is coded as 74 →

Sum of positional values = 7 + 25 + 19 + 21 = 72

Code = 72 + 2 = 74

MAKZ is coded as 53 →

Sum of positional values = 13 + 1 + 11 + 26 = 51

Code = 51 + 2 = 53

Similarly, let's find the code for IHOW:

Sum of positional values = 9 + 8 + 15 + 23 = 55

Code = 55 + 2 = 57

Therefore, the code for 'IHOW' is 57.

Hence, the correct answer is "Option 1".

Q59. Answer: (b) (13, 3, 39)

Logic followed here is:

3rd number = 1st number × 2nd number

Set 1: (14, 3, 42): 14 × 3 = 42

Set 2: (12, 2, 24): 12 × 2 = 24

Similarly, option (2) (13, 3, 39): 13 × 3 = 39

Therefore, the related set is (13, 3, 39).

Hence, the correct answer is "Option 2".

Q60. Answer: (a) 46

Given Series: 11 16 22 29 37 ?

The pattern followed here is:

Therefore According to the pattern followed 46 will replace the (?) mark.

Hence, the correct answer is "Option 1".

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Q61. Answer: (c) 3

Given Series:

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

Required pattern:

Even → Even → Odd

Checking the series:

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

Even digits satisfying the condition:

→ 2 in (4 2 3)

→ 2 in (6 2 3)

→ 4 in (8 4 1)

Therefore, there are 3 such even digits.

Hence, the correct answer is Option 3.

Q62. Answer: (c) Mother's father

Given Codes:

A is | + | - | × | % | # | | --- | --- | --- | --- | --- | | Mother | Brother | Wife | Father | Daughter | B is	**•**	**•**	**×**	**%**	**#**	**Mother**	**Brother**	**Wife**	**Father**	**Daughter**
•	•	×	%	#						
Mother	Brother	Wife	Father	Daughter						

Expression:

T − L # Q # P x E: E is husband of P. P is mother of Q. Q is mother of L. L is sibling of T.

Therefore, E is the grandfather (mother's father) of T.

Hence, the correct answer is "Option 3".

Q63. Answer: (c) 76

Logic followed here is.

Logic: The series follows an alternating pattern of multiplying the current number by 2 and then adding 2 to the result to obtain the next number.

Therefore, the number that should come in place of the question mark is 76.

Hence, the correct answer is "Option 3".

Q64. Answer: (d) One

Given Series:

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

Required pattern:

Even → Even → Even

Checking the series:

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

Even digit satisfying the condition:

→ 4 in (8 4 6)

Therefore, there is one such even digit.

Hence, the correct answer is Option 4.

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Q65. Answer: (c) 10

Given Numbers:

745, 768, 729, 716, 721

Step 1: Arrange numbers in descending order

768 > 745 > 729 > 721 > 716

Step 2: Find the second highest number

Second highest number = 745

Second digit of 745 = 4

Step 3: Find the lowest number

Lowest number = 716

Third digit of 716 = 6

Step 4: Add the digits

4 + 6 = 10

Therefore, the result is 10.

Hence, the correct answer is Option 3.

Q66. Answer: (b) Victoria

Given:

Six friends — Edwin, Preeti, Sunita, Jacob, Victoria, and Sagar — are sitting around a circular table facing the centre.

Conditions:

→ Edwin is an immediate neighbour of both Preeti and Sunita.

→ Jacob is sitting third to the left of Sunita.

→ Victoria is sitting second to the right of Jacob.

From Edwin, move two places to the left (clockwise):

Edwin → Sunita → Victoria

Therefore, Victoria is sitting second to the left of Edwin.

Hence, the correct answer is Option 2.

Q67. Answer: (a) 210

Shortcut Trick

The pattern is based on an increasing common difference.

Common differences: 100 − 85 = 15, 120 − 100 = 20, 145 − 120 = 25, 175 − 145 = 30.

The differences are increasing by 5 in each step: 15, 20, 25, 30, (30 + 5) = 35.

Next term = 175 + 35 = 210.

Therefore The correct answer is 210.

Alternate Method

Given: Series: 85, 100, 120, 145, 175, ?

Method: Analysis of the difference between consecutive terms (Arithmetic progression of differences).

85

+15

→

100

+20

→

120

+25

→

145

+30

→

175

+35

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→

210

The differences are 15, 20, 25, 30... which form an AP with common difference 5.

=> First difference = 100 − 85 = 15

=> Second difference = 120 − 100 = 20

=> Third difference = 145 − 120 = 25

=> Fourth difference = 175 − 145 = 30

=> Expected fifth difference = 30 + 5 = 35

=> Next term = 175 + 35 = 210

Therefore The correct answer is 210.

Additional Information

Arithmetic Series (Addition/Subtraction Pattern)

In this type of series, the next term is obtained by adding or subtracting a constant or a logically progressing number (like multiples of 5 or squares) to the previous term.

Double Difference Series

If the first layer of differences does not show a clear constant pattern, calculate the differences between those differences. This often reveals a constant increment or decrement.

Mixed Series Pattern

A series might combine two operations, such as (Previous Term × n) + m, to find the next term in the sequence.

Q68. Answer: (c) LQW : OTZ

Logic followed here is:

The second group of letters is obtained by adding 3 to the positional values of each letter in the first group of letters (+3, +3, +3 pattern).

For BFL : EIO →

For KPI : NSL →

Option 3) LQW : OTZ:

Therefore, the pair 'LQW : OTZ' follows the same pattern.

Hence, the correct answer is "Option 3".

Q69. Answer: (c) 2

Given Codes:

TUNE → 5279

WAIT → 1428

Therefore The code for T is 2.

Hence, the correct answer is "Option 3".

Q70. Answer: (d) 35

The logic followed here is substituting the letters with their respective mathematical symbols and then solving the equation using the BODMAS rule.

Letter	A	B	C	D
Symbol	×	÷	−	•

Given equation:

27 B 3 D 5 A 10 C 12 D 15 C 27 = ?

Replacing the letters with mathematical signs based on the table:

= 27 ÷ 3 + 5 × 10 − 12 + 15 − 27

= 9 + 50 - 12 + 15 - 27

= 74 - 39

= 35

Therefore, the code for the question mark (?) is 35.

Hence, the correct answer is "Option 4".

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Q71. Answer: (d) Only conclusion (I) follows.

Given Statements:

All helmets are nuts.

All helmets are bins.

Conclusions:

(I) Some nuts are bins: Follows (because all helmets are nuts and all helmets are bins. Therefore, helmets form a common part of nuts and bins.)

(II) All bins are helmets: Does not follows (because only helmets are bins is given, not all bins are helmets.)

Therefore, only conclusion (I) follows.

Hence, the correct answer is Option 4.

Q72. Answer: (d) TX−YF

Logic followed here is based on the positional values of the letters in the English alphabetical order.

Logic: In each pair, the letters follow a specific increment pattern: (+6).

Option 1) GK−MQ →

Option 2) KO−QU →

Option 3) NR−TX →

Option 4) TX−YF →

Therefore, the letter-cluster pair that does not belong to the group is TX−YF.

Hence, the correct answer is "Option 4".

Q73. Answer: (c) 11 km to the north

Given:

→ Warner starts from Point A.

→ Drives 78 km towards west.

→ Turns right and drives 79 km.

→ Turns right and drives 80 km.

→ Turns right and drives 90 km.

→ Turns right and drives 2 km to reach Point P.

Step-by-step movement:

If P is 11 km south of A, then Warner must move 11 km north to reach A.

Hence, the correct answer is Option 3 — 11 km to the north.

Q74. Answer: (a) 134

Shortcut Trick

Interchange signs: (+) → (−), (−) → (+), (×) → (÷), (÷) → (×)

Expression becomes: 24 × 5 − 18 ÷ 6 + 17

Applying BODMAS: 120 − 3 + 17

Calculation: 117 + 17 = 134

Therefore The correct answer is 134.

