RRB Group D Official Paper (Held On: 10 Dec, 2025 Shift 3) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of the following statements about the Archimede's Principle is correct?

(a) When a body is immersed fully or partially in a fluid, it experiences a downward force that is equal to the weight of the fluid displaced by it.

(b) When a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.

(c) When a body is immersed fully or partially in a fluid, it experiences a downward force that is much less than the weight of the fluid displaced by it.

(d) When a body is immersed fully or partially in a fluid, it experiences an upward force that is much less than the weight of the fluid displaced by it.

Q2. If resistors are connected in series, the total or equivalent resistance is _____.

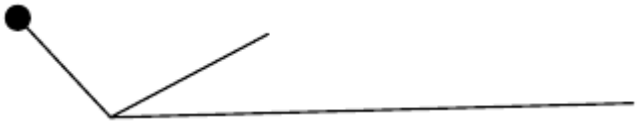
(a) Reciprocal of sum of reciprocals

(b) Product of individual resistances

(c) Sum of individual resistances

(d) Always less than any single resistor

Q3. A smooth ball is resting on an ideal frictionless plane inclined on both sides. The ball is released from the left and the angle of right plane inclination is small in Case-I and zero in Case-II (flat). The ball travels _____ compared to the equally inclined case.



(a) equal distance in Case-I and farther distance in Case-II

(b) equal distance in Case-I and moves forever in Case-II

(c) farther distance in Case-I and moves forever in Case-II

(d) small distance in Case-I and equal distance in Case-II

Q4. Which of the following observations from Rutherford's alpha-particle scattering experiment led to the conclusion that most of the atom's volume is empty?

(a) Some alpha particles were deflected by small angles.

(b) Alpha particles were attracted towards electrons in the atom.

(c) A few alpha particles were deflected by 180°.

(d) Most of the alpha particles passed straight through the gold foil.

Q5. Which of the following statements is correct about the force?

(a) Force is a vector quantity measured in Joule.

(b) Force is a vector quantity measured in Newton.

(c) Force is a scalar quantity measured in Joule.

(d) Force is a scalar quantity measured in Newton.

Q6. Propanone belongs to which homologous series?

(a) Alcohol
(b) Ketone
(c) Aldehyde
(d) Ester

Q7. Which of the following tissues have contractile proteins that contract and relax to cause movement?

(a) Muscular tissue
(b) Cuboidal epithelium tissue
(c) Nervous tissue
(d) Squamous epithelium tissue

Q8. Which of the following statements correctly defines the principal axis of a spherical mirror?

(a) The line passing through the focus and object
(b) The line passing through the centre of curvature and pole
(c) The tangent at the pole
(d) The perpendicular line drawn from the pole

Q9. In sexually reproducing organisms, how many versions of each trait does a child inherit?

(a) One version in total
(b) One version from father only
(c) Two versions from the mother only
(d) One version from each parent

Q10. The calculated formula unit mass of Na_2SO_4 is:

(a) 148 u
(b) 140 u
(c) 146 u
(d) 142 u

Q11. In which of the following groups of organisms sex determination occurs due to environmental temperature?

(a) Few reptiles
(b) Human beings
(c) All fishes
(d) All birds

Q12. What is an ion in chemistry?

(a) An atom with only neutrons
(b) A radioactive stable particle
(c) A charged atom or molecule
(d) A neutral molecule of atom

Q13. Three resistors of 4 Ω, 8 Ω, and 12 Ω are connected in series across a 12 V battery. The current in the circuit is:

(a) 1 A
(b) 0.5 A
(c) 4 A
(d) 2 A

Q14. Which of the following substances have a high chance of contributing to the phenomenon of biological magnification?

(a) Pesticide
(b) Rose petals
(c) Neem bark
(d) Orange peel

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Q15. Washing soda is prepared by heating which compound?

(a) Sodium chloride
(b) Calcium carbonate
(c) Sodium bicarbonate (baking soda)
(d) Calcium oxide

Q16. Which of the following substances is NOT an example of biodegradable substance?

(a) Spoilt food
(b) Waste paper
(c) Plastic bags
(d) Vegetable peels

Q17. Why the manufacturers of chips flush chips bags with nitrogen before packing?

(a) Nitrogen acts as preservative.
(b) Nitrogen prevents reduction of oil.
(c) Nitrogen prevents rancidity.
(d) Nitrogen acts as taste enhancer.

Q18. Which of the following statements is true?

(a) Power and work are independent of each other.
(b) Power decreases when work increases.
(c) More work done in less time means more power.
(d) Work done does not affect power.

Q19. Which of the following is an advantage of vegetative propagation?

(a) Plants grown this way take longer to bear fruits.
(b) All new plants are genetically different from the parent.
(c) It allows propagation of seedless plants such as banana.
(d) It requires cross-pollination to occur.

Q20. What type of solution causes water to move out of a cell through the plasma membrane, making the cell shrink?

(a) Hypertonic solution
(b) Dilute solution
(c) Isotonic solution
(d) Hypotonic solution

Q21. What are the unwanted impurities such as soil and sand present in an ore called?

(a) Slag
(b) Gangue
(c) Flux
(d) Alloy

Q22. Consider the following statements and select the correct option.

Statement A: Salts of strong acids and strong bases are neutral with pH 7.

Statement B: Sodium chloride is an example of a neutral salt.

(a) Statement A is correct but B is incorrect.
(b) Both statements A and B are correct.
(c) Both statements A and B are incorrect.
(d) Statement A is incorrect but B is correct.

Q23. Which of the following statements about complex permanent tissue is correct?

(a) Complex tissues are made of identical cells performing different functions.
(b) Complex tissues are only found in animals for transporting oxygen.
(c) Xylem and phloem are complex tissues that help in conduction and form vascular bundles.
(d) Complex tissues consist of loosely packed parenchyma cells for storage.

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Q24. The angle between the incident ray and the emergent ray from a prism is called _____.

(a) Angle of prism
(b) Angle of incidence
(c) Angle of deviation
(d) Critical angle

Q25. The frequency of a sound wave is 250 Hz. What is its time period?

(a) 0.004 s
(b) 40 s
(c) 0.25 s
(d) 25 s

MATHEMATICS

Q26. If $x^2 + 1/(x^2) = 79$, then a possible value of $(x + 1/x)$ is:

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

Q27. A flight travels a distance of 1,200 km in 3 hours. What is the speed of the flight?

(a) 200 km/hr
(b) 425 km/hr
(c) 400 km/hr
(d) 382 km/hr

Q28. The ratio of the price per unit of lemon chocolate to that of strawberry chocolate is 22 : 6, and a family consumes them in the ratio of 14 : 23 by quantity. Determine the ratio of the expenditure on strawberry chocolate to that on lemon chocolate.

(a) 71 : 159
(b) 68 : 157
(c) 69 : 154
(d) 67 : 156

Q29. Simplify: $(2^3 \times 3^{(-2)} \times 5^4)/(6^{(-1)} \times 10^2)$

(a) $2^4 \times 3^{(-1)} \times 5^2$
(b) $2^2 \times 3^{(-1)} \times 5^2$
(c) $2^1 \times 3^{(-1)} \times 5^2$
(d) $2^2 \times 3^{(-3)} \times 5^3$

Q30. A baker sells 100 cupcakes and earns a profit equal to the selling price of 20 cupcakes. What is his profit percentage?

(a) 18%
(b) 20%
(c) 25%
(d) 33.33%

Q31. A number when multiplied by 3 and then added to 8, results in 29. What is the number?

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

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Q32. Arrange the following schemes in the ascending order of their discounts.

A. Buy 3 get 2 free.

B. A single discount of 65%.

C. Two successive discounts of 31% and 40%.

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

Q33. The marked price of a bed is Rs. 744, which is 36% above the cost price. If the profit percentage is 20%, find the discount percentage (rounded off to two decimal places).

(a) 11.27%
(b) 10.39%
(c) 12.89%
(d) 11.76%

Q34. If 30 workers earn Rs. 4140 in 4 days, how much (in Rs.) will 55 workers earn in 10 days?

(a) 18,725
(b) 18,475
(c) 19,175
(d) 18,975

Q35. The average age of 25 students of a class is 27 years. If the age of the teacher is also included, the average age of the whole group becomes 28 years. The age (in years) of the teacher is:

(a) 53
(b) 55
(c) 52
(d) 56

Q36. The income of Raman is Rs. 68,500. He saves 22.5% of his income. If his income increases by 14% and expenditure increases by 40%, then his savings will:

(a) decrease by Rs. 11,647
(b) increase by Rs. 11,647
(c) decrease by Rs. 11,645
(d) increase by Rs. 11,642

Q37. A, B and C can do a piece of work in 2, 5 and 20 days, respectively. How long (in days) will they take to do thrice the same work, working together?

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

Q38. If the price of a product is first increased by 18% and then decreased by 22%. Find the percentage change in the price (correct to two places of decimals).

(a) Increased 7.96%
(b) Increased 5.85%
(c) Decreased 7.96%
(d) Decreased 5.85%

Q39. Amit and Deeksha together invested Rs. 46,800 in a business. At the end of the year, out of a total profit of Rs. 8,700, Amit's share was Rs. 2,900. What was the investment of Amit?

(a) Rs. 15,225
(b) Rs. 16,730
(c) Rs. 15,600

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(d) Rs. 17,445

Q40. Five years ago, the ratio of the ages of two buildings was 7 : 2. Five years hence, the ratio will be 3 : 1. What is the present age of the newer building?

(a) 45 years
(b) 55 years
(c) 40 years
(d) 50 years

Q41. A hollow metallic sphere with an external radius of 10 cm and an internal radius of 6 cm is melted and recast into a solid cone with a base radius of 8 cm. What is the height of the cone? (Use π = 22/7)

(a) 45 cm
(b) 49 cm
(c) 52 cm
(d) 42 cm

Q42. A cistern of dimensions 100 cm × 80 cm × 120 cm is fitted with an inlet pipe and an outlet pipe. The inlet pipe pours in 2000 cm^3 of water per minute and the outlet pipe can empty the full tank in 3 hours and 20 minutes. If the tank is full and both pipes are open, then how many hours will it take to empty the cistern?

(a) 55/7
(b) 4
(c) 5
(d) 45/7

Q43. A camp has provisions for 42 pupils for 12 days. In how many days will the same provisions finish off if the strength of the camp is increased to 63 pupils?

(a) 8
(b) 7
(c) 9
(d) 11

Q44. P is any point inside the rectangle ABCD. If PA = 86 cm, PB = 49 cm and PC = 79 cm, then the length of PD (in cm) is equal to:

(a) 106
(b) 107
(c) 104
(d) 105

Q45. Two banks, A and B, offered loans at 3.5% and 7% per annum, respectively. Keshav borrowed an amount of Rs. 4,80,000 from each bank. Find the positive difference (in Rs.) between the amounts of simple interest paid to the two banks by Keshav after 2 years.

(a) 34,600
(b) 35,100
(c) 33,600
(d) 33,100

Q46. A solid sphere of radius 7 cm is coated with a layer of paint that increases its radius to 7.5 cm, find the volume of the painted layer.

(Use π = 22/7 and round off your answer to the nearest integer)

(a) 440 cm3
(b) 331 cm3
(c) 330 cm3
(d) 442 cm3

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Q47. A class of 69 students took a Physics test. 17 students had an average score of 94. The other students had an average score of 84. What is the average score (rounded off to one decimal place) of the whole class?

(a) 86.5
(b) 89.3
(c) 95.7
(d) 82.8

Q48. A train of length 299 m takes 12 seconds to pass another train 101 m long coming from the opposite direction. If the speed of the first train is 71 km/hr, then find the speed of the second train.

(a) 56 km/hr
(b) 49 km/hr
(c) 48 km/hr
(d) 41 km/hr

Q49. If 20% of a number is added to 72, then the result is the same number. 60% of the same number is:

(a) 84
(b) 64
(c) 74
(d) 54

Q50. Find the value of (sin 15°)/(cos 75°) + (cos 78°)/(sin 12°) - 1

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

GENERAL INTELLIGENCE & REASONING

Q51. If 1 is added to each odd digit and 2 is subtracted from each even digit in the number 4651783. What will be the sum of the highest digit and the second from the left and first from the right in the new number thus formed?

(a) 16
(b) 19
(c) 12
(d) 14

Q52. If + means -, - means x, x means ÷, ÷ means +, then what will come in place of the question mark (?) in the following equation?

12 - 15 ÷ 143 + 98 x 7 = ?

(a) 306
(b) 303
(c) 312
(d) 309

Q53. In a certain code language, ‘CORM’ is coded as ‘9518’ and ‘MORE’ is coded as ‘5831’. What is the code for ‘E’ in the given code language?

(a) 8
(b) 1
(c) 3
(d) 5

Q54. What should come in place of the question mark (?) in the given series to make it logically complete?

20 34 21 35 22 36 ?

(a) 37
(b) 23

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(c) 38
(d) 24

Q55. A, B, C, D, W, X and Y are sitting around a circular table facing the centre of the table. Only four people sit between B and A when counted from the right of B. B sits third to the left of X. W sits third to the left of Y. C is an immediate neighbour of both A and X. How many people sit between D and C when counted from the right of D?

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

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

Statements:

Some rabbits are fans.

No fan is a car.

Conclusions:

(I): Some rabbits are cars.

(II): Some fans are rabbits.

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

Q57. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only. All numbers are single-digit numbers.

(Left) ? * + ? \ & 3 # 9 % 4 1 6 * @ 5 4 8 8 $ \ (Right)

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

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

Q58. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which letter-cluster pair DOES NOT belong to that group?

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

(a) VS-DV
(b) LI-SL
(c) DA-KD
(d) MJ-TM

Q59. O, P, Q, R, W, X and Y are sitting in a straight line facing north.

Only three people sit to the left of P. Only R sits to the right of Q. Only three people sit between Q and O. X sits at some place to the left of Y but at some place to the right of W.

How many people sit between W and Y?

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

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Q60. If ‘A’ stands for ‘×’, ‘B’ stands for ‘÷’, ‘C’ stands for ‘−’ and ‘D’ stands for ‘+’, what will come in place of the question mark (?) in the following equation?

14 B 2 D 10 A 5 C 12 = ?

(a) 48
(b) 45
(c) 50
(d) 43

Q61. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which letter-cluster pair DOES NOT belong to that group?

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

(a) HL-OJ
(b) FJ-MH
(c) DH-KF
(d) BF-IE

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

Statements:

Some books are novels.

All novels are stories.

Conclusions:

(I): Some stories are books.

(II): No books are stories.

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

Q63. Raghu starts from Point Y and drives 18 km towards west. He then turns right and drives 26 km, takes a left turn, drives 30 km, turns left and drives 68 km. He then takes a right turn and drives 31 km. He takes a right turn, drives 42 km, turns left and drives 16 km to stop at Point Z. How far (shortest distance) and towards which direction should he drive in order to reach Point Y again?

(All turns are 90° turns only unless specified.)

(a) 89 km towards west
(b) 97 km towards east
(c) 95 km towards east
(d) 91 km towards west

Q64. P, Q, R, S, T and U are sitting in a row facing the north. S is sitting to the immediate left of Q.P is sitting to the immediate right of Q. U is sitting to the immediate right of P and immediate left of T. S and R are sitting at the ends of the line not necessarily in the same order. Who is sitting to the immediate right of T?

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

Q65. Srinivas ranked 2^(nd) from the top and 19^(th) from the bottom in his class. How many students are there in the class?

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

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Q66. 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 its constituent digits. E.g. 13 – Operations on 13 such as adding/subtracting/multiplying etc. to 13 can be performed. Breaking down 13 into 1 and 3 and then performing mathematical operations on 1 and 3 is not allowed.)

(6, 72, 12)

(5, 60, 12)

(a) (3, 36, 12)
(b) (2, 24, 14)
(c) (7, 82, 12)
(d) (4, 48, 13)

Q67. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only). (Counting to be done from left to right only.)

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

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

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

Q68. In a certain code language, ‘LOVE’ is coded as ‘4958’ and ‘VALE’ is coded as ‘3589’. What is the code for ‘A’ in the given code language?

(a) 3
(b) 5
(c) 9
(d) 8

Q69. Refer to the given number, symbol series and answer the question that follows.

(Left) 7 $ 5 @ 3 ! 3 5 6 7 & % $ 3 # 2 7 + ? > < (Right)

If all the numbers are dropped from the series, which of the following will be seventh from the right?

(a) @
(b) %
(c) $
(d) #

Q70. Aditi starts from Point A and drives 10 km towards the west. She then takes a left turn, drives 8 km, turns right and drives 5 km. She then takes a left turn and drives 8 km. She then takes a left turn and drives 15 km. She takes a final right turn, drives 4 km and stops at Point D. How far (shortest distance) and in which direction is Point D with respect from Point A?

(All turns are 90° turns only unless specified.)

(a) 18 km towards south
(b) 20 km towards south
(c) 16 km towards north
(d) 11 km towards east

Q71. TQKG is related to XUOK in a certain way based on the English alphabetical order. In the same way, SPJF is related to WTNJ. To which of the given options is ROIE related, following the same logic?

(a) VSMI
(b) VPMF
(c) UQKI
(d) UPKF

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Q72. Which of the given letter-number clusters will replace the question mark (?) in the following series to make it logically complete?

ECP 1 GEM −2 IGJ 4 KIG −8 ?

(a) LKM −19
(b) MKD 16
(c) KMD 15
(d) MKK −13

Q73. This question is based on the five, three-digit numbers given below.

(Left) 316 562 149 379 433 (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) 13
(b) 9
(c) 15
(d) 11

Q74. What should come in place of the question mark (?) in the given series?

5 8 14 23 35 50 ?

(a) 65
(b) 67
(c) 69
(d) 68

Q75. What should come in place of the question mark (?) in the given series?

10, 23, 49, 88, 140, ?

(a) 207
(b) 206
(c) 204
(d) 205

Q76. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one that follows the same logic.

RAGE - ARGE - EARG

QUIZ - UQIZ - ZUQI

(a) KIND - KNID - DNIK
(b) COLD - OCLD - DOLC
(c) HERD - EHRD - DEHR
(d) SAME - ASME - AMES

Q77. Seven boxes A, B, C, D, I, J and K are kept one over the other but not necessarily in the same order. K is kept second from the bottom. Only three boxes are kept between K and I. D is kept at one of the positions below K. Only B is kept between I and J. A is kept at one of the positions above I. How many boxes are kept between C and D?

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

Q78. In a certain code language,

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

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

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

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'A √ B' means 'A is the sister of B'.

How is C related to L if 'C ? D = E @ F √ L'?

(a) Daughter
(b) Brother's daughter
(c) Sister's daughter
(d) Brother's wife

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

IDR LGQ OJP RMO ?

(a) UPN
(b) UOO
(c) VPO
(d) VON

Q80. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one which follows the same logic.

SWAP - WSAP - PAWS

ALSO - LASO - OSLA

(a) TIDE - ITDE - EIDT
(b) EARN - AERN - ARNE
(c) USER - SUER - RESU
(d) CROW - CORW - WORC

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Which country's authorities were flagged by India in 2025 for hybrid cannabis smuggling via couriers?

(a) Afghanistan
(b) Thailand
(c) Nigeria
(d) Myanmar

Q82. According to the Union Budget 2025–26, how many new Day Care Cancer Centres will be set up in district hospitals in 2025–26?

(a) 200
(b) 175
(c) 150
(d) 100

Q83. Which Indian footballer received the Padma Shri in 2025 for his contributions to the sport?

(a) Bhaichung Bhutia
(b) Sunil Chhetri
(c) IM Vijayan
(d) Sandesh Jhingan

Q84. Which filmmaker returned to the Cannes Film Festival 2025 as a main jury member after winning the Grand Prix in 2024?

(a) Anuradha Roy
(b) Neeraj Ghaywan
(c) Payal Kapadia
(d) Vikramaditya Motwane

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Q85. What was India’s rank in the Global Innovation Index (GII), 2025, released by the World Intellectual Property Organization (WIPO)?

(a) 28th
(b) 33rd
(c) 38th
(d) 43rd

Q86. Which Indian javelin thrower won the Ostrava Golden Spike event in 2025?

(a) Kishore Kumar
(b) Neeraj Chopra
(c) Rohit Yadav
(d) Annu Rani

Q87. Which of the following schemes announced a financial outlay of Rs. 5,000 crore to promote research & innovation in the pharmaceutical and med-tech sectors in India?

(a) PRIP scheme
(b) Atmanirbhar Bharat Abhiyan
(c) Startup India
(d) Smart Cities Mission

Q88. India’s first-of-its-kind Urban Flood Management Cell (UFMC) powered by Canarys Automations Ltd was inaugurated in which of the following cities in July 2025?

(a) Pune
(b) Guwahati
(c) Bhopal
(d) Gorakhpur

Q89. India's 2030 climate target aims to reduce the intensity of emissions by what percentage as per the report by Council on Energy, Environment and Water (CEEW) and Alliance for an Energy Efficient Economy (AEEE), published in 2025?

(a) 35%
(b) 20%
(c) 60%
(d) 45%

Q90. Which of the following states became the first to launch the Tribal Genome Sequencing Project in July 2025?

(a) Jharkhand
(b) Gujarat
(c) Odisha
(d) Chhattisgarh

Q91. Which of the following states activated a 24×7 flood-control room after rivers Subarnarekha, Budhabalanga and Jalaka swelled in June 2025?

(a) Assam
(b) Odisha
(c) Bihar
(d) West Bengal

Q92. Who took office as the Deputy Governor of the RBI on 2 April 2025?

(a) Michael Debroy
(b) Ashwani Bhatia
(c) Poonam Gupta
(d) Michael Patra

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Q93. What are the revised investment caps for Foreign Portfolio Investors (FPIs) in corporate bonds for FY 2025-26, as announced by the Reserve Bank of India (RBI) in April 2025?

(a) 18%
(b) 12%
(c) 15%
(d) 10%

Q94. In May 2025, minutes after the PSLV-C61, carrying the earth observation satellite EOS-09, lifted off from the Satish Dhawan Space Centre in Sriharikota, the space agency reported a glitch in the _____.

(a) third stage of the launch vehicle
(b) second stage of the launch vehicle
(c) fourth stage of the launch vehicle
(d) first stage of the launch vehicle

Q95. Who among the following won the Laureus World Action Sportsperson of the Year award in 2025?

(a) Tom Pidcock
(b) Yuto Horigome
(c) Kelly Slater
(d) Chloe Kim

Q96. In August 2025, Union Health Secretary, Punya Salila Srivastava, virtually inaugurated an innovative national mechanism aimed at evaluating and improving state drug regulatory frameworks through an open and evidence-based approach named _____.

(a) National Drug Regulatory Reform Index
(b) State Health Regulatory Excellence Index
(c) Pharmaceutical Compliance Monitoring Index
(d) Health Infrastructure Performance Index

Q97. The Emerging Science, Technology and Innovation Conclave (ESTIC) 2025, conducted in November 2025, was held in _____.

(a) Uttar Pradesh
(b) New Delhi
(c) Haryana
(d) Maharashtra

Q98. Which polo team made history in 2025 by sweeping all major awards for the fourth consecutive year at the Indian Polo Awards held in Jaipur?

(a) Jaipur Warriors
(b) Royal Riders
(c) Achievers
(d) Desert Stallions

Q99. India joined which European drone programme as an observer in January 2025?

