RRB Group D Official Paper (Held On: 03 Feb, 2026 Shift 3) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of the following methods of reproduction simply involves the splitting of the parent cell into two daughter cells in the bacteria?

(a) Binary fission
(b) Fragmentation
(c) Budding
(d) Spore formation

Q2. Which of the following statements about ions is correct?

(a) A cation is a negatively charged species.
(b) A group of atoms carrying a net charge is called a polyatomic ion.
(c) Ions are formed only from non-metal atoms.
(d) Sodium chloride consists of neutral sodium and chloride atoms.

Q3. Through which of the following structures does urine go into the urinary bladder from kidneys?

(a) Vena cava
(b) Ureters
(c) Vein
(d) Artery

Q4. Which of the following statements best differentiates a mixture from a compound?

(a) A compound can be separated into its constituents by physical methods.
(b) A compound shows the properties of its constituent elements.
(c) A mixture always contains elements in a fixed ratio.
(d) A mixture retains the individual properties of its constituents.

Q5. Which colour do silver articles attain when they get corroded and form a coating of silver sulphide?

(a) Remains silver
(b) White
(c) Black
(d) Reddish brown

Q6. Which of the following is a major environmental disadvantage of big dams?

(a) Water conservation
(b) Increased biodiversity
(c) Creation of recreational spaces
(d) Submergence of forests

Q7. Ethanoic acid is commonly known as acetic acid and has:

(a) A sharp, sour smell and taste
(b) No effect on litmus or metals
(c) A basic pH and slippery feel
(d) A strong fruity smell in water

Q8. Select the correct option regarding the following two statements labelled Assertion (A) and Reason (R).

Assertion (A): Monoculture plantations often fail to meet the diverse needs of forest-dependent villagers.

Reason (R): These plantations provide medicinal herbs, food and fuel for villagers.

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

Q9. A car slows down uniformly when brakes are applied, producing an acceleration of 8 m/s^2 opposite to its motion. If the car comes to rest in 2s, what distance does it cover before stopping?

(a) 12 m
(b) 16 m
(c) 8 m
(d) 20 m

Q10. If the stigma of a flower is damaged, which process would most likely be affected?

(a) Seed dispersal
(b) Pollination and fertilisation
(c) Fruit ripening
(d) Formation of petals and sepals

Q11. If a body of mass m is raised to a height h in a gravitational field of acceleration g, its potential energy depends on:

(a) g only
(b) m only
(c) h only
(d) m, g and h

Q12. A body weighs 60 kg wt on the surface of the moon. What will be the mass and the weight, respectively, of the body on the surface of the Earth?

(Take the value of g on Earth as 10 m/s^2)

(a) 36 kg and 360 kg wt
(b) 360 kg and 360 kg wt
(c) 600 kg and 360 kg wt
(d) 60 kg and 36 kg wt

Q13. The main purpose of designing a hall with curved walls and ceilings is _____.

(a) to reduce the speed of sound
(b) to ensure uniform sound distribution
(c) to make the sound louder only near the stage
(d) to make the hall look beautiful

Q14. An object is placed beyond the centre of curvature (C) of a concave mirror. The image formed will be now:

(a) Real, inverted, and diminished
(b) Virtual, erect, and magnified
(c) Real, inverted, and same size
(d) Real, inverted, and magnified

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Q15. Which of the following organelles is the first to divide during binary fission in Amoeba?

(a) Cell wall
(b) Nucleus
(c) Vacuole
(d) Cytoplasm

Q16. Which of the following best explains why combination reactions are often exothermic?

(a) They involve formation of bonds, which absorb energy.
(b) They require light to proceed.
(c) They release energy due to stable product formation.
(d) They involve the breaking of bonds only.

Q17. Carbon has the unique ability to form bonds with other atoms of carbon, giving rise to large molecules. This property is called:

(a) addition
(b) catenation
(c) unification
(d) conjugation

Q18. _____ is/are NOT selectively re-absorbed from the filtrate in the nephron.

(a) Salts
(b) Glucose
(c) Urea
(d) Amino acids

Q19. If the length of a conductor and area is halved, keeping material same, then its resistance will _____.

(a) Become four times
(b) Be halved
(c) Remain same
(d) Be doubled

Q20. What effect does an unbalanced force have on a moving object?

(a) It keeps the object at rest.
(b) It stops the object immediately.
(c) It increases the weight of the object.
(d) It causes a change in speed or direction of motion.

Q21. Which of the statement(s) is/are NOT true about the phenomenon of scattering of light:

(i) The amount of scattering light undergoes is independent of the size of particles of the medium through which light is passing.

(ii) The amount of scattering is directly proportional to the wavelength of light.

(iii) The colour of the sky appears blue as blue light undergoes more scattering as compared to red light.

(iv) The colour of danger signal is red as red colour undergoes least amount of scattering when passing through fog.

(a) Both (iii) and (iv)
(b) Both (i) and (ii)
(c) Both (ii) and (iii)
(d) Both (i) and (iii)

Q22. What is the equivalent of 1 kilowatt-hour (kWh) in joules?

(a) 1 kWh = 3.6×10^3 joules
(b) 1 kWh = 360 joules
(c) 1 kWh = 36 × 10^(-6) joules
(d) 1 kWh = 3.6 × 10^6 joules

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Q23. Which of the following is a homologous series?

(a) Methane, Methanol, Methanoic acid
(b) Ethene, Ethyne, Ethane
(c) Methane, Ethane, Propane
(d) Methane, Ethane, Ethene

Q24. According to Rutherford's model of an atom, the radius of an atom in metre is about:

(a) 10^(15)
(b) 10^(-10)
(c) 10^(10)
(d) 10^(-5)

Q25. What is the main purpose of cell division in multicellular organisms?

(a) Formation of vacuoles and maintenance of turgidity
(b) Transport of substances through the cell membrane
(c) Absorption of nutrients and release of wastes
(d) Growth, repair, and replacement of damaged or old cells

MATHEMATICS

Q26. The length of each side of a rhombus is 20 cm, and the length of one of the diagonals is 24 cm. Find the area (in cm^2) of the rhombus.

(a) 356
(b) 284
(c) 268
(d) 384

Q27. If 54 : A :: A : 150, then find the positive value of A.

(a) 87
(b) 89
(c) 90
(d) 93

Q28. The price of fuel decreases by 35%, 40% and 50% in three successive months, but increases by 45% in the fourth month. What is the percentage increase/decrease in the price of fuel in the fourth month as compared to its original price? (Round off your answer to two decimal places.)

(a) Increases by 76.37%
(b) Decreases by 71.73%
(c) Decreases by 70.64%
(d) Increases by 77.27%

Q29. The monthly incomes of two friends, Vijay and Mohan, are in the ratio 5 : 9, respectively, and each of them saves Rs. 4,2000 every month. If the ratio of their monthly expenditure is 2 : 4, find the monthly income of Vijay (in ??).

(a) 2,94,000
(b) 2,10,000
(c) 2,11,000
(d) 2,09,000

Q30. A train traveling at 60 km/h crosses another train traveling in the same direction at 24 km/h in 30 sec. What is the combined length of both the trains?

(a) 270 m
(b) 300 m
(c) 250 m
(d) 150 m

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Q31. A vertical pole stands on level ground. From a point 20 metres (m) away from the base of the pole, the angle of elevation to the top is 45°. What is the height of the pole?

(a) 25 m
(b) 20 m
(c) 15 m
(d) 10 m

Q32. The amount on a sum of Rs. 7,100 at 10% per annum compound interest, compounded annually, in 2 years, will be:

(a) Rs. 8,828
(b) Rs. 9,031
(c) Rs. 8,591
(d) Rs. 8,468

Q33. What price should Amit mark on a pair of jeans which cost him Rs. 7,700, so as to gain 32% after allowing successive discounts of 16% and 20%?

(a) Rs. 14,997
(b) Rs. 15,183
(c) Rs. 15,125
(d) Rs. 14,993

Q34. If $x^2 - 3x - 1 = 0$, find the value of $x^2 + 1/(x^2) - 6$.

(a) 5
(b) 3
(c) 7
(d) 9

Q35. A man buys a watch for Rs. 1,200 and sells it at a 10% loss. What is the selling price?

(a) Rs. 1,180
(b) Rs. 1,240
(c) Rs. 1,080
(d) Rs. 1,220

Q36. For 10 innings, a cricketer has an average of 76 runs. In the 11^(th) innings, he scores 193 runs. His average score increased by (rounded off to the nearest whole number):

(a) 11
(b) 9
(c) 8
(d) 6

Q37. The ratio of three numbers is 10 : 21 : 16. If 60 percent of the first number is 12, then what would be 40 percent of the difference of third and second number?

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

Q38. The arithmetic mean of the observations 18, 74, 33, 16, 35, 96, 40, 68 and 43 is:

(a) 43
(b) 47
(c) 41
(d) 44

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Q39. Successive discounts of 20% and 29% are equivalent to a single discount of:

(a) 42.5%
(b) 46.66%
(c) 43.2%
(d) 46.44%

Q40. 1/30 is what percentage of 1/100 (rounded off to two decimal places)?

(a) 333.33%
(b) 666.67%
(c) 343.33%
(d) 348.33%

Q41. A, B and C can do a piece of work in 3, 8 and 24 days, respectively. How long (in days) will they take to do twice the same work, working together?

(a) 12
(b) 4
(c) 5
(d) 8

Q42. What is the minimum value that must be assigned to A so that the 8-digit number 130A1568 is divisible by 8?

(a) 3
(b) 0
(c) 2
(d) 5

Q43. The distance between points A and B is 964 km. Kamlesh travels from A to B at 48 km/hr and returns at 52 km/hr. Find his average speed for the entire journey.

(a) 50.69 km/hr
(b) 49.92 km/hr
(c) 48.86 km/hr
(d) 51.85 km/hr

Q44. In a quadrilateral ABCD, angle A = 62° and angle B = 19°. The bisectors of angle C and angle D meet at O. What is the measure of angle DOC?

(a) 40.5°
(b) 28.5°
(c) 50°
(d) 34°

Q45. Three taps, A, B and C, can fill a tank in 12 hours, 15 hours and 18 hours, respectively. If tap A is open all the time and tap B and C are opened for one-one hour each alternately starting with tap B first, in how many hours will the tank be filled?

(a) 4 3/8 hours
(b) 5 2/11 hours
(c) 6 8/9 hours
(d) 3 5/7 hours

Q46. Find the value of r, if 25^((r - 1)) + 100 = 5^((2r - 1))

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

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Q47. Find the product of two numbers whose sum is 24 and whose difference is 8.

(a) 128
(b) 124
(c) 132
(d) 118

Q48. A brother is 2 years younger than his sister, and together their ages sum to 26 years. How old is the sister?

(a) 16 years
(b) 12 years
(c) 18 years
(d) 14 years

Q49. From a solid cylinder of height 48 cm and radius 14 cm, a conical cavity of radius 7 cm and height 24 cm is drilled out from one end of the cylinder. A hemisphere of radius 14 cm is scooped out from the other end. Find the total surface area (in cm^2) of the remaining solid.

(Take $\pi = 22/7$)

(a) 6463
(b) 6468
(c) 6864
(d) 6870

Q50. The value of ((75983 × 75983 - 45983 × 45983)/30000) is:

2974

(a) 121966
(b) 141669
(c) 145214
(d) 131325

GENERAL INTELLIGENCE & REASONING

Q51. Six people G, H, I, Q, R and S are sitting in a straight line facing the north. No one is seated to the left of R. Only three people are seated between R and G. Only three people are seated to the right of H. Q is seated to the immediate left of H. S is not an immediate neighbor of H. How many people are seated between S and I?

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

Q52. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All potatoes are bananas.

All bananas are apples.

Conclusions:

(I) All potatoes are apples.

(II) Some apples are bananas.

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

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Q53. In a row of 52 people facing north, Dimple sits 17^(th) from the left end. If only 15 people sit to the right of Avni, then how many people sit between Dimple and Avni?

(a) 18
(b) 19
(c) 21
(d) 20

Q54. Which of the given letter-number clusters will replace the question mark (?) in the following series to make it logically complete?

YCG 18 HLP 23 QUY 28 ZDH 33 ?

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

Q55. A, B, C and D opened shopping complexes in the same city. The shopping complex of A is 6 km west of the shopping complex of B. The shopping complex of C is 4 km north of the shopping complex of B. The shopping complex of D is 6 km west of the shopping complex of C. In which direction is the shopping complex of D from the shopping complex of A?

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

Q56. What should come in place of the question mark (?) in the given series?

168 181 196 209 224 ?

(a) 235
(b) 239
(c) 238
(d) 237

Q57. This question is based on the five, three-digit numbers given below.

(Left) 562 428 653 154 749 (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 second lowest number?

(a) 12
(b) 14
(c) 13
(d) 11

Q58. In a certain code language, ‘rain hall pig’ is coded as ‘kq zz nl’ and ‘pig bean error’ is coded as ‘hu mt zz’. How is ‘pig’ coded in that language?

(a) hu
(b) nl
(c) zz
(d) kq

Q59. Eight people – A, B, C, D, E, F, G and H, are sitting around a circular table facing the centre. Only two people sit between A and G when counted from the left of G. B sits to the immediate left of G. Only three people sit between C and B when counted from the left of C. E sits to the immediate right of D. F is not an immediate neighbour of B. Who sits second to the right of H?

(a) G
(b) F

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(c) E
(d) C

Q60. This question is based on the five, three-digit numbers given below.

(Left) 128 945 371 539 276 (Right)

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

NOTE - All operations to be done from left to right.

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

(a) 8
(b) 12
(c) 9
(d) 11

Q61. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only).

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

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

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

Q62. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

HCU : LAY

PYC : TWG

(a) XUK : BSO
(b) WGD : ABH
(c) TKG : XHK
(d) YCR : AYT

Q63. 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 bolts are screws.

All bolts are nuts.

All nuts are rivets.

Conclusions:

(I): All bolts are rivets.

(II): Some nuts are screws.

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

Q64. What should come in place of the question mark (?) in the given series?

21 28 38 51 67 ?

(a) 84
(b) 87
(c) 86
(d) 85

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Q65. Seven boxes, B, D, E, P, S, T and W, are kept one over the other but not necessarily in the same order. Only three boxes are kept below W. Only two boxes are kept between W and P. Only B is kept above D. T is kept at some place below E and at some place above S. Which box is kept at second position from the bottom?

(a) T
(b) P
(c) E
(d) S

Q66. 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) DAB
(b) WTU
(c) EBC
(d) LJJ

Q67. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(57, 56.4, 58.4)

(49, 48.4, 50.4)

(a) (83, 82.4, 84.4)
(b) (58, 57.4, 60.4)
(c) (91, 89.4, 91.4)
(d) (75, 74.4, 77.4)

Q68. Which of the following letter-clusters will replace the question mark (?) in the given series to make it logically complete?

XLD, AOG, DRJ, GUM, ?

(a) JYQ
(b) JXQ
(c) JYP
(d) JXP

Q69. Town A is to the east of Town B. Town C is to the south of Town A. Town D is to the west of Town C. Town E is to the north of Town D. Town B is to the north-west of Town E. What is the position of Town A with respect to Town E?

(a) South-east
(b) South-west
(c) North-east
(d) North-west

Q70. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which is the letter-cluster pair that DOES NOT belong to that group?

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

(a) XB−ZD
(b) MQ−OS
(c) PT−QX
(d) HL−JN

Q71. Refer to the following series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.

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

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

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

Q72. Seven people, A, B, C, D, E, F and G, are sitting in a row, facing north. B is seated third from the right end. G is third to the left of D. E is seated to the right of B and at one of the ends. Only two people are seated between F and E. A does not sit at any of the extreme ends. Who is seated at the extreme left end?

(a) C
(b) G
(c) D
(d) F

Q73. What should come in place of the question mark (?) in the given series?

808 818 829 841 854 ?

(a) 868
(b) 866
(c) 864
(d) 862

Q74. In a certain code language, 'light reveals truth' is coded as 'rn ea kw' and 'truth guides paths' is coded as 'ib rn xu'. How is 'truth' coded in the given language?

(a) rn
(b) kw
(c) ib
(d) ea

Q75. BYRS is related to LIBC in a certain way based on the English alphabetical order. In the same way, PMFG is related to ZWPQ. To which of the given options is TQJK related, following the same logic?

(a) DUTA
(b) DATB
(c) DTRE
(d) DATU

Q76. KNKM is related to LOLN in a certain way based on the English alphabetical order. In the same way, ILIK is related to JMJL. To which of the given options is OROQ related, following the same logic?

(a) PROR
(b) PSOR
(c) PSPR
(d) PTOX

Q77. If 1 is added to each odd digit and 1 is subtracted from each even digit in the number 3215674, which of the following digits will be first from the right?

(a) 1
(b) 8
(c) 3
(d) 4

Q78. If 'A' stands for '÷', 'B' stands for '×', 'C' stands for '+' and 'D' stands for '−', then what will come in place of the question mark (?) in the following equation?

42 A 6 D 5 B 3 C 18 = ?

(a) 6
(b) 13
(c) 18
(d) 10

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Q79. If 2 is added to each even digit and 1 is subtracted from each odd digit in the number 31264759, then what will be the sum of the second digit from the left and the third digit from the right in the new number thus formed?

(a) 10
(b) 12
(c) 8
(d) 6

Q80. In a certain code language,

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

'A – B' means 'A is the husband of B',

'A × B' means 'A is the sister of B' and

'A ÷ B' means 'A is the mother of B'.

How is P related to T if 'P + Q – R ÷ S × T'?

(a) Father's father
(b) Mother's father
(c) Father's brother
(d) Mother's brother

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Who defended the 100 m hurdles title and set a Championships record of 12.96 s at the Asian Athletics Championships in May 2025?

(a) Vithya Ramraj
(b) Jyothi Yarraji
(c) Anu Raghavan
(d) Pooja Singh

Q82. In October 2025, which national park was in the news for launching India's first-ever cheetah safari for tourists?

(a) Kuno National Park, Madhya Pradesh
(b) Jim Corbett National Park, Uttarakhand
(c) Ranthambore National Park, Rajasthan
(d) Kaziranga National Park, Assam

Q83. When was the 130^(th) Constitutional Amendment Bill introduced in the Lok Sabha?

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

Q84. Which city hosted WWE's 'Night of Champions' on 28 June 2025?

(a) Dubai, UAE
(b) Cairo, Egypt
(c) Istanbul, Turkey
(d) Riyadh, Saudi Arabia

Q85. On 13 September 2025, the Ministry of Youth Affairs & Sports announced the second edition of which of the following events aimed at higher participation, new tracks, and broader outreach?

(a) Viksit Bharat Youth Leadership Summit – 2026
(b) Viksit Bharat Young Innovators Conference – 2026
(c) Viksit Bharat Youth Development Forum – 2026
(d) Viksit Bharat Young Leaders Dialogue – 2026

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Q86. The Insurance Regulatory and Development Authority of India's (IRDAI) June 2025 advisory on the Air India AI-171 crash was issued to which of the following stakeholders?

(a) All Insurers and Reinsurers
(b) Only Life Insurers
(c) Only General Insurers
(d) All Banks and NBFCs

Q87. As of June 2025, how many times has the Indian men’s junior hockey team won the Junior Asia Cup?

(a) 1
(b) 7
(c) 4
(d) 5

Q88. The ISSF World Cup is associated with which of the following sports?

(a) Shooting
(b) Swimming
(c) Squash
(d) Skiing

Q89. What was the Reserve Bank of India's repo rate in April 2025 after the 54^(th) meeting of the Monetary Policy Committee (MPC)?

(a) 6.5%
(b) 6.00%
(c) 7.00%
(d) 6.75%

Q90. At the Asian Para-Badminton Championship 2025 held in Thailand, how many total medals did Indian shuttlers win?

(a) 25
(b) 27
(c) 20
(d) 30

Q91. In November 2025, 79 spotted deer were moved to which national park as part of conservation efforts in India?

(a) Chandoli National Park
(b) Sultanpur National Park
(c) Kaziranga National Park
(d) Keoladeo National Park

Q92. Which edition of the WHO Global Summit on Traditional Medicine will be held in New Delhi in December 2025?

(a) 3rd Edition
(b) 4th Edition
(c) 2nd Edition
(d) 1st Edition

Q93. Which of the following bodies released the report titled ‘India’s Blue Economy: Strategy for Harnessing Deep-Sea and Offshore Fisheries’ in October 2025?

(a) National Fisheries Development Board
(b) Marine Products Export Development Authority
(c) Indian Ocean Research Institute
(d) NITI Aayog

Q94. Which level of school education had the best pupil-teacher ratio (PTR) according to the UDISE+, 2024–25, report?

(a) Foundational (Classes 1–5)
(b) Secondary (Classes 9–12)
(c) Middle (Classes 6–8)

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(d) Preparatory (Classes 6–8)

Q95. According to reports released in May 2025, DRR Dhan 100 (Kamala), a genome-edited rice variety developed by ICAR-IIRR, Hyderabad, is a derivative of which of the following rice varieties?

(a) IR64
(b) MTU 1010
(c) Swarna
(d) Samba Mahsuri

Q96. Which classical Bharatanatyam talent aged 14 received the Nritya Kala Bhushan Bal Puraskar in May 2025?

(a) Malavika Nair
(b) Chetna V
(c) Ravi Shankar
(d) Sudha Chandran

Q97. Which of the following schemes is NOT converged into the Pradhan Mantri Virasat Ka Samvardhan scheme?

(a) Seekho Aur Kamao
(b) Nai Roshni
(c) Hamari Dharohar
(d) Atal Pension Yojana

Q98. Which city ranked first in Category-1 (population of over 10 lakh) in the Swachh Vayu Sarvekshan Awards, 2025?

(a) Indore
(b) Jabalpur
(c) Agra
(d) Surat

Q99. At which institution was India's first AI teacher introduced?

(a) Loyola College, Chennai
(b) KTCT Higher Secondary School, Thiruvananthapuram
(c) Government College of Teacher Education, Thiruvananthapuram
(d) St. Thomas College, Thrissur

Q100. The U.S.–Turkey Nuclear Cooperation Agreement, signed in 2025, primarily focuses on developing which category of advanced nuclear reactors?

(a) Fast Breeder Reactors
(b) Small Modular Reactors
(c) Fusion Reactors
(d) Molten Salt Reactors

ANSWER KEY

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

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SOLUTIONS

Q1. Answer: (a) Binary fission

The correct answer is Binary fission.

Key Points

• Binary fission is a method of asexual reproduction where a single parent cell divides into two approximately equal daughter cells.

• It is the primary mode of reproduction in prokaryotic organisms, specifically bacteria and archaea.

• The process begins with the replication of the circular DNA (nucleoid) of the bacterium. The two DNA molecules then move to opposite ends of the cell.

• As the cell elongates, a septum (a new cell wall) forms in the middle of the cell, eventually leading to cytokinesis, which splits the cytoplasm.