Alternate Method

Given equation: 24 ÷ 5 + 18 × 6 − 17

According to the question, the signs are interchanged as follows:

• ↔ −

× ↔ ÷

Substituting the new signs into the equation:

=> 24 × 5 − 18 ÷ 6 + 17

Applying the BODMAS rule (Division first, then Multiplication, then Addition/Subtraction):

=> 24 × 5 − (18 ÷ 6) + 17

=> 24 × 5 − 3 + 17

=> 120 − 3 + 17

=> 117 + 17

=> 134

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Therefore The correct answer is 134.

Additional Information

BODMAS / VBODMAS Rule

It stands for Vinculum, Bracket, Of, Division, Multiplication, Addition, and Subtraction. Always follow this hierarchy to solve mathematical expressions correctly.

Sign Substitution

In substitution problems, carefully replace all specified operators before beginning any calculations to avoid sequential errors.

Mental Math for BODMAS

Groups of (Multiplication/Division) and (Addition/Subtraction) can often be simplified simultaneously if separated by plus or minus signs.

Q75. Answer: (c) BHIM

Logic followed here is:

The difference between the positional values of the consecutive letters in each letter-cluster follows a constant pattern of (+6, +2, +4).

1) UACG →

2) AGIM →

3) BHIM →

4) GMOS →

Therefore, the letter-cluster 'BHIM' is the odd one out because it follows a (+6, +1, +4) pattern instead of (+6, +2, +4).

Hence, the correct answer is "Option 3".

Q76. Answer: (b) 17

Given:

→ Total people = 55

→ Nalini sits 20^(th) from the right end

→ Ranjit sits 18^(th) from the left end

Step 1: Find Nalini's position from the left

Position from left = Total people − Position from right + 1

= 55 − 20 + 1 = 36

So, Nalini is 36^(th) from the left end.

Step 2: Find people between Nalini and Ranjit

Nalini's position = 36

Ranjit's position = 18

People between them = 36 − 18 − 1 = 17

Therefore, 17 people sit between Nalini and Ranjit.

Hence, the correct answer is "Option 2".

Q77. Answer: (d) Second to the left

Given:

B sits to the immediate right of A and B sits second to the left of F

C is an immediate neighbour of A.

D sits second to the left of E.

Therefore, the position of E with respect to A is Second to the left.

Hence, the correct answer is "Option 4".

Q78. Answer: (c) Immediate right

Given: Eight people (A, B, C, D, P, Q, R and S) are sitting around a circular table facing towards the centre.

1) B is an immediate neighbour of both S and P

2) C sits second to the right of P.

3) R is an immediate neighbour of both D and Q (R is between D and Q).

4) A sits second to the left of Q.

Therefore, the position of Q with respect to C is Immediate right.

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Q79. Answer: (a) TRS 74

Given Series: BZA 30 ZXY 41 XVW 52 VTU 63 ?

The logic followed here is:

Therefore According to the logic TRS 74 will replace the (?) mark.

Hence, the correct answer is "Option 1".

Q80. Answer: (d) VPN81

Given Series: ZDF1, YGH3, XJJ9, WML27, ?

The logic followed here is:

Therefore According to the logic followed here VPN 81 will replace the (?) mark.

Hence, the correct answer is "Option 4".

Q81. Answer: (d) August 2025

p>The correct answer is August 2025.

Key Points

• IndusInd Bank officially launched its specialized 'Indus StartUp Banking' programme in August 2025 to provide a holistic ecosystem for the growth of early-stage startups.

• The programme is specifically designed to address the unique financial and operational needs of startups, offering them a suite of tailor-made banking products and services.

• This initiative by IndusInd Bank aims to support the Government of India’s vision of fostering a robust startup ecosystem and driving entrepreneurship across the country.

• Under this programme, startups gain access to dedicated relationship managers who possess deep expertise in the fintech and venture capital sectors.

• The launch in August 2025 marked a significant milestone for the bank in strengthening its presence in the digital banking and corporate banking segments.

Additional Information

• IndusInd Bank Overview:

• IndusInd Bank is a leading New Generation Private Sector Bank in India that commenced its operations in April 1994.

• The bank was conceptualized by S. P. Hinduja, the Chairman of the Hinduja Group, with a focus on serving both retail and corporate customers.

• Its corporate headquarters is situated in Mumbai, Maharashtra, while its registered office is located in Pune.

• Features of Indus StartUp Banking:

• The programme offers API-based banking solutions, which allow startups to integrate banking functions directly into their business platforms.

• It provides priority processing for account opening and specialized current accounts with low or zero average quarterly balance (AQB) requirements for the initial years.

• Startups can also benefit from innovative payment solutions, forex services, and wealth management advisory tailored for founders and employees.

Important Points

• Strategic Partnerships: The Indus StartUp Banking programme leverages partnerships with incubators, accelerators, and venture capital funds to provide a 360-degree support system.

• Digital Transformation: The bank’s focus on digitalization is evident through its mobile banking apps and omni-channel platforms designed to make banking transactions seamless for tech-savvy entrepreneurs.

• Financial Inclusion: By targeting early-stage startups, IndusInd Bank contributes to the economic growth of India, facilitating job creation and technological innovation.

• Market Position: As of the year 2025, IndusInd Bank continues to expand its network of branches and ATMs across India, maintaining a strong Capital Adequacy Ratio (CAR) as per Reserve Bank of India (RBI) guidelines.

Q82. Answer: (b) Iris

The correct answer is Iris.

Key Points

• Iris is recognized as India’s first Generative AI teacher, introduced to revolutionize the classroom experience through humanoid robotics.

• It was officially unveiled in March 2024 at the KTCT Higher Secondary School in Thiruvananthapuram, Kerala.

• The robot was developed by Makerlabs Edutech, a private firm based in Kerala, in collaboration with the Atal Tinkering Lab

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(ATL) project.

• Iris is designed to provide personalized learning experiences, capable of answering complex questions across various subjects and interacting with students in a human-like manner.

• The AI teacher is built on Generative AI technology, which allows it to process and generate content in real-time, supporting three different languages to cater to a diverse student base.

Additional Information

• Physical Features and Mobility:

• Iris has a humanoid appearance, specifically designed to look like a female teacher wearing a traditional saree.

• It is equipped with a wheeled base to facilitate movement within the classroom and features hand gestures to make the interaction more engaging for students.

• The robot uses a voice assistant and high-quality speakers to deliver lessons and respond to queries.

• Atal Tinkering Lab (ATL) Initiative:

• The ATL project is a flagship initiative of the Atal Innovation Mission (AIM) under NITI Aayog, Government of India.

• It aims to cultivate a spirit of curiosity, creativity, and imagination in young minds by providing access to STEM (Science, Technology, Engineering, and Math) tools and AI technologies.

• The deployment of Iris highlights the success of these labs in encouraging homegrown technological solutions.

• Role of Makerlabs Edutech:

• Makerlabs Edutech is the technology partner responsible for the hardware and software development of Iris.

• The company focused on creating a low-cost yet highly capable educational robot that could eventually be scaled to other schools across India.

• Comparison with Other AI Robots:

• While Sophia (developed by Hanson Robotics) is famous as the world's first robot citizen, Iris is specifically tailored for the Indian educational curriculum and classroom environment.

• Unlike standard chatbots, Iris combines physical presence with AI logic, which helps in maintaining student attention and fostering a better learning atmosphere.

Important Points

• Language Support: Iris currently supports English, Hindi, and Malayalam, which are the primary languages of instruction in Kerala.

• Technological Foundation: The robot utilizes Intel processors and specialized AI chips to handle the heavy computational load required for Generative AI tasks.

• Future Scope: The introduction of Iris in 2024 marks a significant milestone in the National Education Policy (NEP) 2020 goals of integrating AI and coding into the school system.