(a) Eurodrone
(b) Global Hawk
(c) nEUROn
(d) Predator XP

Q100. Who won India’s only gold medal in women’s freestyle wrestling at the Asian Wrestling Championships, 2025?

(a) Vinesh Phogat
(b) Manisha Bhanwala
(c) Antim Panghal
(d) Reetika Hooda

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ANSWER KEY

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

SOLUTIONS

Q1. Answer: (b) When a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the...

The correct answer is When a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it..

Key Points

• Archimedes' Principle states that when a body is fully or partially submerged in a fluid (liquid or gas), it experiences an upward buoyant force. This force is equal to the weight of the fluid displaced by the body.

• The upward force, commonly referred to as the buoyant force, acts in the opposite direction of gravity and is responsible for the floating or sinking of objects in fluids.

• This principle explains why some objects float while others sink. If the weight of the displaced fluid is greater than or equal to the weight of the object, the object will float. Otherwise, it will sink.

• The principle is widely used in designing ships, submarines, hot air balloons, and other engineering applications where buoyancy is a critical factor.

• The formula used in Archimedes' Principle is: Buoyant Force (F_b) = Weight of Displaced Fluid = ρ × V × g, where:

• ρ = Density of the fluid

• V = Volume of the fluid displaced

• g = Acceleration due to gravity

Additional Information

• Explanation of Options:

• Option 1: Incorrect. This statement is wrong because Archimedes' Principle describes an upward force, not a downward force.

• Option 2: Correct. This option accurately explains Archimedes' Principle that the body experiences an upward force equal to the weight of the fluid displaced.

• Option 3: Incorrect. The downward force (weight of the body) is not less than the weight of the displaced fluid; instead, the upward buoyant force balances the weight of the object in certain cases (floating).

• Option 4: Incorrect. The upward force is not less than the weight of the displaced fluid; it is equal to the weight of the displaced fluid as per Archimedes' Principle.

• Applications of Archimedes' Principle:

• Shipbuilding: Ships float because the weight of the water displaced by the ship is equal to the ship's weight.

• Submarines: Submarines use Archimedes' Principle to dive and resurface by controlling the amount of water in their ballast tanks.

• Hot Air Balloons: Hot air balloons rise because the air displaced by the balloon weighs more than the balloon itself.

• Hydrometers: Used to measure the density of liquids based on the principle of buoyancy.

• Important Terms:

• Buoyant Force: The upward force exerted by a fluid on a submerged or partially submerged object.

• Displaced Fluid: The volume of fluid pushed aside by a submerged object.

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• Density: The mass per unit volume of a substance, which determines whether an object will float or sink.

• Historical Background: Archimedes' Principle was discovered by the ancient Greek mathematician and inventor Archimedes in the 3rd century BCE.

Important Points

• Key Applications in Modern Science:

• Archimedes' Principle is used extensively in fluid mechanics and engineering design to ensure stability and functionality of devices like ships, submarines, and balloons.

• It is also used in laboratories to calculate the density and specific gravity of objects by measuring the weight of displaced fluid.

Q2. Answer: (c) Sum of individual resistances

The correct answer is Sum of individual resistances.

Key Points

• When resistors are connected in series, the total or equivalent resistance is the sum of all individual resistances in the circuit.

• The formula to calculate the total resistance in a series circuit is: R_(total) = R1 + R2 + R3 + ... + R_n, where R1, R2, R3, etc., are the resistances of individual resistors.

• This is because, in a series connection, the current remains the same across all resistors, but the voltage drop adds up across each resistor.

• The concept of adding resistances in series ensures that the total resistance is always greater than any individual resistance.

• The series connection is commonly used in circuits where a higher resistance is required or to divide the voltage across multiple components.

Additional Information

• Characteristics of Resistors in Series:

• In a series circuit, the current is the same through all the resistors.

• The voltage drop across each resistor depends on its resistance and can be calculated using Ohm's Law: V = I × R, where I is the current, and R is the resistance.

• Adding more resistors in series increases the total resistance of the circuit.

• Applications of Series Circuits:

• Used in devices like string lights, where the same current flows through all bulbs.

• Series resistors are often used to reduce current or limit voltage in circuits.

• Comparison with Parallel Circuits:

• In a parallel circuit, the total resistance is calculated as the reciprocal of the sum of reciprocals of individual resistances: 1/R_(total) = 1/R1 + 1/R2 + ...

• Parallel circuits have a lower total resistance compared to series circuits for the same resistors.

• Practical Example:

• If three resistors of 5 Ω, 10 Ω, and 15 Ω are connected in series, the total resistance is: R_(total) = 5 + 10 + 15 = 30 Ω.

Important Points

• Option 1 (Reciprocal of sum of reciprocals): This is the formula for calculating total resistance in a parallel circuit, not a series circuit. Hence, this option is incorrect.

• Option 2 (Product of individual resistances): The product of resistances is not used to calculate total resistance in any standard circuit configuration. Hence, this option is incorrect.

• Option 3 (Sum of individual resistances): This is the correct formula for calculating total resistance in a series circuit. Hence, this option is correct.

• Option 4 (Always less than any single resistor): In a series circuit, the total resistance is always greater than the highest individual resistance. Hence, this option is incorrect.

Q3. Answer: (c) farther distance in Case-I and moves forever in Case-II

The correct answer is Option 3: farther distance in Case-I and moves forever in Case-II.

Key Points

• Case-I: Inclined Plane with Small Angle: In Case-I, the ball is released from a plane inclined on the left and rolls onto a plane inclined on the right, but with a smaller angle. The smaller angle on the right reduces the slope, thereby extending the rolling distance before the ball comes to a stop. Hence, the ball travels farther compared to an equally inclined case.

• Case-II: Flat Surface (Zero Inclination): When the ball transitions from the inclined plane on the left to a flat surface on the right, there is no opposing force to stop its motion. Since the plane is frictionless, the ball continues to move indefinitely due to the absence of friction or any other resisting force. Hence, the ball moves forever.

• Comparison with Equally Inclined Case: In an equally inclined scenario, the ball's motion would be symmetrical, and the ball

would stop at an equal distance on both sides due to gravity's equal opposing forces. Case-I modifies this condition, causing the ball to travel farther on the smaller inclined plane. Case-II, with no inclination, eliminates the stopping mechanism altogether. Thus, option 3 correctly identifies the outcomes.

• Physics of Motion on Frictionless Planes: The ball's behavior is determined solely by gravitational forces and the plane's inclination. A smaller inclination reduces the gravitational component acting against the motion, and a flat surface eliminates it entirely, allowing perpetual motion. This matches the behavior described in the question.

• Hence, the correct answer is Option 3.

Additional Information

• Frictionless Plane: A frictionless plane is an idealized surface where no resistance opposes the motion of objects. In reality, such surfaces are rare, but they serve as a useful approximation for studying concepts of motion and forces in physics.

• Gravitational Component: On an inclined plane, the force acting on an object due to gravity can be divided into two components: one parallel to the plane (causing motion) and one perpendicular to the plane (pressing the object against the surface). The parallel component decreases with the angle of inclination.

• Perpetual Motion: On a frictionless flat surface, an object in motion will continue moving indefinitely according to Newton's First Law of Motion, which states that an object will remain in its state of motion unless acted upon by an external force.

• Inclined Plane Dynamics: Inclined planes are simple machines that modify the effect of gravity on objects. The steeper the incline, the greater the gravitational force acting to accelerate the object down the slope.

• Practical Applications: Concepts involving frictionless planes and inclined surfaces are used in designing systems like roller coasters, ramps, and experimental setups in physics labs to study motion and forces.

Important Points

• Newton's Laws of Motion: These laws govern the behavior of objects in motion. In this scenario, Newton's First Law explains why the ball moves forever on a frictionless flat surface, and Newton's Second Law helps calculate the acceleration caused by gravity on the inclined plane.

• Energy Conservation: The ball's motion on the inclined plane follows the principle of conservation of energy, where potential energy converts to kinetic energy as it rolls down. On a flat surface, the kinetic energy remains constant without losses due to friction.

• Ideal Conditions: The question assumes ideal conditions like a perfectly smooth ball and frictionless planes, which are theoretical but simplify understanding of motion concepts.

• Real-World Examples: While frictionless planes are theoretical, low-friction surfaces like ice or air tracks can approximate such conditions and are used in physics experiments.

Q4. Answer: (d) Most of the alpha particles passed straight through the gold foil.

The correct answer is Most of the alpha particles passed straight through the gold foil.

Key Points

• Rutherford's alpha-particle scattering experiment demonstrated that most of the alpha particles passed straight through the gold foil. This indicated that most of the atom's volume is empty space, as the particles encountered no obstruction.

• The alpha particles, which are positively charged helium nuclei, moved through the gold foil without significant deflection because the atomic structure is largely empty.

• A few alpha particles were deflected at small angles, which suggested the presence of a positive charge in the atom but did not affect the conclusion that most of the atom is empty space.

• Very few alpha particles were deflected by 180°, indicating a highly concentrated and positively charged nucleus at the center of the atom. However, the rarity of this event further supported the notion that the atom's interior is mostly empty.

• The experiment disproved the earlier "plum pudding model" of the atom, which suggested that positive and negative charges were distributed evenly throughout the atom.

Additional Information

• Rutherford's Experiment Details:

• Conducted by Ernest Rutherford in 1911, the experiment involved bombarding a thin gold foil with alpha particles emitted from a radioactive source.

• A fluorescent screen was used to detect the scattering of alpha particles.

• The experiment provided evidence for the nuclear model of the atom, replacing J.J. Thomson's plum pudding model.

• Structure of the Atom:

• The atom consists of a dense, positively charged nucleus at its center, containing protons and neutrons.

• Electrons, which are negatively charged, revolve around the nucleus in defined orbits.

• Most of the atom's volume is empty space, as evidenced by the large fraction of alpha particles passing through the foil without deflection.

• Key Observations from the Experiment:

• Most alpha particles passed straight through the foil, indicating empty space in the atom.
• A small fraction of alpha particles were deflected at small angles, suggesting the presence of a dense positive charge.
• A very few particles rebounded back, confirming the existence of a concentrated nucleus.
• Impact of the Experiment:
• It led to the development of the nuclear model of the atom, which forms the basis of modern atomic theory.
• The discovery of the nucleus paved the way for further research into subatomic particles, such as protons, neutrons, and later electrons.

Important Points

• Alpha Particles:
• Alpha particles are helium nuclei, consisting of 2 protons and 2 neutrons, with a positive charge.
• Their high energy and positive charge made them suitable for the scattering experiment.
• Gold Foil:
• The gold foil used in the experiment was extremely thin, about 0.00004 cm thick.
• Gold was chosen because it is malleable and can be beaten into very thin sheets.
• Nucleus Characteristics:
• The nucleus occupies a very small volume of the atom (approximately 1/10,000th of the atom's diameter).
• It contains nearly all the atom's mass and is positively charged.
• Significance of the Experiment:
• It confirmed the existence of a nucleus and laid the foundation for the Bohr model of the atom.
• The findings eventually contributed to the development of quantum mechanics and nuclear physics.

Q5. Answer: (b) Force is a vector quantity measured in Newton.

The correct answer is Force is a vector quantity measured in Newton..

Key Points

• Force is a vector quantity: A force has both magnitude and direction, which makes it a vector quantity. This distinguishes it from scalar quantities, which only have magnitude.
• SI Unit of Force: The SI unit of force is the Newton (N). It is defined as the force required to accelerate a 1 kg mass by 1 m/s^2.
• Force and Energy are Different: Force is not measured in Joules. Joule is the unit of energy, while Newton is the unit of force. Hence, energy and force are fundamentally different physical quantities.
• Directionality of Force: Since force is a vector quantity, it requires both direction and magnitude for its complete specification. The direction determines the way the force acts.
• Examples: Pushing a door, pulling a rope, and the gravitational force acting on an object are examples that demonstrate the vector nature of force.

Additional Information

• Newton's Second Law of Motion: Force is mathematically expressed using Newton's second law of motion as $F = ma$, where F is force, m is mass, and a is acceleration.
• Types of Forces: Forces can be broadly categorized into two types: contact forces (e.g., friction, tension) and non-contact forces (e.g., gravitational force, magnetic force).
• Representation of Force: Forces are represented using arrows in diagrams. The length of the arrow corresponds to the magnitude of the force, and the arrow's direction indicates the direction of the force.
• Force and Work: Work is done when a force is applied to an object and the object moves in the direction of the force. The formula for work is $W = F \times d \times \cos(\theta)$, where θ is the angle between the force and the displacement direction.
• Gravitational Force: A common example of force is the gravitational force, which acts between two masses. Its magnitude is given by Newton's law of gravitation: $F = G(m1m2)/r^2$, where G is the gravitational constant, m1 and m2 are the masses, and r is the distance between them.

Important Points

• Scalar Quantity: Scalar quantities have only magnitude and no direction. Examples include speed, mass, time, and energy.
• Joule as a Unit: The Joule (J) is the SI unit of energy and work. One Joule is defined as the energy transferred when a force of one Newton displaces an object by one meter in the direction of the force.
• Misconception About Force: Force is often misunderstood as a scalar quantity, but its vectorial nature is critical in understanding phenomena like motion, equilibrium, and dynamics.
• Practical Applications of Force: Forces are integral to various fields such as engineering (e.g., structural analysis), physics (e.g., mechanics), and daily life (e.g., using tools, driving vehicles).
• Historical Context: The concept of force was formalized by Sir Isaac Newton in the 17th century through his laws of motion, which form the foundation of classical mechanics.

Q6. Answer: (b) Ketone

The correct answer is Ketone.

Key Points

• Propanone, commonly known as acetone, belongs to the ketone group. Ketones are organic compounds characterized by the presence of a carbonyl group (C=O) bonded to two carbon atoms.

• The chemical formula of propanone is CH3COCH3, where the carbonyl group is bonded to two methyl groups.

• Ketones are a part of a larger class of organic compounds known as carbonyl compounds, which include aldehydes and carboxylic acids.

• Propanone is the simplest ketone and is widely used as a solvent in industries for applications such as nail polish remover and cleaning agents.

• The distinguishing feature of ketones is that the carbonyl group is not bonded to a hydrogen atom, which differentiates them from aldehydes where the carbonyl group is bonded to at least one hydrogen atom.

Additional Information

• Alcohol:

• Alcohols are organic compounds containing one or more hydroxyl groups (-OH) attached to a saturated carbon atom.

• Examples include ethanol (C2H5OH) and methanol (CH3OH).

• Alcohols are classified into primary, secondary, and tertiary alcohols based on the number of carbon atoms attached to the carbon holding the hydroxyl group.

• Aldehyde:

• Aldehydes are characterized by the presence of a carbonyl group (C=O) bonded to at least one hydrogen atom.

• An example is formaldehyde (HCHO), which is used in disinfectants and preservatives.

• Aldehydes have a distinct odor and are commonly found in flavoring agents and perfumes.

• Ester:

• Esters are organic compounds formed by the reaction of an alcohol and an acid, with the elimination of water.

• They contain the functional group -COOR, where R is an alkyl or aryl group.

• Esters are widely used in perfumes, flavorings, and as solvents in industries.

• Ketones:

• Ketones are used as solvents in industries for applications such as cleaning agents, paint thinners, and nail polish removers.

• They are also precursors in the synthesis of various compounds, including pharmaceuticals.

• Propanone (acetone) is a well-known example and is widely used due to its effectiveness as a solvent.

• Ketones are produced naturally in the human body during fat metabolism in the form of ketone bodies.

Important Points

• Propanone (Acetone):

• Propanone is highly volatile and flammable, making it suitable for use in laboratory and industrial processes.

• It is miscible with water and many organic solvents, making it a versatile solvent.

• The chemical structure of propanone is planar due to the sp2 hybridization of the carbonyl carbon.

• Propanone plays a role in the pharmaceutical industry as a precursor in drug synthesis.

• Applications of Ketones:

• Ketones are used in the production of plastics and synthetic fibers.

• They are intermediates in the synthesis of perfumes, dyes, and explosives.

• Ketones serve as solvents for paints, varnishes, and adhesives.

Q7. Answer: (a) Muscular tissue

The correct answer is Muscular tissue.

Key Points

• Muscular tissue contains specialized contractile proteins such as actin and myosin, which are essential for contraction and relaxation, facilitating movement in the body.

• These proteins interact in a highly coordinated manner, generating the force required for activities such as walking, running, breathing, and digestion.

• Muscular tissue is classified into three types: skeletal, smooth, and cardiac muscles, each of which plays a distinct role in movement and function.

• Skeletal muscles are involved in voluntary movements such as limb movement, while smooth muscles control involuntary processes like digestion and blood vessel contraction. Cardiac muscles are responsible for the rhythmic contraction of the heart.

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• The presence of contractile proteins makes muscular tissue uniquely capable of generating force and motion, distinguishing it from other tissue types. Hence, the correct answer is muscular tissue.

Additional Information

• Cuboidal epithelium tissue:

• This type of tissue consists of cube-shaped cells and is primarily involved in secretion and absorption.

• It is found in regions like the kidney tubules and glands.

• Unlike muscular tissue, cuboidal epithelium lacks contractile proteins and does not participate in movement.

• Nervous tissue:

• Composed of neurons and glial cells, nervous tissue is specialized for communication and signal transmission.

• It facilitates the transfer of electrical signals between different parts of the body, enabling coordination and response to stimuli.

• Although nervous tissue is essential for muscle activation, it does not directly cause movement since it lacks contractile proteins.

• Squamous epithelium tissue:

• This tissue consists of flat, thin cells and is adapted for diffusion and filtration.

• It is found lining structures such as alveoli in the lungs and blood vessels, where rapid exchange of gases and nutrients occurs.

• Squamous epithelium does not have contractile properties and is not involved in movement.

• Important Points:

• The key difference between muscular tissue and other tissue types lies in the presence of contractile proteins that enable movement.

• Muscular tissue also consumes a significant amount of energy (ATP) during contraction, highlighting its distinct metabolic demands compared to other tissues.

• Each type of muscle tissue (skeletal, smooth, cardiac) has specific roles and structural adaptations suited to its function.

Q8. Answer: (b) The line passing through the centre of curvature and pole

The correct answer is The line passing through the centre of curvature and pole..

Key Points

• The principal axis of a spherical mirror is defined as the straight line that passes through the centre of curvature (C) and the pole (P) of the mirror.

• This line acts as the reference line for all measurements and is perpendicular to the surface of the spherical mirror at the pole.

• The principal axis is significant because it determines the symmetry of the mirror and is the axis along which the mirror's properties, such as focus and curvature, are defined.

• In both concave and convex mirrors, the principal axis is the central line that helps in locating key points like the focus (F) and the centre of curvature (C).

• Hence, the correct definition of the principal axis is the line passing through the centre of curvature and pole, making Option 2 the right answer.

Additional Information

• Pole (P):

• The pole is the geometric center of the mirror's reflecting surface.

• It is the point where the principal axis intersects the mirror's surface.

• Centre of Curvature (C):

• The centre of curvature is the center of the sphere of which the spherical mirror is a part.

• It lies outside the mirror for both concave and convex mirrors and is located on the principal axis.

• Focus (F):

• The focus is the point on the principal axis where parallel rays of light, after reflection, converge (in concave mirrors) or appear to diverge from (in convex mirrors).

• The distance from the pole to the focus is called the focal length (f).

• Radius of Curvature (R):

• The radius of curvature is the distance between the pole and the centre of curvature.

• It is equal to twice the focal length, i.e., R = 2f.

• Convex vs. Concave Mirrors:

• Concave mirrors are converging mirrors that reflect light inward, while convex mirrors are diverging mirrors that spread light outward.

• The principal axis remains the same in both types, helping locate key points like the focus and the centre of curvature.

Important Points

• Option 1: "The line passing through the focus and object" is incorrect because the principal axis does not depend on the object's position.

• Option 3: "The tangent at the pole" is incorrect as a tangent is a line that touches the surface at one point and does not represent the principal axis.

• Option 4: "The perpendicular line drawn from the pole" is vague and does not define the axis passing through the centre of curvature.

• Always remember, the principal axis is the line that passes through the centre of curvature and the pole of the mirror.

Q9. Answer: (d) One version from each parent

The correct answer is One version from each parent.

Key Points

• Sexual reproduction involves the fusion of male and female gametes (sperm and egg), each of which carries one set of chromosomes. The child inherits one version of each trait from each parent.

• Each parent contributes one allele for every trait. An allele is a version of a gene that determines specific characteristics, such as eye color or blood type.

• The combination of alleles inherited from both parents determines the genotype (genetic makeup) of the offspring. This may lead to the expression of dominant or recessive traits.

• For example, in humans, each individual has 23 pairs of chromosomes, for a total of 46. One chromosome in each pair is inherited from the mother, and the other is inherited from the father.

• Traits such as height, hair color, and even predisposition to certain diseases are determined by the interaction of the alleles contributed by both parents, following principles of Mendelian inheritance.

Additional Information

• Chromosomes and Genes:

• Humans have 23 pairs of chromosomes in each cell. Chromosomes carry genes, which are the basic units of heredity.

• Each chromosome contains numerous genes. These genes exist in pairs, with one copy coming from the father and the other from the mother.

• Alleles and Genetic Variation:

• An allele is a variant form of a gene. For example, the gene for eye color may have alleles for blue, green, or brown eyes.

• The presence of different alleles contributes to genetic diversity, which is essential for survival and adaptation in changing environments.

• Mendel's Laws of Inheritance:

• Law of Segregation: Each parent contributes only one allele for a trait to their offspring. This occurs because alleles separate during the formation of gametes.

• Law of Independent Assortment: Alleles for different traits are inherited independently of each other, provided the genes are located on different chromosomes.

• Dominant and Recessive Traits:

• A dominant allele masks the effect of a recessive allele when both are present. For example, in pea plants, the allele for tallness is dominant over the allele for shortness.

• Recessive traits are expressed only when an individual inherits two copies of the recessive allele.

• Examples of Inherited Traits:

• Eye Color: Controlled by multiple genes, with dominant and recessive alleles determining the final color.

• Blood Type: Determined by three alleles (A, B, and O), with combinations like AB, A, B, and O resulting from inheritance from both parents.

• Genetic Disorders: Some conditions, like sickle cell anemia and cystic fibrosis, are inherited when both parents contribute a recessive allele for the disorder.

Important Points

• Gregor Mendel: Known as the "Father of Genetics," Mendel's experiments with pea plants laid the foundation for understanding inheritance patterns.

• Genotype vs. Phenotype: Genotype refers to the genetic makeup of an organism, while phenotype refers to the observable traits resulting from the genotype.

• Heredity and Environment: While genes determine potential traits, environmental factors can influence their expression, such as height being affected by nutrition.

• Mutation: A mutation is a change in the DNA sequence. While some mutations are harmful, others can introduce beneficial traits that aid evolution.

• Sex-linked Traits: Traits like color blindness and hemophilia are linked to genes found on sex chromosomes (X and Y) and are

often inherited differently in males and females.

Q10. Answer: (d) 142 u

The correct answer is 142 u.

Key Points

• The formula unit mass of a compound is calculated by summing up the atomic masses of all the atoms present in its chemical formula.

• The chemical formula of sodium sulfate is Na2SO4, which consists of:

• 2 sodium (Na) atoms, each with an atomic mass of 23 u.