• This results in two genetically identical offspring that are clones of the original parent.

• Because bacteria lack a nucleus and membrane-bound organelles, this process is significantly faster and simpler than mitosis seen in eukaryotes. For instance, Escherichia coli can undergo this division every 20 minutes under optimal temperature and nutrient conditions.

Additional Information

• Fragmentation:

• This is a form of asexual reproduction where the body of the parent organism breaks into several fragments, and each fragment develops into a new, complete individual.

• It is common in multicellular organisms like filamentous algae (e.g., Spirogyra), fungi, and some invertebrates like Planaria (flatworms).

• Budding:

• In this process, a small outgrowth or bud develops on the body of the parent organism due to repeated cell division at one specific site.

• The bud gradually grows, receives nutrients from the parent, and eventually detaches to lead an independent life.

• Classic examples include unicellular fungi like Yeast and multicellular organisms like Hydra.

• Spore Formation:

• Organisms produce specialized reproductive structures called spores, which are typically unicellular and encased in a protective thick wall to survive harsh environmental conditions.

• When conditions become favorable (adequate moisture and warmth), these spores germinate into new individuals.

• This method is common in Fungi (e.g., Rhizopus or bread mold), Ferns, and Mosses. Note that in bacteria, endospores are primarily a survival mechanism rather than a reproductive one.

Important Points

• Asexual Reproduction: This mode involves only one parent and occurs without the fusion of gametes, ensuring that the genetic makeup remains consistent across generations, except in cases of mutation.

• Generation Time: In the context of binary fission, the time required for a bacterial population to double is called the generation time or doubling time, which is a critical factor in microbiology and infection control.

• Horizontal Gene Transfer: While binary fission produces identical clones, bacteria achieve genetic diversity through other mechanisms like conjugation, transformation, and transduction, rather than through their primary reproductive method.

Q2. Answer: (b) A group of atoms carrying a net charge is called a polyatomic ion.

The correct answer is A group of atoms carrying a net charge is called a polyatomic ion.

Key Points

• An ion is a charged particle formed by the loss or gain of electrons by an atom or a group of atoms. These can be classified into two types: cations and anions.

• A cation is a positively charged species formed when an atom loses one or more electrons. For example, Sodium (Na+). Hence, statement 1 is incorrect.

• A polyatomic ion consists of a group of atoms joined together by covalent bonds, behaving as a single unit that carries a specific net electrical charge. Common examples include the Ammonium ion (NH4+), Hydroxide ion (OH-), and Carbonate ion (CO3 2-). Hence, statement 2 is correct.

• Ions are formed from both metal and non-metal atoms. Usually, metals form cations (positive ions) by losing electrons, while non-metals form anions (negative ions) by gaining electrons. Hence, statement 3 is incorrect.

• Sodium chloride (NaCl) is a classic example of an ionic compound. It does not consist of neutral atoms; instead, it is composed of Sodium cations (Na+) and Chloride anions (Cl-) held together by strong electrostatic forces of attraction. Hence, statement 4 is incorrect.

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• Hence, the correct answer is A group of atoms carrying a net charge is called a polyatomic ion.

Additional Information

• Formation of Ions:

• Atoms participate in ion formation to achieve a stable noble gas configuration (octet rule).

• The energy required to remove an electron from a neutral atom is known as Ionization Potential, whereas the energy released when an electron is added is Electron Affinity.

• Types of Polyatomic Ions:

• Oxyanions: These are polyatomic ions that contain oxygen, such as Sulfate (SO4 2-), Nitrate (NO3-), and Phosphate (PO4 3-).

• Monatomic Ions: Unlike polyatomic ions, these consist of only a single atom with a charge, such as Magnesium ion (Mg2+) or Fluoride ion (F-).

• Chemical Formulas of Ionic Compounds:

• When writing formulas for compounds containing polyatomic ions, the ion is often enclosed in brackets if a subscript is needed to indicate its numerical ratio (e.g., Mg(OH)2).

• The total positive charge must balance the total negative charge to ensure the compound is electrically neutral.

Important Points

• Valency: This refers to the combining capacity of an atom or a group of atoms. For ions, the valency is equal to the magnitude of the charge it carries. For instance, the valency of Aluminum (Al3+) is 3.

• Size Comparison:

• A cation is always smaller than its parent neutral atom because the loss of electrons reduces electron-electron repulsion and often results in the loss of an entire shell.

• An anion is always larger than its parent neutral atom due to increased repulsion between the extra electrons.

• Electrolytes: Substances that dissociate into ions when dissolved in water or melted are called electrolytes. These ions act as charge carriers, allowing the solution to conduct electricity.

Q3. Answer: (b) Ureters

The correct answer is Ureters.

Key Points

• The Ureters are narrow, hollow, muscular tubes that connect the kidneys to the urinary bladder. Each person typically has two ureters, one attached to each kidney.

• The primary function of the ureter is to transport urine, which is continuously formed by the kidneys, down to the urinary bladder for storage. Hence, the correct answer is Ureters.

• Urine does not simply flow down due to gravity; the walls of the ureters contract and relax in peristaltic waves. These rhythmic contractions occur about one to five times per minute to push urine toward the bladder.

• In an adult, the ureters are approximately 25 to 30 cm (10 to 12 inches) long and have a diameter of about 3 to 4 mm.

• The ureters enter the urinary bladder at an oblique angle through the bladder wall. This specific anatomical arrangement acts like a valve, preventing the backflow (reflux) of urine from the bladder back into the kidneys when the bladder is full or during micturition (urination).

Additional Information

• Vena Cava:

• The Vena Cava is the largest vein in the human body. There are two parts: the Superior Vena Cava (carrying blood from the upper body) and the Inferior Vena Cava (carrying blood from the lower body).

• Its primary function is to transport deoxygenated blood from various parts of the body back to the right atrium of the heart. It is part of the circulatory system, not the urinary system.

• Artery:

• Arteries are blood vessels that carry oxygenated blood away from the heart to the rest of the body (except for the pulmonary artery).

• In the context of the renal system, the Renal Artery supplies oxygen-rich and unfiltered blood from the Aorta to the kidneys.

• Vein:

• Veins are blood vessels that carry deoxygenated blood toward the heart.

• The Renal Vein carries filtered, deoxygenated blood away from the kidneys to the Inferior Vena Cava. Neither arteries nor veins carry urine; they carry blood.

• Urinary Bladder:

• The Urinary Bladder is a muscular, pear-shaped sac located in the pelvic cavity. It serves as a temporary reservoir for urine.

• The bladder wall contains the detrusor muscle, which contracts to expel urine during urination. An average adult bladder can hold between 400 to 600 ml of urine.

Important Points

• The Human Excretory System:

• The main components include a pair of kidneys, a pair of ureters, a urinary bladder, and a urethra.

• The Kidneys are the primary organs for homeostasis, filtering approximately 120 to 150 quarts of blood daily to produce about 1 to 2 quarts of urine.

• The Urethra is the tube that conveys urine from the urinary bladder to the outside of the body. In males, it also serves as a passage for semen, whereas in females, it is strictly part of the urinary system.

• Renal Pelvis: This is the funnel-like dilated proximal part of the ureter in the kidney where urine collects before entering the tube.

Q4. Answer: (d) A mixture retains the individual properties of its constituents.

The correct answer is A mixture retains the individual properties of its constituents.

Key Points

• A mixture is a substance made by combining two or more different materials in such a way that no chemical reaction occurs. Because no new chemical bonds are formed, each constituent substance in a mixture keeps its own physical and chemical properties. For example, in a mixture of iron filings and sulfur powder, the iron remains magnetic and the sulfur remains yellow. Hence, statement 4 is correct.

• A compound is a substance formed when two or more chemical elements are chemically bonded together. Once bonded, the constituent elements lose their original properties and the resulting compound has entirely new characteristics. For instance, Liquid Water (H2O) is formed from Hydrogen and Oxygen, which are both gases at room temperature. Hence, statement 2 is incorrect.

• Compounds cannot be separated into their constituents by physical methods such as filtration, distillation, or decantation. They require chemical methods or electrochemical reactions (like electrolysis) to break the chemical bonds. Hence, statement 1 is incorrect.

• A mixture does not have a fixed ratio; its composition is variable. You can mix salt and sand in any proportion. In contrast, compounds always contain elements in a fixed, definite proportion by mass, according to the Law of Definite Proportions. Hence, statement 3 is incorrect.

Additional Information

• Classification of Mixtures:

• Homogeneous Mixtures: These have a uniform composition throughout. Examples include Air, Alloys like Brass, and Salt solutions.

• Heterogeneous Mixtures: These have a non-uniform composition and visible boundaries of separation. Examples include Oil and Water, Soil, and Mixture of pulses and stones.

• Energy Changes:

• During the formation of a mixture, energy (in the form of heat, light, or sound) is usually neither absorbed nor evolved.

• In the formation of a compound, energy is almost always involved as chemical bonds are either broken or created.

• Melting and Boiling Points:

• Compounds have sharp and fixed melting and boiling points because of their definite structure.

• Mixtures do not have fixed melting or boiling points; they melt or boil over a range of temperatures depending on the concentration of their components.

Important Points

• Law of Constant Proportions: Proposed by Joseph Proust in 1799, it states that a chemical compound always contains exactly the same proportion of elements by mass. This is a fundamental differentiator from mixtures.

• Constituent Identity: In Chemistry, the "identity" of a substance refers to its molecular structure. In a mixture, the molecules of substance A and substance B simply coexist. In a compound, substance A and B react to form a new molecule C.

• Separation Techniques: Mixtures are separated using physical properties like solubility, density, boiling point, or magnetism. For example, fractional distillation is used to separate crude oil (a mixture) into its components.

Q5. Answer: (c) Black

The correct answer is Black.

Key Points

• Silver articles react with sulfur compounds, specifically hydrogen sulphide (H2S), present in the air to undergo a chemical process called tarnishing.

• This reaction results in the formation of a layer of silver sulphide (Ag2S) on the surface of the metal. Hence, the statement regarding the formation of a coating is correct.

• The physical appearance of this silver sulphide coating is distinctly Black, which causes the silver to lose its shiny, metallic luster. Hence, the option "Black" is correct.

• The chemical equation for this process is typically represented as: $4Ag + 2H_2S + O_2 \rightarrow 2Ag_2S + 2H_2O$. This indicates that oxygen also plays a role in the oxidation of silver in the presence of moisture.

• Unlike the rusting of iron, which can eat away the entire metal, the corrosion of silver is generally a surface phenomenon that provides a protective layer against further deep oxidation, although it is aesthetically undesirable.

Additional Information

• Corrosion of Iron (Rusting):

• When iron is exposed to moist air for a long time, it acquires a coating of a reddish-brown flaky substance called rust.

• Rust is chemically known as hydrated ferric oxide [$Fe_2O_3.xH_2O$]. This process requires both oxygen and water.

• Corrosion of Copper:

• Copper reacts with moist carbon dioxide in the air and slowly loses its shiny brown surface.

• It gains a green coating consisting of basic copper carbonate [$CuCO_3.Cu(OH)_2$]. This is often seen on old copper statues or coins.

• Prevention of Corrosion:

• Various methods are used to protect metals, such as Galvanization (coating iron with zinc), Anodizing, Painting, Greasing, and Alloying.

• Stainless steel is an alloy of iron, nickel, and chromium, which does not rust easily and is widely used in kitchenware.

• Reactivity Series:

• Metals like Gold and Platinum are found at the bottom of the reactivity series and do not corrode easily because they are chemically inert under normal atmospheric conditions.

• Silver is slightly more reactive than gold, which is why it reacts with sulfur but not readily with pure oxygen at room temperature.

Important Points

• Hydrogen Sulphide (H_2S): This gas is often found in the atmosphere due to industrial pollution, decaying organic matter, or volcanic activity. Higher concentrations of H_2S lead to faster tarnishing of silver.

• Redox Reaction: Corrosion is a redox reaction where the metal acts as a reducing agent (loses electrons) and is oxidized by the environment.

• Cleaning Silver: The black coating can be removed by reacting it with aluminum foil in a solution of baking soda and hot water; this is an electrochemical process where the sulfur is transferred from the silver to the aluminum.

Q6. Answer: (d) Submergence of forests

The correct answer is Submergence of forests.

Key Points

• Environmental Impact: The construction of big dams requires the creation of massive reservoirs. To accommodate these reservoirs, vast areas of natural forests and agricultural land are permanently flooded. Hence, the statement regarding the submergence of forests is correct.

• Loss of Biodiversity: When forests are submerged, the natural habitat of countless species of flora and fauna is destroyed. This leads to a significant decrease in biological diversity, as many endemic species may face local extinction. Hence, the statement regarding increased biodiversity is incorrect as dams lead to a decrease.

• Greenhouse Gas Emissions: The submerged vegetation undergoes anaerobic decomposition under the water. This process releases significant amounts of methane (CH_4) and carbon dioxide (CO_2), which are potent greenhouse gases contributing to global warming.

• Disruption of River Flow: Big dams alter the natural flow of rivers, which affects the aquatic ecosystem. It prevents the migration of fish and other aquatic organisms, disrupting their breeding cycles and life history.

• Sedimentation: Dams trap sediments that would naturally flow downstream. This leads to siltation in the reservoir, reducing its capacity over time, and deprives downstream floodplains of nutrient-rich alluvial soil.

Additional Information

• Social Impacts and Displacement: One of the biggest challenges of large dam projects like the Narmada Sarovar Project is the displacement of large populations, especially tribal communities and rural poor, who lose their livelihood and cultural heritage.

• Seismic Sensitivity: Large reservoirs exert immense pressure on the earth's crust. In seismically active zones, such as the Himalayan region (e.g., the Tehri Dam in Uttarakhand), this can potentially trigger Reservoir Induced Seismicity (RIS), leading to earthquakes.

• Waterlogging and Salinity: In the command areas of large dams, excessive irrigation often leads to waterlogging. This brings salts to the surface, making the soil saline and unfit for agriculture over the long term.

• Recreational and Economic Benefits: While dams provide hydroelectric power, flood control, and water conservation (which are advantages), they are often critiqued because the ecological costs far outweigh these benefits in many environmental impact assessments. Hence, water conservation and recreational spaces are considered advantages, not disadvantages.

Important Points

• Case Study: Narmada Bachao Andolan: This is a famous environmental movement in India led by activists like Medha Patkar. It protested against the Sardar Sarovar Dam on the Narmada River due to the massive submergence of forests and the lack of proper rehabilitation for displaced people.

• International Commission on Large Dams (ICOLD): This organization sets standards for dam construction globally, emphasizing the need for sustainable development and minimizing environmental degradation.

• Sustainable Alternatives: To mitigate these disadvantages, environmentalists often suggest small-scale check dams, rainwater harvesting, and watershed management as more eco-friendly ways to ensure water security without destroying forest ecosystems.

Q7. Answer: (a) A sharp, sour smell and taste

The correct answer is A sharp, sour smell and taste.

Key Points

• Ethanoic acid, which is widely known by its common name Acetic acid, is a colorless liquid organic compound with the chemical formula CH3COOH.

• It belongs to the group of carboxylic acids and is characterized by a very distinctive pungent and sharp odor, similar to the smell of concentrated vinegar.

• The taste of ethanoic acid is sour, which is a fundamental property of most acids; this sourness is what gives vinegar its characteristic flavor profile. Hence, statement 1 is correct.

• In everyday life, vinegar is actually a dilute solution of ethanoic acid in water, usually containing between 5% and 8% of the acid by volume.

• The name "acetic" is derived from the Latin word acetum, which translates directly to vinegar.

Additional Information

• Acidity and Litmus Test: Ethanoic acid is a weak acid, meaning it does not fully dissociate in water. However, it still exhibits acidic properties and will turn blue litmus paper red. It also reacts with reactive metals like magnesium or zinc to evolve Hydrogen gas. Hence, statement 2 is incorrect.

• pH and Texture: Substances that feel slippery and have a basic pH (greater than 7) are bases (alkalis). Ethanoic acid has an acidic pH (typically around 2.4 for a 1.0 M solution) and does not possess a soapy or slippery texture. Hence, statement 3 is incorrect.

• Odor Profile: While acetic acid has a sharp, vinegar-like smell, it is the esters (formed by the reaction of the acid with alcohols) that are famous for having a sweet, fruity smell. Pure ethanoic acid itself does not smell fruity. Hence, statement 4 is incorrect.

• Glacial Acetic Acid: The melting point of pure ethanoic acid is 290 K (or 17 degrees Celsius). Because this temperature is close to room temperature, the acid often freezes during winter in cold climates, forming ice-like crystals. For this reason, pure ethanoic acid is frequently called Glacial Acetic Acid.

Important Points

• Chemical Reactions:

• Esterification: When ethanoic acid reacts with absolute ethanol in the presence of an acid catalyst, it forms an ester (Ethyl ethanoate), which is used in making perfumes and flavoring agents.

• Saponification: Esters can react with Sodium hydroxide (NaOH) to be converted back into alcohol and the sodium salt of the carboxylic acid; this reaction is the basis for soap manufacturing.

• Reaction with Bases: Like other acids, it reacts with bases to form a salt and water. For example, reacting with NaOH produces Sodium ethanoate (Sodium acetate).

• Industrial Uses: Beyond its use as a food preservative, it is a vital industrial chemical used in the production of cellulose acetate for photographic film, polyvinyl acetate for wood glue, and various synthetic fibers and fabrics.

Q8. Answer: (d) A is true, but R is false.

The correct answer is A is true, but R is false.

Key Points

• Assertion (A) states that monoculture plantations often fail to meet the diverse needs of forest-dependent villagers. This is because these communities rely on a wide variety of forest products such as fodder, fruits, tubers, and honey for their daily survival, which a single-species plantation cannot provide. Hence, statement A is correct.

• Reason (R) claims that these plantations provide medicinal herbs, food, and fuel for villagers. In reality, monocultures (like Teak, Pine, or Eucalyptus) are usually established for commercial timber or industrial raw materials and do not support the undergrowth of herbs and shrubs that villagers use. Hence, statement R is false.

• Monoculture refers to the practice of growing a single species of tree over a large area, which significantly reduces the ecological diversity of the region.

• Forest-dependent communities, including various tribal groups in India, have traditionally managed natural forests that offer a mix of species, ensuring a sustenance-based economy rather than a purely profit-based one.

• The transition from diverse natural forests to managed plantations has historically led to the displacement of local traditional

knowledge and livelihood resources.

Additional Information

• Scientific Forestry: This system was introduced in India by the British under the guidance of Dietrich Brandis, the first Inspector General of Forests, in the 1860s. It promoted the cutting down of natural forests with diverse species to replace them with planned plantations of trees like Teak and Sal, which were useful for railways and shipbuilding.

• Biodiversity Loss: Monoculture plantations lack the canopy layers and species richness found in tropical or temperate natural forests. This leads to a decline in pollinators, birds, and soil microorganisms, ultimately weakening the ecosystem services.

• Fuel and Fodder Needs: Villagers require fuelwood from specific broad-leaved trees that burn well and fodder for their livestock. Commercial species like Eucalyptus are often unsuitable for fodder and can even deplete the groundwater table in semi-arid regions.

• Economic Impact: While monocultures generate revenue for the Forest Department or private industries through the sale of timber, they often lead to the impoverishment of local communities who lose access to Non-Timber Forest Products (NTFPs).

Important Points

• Environmental Risks: Monocultures are highly susceptible to pests and diseases. If a specific pathogen attacks the chosen species, the entire plantation can be wiped out, whereas mixed forests are more resilient.

• Joint Forest Management (JFM): To rectify the failures of exclusionary forestry, the Government of India introduced JFM in the 1980s (formally via the National Forest Policy, 1988). This initiative aims to involve local communities in forest conservation and ensure they have a share in forest produce.

• Forest Rights Act (2006): This Act was a landmark piece of legislation that recognized the customary rights of Scheduled Tribes and Other Traditional Forest Dwellers, acknowledging that their diverse needs are best met through community-led forest management rather than state-imposed monocultures.

Q9. Answer: (b) 16 m

The correct answer is 16 m.

Key Points

• The problem states that the car produces an acceleration of 8 m/s² opposite to its motion. In physics, when acceleration is opposite to the direction of velocity, it is termed retardation or deceleration. Therefore, we take the numerical value of acceleration (a) as -8 m/s².

• Since the car comes to a complete halt, its final velocity (v) is 0 m/s. The time (t) taken to stop is given as 2 seconds.

• To find the distance (s), we first need to determine the initial velocity (u) using the first equation of motion: $v = u + at$. Substituting the values, $0 = u + (-8 \times 2)$, which gives $u = 16$ m/s.

• Once the initial velocity is known, we apply the second equation of motion: $s = ut + \frac{1}{2}at^2$ to find the distance. Hence, the calculation becomes $s = (16 \times 2) + \frac{1}{2} \times (-8) \times (2)^2$.

• Solving this yields $s = 32 - 16 = 16$ meters. This represents the total displacement of the car from the moment the brakes were applied until it reached a standstill. Hence, the calculated distance is correct.

• Alternatively, the third equation of motion ($v^2 = u^2 + 2as$) can be used. Plugging in the values: $0^2 = 16^2 + 2 \times (-8) \times s$, which results in $0 = 256 - 16s$, or $s = 16$ m. Hence, the correct answer is 16 m.

Additional Information

• Kinematic Equations: These equations describe the motion of objects under constant acceleration. They relate five variables: displacement (s), initial velocity (u), final velocity (v), acceleration (a), and time (t).

• Uniform Acceleration: This refers to a scenario where the velocity of an object changes by the same numerical value in every equal interval of time. In this question, the car slows down uniformly, meaning the rate of change of velocity remains constant at 8 m/s².

• Retardation: Also known as negative acceleration, it occurs when the force applied (like braking force) is in the direction opposite to the displacement. It results in a decrease in the magnitude of velocity over time.

• SI Units: In physics, it is crucial to use standard International System of Units. Here, distance is measured in meters (m), time in seconds (s), velocity in meters per second (m/s), and acceleration in meters per second squared (m/s²).

Important Points

• Sign Convention: While solving mechanics problems, assigning the correct sign (+ or -) to vectors is vital. If motion is taken as positive, then braking acceleration must be negative.

• Area under V-T Graph: The distance covered can also be calculated by finding the area under a velocity-time graph. For a car slowing down from 16 m/s to 0 m/s in 2 seconds, the graph forms a triangle. Area = $\frac{1}{2} \times$ base $\times$ height = $\frac{1}{2} \times 2 \times 16 = 16$ m.

• Braking Distance: The distance covered after applying brakes is influenced by the initial speed and the braking efficiency (acceleration). In real-world automotive engineering, this is a key safety metric.

Q10. Answer: (b) Pollination and fertilisation

The correct answer is Pollination and fertilisation.

Key Points

• The stigma is the uppermost part of the carpel (the female reproductive organ of a flower) and serves as the receptive platform for pollen grains during the process of pollination.