• Impact: By acting as a 24/7 teaching assistant, Iris helps human teachers focus on mentorship while the AI handles factual queries and repetitive explanations.

Q83. Answer: (c) United States

The correct answer is United States.

Key Points

• In February 2025, the India Shrimp Tariff Act was introduced in the United States Senate by Senators Bill Cassidy and John Kennedy, both representing the state of Louisiana.

• The primary objective of this legislation is to impose a protective tariff on shrimp imported from India to safeguard the domestic shrimping industry in the United States.

• The bill was prompted by allegations that Indian shrimp exporters engage in unfair trade practices, including market dumping and receiving government subsidies that allow them to sell products at prices lower than the cost of production in the U.S..

• India is one of the largest suppliers of shrimp to the United States, and the influx of low-priced imports has placed significant economic pressure on American shrimpers in the Gulf of Mexico and South Atlantic regions.

• The act specifically targets shrimp imports to address concerns regarding labor standards and environmental regulations in the Indian aquaculture sector, which U.S. lawmakers argue provide an unfair competitive advantage.

Additional Information

• U.S. Shrimp Industry: The domestic shrimp industry is a vital economic driver for coastal states such as Louisiana, Mississippi, Texas, Alabama, and Florida. It supports thousands of jobs and maintains traditional maritime cultures.

• Trade Deficit and Imports: The United States imports over 90% of the shrimp consumed domestically. India, Ecuador, and Vietnam are the leading exporters of shrimp to the U.S. market, often leading to trade friction.

• Regulatory Bodies: Trade disputes of this nature are typically overseen by the U.S. Department of Commerce and the International Trade Commission (ITC), which investigate claims of Anti-Dumping (AD) and Countervailing Duties (CVD).

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• Southern Shrimp Alliance: This is a powerful advocacy group representing shrimpers in eight U.S. states. They have been instrumental in lobbying for the India Shrimp Tariff Act and other measures to combat what they term "foreign industrial shrimp" dominance.

• Impact on India: For India, shrimp is a major seafood export, contributing significantly to its foreign exchange earnings. Any imposition of high tariffs by the United States could impact the livelihoods of millions of small-scale farmers and workers in states like Andhra Pradesh and West Bengal.

Important Points

• Legislative Context: The introduction of the act in 2025 reflects a continuing trend of bipartisan concern in the United States regarding trade imbalances and the protection of local food supply chains.

• Labor and Safety Concerns: U.S. lawmakers often cite reports regarding forced labor and the use of prohibited antibiotics in foreign shrimp farms as additional reasons for restrictive trade measures.

• Economic Significance: In 2023-2024, India exported shrimp worth billions of dollars to the United States, making the U.S. its largest market for frozen shrimp. This act serves as a potential non-tariff barrier or a direct fiscal deterrent to maintain market equilibrium.

Q84. Answer: (c) China

The correct answer is China.

Key Points

• In 2025, China conducted a successful test of a revolutionary hydrogen bomb that marks a significant departure from traditional nuclear weapon designs.

• This new generation of thermonuclear weapons is distinguished by its ability to function without the need for traditional fissile materials such as Uranium-235 or Plutonium-239.

• The core technology involves advanced fusion techniques that utilize magnesium hydride-based fusion. This allows the weapon to achieve the extreme temperatures and pressures required for a fusion reaction without a primary fission trigger.

• By eliminating the fission stage, the weapon significantly reduces the long-term radioactive fallout typically associated with nuclear detonations, making it a "cleaner" yet equally powerful alternative to standard hydrogen bombs.

• The test underscores China's rapidly advancing capabilities in high-energy density physics and its commitment to modernizing its strategic nuclear arsenal with fourth-generation nuclear technology.

Additional Information

• Traditional Hydrogen Bombs (Thermonuclear Weapons):

• Standard designs, such as the Teller-Ulam configuration, rely on a two-stage process. The first stage is a fission bomb (using Uranium or Plutonium) which acts as a trigger to provide the X-rays and heat necessary to ignite the second fusion stage.

• The fission process creates significant nuclear waste and radioactive isotopes that persist in the environment for thousands of years.

• Magnesium Hydride (MgH_2) in Fusion:

• Magnesium hydride is a chemical compound that serves as a high-capacity storage medium for hydrogen.

• In the context of fusion technology, it can be engineered to release and compress deuterium and tritium (isotopes of hydrogen) under specialized conditions, potentially triggered by high-powered lasers or electromagnetic pulses rather than a fission explosion.

• Strategic Implications:

• The development of fissile-free weapons bypasses many constraints of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and the Nuclear Non-Proliferation Treaty (NPT), as these frameworks focus heavily on the regulation of enriched uranium and plutonium.

• This breakthrough positions China as a leader in directed energy and pure fusion research, technologies that also have applications in civilian energy production.

Important Points

• Pure Fusion Weapons: These have been a theoretical goal for physicists for decades. Unlike current weapons, a pure fusion weapon would require an extremely small "spark" to ignite, allowing for variable yield weapons that could be used with high precision.

• Nuclear Fission vs. Fusion:

• Fission involves the splitting of heavy nuclei (like Uranium), while fusion involves the joining of light nuclei (like Hydrogen).

• Fusion releases substantially more energy per unit of mass than fission and is the process that powers the Sun.

• China's "Artificial Sun": China has been a pioneer in magnetic confinement fusion through projects like the Experimental Advanced Superconducting Tokamak (EAST) and the HL-2M Tokamak, which achieved temperatures over 150 million degrees Celsius, providing the foundational research for this 2025 military application.

Q85. Answer: (d) Odisha Coast

The correct answer is Odisha Coast.

Key Points

• The Defence Research and Development Organisation (DRDO) successfully conducted the maiden flight-test of the Integrated Air Defence Weapon System (IADWS) on 23 August 2025.

• The test was carried out from the Integrated Test Range (ITR), Chandipur, located off the Odisha Coast. This facility is the primary site for evaluating the performance of India's missile systems and flight vehicles.

• The flight-test was aimed at demonstrating the vertical launch capability and the integrated functioning of the weapon system against a high-speed, low-altitude aerial target.

• The IADWS mission achieved all its technical objectives, with the missile following the predicted trajectory and successfully intercepting the target. The performance was monitored by various Range Sensors, such as Radar, Electro-Optical Tracking System (EOTS), and Telemetry stations.

• This successful trial confirms the operational efficiency of the system's propulsion, control systems, and guidance algorithms, marking a significant milestone in India's indigenous air defense capabilities.

Additional Information

• DRDO (Defence Research and Development Organisation):

• Established in 1958, DRDO is the premier research and development wing of the Ministry of Defence, Government of India.

• It is headquartered in DRDO Bhavan, New Delhi, and operates a network of over 50 laboratories across the country.

• Its primary mission is to empower the Indian Armed Forces with state-of-the-art indigenous defence technologies and systems, ranging from missiles and combat vehicles to radars and electronic warfare systems.

• Integrated Air Defence Weapon System (IADWS):

• The IADWS is designed to provide short-range protection to vital assets against a variety of aerial threats, including UAVs, fighter aircraft, and cruise missiles.

• It utilizes a canister-based launch system, which allows for rapid deployment and provides 360-degree coverage to the user.

• The system integrates advanced Active Radar Seeker technology to ensure high precision during the terminal phase of engagement.

• Integrated Test Range (ITR) Chandipur:

• Located in the Balasore district of Odisha, ITR Chandipur is India’s most important missile testing ground.

• Its unique geographical location provides a wide flight corridor over the Bay of Bengal, making it ideal for testing long-range and short-range surface-to-air and surface-to-surface missiles.

Important Points

• Technological Features: The IADWS features sophisticated Electronic Counter Counter Measures (ECCM), which allow it to operate effectively even in the presence of intense electronic jamming from enemy assets.