• 1 sulfur (S) atom, with an atomic mass of 32 u.

• 4 oxygen (O) atoms, each with an atomic mass of 16 u.

• Calculation of formula unit mass:

• Mass of sodium: 2 × 23 = 46 u

• Mass of sulfur: 1 × 32 = 32 u

• Mass of oxygen: 4 × 16 = 64 u

• Total formula unit mass: 46 + 32 + 64 = 142 u

• Thus, the calculated formula unit mass of Na2SO4 is 142 u.

Additional Information

• Atomic Mass:

• The atomic mass of an element is the average mass of its atoms, typically measured in atomic mass units (u).

• For example:

• Sodium (Na): 23 u

• Sulfur (S): 32 u

• Oxygen (O): 16 u

• Formula Unit Mass:

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

• It is expressed in atomic mass units (u).

• Sodium Sulfate (Na2SO4):

• Sodium sulfate is an ionic compound composed of sodium cations (Na^+) and sulfate anions (SO4^(2-)).

• It is used in various industries, such as in detergents, paper production, and as a drying agent.

• Applications of Formula Unit Mass:

• It helps in determining the proportion of elements in a compound.

• It is essential for stoichiometric calculations in chemical reactions.

Important Points

• Difference Between Atomic Mass and Molecular Mass:

• Atomic mass: The mass of a single atom of an element.

• Molecular mass: The sum of atomic masses of all atoms in a molecule.

• Units of Measurement:

• The atomic mass unit (u) is based on the carbon-12 isotope, where 1 u = 1/12th the mass of a carbon-12 atom.

• Relevance in Chemistry:

• Understanding formula unit mass is crucial for analyzing chemical formulas and performing stoichiometric calculations.

• It is widely used in academic and industrial chemistry applications.

Q11. Answer: (a) Few reptiles

The correct answer is Few reptiles.

Key Points

• Sex determination in certain reptiles is influenced by environmental temperature during a critical period of embryo development, known as the thermosensitive period (TSP).

• This phenomenon is termed temperature-dependent sex determination (TSD) and is observed in species such as turtles, crocodiles, and some lizards.

• In TSD, the sex of the offspring is not determined by genetic factors but by the temperature at which the eggs are incubated. For example, in many turtle species, warmer temperatures produce females, while cooler temperatures produce males.

• Unlike mammals and birds, which have chromosomal sex determination, these reptiles lack sex chromosomes and instead rely

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on environmental cues for sex determination.

• This adaptation is thought to be linked to the evolutionary success of these species, as it allows populations to adjust the sex ratio in response to environmental conditions.

Additional Information

• Human beings:

• The sex of humans is determined by chromosomal sex determination, specifically the XX/XY system.

• Males have one X chromosome and one Y chromosome (XY), while females have two X chromosomes (XX).

• This system is not influenced by environmental factors.

• All fishes:

• Some fish species exhibit environmental sex determination (ESD), but it is not universally observed in all fishes.

• For example, in clownfish, sex can change based on social hierarchy rather than temperature.

• However, sex determination in most fishes is genetically determined.

• All birds:

• Birds follow a ZW sex determination system, where males are ZZ and females are ZW.

• This system is genetically determined and is not influenced by environmental temperature.

• Temperature-dependent sex determination (TSD):

• TSD is primarily observed in reptiles such as turtles, crocodiles, and some lizards.

• The critical temperature range that determines sex varies across species. For example, in the American alligator, males are produced at intermediate temperatures, while females are produced at both high and low temperatures.

• This mechanism allows reptiles to adapt their reproductive output to environmental changes.

Important Points

• Significance of TSD:

• TSD plays an important role in the ecology and evolution of reptiles by allowing populations to adjust their sex ratio based on environmental conditions.

• However, rising global temperatures due to climate change could disrupt this balance, leading to skewed sex ratios and threatening the survival of certain species.

• Examples of TSD species:

• Red-eared slider turtle: Females are produced at higher temperatures, while males are produced at lower temperatures.

• American alligator: Males are produced at intermediate temperatures, while females are produced at both high and low temperatures.

• Research and conservation:

• Understanding TSD is crucial for conservation efforts, especially in the context of climate change.

• Artificial incubation and temperature control are used in conservation programs to ensure balanced sex ratios in endangered reptile populations.

Q12. Answer: (c) A charged atom or molecule

The correct answer is A charged atom or molecule.

Key Points

• An ion is a particle, atom, or molecule that carries a net electrical charge due to the loss or gain of electrons. This charge can be either positive (cation) or negative (anion).

• Cations are positively charged ions formed when an atom or molecule loses electrons. Example: Na^+ (Sodium ion).

• Anions are negatively charged ions formed when an atom or molecule gains electrons. Example: Cl^- (Chloride ion).

• Ions play a crucial role in chemical reactions, particularly in ionic bonding and electrochemical processes.

• Electrolytes, substances that produce ions in solution, are essential for biological processes like nerve transmission and muscle contraction.

Additional Information

• Formation of Ions:

• Atoms achieve stability by following the Octet Rule, which states that atoms prefer to have eight electrons in their outer shell.

• To achieve this, atoms may lose or gain electrons, resulting in the formation of ions.

• Example: Sodium (Na) loses one electron to form Na^+, and Chlorine (Cl) gains one electron to form Cl^-.

• Types of Ions:

• Monoatomic ions: Ions consisting of only one atom (e.g., K^+, Mg^{2}^+).

• Polyatomic ions: Ions consisting of two or more atoms bonded together (e.g., $SO4^{2}$^-, NH4^+).

• Applications of Ions:

• In industrial processes, ions are crucial for electroplating, electrolysis, and battery operation.

• In biology, ions like Na^+, K^+, and Ca²^+ are essential for cell signaling and maintaining osmotic balance.

• In water chemistry, ions determine water hardness and pH levels (e.g., carbonate ions in water hardness).

• Role in Ionic Bonding:

• Ionic bonds form when electrons are transferred from one atom to another, creating oppositely charged ions.

• Example: Sodium chloride (NaCl) forms via the transfer of an electron from Na to Cl, resulting in Na^+ and Cl^- ions.

Important Points

• Characteristics of Neutral Molecules:

• Neutral molecules have no net electrical charge as the number of protons equals the number of electrons.

• They can participate in covalent bonding but do not form ions unless chemical or physical conditions cause electron transfer.

• Misconceptions about Ions:

• Ions are not necessarily radioactive or unstable; many ions, such as Na^+ or Cl^-, are stable and play important roles in everyday chemistry.

• Atoms with only neutrons do not exist as independent entities; neutrons are subatomic particles found within the nucleus of atoms.

• Examples of Ionic Compounds:

• Common table salt (NaCl) consists of Na^+ and Cl^- ions.

• Magnesium oxide (MgO) forms from Mg²^+ and O²^- ions.

• Calcium carbonate (CaCO3) contains Ca²^+ and CO3²^- ions.

Q13. Answer: (b) 0.5 A

The correct answer is 0.5 A.

Key Points

• The given resistors of 4 Ω, 8 Ω, and 12 Ω are connected in series. In a series connection, the total or equivalent resistance is the sum of the individual resistances.

• The formula to calculate the total resistance in a series circuit is:

R_(total) = R1 + R2 + R3.

Substituting the given values:

R_(total) = 4 Ω + 8 Ω + 12 Ω = 24 Ω.

• The circuit is powered by a 12 V battery. Using Ohm's Law, which is V = IR, we can calculate the current in the circuit. Rearranging the formula:

I = V / R.

• Substitute the values for voltage and total resistance:

I = 12 V / 24 Ω = 0.5 A.

• Thus, the current in the circuit is 0.5 A, which matches the given correct option.

Additional Information

• Ohm's Law:

• Ohm's Law states that the current (I) through a conductor between two points is directly proportional to the voltage (V) across the two points and inversely proportional to the resistance (R) of the conductor.

• The formula is expressed as: V = IR, where V is voltage, I is current, and R is resistance.

• This law is fundamental in understanding the behavior of electrical circuits.

• Series Circuit:

• In a series circuit, the current remains the same across all components, but the voltage is divided among them.

• The total resistance in a series circuit is the sum of all individual resistances: R_(total) = R1 + R2 + ... + R_n.

• Resistors in Series vs. Parallel:

• In a series connection, resistors add up to increase the total resistance, while in a parallel connection, the total resistance decreases.

• The formula for total resistance in a parallel circuit is:

1/R_(total) = 1/R1 + 1/R2 + ... + 1/R_n.

• Electric Current:

• Electric current is the rate of flow of electric charge through a conductor.

• The unit of electric current is the ampere (A), named after French physicist André-Marie Ampère.

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• 1 ampere is equivalent to 1 coulomb of charge passing through a point in 1 second.

Important Points

• Power in an Electrical Circuit:

• The power (P) dissipated in an electrical circuit is calculated using the formula: P = VI, where V is voltage and I is current.

• For resistors, power can also be expressed as: $P = I^2R$ or $P = V^2/R$.

• Applications of Series Circuits:

• Series circuits are commonly used in applications where the same current is required to flow through multiple components, such as decorative lights.

• However, if one component in the series circuit fails, the entire circuit is interrupted.

• Units of Measurement:

• Voltage: Measured in volts (V).

• Resistance: Measured in ohms (Ω).

• Current: Measured in amperes (A).

Q14. Answer: (a) Pesticide

The correct answer is Pesticide.

Key Points

• Pesticides are chemical substances used to eliminate or control pests in agricultural practices. These include herbicides, insecticides, fungicides, and rodenticides.

• Pesticides are non-biodegradable and persist in the environment, leading to their accumulation in the food chain. This process is termed biological magnification, where concentrations increase as one moves up the trophic levels.

• The phenomenon of biological magnification is particularly harmful as it affects organisms at the top of the food chain, such as humans, by causing severe health risks like cancer, neurological disorders, and reproductive issues.

• Other organic substances like rose petals, neem bark, and orange peel do not contribute to biological magnification as they are biodegradable and decompose naturally in the environment. Hence, these are incorrect options.

• Examples of pesticides that cause biological magnification include DDT, Aldrin, Heptachlor, and Mercury-based compounds.

Additional Information

• Biological Magnification:

• Definition: Biological magnification refers to the increase in concentration of toxic substances, such as pesticides or heavy metals, as they move up the food chain.

• Impact: Organisms at higher trophic levels, such as predatory birds, fish, and humans, accumulate higher concentrations of toxins, leading to severe ecological and health impacts.

• Examples: Persistent Organic Pollutants (POPs) like DDT and mercury compounds are common substances involved in magnification.

• Global Concerns: The Stockholm Convention on Persistent Organic Pollutants aims to eliminate or restrict the production and use of POPs to prevent biological magnification.

• Pesticides and Environmental Impact:

• Types: Pesticides include chemical categories like organophosphates, carbamates, and pyrethroids.

• Health Risks: Long-term exposure to pesticides can cause cancer, developmental disorders, and endocrine disruption.

• Regulation: Countries have established strict guidelines for pesticide use. For instance, in India, the Insecticides Act of 1968 regulates pesticide production and use.

• Biodegradable Substances:

• Substances like rose petals, neem bark, and orange peel are biodegradable and decompose naturally through microbial action.

• They do not persist in the environment or accumulate in the food chain, making them environmentally safe.

• Neem bark, for example, is widely used as a natural pesticide due to its antibacterial and antifungal properties, but it does not contribute to biological magnification.

• Examples of Biological Magnification:

• The pesticide DDT was widely used until its ecological impact was recognized. It caused eggshell thinning in birds like eagles and falcons, leading to population declines.

• Mercury poisoning in aquatic ecosystems has led to fish contamination, impacting human health when consumed.

• Other examples include toxic accumulation of PCBs (Polychlorinated Biphenyls) in marine food chains.

Important Points

• Stockholm Convention: An international treaty signed in 2001 to eliminate or restrict the use of Persistent Organic Pollutants (POPs).

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• Silent Spring: A book by Rachel Carson, published in 1962, which raised awareness about the environmental impact of pesticides, especially DDT.

• DDT Ban: Many countries, including India, banned the use of DDT in agriculture due to its ecological and health hazards.

• Alternative Solutions: The use of biopesticides, integrated pest management (IPM), and organic farming are promoted to reduce reliance on harmful chemical pesticides.

Q15. Answer: (c) Sodium bicarbonate (baking soda)

The correct answer is Sodium bicarbonate (baking soda).

Key Points

• Washing soda (sodium carbonate, $Na_2CO_3 \cdot 10H_2O$) is prepared by heating sodium bicarbonate ($NaHCO_3$).

• The process involves thermal decomposition of sodium bicarbonate, which produces sodium carbonate, carbon dioxide (CO_2), and water.

• The chemical equation for this process is as follows:

$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$.

• The sodium carbonate formed is then recrystallized to obtain washing soda, which contains 10 molecules of water of crystallization ($Na_2CO_3 \cdot 10H_2O$).

• Washing soda is commonly used in cleaning and laundry applications due to its ability to soften water and remove grease and stains.

Additional Information

• Sodium Bicarbonate (Baking Soda):

• It is a white crystalline compound with the formula $NaHCO_3$.

• It decomposes when heated to release carbon dioxide (CO_2) and water, leaving behind sodium carbonate.

• Commonly used in baking as a leavening agent, in fire extinguishers, and for neutralizing acids.

• Washing Soda (Sodium Carbonate):

• It is a hydrated salt of sodium carbonate with 10 molecules of water ($Na_2CO_3 \cdot 10H_2O$).

• Has applications in laundry, cleaning agents, and water softening.

• It is alkaline in nature and is used in various industrial processes, including glass manufacturing.

• Other Options:

• Sodium Chloride: Common salt, primarily used as a seasoning and preservative. Not involved in producing washing soda.

• Calcium Carbonate: Found in limestone and chalk; decomposes to form calcium oxide and carbon dioxide but is unrelated to washing soda preparation.

• Calcium Oxide: Also known as quicklime, used in construction and chemical processes. It does not form washing soda.

Important Points

• Applications of Washing Soda:

• Used as a water softener to remove calcium and magnesium ions in hard water.

• Essential in the production of glass, paper, and detergents.

• Helps in cleaning tough stains and grease in household cleaning tasks.

• Difference Between Washing Soda and Baking Soda:

• Baking soda: Sodium bicarbonate ($NaHCO_3$), mild alkaline, used in food and as an antacid.

• Washing soda: Sodium carbonate (Na_2CO_3), strong alkaline, used for cleaning and industrial purposes.

Q16. Answer: (c) Plastic bags

The correct answer is Plastic bags.

Key Points

• Biodegradable substances are materials that can decompose naturally through the action of microorganisms like bacteria and fungi.

• Plastic bags are made from synthetic polymers like polyethylene, which are derived from petroleum. These materials are non-biodegradable as they cannot be broken down by natural processes. Hence, they persist in the environment for hundreds of years.

• Spoilt food, waste paper, and vegetable peels are examples of biodegradable substances. They decompose naturally and contribute to the formation of compost or organic matter. Therefore, these options are incorrect.

• The accumulation of plastic waste poses significant environmental hazards, including soil and water pollution, harm to wildlife, and a contribution to microplastic pollution in ecosystems.

• The use of biodegradable alternatives to plastic bags, such as cloth or jute bags, is encouraged to reduce environmental impact.

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Additional Information

• Plastic Pollution:

• Plastic pollution occurs when plastic products accumulate in the environment, causing harm to ecosystems and human health.

• Microplastics, which are tiny plastic particles, have been found in oceans, rivers, and even in the food chain, posing a risk to marine life and humans.

• Globally, only a small percentage of plastic waste is recycled, while the rest ends up in landfills or as litter in the environment.

• Biodegradable Substances:

• Examples include food waste, paper, wood, and natural fibers like cotton and wool.

• These materials decompose naturally through biological processes, producing nutrient-rich compost beneficial for soil health.

• The decomposition process reduces environmental waste and supports sustainable waste management practices.

• Non-Biodegradable Substances:

• These are materials that do not decompose naturally, including plastics, metals, and synthetic chemicals.

• They persist in the environment and often require specialized recycling or disposal methods to mitigate their impact.

• The slow breakdown of these materials contributes to long-term environmental challenges, including pollution and habitat destruction.

• Efforts to Reduce Plastic Use:

• Many countries have implemented bans or restrictions on single-use plastics to combat plastic pollution.

• Innovative solutions, such as biodegradable plastics and recycling technologies, are being developed to address the issue.

• Public awareness campaigns encourage individuals to adopt sustainable practices, such as using reusable bags and reducing plastic consumption.

• Government Initiatives in India:

• The Plastic Waste Management Rules, 2016, mandate proper disposal and recycling of plastic waste.

• India pledged to eliminate single-use plastics by 2022 as part of its commitment to environmental sustainability.

• Campaigns like Swachh Bharat Abhiyan promote waste segregation and the use of biodegradable materials.

Q17. Answer: (c) Nitrogen prevents rancidity.

The correct answer is Nitrogen prevents rancidity..

Key Points

• Nitrogen prevents rancidity: Chips manufacturers flush bags with nitrogen gas to prevent rancidity caused by the oxidation of fats and oils present in the chips. This helps maintain their freshness and taste.

• Oxygen removal: By replacing oxygen with nitrogen, the chances of oxidative reactions that cause spoilage are minimized, as oxygen is a key contributor to oxidation.

• Preservation of quality: Nitrogen acts as an inert gas, which creates a protective atmosphere inside the bag and preserves the flavor, texture, and aroma of the chips.

• Packaging protection: Nitrogen filling also prevents the bag from collapsing or crushing the chips, as it creates a cushioning effect.

• Non-reactive nature: Unlike oxygen, nitrogen is chemically inert, meaning it does not react with the chips or their packaging material, ensuring extended shelf life.

Additional Information

• Rancidity:

• Rancidity is a chemical process where fats and oils are oxidized, leading to an unpleasant smell, taste, and sometimes harmful by-products.

• The oxidation of unsaturated fatty acids is the primary cause of rancidity, and exposure to oxygen accelerates this process.

• Role of nitrogen in food packaging:

• Nitrogen is widely used in the food industry to preserve the freshness and quality of perishable items such as chips, coffee, and nuts.

• It is also used in Modified Atmosphere Packaging (MAP), where the food is stored in an atmosphere of gases like nitrogen and carbon dioxide to extend shelf life.

• Alternative preservation methods:

• Other preservation techniques include vacuum sealing, freezing, and the use of preservatives such as antioxidants (e.g., vitamin E and BHT).

• While these methods are effective, nitrogen flushing is particularly favored for dry snacks due to its simplicity and efficiency.

• Other benefits of nitrogen:

• Nitrogen is non-toxic, odorless, and tasteless, making it a safe choice for food preservation.

• It also prevents the growth of aerobic microorganisms, further ensuring food safety and quality.

• Incorrect options explained:

• Nitrogen acts as a preservative: While nitrogen helps preserve chips, it does not directly act as a chemical preservative like additives; its role is to prevent oxidation.

• Nitrogen prevents reduction of oil: This is incorrect as nitrogen does not prevent the reduction of oil content but rather prevents its oxidation.

• Nitrogen acts as a taste enhancer: Nitrogen does not enhance taste; it simply maintains the original flavor by preventing spoilage.

Important Points

• Industrial use of nitrogen: Nitrogen is used in multiple industries, including electronics, pharmaceuticals, and food packaging, because of its inert nature.

• Environmental impact: Nitrogen flushing is environmentally friendly as it does not release harmful by-products.

• Shelf life improvement: Nitrogen-filled packaging can significantly enhance the shelf life of products by creating a stable, oxygen-free environment.

Q18. Answer: (c) More work done in less time means more power.

The correct answer is More work done in less time means more power..

Key Points

• Power is defined as the rate at which work is done or energy is transferred over time. The formula for power is: Power = Work Done / Time.

• When more work is done in less time, the numerator (work done) increases while the denominator (time) decreases, resulting in a higher value of power. Hence, this statement is correct.

• Statement 1: Power and work are not independent of each other, as power is directly dependent on the amount of work done and the time taken. Hence, this statement is incorrect.

• Statement 2: Power does not necessarily decrease when work increases. If the time remains constant or decreases, power will increase. Hence, this statement is incorrect.

• Statement 4: Work done directly affects power as they are mathematically related. Power increases when work increases, provided time remains constant or decreases. Hence, this statement is incorrect.

Additional Information

• Power:

• Power is measured in Watts (W), where 1 Watt equals 1 Joule of work done per second.

• Power can also be expressed in terms of energy transfer: Power = Energy Transferred / Time.

• Work:

• Work is defined as the product of force and displacement in the direction of the force: Work = Force × Displacement × cos(θ), where θ is the angle between force and displacement.

• Work is measured in Joules (J).

• Time:

• Time is a crucial parameter in determining power. A shorter time for the same amount of work results in higher power output.

• Examples of Power:

• A 60-Watt bulb consumes 60 Joules of energy per second.

• A car engine with a power rating of 100 horsepower (~74600 Watts) does more work in a shorter time compared to a less powerful engine.

Important Points

• Relation Between Power, Work, and Time:

• If work increases and time remains constant, power increases proportionally.

• If work remains constant but time decreases, power also increases.

• Units of Power:

• The SI unit of power is the Watt (W).

• Other units include horsepower (1 HP = 746 W) and kilowatts (1 kW = 1000 W).

• Practical Applications:

• In mechanical systems, power ratings determine the efficiency of machines, such as engines and motors.

• In electrical systems, power ratings indicate energy consumption, as seen in household appliances like air conditioners and refrigerators.

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Q19. Answer: (c) It allows propagation of seedless plants such as banana.

The correct answer is It allows propagation of seedless plants such as banana.

Key Points

• Vegetative propagation is a method of plant reproduction that occurs through vegetative parts of the plant such as roots, stems, or leaves, without involving seeds.

• This technique is particularly beneficial for plants like bananas, sugarcane, and potatoes, which are seedless or have seeds that are not viable for propagation.

• Since vegetative propagation produces genetically identical plants to the parent, it helps maintain desirable traits such as taste, size, and disease resistance.

• It is a faster method of reproduction compared to growing plants from seeds, as it skips the germination phase and directly establishes a mature plant.

• Vegetative propagation is widely used in horticulture and agriculture for commercial cultivation of high-yield or disease-resistant varieties.

Additional Information

• Methods of Vegetative Propagation:

• Natural Vegetative Propagation: Occurs through plant structures like runners (e.g., grass), tubers (e.g., potato), rhizomes (e.g., ginger), and bulbs (e.g., onion).

• Artificial Vegetative Propagation: Techniques include grafting, cutting, layering, and tissue culture, which are often used in commercial agriculture.

• Advantages of Vegetative Propagation:

• Ensures uniformity in crop quality, as all offspring are clones of the parent plant.

• Allows cultivation of plants that are sterile or have non-viable seeds, such as bananas, seedless grapes, and some citrus varieties.

• Speeds up the growth and production process as plants bypass the germination and seedling stages.

• Disadvantages of Vegetative Propagation:

• Since the plants are genetically identical, they are vulnerable to the same diseases or pests.

• Does not introduce genetic variation, which can limit adaptability to changing environmental conditions.

• Examples of Plants Propagated Vegetatively:

• Bananas: Propagated using suckers or tissue culture due to their sterility.

• Potatoes: Propagated through tubers that have "eyes."

• Sugarcane: Propagated using cuttings of stems with nodes.