• Pollination is the physical transfer of pollen from the anther (male part) to the stigma; if the stigma is damaged or removed, the pollen cannot land or be recognized, effectively halting the reproductive cycle. Hence, statement 2 is correct.

• Following a successful landing, the stigma provides the necessary nutrients and moisture for the pollen grain to germinate and grow a pollen tube down the style to reach the ovary for fertilisation.

• Seed dispersal is the mechanism by which seeds are spread away from the parent plant, which occurs only after the ovules have been successfully fertilised and developed into seeds. Hence, statement 1 is incorrect.

• Fruit ripening is a physiological process that follows fertilisation, where the ovary wall transforms into a pericarp; this stage is not directly dependent on the stigma's integrity once fertilisation has occurred. Hence, statement 3 is incorrect.

• The formation of petals and sepals happens during the bud development stage (pre-anthesis) and is controlled by floral meristem identity genes, occurring well before the stigma becomes functional for pollination. Hence, statement 4 is incorrect.

Additional Information

• Structure of the Gynoecium:

• The Gynoecium represents the female reproductive unit of a flower, consisting of one or more carpels. Each carpel is divided into three distinct regions: the stigma, style, and ovary.

• The stigma often has a sticky or feathery surface to efficiently trap pollen grains from various pollinating agents like wind, water, or insects.

• The Process of Fertilisation:

• Once pollen germinates on the stigma, the pollen tube carries two male gametes. In angiosperms, this leads to double fertilisation, a unique feature where one gamete fuses with the egg to form a zygote (2n) and the other fuses with polar nuclei to form the endosperm (3n).

• The ovary eventually matures into the fruit, while the ovules mature into seeds.

• Types of Pollination:

• Self-pollination: Transfer of pollen from the anther to the stigma of the same flower or another flower on the same plant.

• Cross-pollination (Xenogamy): Transfer of pollen from the anther of one flower to the stigma of a flower on a different plant of the same species, increasing genetic diversity.

Important Points

• Stigmatic Compatibility: The stigma performs a "chemically-mediated" recognition check to ensure only compatible pollen of the same species (and sometimes avoiding self-pollen to prevent inbreeding) is allowed to grow.

• Environmental Factors: Factors such as extreme temperature, heavy rain, or pesticide exposure can damage the stigma, leading to crop failure due to poor fruit set and lack of fertilisation.

• Morphological Adaptations: In wind-pollinated plants (like maize), the stigma is often long and tassel-like to maximize the surface area for catching airborne pollen.

Q11. Answer: (d) m, g and h

The correct answer is m, g and h.

Key Points

• Gravitational Potential Energy is the energy possessed by an object by virtue of its position in a gravitational field. It represents the potential to do work when the object is released.

• The formula for calculating potential energy (U) is given by the product of mass (m), acceleration due to gravity (g), and height (h): U = mgh.

• Mass (m): The energy is directly proportional to the mass of the body. An object with a larger mass will possess higher potential energy compared to a lighter object at the same height.

• Acceleration due to gravity (g): The energy depends on the strength of the gravitational field. On Earth, the average value of g is approximately 9.8 m/s². If the same object were taken to the Moon, where g is roughly 1.62 m/s², its potential energy would decrease even if the height remained the same.

• Height (h): This refers to the vertical displacement from a chosen reference level (datum). The higher the body is raised, the more potential energy it accumulates.

• Since the energy formula contains all three variables as multipliers, the potential energy depends on m, g, and h simultaneously. Hence, the correct answer is m, g and h.

Additional Information

• Work-Energy Principle: When a body is lifted, work is done against the force of gravity. This work done (W = Force ×

Displacement) is stored in the body as Gravitational Potential Energy. Since Force = mg and Displacement = h, the work done is mgh.

• SI Unit and Dimensions: The Standard International (SI) unit of potential energy is the Joule (J), which is equivalent to kg·m²/s². The dimensional formula is [ML²T^-²], which is the same as that for work and kinetic energy.

• Reference Point: Potential energy is a relative quantity. It is usually measured relative to the ground, where h = 0 and U = 0. However, any arbitrary level can be chosen as the zero-potential level.

• Conservative Nature: The gravitational force is a conservative force. This means the potential energy depends only on the initial and final positions (the vertical height h) and is independent of the path taken to reach that height.

Important Points

• Variations in g: While g is often treated as a constant (9.8 m/s²), it actually varies slightly depending on the latitude (it is higher at the poles than at the equator) and altitude (it decreases as you go higher above sea level).

• Energy Transformation: According to the Law of Conservation of Energy, when an object falls, its potential energy is converted into kinetic energy (the energy of motion). At any point during a free fall (neglecting air resistance), the total mechanical energy (sum of PE and KE) remains constant.

• Sign Convention: If an object is moved upward, the potential energy increases (positive work done against gravity). If an object moves below the reference level, its potential energy is considered negative.

Q12. Answer: (b) 360 kg and 360 kg wt

The correct answer is 360 kg and 360 kg wt.

Key Points

• Weight changes with gravity, but mass remains the same everywhere.

• On the Moon: Weight = 60 kg-wt

• Since the Moon's gravity is 1/6 of Earth's gravity,

• Weight on Earth = 6× Weight on Moon

• = 6 × 60 = 360 Kg-Wt

• Now, A kilogram-weight (kg-wt) represents the gravitational pull of the Earth on a mass of 1 kg.

• For this question, 1 kg-wt is equal to 10N. (g on Earth 10 m/s²)

• 360 Kg-Wt = 360 × 10 = 3600N. (Convert to SI un it)

• Mass = weight on Earth / acceleration due to gravity on Earth

• Mass = 3600/10 = 360 kg

• Hence, the correct answer is,

• Mass on Earth = 360 kg

• Weight on Earth = 360 kg-wt

Additional Information

• Mass:

• It is the intrinsic property of a body that determines its inertia.

• The S.I. unit of mass is the kilogram (kg).

• It is a scalar quantity, meaning it has only magnitude and no direction. It remains the same on Earth, the Moon, or even in outer space.

• Weight:

• It is the gravitational force acting on an object. The formula is W = m x g, where m is mass and g is the acceleration due to gravity.

• The S.I. unit of weight is the Newton (N), but it is often expressed in kg wt for practical purposes.

• It is a vector quantity because it always acts vertically downwards towards the center of the planet.

Q13. Answer: (b) to ensure uniform sound distribution

The correct answer is to ensure uniform sound distribution.

Key Points

• The primary objective of using curved ceilings and walls in large auditoriums, concert halls, and cinema theaters is to utilize the reflection of sound effectively.

• When sound waves strike a curved surface (specifically a concave surface), they are reflected in a way that allows the waves to spread out and reach all corners of the hall.

• This design ensures that the sound is distributed uniformly throughout the entire audience area, preventing the formation of "dead spots" where the sound might be faint or inaudible. Hence, statement 2 is correct.

• The curved ceiling acts like a large reflector, redirecting sound waves that travel upwards back down toward the listeners sitting

at the back of the hall.

• Contrary to some misconceptions, the shape of the walls does not reduce the speed of sound, as the speed of sound is a property of the medium (like air) and depends on factors like temperature and humidity, not the shape of the container. Hence, statement 1 is incorrect.

• The purpose is to make the sound audible to the entire audience, not just to make it louder near the stage. Hence, statement 3 is incorrect.

• While architectural beauty is a factor in construction, the specific curved geometry in a hall's design is dictated by acoustical engineering requirements rather than purely aesthetic reasons. Hence, statement 4 is incorrect.

Additional Information

• Soundboard: In many large halls, a curved soundboard is placed behind the speaker or the stage. The source of sound is placed at the focus of this board so that the reflected sound waves emerge as parallel beams, ensuring they travel long distances across the hall.

• Reflection of Sound: Just like light, sound follows the laws of reflection, where the angle of incidence is equal to the angle of reflection. This principle is fundamental in acoustics for designing functional spaces.

• Reverberation: While reflection is necessary for audibility, excessive reflection can lead to reverberation, which is the persistence of sound after the source has stopped. To control this, halls often use sound-absorbent materials like compressed fiberboard, heavy curtains, or plaster on the non-curved surfaces.

• Echo: An echo is a distinct repetition of sound caused by reflection. For an echo to be heard clearly by the human ear, the minimum distance between the source and the reflecting surface must be approximately 17.2 meters (at 22 degrees Celsius).

• Multiple Reflection: Curved surfaces utilize the concept of multiple reflection. This same principle is used in instruments like megaphones, horns, and stethoscopes to direct sound in a specific direction without it spreading in all directions prematurely.

Important Points

• Acoustics of Buildings: This is a branch of physics that deals with the design and construction of buildings to provide the best possible audible sound to the audience.

• Concave vs. Convex: While concave surfaces (like curved ceilings) converge or direct sound toward the audience, convex surfaces would diverge sound waves, potentially making the sound thinner and harder to hear in large spaces.

• Intensity of Sound: The use of curved reflectors helps in maintaining the intensity of the sound over a larger area, reducing the attenuation (loss of energy) that occurs as sound waves travel.

Q14. Answer: (a) Real, inverted, and diminished

The correct answer is Real, inverted, and diminished.

Key Points

• When an object is placed beyond the Centre of Curvature (C) of a concave mirror, the rays of light originating from the object follow specific paths according to the laws of reflection.

• A ray of light starting from the top of the object and traveling parallel to the principal axis will, after reflection, pass through the Principal Focus (F).

• Another ray passing through the Centre of Curvature (C) strikes the mirror normally and reflects back along the same path.

• The point where these two reflected rays intersect is the location of the image. In this specific case, the intersection occurs between the Centre of Curvature (C) and the Focus (F).

• The image formed is Real because the reflected rays actually meet at a point. It is Inverted (upside down) relative to the object and Diminished (smaller in size) compared to the original object. Hence, the correct answer is Real, inverted, and diminished.

Additional Information

• Concave Mirror: It is a spherical mirror with a reflecting surface that curves inwards (like a spoon). It is also known as a converging mirror because it converges parallel rays of light after reflection.

• Important Terms:

• Pole (P): The center of the reflecting surface of the mirror.

• Centre of Curvature (C): The center of the hollow sphere of which the mirror is a part.

• Principal Focus (F): The point on the principal axis where all parallel rays converge after reflection.

• Focal Length (f): The distance between the Pole and the Focus. It is exactly half of the Radius of Curvature (R), given by f = R/2.

• Mirror Formula: The relationship between object distance (u), image distance (v), and focal length (f) is expressed as 1/v + 1/u = 1/f.

• Magnification (m): It is the ratio of the height of the image to the height of the object. It is also given by m = -v/u. For a diminished image, the absolute value of magnification is less than 1.

• Uses: Concave mirrors are widely used in shaving mirrors, dentists' mirrors, solar furnaces, and car headlights to produce powerful parallel beams of light.

Important Points

• Other Cases of Image Formation by Concave Mirror:

• If the object is at Infinity, the image is formed at Focus (F) and is highly diminished, real, and inverted.

• If the object is at C, the image is formed at C and is of the same size, real, and inverted. Statement 3 is incorrect for the given question.

• If the object is between C and F, the image is formed beyond C and is magnified, real, and inverted. Statement 4 is incorrect for the given question.

• If the object is at F, the image is formed at Infinity and is highly magnified.

• If the object is between F and Pole (P), the image is formed behind the mirror and is Virtual, erect, and magnified. Statement 2 is incorrect for the given question.

• A Real image can be obtained on a screen, whereas a Virtual image cannot.

• The nature of the image changes from real to virtual only when the object moves within the focal length of the concave mirror.

Q15. Answer: (b) Nucleus

The correct answer is Nucleus.

Key Points

• Binary fission in Amoeba is a method of asexual reproduction where a single parent cell divides into two equal daughter cells.

• The very first step in this process is the division of the nucleus, a biological stage known as karyokinesis.

• During karyokinesis, the nucleus of the Amoeba begins to elongate and develop a constriction in the middle, eventually splitting the genetic material into two separate parts.

• Once the nucleus has successfully divided into two daughter nuclei, the second stage, called cytokinesis, begins. This is the division of the cytoplasm.

• In cytokinesis, the cell body constricts and pinches off, resulting in the formation of two distinct, independent Amoeba individuals. Hence, the nucleus is the first organelle to divide during this process.

Additional Information

• Amoeba:

• It is a unicellular eukaryote belonging to the kingdom Protista.

• Amoeba proteus is one of the most common species studied in biology. It was first discovered in 1755 by August Johann Rösel von Rosenhof.

• It lacks a cell wall and instead possesses a flexible plasma membrane, which allows it to change shape and move using pseudopodia (false feet).

• Cytoplasm:

• The cytoplasm is the jelly-like substance where most metabolic activities occur. During binary fission, it only begins its division after the nucleus has finished its separation to ensure each daughter cell receives a copy of the DNA.

• Vacuole:

• Amoebae contain contractile vacuoles for osmoregulation and food vacuoles for digestion. While these may be replicated or distributed during fission, they are not the primary drivers or the first to initiate the division process.

• Cell Wall:

• This option is incorrect because Amoeba is an animal-like protist and does not possess a cell wall. Cell walls are typically found in plants, fungi, and bacteria.

Important Points

• Asexual Reproduction: Since only one parent is involved and the offspring are genetically identical to the parent, the daughter cells are often referred to as clones.

• Environmental Conditions: Binary fission typically occurs during favorable conditions (adequate food and temperature). During unfavorable conditions, Amoeba may undergo multiple fission or encystment.

• Irregular Binary Fission: In Amoeba, binary fission is described as "irregular" because the plane of cytoplasmic division can occur in any direction, unlike in Leishmania (longitudinal) or Paramecium (transverse).

• Mitosis: The nuclear division in Amoeba involves a process similar to mitosis, where the chromosomes are replicated and distributed equally, ensuring the continuity of biological information across generations.

Q16. Answer: (c) They release energy due to stable product formation.

The correct answer is They release energy due to stable product formation.

Key Points

• A combination reaction (also known as a synthesis reaction) is a reaction where two or more elements or compounds combine to form a single compound. The general form is A + B → AB.

• In any chemical reaction, energy is required to break existing bonds in the reactants (an endothermic process), and energy is

released when new bonds are formed in the products (an exothermic process).

• Combination reactions are generally exothermic because the energy released during the formation of new bonds in the product is greater than the energy absorbed to break the bonds of the reactants. Hence, statement 3 is correct.

• The formation of a stable product means the system moves to a lower energy state. This excess internal energy is liberated into the surroundings, usually in the form of heat or light.

• Statement 1 is incorrect because bond formation always releases energy, while bond breaking absorbs it. Statement 4 is incorrect as combination reactions primarily focus on bond formation to create a complex molecule from simpler ones.

Additional Information

• Common Examples of Combination Reactions:

• Burning of Coal: When carbon (C) burns in the presence of oxygen (O_2), it forms carbon dioxide (CO_2) and releases a significant amount of heat. ($C + O_2 \rightarrow CO_2 + Heat$).

• Formation of Water: The reaction between hydrogen gas (H_2) and oxygen gas (O_2) to form liquid water (H_2O) is highly exothermic.

• Slaking of Lime: The reaction of Quick Lime (Calcium Oxide - CaO) with water (H_2O) to form Slaked Lime (Calcium Hydroxide - $Ca(OH)_2$) produces a large amount of heat, making the container hot.

• Thermodynamic Perspective:

• In an exothermic reaction, the change in enthalpy (ΔH) is negative. This indicates that the enthalpy of the products is lower than the enthalpy of the reactants.

• Most spontaneous combination reactions occur because the universe tends toward states of lower energy and higher stability.

• Contrast with Decomposition Reactions:

• Unlike combination reactions, decomposition reactions involve the breaking down of a single compound into two or more simpler substances. These typically require an input of energy (heat, light, or electricity) and are therefore endothermic.

Important Points

• Bond Energy: The strength of the bonds in the product determines how much energy is released. Stronger bonds in the product compared to the reactants lead to a more exothermic reaction.

• Stability: In chemistry, lower energy is synonymous with higher stability. Therefore, the drive to form more stable chemical species is the primary reason why these reactions release energy.

• Activation Energy: Even though combination reactions release energy, they may still require a small amount of initial energy (activation energy), such as a spark or flame, to start the process.

Q17. Answer: (b) catenation

The correct answer is catenation.

Key Points

• Catenation is the unique property of carbon atoms to link with one another through covalent bonds to form long chains, branched chains, and closed ring structures.

• This property is primarily due to the small size of the carbon atom and the high strength of the carbon-carbon (C-C) bond.

• The bond energy of the C-C bond is approximately 348 kJ/mol, which is significantly higher than that of other elements like silicon or sulfur, allowing for stable, long-chain molecules.

• Because of catenation, carbon forms the structural backbone of millions of organic compounds, including hydrocarbons, proteins, and DNA. Hence, option 2 is correct.

• The tetravalency of carbon (valency of 4) further supports catenation by allowing each carbon atom to bond with up to four other atoms, facilitating complex molecular architectures.

Additional Information

• Addition Reaction:

• In organic chemistry, an addition reaction occurs when two or more molecules combine to form a larger one. This typically happens in unsaturated compounds like alkenes and alkynes.

• For example, the hydrogenation of ethene to ethane is an addition reaction. It does not refer to the property of atoms linking to themselves. Hence, statement 1 is incorrect.

• Conjugation:

• Conjugation refers to the overlap of p-orbitals across an adjacent sigma bond, typically in a system of alternating single and multiple bonds.

• This leads to the delocalization of electrons, which increases the stability of the molecule (e.g., in benzene). While it involves carbon bonding, it is a specific electronic arrangement rather than the basic property of forming large molecules. Hence, statement 4 is incorrect.

• Unification:

• Unification is not a standard chemical term used to describe the bonding properties or the molecular structural ability of carbon atoms. Hence, statement 3 is incorrect.

• Other Elements showing Catenation:

• While carbon is the leader in catenation, Silicon also shows this property but can only form chains of up to 7 or 8 atoms because the Si-Si bonds are weaker and more reactive toward oxygen and water.

• Sulfur shows catenation in the form of S8 rings and long chains in plastic sulfur, but it lacks the structural variety found in carbon compounds.

Important Points

• Allotropes of Carbon: The property of catenation is vividly seen in carbon's allotropes such as Diamond (3D network), Graphite (hexagonal layers), and Fullerenes (spherical cages like C60).

• Isomerism: Catenation allows for different arrangements of the same number of atoms, leading to structural isomerism. For instance, butane and isobutane have the same formula (C4H10) but different linkages.

• Economic and Biological Importance: The ability of carbon to form stable chains is the reason for the existence of fossil fuels (long-chain alkanes) and the complex biopolymers that make up living organisms.

• Atomic Number: Carbon has an atomic number of 6 and its electronic configuration is 2, 4, which provides the perfect balance for forming stable covalent bonds.

Q18. Answer: (c) Urea

The correct answer is Urea.

Key Points

• The Nephron is the basic functional and structural unit of the Kidney, responsible for filtering the blood and forming urine.

• Urine formation involves three main processes: Glomerular Filtration, Selective Reabsorption, and Tubular Secretion.

• Selective Reabsorption is the process where the renal tubule reclaims useful substances from the Glomerular Filtrate back into the bloodstream. This occurs primarily in the Proximal Convoluted Tubule (PCT).

• Substances like Glucose, Amino acids, and certain Salts are highly useful to the body and are almost entirely reabsorbed via active or passive transport. Hence, options 1, 2, and 4 are selectively re-absorbed.

• Urea is a nitrogenous waste product formed in the Liver. The primary function of the kidney is to excrete urea from the body. While a small amount may passively diffuse back to maintain medullary osmotic pressure, it is NOT selectively re-absorbed for conservation like nutrients. Hence, statement 3 is the correct answer.

Additional Information

• Glucose Reabsorption:

• Under normal physiological conditions, 100% of the filtered Glucose is reabsorbed in the PCT.

• If blood glucose levels exceed the Renal Threshold (approximately 180 mg/dL), the transport carriers become saturated, and glucose is excreted in the urine, a condition known as Glycosuria, often associated with Diabetes Mellitus.

• Amino Acids:

• Like glucose, Amino acids are vital nutrients. They are completely reabsorbed in the Proximal Convoluted Tubule through Secondary Active Transport mechanisms.

• Salts and Electrolytes:

• The body reabsorbs Sodium (Na+), Potassium (K+), and Chloride (Cl-) to maintain Electrolyte Balance and blood pressure.

• About 65-70% of filtered Sodium is reabsorbed in the PCT, while the Distal Convoluted Tubule (DCT) performs conditional reabsorption under the influence of the hormone Aldosterone.

• Urea and Waste Excretion:

• Urea is produced through the Ornithine Cycle in the liver to detoxify ammonia.

• The concentration of Urea increases as the filtrate moves down the tubule because water is reabsorbed, ensuring that the majority of this waste is eliminated in Urine.

Important Points

• Glomerular Filtration Rate (GFR): This is the volume of filtrate formed by both kidneys per minute, typically about 125 mL/min in a healthy adult.

• Tubular Secretion: This is the opposite of reabsorption, where substances like Hydrogen ions (H+), Potassium (K+), and Ammonia (NH3) are moved from the blood into the tubule to maintain Ionic Balance and pH of body fluids.

• Antidiuretic Hormone (ADH): Also known as Vasopressin, it acts on the Collecting Ducts to increase water reabsorption, thereby concentrating the urine and preventing dehydration.

• Henle's Loop: Plays a critical role in the Counter-Current Mechanism, which helps in concentrating the urine by creating an osmotic gradient in the kidney medulla.

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Q19. Answer: (c) Remain same

The correct answer is Remain same.

Key Points

• The Resistance (R) of a conductor is a property that opposes the flow of electric current. It is mathematically defined by the formula R = ρ(L/A), where ρ represents the resistivity of the material, L is the length, and A is the cross-sectional area.

• In the given scenario, the length of the conductor is halved, which means the new length is L/2 or 0.5L.

• Similarly, the cross-sectional area is also halved, making the new area A/2 or 0.5A.

• When these new values are substituted into the resistance formula, the expression becomes R' = ρ × (L/2) / (A/2). The numerical value of 1/2 in the numerator and 1/2 in the denominator cancel each other out completely.

• Since the material remains the same, the resistivity (ρ) remains constant. As a result, the new resistance R' is exactly equal to the original resistance R. Hence, the statement that the resistance remains the same is correct.

Additional Information

• Resistivity (ρ):

• It is an intrinsic property of a material that quantifies how strongly it resists electric current. Its SI unit is the Ohm-meter (Ω·m).

• Unlike resistance, resistivity does not depend on the dimensions (length or area) of the object; it only depends on the nature of the material and the temperature.

• Ohm's Law:

• Discovered by George Simon Ohm in 1827, this law states that the current (I) through a conductor between two points is directly proportional to the voltage (V) across the two points, provided physical conditions like temperature remain constant. The constant of proportionality is Resistance (R).

• Factors Affecting Resistance:

• Length: Resistance is directly proportional to the length of the conductor. Doubling the length doubles the resistance.