• Self-Reliance: The development of the IADWS is a critical part of the Atmanirbhar Bharat (Self-reliant India) initiative, aiming to reduce dependence on foreign-made Integrated Air Defence solutions.

• Strategic Impact: The deployment of such indigenous systems significantly enhances the Indian Navy and Indian Air Force's ability to respond to low-altitude threats in maritime and border regions.

• Collaborative Development: The system's development involves multiple DRDO labs, including the Defence Research and Development Laboratory (DRDL) and the Research Centre Imarat (RCI), highlighting the collaborative nature of Indian defence engineering.

Q86. Answer: (c) 5 million metric tonnes (MMT) per year

The correct answer is 5 million metric tonnes (MMT) per year.

Key Points

• The National Green Hydrogen Mission was approved by the Union Cabinet on January 4, 2023, with the aim to make India a global hub for the production, usage, and export of Green Hydrogen.

• The mission has set a target to build a green hydrogen production capacity of at least 5 MMT (Million Metric Tonnes) per annum by the year 2030. Hence, the statement regarding the 5 MMT target is correct.

• This production target is expected to be supported by an associated renewable energy capacity addition of about 125 GW in the country by 2030.

• The mission is being administered by the Ministry of New and Renewable Energy (MNRE), which oversees the implementation and achievement of these milestones.

• The total initial outlay for the mission is Rs. 19,744 crore, which includes allocations for the SIGHT program, pilot projects, R&D, and other mission components.

Additional Information

• SIGHT Program: The Strategic Interventions for Green Hydrogen Transition (SIGHT) is a major financial incentive mechanism under the mission. It provides two distinct financial incentive sub-schemes: one for the domestic manufacturing of electrolyzers and another for the production of Green Hydrogen.

• Environmental Impact: The mission aims to result in a significant reduction in fossil fuel imports, saving over Rs. 1 lakh crore by 2030. Furthermore, it is expected to abate nearly 50 MMT of annual CO_2 emissions.

• Economic Growth: It is projected that the mission will bring in over Rs. 8 lakh crore in total investments and lead to the creation of more than 6 lakh jobs by the end of the decade.

• Definition of Green Hydrogen: Green Hydrogen is defined as hydrogen produced through the electrolysis of water using electricity generated from renewable energy sources (like solar or wind), ensuring that the process has a low carbon footprint.

Important Points

• Decarbonization: The mission facilitates the decarbonization of "hard-to-abate" sectors such as steel, refineries, and fertilizers, where hydrogen is used as a feedstock or fuel.

• Energy Independence: This mission is a crucial step towards India's goal of becoming energy independent by 2047 and achieving Net Zero emissions by 2070, as pledged at COP26.

• Export Hub: By developing large-scale production capabilities, India intends to export Green Hydrogen and its derivatives like Green Ammonia to international markets, particularly Europe and East Asia.

• Research and Development: A dedicated Strategic Hydrogen Innovation Partnership (SHIP) is being encouraged to foster public-private partnerships for R&D to improve the efficiency and cost-effectiveness of hydrogen technologies.

Q87. Answer: (c) Simone Biles

The correct answer is Simone Biles.

Key Points

• Simone Biles, the legendary American gymnast, became the second woman in history to secure the Laureus World Sportswoman of the Year title four times by the April 2025 award cycle.

• She previously won this prestigious award in 2017, 2019, and 2020, following her dominant performances in the Rio Olympics and various World Championships.

• Her fourth win follows an extraordinary performance at the 2024 Paris Olympics, where she won three gold medals (Team, All-around, and Vault) and one silver (Floor exercise). Hence, the correct answer is Simone Biles.

• By achieving her fourth win, she matched the record held by tennis icon Serena Williams, who was the first female athlete to win the category four times.

• The Laureus World Sports Awards are often referred to as the "Oscars of Sport" and recognize the greatest sporting achievements of the year.

Additional Information

• Serena Williams:

• She was the first woman to win the Laureus World Sportswoman of the Year four times, receiving the honors in 2003, 2010, 2016, and 2018.

• With 23 Grand Slam singles titles, she is considered one of the greatest athletes of all time.

• Laureus World Sports Awards:

• Established in 1999 by the Laureus Sport for Good Foundation, with the inaugural ceremony held in 2000 in Monte Carlo.

• The awards are presented in several categories, including World Sportsman of the Year, World Team of the Year, and World Breakthrough of the Year.

• The winners are selected by the Laureus World Sports Academy, a jury consisting of 60+ sporting legends.

• Naomi Osaka:

• The Japanese tennis player won the Laureus World Sportswoman of the Year in 2021 and the Breakthrough of the Year award in 2019.

• Rebeca Andrade:

• A prominent Brazilian gymnast who has been a major rival to Biles, winning multiple medals at the Tokyo 2020 and Paris 2024 Olympics.

Important Points

• Simone Biles' Career Highlights:

• She is the most decorated gymnast in history, with a combined total of 41 Olympic and World Championship medals.

• As of the 2024 Paris Games, she holds 11 Olympic medals (7 Gold, 2 Silver, 2 Bronze).

• In 2024, Biles also received the Laureus World Comeback of the Year award for her return to elite competition following a hiatus to prioritize her mental health.

• Statistical Facts:

• Biles has five skills named after her in the Code of Points across vault, floor exercise, and balance beam.

• She was awarded the Presidential Medal of Freedom in 2022 by Joe Biden, becoming the youngest person to receive the honor.

Q88. Answer: (a) Vithya Ramraj

The correct answer is Vithya Ramraj.

Key Points

• The Indian athlete Vithya Ramraj secured the gold medal in the women's 400m hurdles event at the 2025 National Games.

• She recorded a winning time of 58.11 seconds to finish first on the podium, demonstrating her continued dominance in the domestic circuit.

• The National Games 2025, which is the 38th edition of the prestigious multi-sport event, was hosted by the state of Uttarakhand.

• Vithya Ramraj is known for her versatility, competing in both the 400m sprint and the 400m hurdles, and she represents the state of Tamil Nadu in national competitions.

• Her performance at the 2025 National Games is a significant milestone as athletes prepare for the upcoming international athletic season and qualifying events for global championships.

Additional Information

• Vithya Ramraj:

• She rose to national prominence by equalling the national record of 55.42 seconds in the 400m hurdles, a record previously held solely by the legendary P.T. Usha since the 1984 Los Angeles Olympics.

• She has been a consistent performer for India at the Asian Games, winning medals in both individual hurdles and relay events (4x400m).

• Aishwarya Mishra:

• She is a specialist 400m runner from Maharashtra. She has represented India in various Asian Athletics Championships and is known for her speed in the flat quarter-mile event.

• Revathi Veeramani:

• An Olympian from Tamil Nadu, she was part of the mixed 4x400m relay team at the Tokyo 2020 Olympics. She primarily competes in the 400m and 200m sprints.

• Anjali Devi:

• A prominent 400m sprinter from Haryana, she has won several gold medals at the Inter-State Athletics Championships and has been one of the fastest Indian women in the 400m flat category in recent years.

Important Points

• 38th National Games (2025):

• The event was organized under the aegis of the Indian Olympic Association (IOA) and the Government of Uttarakhand.

• The games featured over 30 sporting disciplines, held across major cities in Uttarakhand including Dehradun, Haldwani, and Rishikesh.

• The National Games serve as a platform to identify and groom talent for the Asian Games, Commonwealth Games, and the Olympic Games.

• 400m Hurdles Standards:

• In the women's category, the 400m hurdles involves jumping over 10 hurdles placed at a height of 30 inches (0.762 meters) over a full lap of the track.

• Success in this event requires a unique combination of sprinting speed, rhythm, and hurdling technique.

Q89. Answer: (b) Harmanpreet Kaur

The correct answer is Harmanpreet Kaur.