• Ornamental Plants: Roses and hibiscus are often propagated through cuttings.

Important Points

• Explanation of Incorrect Options:

• Option 1: "Plants grown this way take longer to bear fruits." – Incorrect, as vegetative propagation often accelerates fruiting compared to seed-based growth.

• Option 2: "All new plants are genetically different from the parent." – Incorrect, as vegetative propagation produces genetically identical offspring.

• Option 4: "It requires cross-pollination to occur." – Incorrect, as vegetative propagation does not involve pollination or sexual reproduction.

• Applications in Agriculture and Horticulture: Vegetative propagation is a crucial technique for rapidly multiplying desirable plant varieties, ensuring consistent quality and yield in crops.

Q20. Answer: (a) Hypertonic solution

The correct answer is Hypertonic solution.

Key Points

• A hypertonic solution is one where the concentration of solutes outside the cell is higher than inside the cell. This difference in solute concentration creates an osmotic gradient.

• When a cell is placed in a hypertonic solution, water moves out of the cell through the plasma membrane via osmosis to balance the solute concentration. This results in the cell shrinking, a process known as crenation in animal cells.

• The movement of water occurs because of the principle of osmosis, where water flows from a region of lower solute concentration to a region of higher solute concentration.

• The shrinkage of the cell due to water loss can disrupt its normal functions and, in extreme cases, lead to cell death.

• Hypertonic solutions are commonly used in medical treatments, such as reducing edema or managing certain infections, but they must be administered carefully to avoid cellular damage.

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Additional Information

• Hypotonic Solution:

• A hypotonic solution has a lower solute concentration outside the cell compared to the inside.

• In such a solution, water moves into the cell, causing it to swell and potentially burst in a process called lysis.

• Hypotonic solutions are often used in treatments where hydration of cells is required, such as in patients suffering from severe dehydration.

• Isotonic Solution:

• An isotonic solution has an equal concentration of solutes inside and outside the cell, resulting in no net movement of water.

• Isotonic conditions are ideal for maintaining cell shape and function, and such solutions are commonly used in intravenous fluids like saline (0.9% NaCl).

• Osmosis:

• Osmosis is the movement of water molecules across a semipermeable membrane from a region of low solute concentration to a region of high solute concentration.

• This process is critical for maintaining cellular homeostasis and plays a key role in various physiological processes.

• Applications of Hypertonic Solutions:

• Hypertonic saline solutions are used in medical treatments to reduce intracranial pressure or treat pulmonary edema.

• In food preservation, hypertonic solutions like concentrated sugar or salt are used to prevent microbial growth by drawing water out of cells.

Important Points

• Cellular Effects of Different Solutions:

• In a hypertonic solution, cells shrink (crenation in animal cells, plasmolysis in plant cells).

• In a hypotonic solution, cells swell and may burst (lysis in animal cells, turgidity in plant cells).

• In an isotonic solution, cells maintain their normal size and shape.

• Osmoregulation:

• Organisms regulate water and solute concentrations to prevent damage caused by hypertonic, hypotonic, or isotonic conditions.

• For example, freshwater organisms actively expel excess water, while marine organisms regulate salt intake to maintain balance.

• Medical Implications:

• Understanding the effects of hypertonic, hypotonic, and isotonic solutions is critical in administering intravenous (IV) fluids to patients.

• Incorrect use of these solutions can lead to severe conditions like cellular dehydration or swelling.

Q21. Answer: (b) Gangue

The correct answer is Gangue.

Key Points

• Gangue refers to the unwanted impurities such as soil, sand, and rocks that are present along with the desired mineral in an ore.

• These impurities do not hold any economic value and must be separated from the ore to extract the valuable minerals.

• The process of removing gangue from ore is done through various techniques such as crushing, grinding, magnetic separation, froth flotation, or gravity separation.

• The presence of gangue increases the cost of extraction and processing of the ore, as additional steps are required to isolate the valuable minerals.

• Examples of gangue materials include silica (SiO_2), alumina (Al_2O_3), and other non-metallic impurities that are found alongside metallic ores like iron, copper, and gold.

Additional Information

• Slag:

• Slag is the byproduct formed during the smelting process of extracting metal from its ore. It consists of flux and impurities that are separated from the molten metal.

• Unlike gangue, slag is formed after the processing of ore and can sometimes be used in construction or cement industries.

• For example, in iron extraction, slag contains calcium silicate formed by the reaction of limestone (flux) with silica impurities.

• Flux:

• Flux is a substance added during smelting to remove impurities or gangue by forming a liquid slag.

• Common flux materials include limestone ($CaCO_3$) and silica (SiO_2), which react with gangue to form slag.

• Example: In the extraction of iron from hematite, limestone acts as a flux to remove silica impurities.

• Alloy:

• An alloy is a homogeneous mixture of two or more metals or a metal and a non-metal.
• Alloys have enhanced properties like strength, corrosion resistance, and hardness compared to pure metals.
• Examples include steel (iron and carbon), bronze (copper and tin), and brass (copper and zinc).
• Ore:
• An ore is a naturally occurring solid material from which a metal or valuable mineral can be profitably extracted.
• Examples of ores include hematite (iron), bauxite (aluminum), and chalcopyrite (copper).
• Ores consist of two components: valuable minerals and gangue (impurities).

Important Points

• Difference between Gangue and Slag:
• Gangue refers to impurities present in the ore before processing, while slag is a byproduct formed after processing during smelting.
• Gangue is separated through physical or chemical processes, while slag is separated during the metallurgical process.
• Economic Impact of Gangue:
• The presence of gangue in ore increases the cost of extraction due to additional beneficiation processes.
• Industries aim to minimize gangue by selecting high-grade ores to reduce production costs.
• Examples of Processes to Remove Gangue:
• Magnetic Separation: Used to separate magnetic materials (e.g., iron ores) from non-magnetic gangue.
• Froth Flotation: Used for sulfide ores like zinc sulfide, where gangue is separated using frothing agents.
• Gravity Separation: Relies on differences in density between ore and gangue particles.

Q22. Answer: (b) Both statements A and B are correct.

The correct answer is Option 2.

Key Points

• Statement A: Salts derived from strong acids and strong bases are neutral with a pH of 7.
• A strong acid completely dissociates to release hydrogen ions (H^+), while a strong base dissociates to release hydroxide ions (OH^-).
• When combined, their ions neutralize each other, forming water and a neutral salt with no acidic or basic character.
• For example, sodium chloride (NaCl) is formed from hydrochloric acid (HCl) and sodium hydroxide (NaOH), both strong compounds. This salt has a pH of 7 in an aqueous solution.
• Statement A is correct.
• Statement B: Sodium chloride is a neutral salt.
• Sodium chloride (NaCl) is formed by the neutralization reaction between hydrochloric acid (HCl) and sodium hydroxide (NaOH).
• Neither ion of NaCl (Na^+ and Cl^-) undergoes hydrolysis in water, keeping the solution neutral.
• Therefore, it is an example of a neutral salt.
• Statement B is correct.
• Both Statements A and B are correct, making Option 2 the correct answer.

Additional Information

• Types of Salts:
• Neutral salts: Formed from strong acids and strong bases; examples include NaCl and KNO3.
• Acidic salts: Formed from a strong acid and a weak base; examples include NH4Cl and AlCl3.
• Basic salts: Formed from a weak acid and a strong base; examples include Na2CO3 and CH3COONa.
• Neutralization Reaction: - This chemical reaction occurs when an acid and a base react to form water and a salt. - Example: HCl + NaOH → NaCl + H2O
• pH Scale: - The pH scale ranges from 0 to 14, where 7 is neutral. Values below 7 indicate acidity, and values above 7 indicate basicity. - Neutral salts have a pH of 7 because they do not affect the concentration of H^+ or OH^- ions in solution.
• Hydrolysis of Salts: - Salts derived from weak acids or weak bases may undergo hydrolysis, altering the pH of the solution. - For example, NH4Cl (ammonium chloride) hydrolyzes to form a slightly acidic solution.
• Examples of Neutral Salts: - Sodium chloride (NaCl) - Potassium nitrate (KNO3) - Calcium chloride (CaCl2)

Important Points

• Strong Acids: HCl, H2SO4, HNO3, etc.
• Strong Bases: NaOH, KOH, Ca(OH)2, etc.
• Neutralization Reaction Applications: Used in water treatment, antacid production, and chemical manufacturing.
• pH Monitoring: Essential in industries like agriculture, cosmetics, and pharmaceuticals to ensure product efficacy and safety.

Q23. Answer: (c) Xylem and phloem are complex tissues that help in conduction and form vascular bundles.

The correct answer is Xylem and phloem are complex tissues that help in conduction and form vascular bundles..

Key Points

• Complex permanent tissues are composed of more than one type of cell, working together to perform a common function. This makes them distinct from simple permanent tissues like parenchyma, collenchyma, and sclerenchyma.

• Xylem is a type of complex tissue responsible for the transportation of water and minerals from roots to other parts of the plant. It consists of different elements like tracheids, vessels, xylem fibers, and xylem parenchyma.

• Phloem is the tissue responsible for transporting food (sugar and organic nutrients) from the leaves to other parts of the plant. Its components include sieve tubes, companion cells, phloem fibers, and phloem parenchyma.

• The combination of xylem and phloem forms vascular bundles, which are essential for the conduction of water, minerals, and food in plants. These bundles also provide mechanical support to the plant body.

• The other options are incorrect as they misrepresent the structure and function of complex permanent tissues. For instance, complex tissues are not made of identical cells, nor are they exclusive to animals.

Additional Information

• Xylem:

• Tracheids: Long, tube-like cells that aid in the conduction of water and provide mechanical support.

• Vessels: Shorter, wider cells aligned end-to-end to form continuous tubes for water conduction.

• Xylem parenchyma: Stores food and helps in lateral conduction of water.

• Xylem fibers: Provide mechanical strength to the plant.

• Phloem:

• Sieve tubes: Cylindrical cells responsible for transporting food.

• Companion cells: Assist sieve tubes in the transport of nutrients and maintain their functionality.

• Phloem parenchyma: Stores food and other substances like resin and latex.

• Phloem fibers: Provide mechanical support to the plant.

• Vascular bundles:

• They are classified into three types based on arrangement: collateral, bicollateral, and radial vascular bundles.

• These bundles are vital for the growth and survival of plants by ensuring the efficient transport of essential substances.

• Incorrect options explained:

• Option 1: Complex tissues are not made of identical cells; they consist of different cell types working together.

• Option 2: Complex tissues are not exclusive to animals; they are found in plants.

• Option 4: Complex tissues like xylem and phloem are tightly packed, not loosely packed like parenchyma cells.

Important Points

• Other plant tissues:

• Simple permanent tissue: Includes parenchyma, collenchyma, and sclerenchyma, each with distinct functions like storage, support, and strength.

• Meristematic tissue: Responsible for plant growth as it contains actively dividing cells.

• Transport in plants:

• Water and minerals are transported through xylem via processes like root pressure, cohesion-tension, and capillary action.

• Food is transported in phloem through a process called translocation, driven by osmotic pressure.

• Applications: Understanding plant tissues is crucial for fields like agriculture, horticulture, and forestry, where plant growth and health are of utmost importance.

Q24. Answer: (c) Angle of deviation

The correct answer is Angle of deviation.

Key Points

• The angle of deviation is defined as the angle between the direction of the incident ray and the direction of the emergent ray as it exits a prism.

• When a light ray passes through a prism, it undergoes refraction twice: once when it enters the prism and once when it exits the prism. This bending of light results in the angle of deviation.

• The magnitude of the angle of deviation depends on factors like the angle of incidence, the refractive index of the material of the prism, and the apex angle of the prism.

• For a given prism, there is a specific angle of incidence at which the angle of deviation is minimum. This is called the minimum deviation angle, and it is often used to calculate the refractive index of the prism.

• It is an important concept in optics and is widely studied in the context of prism-based dispersion and light refraction.

Additional Information

• Angle of Prism:

• The angle of prism refers to the angle between the two refracting surfaces of the prism. It is also known as the apex angle.

• The angle of prism plays a significant role in determining the extent of deviation of light passing through the prism.

• Angle of Incidence:

• The angle of incidence is the angle between the incident ray and the normal to the surface at the point of incidence.

• This angle affects the refraction of light and consequently influences the angle of deviation in a prism.

• Critical Angle:

• The critical angle is the angle of incidence above which total internal reflection occurs for light traveling from a denser to a rarer medium.

• It is not directly related to the angle of deviation but is a key concept in understanding refraction and reflection phenomena.

• Applications of Angle of Deviation:

• It is used in the design of optical instruments like spectrometers to measure the refractive index of materials.

• The concept is also applied in the study of dispersion, where light is separated into its constituent colors using a prism.

Important Points

• Light Dispersion:

• The angle of deviation is responsible for the splitting of white light into its constituent colors when it passes through a prism. This phenomenon is called dispersion.

• The deviation angle is different for different wavelengths of light, which leads to the formation of a spectrum.

• Minimum Deviation:

• At minimum deviation, the refracted ray inside the prism is symmetric with respect to the prism's base, and the path of light is at its most efficient.

• This condition is often used in experiments to determine the refractive index of the prism material.

Q25. Answer: (a) 0.004 s

The correct answer is 0.004 s.

Key Points

• The time period of a wave is the reciprocal of its frequency. It is calculated using the formula:

Time Period (T) = 1 / Frequency (f)

• The given frequency of the sound wave is 250 Hz.

Substituting this into the formula:

T = 1 / 250 = 0.004 seconds.

• Therefore, the time period of the sound wave is 0.004 seconds.

• The unit of frequency is Hertz (Hz), which represents the number of cycles per second. The unit of time period is seconds (s).

• This calculation confirms that the correct option is 0.004 s, which corresponds to Option 1.

Additional Information

• Frequency and Time Period Relationship:

• Frequency (f) and time period (T) are inversely proportional. This means as frequency increases, the time period decreases, and vice versa.

• The mathematical expression for their relationship is:

T = 1 / f or f = 1 / T.

• Definition of Frequency:

• Frequency is the number of complete oscillations or cycles a wave completes in one second.

• It is measured in Hertz (Hz). For example, 1 Hz = 1 cycle per second.

• Definition of Time Period:

• The time period is the time taken to complete one oscillation or cycle of a wave.

• It is measured in seconds (s).

• Applications of Frequency and Time Period:

• These concepts are widely used in fields like acoustics, electronics, and signal processing.

• In sound waves, frequency determines the pitch of the sound, while the time period provides insights into the wave's periodicity.

• Real-life Examples:

• A guitar string vibrating at 440 Hz has a time period of approximately 0.00227 seconds.

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• The human ear can typically hear frequencies ranging from 20 Hz to 20,000 Hz.

Important Points

• Speed of Sound:

• The speed of sound in air is approximately 343 m/s at room temperature (20°C).

• The speed depends on factors like medium, temperature, and pressure.

• Wavelength and Frequency:

• Wavelength (λ) is inversely proportional to frequency when the speed of the wave is constant:

λ = v / f, where v is the speed of the wave.

• Higher frequency waves have shorter wavelengths.

• Practical Use:

• Frequency and time period calculations are vital in designing musical instruments, speakers, and communication devices.

• They are also crucial in medical imaging techniques like ultrasound.

Q26. Answer: (a) 9

If $x^2 + 1/x^2 = k$, then $x + 1/x = \sqrt{(k + 2)}$.

Given: k = 79

$x + 1/x = \sqrt{(79 + 2)} = \sqrt{81}$

$x + 1/x = 9$

Therefore The correct answer is 9.

Given: $x^2 + 1/x^2 = 79$

Formula used: $(a + b)^2 = a^2 + b^2 + 2ab$

$\Rightarrow (x + 1/x)^2 = x^2 + (1/x)^2 + 2 \times x \times (1/x)$

$\Rightarrow (x + 1/x)^2 = x^2 + 1/x^2 + 2$

$\Rightarrow (x + 1/x)^2 = 79 + 2$

$\Rightarrow (x + 1/x)^2 = 81$

$\Rightarrow x + 1/x = \pm\sqrt{81}$

$\Rightarrow x + 1/x = 9$ or -9

From the given options, the possible value is 9.

Therefore The correct answer is 9.

Reciprocal Subtraction Identity

$(x - 1/x)^2 = x^2 + 1/x^2 - 2$. Therefore, $x - 1/x = \sqrt{((x^2 + 1/x^2) - 2)}$.

Higher Power Relation

If $x + 1/x = k$, then $x^3 + 1/x^3 = k^3 - 3k$. This is derived from the $(a + b)^3$ expansion.

Standard Algebraic Identity

The base for these formulas is $(a + b)^2 = a^2 + b^2 + 2ab$ and $(a - b)^2 = a^2 + b^2 - 2ab$.

Q27. Answer: (c) 400 km/hr

Shortcut Trick

Direct formula for Speed = Distance ÷ Time

Speed = 1200 ÷ 3

Speed = 400 km/hr

Therefore The correct option is C.

Alternate Method

Given:

Distance traveled by flight = 1200 km

Time taken = 3 hours

Formula Used:

Speed = Distance ÷ Time

Start End FLIGHT 1200 km 3 hours Speed = 1200 ÷ 3

Calculations:

=> Speed = 1200 ÷ 3

=> Speed = 400 km/hr

Therefore The correct option is 3.

Additional Information

Unit Conversion

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

Average Speed

Average Speed = Total Distance ÷ Total Time. If a journey is divided into two equal distances with speeds x and y, Average Speed = 2xy ÷ (x + y).

Relative Speed

When two objects move in the same direction, Relative Speed = S1 − S2. When they move in opposite directions, Relative Speed = S1 + S2.

Q28. Answer: (c) 69 : 154

Shortcut Trick

Price Ratio (Lemon : Strawberry) = 22 : 6

Quantity Ratio (Lemon : Strawberry) = 14 : 23

Expenditure Ratio (S : L) = (6 × 23) : (22 × 14)

Ratio = 138 : 308 = 69 : 154

Therefore The correct option is C.

Alternate Method

Given:

Price ratio of Lemon (P_L) to Strawberry (P_S) = 22 : 6

Quantity ratio of Lemon (Q_L) to Strawberry (Q_S) = 14 : 23

Formula Used:

Expenditure = Price per unit × Quantity consumed

Lemon (L) Price: 22 units Qty: 14 units Strawberry (S) Price: 6 units Qty: 23 units Exp (L) = 308 Ratio S:L Exp (S) = 138 Final Ratio = 69 : 154

Calculations:

=> Expenditure on Lemon = Price_L × Quantity_L

=> Expenditure on Lemon = 22 × 14 = 308 units

=> Expenditure on Strawberry = Price_S × Quantity_S

=> Expenditure on Strawberry = 6 × 23 = 138 units

=> Required Ratio = Expenditure (Strawberry) : Expenditure (Lemon)

=> Required Ratio = 138 : 308

=> Dividing both sides by 2:

=> Ratio = 69 : 154

Therefore The correct option is C.

Additional Information

Compounding of Ratios

When two ratios a:b and c:d are multiplied, the resulting ratio is (a × c) : (b × d), which is called the compounded ratio.

Expenditure Relationship

If the price changes by a ratio x:y and consumption changes by a ratio m:n, the total expenditure changes by the ratio (x × m) : (y × n).

Ratio Simplification

A ratio a : b remains unchanged if both terms are multiplied or divided by the same non-zero constant k. (a/k : b/k = a : b).

Q29. Answer: (b) $2^2 \times 3^{(-1)} \times 5^2$

Shortcut Trick

Convert composite bases to prime factors: 6 = 2 × 3 and 10 = 2 × 5.

Denominator = $(2 \times 3)^{(-1)} \times (2 \times 5)^2 = 2^{(-1)} \times 3^{(-1)} \times 2^2 \times 5^2 = 2^1 \times 3^{(-1)} \times 5^2$.

Subtract denominator exponents from numerator exponents for like bases: $2^{(3-1)}$, $3^{(-2-(-1))}$, $5^{(4-2)}$.

Result = $2^2 \times 3^{(-1)} \times 5^2$.

Therefore The correct option is B.

Alternate Method

Given: $(2^3 \times 3^{(-2)} \times 5^4) / (6^{(-1)} \times 10^2)$

Formula Used: $(a \times b)n = an \times bn$ and $am \div an = am-n$

=> Expression = $(2^3 \times 3^{(-2)} \times 5^4) / ((2 \times 3)^{(-1)} \times (2 \times 5)^2)$

=> Expression = $(2^3 \times 3^{(-2)} \times 5^4) / (2^{(-1)} \times 3^{(-1)} \times 2^2 \times 5^2)$

=> Expression = $(2^3 \times 3^{(-2)} \times 5^4) / (2^{(-1+2)} \times 3^{(-1)} \times 5^2)$

=> Expression = $(2^3 \times 3^{(-2)} \times 5^4) / (2^1 \times 3^{(-1)} \times 5^2)$

=> Expression = $2^{((3-1))} \times 3^{((-2-(-1)))} \times 5^{((4-2))}$

=> Expression = $2^2 \times 3^{(-2+1)} \times 5^2$

=> Expression = $2^2 \times 3^{(-1)} \times 5^2$

Therefore The correct option is 2.

Additional Information

Laws of Exponents (Product and Quotient)

For any non-zero base, $a^m \times a^n = a^{(m+n)}$ and $a^m \div a^n = a^{(m-n)}$.

Negative Exponents

A term with a negative exponent can be moved to the denominator (or vice versa) to make the exponent positive: $a^{(-n)} = 1/a^n$.

Power of a Product Rule

When a product is raised to a power, each factor is raised to that power: $(ab)^n = a^n \times b^n$.

Q30. Answer: (c) 25%

Shortcut Trick

When profit is equal to the Selling Price (SP) of x items for n items sold:

Profit % = [x ÷ (n − x)] × 100

Profit % = [20 ÷ (100 − 20)] × 100

Profit % = (20 ÷ 80) × 100 = 25%

In decimal form: 25 ÷ 100 = 0.25

Therefore The correct answer is 0.25.

Alternate Method

Given: Total cupcakes sold = 100, Profit = SP of 20 cupcakes.

Formula: Profit = Selling Price (SP) − Cost Price (CP)

Total Selling Price (100 units) Cost Price (80 units) Profit (20 units) Base for % Calculation (CP)

Let the Selling Price (SP) of 1 cupcake = 1 unit.

=> Total SP of 100 cupcakes = 100 units.

=> Profit = SP of 20 cupcakes = 20 units.

=> Cost Price (CP) = SP − Profit

=> CP = 100 − 20 = 80 units.

=> Profit % = (Profit ÷ CP) × 100

=> Profit % = (20 ÷ 80) × 100 = 25%.

=> Profit in decimal = 0.25.

Therefore The correct answer is 0.25.

Additional Information

Profit based on Cost Price

If profit is equal to the CP of x items while selling n items, then Profit % = (x ÷ n) × 100.

Loss based on Selling Price

If loss is equal to the SP of x items while selling n items, then Loss % = [x ÷ (n + x)] × 100.

Marked Price (MP)

Discount is always calculated on the Marked Price. Selling Price = MP × [1 − (Discount % ÷ 100)].

Q31. Answer: (d) 7

Shortcut Trick

Apply the Reverse Operation method (backtracking).

Start from the final result 29.

Subtract the added value: 29 − 8 = 21.