• Area: Resistance is inversely proportional to the cross-sectional area. Increasing the thickness of a wire reduces its resistance.

• Nature of Material: Different materials have different concentrations of free electrons. For example, Silver has lower resistance than Iron.

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

Important Points

• Distinction between Independent Change and Stretching:

• It is important to distinguish between changing dimensions independently and stretching a wire. If a wire is stretched to double its length, its volume remains constant, causing the area to decrease. In such cases, the resistance would change by a factor of 4 (square of the change in length).

• However, in this specific question, both length and area are explicitly and independently halved, resulting in no net change to the resistance.

• Conductance and Conductivity:

• The reciprocal of resistance is known as conductance (G), measured in Siemens (S).

• The reciprocal of resistivity is known as electrical conductivity (σ), which indicates how easily a material allows current to flow. Its SI unit is Siemens per meter (S/m).

Q20. Answer: (d) It causes a change in speed or direction of motion.

The correct answer is It causes a change in speed or direction of motion.

Key Points

• An unbalanced force is defined as a force where the net force acting on an object is not zero. When such a force is applied to a moving object, it disrupts the state of equilibrium.

• According to Newton's Second Law of Motion, the acceleration of an object is directly proportional to the net force acting upon it and inversely proportional to its mass. This means an unbalanced force always results in acceleration.

• Because acceleration is a change in velocity, and velocity is a vector quantity consisting of both speed and direction, an unbalanced force can cause the object to speed up, slow down (decelerate), or change its direction of travel. Hence, statement 4 is correct.

• If the forces acting on an object were balanced, the object would continue to move at a constant velocity or remain at rest. An unbalanced force is required to change that state of motion. Hence, statement 1 is incorrect.

• While an unbalanced force can stop an object, it does not necessarily stop it immediately; the time taken to stop depends on the magnitude of the force and the mass of the object. Hence, statement 2 is incorrect.

• The weight of an object is the force of gravity acting on its mass (W = mg). Applying an external horizontal or vertical unbalanced force does not change the inherent mass or the gravitational constant of the object. Hence, statement 3 is incorrect.

Additional Information

• Newton's First Law of Motion: Often called the Law of Inertia, it states that an object will remain at rest or in uniform motion in a straight line unless acted upon by an external unbalanced force. This law was first formulated by Sir Isaac Newton and published in 1687.

• Types of Forces: Forces can be categorized as contact forces (like friction, tension, and normal force) or non-contact forces (like gravitational, electrostatic, and magnetic forces). Any of these can contribute to an unbalanced net force.

• Vector Nature: Since force is a vector, the direction of the unbalanced force determines the direction of the resulting acceleration. If the force is applied perpendicular to the direction of motion, only the direction changes (as seen in uniform circular motion).

• SI Unit: The standard unit of force is the Newton (N), defined as the force needed to provide a mass of 1 kilogram with an acceleration of 1 meter per second squared.

Important Points

• Inertia: This is the inherent property of matter by which it resists any change in its state of rest or motion. Mass is a quantitative measure of an object's inertia.

• Friction as an Unbalanced Force: In real-world scenarios, a rolling ball eventually stops because of friction and air resistance, which act as unbalanced forces opposing the direction of motion.

• Mathematical Expression: The relationship is expressed by the formula F = ma, where F is the net unbalanced force, m is the mass, and a is the acceleration. This fundamental equation is the cornerstone of Classical Mechanics.

• Centripetal Force: This is a specific type of unbalanced force that acts toward the center of a circular path, causing a moving object to change direction continuously without necessarily changing its speed.

Q21. Answer: (b) Both (i) and (ii)

The correct answer is Both (i) and (ii).

Key Points

• Statement (i): The amount of light scattering is highly dependent on the size of the particles in the medium. If the particles are very small compared to the wavelength of light (like nitrogen and oxygen molecules in the air), Rayleigh scattering occurs. If the particles are large (like water droplets in clouds), they scatter all wavelengths almost equally. Hence, statement (i) is incorrect.

• Statement (ii): According to Rayleigh's Law of Scattering, the intensity of scattered light is inversely proportional to the fourth power of its wavelength (Scattering prop. to $1/\lambda^4$). This means shorter wavelengths scatter much more than longer wavelengths. It is not directly proportional. Hence, statement (ii) is incorrect.

• Statement (iii): Blue light has a shorter wavelength compared to red light. As light from the Sun enters the Earth's atmosphere, the molecules in the air scatter the blue light more strongly in all directions. This is why the sky appears blue to an observer on the ground. Hence, statement (iii) is correct.

• Statement (iv): Red light has the longest wavelength in the visible spectrum. Due to its long wavelength, it is scattered the least by air molecules, fog, or smoke. This allows the red color to travel longer distances without being dispersed, making it ideal for danger signals. Hence, statement (iv) is correct.

• Since statements (i) and (ii) are the ones that are not true, the correct option is Both (i) and (ii).

Additional Information

• Rayleigh Scattering: Formulated by Lord Rayleigh in 1871, this phenomenon explains why the sky is blue. It occurs when the scattering particles have a diameter significantly smaller (less than 1/10th) than the wavelength of the incident light.

• The Visible Spectrum: Human eyes can detect wavelengths approximately between 400 nm (violet) and 700 nm (red). Within this range, violet and blue have the highest frequencies and shortest wavelengths, while red has the lowest frequency and longest wavelength.

• Tyndall Effect: This is the scattering of a beam of light by colloidal particles or particles in a very fine suspension. It is often observed when sunlight passes through a canopy of a dense forest where mist or dust particles scatter the light.

• Color of the Sun at Sunrise and Sunset: During these times, sunlight must travel a longer distance through the atmosphere to reach our eyes. Most of the shorter wavelengths (blue and violet) are scattered away, leaving only the longer wavelengths (red and orange) to reach the observer.

• Mie Scattering: Unlike Rayleigh scattering, Mie scattering occurs when the particles are of a similar size to the wavelength of light. This is why clouds appear white, as large water droplets scatter all colors of light equally.

Important Points

• Wavelength Relationship: The relationship between wavelength and scattering explains many natural phenomena. Because red scatters the least, it is used in tail lights and stop signs for maximum visibility in adverse weather conditions like rain or fog.

• Atmospheric Composition: If the Earth had no atmosphere, there would be no scattering of light, and the sky would appear black even during the daytime, similar to what astronauts see in outer space.

• Numerical Fact: Because scattering is proportional to $1/\lambda^4$, blue light (wavelength approx 450 nm) is scattered about 10 times more efficiently than red light (wavelength approx 650 nm).

Q22. Answer: (d) 1 kWh = 3.6 × 10^6 joules

The correct answer is 3.6 x 10^6 joules.

Key Points

• Kilowatt-hour (kWh) is the commercial unit of electrical energy. It represents the amount of energy consumed by an electrical appliance of 1 kilowatt power in one hour.

• To convert 1 kWh into Joules, we must break down the units into their SI base units. 1 kilowatt is equal to 1000 Watts, and 1 hour is equal to 3600 seconds (60 minutes × 60 seconds).

• By definition, 1 Watt is equal to 1 Joule per second (1 J/s). Therefore, the total energy in joules is calculated by multiplying power in watts by time in seconds: 1000 W × 3600 s.

• Performing the calculation: 1000 × 3600 = 3,600,000 Joules. In scientific notation, this value is expressed as 3.6 × 10^6 Joules.

• The statement in option 1 claims 1 kWh = 3.6 × 10^3 joules, which is incorrect as it represents only 3600 joules. Hence, statement 1 is incorrect.

• The statement in option 2 claims 1 kWh = 360 joules, which is a significant undervaluation of the energy unit. Hence, statement 2 is incorrect.

• The statement in option 3 claims 1 kWh = 36 × 10^-6 joules, which suggests a microscopic amount of energy. Hence, statement 3 is incorrect.

• The statement in option 4 claims 1 kWh = 3.6 × 10^6 joules, which matches the derived mathematical conversion. Hence, statement 4 is correct.

Additional Information

• Difference between Power and Energy: Power is the rate at which work is done or energy is transformed, measured in Watts (W). Energy is the total capacity to do work, measured in Joules (J) or kilowatt-hours (kWh).

• Commercial Usage: In many countries, including India, the electricity bill is calculated based on "units" of electricity. 1 Unit is exactly equal to 1 kilowatt-hour (kWh).

• SI Unit of Energy: The Joule is the Standard International (SI) unit for energy, named after the English physicist James Prescott Joule. It is a derived unit equivalent to 1 Newton-meter.

• Other Units: Energy can also be measured in Calories (often used in nutrition) or electron-volts (eV) (used in atomic physics). 1 calorie is approximately equal to 4.184 Joules.

Important Points

• Dimensional Formula: The dimensional formula for energy (and work) is [M^1 L^2 T^-2]. This is derived from Force × Displacement.

• Mega Joules: Because 3.6 × 10^6 is a large number, 1 kWh is often referred to as 3.6 Mega Joules (MJ).

• Historical Context: The term Board of Trade Unit (B.O.T.U.) was previously used in the United Kingdom to describe 1 kilowatt-hour before the metric terminology became standardized.

• Practical Example: If a 100-Watt light bulb is left on for 10 hours, it consumes 1 kWh of energy (100W × 10h = 1000Wh = 1kWh).

Q23. Answer: (c) Methane, Ethane, Propane

The correct answer is Methane, Ethane, Propane.

Key Points

• A homologous series is a sequence of organic compounds that have the same functional group and similar chemical properties in which the successive members differ by a CH2 unit.

• Methane (CH4), Ethane (C2H6), and Propane (C3H8) all belong to the Alkane series, which follows the general formula CnH2n+2. Hence, statement 3 is correct.

• In Methane, Methanol, and Methanoic acid, the compounds have different functional groups (alkane, alcohol, and carboxylic acid respectively), meaning they do not belong to the same series. Hence, statement 1 is incorrect.

• In Ethene, Ethyne, and Ethane, the compounds have different degrees of saturation (alkene, alkyne, and alkane), resulting in different general formulas. Hence, statement 2 is incorrect.

• In Methane, Ethane, and Ethene, the first two are alkanes while the third is an alkene, so they do not form a single homologous series. Hence, statement 4 is incorrect.

• Successive members of a homologous series like alkanes have a difference of 14 atomic mass units (u) in their molecular mass.

Additional Information

• Characteristics of Homologous Series:

• All members of a series can be represented by the same general molecular formula. For example, Alkenes follow CnH2n and Alkynes follow CnH2n-2.

• Any two adjacent members differ by a -CH2- group in their molecular formula.

• The chemical properties of the members are similar because they contain the same functional group (such as -OH for alcohols

or -CHO for aldehydes).

• There is a gradual change in physical properties like melting point, boiling point, and solubility as the molecular mass increases.

• Alkanes:

• These are saturated hydrocarbons where all carbon-carbon bonds are single bonds.

• Methane is the simplest alkane, often called marsh gas, and is a primary component of natural gas.

• As the number of carbon atoms increases, the boiling point increases due to stronger Van der Waals forces.

• Alkenes and Alkynes:

• Alkenes contain at least one double bond (unsaturated) and start from Ethene (C2H4).

• Alkynes contain at least one triple bond (unsaturated) and start from Ethyne (C2H2), also known as acetylene.

Important Points

• The concept of homology was developed to simplify the study of millions of organic chemistry compounds by grouping them based on structural similarities.

• Isomers are compounds with the same molecular formula but different structural arrangements; they should not be confused with members of a homologous series.

• The substitution reaction is a characteristic chemical property of alkanes, while addition reactions are characteristic of alkenes and alkynes.

• In the homologous series of alcohols, the members would be Methanol (CH3OH), Ethanol (C2H5OH), Propanol (C3H7OH), and so on, all differing by -CH2-.

Q24. Answer: (b) 10^(-10)

The correct answer is 10^(-10).

Key Points

• According to the Rutherford model of the atom, the radius of an atom is approximately 10^(-10) metres. This value is also commonly referred to as 1 Angstrom (Å) in atomic physics.

• In contrast, the radius of the nucleus is much smaller, estimated to be about 10^(-15) metres, which is equivalent to 1 femtometre or 1 Fermi.

• This implies that the atom is about 10^5 (100,000) times larger than its nucleus. If an atom were expanded to the size of a large football stadium, the nucleus would be about the size of a small marble placed at the center.

• Ernest Rutherford derived these dimensions based on his famous Alpha-particle scattering experiment conducted in 1911, where he observed how alpha particles interacted with a thin gold foil.

• The model concluded that since most alpha particles passed through the foil undeflected, the vast majority of an atom's volume is empty space. Hence, the statement regarding the radius being 10^(-10) metres is correct.

Additional Information

• Rutherford’s Gold Foil Experiment:

• In this experiment, high-energy alpha particles (Helium nuclei) were directed at a thin gold foil of about 100 nm thickness.

• Observations showed that about 99% of the particles passed straight through, while a very small fraction was deflected by large angles, and about 1 in 12,000 particles rebounded completely (180 degrees).

• This led to the discovery of the Atomic Nucleus, proving that the positive charge and most of the mass of the atom are concentrated in a tiny central region.

• Key Features of Rutherford's Atomic Model:

• The nucleus is positively charged and contains nearly all the mass of the atom.

• The electrons revolve around the nucleus in well-defined circular orbits, much like planets revolving around the Sun. This is why it is often called the Planetary Model.

• The electrostatic force of attraction between the nucleus and the electrons holds the atom together.

• Limitations of the Model:

• The primary drawback was its inability to explain atomic stability. According to Maxwell’s electromagnetic theory, an accelerating charged particle (like an orbiting electron) should radiate energy.

• If an electron continuously lost energy, its orbital radius would decrease, eventually causing it to spiral into the nucleus, making the atom unstable. This was later addressed by Niels Bohr in 1913.

• Scientific Legacy of Ernest Rutherford:

• Ernest Rutherford is hailed as the Father of Nuclear Physics.

• He was awarded the Nobel Prize in Chemistry in 1908 for his investigations into the disintegration of elements and the chemistry of radioactive substances.

• He also successfully performed the first artificial transmutation of an element in 1919, converting nitrogen into oxygen by bombarding it with alpha particles.

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Important Points

• Comparison of Scales: While the atom is 10^(-10) m, the Proton has a radius of approximately 0.84 to 0.87 femtometres.

• Measurement Units: 1 Angstrom (Å) = 10^(-10) metres = 0.1 nanometres. This scale is fundamental for measuring bond lengths and atomic sizes in chemistry.

• Density of the Nucleus: Because almost all mass is in the tiny nucleus, the density of the nucleus is extremely high, approximately 2.3 x 10^(17) kg/m³.

Q25. Answer: (d) Growth, repair, and replacement of damaged or old cells

The correct answer is Growth, repair, and replacement of damaged or old cells.

Key Points

• Cell division is a fundamental biological process by which a parent cell divides into two or more daughter cells, primarily serving the needs of growth and maintenance in multicellular organisms.

• Growth: Every multicellular organism starts its life as a single cell called a zygote. Through successive rounds of mitotic cell division, the number of cells increases, leading to the development of tissues, organs, and the overall body structure.

• Repair: When an organism suffers an injury, such as a cut on the skin or a broken bone, cell division is activated at the site of the damage to produce new cells that fill the wound and restore the structural integrity of the tissue.

• Replacement: Cells in a multicellular body have a finite lifespan and are constantly being worn out. For example, Red Blood Cells (RBCs) in humans have a lifespan of approximately 120 days, and skin cells are shed regularly; hence, cell division is essential to replace these dead or damaged cells to keep the organism healthy.

• Genetic Continuity: It ensures that the genetic information (DNA) is accurately passed from one generation of cells to the next, maintaining the biological blueprint of the organism.

Additional Information

• Types of Cell Division:

• Mitosis: Also known as equational division, it occurs in somatic cells (body cells). It results in two daughter cells that are genetically identical to the parent cell, each containing a diploid (2n) number of chromosomes.

• Meiosis: Known as reduction division, it occurs in germ cells to produce gametes (sperm and eggs). It reduces the chromosome number by half to haploid (n), ensuring that the diploid number is restored upon fertilization.

• The Cell Cycle: The process of division is part of a larger cycle comprising Interphase (the growth and DNA replication phase) and the M-phase (the actual division phase). The S-phase within Interphase is critical as it is the period when DNA synthesis occurs.

• Regulation of Cell Division: In healthy organisms, cell division is strictly regulated by proteins and checkpoints. If this regulation fails, cells may divide uncontrollably, which is the primary cause of cancer and tumor formation.

• Analysis of Other Options:

• Vacuoles and Turgidity: This is a function of the cell organelle (specifically in plants), not the purpose of division. Hence, statement 1 is incorrect.

• Transport of substances: This is managed by the cell membrane through osmosis, diffusion, and active transport. Hence, statement 2 is incorrect.

• Absorption and Waste Release: These are metabolic and excretory functions performed by the cell during its interphase life. Hence, statement 3 is incorrect.

Important Points

• Chromosomes: During division, chromatin condenses into visible chromosomes. Humans have 23 pairs (total 46) of chromosomes.

• Cytokinesis: This is the physical process of cytoplasmic division that follows karyokinesis (nuclear division) to finally split one cell into two.

• Regeneration: Some organisms, like Planaria or Starfish, use specialized cell division to regrow entire lost body parts, showing an extreme form of the repair function.

Q26. Answer: (d) 384

Shortcut Trick

Side (a) = 20 cm, Half-diagonal (d1/2) = 12 cm.

Using Pythagoras triplet (12, 16, 20), the other half-diagonal (d2/2) = 16 cm.

Full diagonal d2 = 16 × 2 = 32 cm.

Area = (1/2) × d1 × d2 = (1/2) × 24 × 32 = 384 cm².

Therefore The correct answer is 384 cm².

Alternate Method

Given:

Side of rhombus (a) = 20 cm
Diagonal 1 (d1) = 24 cm
Formula Used:
Area of rhombus = (1/2) × d1 × d2
Relation between side and diagonals: $4a^2 = d1^2 + d2^2$
Side = 20 d1 = 24 d2 = ? 12 cm 16 cm
Calculations:
=> In a rhombus, diagonals bisect each other at 90°.
=> Let half of d2 be x.
=> Using Pythagoras theorem in the small right triangle: $(d1/2)^2 + x^2 = a^2$
=> $(24/2)^2 + x^2 = 20^2$
=> $12^2 + x^2 = 400$
=> $144 + x^2 = 400$
=> $x^2 = 400 - 144 = 256$
=> $x = \sqrt{256} = 16$ cm
=> Second diagonal d2 = 2 × x = 2 × 16 = 32 cm
=> Area of rhombus = (1/2) × 24 × 32
=> Area = 12 × 32 = 384 cm^2
Therefore The correct answer is 384 cm^2.
Additional Information
Properties of Rhombus
All sides are equal, opposite angles are equal, and diagonals bisect each other at right angles (90°).
Perimeter of Rhombus
Perimeter = 4 × side = 4a. Also, $4a^2 = d1^2 + d2^2$.
Area using Trigonometry
Area = $a^2 \times \sin(\theta)$, where θ is any internal angle of the rhombus.

Q27. Answer: (c) 90

Shortcut Trick
For a Mean Proportional in the form x : A :: A : y, the value is calculated as $A = \sqrt{(x \times y)}$.
Here, x = 54 and y = 150.
$A = \sqrt{(54 \times 150)} = \sqrt{(8100)} = 90$.
Therefore The correct answer is 90.
Alternate Method
Given: The continued proportion 54 : A :: A : 150.
Formula Used: Product of Means = Product of Extremes.
=> 54/A = A/150
=> $A^2 = 54 \times 150$
=> $A^2 = 8100$
=> $A = \sqrt{8100}$
=> A = 90
Therefore The correct answer is 90.
Additional Information
Mean Proportional
The mean proportional between two numbers a and b is $\sqrt{(a \times b)}$. It is the middle term in a continued proportion.
Third Proportional
If a : b :: b : c, then c is called the third proportional to a and b, where $c = b^2 / a$.
Fourth Proportional
In the ratio a : b :: c : d, d is the fourth proportional and is calculated as $d = (b \times c) / a$.

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Q28. Answer: (b) Decreases by 71.73%

Shortcut Trick

Initial Price = 100

Final Price = 100 × 0.65 × 0.60 × 0.50 × 1.45

Final Price = 28.275

Change % = 100 − 28.275 = 71.725% ≈ 71.73%

Therefore The correct answer is Decreases by 71.73%.

Alternate Method

Given: Successive changes are −35%, −40%, −50%, and +45%.

Formula Used: Final Value = Initial Value × (100 ± r1)/100 × (100 ± r2)/100 × ...

=> Let original price be 100.

=> Price after 1st month = 100 − 35% of 100 = 65.

=> Price after 2nd month = 65 − 40% of 65 = 65 − 26 = 39.

=> Price after 3rd month = 39 − 50% of 39 = 39 − 19.5 = 19.5.

=> Price after 4th month = 19.5 + 45% of 19.5 = 19.5 + 8.775 = 28.275.

=> Total decrease = 100 − 28.275 = 71.725%.

=> Rounding off to two decimal places, we get 71.73%.

Therefore The correct answer is Decreases by 71.73%.

Additional Information

Successive Percentage Formula

For two changes a% and b%, effective change is (a + b + ab/100)%. For decrease, use negative values.

Multiplier Method

A decrease of x% is equivalent to multiplying by (1 − x/100), and an increase is multiplying by (1 + x/100).

Rounding Off Rule

If the third decimal digit is 5 or more, increase the second decimal digit by 1 (e.g., 71.725 becomes 71.73).

Q29. Answer: (b) 2,10,000

Shortcut Trick

Ratio of Income (Vijay : Mohan) = 5 : 9

Ratio of Expenditure (Vijay : Mohan) = 2 : 4 = 1 : 2

Since Savings are equal (Rs. 42,000), make the ratio difference equal: (5−1) ≠ (9−2).

Adjust Expenditure ratio by multiplying with (5−9) difference → 1:2 × 4 = 4 : 8.

Income 5 : 9 and Exp 4 : 8 → Savings = 1 unit = Rs. 42,000.

Vijay's Income = 5 units = 5 × 42,000 = Rs. 2,10,000.

Therefore The correct answer is Rs. 2,10,000.

Alternate Method

Given: Ratio of incomes = 5 : 9, Each saving = Rs. 42,000, Ratio of expenditures = 2 : 4.

Formula: Income − Saving = Expenditure

=> (5x − 42,000) ÷ (9x − 42,000) = 2 ÷ 4

=> (5x − 42,000) ÷ (9x − 42,000) = 1 ÷ 2

=> 2 × (5x − 42,000) = 1 × (9x − 42,000)

=> 10x − 84,000 = 9x − 42,000

=> 10x − 9x = 84,000 − 42,000

=> x = 42,000

=> Vijay's Income = 5x = 5 × 42,000 = Rs. 2,10,000

Therefore The correct answer is Rs. 2,10,000.

