RRB Group D Official Paper (Held On: 29 Dec, 2025 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of these processes begins after pollen lands on the stigma of a flower?

(a) The leaves begin photosynthesis immediately.
(b) The petals open wider.
(c) It develops into a seed directly.
(d) A pollen tube grows through the style to reach the ovary.

Q2. When is a neutral salt formed?

(a) When strong acid reacts with weak base
(b) When weak acid reacts with strong base
(c) When strong acid reacts with strong base
(d) When acid reacts with metal

Q3. Which of the following correctly matches a floral part with its primary biological function in reproduction?

(a) Pistil – attraction of pollinators
(b) Sepals – development of ovules
(c) Stamens – production of pollen grains
(d) Petals – production of female gametes

Q4. A small amount of copper oxide taken in a beaker and dilute hydrochloric acid is added to it slowly while stirring, results in:

(a) formation of reddish-brown colour solution of copper sulphate
(b) formation of reddish-brown colour solution of copper chloride
(c) formation of bluish-green colour solution of copper chloride
(d) formation of reddish-brown colour solution of cupric chloride

Q5. Which method is used to purify metals like Zinc and Copper?

(a) Alloying
(b) Electrolytic refining
(c) Roasting
(d) Smelting

Q6. Which of the following represents non-uniform linear velocity?

(a) A ball rolling at uniform rate
(b) A body moving in a straight line at fixed speed
(c) A car moving at constant speed
(d) A train starting from rest

Q7. In India, cows are classified under which scientific species name?

(a) Bos taurus
(b) Bos bubalis
(c) Bos indicus
(d) Bubalus bubalis

Q8. Momentum (p) is a vector quantity. That means, momentum has both _____.

(a) speed and time
(b) force and acceleration
(c) magnitude and direction
(d) mass and velocity

Q9. For a given wave, if the speed becomes three times and the wavelength becomes three times, the frequency _____.

(a) becomes nine times
(b) becomes one-third
(c) becomes three times
(d) remains the same

Q10. Which of the following is NOT an application of Archimedes' Principle?

(a) Calculating buoyant force on a body in fluid
(b) Determining the density of an irregular solid
(c) Measuring electrical resistance of a wire
(d) Submarine floating and diving

Q11. A science teacher asks students to measure the current through a bulb using an ammeter. What precaution must the students follow?

(a) Connect the ammeter without a battery
(b) Connect the ammeter in series with correct polarity
(c) Connect the ammeter with reversed polarity
(d) Connect the ammeter in parallel with the bulb

Q12. If an object is placed at the centre of curvature of a concave mirror, the image formed will be:

(a) between focus and pole, virtual and erect
(b) at infinity, virtual and magnified
(c) at the focus, real and diminished
(d) at the centre of curvature itself, real and of the same size

Q13. What does the Law of Conservation of Mass state?

(a) Mass of reactants is always lost
(b) Mass remains unchanged in reactions
(c) Energy can be converted into mass
(d) Mass of products is always greater

Q14. Which of the following species is reduced in the given reaction?

$CuO + H_2 \rightarrow (Heat)\ Cu + H_2O$

(a) H_2
(b) Cu
(c) H_2O
(d) O

Q15. When applying the sign conventions for spherical lenses to measure object and image distances, where are all measurements taken from?

(a) The pole of the lens
(b) The optical centre of the lens
(c) The centre of curvature

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(d) The principal focus

Q16. Which of the following statements is correct about the definition of complex permanent tissues?

(a) Complex permanent tissues are made up of different types of cells performing different tasks.
(b) Complex permanent tissues are made up of different types of cells performing similar tasks.
(c) Complex permanent tissues are made of simple permanent tissues.
(d) Complex permanent tissues are made up of similar type of cells.

Q17. Which of the following is a key feature of offsprings produced through vegetative propagation?

(a) They are genetically diverse from the parent plant.
(b) They always grow slower than seed-grown plants.
(c) They require fertilisation to develop.
(d) They are genetically identical to the parent plant.

Q18. When is the work done by a force considered negative?

(a) When the force acts opposite to the direction of displacement
(b) When the force acts in the same direction as displacement
(c) When the force is zero
(d) When there is no displacement

Q19. Which of the following statements is true?