Divide by the multiplier: 21 ÷ 3 = 7.
Therefore The correct answer is 7.
Alternate Method
Given:
Result = 29
Multiplier = 3
Addition constant = 8
Formula: (Number × 3) + 8 = Result
x × 3 3x + 8 29 Reverse: (29 − 8) ÷ 3
Let the required number be x.
=> 3 × x + 8 = 29
=> 3x = 29 − 8
=> 3x = 21
=> x = 21 ÷ 3
=> x = 7
Therefore The correct answer is 7.
Additional Information
Linear Equations
An equation of the form ax + b = c is a linear equation in one variable where x is the unknown value to be determined.
Order of Operations (BODMAS)
When solving or forming expressions, follow Brackets, Of, Division, Multiplication, Addition, and Subtraction.
Inverse Operations
To isolate the variable, perform the opposite operation: use subtraction for addition and division for multiplication.

Q32. Answer: (b) A, C, B

Shortcut Trick
Scheme A: Discount = 2 ÷ 5 × 100 = 40%
Scheme B: Discount = 65%
Scheme C: Discount = 31 + 40 − (31 × 40 ÷ 100) = 58.6%
Comparing discounts: 40% (A) < 58.6% (C) < 65% (B)
Ascending order: A, C, B
Therefore The correct option is B.
Alternate Method
Given:
Scheme A = Buy 3 get 2 free
Scheme B = Single discount of 65%
Scheme C = Successive discounts of 31% and 40%
Formula Used:
1. Discount % (Buy x get y free) = [y ÷ (x + y)] × 100
2. Equivalent Single Discount for x% and y% = [x + y − (xy ÷ 100)]%
Calculations:
=> Discount % for Scheme A = [2 ÷ (3 + 2)] × 100
=> Discount % for Scheme A = (2 ÷ 5) × 100 = 40%
=> Discount % for Scheme B = 65%
=> Discount % for Scheme C = [31 + 40 − (31 × 40 ÷ 100)]%
=> Discount % for Scheme C = [71 − 1240 ÷ 100]% = 71 − 12.4 = 58.6%
=> Arranging in ascending order: 40% < 58.6% < 65%
=> Order: Scheme A < Scheme C < Scheme B
Therefore The correct option is B.
Additional Information
Successive Discount Formula
For two successive discounts of a% and b%, the equivalent single discount is given by (a + b − ab/100)%.

Buy X Get Y Free Concept

In this scheme, the customer gets (X + Y) items but pays only for X items. The discount percentage is calculated as [Free Items ÷ Total Items] × 100.

Successive Multiplier Method

For multiple successive discounts, the final Selling Price = Marked Price × (1 − d1/100) × (1 − d2/100) × ... × (1 − d_n/100).

Q33. Answer: (d) 11.76%

Shortcut Trick

Let Cost Price (CP) = 100 units.

Marked Price (MP) = 100 + 36% of 100 = 136 units.

Selling Price (SP) = 100 + 20% of 100 = 120 units.

Discount = MP − SP = 136 − 120 = 16 units.

Discount % = (16 ÷ 136) × 100 = (2 ÷ 17) × 100 ≈ 11.76%.

Decimal value = 11.76%.

Therefore The correct option is D.

Alternate Method

Given:

Marked Price (MP) = Rs. 744

Mark-up Percentage = 36%

Profit Percentage = 20%

Formula Used:

MP = CP × (1 + Markup%/100)

SP = CP × (1 + Profit%/100)

Discount % = [(MP − SP) ÷ MP] × 100

CP SP MP (744) Mark-up: +36% Profit: +20% Discount: ?

=> CP = 744 ÷ (1 + 36/100) = 744 ÷ 1.36

=> CP = 547.0588

=> SP = CP × (1 + 20/100) = 547.0588 × 1.20

=> SP = 656.4705

=> Discount = MP − SP = 744 − 656.4705 = 87.5295

=> Discount % = (87.5295 ÷ 744) × 100

=> Discount % ≈ 11.7647%

=> In decimal form = 11.76%

Therefore The correct option is D.

Additional Information

Relation between CP and MP

The direct ratio of MP to CP is given by: MP/CP = (100 + Profit%) / (100 − Discount%).

Marked Price Formula

MP = SP + Discount = CP + Mark-up amount. Mark-up is always calculated on the Cost Price.

Successive Discounts

If two successive discounts d1 and d2 are given, the single equivalent discount is (d1 + d2 − (d1 × d2)/100)%.

Q34. Answer: (d) 18,975

Shortcut Trick

Using the formula: (M1 × D1) / W1 = (M2 × D2) / W2

(30 × 4) / 4140 = (55 × 10) / W2

120 / 4140 = 550 / W2

W2 = (550 × 4140) / 120 = 550 × 34.5

W2 = 18975

Therefore The correct answer is 18975.

Alternate Method

Given:

Initial workers (M1) = 30
Initial days (D1) = 4
Initial earnings (W1) = Rs. 4140
Final workers (M2) = 55
Final days (D2) = 10
Formula Used:
The total earning is directly proportional to the number of workers and the number of days: W prop. to M × D
=> (M1 × D1) / W1 = (M2 × D2) / W2
Case 1 30 Workers 4 Days Rs. 4140 Case 2 55 Workers 10 Days Rs. 18975 Earning prop. to (Workers × Days)
Calculations:
=> (30 × 4) / 4140 = (55 × 10) / W2
=> 120 / 4140 = 550 / W2
=> 1 / 34.5 = 550 / W2
=> W2 = 550 × 34.5
=> W2 = 18975
Therefore The correct answer is 18975.
Additional Information
Chain Rule Formula
The general formula is (M1×D1×H1)/W1 = (M2×D2×H2)/W2, where M = men, D = days, H = hours, and W = work or wages.
Direct Proportion
Wages are directly proportional to the total work done. If number of workers or days increase, the total wage also increases linearly.
Efficiency Aspect
If efficiencies are different, include it in the numerator: (M1×D1×E1)/W1 = (M2×D2×E2)/W2.

Q35. Answer: (a) 53

Shortcut Trick
Teacher’s age = New Average + (Initial Number × Increase in Average)
New Average = 28, Initial Students = 25, Increase = 28 − 27 = 1
Teacher’s age = 28 + (25 × 1)
Teacher’s age = 28 + 25 = 53 years
Therefore The correct answer is 53.
Alternate Method
Given:
Number of students = 25
Average age of students = 27 years
Average age including teacher = 28 years
Formula Used:
Average = Sum of values ÷ Total number of values
Sum of values = Average × Total number of values
Initial Group Students: 25 Avg Age: 27 + Teacher New Group Total People: 26 Avg Age: 28 Teacher Age = (26 × 28) − (25 × 27)
=> Initial sum of ages of 25 students = 25 × 27 = 675 years
=> Total number of people including teacher = 25 + 1 = 26
=> New sum of ages including teacher = 26 × 28
=> New sum = 728 years
=> Teacher’s age = New sum − Initial sum
=> Teacher’s age = 728 − 675
=> Teacher’s age = 53 years
Therefore The correct answer is 53.
Additional Information
Deviation Method
If the average increases by x when a new member joins, the new member's value = Old Average + New Count × x.

Weighted Average

The combined average of two groups is given by (n1A1 + n2A2) ÷ (n1 + n2), where n is count and A is average.

Effect of Constant Change

If every observation in a set is increased or decreased by a constant k, the average also increases or decreases by k.

Q36. Answer: (c) decrease by Rs. 11,645

Shortcut Trick

Let Income = 100 units, Savings = 22.5 units, Expenditure = 77.5 units.

Income increase = 14% of 100 = 14 units.

Expenditure increase = 40% of 77.5 = 31 units.

Savings change = 14 − 31 = −17 units (Decrease).

Given 100 units = Rs. 68,500 => 17 units = 17 × 685 = Rs. 11,645.

Therefore The correct option is C.

Alternate Method

Given:

Income = Rs. 68,500, Savings Percentage = 22.5%

Formula Used:

Income = Expenditure + Savings

Income: Rs. 68,500 (100%) Exp: 77.5% Sav: 22.5% Income ↑ 14% (Rs. 9,590) | Exp ↑ 40% (Rs. 21,235) Savings Decrease = Rs. 11,645

Calculations:

=> Original Savings = 22.5% of 68,500 = (22.5 ÷ 100) × 68,500 = Rs. 15,412.5

=> Original Expenditure = 68,500 − 15,412.5 = Rs. 53,087.5

=> Increase in Income = 14% of 68,500 = (14 ÷ 100) × 68,500 = Rs. 9,590

=> Increase in Expenditure = 40% of 53,087.5 = (40 ÷ 100) × 53,087.5 = Rs. 21,235

=> Change in Savings = Increase in Income − Increase in Expenditure

=> Change in Savings = 9,590 − 21,235 = −Rs. 11,645

=> The negative value denotes a decrease in savings.

Therefore The correct option is C.

Additional Information

Income-Expenditure Identity

The fundamental relation is Income = Expenditure + Savings. Any change in two components directly determines the change in the third.

Net Change in Savings

Change in Savings = (Income × Income increase %) − (Expenditure × Expenditure increase %). If the result is negative, savings have decreased.

Percentage Change Formula

Percentage change in savings = (Change in Savings ÷ Original Savings) × 100. This helps in identifying the growth or reduction rate.

Q37. Answer: (d) 4

Shortcut Trick

Efficiency: A = 1/2, B = 1/5, C = 1/20

Total efficiency = 1/2 + 1/5 + 1/20 = 10/20 + 4/20 + 1/20 = 15/20 = 3/4

Time for 1 work = 1 ÷ (3/4) = 4/3 days

Time for 3 works = 3 × (4/3) = 4 days

Therefore The correct answer is 4 days.

Alternate Method

Person	Days	Total Work	Efficiency
A	2	20	10
B	5	4	
C	20	1	

=> Total efficiency = 10 + 4 + 1 = 15 units/day

=> Time for 1 work = 20 ÷ 15 = 4/3 days

=> Time for 3 works = 3 × (4/3) = 4 days

Therefore The correct answer is 4 days.

Additional Information

LCM Method

Take LCM of days as total work. Efficiency = Total Work ÷ Days.

Combined Work Formula

If efficiencies are a, b, c then total = a + b + c and Time = Total Work ÷ Combined Efficiency.

Multiple Work Concept

If 1 work takes T days, then n works take n × T days.

Efficiency Relation

Efficiency is inversely proportional to time: Efficiency prop. to 1/Time.

Q38. Answer: (c) Decreased 7.96%

Shortcut Trick

Net % change = a + b + ab/100 where a = +18, b = −22

= 18 + (−22) + (18 × −22)/100

= 18 − 22 − 396/100

= −4 − 3.96 = −7.96%

Negative sign means decrease.

Therefore The correct answer is 7.96% decrease.

Alternate Method

Given:

First change = +18% (increase)

Second change = −22% (decrease)

Formula used:

Net % change = a + b + (a × b) ÷ 100

Where a = first % change | b = second % change

Use + for increase and − for decrease.

Original Rs. 100 +18% After +18% Rs. 118 −22% After −22% Rs. 92.04 Net change = 92.04 − 100 = −7.96% a + b + ab/100 = 18 − 22 − 3.96 = −7.96% Decrease of 7.96%

Calculations:

Let original price = Rs. 100

=> After 18% increase = 100 × 118/100 = Rs. 118

=> After 22% decrease on Rs. 118 = 118 × 78/100 = Rs. 92.04

=> Net change = 92.04 − 100 = −7.96

=> % change = −7.96%

Using direct formula: a + b + ab/100 = 18 + (−22) + (18 × −22)/100

=> = 18 − 22 − 396/100

=> = −4 − 3.96

=> = −7.96%

Since value is negative => it is a decrease.

Therefore The correct answer is 7.96% decrease.

Additional Information

Successive Percentage Change — Direct Formula

For two successive % changes a and b: Net % = a + b + ab/100. Use + for increase and − for decrease. Example: +20% then −20% => net = 20 − 20 + (20 × −20)/100 = −4% — always results in a net decrease when same % is applied both ways.

Multiplying Factor Method

x% increase → multiply by (100+x)/100 | x% decrease → multiply by (100−x)/100. For this question: 100 × 118/100 × 78/100 = 92.04. Net factor = 0.9204 => decrease of 7.96%. This method works for any number of successive changes.

Three Successive % Changes

For three changes a, b, c: apply the formula twice. First find net of a and b => then apply formula again with c. Or use multiplying factor method directly: Original × (1±a/100) × (1±b/100) × (1±c/100). This is the fastest method for three or more changes.

% Increase Needed to Recover After Decrease

If price drops by x%, the % increase needed to recover = x/(100−x) × 100. For this question final price is 92.04% of original — to recover: 7.96/92.04 × 100 ≈ 8.65% increase is needed. Recovery % is always greater than the decrease %.

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Q39. Answer: (c) Rs. 15,600

Shortcut Trick

Profit Ratio of Amit : Total = 2,900 : 8,700 = 1 : 3

Since time is constant, Investment Ratio = Profit Ratio.

Amit's Investment = (1/3) × Total Investment

Amit's Investment = 46,800 ÷ 3 = Rs. 15,600

Therefore The correct option is C.

Alternate Method

Given:

Total Investment = Rs. 46,800

Total Profit = Rs. 8,700

Amit's Profit Share = Rs. 2,900

Formula Used:

Profit Ratio = (Investment1 × Time1) : (Investment2 × Time2)

Amit: Rs. 2,900 Deeksha: Rs. 5,800 Profit Ratio = 2900 : 5800 = 1 : 2 Total Investment = Rs. 46,800 Amit's Share = 1/3 of 46,800

Calculations:

=> Deeksha's Profit = Total Profit − Amit's Profit

=> Deeksha's Profit = 8,700 − 2,900 = Rs. 5,800

=> Ratio of Profit (Amit : Deeksha) = 2,900 : 5,800

=> Ratio of Profit (Amit : Deeksha) = 1 : 2

=> Since time period is same, Investment Ratio = Profit Ratio = 1 : 2

=> Sum of ratio parts = 1 + 2 = 3

=> 3 units = Rs. 46,800

=> 1 unit = 46,800 ÷ 3 = Rs. 15,600

=> Amit's Investment = 1 unit = Rs. 15,600

Therefore The correct option is C.

Additional Information

Simple Partnership

When partners invest their capital for the same duration, the profit or loss is divided in the ratio of their capital (P1 : P2 = C1 : C2).

Compound Partnership

When partners invest capital for different time periods, profit is divided in the ratio of (Capital × Time), i.e., P1 : P2 = (C1 × T1) : (C2 × T2).

Ratio and Proportion in Partnership

Total Investment = Individual Investment × (Total Profit ÷ Individual Profit Share), provided time is constant for all partners.

Q40. Answer: (a) 45 years

Shortcut Trick

Ratio 5 yrs ago = 7 : 2 (diff 5) | Ratio 5 yrs hence = 3 : 1 (diff 2)

Equalize difference: (7:2) × 2 = 14 : 4 and (3:1) × 5 = 15 : 5

Increase of 1 unit (15−14 or 5−4) = 10 years (5 years ago to 5 years hence)

Newer building age 5 years ago = 4 units = 4 × 10 = 40 years

Present age = 40 + 5 = 45 years

Therefore The correct answer is 45 years.

Alternate Method

Given:

Ratio 5 years ago = 7 : 2

Ratio 5 years hence = 3 : 1

Formula Used:

Age = Ratio value × Constant factor (x)

5 Yrs Ago Present 5 Yrs Hence 7 : 2 3 : 1 Total Gap = 10 Yrs

Let the ages of the two buildings 5 years ago be 7x and 2x.

Present ages = (7x + 5) and (2x + 5)

Ages 5 years hence = (7x + 5 + 5) and (2x + 5 + 5) = (7x + 10) and (2x + 10)

According to the question:

=> (7x + 10) / (2x + 10) = 3 / 1

=> 7x + 10 = 3 × (2x + 10)

=> 7x + 10 = 6x + 30

=> 7x − 6x = 30 − 10

=> x = 20

Age of newer building 5 years ago = 2x

=> 2 × 20 = 40 years

Present age of newer building = 40 + 5 = 45 years

Therefore The correct answer is 45 years.

Additional Information

Constant Age Difference

The difference between the ages of two individuals or objects always remains constant, regardless of how many years pass.

Ratio Balancing Method

To solve age problems quickly, multiply the ratios so that the numerical difference between the ratio parts (e.g., 7−2=5 and 3−1=2) becomes equal.

Time Gap Calculation

Total time gap between 'n' years ago and 'm' years hence is always (n + m) years.

Q41. Answer: (b) 49 cm

Shortcut Trick

Equate volumes: Volume of Hollow Sphere = Volume of Cone

=> (4/3) × π × ($R^3 - r^3$) = (1/3) × π × $r_(cone)^2$ × h

=> 4 × ($10^3 - 6^3$) = 8^2 × h

=> 4 × (1000 − 216) = 64 × h

=> 4 × 784 = 64 × h => 784 = 16 × h

=> h = 49 cm

Therefore The correct answer is 49 cm.

Alternate Method

Given:

External radius of sphere (R) = 10 cm

Internal radius of sphere (r) = 6 cm

Base radius of cone (r_c) = 8 cm

Value of π = 22/7

R=10 r=6 Hollow Sphere Recast r=8 h=? Solid Cone

Formula Used:

Volume of hollow sphere = (4/3) × π × ($R^3 - r^3$)

Volume of cone = (1/3) × π × r^2 × h

Calculations:

=> Volume of hollow sphere = (4/3) × (22/7) × ($10^3 - 6^3$)

=> Volume of hollow sphere = (4/3) × (22/7) × (1000 − 216)

=> Volume of hollow sphere = (4/3) × (22/7) × 784

=> Volume of cone = (1/3) × (22/7) × 8^2 × h

=> (4/3) × (22/7) × 784 = (1/3) × (22/7) × 64 × h

=> 4 × 784 = 64 × h

=> 3136 = 64 × h

=> h = 3136 / 64

=> h = 49 cm

Therefore The correct answer is 49 cm.

Additional Information

Volume of Solid Sphere

The volume of a solid sphere with radius r is given by V = (4/3) × π × r³.

Curved Surface Area of Cone

The curved surface area (CSA) of a cone is π × r × l, where l = √(r² + h²) is the slant height.

Total Surface Area of Hollow Sphere

The total surface area of a hollow sphere is the sum of inner and outer surface areas: 4 × π × (R² + r²).

Volume of Cylinder

A solid cylinder has a volume equal to π × r² × h, which is three times the volume of a cone with the same base and height.

Q42. Answer: (a) 55/7

Shortcut Trick

Volume = 100 × 80 × 120 = 9,60,000 cm³

Outlet Rate = 9,60,000 ÷ 200 min = 4800 cm³/min

Net Emptying Rate = 4800 − 2000 = 2800 cm³/min

Time = 9,60,000 ÷ 2800 = 40/7 hours = 5 ^5/7 hours

Therefore The correct option is A.

Alternate Method

Given:

Dimensions = 100 cm × 80 cm × 120 cm

Inlet rate = 2000 cm³/min

Outlet time = 3 hours 20 minutes

Formula Used:

Volume of Cistern = Length × Breadth × Height

Emptying Rate = Total Volume ÷ Time to empty

Net Rate (Emptying) = Outlet Rate − Inlet Rate

Inlet: 2000 cm3/min Outlet: 4800 cm3/min Vol: 9,60,000 cm3

Calculations:

=> Volume of the cistern = 100 × 80 × 120 = 9,60,000 cm³

=> Time taken by outlet pipe to empty = 3 × 60 + 20 = 200 min

=> Rate of outlet pipe = 9,60,000 ÷ 200 = 4800 cm³/min

=> Rate of inlet pipe = 2000 cm³/min

=> Net emptying rate = 4800 − 2000 = 2800 cm³/min

=> Time required to empty the full cistern = 9,60,000 ÷ 2800 = 2400/7 min

=> Time in hours = (2400 ÷ 7) × (1 ÷ 60) = 40/7 hours

=> Time = 5 ^5/7 hours

Therefore The correct option is A.

Additional Information

Net Rate Logic

When both pipes are open and the tank empties, the net rate of emptying is calculated as (Outlet Rate − Inlet Rate). If the result is positive, the tank will eventually empty.

Volume to Rate Relationship

Rate is defined as the volume of liquid flowing per unit time. Rate = Total Volume ÷ Total Time. In this case, 1 cm³ is equivalent to 1 milliliter (ml).

Mixed Fraction Conversion

To convert an improper fraction like 40/7 to a mixed fraction, divide 40 by 7 to get the quotient (5) and the remainder (5), written as 5 ^5/7.

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Q43. Answer: (a) 8

Shortcut Trick

Inverse Proportion: More pupils → Fewer days.

Product constant: M1 × D1 = M2 × D2

42 × 12 = 63 × Days

Days = (42 × 12) ÷ 63 = 504 ÷ 63 = 8 days

Therefore The correct option is A.

Alternate Method

Given: Initial Pupils (M1) = 42, Initial Days (D1) = 12, New Pupils (M2) = 63

Formula: Total Provisions = Number of Pupils × Number of Days

42 Pupils → 12 Days 63 Pupils → x Days Total Provisions = 42 × 12 = 504 pupil-days => M1 × D1 = M2 × D2 => 42 × 12 = 63 × D2 => 504 = 63 × D2 => D2 = 504 ÷ 63 => D2 = 8

Therefore The correct option is A.

Additional Information

Inverse Proportion

When one value increases while the other decreases such that their product remains constant. Formula: x1 × y1 = x2 × y2.

Work & Time Relationship

The number of workers and the time taken to complete a fixed amount of work are inversely proportional.

Chain Rule

General formula for work problems: (M1 × D1 × H1) ÷ W1 = (M2 × D2 × H2) ÷ W2, where H is hours and W is work.

Q44. Answer: (a) 106

Shortcut Trick

By British Flag Theorem: $PA^2 + PC^2 = PB^2 + PD^2$

=> $86^2 + 79^2 = 49^2 + PD^2$

=> 7396 + 6241 = 2401 + PD^2

=> 13637 − 2401 = PD^2

=> PD = √11236 = 106 cm

Therefore The correct option is 1.

Alternate Method

Given:

Rectangle ABCD with internal point P.

PA = 86 cm, PB = 49 cm, PC = 79 cm.

Formula Used:

British Flag Theorem: For any point P inside or outside a rectangle ABCD, the sum of the squares of the distances from P to opposite vertices is equal.

$PA^2 + PC^2 = PB^2 + PD^2$

A B C D P 86 cm 49 cm 79 cm PD = ?

Calculations:

=> $PA^2 + PC^2 = PB^2 + PD^2$

=> $86^2 + 79^2 = 49^2 + PD^2$

=> 7396 + 6241 = 2401 + PD^2

=> 13637 = 2401 + PD^2

=> PD^2 = 13637 − 2401

=> PD^2 = 11236

=> PD = √11236

=> PD = 106 cm

Therefore The correct option is A.

Additional Information

British Flag Theorem

This theorem states that for any point P and rectangle ABCD, $PA^2 + PC^2 = PB^2 + PD^2$. It holds true even if P is outside the rectangle or on its boundary.

Rectangle Diagonals

The diagonals of a rectangle are equal in length and bisect each other. Diagonal length d = √(l² + w²).

Pythagoras Theorem in Rectangles

Any diagonal divides the rectangle into two congruent right-angled triangles where the diagonal acts as the hypotenuse.