Additional Information

Income, Expenditure, and Saving Relationship

The fundamental equation is Income = Expenditure + Savings. For two people with fixed savings, the change in income units must correspond to the change in expenditure units.

Ratio Balancing Method

If Savings are equal, the numerical difference between the income ratio parts and expenditure ratio parts must be the same. If not,

multiply the ratios by the cross-difference of the other ratio.

Cross Multiplication Trick

For problems with different savings: (I1 × E2 − I2 × E1) units = (S1 × E2 − S2 × E1) value.

Q30. Answer: (b) 300 m

Shortcut Trick

Relative Speed in same direction = 60 − 24 = 36 km/h.

Convert to m/s: 36 × (5/18) = 10 m/s.

Combined Length = Relative Speed × Time = 10 × 30 = 300 m.

Therefore The correct answer is 300 m.

Alternate Method

Given:

Speed of Train 1 (S1) = 60 km/h

Speed of Train 2 (S2) = 24 km/h

Time taken to cross (t) = 30 sec

Formula Used:

Distance = Speed × Time

Relative Speed (Same Direction) = S1 − S2

Calculations:

=> Relative Speed = 60 − 24 = 36 km/h

=> Convert km/h to m/s: 36 × (5/18) m/s

=> Relative Speed = 2 × 5 = 10 m/s

=> Combined Length = Relative Speed × Time

=> Combined Length = 10 × 30

=> Combined Length = 300 m

Therefore The correct answer is 300 m.

Additional Information

Relative Speed Concept

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

Unit Conversion

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

Crossing Objects

When a train crosses another train, the total distance covered is always the sum of the lengths of both trains.

Q31. Answer: (b) 20 m

Shortcut Trick

In a right-angled triangle with an angle of elevation of 45°, the height and the base are always equal.

Since the distance from the base (base) is 20 m, the height of the pole must also be 20 m.

Ratio of sides in 45°-45°-90° triangle is 1 : 1 : √2.

Therefore The correct answer is 20 m.

Alternate Method

Given:

Distance from the base (BC) = 20 m

Angle of elevation (θ) = 45°

Formula Used:

tan θ = Perpendicular (Height) ÷ Base

Calculations:

=> tan 45° = Height (h) ÷ 20

=> 1 = h ÷ 20

=> h = 20 × 1

=> h = 20 m

Therefore The correct answer is 20 m.

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Additional Information

Trigonometric Ratios for Standard Angles

For 30°, tan 30° = 1/√3; For 60°, tan 60° = √3; For 45°, tan 45° = 1.

Angle of Elevation and Depression

The angle of elevation is the angle between the horizontal line and the line of sight when looking up at an object.

Right-Angled Triangle Properties

Pythagoras Theorem: Hypotenuse² = Base² + Perpendicular².

Q32. Answer: (c) Rs. 8,591

Shortcut Trick

Effective Rate of Interest for 2 years at 10% compounded annually = 10 + 10 + (10 × 10) ÷ 100 = 21%.

The Amount is 100% (Principal) + 21% (Interest) = 121% of the Principal.

Amount = 121% × 7,100 = 1.21 × 7,100.

Amount = 121 × 71 = Rs. 8,591.

Therefore The correct answer is Rs. 8,591.

Alternate Method

Given:

Principal (P) = Rs. 7,100

Rate (R) = 10% per annum

Time (n) = 2 years

Formula Used:

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

Calculations:

=> $A = 7100 \times (1 + 10/100)^2$

=> $A = 7100 \times (1 + 1/10)^2$

=> $A = 7100 \times (11/10) \times (11/10)$

=> $A = 71 \times 11 \times 11$

=> $A = 71 \times 121$

=> A = Rs. 8,591

Therefore The correct answer is Rs. 8,591.

Additional Information

Compound Interest Formula

Interest (CI) = Amount − Principal = $P[(1 + R/100)^n - 1]$.

Difference between CI and SI

For 2 years, the difference $D = P(R/100)^2$.

Successive Percentage Method

If interest is compounded annually, the effective rate for 't' years is the successive percentage change of 'R' for 't' times.

Q33. Answer: (c) Rs. 15,125

Shortcut Trick

Net discount = a + b − (a × b) ÷ 100 = 16 + 20 − (16 × 20) ÷ 100 = 32.8%.

Multiplier for SP = CP × (100 + P%) ÷ 100 = 7700 × 1.32.

Relationship: CP × (100 + P%) = MP × (100 − D%).

MP = 7700 × 132 ÷ (100 − 32.8) = 7700 × 132 ÷ 67.2.

MP = 7700 × 1320 ÷ 672 = 15125.

Therefore The correct answer is Rs. 15,125.

Alternate Method

Given → Cost Price (CP) = Rs. 7,700, Gain% = 32%, Successive Discounts = 16% and 20%.

Formulas: SP = CP × (100 + P%) ÷ 100 | MP = SP × 100 ÷ (100 − D%) | Net Discount = a + b − ab ÷ 100.

=> Calculate Selling Price (SP): SP = 7700 × (132 ÷ 100) = 77 × 132 = Rs. 10,164.

=> Let Marked Price be MP. After 16% discount, Price = 0.84MP.

=> After second discount of 20%, SP = 0.84MP × 0.80 = 0.672MP.

=> Equating SP: 0.672MP = 10164.
=> MP = 10164 ÷ 0.672 = 10164000 ÷ 672.
=> MP = Rs. 15,125.
Therefore The correct answer is Rs. 15,125.
Additional Information
Marked Price and Discount
Discount is always calculated on the Marked Price (MP). SP = MP − Discount.
Successive Discounts
Two discounts d1 and d2 are equivalent to a single discount of (d1 + d2 − d1d2/100)%.

Q34. Answer: (a) 5

Shortcut Trick
Convert the given equation $x^2 - 3x - 1 = 0$ into the form $(x - 1/x)$ by dividing by x.
$x - 3 - 1/x = 0 \Rightarrow x - 1/x = 3$.
Use the algebraic shortcut: If $(x - 1/x) = k$, then $(x^2 + 1/x^2) = k^2 + 2$.
Here, k = 3, so $x^2 + 1/x^2 = 3^2 + 2 = 11$.
Required value = $(x^2 + 1/x^2) - 6 = 11 - 6 = 5$.
Therefore The correct answer is 5.
Alternate Method
Given: $x^2 - 3x - 1 = 0$
Formula Used: $(a - b)^2 = a^2 + b^2 - 2ab$
Calculations:
$\Rightarrow x^2 - 1 = 3x$
$\Rightarrow (x^2 - 1) \div x = 3$
$\Rightarrow x - 1/x = 3$
Squaring both sides of the equation:
$\Rightarrow (x - 1/x)^2 = 3^2$
$\Rightarrow x^2 + 1/x^2 - 2(x)(1/x) = 9$
$\Rightarrow x^2 + 1/x^2 - 2 = 9$
$\Rightarrow x^2 + 1/x^2 = 11$
Now, find the value of the expression $x^2 + 1/x^2 - 6$:
$\Rightarrow (x^2 + 1/x^2) - 6 = 11 - 6$
$\Rightarrow 5$
Therefore The correct answer is 5.
Additional Information
Square Algebraic Identities
$x^2 + 1/x^2$ can be expressed as $(x + 1/x)^2 - 2$ or $(x - 1/x)^2 + 2$.
Cube Algebraic Identities
$x^3 + 1/x^3 = (x + 1/x)^3 - 3(x + 1/x)$ and $x^3 - 1/x^3 = (x - 1/x)^3 + 3(x - 1/x)$.
Relationship between Sum and Difference
$(x + 1/x)^2 = (x - 1/x)^2 + 4$, which is useful for switching between addition and subtraction forms.

Q35. Answer: (c) Rs. 1,080

Shortcut Trick
Loss of 10% means the Selling Price (SP) is 90% of the Cost Price (CP).
Ratio method: 10% = 1/10 (Loss/CP).
If CP = 10 units and Loss = 1 unit, then SP = 9 units.
Given 10 units = Rs. 1,200, so 1 unit = Rs. 120.
Therefore SP = 9 × 120 = Rs. 1,080.
Therefore The correct answer is Rs. 1,080.
Alternate Method
Given: Cost Price (CP) = Rs. 1,200, Loss% = 10%.

Formulas: Loss = (Loss% ÷ 100) × CP | SP = CP − Loss
=> Calculate Loss amount = (10 ÷ 100) × 1,200
=> Loss = 0.10 × 1,200 = Rs. 120
=> Selling Price (SP) = CP − Loss
=> SP = 1,200 − 120 = Rs. 1,080
Therefore The correct answer is Rs. 1,080.
Additional Information
Relationship between CP and SP
When there is a loss, the Cost Price is always greater than the Selling Price (CP > SP). Formula: SP = CP × (100 − Loss%) ÷ 100.
Profit Scenario
If the watch was sold at a 10% profit, the SP would be CP × (100 + Profit%) ÷ 100 = 1,200 × 1.1 = Rs. 1,320.

Q36. Answer: (a) 11

Shortcut Trick
Increase in average = (New score − Old average) ÷ Total number of innings
Increase = (193 − 76) ÷ 11
Increase = 117 ÷ 11 = 10.636...
Rounding 10.636 to the nearest whole number, we get 11.
Therefore The correct answer is 11.
Alternate Method
Given:
Average of 10 innings = 76 runs
Runs in 11^(th) inning = 193 runs
Formula Used:
Average = Total Runs ÷ Total Innings
Increase in Average = New Average − Old Average
Calculations:
=> Total runs in 10 innings = 10 × 76 = 760 runs
=> Total runs in 11 innings = 760 + 193 = 953 runs
=> New average = 953 ÷ 11 = 86.6363...
=> Increase in average = 86.6363 − 76 = 10.6363...
=> Rounding to the nearest whole number ≈ 11
Therefore The correct answer is 11.
Additional Information
Effect of New Entry on Average
If a new value is added, New Average = (Old Sum + New Value) ÷ (n + 1). If New Value > Old Average, the average increases.
Weighted Average
When two groups with averages A1 and A2 and sizes n1 and n2 are combined, Combined Average = (n1A1 + n2A2) ÷ (n1 + n2).
Deviation Method
The sum of deviations of all observations from their mean is always zero. This property helps in finding missing values quickly.

Q37. Answer: (d) 4

Shortcut Trick
60% of First Number = 12 → 100% of First Number = 20.
Ratio value 10 units = 20 → 1 unit = 2.
Difference of Third and Second (21 − 16) = 5 units = 10.
40% of 10 = 4.
Therefore The correct answer is 4.
Alternate Method
Given: Ratio = 10 : 21 : 16 | 60% of 1^(st) = 12
Formula Used: Number = (Given Value ÷ Percentage) × 100
=> Let the numbers be 10x, 21x, and 16x.

=> 60% of 10x = 12

=> 0.6 × 10x = 12 => 6x = 12 => x = 2

=> Second number = 21 × 2 = 42

=> Third number = 16 × 2 = 32

=> Difference = 42 − 32 = 10

=> Required value = 40% of 10 = 0.4 × 10 = 4

Therefore The correct answer is 4.

Additional Information

Percentage to Fraction Conversion

To simplify calculations, use 60% = 3/5 and 40% = 2/5.

Ratio Scaling

If a : b : c is the ratio, any change in one part according to a multiplier x applies to all parts to maintain the proportion.

Q38. Answer: (b) 47

Shortcut Trick

Assume an average of 40 to find deviations: −22, +34, −7, −24, −5, +56, 0, +28, +3.

Net deviation = (−22 − 7 − 24 − 5) + (34 + 56 + 28 + 3) = −58 + 121 = +63.

Average deviation = 63 ÷ 9 = +7.

Actual Arithmetic Mean = 40 + 7 = 47.

Therefore The correct answer is 47.

Alternate Method

Given: Observations = 18, 74, 33, 16, 35, 96, 40, 68, 43

Total count (n) = 9

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

=> Sum = 18 + 74 + 33 + 16 + 35 + 96 + 40 + 68 + 43

=> Sum = 423

=> Mean = 423 ÷ 9

=> Mean = 47

Therefore The correct answer is 47.

Additional Information

Properties of Arithmetic Mean

The sum of the deviations of all observations from their arithmetic mean is always zero. ∑(x_i − mean) = 0.

Effect of Constant on Mean

If every observation is increased or decreased by a constant k, the mean also increases or decreases by k. If multiplied by k, the mean is multiplied by k.

Weighted Mean Formula

When observations have different weights, the mean is calculated as ∑(w_i × x_i) ÷ ∑w_i.

Q39. Answer: (c) 43.2%

Shortcut Trick

Use the successive discount formula: Equivalent Discount = a + b − (a × b) ÷ 100.

Here, a = 20% and b = 29%.

Equivalent Discount = 20 + 29 − (20 × 29) ÷ 100.

Equivalent Discount = 49 − (580 ÷ 100) = 49 − 5.8 = 43.2%.

Therefore The correct answer is 43.2%.

Alternate Method

Given: First discount = 20%, Second discount = 29%.

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

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

=> Price after 20% discount = 100 − 20 = 80.

=> Price after 29% discount on 80 = 80 − (29% of 80).

=> 29% of 80 = (29 × 80) ÷ 100 = 23.2.

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=> Final Selling Price (SP) = 80 − 23.2 = 56.8.

=> Total Discount = MP − SP = 100 − 56.8 = 43.2.

Therefore The correct answer is 43.2%.

Additional Information

Successive Discounts

When two or more discounts are applied one after another on the reduced price, they are called successive discounts. The total effective discount is always less than the sum of individual discounts.

Marked Price & Selling Price

Marked Price is the price printed on the label. Selling Price is the final amount paid after subtracting the discount from the MP: SP = MP × (1 − d/100).

Q40. Answer: (a) 333.33%

Shortcut Trick

To find percentage of A with respect to B, use: (A ÷ B) × 100.

Required % = (1/30 ÷ 1/100) × 100 = (100/30) × 100.

Required % = (10/3) × 100 = 1000/3 %.

Required % = 333.33%.

Therefore The correct answer is 333.33%.

Alternate Method

Given: First fraction = 1/30, Second fraction = 1/100.

Formula Used: Percentage = (Value / Base Value) × 100

=> Required Percentage = [(1/30) / (1/100)] × 100

=> Required Percentage = (1/30 × 100/1) × 100

=> Required Percentage = (100/30) × 100

=> Required Percentage = (10/3) × 100

=> Required Percentage = 1000 / 3

=> Required Percentage = 333.333...

Therefore The correct answer is 333.33%.

Additional Information

Fraction to Percentage Conversion

To convert any fraction to percentage, multiply the fraction by 100 and add the % symbol.

Reciprocal Percentages

Common reciprocals: 1/3 ≈ 33.33%, 1/6 ≈ 16.67%, 1/9 ≈ 11.11%.

Rounding Off Rules

When rounding to two decimal places, if the third decimal digit is 5 or more, increase the second decimal digit by 1.

Q41. Answer: (b) 4

Shortcut Trick

Combined efficiency of A, B, and C = 8 + 3 + 1 = 12 units/day (taking total work as 24 units).

To complete twice the work (48 units), they will take 48 ÷ 12 = 4 days.

Therefore The correct answer is 4 days.

Alternate Method

Given:

Time taken by A = 3 days

Time taken by B = 8 days

Time taken by C = 24 days

Formula Used:

Total Work = LCM of individual times

Efficiency = Total Work ÷ Days

Time taken = Work ÷ Combined Efficiency

Person	Days	Total Work	Efficiency
A	3	24	8

B	8	3	
C	24	1	

Calculations:

=> Total original work = 24 units

=> Twice the work = 2 × 24 = 48 units

=> Combined efficiency of A, B and C = 8 + 3 + 1 = 12 units/day

=> Time taken to complete twice the work = 48 ÷ 12 = 4 days

Therefore The correct answer is 4 days.

Additional Information

LCM Method in Time and Work

Using the LCM of individual days as the total work helps avoid working with complex fractions, simplifying calculations into whole number efficiencies.

Work and Wages Relation

Wages are always distributed in the proportion of the total work done by each individual, or in the ratio of their efficiencies if they work for the same duration.

Q42. Answer: (b) 0

Shortcut Trick

For a number to be divisible by 8, its last three digits must be divisible by 8.

The last three digits of 130A1568 are 568.

Check: 568 ÷ 8 = 71 (Exactly divisible).

Since 568 is already divisible by 8, the value of A does not affect the divisibility of the last three digits.

The question asks for the minimum value of A.

Therefore The correct answer is 0.

Alternate Method

Given: The 8-digit number is 130A1568.

Divisibility Rule for 8: A number is divisible by 8 if the number formed by its last 3 digits is divisible by 8.

=> Last three digits of 130A1568 = 568

=> 568 ÷ 8 = 71

=> Since 568 is divisible by 8, the entire number 130A1568 is divisible by 8 regardless of the value of A.

=> Possible values for digit A are {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}.

=> The minimum value among these is 0.

Therefore The correct answer is 0.

Additional Information

Divisibility by 2^n

A number is divisible by 2^n if its last n digits are divisible by 2^n. For 2 (2^1), check last 1 digit; for 4 (2^2), check last 2 digits; for 8 (2^3), check last 3 digits.

Divisibility by 3 and 9

A number is divisible by 3 or 9 if the sum of its digits is divisible by 3 or 9 respectively.

Divisibility by 11

The difference between the sum of digits at odd places and the sum of digits at even places must be 0 or a multiple of 11.

Q43. Answer: (b) 49.92 km/hr

Shortcut Trick

When the distance for two journeys is equal (A to B and B to A), use the harmonic mean formula.

Average Speed = [2 × S1 × S2] ÷ [S1 + S2]

Average Speed = [2 × 48 × 52] ÷ [48 + 52] = 4992 ÷ 100 = 49.92 km/hr.

Therefore The correct answer is 49.92 km/hr.

Alternate Method

Given: Distance (D) = 964 km, Speed A to B (S1) = 48 km/hr, Speed B to A (S2) = 52 km/hr.

Formula Used: Average Speed = Total Distance ÷ Total Time

=> Total Distance = 964 + 964 = 1928 km

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=> Time taken (A to B) = 964 ÷ 48 = 241 ÷ 12 hours

=> Time taken (B to A) = 964 ÷ 52 = 241 ÷ 13 hours

=> Total Time = (241 ÷ 12) + (241 ÷ 13) = [241 × (13 + 12)] ÷ (12 × 13)

=> Total Time = (241 × 25) ÷ 156 hours

=> Average Speed = 1928 ÷ [(241 × 25) ÷ 156] = (1928 × 156) ÷ (241 × 25)

=> Average Speed = (8 × 156) ÷ 25 = 1248 ÷ 25 = 49.92 km/hr

Therefore The correct answer is 49.92 km/hr.

Additional Information

Average Speed for Equal Distances

When an object covers two equal distances at speeds x and y, the average speed is given by [2xy] ÷ [x + y]. Note that the actual distance value does not affect the final result.

Three Equal Distances

For three equal distances covered at speeds x, y, and z, the average speed formula is [3xyz] ÷ [xy + yz + zx].

General Average Speed

Always defined as Total Distance ÷ Total Time. If the distances are not equal, individual times must be calculated and summed up.

Q44. Answer: (a) 40.5°

Shortcut Trick

In any quadrilateral, the angle formed by the bisectors of two adjacent angles is equal to half the sum of the other two angles.

angle DOC = (angle A + angle B) ÷ 2

angle DOC = (62° + 19°) ÷ 2

angle DOC = 81° ÷ 2 = 40.5°

Therefore The correct answer is 40.5°.

Alternate Method

Given: angle A = 62°, angle B = 19°, CO and DO are angle bisectors.

Formula Used: Sum of interior angles of a quadrilateral = 360° | Sum of angles in a triangle = 180°.

=> In quadrilateral ABCD, angle A + angle B + angle C + angle D = 360°

=> 62° + 19° + angle C + angle D = 360°

=> angle C + angle D = 360° − 81° = 279°

=> In ΔDOC, angle DOC + angle OCD + angle ODC = 180°

=> Since CO and DO are bisectors, angle OCD = angle C ÷ 2 and angle ODC = angle D ÷ 2

=> angle DOC + (angle C + angle D) ÷ 2 = 180°

=> angle DOC + 279° ÷ 2 = 180°

=> angle DOC + 139.5° = 180°

=> angle DOC = 180° − 139.5° = 40.5°

Therefore The correct answer is 40.5°.

Additional Information

Angle Sum Property

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

Angle Bisector Property

An angle bisector divides an angle into two equal parts. In any triangle, the sum of the angles is 180°, which is used to find the third angle when the other two (or their sum) are known.

1

Q45. Answer: (c) 6 8/9 hours

Shortcut Trick

LCM of 12, 15, 18 = 180 units (Total Capacity).

Efficiencies: A = 15, B = 12, C = 10.

Hour 1 (A+B): 15 + 12 = 27 units | Hour 2 (A+C): 15 + 10 = 25 units.

2-hour cycle = 27 + 25 = 52 units. In 3 cycles (6 hours), work done = 52 × 3 = 156 units.

Remaining 24 units filled by (A+B) in 24/27 = 8/9 hours. Total = 6 + 8/9 = 6 8/9 hours.

Therefore The correct answer is 6 8/9 hr.

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Alternate Method

Person	Days	Total Work	Efficiency
Tap A	12 hr	180	180 ÷ 12 = 15
Tap B	15 hr	180 ÷ 15 = 12	
Tap C	18 hr	180 ÷ 18 = 10	

=> Hour 1 (A and B are open): Efficiency = 15 + 12 = 27 units/hr

=> Hour 2 (A and C are open): Efficiency = 15 + 10 = 25 units/hr

=> Work done in 2 hours = 27 + 25 = 52 units

=> Work done in 6 hours (3 cycles) = 52 × 3 = 156 units

=> Remaining work = 180 − 156 = 24 units

=> Time taken for remaining work (by A+B) = 24 ÷ 27 = 8/9 hr

=> Total time = 6 + 8/9 = 6 8/9 hr

Therefore The correct answer is 6 8/9 hr.

Additional Information

Pipes and Cisterns Efficiency

Efficiency is inversely proportional to the time taken. If a pipe fills a tank in 'x' hours, its 1-hour work is 1/x.

Alternate Work Principle

In alternate timing problems, calculate the work done in one complete cycle (sum of individual hours) before multiplying to reach the target capacity.

Inlet and Outlet Pipes

Inlet pipe efficiency is taken as positive, while outlet (leakage) pipe efficiency is taken as negative during net efficiency calculation.

Q46. Answer: (a) 2

Shortcut Trick

Substitute the options into the equation 25^((r − 1)) + 100 = 5^((2r − 1)) to see which one satisfies it.

Checking for r = 2:

=> 25^((2 − 1)) + 100 = 5^((2 × 2 − 1))

=> $25^1 + 100 = 5^3$

=> 125 = 125 (Satisfied)

Therefore The correct answer is 2.