Key Points

• Harmanpreet Kaur served as the captain of the Indian Women's Cricket Team during the ICC Women's Cricket World Cup 2025.

• The 2025 edition of the tournament was hosted by India, with matches scheduled across various venues during September, October, and November 2025.

• As a seasoned all-rounder, Harmanpreet Kaur took over the permanent captaincy roles in all formats following the retirement of legendary players. Hence, the correct answer is Harmanpreet Kaur.

• The ICC Women's World Cup 2025 was a significant event as it marked the return of the ODI World Cup to India after the 2013 edition.

• Under Harmanpreet Kaur's leadership, the team focused on utilizing home-ground advantages to aim for their maiden World Cup trophy.

Additional Information

• Mithali Raj:

• She is the highest run-scorer in women's international cricket and led India to two World Cup finals (2005 and 2017).

• Mithali Raj announced her retirement from all forms of international cricket in June 2022, making her ineligible to captain in 2025.

• Jhulan Goswami:

• Known as one of the greatest fast bowlers, she holds the record for the highest number of wickets in women's ODIs.

• She retired from international cricket in September 2022 after playing her final match at Lord's in England.

• Smriti Mandhana:

• She is a prolific left-handed opening batter and currently serves as the Vice-captain of the Indian women's team.

• While she is a key leader in the squad, Harmanpreet Kaur remained the designated Captain for the major tournament in 2025.

• ICC Women's Cricket World Cup:

• This is the premier international championship of women's One Day International (ODI) cricket, organized by the International Cricket Council (ICC).

• The 2025 tournament was the 13th edition of the event.

Important Points

• Harmanpreet Kaur created history in 2017 by scoring an unbeaten 171 runs against Australia in the World Cup semi-final, which is one of the highest individual scores in the tournament's history.

• In 2018, she became the first Indian woman to score a century in a Women's T20 International (WT20I).

• The BCCI (Board of Control for Cricket in India) has been actively promoting women's cricket through initiatives like the Women's Premier League (WPL), which launched in 2023 to provide a platform for domestic and international talent.

• The 2025 World Cup featured 8 teams and followed a round-robin format followed by semi-finals and the final.

Q90. Answer: (c) Justice Dinesh Maheshwari

The correct answer is Justice Dinesh Maheshwari.

Key Points

• The Government of India appointed former Supreme Court Judge, Justice Dinesh Maheshwari, as the Chairperson of the 23rd Law Commission of India in April 2025.

• The 23rd Law Commission was constituted to succeed the 22nd Law Commission, which had its term extended previously to complete its reports on various legal subjects.

• Along with the Chairperson, the commission consists of Full-time Members including Professor DP Verma and Hitesh Jain, who contribute to the legal research and reform recommendations.

• The Chairperson and members typically hold office for a term of three years, during which they examine existing laws and suggest new legislative measures to the Ministry of Law and Justice.

• Justice Dinesh Maheshwari served as a Judge of the Supreme Court of India from January 2019 to May 2023, and previously held the position of Chief Justice of the Karnataka High Court and Meghalaya High Court.

Additional Information

• Law Commission of India:

• It is an executive body (non-statutory) established by an order of the Government of India to provide expert advice on legal reforms.

• The commission works as an advisory body to the Ministry of Law and Justice, and its recommendations are not legally binding on the government but carry significant weight in legislative drafting.

• Historical Context:

• The first Law Commission in India was established in 1834 under the Charter Act of 1833 and was presided over by Lord Macaulay. This commission was responsible for the codification of the Penal Code and the Criminal Procedure Code.

• The First Law Commission of Independent India was established in 1955, with M. C. Setalvad, the first Attorney General of India, serving as its Chairman.

• Functions and Mandate:

• Reviewing obsolete laws and recommending their repeal to ensure the legal system remains contemporary and efficient.

• Suggesting legal safeguards to protect the rights of the poor and marginalized sections of society.

• Examining the Directive Principles of State Policy and suggesting ways to implement them through appropriate legislation.

• Conducting research into personal laws, gender equality, and judicial administration to simplify procedures and reduce pendency in courts.

• Structure of the Commission:

• It generally consists of a Chairperson (usually a retired Supreme Court Judge or retired Chief Justice of a High Court), four full-time members, and a Member-Secretary.

• The Secretary of the Department of Legal Affairs and the Secretary of the Legislative Department often serve as ex-officio members.

Important Points

• The 22nd Law Commission, headed by Justice Ritu Raj Awasthi, focused on significant issues such as the Uniform Civil Code (UCC) and Simultaneous Elections (One Nation, One Election).

• The appointment of Justice Dinesh Maheshwari marks a continuation of the tradition of involving high-level judicial expertise in shaping the legal landscape of India.

• The reports submitted by the commission are often placed before Parliament and referred to the relevant Standing Committees for further deliberation.

Q91. Answer: (c) Caste-based enumeration

The correct answer is Caste-based enumeration.

Key Points

• The upcoming Population Census, which was delayed from its 2021 schedule due to the pandemic and is now expected to be conducted starting in 2025 with a target completion in 2027, will include Caste-based enumeration for the first time in independent India's decadal census history.

• While Scheduled Castes (SC) and Scheduled Tribes (ST) have been counted in every census since 1951, the detailed counting of other caste groups, particularly Other Backward Classes (OBCs), has not been part of the regular decadal census since 1931 during the British colonial era. Hence, the statement regarding Caste-based enumeration is correct.

• The Census of India is a massive exercise conducted under the provisions of the Census Act, 1948, which provides the legal framework for the collection of data and ensures the confidentiality of information provided by citizens.

• This specific census exercise is significant as it transitions into a Digital Census, where data will be collected using mobile applications and a self-enumeration portal, reducing the time lag between data collection and publication.

• The inclusion of caste data is aimed at providing a more accurate demographic profile to assist the Government of India in the effective implementation of affirmative action policies and welfare schemes.

Additional Information

• Historical Context of Census:

• The first non-synchronous census in India was conducted in 1872 under Lord Mayo.

• The first synchronous census (covering the entire country at once) was conducted in 1881 under Lord Ripon, and it has been conducted every 10 years since then.

• The Office of the Registrar General and Census Commissioner, under the Ministry of Home Affairs, is responsible for conducting the decadal census.

• Constitutional Status:

• In the Constitution of India, the subject of "Census" falls under the Union List (List I) of the Seventh Schedule.

• It is covered under Article 246, making it the exclusive responsibility of the Parliament of India to legislate on and manage.

• Socio-Economic and Caste Census (SECC):

• The SECC 2011 was a separate exercise from the decadal census, conducted by the Ministry of Rural Development and the Ministry of Housing and Urban Poverty Alleviation.

• Unlike the decadal census, which provides macro-level demographic data, the SECC was intended to identify beneficiaries for specific government subsidies and social programs.

Important Points

• National Population Register (NPR): The NPR is usually updated alongside the first phase of the Census (House Listing). It contains a list of usual residents of the country, defined as a person who has resided in a local area for the past 6 months or more.

• Delimitation Connection: The data from the 2027 Census is expected to be a crucial baseline for the Delimitation Commission to redraw the boundaries of Lok Sabha and State Assembly constituencies, which has been frozen based on the 1971 Census figures until the first census after 2026.

• Data Utility: Census data is used by the Finance Commission for the devolution of taxes to states and by various international agencies like the United Nations to monitor Sustainable Development Goals (SDGs).

• Language and Literacy: The census also captures vital information on mother tongues, literacy rates, and occupational structures, which are essential for planning educational infrastructure and economic policies.

Q92. Answer: (b) Achiever 100; Front Runner 65–99; Performer 50–65; Aspirant <50

The correct answer is Achiever 100; Front Runner 65–99; Performer 50–65; Aspirant <50.

Key Points

• The North Eastern Region (NER) District SDG Index is a comprehensive tool used to measure the progress of districts across the eight states of the North East toward achieving the Sustainable Development Goals (SDGs).