Q45. Answer: (c) 33,600

Shortcut Trick

Rate difference per annum = 7% − 3.5% = 3.5%

Total difference for 2 years = 3.5% × 2 = 7%

Required difference in Interest = 7% of 4,80,000

Difference = (7 ÷ 100) × 4,80,000 = 7 × 4800 = 33,600

Therefore The correct answer is 33600.

Alternate Method

Given:

Principal (P) = Rs. 4,80,000 for each bank

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

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

Time (T) = 2 years

Formula Used:

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

Year 0 (P) Year 2 (T) Rs. 4,80,000 Bank B (7%) Bank A (3.5%) Interest Diff

Calculations:

=> SI paid to Bank A = (4,80,000 × 3.5 × 2) ÷ 100

=> SI paid to Bank A = 4800 × 7 = 33,600

=> SI paid to Bank B = (4,80,000 × 7 × 2) ÷ 100

=> SI paid to Bank B = 4800 × 14 = 67,200

=> Positive Difference = 67,200 − 33,600 = 33,600

Therefore The correct answer is 33600.

Additional Information

Difference in Simple Interest

When Principal (P) and Time (T) are constant, the difference in SI is given by ΔSI = (P × ΔR × T) ÷ 100, where ΔR is the difference in rates.

Total Amount in SI

The total amount (A) to be paid back is the sum of Principal and Interest: A = P + SI = P(1 + RT/100).

Effective Annual Rate

The effective interest over T years at rate R% p.a. in simple interest is simply (R × T)% of the Principal.

Q46. Answer: (b) 331 cm3

Volume of layer = 4/3 × π × (R³ − r³)

R = 7.5 cm, r = 7 cm

Volume = 4/3 × 22/7 × (7.5³ − 7³)

Volume = 88/21 × (421.875 − 343) = 88/21 × 78.875

Volume ≈ 330.52 → 331 cm³

Therefore The correct answer is 331 cm³.

Alternate Method

Given:

Radius of solid sphere (r) = 7 cm

Radius with paint layer (R) = 7.5 cm

π = 22/7

Formula Used:

Volume of spherical shell = 4/3 × π × (R³ − r³)

r = 7 cm R = 7.5 cm Painted Layer Volume = Outer − Inner

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Calculations:

=> Volume = 4/3 × 22/7 × ($7.5^3 - 7^3$)

=> Volume = 88/21 × (421.875 − 343)

=> Volume = 88/21 × 78.875

=> Volume = 6941 ÷ 21

=> Volume ≈ 330.5238 cm^3

Rounding off to the nearest integer, we get 331 cm^3.

Therefore The correct answer is 331 cm^3.

Additional Information

Volume of a Sphere

The amount of space occupied by a sphere is given by $V = 4/3 \times \pi r^3$.

Surface Area of a Sphere

The total surface area of a sphere is given by $A = 4\pi r^2$.

Spherical Shell

A spherical shell is the region between two concentric spheres. Its volume is $V = 4/3 \times \pi(R^3 - r^3)$, where R is the outer radius and r is the inner radius.

Hemisphere Properties

Volume of hemisphere = $2/3\ \pi r^3$ and Total Surface Area = $3\pi r^2$.

Q47. Answer: (a) 86.5

Shortcut Trick

Assume base average = 84.

Deviation of 17 students = 17 × (94 − 84) = +170.

Average deviation for all 69 students = 170 ÷ 69 ≈ 2.46.

Class average = 84 + 2.46 = 86.46 ≈ 86.5.

Therefore The correct answer is 86.5.

Alternate Method

Given:

Total students = 69

Students in Group 1 (n1) = 17, Average score (A1) = 94

Students in Group 2 (n2) = 69 − 17 = 52, Average score (A2) = 84

Formula Used:

Combined Average = (n1 × A1 + n2 × A2) ÷ (n1 + n2)

Group 1 n = 17 Avg = 94 Group 2 n = 52 Avg = 84 Total Class (N = 69)

Calculations:

=> Total score of Group 1 = 17 × 94 = 1598

=> Total score of Group 2 = 52 × 84 = 4368

=> Combined total score = 1598 + 4368 = 5966

=> Average score of class = 5966 ÷ 69

=> Average score ≈ 86.463

=> Rounding to one decimal place = 86.5

Therefore The correct answer is 86.5.

Additional Information

Weighted Average Formula

The combined average of two or more groups is given by A = (n1A1 + n2A2 + ...) ÷ (n1 + n2 + ...).

Net Deviation Principle

The sum of deviations of all observations from their arithmetic mean is always zero. This is used in the shortcut deviation method.

Rounding Rule

When rounding to one decimal place, if the second decimal digit is 5 or more, the first decimal digit is increased by 1.

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Q48. Answer: (b) 49 km/hr

Shortcut Trick

Total distance to cover = Sum of lengths of both trains = 299 + 101 = 400 m

Relative speed in m/s = Total distance ÷ Time = 400 ÷ 12 = 100/3 m/s

Relative speed in km/hr = (100/3) × (18/5) = 120 km/hr

In opposite direction, Relative Speed = Speed1 + Speed2

Speed2 = 120 − 71 = 49 km/hr

Therefore The correct answer is 49 km/hr.

Alternate Method

Given:

Length of Train 1 (L1) = 299 m

Length of Train 2 (L2) = 101 m

Time taken (T) = 12 seconds

Speed of Train 1 (S1) = 71 km/hr

Formula Used:

Relative Speed (Opposite Direction) = S1 + S2

Speed = Distance / Time

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

Train 1: 299 m 71 km/hr Train 2: 101 m x km/hr Total Distance = 299 + 101 = 400 m Time = 12 seconds

Calculations:

=> Total Distance = L1 + L2 = 299 + 101 = 400 m

=> Relative Speed = Total Distance / Time

=> Relative Speed = 400 / 12 m/s

=> Relative Speed in km/hr = (400 / 12) × (18 / 5)

=> Relative Speed = (100 / 3) × (18 / 5)

=> Relative Speed = 20 × 6 = 120 km/hr

=> Since they are moving in opposite directions: S1 + S2 = 120

=> 71 + S2 = 120

=> S2 = 120 − 71

=> S2 = 49 km/hr

Therefore The correct answer is 49 km/hr.

Additional Information

Relative Speed in Opposite Direction

When two objects move towards each other, their relative speed is the sum of their individual speeds: V_(rel) = V1 + V2.

Relative Speed in Same Direction

When two objects move in the same direction, their relative speed is the difference of their individual speeds: V_(rel) = |V1 − V2|.

Speed Conversion

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

Crossing Objects

When a train crosses another train or a bridge, the total distance covered is the sum of the lengths of both entities.

Q49. Answer: (d) 54

Shortcut Trick

Let the original number be 100%.

Given: 20% of number + 72 = 100% of number.

=> 72 = 100% − 20% = 80%.

=> 80% of the number = 72.

=> 60% of the number = (72 ÷ 80) × 60 = 0.9 × 60 = 54.

Therefore The correct answer is 54.

Alternate Method

Given:

20% of a number added to 72 equals the number itself.

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Formula Used:

Value = (Percentage ÷ 100) × Number

20% 80% (Value = 72) Total Number = 100%

Calculations:

=> Let the number be x.

=> (20/100) × x + 72 = x

=> 0.2x + 72 = x

=> 72 = x − 0.2x

=> 72 = 0.8x

=> x = 72 ÷ 0.8

=> x = 90

=> 60% of x = (60/100) × 90

=> 60% of x = 0.6 × 90 = 54

Therefore The correct answer is 54.

Additional Information

Percentage to Fraction Conversion

To solve quickly, convert percentages to fractions: 20% = 1/5, 60% = 3/5, 80% = 4/5. Here, (4/5) × x = 72 gives x = 90.

Base Value Concept

Always identify the 100% base. If a part is given, the remaining part (100% − given%) corresponds to the added or subtracted numerical value.

Successive Percentage Formula

For two successive changes of a% and b%, the net change is [a + b + (a × b)/100]%.

Q50. Answer: (a) 1

Shortcut Trick

If A + B = 90°, then sin A / cos B = 1 and cos A / sin B = 1.

Since 15° + 75° = 90° => sin 15° / cos 75° = 1.

Since 78° + 12° = 90° => cos 78° / sin 12° = 1.

Expression = 1 + 1 − 1 = 1.

Therefore The correct answer is 1.

Alternate Method

Given:

Expression: (sin 15° / cos 75°) + (cos 78° / sin 12°) − 1

Formula Used:

sin θ = cos(90° − θ)

cos θ = sin(90° − θ)

Calculations:

=> sin 15° = cos(90° − 15°) = cos 75°

=> cos 78° = sin(90° − 78°) = sin 12°

=> Value = (cos 75° / cos 75°) + (sin 12° / sin 12°) − 1

=> Value = 1 + 1 − 1

=> Value = 1

Therefore The correct answer is 1.

Additional Information

Complementary Angle Ratios

Trigonometric ratios of complementary angles satisfy: sin θ = cos(90° − θ), tan θ = cot(90° − θ), and sec θ = cosec(90° − θ).

Sum and Difference of Ratios

When the sum of two angles is 90°, the ratio of their sine and cosine (or tangent and cotangent) is always equal to 1.

Fundamental Identities

The three basic identities are $\sin^2\theta + \cos^2\theta = 1$, $1 + \tan^2\theta = \sec^2\theta$, and $1 + \cot^2\theta = \text{cosec}^2\theta$.

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Q51. Answer: (a) 16

Given number: 4651783

According to the question,

Number given	4	6	5	1	7	8	3
Odd digit → (+1) Even digit → (-2)	(-2)	(-2)	(+1)	(+1)	(+1)	(-2)	(+1)
Resultant number	2	4	6	2	8	6	4

So, the sum of the highest digit and the second from the left and first from the right in the new number thus formed → 8 + 4 + 4 = 16

Hence, "Option 1" is the correct answer.

Q52. Answer: (d) 309

Decoding signs:

Sign	•	•	×	÷
Stands For	•	×	÷	•

Given: 12 - 15 ÷ 143 + 98 x 7 = ?

12 - 15 ÷ 143 + 98 × 7 = ? => 12 × 15 + 143 - 98 ÷ 7 = ?

=> 12 × 15 + 143 - 98 ÷ 7 = ?

=> 12 × 15 + 143 - 14 = ?

=> 180 + 143 - 14 = ?

=> 323 - 14 = ?

=> 309 = ?

Hence, "Option 4" is the correct answer.

Q53. Answer: (c) 3

According to the question:

Thus, 'E' is coded as '3'.

Hence, "Option 3" is the correct answer.

Q54. Answer: (b) 23

The logic followed here is:

Hence, "Option 2" is the correct answer.

Alternate Method

Q55. Answer: (c) Two

Given: A, B, C, D, W, X and Y are sitting around a circular table facing the centre of the table.

1) Only four people sit between B and A when counted from the right of B.

2) B sits third to the left of X.

3) W sits third to the left of Y.

4) C is an immediate neighbour of both A and X.

The remaining position will be occupied by the only person left i.e. D.

Thus, two people sit between D and C when counted from the right of D.

Hence, "Option 3" is the correct answer.

Q56. Answer: (a) Only conclusion (II) follows

The least possible Venn diagram for the given statements is as shown below :

Conclusions:

(I) Some rabbits are cars → Does not follow (As some rabbits are fans and no fan is a car. So it is possible but not definite.)

(II) Some fans are rabbits → Follow (As some rabbits are fans. As some part of rabbit is common with fans, therefore it is true.)

Therefore Here, Only conclusion (II) follows.

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Hence, the correct answer is "Option 1".

Q57. Answer: (b) Two

Given series: (Left) ? * + ? \ & 3 # 9 % 4 1 6 * @ 5 4 8 8 $ \ (Right)

According to the question:

Required condition: Number - Number - Symbol

(Left) ? * + ? \ & 3 # 9 % 4 1 6 * @ 5 4 8 8 $ \ (Right)

Thus, there are two such numbers which are immediately preceded by another number and also immediately followed by a symbol.

Hence, "Option 2" is the correct answer.

Q58. Answer: (a) VS-DV

The logic followed here is:

Option 1) VS-DV

Option 2) LI-SL

Option 3) DA-KD

Option 4) MJ-TM

Thus, "VS-DV" is the odd one out.

Hence, "Option 1" is the correct answer.

Q59. Answer: (d) Three

Given: O, P, Q, R, W, X and Y are sitting in a straight line facing north.

1) Only three people sit to the left of P.

2) Only R sits to the right of Q.

3) Only three people sit between Q and O.

4) X sits at some place to the left of Y but at some place to the right of W.

Thus, three people sit between W and Y.

Hence, "Option 4" is the correct answer.

Q60. Answer: (b) 45

Decoding signs:

Sign	A	B	C	D
Stands For	×	÷	•	•

Given: 14 B 2 D 10 A 5 C 12 = ?

14 B 2 D 10 A 5 C 12 = ? => 14 ÷ 2 + 10 × 5 - 12 = ?

=> 14 ÷ 2 + 10 × 5 - 12 = ?

=> 7 + 10 × 5 - 12 = ?

=> 7 + 50 - 12 = ?

=> 57 - 12 = ?

=> 45 = ?

Hence, "Option 2" is the correct answer.

Q61. Answer: (d) BF-IE

The logic followed here is:

Option 1) HL-OJ

Option 2) FJ-MH

Option 3) DH-KF

Option 4) BF-IE

Thus, "BF-IE" is the odd one out.

Hence, "Option 4" is the correct answer.

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Q62. Answer: (b) Only conclusion (I) follows

The least possible Venn diagram for the given statements is as shown below :

Conclusions:

(I) Some stories are books → Follow (As some books are novels and all novels are stories. As some part books is common with novels which whole comes in stories, therefore it is true.)

(II) No books are stories → Does not follow (As some books are novels and all novels are stories. As no direct relation is given between books and stories, therefore it is false.)

Therefore Here, Only conclusion (I) follows.

Hence, the correct answer is "Option 2".

Q63. Answer: (c) 95 km towards east

Given:

Raghu starts from Point Y and drives 18 km towards west.

He then turns right and drives 26 km, takes a left turn, drives 30 km, turns left and drives 68 km.

He then takes a right turn and drives 31 km.

He takes a right turn, drives 42 km, turns left and drives 16 km to stop at Point Z.

Thus, Raghu should drive 95 km in east direction in order to reach Point Y again.

Hence, "Option 3" is the correct answer.

Q64. Answer: (c) R

Given: P, Q, R, S, T and U are sitting in a row facing the north.

1) S and R are sitting at the ends of the line not necessarily in the same order.

2) S is sitting to the immediate left of Q.

3) P is sitting to the immediate right of Q.

4) U is sitting to the immediate right of P and immediate left of T.

Thus, R is sitting to the immediate right of T.

Hence, "Option 3" is the correct answer.

Q65. Answer: (c) 20

According to the question:

Srinivas rank from the top → 2nd

Srinivas rank from the bottom → 19th

Total students → Srinivas rank from the top + Srinivas rank from the bottom - 1

→ 2 + 19 - 1 = 20

Hence, "Option 3" is the correct answer.

Q66. Answer: (a) (3, 36, 12)

The logic followed here is:

(6, 72, 12) → 72 ÷ 6 = 12

And,

(5, 60, 12) → 60 ÷ 5 = 12

Similarly,

(3, 36, 12) → 36 ÷ 3 = 12

Hence, "Option 1" is the correct answer.

Q67. Answer: (c) 2

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

According to the question:

Required condition: Odd Number - Even Number - Even Number

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

Thus, there are two such odd numbers which are immediately preceded by an odd number and also immediately followed by an even number.

Hence, "Option 3" is the correct answer.

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Q68. Answer: (a) 3

According to the question:

Thus, 'A' is coded as '3'.

Hence, "Option 1" is the correct answer.

Q69. Answer: (b) %

Given series: (Left) 7 $ 5 @ 3 ! 3 5 6 7 & % $ 3 # 2 7 + ? > < (Right)

According to the question:

All the numbers are dropped → (Left) 7 $ 5 @ 3 ! 3 5 6 7 & % $ 3 # 2 7 + ? > < (Right)

→ (Left) $ @ ! & % $ # + ? > < (Right)

The 7th element from the right → (Left) $ @ ! & % $ # + ? > < (Right) → %

Hence, "Option 2" is the correct answer.

Q70. Answer: (b) 20 km towards south

Given:

Aditi starts from Point A and drives 10 km towards the west.

She then takes a left turn, drives 8 km, turns right and drives 5 km.

She then takes a left turn and drives 8 km.

She then takes a left turn and drives 15 km.

She takes a final right turn, drives 4 km and stops at Point D.

Thus, Point D is 20 km to the south of Point A.

Hence, "Option 2" is the correct answer.

Q71. Answer: (a) VSMI

The logic followed here is:

TQKG is related to XUOK

And,

SPJF is related to WTNJ

Similarly,

ROIE is related to

Hence, "Option 1" is the correct answer.

Q72. Answer: (b) MKD 16

The logic followed here is:

Hence, "Option 2" is the correct answer.

Q73. Answer: (c) 15

Given series: (Left) 316 562 149 379 433 (Right)

According to the question.

Given	316	562	149	379	433
Arranged in ascending order	149	316	379	433	562

So,

Second digit of the highest number → 562 → 6

Third digit of the lowest number → 149 → 9

So, the second digit of the highest number is added to the third digit of the lowest number → 6 + 9 = 15

Hence, "Option 3" is the correct answer.

Q74. Answer: (d) 68

The logic followed here is:

Hence, "Option 4" is the correct answer.

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Q75. Answer: (d) 205

The logic followed here is:

Hence, "Option 4" is the correct answer.

Q76. Answer: (c) HERD - EHRD - DEHR

The logic followed here is:

RAGE - ARGE - EARG

And,

QUIZ - UQIZ - ZUQI

Similarly,

HERD - EHRD - DEHR

Hence, "Option 3" is the correct answer.

Q77. Answer: (b) One

Given: Seven boxes A, B, C, D, I, J and K are kept one over the other but not necessarily in the same order.

1) K is kept second from the bottom.

2) Only three boxes are kept between K and I.

3) D is kept at one of the positions below K.

Boxes
I
K
D

4) Only B is kept between I and J.

5) A is kept at one of the positions above I.

The remaining position will be occupied by the only box left i.e. C.

Boxes
A
I
B
J
C
K
D

Thus, one box is kept between C and D.

Hence, "Option 2" is the correct answer.

Q78. Answer: (b) Brother's daughter

A is				
Symbol	?	=	@	√
Meaning	Daughter	Son	Father	Sister
of B				

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Given Expression: C ? D = E @ F √ L

C ? D → C is the daughter of D.

D = E → D is the son of E.

E @ F → E is the father of F.

F √ L → F is the sister of L.

Thus, C is L's brother's daughter.

Hence, the correct answer is "Option 2".

Q79. Answer: (a) UPN

The logic followed here is:

Hence, "Option 1" is the correct answer.

Q80. Answer: (c) USER - SUER - RESU

The logic followed here is:

SWAP - WSAP - PAWS

And,

ALSO - LASO - OSLA

Similarly,

USER - SUER - RESU

Hence, "Option 3" is the correct answer.

Q81. Answer: (b) Thailand

The correct answer is Thailand.

Key Points

• In early 2025, Indian drug law enforcement agencies, led by the Narcotics Control Bureau (NCB), flagged Thailand as a major source of hybrid cannabis being smuggled into the country.

• The illicit trade primarily utilizes international courier services and the postal network to deliver high-potency cannabis "buds" to major Indian metropolitan areas such as Mumbai, Delhi, and Bengaluru.

• Hybrid cannabis from Thailand is specifically targeted due to its high THC (Tetrahydrocannabinol) content, which ranges between 15% to 30%, making it far more potent and expensive than the locally grown variety.

• Authorities noted that smugglers often use sophisticated vacuum-sealed packaging to evade detection by K-9 units and conceal the drugs inside harmless items like clothing, food containers, or electronics. Hence, Thailand is the correct answer.

Additional Information

• Decriminalization in Thailand:

• Thailand became the first country in Asia to decriminalize cannabis in June 2022. This move led to a proliferation of cannabis dispensaries across cities like Bangkok and Phuket.

• While intended for medical and domestic economic growth, the lack of stringent export regulations initially allowed hybrid strains to be diverted into the international black market.

• NDPS Act, 1985:

• In India, cannabis is regulated under the Narcotic Drugs and Psychotropic Substances (NDPS) Act, 1985.

• The law strictly prohibits the production, sale, and consumption of the flowering or fruiting tops (ganja) and the separated resin (charas) of the cannabis plant.

• Offenses involving "commercial quantities" of these substances can lead to rigorous imprisonment of 10 to 20 years.

• Economic Impact:

• The street value of Thai hybrid cannabis in India is significantly higher than indigenous varieties, often retailing between Rs. 2,000 and Rs. 5,000 per gram.

• This high profit margin has incentivized organized criminal syndicates to establish robust courier-based supply chains between Southeast Asia and South Asia.

Important Points

• Technological Surveillance: To counter this trend in 2025, the Customs Department and the NCB have increased the deployment of Advanced X-ray Baggage Inspection Systems (AXIS) and AI-based profiling at international courier terminals.

• International Cooperation: India has engaged in bilateral discussions with Thailand to strengthen intelligence sharing and monitor the bulk purchase of cannabis by foreign nationals to prevent transnational smuggling.

• Health Risks: Health experts warn that hybrid cannabis with extreme THC levels can lead to severe psychological issues, including paranoia and cannabis-induced psychosis, particularly among the youth in urban centers.

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Q82. Answer: (a) 200

The correct answer is 200.

Key Points

• During the presentation of the Union Budget 2025–26, Finance Minister Nirmala Sitharaman announced the establishment of 200 new Day Care Cancer Centres across district hospitals in the country.

• The initiative is designed to decentralize oncology services, bringing critical cancer care closer to the homes of patients residing in rural and semi-urban areas.

• The Union Budget 2025–26 was presented in the Parliament on February 1, 2025, outlining several health-centric measures to improve the quality of life and longevity of citizens.

• These centres will primarily cater to patients requiring chemotherapy and palliative care, eliminating the need for long-distance travel to metropolitan tertiary care hospitals.

• By setting up these facilities at the district level, the government aims to address the rising burden of non-communicable diseases (NCDs), particularly cancer, which has seen a significant spike in incidence rates in India.

• This step is aligned with the vision of Universal Health Coverage (UHC) and strengthening the public healthcare delivery system through the National Health Mission (NHM). Hence, the correct answer is 200.

Additional Information

• Concept of Day Care Cancer Centres:

• A Day Care Cancer Centre is a specialized facility where medical procedures such as chemotherapy, blood transfusions, and targeted therapy are performed within a few hours.

• Patients are admitted and discharged on the same day, which significantly reduces hospitalization costs and frees up beds for surgical or emergency cases.

• These centres provide a comfortable environment for patients to receive non-surgical treatment while staying close to their support systems.

• Healthcare in Union Budget 2025–26:

• The 2025–26 budget emphasized Social Justice and Human Resource Development as key pillars for India's growth.

• The allocation for the Ministry of Health and Family Welfare (MoHFW) saw a strategic increase to bolster primary and secondary healthcare infrastructure.

• The focus remains on enhancing the digital health ecosystem and expanding the reach of Ayushman Bharat schemes.