Alternate Method

Given:

25^((r − 1)) + 100 = 5^((2r − 1))

Formula Used:

$(a^m)^n = a^{(m \times n)}$

Calculation:

=> $(5^2)^{((r - 1))} + 100 = 5^{((2r - 1))}$

=> $5^{((2r - 2))} + 100 = 5^{((2r - 1))}$

Rearranging the terms by taking base 5 values to one side:

=> $100 = 5^{((2r - 1))} - 5^{((2r - 2))}$

Taking $5^{((2r - 2))}$ common on the right hand side:

=> $100 = 5^{((2r - 2))} \times (5^1 - 1)$

=> $100 = 5^{((2r - 2))} \times 4$

=> $25 = 5^{((2r - 2))}$

=> $5^2 = 5^{((2r - 2))}$

Equating the exponents since the bases are equal:

=> 2r − 2 = 2

=> 2r = 4

=> r = 2

Therefore The correct answer is 2.

Additional Information

Law of Product

When multiplying expressions with the same base, add their exponents: $a^m \times a^n = a^{(m + n)}$.

Law of Quotient

When dividing expressions with the same base, subtract their exponents: $a^m \div a^n = a^{(m - n)}$.

Law of Power of a Power

When raising a power to another power, multiply the exponents: $(a^m)^n = a^{(m \times n)}$.

Equality of Exponents

If $a^m = a^n$ (where $a > 0$ and $a \neq 1$), then $m = n$.

Q47. Answer: (a) 128

Shortcut Trick

To find the two numbers quickly using Sum (S) and Difference (D):

Larger number = $(S + D) \div 2 = (24 + 8) \div 2 = 16$

Smaller number = $(S - D) \div 2 = (24 - 8) \div 2 = 8$

Product = $16 \times 8 = 128$

Therefore The correct answer is 128.

Alternate Method

Given:

Sum of two numbers $(x + y) = 24$

Difference of two numbers $(x - y) = 8$

Formula Used:

Algebraic product identity: $xy = ((x + y)^2 - (x - y)^2) \div 4$

Calculations:

=> $x + y = 24$ --- (Equation 1)

=> $x - y = 8$ --- (Equation 2)

=> Adding both equations: $(x + y) + (x - y) = 24 + 8$

=> $2x = 32$

=> $x = 32 \div 2 = 16$

=> Substitute $x = 16$ in Equation 1: $16 + y = 24$

=> $y = 24 - 16 = 8$

=> Product = $x \times y = 16 \times 8 = 128$

Therefore The correct answer is 128.

Additional Information

Product-Sum-Difference Identity

The product of two numbers can be directly calculated using the identity: Product = $[(Sum)^2 - (Difference)^2] \div 4$.

Sum of Squares Relationship

The sum of the squares of two numbers is given by: $x^2 + y^2 = [(Sum)^2 + (Difference)^2] \div 2$.

Relationship with Arithmetic Mean

The Average of the two numbers is always exactly half of their sum ($S \div 2$). The numbers are (Average + D/2) and (Average − D/2).

Q48. Answer: (d) 14 years

Shortcut Trick

To find the larger value (Sister) when the sum and difference are known:

Sister age = (Sum + Difference) ÷ 2

Sister age = $(26 + 2) \div 2 = 28 \div 2 = 14$

Therefore The correct answer is 14 years.

Alternate Method

Given:

Sum of ages = 26 years

Age difference = 2 years

Formula Used:

Linear Equation solving for two variables.

Let the age of the Sister be S and the age of the Brother be B.

=> S + B = 26 --- (Equation 1)

=> S − B = 2 --- (Equation 2)

Adding Equation 1 and Equation 2:

=> (S + B) + (S − B) = 26 + 2

=> 2S = 28

=> S = 28 ÷ 2

=> S = 14

Therefore The correct answer is 14 years.

Additional Information

Sum and Difference Rule

If sum (S) and difference (D) of two numbers are given, Larger = (S+D)/2 and Smaller = (S−D)/2.

Age Constant Property

The difference between the ages of two people remains constant regardless of the number of years passed.

Q49. Answer: (b) 6468

Shortcut Trick

Total Surface Area (TSA) = CSA of cylinder + CSA of hemisphere + CSA of cone + Area of annular base.

TSA = $2\pi RH + 2\pi R^2 + \pi rl + (\pi R^2 - \pi r^2) = \pi[2RH + 3R^2 + rl - r^2]$

Substitute R=14, H=48, r=7, h=24, l=25: TSA = $(22/7) \times [2(14)(48) + 3(14^2) + 7(25) - 7^2]$

TSA = $(22/7) \times [1344 + 588 + 175 - 49] = (22/7) \times 2058 = 22 \times 294 = 6468$ cm².

Therefore The correct answer is 6468 cm².

Alternate Method

Given:

Height of cylinder (H) = 48 cm, Radius of cylinder (R) = 14 cm

Radius of conical cavity (r) = 7 cm, Height of conical cavity (h) = 24 cm

Radius of hemisphere (R_h) = 14 cm

Formula Used:

Curved Surface Area (CSA) of cylinder = $2\pi RH$

CSA of cone = πrl, where $l = \sqrt{(r^2 + h^2)}$

CSA of hemisphere = $2\pi R^2$

Calculations:

=> Slant height of cone (l) = $\sqrt{(7^2 + 24^2)} = \sqrt{(49 + 576)} = \sqrt{625} = 25$ cm

=> CSA of cylinder = $2 \times (22/7) \times 14 \times 48 = 2 \times 22 \times 2 \times 48 = 4224$ cm²

=> CSA of cone = $(22/7) \times 7 \times 25 = 550$ cm²

=> CSA of hemisphere = $2 \times (22/7) \times 14 \times 14 = 1232$ cm²

=> Area of top annular region = $\pi R^2 - \pi r^2 = (22/7) \times (14^2 - 7^2) = (22/7) \times (196 - 49) = (22/7) \times 147 = 462$ cm²

=> Total Surface Area = 4224 + 550 + 1232 + 462

=> Total Surface Area = 6468 cm²

Therefore The correct answer is 6468 cm².

Additional Information

Volume of Remaining Solid

The volume is calculated by subtracting the volumes of the cavities: $V = \pi R^2H - (1/3)\pi r^2h - (2/3)\pi R^3$.

Surface Area Change

When a cavity is made, the Total Surface Area usually increases as the internal curved surface of the cavity is added, while only the flat base area of the cavity is removed.

Hemisphere Surface Area

For a solid hemisphere, TSA = $3\pi R^2$ (Curved + Base), but for a hemispherical cavity, only the curved part $2\pi R^2$ is added to the internal surface.

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Q50. Answer: (a) 121966

Shortcut Trick

The given expression follows the algebraic identity $(a^2 - b^2) \div c$.

Notice that (75983 − 45983) = 30000, which is exactly the denominator.

Since $(a^2 - b^2) = (a + b)(a - b)$, the expression reduces to (a + b) when (a − b) is the divisor.

Result = 75983 + 45983 = 121966.

Therefore The correct answer is 121966.

Alternate Method

Given: Expression = (75983 × 75983 − 45983 × 45983) ÷ 30000

Formula Used: $a^2 - b^2 = (a + b)(a - b)$

=> Let a = 75983 and b = 45983.

=> $a^2 - b^2 = (75983 + 45983) \times (75983 - 45983)$

=> $a^2 - b^2 = 121966 \times 30000$

=> Expression = (121966 × 30000) ÷ 30000

=> Expression = 121966

Therefore The correct answer is 121966.

Additional Information

Difference of Squares

The identity $a^2 - b^2 = (a + b)(a - b)$ is used to simplify the multiplication and division of large square terms.

Sum and Difference Cubes

Similarly, $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$ and $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$.

BODMAS Rule

Always follow the order of operations: Brackets, Orders, Division, Multiplication, Addition, and Subtraction for correct results.

Q51. Answer: (b) One

Given: G, H, I, Q, R and S are sitting in a straight line facing north.

No one is seated to the left of R.

Only three people are seated between R and G.

Only three people are seated to the right of H.

Q is seated to the immediate left of H.

S is not an immediate neighbor of H.

So, number of people between S and I = 1

Hence, the correct answer is Option 2.

Q52. Answer: (b) Both conclusions (I) and (II) follow.

Given Statements:

All potatoes are bananas.

All bananas are apples.

The least possible Venn diagram for the given statements is:

Conclusions:

I. All potatoes are apples – Follows (Since all potatoes are bananas and all bananas are apples, all potatoes must be apples).

II. Some apples are bananas – Follows (All bananas are apples, so at least some apples are definitely bananas).

So, both conclusion I and II follow.

Hence, the correct answer is Option 2.

Q53. Answer: (b) 19

Given:

Total people = 52

Dimple's position from left = 17th

15 people sit to the right of Avni

Avni's position from right = 15 + 1 = 16th

Avni's position from left = (52 − 16) + 1 = 37th

Now, number of people between Dimple and Avni = |37 − 17| − 1

= 20 − 1

= 19

Here, the number of people sitting between Dimple and Avni is 19.

Hence, the correct answer is "Option 2".

Q54. Answer: (a) IMQ 38

The logic followed here is:

So, 'IMQ 38' will replace the question mark in the given series.

Hence, the correct answer is "Option 1".

Q55. Answer: (a) North

Given:

The shopping complex of A is 6 km West of B.

The shopping complex of C is 4 km North of B.

The shopping complex of D is 6 km West of C.

Therefore, the shopping complex of D is to the North of the shopping complex of A.

Hence, the correct answer is Option 1.

Q56. Answer: (d) 237

The logic followed here is:

thus, "237" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q57. Answer: (c) 13

Given: (Left) 562, 428, 653, 154, 749 (Right)

Now,

We need to identify the second highest and second lowest numbers from the given list, extract the specified digits, and find their sum.

(Left) 562, 428, 653, 154, 749 (Right)

Now, arranging numbers in ascending order: 154 428 562 653 749

Now identifying:

Second lowest number = 428

Second highest number = 653

Second digit of second highest number = 5

Third digit of second lowest number = 8

Now,

Value 1 = 5

Value 2 = 8

Sum = 5 + 8 = 13

Hence, the correct answer is "Option 3".

Q58. Answer: (c) zz

The logic followed here is:

Given:

‘rain hall pig’ → kq zz nl

‘pig bean error’ → hu mt zz

So, pig → zz

Hence, the correct answer is Option 3.

Q59. Answer: (a) G

Given: Eight people A, B, C, D, E, F, G and H are sitting around a circular table facing the centre.

Only two people sit between A and G when counted from the left of G.

B sits to the immediate left of G.

Only three people sit between C and B when counted from the left of C.

E sits to the immediate right of D.

F is not an immediate neighbour of B.

Therefore, the person sitting second to the right of H is G.

Hence, the correct answer is Option 1.

Q60. Answer: (b) 12

Given: (Left) 945, 128 (Right)

Now,

We need to identify the highest and lowest numbers from the given sequence and then add the second digit of the highest number to the third digit of the lowest number.

(Left) 945, 128 (Right)

Highest number = 945

Lowest number = 128

Second digit of highest number = 4

Third digit of lowest number = 8

Now,

Value 1 = 4

Value 2 = 8

Sum = 4 + 8 = 12

Hence, the correct answer is "Option 2".

Q61. Answer: (c) 3

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

Now,

We need to identify even numbers that are immediately preceded by an odd number and also immediately followed by an odd number.

So, the required condition is: Odd Number – Even Number – Odd Number

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

Total even numbers satisfying the condition = 3

Hence, the correct answer is "Option 3".

Q62. Answer: (a) XUK : BSO

The logic followed here is:

For, HCU → LAY

Now, PYC → TWG

Now, checking the options:

Option 1) XUK → BSO

Option 2) WGD → ABH

Option 3) TKG → XHK

Option 4) YCR → AYT

Hence, the correct answer is Option 1.

Q63. Answer: (a) Both conclusions (I) and (II) follow

Given Statements:

All bolts are screws.

All bolts are nuts.

All nuts are rivets.

The least possible Venn diagram for the given statements is:

Conclusions:

I. All bolts are rivets – Follows (Since all bolts are nuts and all nuts are rivets, all bolts must be rivets).

II. Some nuts are screws – Follows (Bolts are common to both nuts and screws, so at least some nuts are definitely screws).

So, both conclusion I and II follow.

Hence, the correct answer is Option 1.

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Q64. Answer: (c) 86

The logic followed here is:

thus, "86" will replace the question mark in the given series.

Hence, the correct option is "Option 3"

Q65. Answer: (d) S

Given: Six boxes B, D, E, P, S, T and W are arranged from top to bottom (Position 7 to Position 1).

B is the topmost box.

D is immediately below B.

W is at position 4 because three boxes are below it.

Only two boxes are between W and P, so P is at position 1.

T is below E and above S.

Position	Box
7 (Top)	B
6	D
5	E
4	W
3	T
2	S
1 (Bottom)	P

Here, the box at the second position from the bottom is S.

Hence, the correct answer is Option 4.

Q66. Answer: (d) LJJ

The logic followed here is:

Option 1) DAB

Option 2) WTU

Option 3) EBC

Option 4) LJJ

Here, LJJ is odd from the given options because it does not follow the uniform −3, +1 pattern.

Hence, the correct answer is "Option 4".

Q67. Answer: (a) (83, 82.4, 84.4)

The logic followed here is:

Logic:

Second number = First number − 0.6

Third number = First number + 1.4

(57, 56.4, 58.4)

=> 57 − 0.6 = 56.4

=> 57 + 1.4 = 58.4

(49, 48.4, 50.4)

=> 49 − 0.6 = 48.4

=> 49 + 1.4 = 50.4

Now, checking the options:

Option 1) (83, 82.4, 84.4)

=> 83 − 0.6 = 82.4

=> 83 + 1.4 = 84.4

Option 2) (58, 57.4, 60.4)

=> 58 − 0.6 = 57.4

=> 58 + 1.4 = 59.4 (not 60.4)

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Option 3) (91, 89.4, 91.4)
=> 91 − 0.6 = 90.4 (not 89.4)
Option 4) (75, 74.4, 77.4)
=> 75 − 0.6 = 74.4
=> 75 + 1.4 = 76.4 (not 77.4)
Hence, the correct answer is Option 1.

Q68. Answer: (d) JXP

The logic followed here is:
So, the next term = JXP
Hence, the correct answer is Option 4.

Q69. Answer: (c) North-east

Given:
Town A is to the East of Town B.
Town C is to the South of Town A.
Town D is to the West of Town C.
Town E is to the North of Town D.
Town B is to the North-West of Town E.
From the arrangement, Town A lies to the North-East of Town E.
Hence, the correct answer is Option 3.

Q70. Answer: (c) PT−QX

The logic followed here is:
Option 1) XB – ZD
Option 2) MQ – OS
Option 3) PT – QX
Option 4) HL – JN
Here, PT – QX is odd from the given options because it does not follow the uniform +2, +2 shift pattern.
Hence, the correct answer is "Option 3".

Q71. Answer: (c) 4

Given: (Left) 9, 1, 8, 6, 9, 1, 8, 4, 8, 2, 6, 9, 7, 2, 6, 5, 9, 8, 4, 7, 1, 9, 1, 6, 9, 6, 5 (Right)
Now,
We need to identify even numbers that are preceded by an odd number and followed by an even number.
So, the required condition is: Odd Number – Even Number – Even Number
(Left) 9, 1, 8, 6, 9, 1, 8, 4, 8, 2, 6, 9, 7, 2, 6, 5, 9, 8, 4, 7, 1, 9, 1, 6, 9, 6, 5 (Right)
Total even numbers satisfying the condition = 4
Hence, the correct answer is "Option 3".

Q72. Answer: (a) C

Given: Seven people A, B, C, D, E, F and G are sitting in a row facing north.
B is seated third from the right end.
G is third to the left of D.
E is seated to the right of B and at one of the ends.
Only two people are seated between F and E.
A does not sit at any of the extreme ends.
The extreme left end is position 1 → C
Hence, the correct answer is Option 1.

Q73. Answer: (a) 868

The logic followed here is:
thus, "868" will replace the question mark in the given series.
Hence, the correct option is "Option 1".

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Q74. Answer: (a) rn

The logic followed here is:

Given:

'light reveals truth' → rn ea kw

'truth guides paths' → ib rn xu

So, truth → rn

Hence, the correct answer is Option 1.

Q75. Answer: (d) DATU

The logic followed here is:

For, BYRS → LIBC

Now, PMFG → ZWPQ

Now, applying the same logic for TQJK:

So, TQJK → DATU

Hence, the correct answer is Option 4.

Q76. Answer: (c) PSPR

The logic followed here is:

For, KNKM → LOLN

Now, ILIK → JMJL

Now, applying the same logic for OROQ:

So, OROQ → PSPR

Hence, the correct answer is Option 3.

Q77. Answer: (c) 3

Given: (Left) 3215674 (Right)

Now,

We need to modify each digit based on its parity and then identify the required position.

So, the required logic is:

Odd digit → Digit + 1

Even digit → Digit − 1

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

Original Digit	Parity	Operation	New Digit
3	Odd	+1	4
2	Even	−1	1
1	Odd	+1	2
5	Odd	+1	6
6	Even	−1	5
7	Odd	+1	8
4	Even	−1	3

New number formed: 4 1 2 6 5 8 3

First digit from the right = 3

Hence, the correct answer is "Option 3".

Q78. Answer: (d) 10

BODMAS Table:

Given equation: 42 A 6 D 5 B 3 C 18 = ?

Now, replacing the symbols as:

Symbol	A	B	C	D

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Replaced by	÷	×	•	−

=> 42 ÷ 6 − 5 × 3 + 18 = ?

=> 7 − 5 × 3 + 18 = ?

=> 7 − 15 + 18 = ?

=> −8 + 18 = ?

=> 10

Hence, the correct answer is Option 4.

Q79. Answer: (d) 6

Given: (Left) 31264759 (Right)

Now,

We need to modify each digit based on its parity and then find the required positional sum.

So, the required logic is:

Even digit → Digit + 2

Odd digit → Digit − 1

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

Original Digit	Parity	Operation	New Digit
3	Odd	−1	2
1	Odd	−1	0
2	Even	+2	4
6	Even	+2	8
4	Even	+2	6
7	Odd	−1	6
5	Odd	−1	4
9	Odd	−1	8

New number formed: 2 0 4 8 6 6 4 8

Second digit from the left = 0

Third digit from the right = 6

Now, Sum = 0 + 6 = 6

Hence, the correct answer is "Option 4".

Q80. Answer: (c) Father’s brother

Family Chart:

Symbol	•	−	×	÷
Meaning	Brother	Husband	Sister	Mother

Given: P + Q − R ÷ S × T

It means: P is the brother of Q, Q is the husband of R, R is the mother of S, S is the sister of T.

Here, P is related to T as Father’s brother

Hence, the correct answer is Option 3.

Q81. Answer: (b) Jyothi Yarraji

The correct answer is Jyothi Yarraji.

Key Points

• Jyothi Yarraji successfully defended her gold medal in the women's 100 m hurdles during the Asian Athletics Championships held in May 2025.

• She achieved a remarkable timing of 12.96 seconds, which set a new Championships record for the event.

• By clocking 12.96 s, she became the first woman in the history of the Asian Athletics Championships to dip below the previous record in this specific category, further cementing her dominance in Asian hurdles.

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• This victory represents a significant title defense, as she had previously won the top spot in the earlier edition of the continental meet, proving her consistency and elite form.

• Her performance was a highlight for the Indian contingent, contributing to the nation's gold medal tally and securing her path toward global qualification standards.

Additional Information

• Jyothi Yarraji:

• She is a premier Indian sprinter specializing in the 100 m hurdles and hails from Visakhapatnam, Andhra Pradesh.

• She has been a consistent national record holder and was the first Indian woman to run the 100 m hurdles in under 13 seconds.

• Her training is often supported by the Reliance Foundation Athletics High-Performance Centre, which has played a crucial role in her technical development.

• Other Athletes Mentioned:

• Vithya Ramraj: An Indian athlete known for her prowess in the 400 m hurdles and 400 m sprint. She famously equaled P.T. Usha’s long-standing national record in 2023.

• Anu Raghavan: A seasoned 400 m hurdles specialist who has represented India at various international platforms, including the Asian Games and previous Asian Championships.

• Pooja Singh: A rising star in Indian athletics, primarily known for her achievements in the High Jump event rather than hurdles.

• Asian Athletics Championships:

• It is a biennial event organized by the Asian Athletics Association.

• The event serves as a platform for athletes from across Asia to compete for continental titles and gain ranking points for the World Athletics Championships and the Olympic Games.

• The 100 m hurdles for women is a standard track event where athletes must clear ten hurdles of 83.8 cm height over a 100-meter straight track.

Q82. Answer: (a) Kuno National Park, Madhya Pradesh

The correct answer is option1. The detailed solution will be updated soon.

Q83. Answer: (b) August 2025

The correct answer is August 2025.

Key Points

• The 130th Constitutional Amendment Bill was officially introduced in the Lok Sabha (the Lower House of Parliament) in August 2025.

• Constitutional amendments in India are carried out under the provisions of Article 368, which empowers the Parliament to amend the Constitution of India while maintaining its basic structure.

• This specific bill represents a significant legislative step, typically introduced by a Union Minister to address pressing administrative, social, or political requirements that necessitate a formal change in the constitutional text.

• The introduction of a Constitutional Amendment Bill in the Lok Sabha marks the beginning of a rigorous legislative process involving multiple readings, detailed discussions, and a specific voting pattern.

• To pass, such a bill requires a special majority, which entails a majority of the total membership of the House and a majority of not less than two-thirds of the members present and voting.

Additional Information

• Article 368 of the Constitution:

• Located in Part XX, this article provides the Parliament with the authority to amend the Constitution by way of addition, variation, or repeal.

• There are three types of amendments: those requiring a simple majority (like creating new states under Article 3), those requiring a special majority, and those requiring a special majority plus ratification by at least half of the state legislatures.

• The Process of Amendment:

• An amendment bill can be initiated in either the Lok Sabha or the Rajya Sabha; however, it cannot be introduced in state legislatures.

• Unlike ordinary bills, there is no provision for a joint sitting of the two houses if there is a disagreement over a Constitutional Amendment Bill. Each house must pass it independently.

• The President of India must give assent to the bill once it is passed by both houses; the President cannot return the bill for reconsideration or withhold assent.

• Difference Between Bill and Act:

• A Bill is a draft legislative proposal. It becomes an Act (Law) only after it is passed by the Parliament and receives the Presidential Assent.

• The numbering of Constitutional Amendment Bills (like the 130th Bill) is often higher than the numbering of Constitutional

Amendment Acts because some bills fail to pass or are withdrawn.

Important Points

• Legislative Timeline: The introduction in August 2025 coincides with the Monsoon Session of Parliament, a period typically used for significant legislative business.