• According to the second edition released in July 2025, the districts are categorized based on their composite scores into four distinct groups:

• Achiever: Districts that have achieved a perfect score of 100.

• Front Runner: Districts with a score ranging between 65 and 99.

• Performer: Districts with a score ranging between 50 and 65.

• Aspirant: Districts with a score below 50.

• The index is a result of a collaborative effort between NITI Aayog and the Ministry of Development of North Eastern Region (MDoNER), with technical support from the United Nations Development Programme (UNDP).

• The index facilitates evidence-based decision-making by identifying gaps in development and highlighting areas that require immediate policy intervention at the district level.

• It covers all eight states of the region, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura.

Additional Information

• Structure and Indicators:

• The NER District SDG Index typically monitors progress across 15 Sustainable Development Goals (Goal 14: Life Below Water and Goal 17: Partnerships for the Goals are usually excluded at the district level).

• It uses a refined set of indicators (often around 84 to 100) that are relevant to the socio-economic and environmental context of the North Eastern Region.

• Competitive Federalism:

• The ranking system fosters a spirit of competitive federalism among districts, encouraging them to perform better by learning from the best practices of top-ranked districts like those in Sikkim or Mizoram.

• By ranking 100+ districts, the index provides a granular view of development that a state-level index might miss.

• NITI Aayog's Role:

• As India's premier policy think-tank, NITI Aayog is responsible for the localization of SDGs in India.

• The SDG India Index (national level) and the NER District SDG Index are two of its primary monitoring frameworks launched since 2018.

• Significance for the NER:

• The North Eastern Region is geographically challenging and strategically important. This index helps in aligning the "Act East Policy" with local developmental needs.

• It helps the Central Government and State Governments in the targeted allocation of budgetary resources to the most lagging districts.

Important Points

• Evolution of the Index: The first edition of the NER District SDG Index was launched in August 2021. The second edition in 2025 reflects the progress made over the intervening years and incorporates more robust data sets.

• Top Performers: Historically, districts from Sikkim (such as East Sikkim) and Mizoram have frequently featured in the Front Runner category, showcasing high performance in sectors like Education, Health, and Clean Water.

• Data Sourcing: The data for the index is sourced from various official government reports, including the National Family Health Survey (NFHS), Unified District Information System for Education (UDISE+), and Periodic Labour Force Survey (PLFS).

• Goal of 2030: The primary objective remains to align the regional development with the Global Agenda 2030, ensuring that no one is left behind in the journey toward prosperity.

Q93. Answer: (c) Odisha

The correct answer is Odisha.

Key Points

• The Odisha Government, in July 2024 (contextual to the 2025 directive), issued a significant order to all Heads of Departments, District Collectors, and Revenue Divisional Commissioners to ensure the strict implementation of the POSH Act, 2013.

• The primary objective of this directive is to strengthen women's safety at the workplace and ensure a professional environment free from sexual harassment and gender-based discrimination.

• As per the directive, it is mandatory for every government and private office to constitute an Internal Complaints Committee (ICC) to address grievances related to misconduct. Hence, the mention of Odisha as the correct answer is accurate.

• The government emphasized that the Presiding Officer of the ICC must be a woman employed at a senior level at the workplace to ensure the complainant feels secure and heard.

• Departments have been instructed to conduct regular sensitization workshops and awareness programmes to educate employees about their rights and the legal redressal mechanisms available under the POSH Act.

Additional Information

• The POSH Act, 2013:

• The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act was enacted in 2013.

• It was developed based on the Vishaka Guidelines laid down by the Supreme Court of India in the 1997 Vishaka vs. State of Rajasthan case.

• The Act defines "sexual harassment" broadly to include physical contact, a demand for sexual favors, making sexually colored remarks, or any other unwelcome physical, verbal, or non-verbal conduct of a sexual nature.

• Scope of Workplace:

• The definition of "workplace" under this Act is very wide, covering government offices, private organizations, hospitals, educational institutions, sports facilities, and even the unorganized sector.

• It also includes transportation provided by the employer for commuting to and from the place of work.

• Committee Structures:

• Internal Committee (IC): Mandated for every workplace employing 10 or more people. It must include an external member from an NGO or an association committed to the cause of women.

• Local Committee (LC): Formed by the District Officer in every district to receive complaints from establishments that have fewer than 10 employees or if the complaint is against the employer themselves.

Important Points

• Complaint Timeline: A complaint must be submitted in writing within a period of 3 months from the date of the incident. The IC/LC can extend this time limit if they are satisfied with the reasons for the delay.

• Inquiry and Redressal: The committee must complete its inquiry within 90 days. Once the inquiry is completed, the report is sent to the employer, who must act on the recommendations within 60 days.

• Confidentiality: The Act prohibits the publication or making known the contents of the complaint and the identity of the complainant or witnesses to the public or media.

• SHe-Box: The Ministry of Women and Child Development has launched the Sexual Harassment electronic Box (SHe-Box), an online portal for registering complaints, ensuring that women in both public and private sectors have a direct way to seek help.

• Penalties: Failure to comply with the Act can result in a fine of up to Rs. 50,000 for the employer, and repeated violations may lead to the cancellation of the business license or registration.

Q94. Answer: (d) DR Congo and Rwanda

The correct answer is DR Congo and Rwanda.

Key Points

• On 19 June 2025, representatives from the Democratic Republic of the Congo (DRC) and Rwanda reached a significant milestone by initialing a peace agreement draft intended to halt the long-standing hostilities in the eastern regions of the DRC.

• The draft was formulated after intensive diplomatic efforts, primarily facilitated under the Luanda Process, mediated by Angolan President João Lourenço, who has been a key figure in regional peace initiatives. Hence, the statement regarding the involvement of DR Congo and Rwanda is correct.

• The primary objective of this agreement is to address the security crisis in North Kivu and South Kivu, where conflict involving the M23 rebel group has led to a severe humanitarian disaster.

• The agreement outlines a roadmap for the cessation of hostilities, the disengagement of forces, and the establishment of a verification mechanism to monitor border security and prevent the support of non-state armed groups.

• This diplomatic breakthrough is seen as a vital step toward restoring bilateral relations between Kinshasa and Kigali, which had deteriorated significantly due to mutual allegations of supporting proxy militias.

Additional Information

• The Luanda Process:

• Established in 2022, this initiative is led by the African Union (AU) and chaired by Angola. It focuses on the de-escalation of tensions between DRC and Rwanda.

• It works in tandem with the Nairobi Process, which was initiated by the East African Community (EAC) to facilitate internal dialogue between the DRC government and various local armed groups.

• The M23 Insurgency:

• The March 23 Movement (M23) is a rebel military group operating primarily in North Kivu. The group resurfaced in late 2021, capturing significant territory and causing the displacement of over 1 million people.

• The DRC government has frequently accused Rwanda of providing military support to M23, an allegation supported by reports from United Nations (UN) experts, though Kigali has consistently denied these claims.

• Regional Security Dynamics:

• Eastern DRC is home to over 120 armed groups, including the FDLR (Democratic Forces for the Liberation of Rwanda) and the ADF (Allied Democratic Forces), which is linked to international terror networks.

• The Southern African Development Community (SADC) deployed a mission known as SAMIDRC in December 2023 to support the Congolese army (FARDC) in its fight against rebels.

Important Points

• Humanitarian Impact: The conflict in Eastern Congo has resulted in one of the world's most neglected humanitarian crises, with millions of Internally Displaced Persons (IDPs) facing acute food insecurity and lack of healthcare.

• Natural Resources: The region is rich in critical minerals such as cobalt, coltan, and gold. The illegal exploitation and trade of these resources have often been cited as a primary driver and funding source for the ongoing violence.