• Significance of Cancer Care in India:

• According to the Indian Council of Medical Research (ICMR), the number of cancer cases in India is projected to rise to 15.7 lakh by 2025.

• High out-of-pocket expenditure (OOPE) often leads to patients dropping out of treatment; the 200 new centres are expected to mitigate this financial risk for low-income families.

• Early detection and regular follow-up cycles, which are crucial for survival, will become more manageable with localized centres.

• Other Health Initiatives:

• The government continues to promote the Pradhan Mantri Jan Arogya Yojana (PM-JAY), which provides health insurance of Rs. 5 lakh per family.

• There is a continuous effort to increase the number of All India Institute of Medical Sciences (AIIMS) and medical colleges to improve the doctor-to-patient ratio.

Important Points

• The Union Budget 2025–26 has identified 9 priorities for the government, including Health and Social Security.

• The 200 Day Care Cancer Centres will be integrated with the National Digital Health Mission (NDHM) to maintain Electronic Health Records (EHR) for cancer patients.

• This initiative is expected to create employment opportunities for specialized oncology nurses, medical technicians, and counselors at the district level.

• By decentralizing care, the government hopes to reduce the massive footfall at regional cancer centres like Tata Memorial Hospital or AIIMS New Delhi, allowing those institutions to focus on complex research and surgeries.

Q83. Answer: (c) IM Vijayan

The correct answer is IM Vijayan.

Key Points

• Inivalappil Mani Vijayan, popularly known as IM Vijayan, is a legendary former captain of the Indian national football team.

• In 2025, the Government of India announced the Padma Shri, the country's fourth-highest civilian award, for IM Vijayan in recognition of his exceptional contribution to Indian football.

• Hailing from Thrissur, Kerala, he is often referred to by the nickname "Kalo Harin" (Black Buck) due to his incredible speed,

poaching ability, and technical skills on the field.

• He was one of the most prolific goal-scorers for India during the 1990s and early 2000s, forming a famous attacking partnership with Bhaichung Bhutia.

• IM Vijayan was the first player to be named the AIFF Player of the Year three times, achieving this feat in 1993, 1997, and 1999.

• Before receiving the Padma Shri, he was honored with the Arjuna Award in 2003 for his outstanding achievements in national sports.

• Hence, the correct answer is IM Vijayan.

Additional Information

• Bhaichung Bhutia:

• Known as the "Sikkimese Sniper", he is a former Indian captain and the first Indian footballer to sign a professional contract with a European club (Bury FC in England).

• He received the Padma Shri in 2008 and the Arjuna Award in 1998.

• Sunil Chhetri:

• He is the all-time leading goal-scorer for the Indian national team and currently ranks among the top international goal-scorers globally.

• Chhetri was awarded the Padma Shri in 2019 and became the first footballer to receive the Major Dhyan Chand Khel Ratna Award in 2021.

• Sandesh Jhingan:

• A prominent central defender for the Indian national team, he received the Arjuna Award in 2020. He has been a mainstay in the Indian defense for several years.

• Padma Awards:

• The Padma Awards were instituted in 1954 and are announced every year on the eve of Republic Day (January 26).

• The awards are given in three categories: Padma Vibhushan (for exceptional and distinguished service), Padma Bhushan (distinguished service of high order), and Padma Shri (distinguished service).

• The President of India confers these awards at a formal ceremony held at Rashtrapati Bhavan, usually around March or April.

Important Points

• IM Vijayan's Career Highlights: He scored one of the fastest international goals in history, netting a goal against Bhutan in the 1999 SAF Games in just 12 seconds.

• Post-Retirement: After retiring from professional football, IM Vijayan served in the Kerala Police and also pursued a career in acting, appearing in several Malayalam films, including the award-winning movie "Mayaanadhi" and "Shantham".

• AIFF Player of the Year: This award was started in 1992, and IM Vijayan remains one of the few players to have won it multiple times, showcasing his dominance in the Indian domestic circuit.

Q84. Answer: (c) Payal Kapadia

The correct answer is Payal Kapadia.

Key Points

• Payal Kapadia is a distinguished Indian filmmaker who achieved international acclaim at the Cannes Film Festival.

• In May 2024, she won the Grand Prix at the 77th Cannes Film Festival for her film "All We Imagine as Light". This was a historic moment as she became the first Indian filmmaker ever to win this specific award.

• Following her monumental success, she was invited to return to the 78th Cannes Film Festival in 2025 as a member of the main Competition jury.

• The Grand Prix is considered the second-most prestigious prize at the festival, ranking just below the Palme d'Or.

• Her film, "All We Imagine as Light", was the first Indian entry in the Main Competition section at Cannes in 30 years, the last one being Shaji N. Karun's "Swaham" in 1994.

Additional Information

• Educational Background: Payal Kapadia is an alumna of the Film and Television Institute of India (FTII), located in Pune, where she studied film direction.

• Previous Accolades: Before her 2024 success, she won the Golden Eye (L'Œil d'or) for Best Documentary at the 2021 Cannes Film Festival for her work titled "A Night of Knowing Nothing".

• Film Plot: "All We Imagine as Light" is an Indo-French co-production that explores the lives of two nurses from Kerala working in a nursing home in Mumbai, highlighting themes of urban isolation and female bonding.

• Cannes Film Festival: Founded in 1946 and held annually in Cannes, France, it is one of the most publicized and prestigious film festivals in the world. The 78th edition is scheduled to take place in May 2025.

• Indian Jury Members: Over the years, several Indian cinema personalities have served on the Cannes jury, including Mrinal Sen (1982), Mira Nair (1990), Arundhati Roy (2000), Aishwarya Rai (2003), Nandita Das (2005), Sharmila Tagore (2009), Shekhar

Kapur (2010), Vidya Balan (2013), and Deepika Padukone (2022).

Important Points

• Award Hierarchy: In the Cannes Competition, the top award is the Palme d'Or, followed by the Grand Prix, the Jury Prize, and individual awards for Best Director, Best Screenplay, Best Actress, and Best Actor.

• Significance: Kapadia's inclusion in the 2025 jury underscores the global recognition of Indian independent cinema and its evolving narrative style that resonates with international audiences.

• Cultural Impact: Her win in 2024 sparked significant discussion regarding the funding and support for independent filmmakers in India, especially those emerging from institutions like FTII.

Q85. Answer: (c) 38th

The correct answer is 38th.

Key Points

• India has achieved the 38th rank in the Global Innovation Index (GII) 2025, marking a significant milestone in its journey toward becoming a global innovation hub. This ranking reflects a steady ascent from its 81st position in 2015.

• The Global Innovation Index is published annually by the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations. It serves as a benchmark for nations to evaluate their innovation ecosystems.

• India continues to be the top-ranked economy in the Central and Southern Asia region, maintaining its dominance as a leader among lower-middle-income economies.

• The 2025 report highlights that India has consistently performed above expectations relative to its Gross Domestic Product (GDP) per capita for the 15th year in a row, showcasing a high efficiency in converting innovation inputs into outputs.

• India’s strengths are particularly visible in indicators such as ICT services exports, venture capital received, and the quality of its Science and Engineering graduates.

Additional Information

• World Intellectual Property Organization (WIPO):

• WIPO was established in 1967 and is headquartered in Geneva, Switzerland. It currently has 193 member states.

• The organization’s mandate is to promote the protection of intellectual property (IP) throughout the world through cooperation among states and in collaboration with other international organizations.

• It administers 26 international treaties and provides a global forum for IP services, policy, and information.

• Structure of the Global Innovation Index:

• The GII framework relies on two sub-indices: the Innovation Input Sub-Index and the Innovation Output Sub-Index.

• The Innovation Input Sub-Index is built on five pillars: Institutions, Human Capital and Research, Infrastructure, Market Sophistication, and Business Sophistication.

• The Innovation Output Sub-Index is derived from two pillars: Knowledge and Technology Outputs and Creative Outputs.

• The overall score is the average of these two sub-indices, providing a comprehensive view of a nation's innovation capacity.

• India's Innovation Ecosystem:

• India's rise in rankings is attributed to government initiatives such as Startup India, Digital India, and the Atal Innovation Mission (AIM).

• The country has seen a massive surge in Unicorn startups and is home to several major Science and Technology (S&T) clusters, including Bengaluru, Delhi, Chennai, and Mumbai, which rank among the top 100 clusters globally.

Important Points

• Global Innovation Trends: The GII 2025 report emphasizes a shift in innovation leadership, with emerging economies in Asia closing the gap with traditional leaders in Europe and North America.

• Intellectual Property Filings: India has witnessed a record increase in patent filings, trademark registrations, and industrial design applications, which are core metrics monitored by WIPO.

• Role of NITI Aayog: In India, the NITI Aayog has been instrumental in tracking the country's performance and has even launched the India Innovation Index to foster competitive federalism among states.

• Economic Impact: Higher innovation rankings are correlated with increased Foreign Direct Investment (FDI) and improved technological self-reliance, aligning with the Atmanirbhar Bharat vision.

Q86. Answer: (b) Neeraj Chopra

The correct answer is Neeraj Chopra.

Key Points

• Neeraj Chopra, India's premier javelin thrower and Olympic gold medalist, emerged victorious at the Ostrava Golden Spike event held in 2025 in the Czech Republic.

• The Ostrava Golden Spike is a highly prestigious World Athletics Continental Tour Gold meeting that attracts top-tier global talent in track and field. Hence, the statement regarding his victory is correct.

• Chopra has a consistent history with this venue; in the 2024 edition of the same meet, he secured a second-place finish with a best throw of 88.36 meters, finishing just behind Germany's Julian Weber.

• His participation and victory in the 2025 season highlight his continued dominance in the sport and his preparation for major global championships.

• Neeraj Chopra remains the only Indian athlete to have won a gold medal in athletics at the Olympic Games, a feat he achieved at the 2020 Tokyo Olympics.

Additional Information

• Career Milestones: Neeraj Chopra became the World Champion in 2023 by winning the gold medal at the World Athletics Championships in Budapest with a throw of 88.17 meters.

• Personal Best: His national record and personal best stands at 89.94 meters, which he achieved at the Stockholm Diamond League in June 2022.

• Other Options:

• Kishore Kumar Jena: An Indian javelin thrower who rose to prominence by winning the silver medal at the 2022 Hangzhou Asian Games with a throw of 87.54 meters.

• Annu Rani: India's leading female javelin thrower who won the gold medal at the 2022 Asian Games, becoming the first Indian woman to do so in this discipline.

• Rohit Yadav: A promising Indian athlete who has represented the country in the World Athletics Championships and reached the finals in 2022.

• World Rankings: In May 2023, Neeraj Chopra achieved the World Number 1 ranking in the Men's Javelin Throw category for the first time in his career.

Important Points

• National Recognition: For his exceptional contribution to sports, the Government of India conferred the Major Dhyan Chand Khel Ratna upon him in 2021 and the Padma Shri (India's fourth-highest civilian award) in 2022.

• Military Service: Neeraj Chopra serves as a Subedar in the 4 Rajputana Rifles of the Indian Army, having been recruited under the sports quota in 2016.

• Training: He has been primarily coached by Dr. Klaus Bartonietz, a German bio-mechanics expert, who has played a pivotal role in refining his technique.

• Historic Feats: He is the only second Indian after Abhinav Bindra to win an individual Olympic gold medal and the first to win it in a track and field event.

Q87. Answer: (a) PRIP scheme

The correct answer is PRIP scheme.

Key Points

• The PRIP scheme (Promotion of Research and Innovation in Pharma-MedTech Sector) was launched by the Union Ministry of Chemicals and Fertilizers in August 2023 to transform the Indian pharmaceutical industry.

• The scheme has a total financial outlay of Rs. 5,000 crore for a period of five years, from financial year 2023-24 to 2027-28.

• The primary objective of the scheme is to encourage a shift from volume-based production to value-based innovation in the pharmaceutical and medical technology sectors.

• Component A of the scheme involves strengthening the research infrastructure by setting up Centers of Excellence (CoEs) at seven National Institutes of Pharmaceutical Education and Research (NIPERs) with an outlay of Rs. 700 crore.

• Component B focuses on promoting research in the private sector through financial assistance for projects in six priority areas, including New Chemical Entities (NCE), complex generics, medical devices, and antimicrobial resistance (AMR) research.

Additional Information

• Atmanirbhar Bharat Abhiyan:

• Launched in May 2020 by Prime Minister Narendra Modi, this initiative aimed at making India self-reliant across various economic sectors.

• It included a massive economic stimulus package worth Rs. 20 lakh crore, equivalent to 10% of India's GDP, to support businesses, farmers, and the healthcare sector during the pandemic.

• Startup India:

• This flagship initiative was launched on January 16, 2016, to build a strong ecosystem for nurturing innovation and entrepreneurship.

• It provides benefits such as tax exemptions for three consecutive years, a Rs. 10,000 crore Fund of Funds, and relaxed norms for public procurement and patents.

• Smart Cities Mission:

• Launched on June 25, 2015, this mission aims to develop 100 sustainable and citizen-friendly cities across India.

• The focus is on providing core infrastructure, a clean environment, and applying 'Smart' solutions to improve the quality of life for

urban residents.

Important Points

• India is often referred to as the "Pharmacy of the World", ranking 3rd globally by production volume, but it currently ranks 14th in terms of value.

• The PRIP scheme aims to bridge the gap in Research and Development (R&D), where Indian companies currently spend only 7-8% of their revenue compared to 15-20% spent by global multinational corporations.

• The scheme specifically targets high-growth areas like Precision Medicine, Biologicals, and Orphan Drugs to help India lead in the global MedTech market.

• It encourages Industry-Academia collaboration, ensuring that research conducted in institutions like NIPERs is successfully commercialized by the private sector.

Q88. Answer: (d) Gorakhpur

The correct answer is Gorakhpur.

Key Points

• In a significant step towards disaster resilience, India’s first-of-its-kind Urban Flood Management Cell (UFMC) was inaugurated in Gorakhpur, Uttar Pradesh, in July 2025.

• The UFMC is powered by Canarys Automations Ltd, a leading IT and automation solutions provider that specializes in Hydro-Meteorology and Smart City infrastructure.

• This cell is designed to address the critical issue of urban flooding, which has increasingly affected major Indian cities due to rapid urbanization and climate change.

• The facility integrates high-tech Internet of Things (IoT) based monitoring systems that provide real-time data on water levels in drains, rivers, and low-lying areas across the city.

• The deployment of this cell ensures that the Gorakhpur Municipal Corporation and District Administration have access to actionable intelligence for immediate intervention during heavy rainfall events. Hence, the correct answer is Gorakhpur.

Additional Information

• Canarys Automations Ltd: Based in Bengaluru, Karnataka, this company has been a pioneer in automation and digital transformation for over 30 years. It provides specialized solutions in telemetry, flood forecasting, and irrigation automation.

• Urban Flooding in India: Unlike riverine floods, urban flooding occurs when the drainage capacity of a city is overwhelmed by intense rainfall. Cities like Mumbai, Chennai, and Bengaluru have frequently faced this crisis, making the Gorakhpur model a potential national benchmark.

• Technological Components: The UFMC utilizes Automatic Rain Gauges (ARG) and Automatic Water Level Recorders (AWLR). These devices transmit data via GPRS or Satellite to a central dashboard accessible to decision-makers.

• Smart City Mission: The establishment of such cells often aligns with the Smart Cities Mission launched by the Government of India in 2015, which aims to promote sustainable and inclusive cities that provide a decent quality of life.

Important Points

• Early Warning System (EWS): The most critical feature of the Gorakhpur UFMC is its Early Warning System. It can predict potential inundation hours in advance, allowing for the evacuation of vulnerable populations and the proactive deployment of water pumps.

• Gorakhpur’s Geography: Gorakhpur is situated in the Terai belt and is prone to flooding from the Rapti and Rohini rivers. The UFMC specifically targets internal city waterlogging, which is a major grievance for the urban population.

• Data-Driven Governance: The cell helps in mapping flood-prone zones using GIS (Geographic Information System), helping the urban planners to improve the drainage network for future development.

• Implementation Date: The project reached its full operational capacity in July 2025, coinciding with the peak monsoon season in Northern India, providing an immediate test for its predictive capabilities.

Q89. Answer: (d) 45%

The correct answer is 45%.

Key Points

• As per the updated Nationally Determined Contributions (NDC) submitted to the UNFCCC, India is committed to reducing the emission intensity of its GDP by 45% by the year 2030, compared to the 2005 level.

• A report published in 2025 by the Council on Energy, Environment and Water (CEEW) and the Alliance for an Energy Efficient Economy (AEEE) highlights India's accelerated pathway toward this target through enhanced energy efficiency measures and industrial decarbonization.

• The 45% target is a significant enhancement from the initial 2015 target, which aimed for a 33% to 35% reduction in emission intensity.

• The CEEW and AEEE report emphasizes that India has already made substantial progress, having reduced its emission intensity by approximately 33% between 2005 and 2019, putting the country on track to exceed its 2030 goals.

• This climate target is part of the Panchamrit (five nectar elements) action plan announced by the Prime Minister of India at the COP26 summit in Glasgow.

Additional Information

• Net Zero Target: India has set a long-term goal to achieve Net Zero emissions by the year 2070, aligning with global efforts to limit temperature rise.

• Non-Fossil Fuel Capacity: One of the key pillars of India's climate strategy is to reach 500 GW of non-fossil fuel-based energy capacity by 2030.

• Energy Mix Goal: India aims to ensure that 50% of its cumulative electric power installed capacity comes from non-fossil fuel-based energy resources by the end of this decade.

• Carbon Sink Creation: The NDC includes a commitment to create an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through additional forest and tree cover by 2030.

• Mission LiFE: Introduced as Lifestyle for Environment, this movement encourages individual and community action to protect and preserve the environment, which is a central theme in the CEEW and AEEE 2025 report.

Important Points

• Emission Intensity: This metric calculates the total Greenhouse Gas (GHG) emissions produced per unit of Gross Domestic Product (GDP), allowing India to grow its economy while decoupling it from carbon emissions.

• Role of CEEW and AEEE: These organizations are leading think tanks in India; CEEW focuses on policy research in energy and water, while AEEE advocates for energy efficiency as a "first fuel" for the economy.

• National Green Hydrogen Mission: Launched to support the 2030 targets, this mission aims to make India a global hub for the production and export of Green Hydrogen, targeting 5 MMT (Million Metric Tonnes) of annual production by 2030.

• Climate Change Performance Index (CCPI): Because of these ambitious targets and proactive policies, India has consistently ranked among the top 10 countries in the CCPI, reflecting its leadership in global climate action.

Q90. Answer: (b) Gujarat

The correct answer is Gujarat.

Key Points

• In July 2025, the state of Gujarat became the first in India to officially launch a specialized Tribal Genome Sequencing Project to study the genetic diversity of its indigenous populations.

• The project is a landmark initiative by the Government of Gujarat, aimed at creating a comprehensive genetic database of the various tribal groups living within the state.

• A primary objective of the Tribal Genome Sequencing Project is to identify genetic markers for diseases that disproportionately affect tribal communities, such as Sickle Cell Anemia and G6PD deficiency.

• The Gujarat Biotechnology Research Centre (GBRC), an autonomous institute under the Department of Science and Technology, is the lead agency responsible for the execution and data analysis of this project.

• By mapping the genomes, the state aims to implement personalized healthcare strategies, ensuring that medical treatments are tailored to the specific genetic makeup of the tribal individuals.

Additional Information

• Tribal Population in Gujarat: As per the 2011 Census, Gujarat possesses a substantial tribal population, constituting approximately 14.8% of the state's total residents, with major tribes including the Bhil, Rathwa, and Halpati.

• National Sickle Cell Anemia Elimination Mission: The Government of India launched this mission with the goal of eliminating Sickle Cell Anemia by the year 2047, and the Gujarat project directly contributes to this national target.

• Genome India Project: This is a national-level endeavor supported by the Department of Biotechnology to sequence 10,000 Indian genomes to capture the biological diversity of India.

• Next-Generation Sequencing (NGS): The project utilizes advanced NGS technology, which allows for rapid and accurate sequencing of large amounts of DNA, facilitating deep insights into human genomics.

• Social Security and Health: This initiative is part of a broader push for Social Security in health, ensuring that marginalized sections of society benefit from the latest advancements in biotechnology.

Important Points

• Ethical Framework: The project follows strict ethical guidelines regarding informed consent and the protection of biological privacy for all participants from the tribal communities.

• Research Outcomes: The data generated will assist in understanding the evolutionary history and migration patterns of tribes in the Western Ghats and surrounding regions of Gujarat.

• Infrastructure: The state has invested in high-end laboratory infrastructure at Gandhinagar to support the large-scale data processing required for genome mapping.

• Collaborations: The project involves collaboration between scientists, healthcare professionals, and tribal welfare officers to ensure the findings are translated into effective public health policies.

Q91. Answer: (b) Odisha

The correct answer is Odisha.

Key Points

• In June 2025, the Odisha state government activated a 24×7 flood-control room following intensive rainfall that led to the swelling of major rivers in the northern part of the state.

• The rivers Subarnarekha, Budhabalanga, and Jalaka reached critical levels, prompting the Balasore district administration to initiate emergency protocols to mitigate potential flood damage.

• The Water Resources Department of Odisha deployed technical teams to monitor river embankments and ensure that any breaches could be addressed immediately to protect nearby villages.

• The Jalaka river, in particular, frequently flows above the danger level at Mathani in the Basta block, making it one of the most volatile rivers during the early monsoon season.

• The Special Relief Commissioner (SRC) of Odisha coordinated with the Odisha Disaster Rapid Action Force (ODRAF) and Fire Services to be on high alert for evacuation operations in low-lying areas.

Additional Information

• Subarnarekha River:

• The Subarnarekha (meaning "Streak of Gold") is a multi-state river that flows through Jharkhand, West Bengal, and Odisha.

• It originates near Ranchi on the Chota Nagpur Plateau and has a total length of approximately 395 kilometers before emptying into the Bay of Bengal.

• It is a rain-fed river, and its basin covers an area of about 18,951 square kilometers.

• Budhabalanga River:

• This river originates in the Similipal Biosphere Reserve in the Mayurbhanj district of Odisha.

• It flows through the districts of Mayurbhanj and Balasore and has a length of about 175 kilometers.

• The river is famous for the Barehipani Falls, which is one of the highest waterfalls in India, located within the Similipal National Park.

• Jalaka River:

• The Jalaka is a smaller but significant river in the Balasore district that originates from the Rasgovindpur block of Mayurbhanj.

• It is notorious for causing flash floods due to its narrow channel and the heavy siltation that reduces its water-carrying capacity during the monsoon.

• Disaster Management in Odisha:

• Odisha is considered a leader in disaster management in India, having established the Odisha State Disaster Management Authority (OSDMA) after the 1999 Super Cyclone.

• The state utilizes the Early Warning Dissemination System (EWDS) to alert coastal and riverine populations about incoming natural calamities like cyclones and floods.

• The Southwest Monsoon typically enters Odisha in the second or third week of June, marking the start of the high-risk period for riverine flooding.

Important Points

• Geographical Impact: The northern districts of Odisha, including Balasore, Bhadrak, and Mayurbhanj, are highly susceptible to floods because they serve as the drainage point for rivers flowing from the Chota Nagpur Plateau.