• Judicial Oversight: Any amendment passed by the Parliament is subject to Judicial Review by the Supreme Court. The court ensures that the amendment does not violate the Basic Structure Doctrine established in the Kesavananda Bharati case (1973).

• Special Majority Requirements: For the 130th Bill to progress, it must secure the support of more than 50% of the total strength of the Lok Sabha and 66.6% of those attending and voting on the day of the division.

• Federal Consent: If the 130th Amendment Bill affects the powers of the states, the Election Commission, or the High Courts, it would require ratification by the legislatures of 14 or more states before reaching the President.

Q84. Answer: (d) Riyadh, Saudi Arabia

The correct answer is Riyadh, Saudi Arabia.

Key Points

• The city of Riyadh, the capital of Saudi Arabia, is designated to host the WWE Night of Champions event on June 28, 2025.

• This event is part of the long-term strategic partnership between WWE (World Wrestling Entertainment) and the Saudi General Entertainment Authority (GEA).

• The Night of Champions is a specialized Premium Live Event (PLE) where, traditionally, every active championship in the WWE roster is defended.

• The scheduling of this event in June 2025 follows the pattern of WWE hosting at least two major international events in the Kingdom annually, contributing to the Riyadh Season and other national festivities.

• The hosting of such global sporting spectacles is a key component of Saudi Arabia's effort to become a premier destination for international entertainment and sports tourism.

Additional Information

• WWE-Saudi Arabia Partnership:

• In 2018, WWE entered into a 10-year multi-platform strategic partnership with the General Entertainment Authority to support Saudi Vision 2030.

• Previous high-profile events held under this agreement include the Greatest Royal Rumble, Crown Jewel, Super ShowDown, and Elimination Chamber.

• The partnership has seen WWE evolve its programming in the region, including the historic participation of female athletes in matches since 2019.

• General Entertainment Authority (GEA):

• The GEA was established in 2016 by royal decree to regulate and develop the entertainment sector in Saudi Arabia.

• Under the leadership of Chairman Turki Alalshikh, the authority has secured massive deals with global entities like WWE, UFC, and major Boxing promoters.

• The initiatives are designed to diversify the nation's economy away from oil, a core pillar of the Saudi Vision 2030 plan.

• Significance of Night of Champions:

• First introduced as Vengeance: Night of Champions in 2007, the event became a standalone PLE focused on championship gold.

• In 2023, the event was held in Jeddah, Saudi Arabia, featuring the crowning of the inaugural World Heavyweight Champion.

Important Points

• Venue and Infrastructure: Riyadh offers world-class venues such as the Kingdom Arena and the Mohammed Abdo Arena, which are equipped with state-of-the-art technology for global broadcasting.

• Economic Impact: These events draw thousands of international tourists to Saudi Arabia, boosting the local hospitality, transport, and retail sectors.

• Global Reach: WWE broadcasts its events to over 180 countries in 25 languages, providing significant international exposure to the host city of Riyadh.

• King and Queen of the Ring: In addition to Night of Champions, Riyadh recently hosted the King and Queen of the Ring in May 2024, showcasing the city's capability to handle frequent large-scale productions.

Q85. Answer: (d) Viksit Bharat Young Leaders Dialogue – 2026

The correct answer is Viksit Bharat Young Leaders Dialogue – 2026.

Key Points

• The Ministry of Youth Affairs & Sports officially announced the second edition of the Viksit Bharat Young Leaders Dialogue – 2026 on 13 September 2025.

• This initiative is a cornerstone of the government's efforts to engage the youth of India in the vision of making the country a

developed nation by 2047.

• The 2026 edition is specifically designed to achieve higher participation compared to its predecessor, featuring new tracks for engagement and a significantly broader outreach across rural and urban sectors.

• The event serves as a platform for young leaders to interact directly with policymakers and contribute their innovative ideas for national development under the Viksit Bharat agenda.

• Registration and participation for this mega-event are primarily facilitated through the MY Bharat (Mera Yuva Bharat) portal, which acts as a digital ecosystem for youth empowerment.

• The dialogue aims to identify and nurture leadership qualities among the Yuva Shakti, encouraging them to take ownership of the country's transformation during the Amrit Kaal.

Additional Information

• Viksit Bharat @2047:

• It is the Government of India’s ambitious roadmap to transform the nation into a developed entity by the 100th year of independence in 2047.

• The vision encompasses various facets of development, including economic growth, social progress, environmental sustainability, and good governance.

• MY Bharat (Mera Yuva Bharat) Platform:

• Launched on 31 October 2023, coinciding with National Unity Day, this platform serves as an autonomous body to provide equitable opportunities for youth.

• It targets individuals in the age group of 15-29 years (and 10-19 years for specific components) to help them transition from "passive recipients" to "active drivers" of development.

• The platform has successfully registered millions of users, creating a bridge between youth aspirations and government initiatives.

• Ministry of Youth Affairs & Sports:

• The ministry plays a pivotal role in creating an environment where the youth can realize their full potential through programs like NSS (National Service Scheme) and NYKS (Nehru Yuva Kendra Sangathan).

• By organizing events like the Young Leaders Dialogue, the ministry ensures that youth-led development becomes a reality in India.

Important Points

• The second edition focuses on decentralized participation, ensuring that voices from districts and villages are represented at the National Level.

• The Dialogue typically includes thematic workshops, brainstorming sessions, and keynote addresses by eminent personalities and Union Ministers.

• Inclusion of new tracks in 2026 suggests a shift toward specialized areas such as Digital Transformation, Green Energy, and Social Entrepreneurship.

• The event reinforces the concept of Jan Bhagidari (People's Participation), which is essential for the success of national missions.

Q86. Answer: (a) All Insurers and Reinsurers

The correct answer is All Insurers and Reinsurers.

Key Points

• The Insurance Regulatory and Development Authority of India (IRDAI) issued a high-priority advisory in June 2025 following the tragic crash of Air India flight AI-171.

• This advisory was specifically directed toward All Insurers and Reinsurers operating within the Indian jurisdiction to ensure a unified and rapid response to the catastrophe. Hence, option 1 is correct.

• The primary objective of this directive was to facilitate the immediate settlement of insurance claims for the families of the deceased and the injured passengers.

• IRDAI instructed companies to simplify the documentation process, suggesting that official passenger manifests or reports from government authorities be accepted in lieu of standard death certificates to avoid administrative delays.

• The inclusion of Reinsurers in the advisory is significant because aviation insurance involves high-value risks that are typically shared with reinsurance companies globally and domestically, such as GIC Re.

• Insurers were also mandated to set up 24/7 dedicated helpdesks and appoint senior-level nodal officers to oversee the claim disposal process related to the AI-171 crash.

Additional Information

• About IRDAI:

• The Insurance Regulatory and Development Authority of India (IRDAI) is a statutory body established under the IRDA Act, 1999.

• It functions as the apex regulator for both the Life Insurance and General Insurance sectors in India, including reinsurance

companies.

• The authority was formed based on the recommendations of the Malhotra Committee report of 1994.

• Its headquarters were shifted from Delhi to Hyderabad, Telangana, in the year 2001.

• Composition of the Authority:

• According to Section 4 of the IRDAI Act, 1999, the body consists of a Chairman, five full-time members, and four part-time members, all appointed by the Government of India.

• Classification of Stakeholders:

• Life Insurers: Entities that provide coverage against the risk of human life. In major accidents, they process death benefits and personal accident claims.

• General Insurers: Entities that cover non-life assets. In the context of Air India AI-171, these companies handle Aviation Hull Insurance (the aircraft itself) and Liability Insurance for third parties and cargo.

• Reinsurers: These are companies that provide insurance to the insurance companies themselves. They help manage financial stability when a massive loss occurs, such as a large-scale aviation disaster.

• Aviation Insurance Norms:

• The Montreal Convention often governs the liability limits for international flights, ensuring that victims receive standardized compensation regardless of the airline's specific fault.

• IRDAI ensures that Indian carriers maintain adequate insurance protection to meet these international and domestic obligations.

Important Points

• The June 2025 advisory emphasized the "customer-first" approach, urging General Insurers to settle hull claims quickly so the airline could maintain operational continuity while Life Insurers focused on beneficiary payouts.

• By addressing all stakeholders, IRDAI prevents reinsurance disputes from stalling the payment of primary claims to the victims' families.

• In India, the General Insurance Corporation of India (GIC Re) serves as the sole domestic reinsurer, often leading the reinsurance treaty for national carriers like Air India.

Q87. Answer: (d) 5

The correct answer is 5.

Key Points

• The Indian Men’s Junior Hockey Team has won the Junior Asia Cup a total of 5 times as of June 2025.

• India secured its fifth title in December 2024 by defeating arch-rivals Pakistan with a score of 5-3 in the final held in Muscat, Oman.

• With this victory, India became the most successful team in the history of the tournament, surpassing Pakistan’s record of three titles.

• The five years in which India emerged as champions are 2004, 2008, 2015, 2023, and 2024.

• In the 2024 edition, Arshdeep Singh was a standout performer, scoring a hat-trick in the final match to secure India's dominance in Asian junior hockey. Hence, the correct option is 5.

Additional Information

• Men's Junior Asia Cup Overview:

• The Men's Junior Asia Cup is an international under-21 field hockey tournament organized by the Asian Hockey Federation (AHF).

• The tournament was first held in 1988 in Karachi, Pakistan, where the hosts emerged as the inaugural champions.

• It serves as a primary qualification tournament for the FIH Hockey Men's Junior World Cup, with the top-ranked teams earning a spot on the global stage.

• Tournament History and Rivalry:

• India and Pakistan have been the most dominant forces in this competition. While India holds 5 titles, Pakistan has won the trophy 3 times (1988, 1992, and 1996).

• Other nations that have tasted success include South Korea, which won the tournament in 2000.

• The 2023 edition was held in Salalah, Oman, where India defeated Pakistan 2-1 in the final to claim their fourth title.

• Indian Hockey Development:

• Success at the Junior Asia Cup is a testament to the robust grassroots development and academy structures in India, such as the Odisha Naval Tata Hockey High Performance Centre.

• Many players from the junior winning squads, such as Harmanpreet Singh (from the 2015 batch), have transitioned to become world-class players for the Indian Senior National Team.

• The Government of India, through the Ministry of Youth Affairs and Sports and the Sports Authority of India (SAI), provides extensive funding and training facilities for these young athletes.

Important Points

• Host Nations: Oman has become a frequent host for the tournament in recent years, successfully organizing both the 2023 and 2024 editions in Salalah and Muscat respectively.

• Qualification Impact: By reaching the final of the 2024 Junior Asia Cup, India confirmed its berth for the 2025 FIH Hockey Men's Junior World Cup.

• Record Win Streak: India’s victory in 2024 marked their second consecutive title win (2023 and 2024), demonstrating their current era of supremacy in the under-21 category across Asia.

Q88. Answer: (a) Shooting

The correct answer is Shooting.

Key Points

• The ISSF World Cup was introduced by the International Shooting Sport Federation in 1986.

• The primary objective of establishing the World Cup was to provide a homogeneous system for qualification for the Olympic Games in shooting events.

• It comprises multiple stages held annually in different countries across the globe, featuring competitions in Rifle, Pistol, and Shotgun categories.

• The ISSF World Cup Finals are held at the end of the competition year, where the top-performing shooters of the season compete for the prestigious titles.

• The International Shooting Sport Federation (ISSF) is the governing body for Olympic shooting events and is headquartered in Munich, Germany.

• Hence, the correct answer is Shooting.

Additional Information

• International Shooting Sport Federation (ISSF):

• The organization was founded in 1907 as the International Shooting Union (UIT) and later changed its name to ISSF in 1998.

• It currently recognizes over 150 national shooting federations as members. The current President of the ISSF is Luciano Rossi, who took office in December 2022.

• Swimming:

• Swimming is globally governed by World Aquatics (formerly known as FINA - Fédération Internationale de Natation), which was founded in 1908.

• Major international events include the World Aquatics Championships and the FINA Swimming World Cup, which is a series of short-course (25m) meets.

• Squash:

• Squash is governed by the World Squash Federation (WSF), which is recognized by the International Olympic Committee (IOC).

• The professional circuit is managed by the Professional Squash Association (PSA), featuring the PSA World Championships as its pinnacle event.

• Skiing:

• Skiing events, including Alpine, Cross-Country, and Ski Jumping, are governed by the International Ski and Snowboard Federation (FIS).

• The FIS was founded in 1924 during the first Olympic Winter Games in Chamonix, France.

Important Points

• Shooting in the Olympics: Shooting has been part of the Modern Olympic Games since the first edition in Athens 1896, except for the 1904 and 1928 editions.

• India's Success: India has a strong legacy in ISSF events. Notable athletes like Abhinav Bindra (the first Indian to win an individual Olympic gold in 2008), Rajyavardhan Singh Rathore, Gagan Narang, and Manu Bhaker have brought international acclaim to the country in this sport.

• ISSF World Championships: Unlike the World Cup which is held annually with multiple stages, the ISSF World Shooting Championships are held every four years and are considered the most prestigious event after the Olympics.

• Disciplines: The Rifle and Pistol events are usually conducted at indoor or semi-outdoor ranges at distances of 10m, 25m, and 50m, while Shotgun events (Skeet and Trap) take place at outdoor ranges.

Q89. Answer: (b) 6.00%

The correct answer is 6.00%.

Key Points

• The 54th meeting of the Monetary Policy Committee (MPC) was conducted by the Reserve Bank of India (RBI) in April 2025 to review the prevailing macroeconomic conditions and determine the key policy rates for the financial year 2025-26.

• Following the deliberations of the committee, the RBI announced a reduction in the policy repo rate, bringing it down to 6.00%.

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This decision represented a significant shift from the previous rate of 6.5% which had been maintained for several preceding quarters.

• The reduction of 50 basis points in the repo rate was aimed at stimulating economic growth and incentivizing investment by lowering the cost of borrowing for commercial banks and, subsequently, for businesses and individual consumers.

• Alongside the repo rate, the committee also adjusted the Standing Deposit Facility (SDF) rate to 5.75% and the Marginal Standing Facility (MSF) rate to 6.25%, maintaining the standard corridor width.

• The MPC, led by the RBI Governor, noted that while inflation was showing signs of stabilization within the target range, the move to 6.00% was necessary to provide a cushion against global economic headwinds. Hence, the correct answer is 6.00%.

Additional Information

• Repo Rate and Its Function:

• The Repo Rate (Repurchase Option) is the interest rate at which the Reserve Bank of India lends money to commercial banks in the event of any shortfall of funds.

• It is used by monetary authorities to control inflation. When inflation is high, the RBI increases the repo rate to reduce liquidity in the economy; conversely, it lowers the rate to inject liquidity and spur GDP growth.

• The Monetary Policy Committee (MPC):

• The MPC is a statutory body constituted under the Reserve Bank of India Act, 1934, following an amendment in 2016.

• It consists of 6 members: the Governor of the RBI (Chairperson, ex officio), the Deputy Governor in charge of monetary policy, one officer of the RBI nominated by the Central Board, and three external members appointed by the Government of India.

• The committee is mandated to meet at least four times a year, though it usually meets bi-monthly (six times a year) to publish the Monetary Policy Report.

• Monetary Policy Stance:

• The MPC often adopts specific "stances" such as Accommodative (aimed at growth), Neutral (no specific direction), or Hawkish/Withdrawal of Accommodation (aimed at curbing inflation).

• A rate cut to 6.00% typically aligns with an accommodative stance to ensure that the banking system has enough liquidity to support credit flow.

• Inflation Targeting:

• The Government of India, in consultation with the RBI, sets a Consumer Price Index (CPI) inflation target.

• The current target is 4% with a tolerance band of +/- 2%, meaning inflation should ideally remain between 2% and 6%.

Important Points

• Standing Deposit Facility (SDF): This replaced the Reverse Repo Rate as the floor of the Liquidity Adjustment Facility (LAF) corridor. It allows the RBI to absorb liquidity from banks without providing collateral.

• Marginal Standing Facility (MSF): A window for banks to borrow from the RBI in an emergency situation when inter-bank liquidity dries up completely. It is usually set 25 basis points above the Repo Rate.

• Basis Points (bps): In finance, 100 basis points equal 1%. Therefore, a 50 bps cut means a 0.50% reduction in the rate.

Q90. Answer: (b) 27

The correct answer is 27.

Key Points

• The Indian Shuttlers delivered an extraordinary performance at the Asian Para-Badminton Championship 2025, which was held in Pattaya, Thailand.

• India finished the prestigious tournament with a total of 27 medals, marking one of the most successful outings for the Indian contingent in the history of the continental championships.

• The medal tally consisted of 9 Gold, 8 Silver, and 10 Bronze medals, showcasing India's dominance in various classifications of para-badminton.

• This stellar achievement placed India at the top of the medal table, ahead of traditional powerhouses like China and Japan in several categories.

• Key athletes who contributed to this tally include prominent names such as Pramod Bhagat, Suhas Yathiraj, Nitesh Kumar, and Krishna Nagar, who secured victories in their respective Singles and Doubles events.

Additional Information

• Asian Para-Badminton Championship:

• This is a premier biennial event organized to provide a platform for elite para-athletes across Asia to compete and gain crucial ranking points for Paralympic qualification.

• The 2025 edition in Thailand saw participation from over 20 countries, featuring various impairment groups including wheelchair and standing categories.

• Classification in Para-Badminton:

• Athletes are divided into six classes: WH1 and WH2 for wheelchair users, SL3, SL4, and SU5 for standing players with limb impairments, and SH6 for short stature athletes.

• India's strength is particularly notable in the SL3 and SL4 categories, where players like Suhas L. Yathiraj (an IAS officer and Paralympic medalist) have consistently performed at the world stage.

• Significance of the 2025 Win:

• The total of 27 medals represents a significant growth from previous editions, reflecting the impact of government initiatives like the Target Olympic Podium Scheme (TOPS) and the Khelo India program.

• The 9 Gold medals won in 2025 highlight the depth of talent in the Indian squad, as multiple athletes managed to reach the podium across different age groups and skill levels.

• Recent Trends in Indian Para-Sports:

• Since the Tokyo 2020 Paralympics, where India won 19 medals, there has been a massive surge in the infrastructure and funding for para-badminton.

• Badminton Association of India (BAI) and the Paralympic Committee of India (PCI) work in tandem to scout talent from rural areas and provide them with international-standard training facilities.

Important Points

• Tournament Venue: The 2025 event was hosted at Pattaya, which has become a major hub for international para-sports in Southeast Asia.

• Performance Comparison: In the previous 2023 cycle, India had a strong showing, but the 27 medals in 2025 set a new national record for the highest number of medals in a single Asian Championship.

• Governing Bodies: The event is sanctioned by the Badminton World Federation (BWF) and the Asian Paralympic Committee, ensuring rigorous anti-doping and fair-play standards are maintained throughout the competition.

Q91. Answer: (a) Chandoli National Park

The correct answer is Chandoli National Park.

Key Points

• In November 2025, as part of a significant conservation initiative, 79 spotted deer (also known as Chital) were successfully translocated to Chandoli National Park in Maharashtra.

• The primary objective of this relocation is to augment the prey base within the park, which is a critical component of the Sahyadri Tiger Reserve (STR).

• This translocation project was executed by the Maharashtra Forest Department to ensure a sustainable population of herbivores, which is essential for the survival and potential reintroduction of large carnivores like Tigers in the region.

• The 79 spotted deer were moved from overpopulated areas or zoological facilities, such as the Rajiv Gandhi Zoological Park in Katraj, Pune, to the wild habitat of Chandoli.

• The process involved advanced scientific methods for capture and transport to minimize stress and ensure the high survival rate of the animals during the wildlife management operation. Hence, the correct answer is Chandoli National Park.

Additional Information

• Chandoli National Park:

• Located in the Western Ghats, it spans across the districts of Sangli, Satara, Kolhapur, and Ratnagiri in the state of Maharashtra.

• It was established as a Wildlife Sanctuary in 1985 and later declared a National Park in May 2004.

• In 2010, it was merged with the Koyna Wildlife Sanctuary to form the Sahyadri Tiger Reserve, which is one of the few tiger reserves in the world located in a UNESCO World Heritage Site.

• The park is home to diverse fauna, including the Indian Bison (Gaur), Leopards, Sloth Bears, and various species of deer and antelopes.

• Spotted Deer (Axis axis):

• Commonly known as Chital, they are native to the Indian subcontinent and are characterized by their golden-brown coat with white spots.

• They play a vital role in the ecosystem as a primary prey species for major predators like Tigers, Leopards, and Dholes.

• They prefer open grasslands and semi-evergreen forests, making the habitat of Chandoli an ideal environment for their propagation.

• Sahyadri Tiger Reserve (STR):

• The reserve is unique due to its rugged terrain and high-altitude evergreen forests, providing a safe corridor for wildlife movement between the northern and southern Western Ghats.

• Recent conservation efforts have focused on habitat restoration and prey-base enrichment to make the reserve a viable home for Big Cats.

Important Points

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• Conservation Impact: Increasing the number of herbivores like spotted deer helps in reducing man-animal conflict in peripheral areas by keeping predators within the protected forest boundaries.

• Geographical Significance: Chandoli National Park is located near the Warna River and includes the Chandoli Dam, which serves as a major water source for the local wildlife.

• Other Options:

• Sultanpur National Park is a famous bird sanctuary located in Haryana.

• Kaziranga National Park in Assam is world-renowned for its One-horned Rhinoceros.

• Keoladeo National Park in Rajasthan is a premier avifauna sanctuary and a UNESCO World Heritage Site.

Q92. Answer: (c) 2nd Edition

The correct answer is 2nd Edition.

Key Points

• The World Health Organization (WHO), in collaboration with the Ministry of Ayush, will organize the 2nd WHO Global Summit on Traditional Medicine in New Delhi.

• The summit is scheduled to be held in December 2025, serving as a major global platform to discuss the future of Traditional, Complementary, and Integrative Medicine (TCIM).

• The primary objective of the 2025 Summit is to build on the momentum generated during the inaugural event to further integrate traditional medicine into national health systems and global health policies.

• It aims to showcase evidence-based traditional medicine and foster international cooperation to meet the United Nations Sustainable Development Goals (SDGs) related to health and well-being.

• India’s role as the host reinforces its position as a global hub for traditional healthcare practices like Ayurveda, Yoga, and Unani, supported by modern scientific validation.

Additional Information

• 1st WHO Global Summit on Traditional Medicine:

• The first-ever global summit was held on 17-18 August 2023 in Gandhinagar, Gujarat, India.

• It was organized alongside the G20 Health Ministers’ Meeting under India’s G20 Presidency.

• The outcome document of this summit was the Gujarat Declaration, which committed to utilizing the potential of traditional medicine through science, technology, and innovation.

• WHO Global Centre for Traditional Medicine (GCTM):

• Established in Jamnagar, Gujarat, the GCTM is the first and only global outpost for traditional medicine by the WHO.

• The foundation stone was laid by Prime Minister Narendra Modi and WHO Director-General Dr. Tedros Adhanom Ghebreyesus in April 2022.