(a) On increasing the resistance of the wire, the strength of the magnetic field in a solenoid increases.
(b) The magnetic field inside a solenoid carrying current does not depend on the strength of the current.
(c) On increasing the number of turns per unit length in a solenoid, the strength of the magnetic field in the solenoid increases.
(d) The magnetic field lines inside a solenoid are circular.

Q20. Which of the following methods will NOT help in the management of garbage and other wastes produced by humans?

(a) Landfilling plastics in soil
(b) Treating wastes before release
(c) Vermicomposting
(d) Following 3R's (Reduce, Reuse, Recycle)

Q21. What is the IUPAC rule for writing element symbols?

(a) First letter uppercase, second lowercase (in case of two letters)
(b) Both letters always in uppercase form (in case of two letters)
(c) Symbols written in numeric codes
(d) Two lowercase letters always used (in case of two letters)

Q22. Which is the main transport system in animals?

(a) Circulatory system
(b) Respiratory system
(c) Muscular system
(d) Nervous system

Q23. Which of the following statements are correct for benzene?

a. It is a six-membered cyclic carbon compound.
b. It has three single and three double bonds.
c. The molecular formula is C6H14.

(a) Only b and c
(b) a, b and c
(c) Only a and b
(d) Only a and c

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Q24. Which of the following is a pure substance consisting of only one type of atom?

(a) Sodium
(b) Air
(c) Water
(d) Milk

Q25. Which of the following statements best describes autotrophic nutrition?

(a) It requires digestion of complex substances outside the body.
(b) It depends entirely on consuming other living organisms for food.
(c) It involves making food using carbon dioxide and water in the presence of sunlight.
(d) It involves direct absorption of organic compounds from other organisms.

MATHEMATICS

Q26. An agent sells a turbo cooker with a marked price of Rs. 6,370 at a discount of 50%. What is the selling price (in Rs.) of the turbo cooker?

(a) 3,158
(b) 2,548
(c) 3,185
(d) 2,549

Q27. P and Q together can fill a cistern with water in 15 hours. If P alone can fill the cistern with water in 40 hours, then in how many hours will Q alone fill one-fourth of the same cistern with water?

(a) 12
(b) 13
(c) 7
(d) 6

Q28. The value of $((a^2 - b^2)^3 + (b^2 - c^2)^3 + (c^2 - a^2)^3)/((a - b)^3 + (b - c)^3 + (c - a)^3)$ is:

(a) $2(a - b)(b - c)(c - a)$
(b) $(a - b)(b - c)(c - a)$
(c) $(a + b)(b + c)(c + a)$
(d) $3abc$

Q29. Simplify: $86 - (-16) \times (-8 - 20 - 18) \div [1 \times \{10 + (-2) \times (-3)\}]$

(a) 40
(b) 46
(c) 31
(d) 42

Q30. The volume (in m^3) of a cube with edges of 31 m is:

(a) 29959
(b) 29898
(c) 29791
(d) 29595

Q31. Sunita, Javed, and Rani invest Rs. 13,90,000, Rs. 4,70,000, and Rs. 15,40,000, respectively, to start a business. If the profit at the end of the year is Rs. 4,50,500, then what is the share of Rani in the profit?

(a) Rs. 2,04,048
(b) Rs. 2,04,052
(c) Rs. 2,04,050
(d) Rs. 2,04,053

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Q32. The distance between points A and B is 663 km. Amit travels from A to B at 131 km/hr and returns at 24 km/hr. Calculate his average speed for the entire journey (rounded off to two decimal places).

(a) 46.18 km/hr
(b) 40.57 km/hr
(c) 43.79 km/hr
(d) 39.54 km/hr

Q33. The sum of two numbers is 74 and their difference is 12. Find the product of the two numbers.

(a) 1533
(b) 1333
(c) 1233
(d) 1433

Q34. In a quadrilateral EFGH, angle E = 52° and angle F = 37°. The bisectors of angle G and angle H meet at X. What is the measure of angle HXG?

(a) 48.5°
(b) 49°
(c) 37°
(d) 44.5°

Q35. The cost price of a dress is Rs. 1,600. The shopkeeper makes a profit of 20% on selling it. If he offers a discount of 25% at the time of sale, find the marked price (in Rs.).