• Infrastructure: The state government often utilizes flood-resilient shelters and geospatial mapping to track the progression of floodwaters in real-time.

• Inter-State Coordination: Flood management for the Subarnarekha often requires coordination between Odisha and Jharkhand regarding the release of water from the Galudih Barrage.

Q92. Answer: (c) Poonam Gupta

The correct answer is Poonam Gupta.

Key Points

• Dr. Poonam Gupta officially took office as the Deputy Governor of the Reserve Bank of India (RBI) on 2 April 2025.

• She was appointed by the Appointments Committee of the Cabinet (ACC) following the recommendations of the Financial Sector Regulatory Appointments Search Committee (FSRASC).

• Her appointment is significant as she transitions from her role as the Director General of the National Council of Applied Economic Research (NCAER), where she was the first woman to lead the institution since its inception in 1956.

• As Deputy Governor, she is expected to oversee critical portfolios, likely including the Monetary Policy Department and the Department of Economic and Policy Research, given her extensive background in macroeconomics.

• She succeeds Michael Debabrata Patra, who served multiple extended terms as the Deputy Governor in charge of monetary policy before his tenure concluded in 2025.

Additional Information

• Structure of RBI Leadership:

• The Reserve Bank of India is governed by a Central Board of Directors. The executive leadership consists of one Governor and a maximum of four Deputy Governors.

• The appointments are made under Section 8 of the Reserve Bank of India Act, 1934.

• The Governor and Deputy Governors are appointed for a period not exceeding five years and are eligible for reappointment.

• Profile of Poonam Gupta:

• Before joining NCAER, she served as a Lead Economist at the World Bank and held positions at the International Monetary Fund (IMF).

• She has been a member of the Economic Advisory Council to the Prime Minister (EAC-PM), providing insights on fiscal and monetary health.

• Her expertise lies in international finance, banking, and the Indian economy, with numerous publications in global economic journals.

• Other Options Analysis:

• Michael Debabrata Patra: Served as Deputy Governor from 2020 to 2025. He was a vital member of the Monetary Policy Committee (MPC) and was known for his hawkish stance on inflation.

• Ashwani Bhatia: A former Managing Director of the State Bank of India (SBI), he later served as a Whole-Time Member (WTM) at the Securities and Exchange Board of India (SEBI).

• Michael Debroy: This appears to be a distractor name, potentially conflating Bibek Debroy (former Chairman of EAC-PM) and Michael Patra.

Important Points

• The RBI Headquarters is located in Mumbai, Maharashtra. It was moved from Kolkata to Mumbai in 1937.

• The Monetary Policy Committee (MPC) consists of six members, including the Governor and the Deputy Governor in charge of monetary policy, alongside three external members.

• The role of the Deputy Governor is diverse, ranging from managing the Foreign Exchange Department to Banking Regulation and Currency Management (issuance of banknotes).

• Historical Significance: While there have been several female Deputy Governors in the past (such as K.J. Udeshi, Shyamala Gopinath, and Usha Thorat), the appointment of a specialist from a research background like Poonam Gupta continues the tradition of blending lateral entry with internal promotion within the central bank.

Q93. Answer: (c) 15%

The correct answer is 15%.

Key Points

• The Reserve Bank of India (RBI), in its move to regulate foreign capital inflows, announced the revised investment caps for Foreign Portfolio Investors (FPIs) for the fiscal year 2025-26 in April 2025.

• As per the notification, the limit for FPI investment in corporate bonds has been maintained at 15% of the outstanding stock of corporate bonds.

• This limit is part of the Medium-Term Framework (MTF), which aims to provide a predictable regime for foreign investment in the Indian debt market while ensuring financial stability.

• The RBI keeps these limits under review to balance the need for attracting foreign exchange and managing the volatility associated with portfolio flows.

• These regulations apply to all FPIs registered with the Securities and Exchange Board of India (SEBI), ensuring that the total holdings of all foreign investors do not exceed the specified 15% threshold of the total market value of outstanding corporate debt.

Additional Information

• Foreign Portfolio Investment (FPI):

• FPI refers to the entry of funds into a country where foreigners deposit money in a country's bank or make purchases in the country's stock and bond markets.

• Unlike Foreign Direct Investment (FDI), FPI does not provide the investor with direct control over the assets or the management of the companies.

• Corporate Bonds:

• These are debt instruments issued by private and public corporations to raise capital for various purposes, such as business expansion or refinancing existing debt.

• In India, the corporate bond market is a crucial source of funding for infrastructure and industrial projects, and FPI participation provides necessary liquidity to this market.

• Regulatory Authority:

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• The Reserve Bank of India (RBI) and the Securities and Exchange Board of India (SEBI) jointly manage the framework for foreign investments.

• The RBI determines the macro-prudential limits (the caps), while SEBI manages the registration and operational guidelines for the investors.

• Voluntary Retention Route (VRR):

• The VRR is a separate channel introduced by the RBI to encourage FPIs to invest in debt markets in India over a longer period.

• Investments through VRR are exempt from certain regulatory prescriptions, provided the investors voluntarily commit to retaining a required minimum percentage of their investment in India for a specific period.

Important Points

• Government Securities (G-Secs): Apart from corporate bonds, the RBI also sets limits for G-Secs. Historically, the limit for FPIs in Central Government Securities has been around 6% of the outstanding stock, which is significantly lower than the 15% allowed for corporate debt.

• State Development Loans (SDLs): For SDLs, the investment limit is typically set at 2% of the outstanding stock.

• Impact on Economy: A 15% cap helps in deepening the debt market without making it overly dependent on foreign "hot money," which can be pulled out quickly during global financial crises, leading to currency depreciation.

• Fully Accessible Route (FAR): Certain specified categories of Government Securities are opened fully for FPIs without any macro-prudential caps under the FAR scheme, which was a major step towards India's inclusion in global bond indices.

Q94. Answer: (a) third stage of the launch vehicle

The correct answer is third stage of the launch vehicle.

Key Points

• The PSLV-C61 mission, launched in May 2025, was intended to place the EOS-09 satellite into its designated Sun-Synchronous Polar Orbit.

• Shortly after a successful lift-off from the Satish Dhawan Space Centre (SDSC) in Sriharikota, ISRO (Indian Space Research Organisation) identified a technical glitch specifically in the third stage (PS3) of the launch vehicle. Hence, option 1 is correct.

• The third stage of the PSLV is critical as it utilizes a solid rocket motor to provide the necessary thrust after the vehicle has exited the denser layers of the Earth's atmosphere.

• Preliminary reports indicated that the anomaly occurred during the ignition or burn phase of this stage, which hindered the vehicle's ability to reach the required velocity for the next phase of the mission.

• While the first and second stages performed nominally, the failure in the third stage prevented the fourth stage from executing the final orbital injection. Hence, options 2, 3, and 4 are incorrect.

Additional Information

• PSLV (Polar Satellite Launch Vehicle) Structure:

• First Stage (PS1): This stage uses a solid propellant (HTPB) and is augmented by strap-on boosters to provide massive initial thrust.

• Second Stage (PS2): This stage employs the Vikas Engine, which uses liquid propellants (UH25 and N2O4).

• Third Stage (PS3): A solid motor stage that provides high thrust at high altitudes. It is designed to operate in a vacuum.

• Fourth Stage (PS4): The uppermost stage of the PSLV, comprising two liquid engines that are restartable to ensure precise satellite placement.

• EOS-09 (Earth Observation Satellite):

• The EOS-09 is a high-resolution imaging satellite designed for Earth observation.

• Its primary applications include urban planning, agriculture monitoring, forestry management, and disaster mitigation.

• It was equipped with advanced optical sensors to provide data for cartographic and oceanographic studies.

Important Points

• Satish Dhawan Space Centre (SDSC): Located in Sriharikota, Andhra Pradesh, it is India’s primary spaceport responsible for launching PSLV, GSLV, and LVM3 missions.

• PSLV Glitches: Though known as the Workhorse of ISRO due to its high success rate, the PSLV has occasionally faced challenges, such as the PSLV-C39 mission failure (heat shield separation issue) and early developmental flight anomalies.

• Mission Analysis: In the event of a third-stage glitch, a Failure Analysis Committee (FAC) is typically formed by ISRO to investigate the telemetry data and identify the root cause, such as pressure drops or propellant exhaustion.

• Significance of May 2025: This mission was part of India's ongoing effort to enhance its space-based surveillance and remote sensing capabilities.

Q95. Answer: (a) Tom Pidcock

The correct answer is Tom Pidcock.

Key Points

• Tom Pidcock has been honored with the Laureus World Action Sportsperson of the Year award in 2025, recognizing his extraordinary achievements in the field of extreme and action sports during the previous calendar year.

• The British cyclist secured this prestigious title primarily due to his spectacular performance at the 2024 Paris Olympics, where he won the Gold Medal in the Men's Cross-country Mountain Bike event despite suffering a mid-race puncture.

• Tom Pidcock is widely regarded as one of the most versatile athletes in modern cycling, competing at the highest level in Mountain Biking, Road Cycling, and Cyclo-cross.

• He represents the INEOS Grenadiers professional cycling team and has previously won major titles such as the Olympic Gold in Tokyo 2020 and the Cyclo-cross World Championship in 2022.

• This award marks a significant milestone as he becomes one of the few cyclists to be recognized in the Action Sportsperson category, which is typically dominated by sports like surfing, skating, and snowboarding.

Additional Information

• Laureus World Sports Awards:

• Established in 1999 by the Laureus Sport for Good Foundation, these awards are often described as the "Oscars of Sports."

• The awards ceremony honors individuals and teams for their sporting achievements throughout the year.

• Other Nominees and Profiles:

• Yuto Horigome: A Japanese professional skateboarder who made history by winning the first-ever Olympic Gold Medal in the men's street event at the 2020 Tokyo Games and defended it at the 2024 Paris Games.

• Kelly Slater: An American professional surfer who is an 11-time World Surf League champion. He is considered the greatest professional surfer of all time, holding records for both the youngest and oldest world champion.

• Chloe Kim: An American snowboarder and two-time Olympic Gold Medalist. She became the youngest woman to win an Olympic snowboarding gold medal at the 2018 PyeongChang Winter Olympics at the age of 17.

• Tom Pidcock's Notable Achievements:

• Born in July 1999 in Leeds, United Kingdom.

• Won the iconic Alpe d'Huez stage of the Tour de France in 2022, becoming the youngest rider ever to win on that specific climb.

• He holds World Championship titles across multiple disciplines, showcasing his unique functions and applications of skill in diverse cycling terrains.

Important Points

• The Laureus World Action Sportsperson of the Year category specifically focuses on non-traditional sports that involve high levels of risk and physical dexterity.

• The selection process involves a two-step system: a Nominations Panel of the world's leading sports editors, writers, and broadcasters votes to create a shortlist, and then the Laureus World Sports Academy members (sporting legends) vote for the winners by secret ballot.

• The 2025 awards highlighted the features of resilience and mental strength, epitomized by Tom Pidcock's recovery from a 30-second deficit during his Olympic race in Paris.

• Other major categories at the Laureus Awards include World Sportsman of the Year, World Sportswoman of the Year, World Team of the Year, and Breakthrough of the Year.

Q96. Answer: (b) State Health Regulatory Excellence Index

The correct answer is State Health Regulatory Excellence Index.

Key Points

• In August 2025, the Union Health Secretary, Punya Salila Srivastava, inaugurated a significant national mechanism known as the State Health Regulatory Excellence Index.

• This index is designed as a strategic tool to evaluate and improve state drug regulatory frameworks across India. It focuses on creating a competitive yet collaborative environment for states to enhance their oversight of the pharmaceutical sector.

• The mechanism follows an open and evidence-based approach, ensuring that the performance of State Drug Controller offices is measured against standardized benchmarks and data-driven metrics.

• The primary objective of the index is to achieve regulatory harmonization, which is essential for maintaining the safety, efficacy, and quality of medical products manufactured and distributed within the country.

• By identifying specific gaps in the regulatory ecosystem, the index encourages State Governments to invest in human resources, testing laboratories, and digital infrastructure to meet international standards.

Additional Information

• Central Drugs Standard Control Organisation (CDSCO):

• The CDSCO is the National Regulatory Authority (NRA) of India under the Ministry of Health and Family Welfare.

• It works in coordination with State Drug Regulatory Authorities to enforce the Drugs and Cosmetics Act, 1940 and the Rules, 1945.

• The Drugs Controller General of India (DCGI) heads the CDSCO and is responsible for the approval of new drugs and clinical trials.

• Regulatory Framework in India:

• The pharmaceutical industry in India is the 3rd largest in the world by volume. To sustain this, robust compliance monitoring is required.

• The State Health Regulatory Excellence Index acts as a catalyst for Ease of Doing Business by streamlining the licensing process and reducing administrative bottlenecks.

• It promotes the adoption of Good Manufacturing Practices (GMP) and Good Distribution Practices among small and medium enterprises (SMEs).

• Pharmaceutical Compliance:

• Maintaining Global Supply Chain integrity requires strict adherence to quality control protocols.

• The index monitors parameters such as the number of inspections conducted, the sampling of drugs for testing, and the prosecution of offenders dealing in spurious or sub-standard drugs.

Important Points

• Evidence-Based Evaluation: The index utilizes real-time data from integrated portals to minimize manual errors and enhance transparency in reporting.

• Capacity Building: One of the critical outcomes of this initiative is the training and development of Drug Inspectors to handle complex biotechnology and medical device regulations.

• Public Health Impact: By strengthening the regulatory frameworks, the Government of India aims to bolster public trust in the healthcare system and ensure that every citizen has access to safe and affordable medicines.

• Viksit Bharat 2047: This initiative is a part of the broader vision to make India a global leader in healthcare innovation and pharmaceutical manufacturing by the centenary of independence.

Q97. Answer: (b) New Delhi

The correct answer is New Delhi.

Key Points

• The Emerging Science, Technology and Innovation Conclave (ESTIC) 2025 was officially convened in New Delhi during the month of November 2025.

• This high-level conclave serves as a strategic platform for policymakers, scientists, industry leaders, and academicians to deliberate on the future of India's scientific landscape.

• The primary focus of the ESTIC 2025 was to foster a collaborative ecosystem for deep-tech startups and to accelerate the commercialization of homegrown technologies.

• During the event, several sessions were dedicated to the integration of Artificial Intelligence (AI), Quantum Computing, and Biotechnology into the national mainstream to drive economic growth.

• The venue, New Delhi, was chosen due to its status as the administrative hub where key decisions regarding the National Science and Technology Policy are formulated and implemented.

Additional Information

• Significance of New Delhi in Innovation:

• As the capital city, New Delhi hosts major research institutions such as the Indian Institute of Technology (IIT Delhi) and the headquarters of the Council of Scientific and Industrial Research (CSIR).

• The city acts as the primary link between government ministries and international scientific delegations, making it the ideal location for global conclaves like ESTIC.

• Focus Areas of ESTIC 2025:

• Quantum Technology: Discussions centered on the National Quantum Mission (NQM), aiming to make India a global leader in quantum communication and sensing by 2031.

• Green Energy: The conclave highlighted innovations in Green Hydrogen and Solid-state Batteries to meet the Net Zero targets by 2070.

• Digital Infrastructure: Strengthening the India Stack and expanding 6G technology research were key highlights of the technological roadmap discussed during the event.

• Government Initiatives Supporting Innovation:

• The Anusandhan National Research Foundation (ANRF), established to seed and promote research across universities, played a pivotal role in the themes of the 2025 conclave.

• India’s consistent rise in the Global Innovation Index (GII), where it moved from the 81st rank in 2015 to within the top 40 in recent years, provided the backdrop for the high optimism at the event.

• The Startup India initiative has also been a major contributor, with India now hosting over 100 unicorns, many of which are in the science and technology sectors.

• Future Outlook:

• The conclave emphasized the vision of Viksit Bharat @2047, where Science, Technology, and Innovation (STI) will be the cornerstones of a developed Indian economy.

• Emphasis was placed on IPR (Intellectual Property Rights) awareness to ensure that Indian innovations are protected and incentivized on a global scale.

Important Points

• Dates and Venue: The event was specifically held in November 2025 at a prominent convention center in New Delhi.

• Technology Missions: A major part of the conclave was the review of the National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS).

• Collaborations: High-level MoUs between Indian startups and Global Tech Firms were signed to enhance the manufacturing of semiconductors within the country under the India Semiconductor Mission.

• Sustainability: The ESTIC 2025 conclave itself adopted eco-friendly practices, showcasing a commitment to the Lifestyle for Environment (LiFE) movement.

Q98. Answer: (c) Achievers

The correct answer is Achievers.

Key Points

• The Achievers polo team created history in 2025 by sweeping all major honors at the Indian Polo Awards.

• This remarkable achievement marked the fourth consecutive year that the team has dominated the awards ceremony, establishing a record for consistency in the sport.

• The ceremony was held in Jaipur, Rajasthan, which is widely considered the heart of polo in India.

• The awards recognized the team's exceptional performance across the national circuit, including their victories in several high-handicap tournaments during the season.

• By winning categories such as Best Team and producing the Most Valuable Player, the Achievers have solidified their status as the premier polo outfit in the country.

Additional Information

• The Indian Polo Awards:

• This is a prestigious annual event designed to celebrate the heritage, talent, and spirit of polo in India.

• The awards recognize players, patrons, and support staff, including grooms and horse trainers, who contribute to the "Sport of Kings."

• History of Polo in India:

• Modern polo originated in Manipur, India, and was later formalized by British officers in the 19th century.

• The Indian Polo Association (IPA) was established in 1892 to regulate the sport and maintain its standards across the nation.

• Jaipur as a Polo Hub:

• Jaipur has a deep-rooted association with polo, largely due to the patronage of its Royal Family.

• The Rambagh Polo Ground in the city is one of the most famous venues globally, hosting international stars and high-profile tournaments like the Jaipur Open.

• Sport Mechanics:

• A standard polo match is divided into periods called Chukkas, each lasting seven minutes.

• A team typically consists of four players, and the handicaps of players range from -2 to 10 goals, indicating their skill level.

Important Points

• Growth of the Sport: In recent years, polo in India has seen a resurgence with increased corporate sponsorships and the emergence of professional teams like the Achievers, Sahara Warriors, and Rajnigandha Achievers.

• Key Locations: Apart from Jaipur, significant polo centers in India include Delhi, Jodhpur, Hyderabad, and Kolkata.

• International Standing: India is a member of the Federation of International Polo (FIP) and regularly participates in the Polo World Cup qualifiers, showcasing the nation's historical expertise on the global stage.

Q99. Answer: (a) Eurodrone

The correct answer is Eurodrone.

Key Points

• In January 2025, India officially joined the Eurodrone program as an observer, marking a significant expansion of its defense cooperation with European nations.

• The Eurodrone is a collaborative project between Germany, France, Italy, and Spain, designed to develop an advanced Medium-Altitude Long-Endurance (MALE) Remotely Piloted Aircraft System (RPAS).

• The program is managed by OCCAR (Organisation for Joint Armament Co-operation), which acts as the executive agent on

behalf of the participating European member states.

• As an observer, India will have the opportunity to participate in technical briefings, track the progress of aerospace development, and understand the technical standards required for unmanned aerial systems in non-segregated airspace.

• This move is seen as a strategic step for India to diversify its surveillance and reconnaissance capabilities while strengthening the India-EU defense and security partnership.

Additional Information

• Technical Specifications of Eurodrone:

• The Eurodrone is notable for its twin-turboprop engine configuration, which provides enhanced safety and reliability compared to single-engine platforms.

• It is designed for multi-mission capabilities, including Intelligence, Surveillance, Target Acquisition, and Reconnaissance (ISTAR), as well as potential future combat applications.

• Key industrial partners involved in the project include Airbus Defence and Space, Dassault Aviation, and Leonardo.

• Strategic Significance for India:

• India's Ministry of Defence aims to reduce dependence on any single source for HALE and MALE drones. Currently, India utilizes Heron drones from Israel and is in the process of inducting MQ-9B Predator drones from the USA.

• The observer status allows DRDO and Indian aerospace experts to gain insights into European digital design and manufacturing processes, which could benefit indigenous projects like TAPAS-BH-201.

• Context of Other Options:

• nEUROn: This is an experimental unmanned combat aerial vehicle (UCAV) developed by Dassault Aviation focused on stealth technology.

• Global Hawk: A High-Altitude Long-Endurance (HALE) platform produced by Northrop Grumman in the United States.

• Predator XP: An export variant of the MQ-1 Predator drone manufactured by General Atomics; it is an older generation system compared to the current MQ-9B series.

Important Points

• The Eurodrone program officially entered its contract phase in 2022, with the first flight originally targeted for the late 2020s.

• India's inclusion as an observer follows high-level diplomatic engagements and security dialogues held in New Delhi and Brussels during 2024.

• Participation in such programs is essential for India to ensure that its future RPAS fleets are interoperable with international air traffic management standards, allowing them to fly in civilian airspace without specific restrictions.

• The India-EU roadmap for 2025 emphasizes cooperation in cutting-edge technology, and the Eurodrone observer status is a tangible outcome of this policy framework.

Q100. Answer: (b) Manisha Bhanwala

The correct answer is Manisha Bhanwala.

Key Points

• Manisha Bhanwala secured the solitary gold medal for India in the women’s freestyle wrestling category at the Asian Wrestling Championships 2025.

• She competed in the 65 kg weight division and delivered a dominant performance throughout the tournament to reach the top of the podium.

• The Asian Wrestling Championships 2025 was held in Amman, Jordan, during April 2025, featuring elite wrestlers from across the continent including powerhouses like Japan and Kyrgyzstan.

• Her victory is a significant milestone as she was the only Indian woman to clinch a gold medal in this edition, highlighting her rising status in the international wrestling circuit.

• This achievement adds to India’s overall medal tally, where the team also secured various silver and bronze medals in other categories and weight classes.

Additional Information

• Vinesh Phogat:

• She is one of India's most decorated wrestlers, having won multiple Commonwealth Games gold medals and an Asian Games gold.

• Traditionally competing in the 50 kg or 53 kg categories, she has been a trailblazer for women's wrestling in India for over a decade.

• Antim Panghal:

• She made history by becoming the first Indian woman to win back-to-back U20 World Championships titles in 2022 and 2023.

• She competes in the 53 kg weight class and is considered one of the strongest contenders for Olympic and World Championship medals.

• Reetika Hooda:

• She achieved fame by becoming the first Indian woman to win the U23 World Wrestling Championship gold medal in 2023.

• She competes in the 76 kg heavy-weight category and has shown exceptional progress in senior-level continental tournaments.

• Asian Wrestling Championships:

• This is an annual event organized by United World Wrestling (UWW), the international governing body for the sport.

• The tournament serves as a crucial platform for athletes to earn ranking points, which determine seeding for major events like the World Championships and the Olympic Games.

• India has consistently performed well in this event, particularly in the freestyle and Greco-Roman disciplines.

Important Points

• Manisha Bhanwala's journey includes significant success at the U23 and Junior levels before transitioning successfully into the senior international arena.

• Her gold medal win in 2025 is crucial for India’s wrestling landscape, especially as the sport undergoes transition and focuses on developing new talent for the 2028 Los Angeles Olympics.

• The 65 kg category is known for being highly competitive in Asia, making her victory over top-seeded athletes from Central Asia and East Asia a remarkable feat of technical skill and endurance.

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