• MONUSCO: The United Nations Organization Stabilization Mission in the DR Congo (MONUSCO) has been operational since 1999. Following the peace draft, discussions have intensified regarding the phased withdrawal of UN peacekeepers to allow national and regional forces to take over security responsibilities.

• Economic Significance: Stable relations between Rwanda and DRC are crucial for cross-border trade and the economic integration of the Great Lakes Region of Africa.

Q95. Answer: (b) Accommodative

The correct answer is Accommodative.

Key Points

• The Reserve Bank of India (RBI) adopts an Accommodative stance when it aims to expand the money supply to boost economic growth. This stance is typically characterized by a willingness to either keep the Repo Rate unchanged or reduce it further.

• Following the April 2025 monetary policy review, the decision to cut the Repo Rate was a clear indicator of this stance, intended to lower borrowing costs for both consumers and businesses.

• An Accommodative stance signals to the financial markets that the central bank is prioritizing liquidity injection and investment over immediate concerns regarding inflationary pressures, provided inflation remains within the tolerance band.

• The Monetary Policy Committee (MPC), which consists of six members, evaluates various macroeconomic indicators such as GDP growth and the Consumer Price Index (CPI) before deciding on such a shift in stance.

• By maintaining this stance, the RBI ensures that commercial banks have sufficient liquidity to provide loans at cheaper rates, thereby stimulating aggregate demand in the Indian economy.

Additional Information

• Monetary Policy Committee (MPC):

• The MPC is a statutory body established under Section 45ZB of the amended Reserve Bank of India Act, 1934.

• It is chaired by the Governor of the RBI and is responsible for fixing the benchmark policy rate (Repo Rate) to contain inflation within the specified target level.

• The committee meets at least four times a year, and its decisions are published after every meeting.

• Types of Monetary Policy Stances:

• Neutral Stance: This implies that the RBI can move the interest rates in either direction (increase or decrease) based on incoming data.

• Hawkish/Restrictive Stance: The central bank focuses on curbing inflation by increasing interest rates and reducing the money supply.

• Withdrawal of Accommodation: This indicates a transition where the RBI starts reducing the liquidity it had previously pumped into the system, moving toward a neutral or tight policy.

• Important Instruments of Monetary Policy:

• Repo Rate: The interest rate at which the RBI lends money to commercial banks against government securities.

• Reverse Repo Rate: The rate at which the RBI borrows money from commercial banks within the country.

• Cash Reserve Ratio (CRR): The specific percentage of net demand and time liabilities (NDTL) that banks must keep with the RBI in the form of cash.

Important Points

• Inflation Targeting: The Government of India, in consultation with the RBI, set an inflation target of 4% with a flexibility band of +/- 2% (i.e., between 2% and 6%).

• Economic Impact: A cut in the Repo Rate usually leads to a decrease in Equated Monthly Installments (EMIs) for home loans, car loans, and personal loans, provided the transmission of rates by banks is efficient.

• Liquidity Management: Under an Accommodative stance, the RBI often uses Open Market Operations (OMO) to buy government bonds, thereby increasing the cash flow in the banking system.

• Global Context: The RBI's stance in 2025 is also influenced by global economic conditions, including the monetary policy of the US Federal Reserve and international crude oil prices.

Q96. Answer: (c) Maharashtra

The correct answer is Maharashtra.

Key Points

• Maharashtra secured the first position in the overall medal tally at the National Games 2025, continuing its dominant run in Indian domestic sports.

• The state was awarded the prestigious Raja Bhalindra Singh Trophy, which is presented to the overall champion of the National Games.

• Maharashtra's success was driven by exceptional performances across a wide range of disciplines, particularly in Gymnastics, Swimming, Wrestling, and traditional sports like Mallakhamb and Yogasana.

• The state managed to surpass the medal counts of other major sporting powerhouses such as the Services Sports Control Board (SSCB) and Haryana.

• This victory follows Maharashtra's previous triumph in the 37th National Games held in Goa, where they also topped the table with more than 200 medals.

Additional Information

• Host State:

• The 38th edition of the National Games was hosted by Uttarakhand in 2025.

• The events were spread across various cities, including Dehradun, Haldwani, Haridwar, and Rudrapur, to showcase the state's sporting infrastructure.

• The official mascot for the Uttarakhand games was the Himalayan Monal, the state bird, symbolizing the natural heritage of the region.

• Governance and Organization:

• The National Games are organized by the Indian Olympic Association (IOA) in collaboration with the host state government.

• The primary goal of these games is to identify and nurture athletic talent at the national level for future international events like the Asian Games and the Olympic Games.

• The 2025 edition featured over 38 sports disciplines, reflecting the growing diversity of sports in India.

Important Points

• Historical Context:

• The first National Games, originally known as the Indian Olympic Games, were held in 1924 in Lahore (now in Pakistan).

• The modern format of the games, modeled after the Olympics, began with the 26th edition held in New Delhi in 1985.

• The Raja Bhalindra Singh Trophy:

• This trophy is named after Raja Bhalindra Singh, who served as the President of the Indian Olympic Association for several years and was instrumental in modernizing the games.

• It is considered the highest honor for any participating State or Union Territory in the competition.

• Participation:

• The games see participation from all 28 States, 8 Union Territories, and the Services Sports Control Board (SSCB), making it the largest multi-sport event in the country.

Q97. Answer: (a) Piyush Goyal

The correct answer is Piyush Goyal.

Key Points

• Union Minister of Commerce and Industry, Shri Piyush Goyal, inaugurated the Startup Mahakumbh, a premier event celebrating the entrepreneurial spirit of India.

• The Minister described his visit to the event as “an experience of a lifetime”, highlighting the vibrant energy, diverse innovations, and the scale of participation from young entrepreneurs across the country.

• The Startup Mahakumbh aims to bring together all stakeholders of the startup ecosystem, including investors, incubators, accelerators, and industry leaders to foster collaboration and growth.

• The event is supported by the Department for Promotion of Industry and Internal Trade (DPIIT) under the Ministry of Commerce and Industry, showcasing the government’s commitment to making India a global innovation hub.

• The organizing committee includes leading industry bodies such as ASSOCHAM, nasscom, Bootstrap Foundation, TiE, and IVCA, working together to showcase Bharat’s startup prowess.

Additional Information

• The Startup India Initiative:

• Launched on January 16, 2016, by Prime Minister Narendra Modi, the Startup India initiative was designed to build a strong ecosystem for nurturing innovation and startups.

• As of 2024-2025, India has emerged as the third-largest startup ecosystem globally, with over 1,25,000 startups recognized by the DPIIT.

• The initiative offers various benefits, including tax exemptions for three years, self-certification under labor and environmental laws, and a faster exit mechanism for companies.

• National Startup Day:

• In 2022, the Government of India officially declared January 16 as National Startup Day to mark the anniversary of the Startup

India launch.

• This day is dedicated to acknowledging the contribution of entrepreneurs to the economy and encouraging the “startup culture” in every corner of the nation.

• MAARG Portal:

• The MAARG (Mentorship, Advisory, Assistance, Resilience, and Growth) portal is a one-stop mentorship platform launched by DPIIT to facilitate mentorship for startups across diverse sectors and stages.

• It connects mentors with mentees based on their specific needs and geographic locations, helping them scale their business models effectively.

• Funding and Unicorns:

• The Fund of Funds for Startups (FFS) with a corpus of Rs. 10,000 crore was established to provide much-needed capital to startups through SEBI-registered Alternative Investment Funds (AIFs).

• India has produced more than 110 Unicorns (startups with a valuation exceeding $1 billion), reflecting the rapid maturity and investment potential of the Indian market.

Important Points

• Bharat Mandapam: The Startup Mahakumbh was held at the iconic Bharat Mandapam in New Delhi, which also hosted the G20 Summit in 2023.

• Key Themes: The event focused on emerging technologies such as Artificial Intelligence (AI), Deep Tech, SaaS, Agritech, and Fintech, reflecting the diverse sectors where Indian startups are leading.