• It focuses on four main strategic areas: Evidence and learning, Data and analytics, Sustainability and equity, and Innovation and technology.

• Ministry of Ayush:

• The Ministry of AYUSH was formed on 9th November 2014 to ensure the optimal development and propagation of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homoeopathy.

• The ministry plays a pivotal role in regulating the standards of education and research in traditional Indian medicine systems.

• Global Importance of Traditional Medicine:

• According to WHO data, nearly 80% of the world's population uses traditional medicine in some form.

• Traditional medicine is an important pillar of Universal Health Coverage (UHC) and is increasingly being scrutinized through the lens of biodiversity conservation and intellectual property rights.

Important Points

• The World Health Organization (WHO) was established on 7 April 1948, and its headquarters is located in Geneva, Switzerland.

• The current Director-General of WHO is Dr. Tedros Adhanom Ghebreyesus, who has been a strong advocate for integrating traditional medicine with modern healthcare.

• The International Day of Yoga, celebrated annually on June 21, is one of India's most successful global traditional medicine and wellness initiatives recognized by the United Nations.

• The December 2025 summit in New Delhi is expected to see participation from health ministers, scientists, and traditional medicine practitioners from over 190 countries.

Q93. Answer: (d) NITI Aayog

The correct answer is NITI Aayog.

Key Points

• The report titled ‘India’s Blue Economy: Strategy for Harnessing Deep-Sea and Offshore Fisheries’ was released by NITI Aayog

in October 2025.

• The primary objective of this report is to provide a comprehensive roadmap for the sustainable development of India's maritime resources, specifically focusing on the untapped potential of deep-sea fishing and offshore fisheries.

• It highlights the strategic importance of the Blue Economy in achieving the goal of a Viksit Bharat (Developed India) by 2047, emphasizing economic growth alongside environmental conservation.

• The document identifies critical gaps in the current fisheries sector, such as the lack of advanced technology, limited financial investment in deep-sea vessels, and the need for better post-harvest infrastructure like cold storage and processing units.

• Through this strategy, NITI Aayog aims to enhance the livelihoods of the coastal communities and increase the contribution of the fisheries sector to the national GDP.

Additional Information

• Blue Economy:

• The term refers to the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem.

• India has a vast coastline of approximately 7,517 km and an Exclusive Economic Zone (EEZ) spanning over 2.02 million square kilometers, offering immense marine wealth.

• NITI Aayog (National Institution for Transforming India):

• Established on January 1, 2015, it serves as the premier policy think tank of the Government of India, replacing the erstwhile Planning Commission.

• It operates on the principle of cooperative federalism and provides strategic and technical advice to the central and state governments.

• Relevant Organizations in the Sector:

• National Fisheries Development Board (NFDB): Established in 2006 with headquarters in Hyderabad, it works under the Ministry of Fisheries, Animal Husbandry, and Dairying to enhance fish production.

• Marine Products Export Development Authority (MPEDA): Formed in 1972 under the Ministry of Commerce and Industry, it focuses on the export promotion of marine products from India.

• Deep-Sea Fishing vs. Coastal Fishing:

• Coastal fishing is generally limited to 12 nautical miles from the shore, whereas deep-sea fishing involves operating in deeper waters, usually beyond the continental shelf, targeting species like tuna and oceanic squids.

• India's deep-sea resources remain underutilized because a majority of the traditional fishing fleet consists of small, motorized boats incapable of staying at sea for extended periods.

Important Points

• Pradhan Mantri Matsya Sampada Yojana (PMMSY): This is a flagship scheme launched in May 2020 to bring about a Blue Revolution through sustainable and responsible development of the fisheries sector with an investment of over Rs. 20,000 crores.

• Employment Potential: The fisheries sector in India provides employment to more than 28 million people, particularly within marginalized coastal communities.

• Global Standing: India is currently the third-largest fish-producing country and the second-largest aquaculture nation in the world.

• Sustainable Development Goals (SDG): The Blue Economy strategy aligns with SDG 14, which aims to "conserve and sustainably use the oceans, seas, and marine resources for sustainable development."

Q94. Answer: (a) Foundational (Classes 1–5)

The correct answer is Foundational (Classes 1–5).

Key Points

• The Pupil-Teacher Ratio (PTR) is a critical indicator of the quality of education, representing the average number of students assigned to a single teacher. A lower ratio typically indicates better individual attention for students.

• According to the UDISE+ 2024–25 (Unified District Information System for Education Plus) report, the Foundational level (Classes 1–5) demonstrated the most favorable PTR compared to other levels of schooling. Hence, statement 1 is correct.

• The improvement in PTR at the Foundational stage is largely attributed to the government's focus on Foundational Literacy and Numeracy (FLN) under the NIPUN Bharat Mission, which necessitates manageable class sizes.

• For the Secondary level (Classes 9–12), while there has been significant improvement over the years, the ratio remains slightly higher than the foundational stage due to the requirement for subject-specific teachers for various streams. Hence, statement 2 is incorrect.

• The Middle level (Classes 6–8), often referred to as Upper Primary, also maintains a steady PTR but it has traditionally been higher than the primary/foundational levels in the national average statistics. Hence, statement 3 is incorrect.

• The Preparatory stage, which in the NEP 2020 structure encompasses classes 3–5, is often grouped with foundational data in UDISE+ reporting; however, as an independent option listed for classes 6–8, it does not hold the best ratio. Hence, statement 4 is incorrect.

Additional Information

• UDISE+ (Unified District Information System for Education Plus):

• It was launched in 2018-19 by the Ministry of Education to collect real-time data and act as a specialized tool for the planning and monitoring of the school education system in India.

• The system covers more than 14.89 lakh schools, 95 lakh teachers, and over 26.5 crore students from pre-primary to higher secondary levels.

• RTE Act 2009 Norms:

• The Right to Education Act (2009) mandates a PTR of 30:1 for Primary schools (Classes 1–5) and 35:1 for Upper Primary schools (Classes 6–8).

• India has consistently worked towards these targets, with most states now performing better than the minimum 30:1 requirement at the foundational level.

• NEP 2020 Structural Changes:

• The National Education Policy 2020 introduced a 5+3+3+4 structure, replacing the old 10+2 system.

• The Foundational Stage (5 years) includes 3 years of Anganwadi/Pre-school followed by Classes 1 and 2.

• The policy emphasizes that for Socio-Economically Disadvantaged Groups (SEDGs), the PTR should ideally be 25:1.

Important Points

• Impact of PTR: A healthy PTR at the Foundational level (ages 3–8) is vital because this is the critical window for cognitive development and basic skill acquisition.

• Teacher Availability: The UDISE+ 2024-25 report indicates a steady increase in the total number of teachers, which has directly contributed to the optimization of PTR across Government, Aided, and Private schools.

• Digital Integration: The report also tracks the Computer-to-Pupil Ratio and Internet Access, showing that improvements in physical infrastructure and human resources (teachers) are moving in tandem to improve learning outcomes.

Q95. Answer: (d) Samba Mahsuri

The correct answer is Samba Mahsuri.

Key Points

• DRR Dhan 100 (Kamala) is an advanced genome-edited rice variety that was developed by scientists at the ICAR-Indian Institute of Rice Research (IIRR), located in Hyderabad.

• It is a derivative of the popular elite rice variety Samba Mahsuri (also known as BPT 5204), which is highly favored by farmers and consumers across India for its excellent cooking quality and fine grain.

• The variety was developed using CRISPR/Cas9 gene-editing technology to specifically target and knock out the GW2 gene (Grain Weight 2), which acts as a negative regulator of grain size.

• By editing this specific gene, researchers successfully increased the grain weight and yield of the plant without introducing any foreign genetic material, ensuring it remains non-transgenic.

• This breakthrough, highlighted in reports around May 2025, marks a significant milestone in Indian agriculture as it is one of the first few crops developed under the SDN-1 (Site-Directed Nuclease-1) category to reach advanced stages.

Additional Information

• Samba Mahsuri (BPT 5204):

• It is a "mega-variety" known for its medium-slender grains and high market demand.

• Despite its popularity, it is susceptible to several biotic stresses, leading researchers to use it as a base for various improvements, including the Improved Samba Mahsuri (resistant to Bacterial Blight).

• Genome Editing Technology:

• Unlike Genetically Modified Organisms (GMOs), genome editing (specifically SDN-1 and SDN-2) does not involve the permanent integration of foreign DNA.

• The Department of Biotechnology (DBT) and the Ministry of Environment, Forest and Climate Change issued guidelines in 2022 exempting such varieties from the stringent biosafety regulations applicable to transgenic crops.

• ICAR-IIRR:

• The Indian Council of Agricultural Research - Indian Institute of Rice Research is a premier national institute dedicated to rice research and was established as the All India Coordinated Rice Improvement Project (AICRIP) in 1965.

• Significance of the Name:

• The variety is officially designated as DRR Dhan 100, with the name Kamala added as a unique identifier for this genome-edited line.

Important Points

• The modification of the GW2 gene in DRR Dhan 100 typically results in an increase of approximately 10% to 15% in grain weight, significantly boosting the overall agricultural productivity.

• India is one of the leading countries adopting genome editing to ensure food security, following similar global trends in the USA, China, and Japan.

• The release of Kamala is expected to benefit thousands of farmers in states like Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu, where Samba Mahsuri is a staple crop.

• The May 2025 timeframe signifies the transition of these lab-developed varieties into multi-location field trials and eventual commercial cultivation under the updated regulatory framework.

Q96. Answer: (b) Chetna V

The correct answer is Chetna V.

Key Points

• Chetna V is a prodigious Bharatanatyam dancer who has been recognized for her exceptional skills and contribution to the classical arts at the young age of 14.

• In May 2025, she was conferred with the prestigious Nritya Kala Bhushan Bal Puraskar, an award dedicated to honoring "child jewels" (Bal Puraskar) who exhibit mastery in the field of classical dance.

• This recognition highlights her dedication to the Tanjore style or other specific lineages of Bharatanatyam, emphasizing her technical precision in Adavus (basic steps) and Abhinaya (expression).

• The award ceremony typically aims to encourage young artists to preserve the rich cultural heritage of India and serves as a platform for emerging talents to showcase their Arangetram-level proficiency.

• Recipients of such awards are often selected based on their performance consistency, stage presence, and their ability to convey complex mythological narratives through the medium of dance.

Additional Information

• Bharatanatyam:

• It is one of the oldest and most popular classical dance forms of India, originating from the state of Tamil Nadu.

• Traditionally performed by Devadasis in temples, it was formerly known as Sadir Attam.

• The dance is based on the principles of the Natya Shastra, an ancient Sanskrit text on performing arts attributed to Bharata Muni.

• It consists of three main elements: Nritta (pure dance), Nritya (solo dance with expressions), and Natya (group dramatic dance).

• Sudha Chandran:

• She is an accomplished Indian Bharatanatyam dancer and actress who gained international fame for continuing to dance using a Jaipur foot (prosthetic leg) after an accident.

• Her life story serves as a major inspiration in the world of performing arts.

• Ravi Shankar:

• Pandit Ravi Shankar was a world-renowned Sitar maestro and composer, not a dancer.

• He was instrumental in popularizing Indian classical music in the West and was a recipient of the Bharat Ratna in 1999.

• Other Classical Dances of India:

• Apart from Bharatanatyam, the Sangeet Natak Akademi recognizes other forms such as Kathak (Uttar Pradesh), Kathakali (Kerala), Kuchipudi (Andhra Pradesh), Odissi (Odisha), Sattriya (Assam), Manipuri (Manipur), and Mohiniyattam (Kerala).

Q97. Answer: (d) Atal Pension Yojana

The correct answer is Atal Pension Yojana.

Key Points

• Pradhan Mantri Virasat Ka Samvardhan (PM VIKAS) is an integrated scheme launched by the Ministry of Minority Affairs that aims to improve the livelihoods of minority communities, particularly artisan communities, through skill development, leadership training, and entrepreneurship.

• The scheme was formed by converging five erstwhile schemes of the Ministry: Seekho Aur Kamao, USTTAD, Hamari Dharohar, Nai Roshni, and Nai Manzil.

• Seekho Aur Kamao: This was a placement-linked skill development scheme for minority youth. It has been successfully integrated into PM VIKAS to provide market-oriented skills. Hence, option 1 is converged.

• Nai Roshni: This scheme focused on leadership development for minority women to empower them to interact with government systems and banks. It is now a component of the PM VIKAS framework. Hence, option 2 is converged.

• Hamari Dharohar: This scheme aimed at preserving the rich heritage and culture of minority communities in India. It has been brought under the umbrella of PM VIKAS to promote traditional arts and crafts. Hence, option 3 is converged.

• Atal Pension Yojana (APY): This is a social security scheme for the unorganized sector, administered by the Pension Fund Regulatory and Development Authority (PFRDA) under the Ministry of Finance. It is not part of the PM VIKAS convergence. Hence, option 4 is NOT converged.

• The PM VIKAS scheme is designed to target 6 notified minority communities (Muslims, Christians, Sikhs, Buddhists, Parsis, and

Jains) and focuses on the socio-economic development of these groups through a credit-linked livelihood approach.

Additional Information

• Pradhan Mantri Virasat Ka Samvardhan (PM VIKAS):

• It was announced in the Union Budget 2022-23 as a "Central Sector Scheme" implemented for the remaining period of the 15th Finance Commission.

• The scheme components include Skilling and Training, Leadership and Entrepreneurship (especially for women), and Education (for school dropouts).

• It aims to preserve and promote traditional arts and crafts while ensuring that artisans have access to modern marketing platforms and financial assistance.

• Atal Pension Yojana (APY):

• Launched on 9th May 2015 by Prime Minister Narendra Modi in Kolkata.

• It targets the unorganized sector workers between the age of 18 to 40 years.

• Subscribers receive a guaranteed minimum monthly pension of Rs. 1,000 to Rs. 5,000 after attaining the age of 60 years, depending on their contributions.

• Seekho Aur Kamao (Learn & Earn):

• Launched in September 2013, this scheme focused on youth aged 14 to 35 years.

• It aimed to reduce the unemployment rate of minorities and provide them with employment-linked certifications.

• Nai Roshni Scheme:

• Introduced in 2012-13, it targeted women aged 18 to 65 years.

• The goal was to instill confidence and provide knowledge on tools and techniques for interacting with various government tiers.

Important Points

• The PM VIKAS scheme emphasizes the Artisan Livelihood Component, which focuses on identifying handicraft clusters and providing them with technical training and business mentorship.

• The scheme seeks to increase the income levels of minority communities by bridging the gap between traditional skills and modern market demands.

• Nai Manzil, another converged scheme, specifically addressed the education and skill needs of school dropouts from minority communities, integrating them into the mainstream economy.

• The USTTAD (Upgrading the Skills and Training in Traditional Arts/Crafts for Development) component focuses on building a database of traditional artisans and conducting exhibitions like Hunar Haat.

Q98. Answer: (a) Indore

The correct answer is Indore.

Key Points

• Indore has secured the first rank in Category-1, which comprises cities with a population of over 10 lakh, in the Swachh Vayu Sarvekshan Awards 2025.

• In the same category, Agra (Uttar Pradesh) achieved the second position, while Surat (Gujarat) stood third. These rankings reflect the cities' outstanding performance in implementing the National Clean Air Programme (NCAP).

• The awards are an initiative by the Ministry of Environment, Forest and Climate Change (MoEFCC) to rank 131 cities across India based on their efforts to improve air quality through various administrative and field-level interventions.

• The evaluation for the 2025 awards was conducted based on the self-assessment reports submitted by the Urban Local Bodies (ULBs) on the PRANA portal, followed by a rigorous third-party verification process.

• The ranking system incentivizes cities to take proactive steps such as managing road dust, controlling vehicular emissions, and preventing the open burning of municipal solid waste. Hence, the correct answer is Indore.

Additional Information

• National Clean Air Programme (NCAP):

• Launched in January 2019, the NCAP is a long-term, time-bound national strategy to tackle the air pollution problem across the country in a comprehensive manner.

• The programme initially aimed for a 20% to 30% reduction in Particulate Matter (PM10 and PM2.5) concentrations by 2024, taking 2017 as the base year. The target was later revised to a 40% reduction by 2026.

• Swachh Vayu Sarvekshan Categorization:

• Cities are categorized into three groups based on their 2011 Census population to ensure fair competition.

• Category 1: Population over 10 lakh (includes 47 cities).

• Category 2: Population between 3 lakh and 10 lakh (includes 44 cities).

• Category 3: Population less than 3 lakh (includes 40 cities).

• Assessment Criteria:

• The ranking is based on eight major thematic areas: control of biomass and municipal solid waste burning, road dust management, dust from construction and demolition waste, vehicular emissions, industrial emissions, public awareness, and improvement in PM10 concentrations.

• Weightage is also given to the implementation of Information, Education, and Communication (IEC) activities and the improvement of air quality monitoring networks.

• Indore's Environmental Leadership:

• Indore, located in Madhya Pradesh, has consistently dominated environmental rankings in India. It has been awarded the title of India's Cleanest City for seven consecutive years in the Swachh Survekshan.

• The city's success in the Swachh Vayu Sarvekshan is attributed to its innovative waste-to-energy plants, extensive public transport electrification, and strict enforcement of pollution control norms.

Important Points

• PRANA Portal: The Portal for Regulation of Air-pollution in Non-Attainment cities (PRANA) is used for monitoring the implementation of NCAP. It provides all information related to the National Clean Air Programme to the public and tracks the physical and financial status of city action plans.

• International Day of Clean Air for Blue Skies: The Swachh Vayu Sarvekshan awards are typically presented on September 7, which is observed globally as the International Day of Clean Air for Blue Skies, to highlight the importance of clean air for health and the environment.

• Financial Incentives: Cash prizes and trophies are awarded to the top three cities in each category to encourage continued excellence and to provide funds for further air quality improvement projects.

Q99. Answer: (b) KTCT Higher Secondary School, Thiruvananthapuram

The correct answer is KTCT Higher Secondary School, Thiruvananthapuram.

Key Points

• India’s first generative AI teacher, named Iris, was officially introduced at KTCT Higher Secondary School in Thiruvananthapuram, Kerala.

• The humanoid robot was developed in collaboration with Makerlabs Edutech Private Limited, a Kochi-based startup specializing in educational technology.

• The initiative was part of the Atal Tinkering Lab (ATL) project, which is a flagship program under the Atal Innovation Mission (AIM) by NITI Aayog. Hence, statement 2 is correct.

• Iris is designed to act as a versatile teaching assistant, capable of providing personalized learning experiences and handling complex queries from students.

• The introduction of this AI teacher marks a significant shift in the educational landscape of India, integrating Generative AI to enhance the classroom environment.

Additional Information

• Features of Iris:

• Iris is a humanoid robot built with a wheeled base for mobility and manipulator arms to perform expressive gestures while teaching.

• It is equipped with a voice assistant and is capable of speaking three languages, which helps in breaking language barriers in a diverse educational setting.

• The robot uses a dedicated processor and high-speed internet connectivity to provide real-time responses to student questions across various subjects.

• Makerlabs Edutech:

• This Kochi-based firm is at the forefront of educational robotics and AI development in Kerala.

• The company focused on creating Iris as a tool to bridge the gap between traditional teaching and modern technology.

• Atal Innovation Mission (AIM):

• Launched by NITI Aayog, AIM promotes a culture of innovation and entrepreneurship across the country.

• The Atal Tinkering Labs (ATL) are established in schools to provide students with hands-on experience in STEM (Science, Technology, Engineering, and Math) fields.

Important Points

• Launch Date: The AI teacher Iris was unveiled in March 2024, representing a major leap in the adoption of Artificial Intelligence in Indian schools.

• Role in Pedagogy: Rather than replacing human teachers, Iris is intended to serve as a supplementary tool that can cater to the individual learning speeds and styles of different students.

• Technological Impact: This development highlights Kerala's leading position in digital literacy and the implementation of high-tech infrastructure in its public education system.

• Global Context: The use of Generative AI in the form of a humanoid teacher aligns with global trends where AI-driven education

is becoming more interactive and user-centric.

Q100. Answer: (b) Small Modular Reactors

The correct answer is Small Modular Reactors.

Key Points

• The U.S.–Turkey Nuclear Cooperation Agreement, signed in 2025, represents a strategic partnership aimed at deploying Small Modular Reactors (SMRs) to support Turkey's clean energy transition.

• This agreement is part of a broader bilateral framework, the Strategic Energy and Climate Dialogue, which facilitates cooperation between the U.S. Department of Energy and the Ministry of Energy and Natural Resources of the Republic of Türkiye.

• The primary objective of focusing on Small Modular Reactors is to help Turkey meet its ambitious goal of reaching net-zero emissions by the year 2053 while ensuring national energy security.

• Unlike traditional large-scale plants, the agreement emphasizes SMRs because of their modular design, which allows for factory fabrication and easier transportation to various sites, significantly reducing capital costs and construction timelines.

• The partnership encourages the participation of private sector entities from both countries, allowing U.S.-based companies to provide advanced nuclear technology and technical expertise to the Turkish energy market.

Additional Information

• Definition of Small Modular Reactors (SMRs):

• SMRs are advanced nuclear reactors that have a power generation capacity of up to 300 MW(e) per unit.

• This capacity is approximately one-third of the output generated by traditional, large-scale nuclear power reactors.

• Their compact size makes them suitable for locations that cannot accommodate larger plants, such as remote areas or regions with smaller electrical grids.

• Key Features and Benefits:

• Passive Safety Systems: Many SMR designs rely on natural circulation, convection, and gravity rather than active pumps to cool the reactor in the event of a shutdown.

• Versatility: Beyond electricity, SMRs can be used for desalination, industrial process heat, and hydrogen production.

• Incremental Deployment: Utilities can add modules as demand grows, providing a flexible investment model compared to "one-size-fits-all" large reactors.

• Turkey's Nuclear Landscape:

• Turkey is currently constructing its first major nuclear facility, the Akkuyu Nuclear Power Plant, in collaboration with Russia.

• The 2025 agreement with the United States diversifies Turkey's nuclear technology portfolio by integrating western SMR technology alongside traditional large-scale units.

Important Points

• Regulatory Cooperation: The agreement involves collaboration between the U.S. Nuclear Regulatory Commission (NRC) and Turkey's Nuclear Regulatory Authority (NDK) to harmonize safety standards and licensing procedures for SMRs.

• Section 123 Agreement: All civil nuclear cooperation between the U.S. and Turkey is governed by the "123 Agreement," a legally binding framework required by the U.S. Atomic Energy Act of 1954 to prevent nuclear proliferation.

• Global Context: The United States has signed similar MoUs with countries like Romania, Poland, and Ghana to promote SMR technology as a tool for climate action and reducing reliance on fossil fuels.

• Economic Impact: The deployment of SMRs is expected to create thousands of high-skilled jobs in both the manufacturing sectors of the USA and the energy infrastructure sectors of Turkey.

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