• DPIIT: It is the nodal department for startup policies in India and plays a crucial role in Ease of Doing Business reforms and Foreign Direct Investment (FDI) policy formulation.

• Global Recognition: The Global Innovation Index (GII) has seen India’s rank jump from 81 in 2015 to 40 in recent years, largely driven by the growth of the startup ecosystem.

Q98. Answer: (a) 23 January

The correct answer is 23 January.

Key Points

• Netaji Subhas Chandra Bose Jayanti, celebrated as Parakram Diwas (Day of Valor), is observed every year on 23 January to honor the birth anniversary of one of India’s most prominent freedom fighters.

• In 2025, India will celebrate the 128th birth anniversary of Netaji, reflecting on his indomitable spirit and contribution to the country’s struggle for independence.

• The Government of India officially designated 23 January as Parakram Diwas in 2021 to inspire the youth of the nation to act with fortitude in the face of adversity.

• Subhas Chandra Bose was born on 23 January 1897 in Cuttack, Odisha, which was then a part of the Bengal Presidency.

• This day is marked by various national events, including tributes at India Gate and across various states, to commemorate his vision of a free and united India.

Additional Information

• Indian National Army (INA):

• Commonly known as the Azad Hind Fauj, it was first formed by Rash Behari Bose and Captain Mohan Singh.

• Netaji took command of the INA in Singapore in 1943 and reorganized it to launch a military campaign against the British government.

• Political Career:

• Netaji was elected as the President of the Indian National Congress (INC) twice, first at the Haripura Session in 1938 and then at the Tripuri Session in 1939.

• Due to ideological differences with other leaders, he resigned from the INC and founded the All India Forward Bloc on 22 June 1939.

• Slogans and Legacy:

• He gave the famous call to arms, "Give me blood, and I shall give you freedom" (Tum mujhe khoon do, main tumhe azadi dunga).

• The slogan "Jai Hind", which is used as a formal greeting in India today, was popularized by him and his followers in the Azad Hind Fauj.

Important Points

• Civil Services Achievement: Netaji successfully cleared the Indian Civil Services (ICS) examination in 1920 in England, securing the 4th rank, but he later resigned in 1921 to join the non-cooperation movement led by Mahatma Gandhi.

• Island Renaming: In December 2018, Prime Minister Narendra Modi renamed Ross Island in the Andaman and Nicobar Islands as Netaji Subhas Chandra Bose Dweep to mark the 75th anniversary of the hoisting of the Tricolour on Indian soil.

• Statue at Kartavya Path: In September 2022, a grand 28-foot granite statue of Netaji was unveiled at the canopy near India Gate in New Delhi (formerly known as Rajpath/Kartavya Path) to honor his legacy.

• Provisional Government: He established the Provisional Government of Free India (Azad Hind) in Singapore on 21 October 1943, which was recognized by several axis powers during World War II.

Q99. Answer: (c) Kelly Slater

p>The correct answer is Kelly Slater.

Key Points

• The legendary American surfer Kelly Slater was honored with the prestigious Lifetime Achievement Award at the Laureus World Sports Awards 2025.

• This award recognizes his extraordinary career spanning over three decades and his immense contribution to the sport of surfing globally.

• Kelly Slater is widely regarded as the greatest professional surfer of all time, having secured a record 11 World Surf League (WSL) titles between 1992 and 2011.

• Born on February 11, 1972, in Cocoa Beach, Florida, he holds the distinction of being both the youngest (at age 20) and the oldest (at age 39) world champion in the history of the sport.

• The Laureus Lifetime Achievement Award is presented to athletes who have demonstrated a long-term commitment to sport and have had a significant impact on society through their achievements. Hence, the correct answer is Kelly Slater.

Additional Information

• Stephanie Gilmore:

• She is an Australian professional surfer and an 8-time World Champion on the Women's World Tour.

• In 2010, she was inducted into the Surfing Hall of Fame at the age of 22.

• While a legend in her own right, she was not the recipient of the 2025 Lifetime Achievement Award. Hence, statement 1 is incorrect.

• Mick Fanning:

• Nicknamed "White Lightning," Fanning is an Australian professional surfer who won three world titles in 2007, 2009, and 2013.

• He gained global mainstream attention in 2015 after surviving a shark attack during a competition in South Africa. Hence, statement 2 is incorrect.

• Tom Carroll:

• An Australian surfing icon of the 1980s, Carroll won two consecutive world titles in 1983 and 1984.

• He was the first professional surfer to sign a million-dollar contract with a major sponsor (Quiksilver) in 1989. Hence, statement 4 is incorrect.

Important Points

• Laureus World Sports Awards: Established in 1999, these awards are often referred to as the "Oscars of Sport." The winners are selected by the Laureus World Sports Academy, a jury made up of over 70 sporting legends.

• Slater's Laureus History: Before receiving the Lifetime Achievement Award, Kelly Slater had already won the Laureus World Action Sportsperson of the Year award four times (in 2007, 2009, 2011, and 2012).

• Innovation and Activism: Beyond competition, Slater is known for his Surf Ranch wave technology in Lemoore, California, and his work in ocean conservation and environmental sustainability.

• Records: Over his career, Slater has accumulated 56 Championship Tour (CT) victories, a record that remains unsurpassed in the surfing world.

Q100. Answer: (d) SDG 9

The correct answer is SDG 9.

Key Points

• SDG 9 aims to "Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation." The rise in internet subscriptions is a direct measure of the progress in digital infrastructure and Information and Communication Technology (ICT) access. Hence, the correct answer is SDG 9.

• The Sustainable Development Goals — National Indicator Framework (NIF) Progress Report 2025, published in June 2025 by the Ministry of Statistics and Programme Implementation (MoSPI), tracks the progress of India across various targets.

• Under SDG 9, specifically Target 9.c, the goal is to significantly increase access to ICT and strive to provide universal and affordable access to the Internet. The indicator used in the National Indicator Framework is the number of internet subscriptions per 100 population.

• The growth in internet subscriptions during the 2024–25 period reflects India's efforts to bridge the digital divide and enhance connectivity, which is foundational for modern innovation and industrial growth.

• This indicator is vital because internet penetration facilitates other digital services like e-governance, online education, and digital

payments, though its primary categorization remains under infrastructure (Goal 9).

Additional Information

• SDG 1 (No Poverty):

• This goal focuses on eradicating poverty in all its forms by 2030.

• While digital inclusion helps in poverty alleviation through direct benefit transfers, it is not the primary goal associated with internet subscription metrics. Hence, option 1 is incorrect.

• SDG 6 (Clean Water and Sanitation):

• This goal ensures the availability and sustainable management of water and sanitation for all.

• Key indicators include access to safe drinking water and open defecation-free status. Hence, option 2 is incorrect.

• SDG 13 (Climate Action):

• This goal focuses on taking urgent action to combat climate change and its impacts.

• Indicators include disaster risk reduction strategies and greenhouse gas emissions. Hence, option 3 is incorrect.

• Digital India Mission:

• Launched in 2015, this flagship program of the Government of India has been the primary driver for the surge in internet users.

• Initiatives like BharatNet aim to provide high-speed broadband to all Gram Panchayats, directly boosting the SDG 9 indicators.

Important Points

• National Indicator Framework (NIF):

• The NIF is the largest monitoring framework in India for SDGs, consisting of nearly 300 indicators tailored to the Indian context.

• The MoSPI (Ministry of Statistics and Programme Implementation) is the nodal ministry for developing and maintaining the NIF.

• Growth Data:

• As of 2024–25, the surge in 5G rollout and fiber-to-the-home (FTTH) connections has significantly improved the subscription density in rural areas.

• The Telecom Regulatory Authority of India (TRAI) serves as the primary data source for internet subscription figures reported in the SDG NIF.

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