(a) 1,920
(b) 2,380
(c) 2,560
(d) 2,050

Q36. A shopkeeper sells 10 identical watches for Rs. 10,500, which is the cost price of 8 watches. Find his loss percentage.

(a) 10%
(b) 30%
(c) 40%
(d) 20%

Q37. 1/30 is what percentage of 2/20 (rounded off to two decimal places)?

(a) 66.67%
(b) 48.33%
(c) 43.33%
(d) 33.33%

Q38. What is the mode of the following data?

53, 53, 40, 49, 50, 48, 53, 50, 41, 40, 53, 45, 40, 47, 43, 52, 51, 42, 51, 53

(a) 53
(b) 49
(c) 40
(d) 50

Q39. Two pipes, F and M, can fill a cistern in 25 minutes and 30 minutes, respectively. If both pipes are opened together, after how many minutes should pipe F be closed so that the cistern is completely filled in 15 minutes?

(a) 12.5 min
(b) 15 min
(c) 12 min
(d) 10 min

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Q40. A tower stands vertically on the ground. From a point on the ground which is 29.6 m away from the foot of the tower, the angle of elevation of the top of the tower is found to be 45°. Find the height of the tower.

(a) 23.6 m
(b) 27.6 m
(c) 29.6 m
(d) 25.6 m

Q41. If A6B59 is exactly divisible by 9, then find the least possible value of (A^2+2B).

(a) 19
(b) 13
(c) 14
(d) 21

Q42. A metallic sphere of unknown radius is melted and recast into 64 smaller spherical balls. During the recasting process, 20% of the total metal is lost as waste. If the total volume of the 64 smaller spheres after the loss is 10,752 cm^3, determine the radius (rounded off to the nearest integer) of the original sphere. (Use $\pi = 3.14$)

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

Q43. The monthly incomes of two friends Chetan and Vipul, are in the ratio 5 : 9, respectively, and each of them saves Rs. 51,000 every month. If the ratio of their monthly expenditure is 1 : 3, find the monthly income of Chetan(in Rs.).

(a) 85,000
(b) 84,000
(c) 86,000
(d) 1,19,000

Q44. The ratio of three numbers is 12:14:4. If 25% of the first number is 18, then what would 30% of the difference between the third and second numbers be?

(a) 19
(b) 17
(c) 18
(d) 16

Q45. The ratio of the ages of a wife and husband is 6 : 7 at present. If the sum of their ages after 20 years from now is 92, then find their present ages (in years), respectively.

(a) 42, 49
(b) 24, 28
(c) 18, 21
(d) 30, 42

Q46. The mean and the mode of a set of data are 20 and 88.7, respectively. Find the median of the data, using the empirical formula.

(a) 42.9
(b) 44.5
(c) 42.5
(d) 43.1

Q47. If the HCF of three numbers is 23 and they are in the ratio 1:2:3, then the numbers are:

(a) 23, 56, 59
(b) 23, 46, 92
(c) 13, 46, 92
(d) 23, 46, 69

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Q48. The amount on a sum of Rs. 5,200 at 20% per annum compound interest, compounded annually, in 2 years will be:

(a) Rs. 6,916
(b) Rs. 7,472
(c) Rs. 7,488
(d) Rs. 7,105

Q49. Two trains, Train A and Train B, are traveling towards each other on parallel tracks. Train A is 150 meters long and moves at a speed of 72 km/h. Train B is 100 meters long and moves at a speed of 54 km/h. How much time (rounded off to two decimal places) will it take for Train A to completely pass Train B?

(a) 6.14 seconds
(b) 9.14 seconds
(c) 10.14 seconds
(d) 7.14 seconds

Q50. The price of fuel decreases by 15%, 30% and 60% in three successive months, but increases by 60% in the fourth month. What is the percentage increase/decrease in the price of fuel in the fourth month as compared to its original price?

(a) Decreases by 61.92%
(b) Decreases by 67.07%
(c) Increases by 58.55%
(d) Increases by 66.82%

GENERAL INTELLIGENCE & REASONING

Q51. In a certain code language, ‘ELMS’ is coded as ‘4892’ and ‘ALES’ is coded as ‘7428’.What is the code for ‘A’ in the given code language?

(a) 4
(b) 8
(c) 7
(d) 2

Q52. What should come in place of the question mark (?) in the given series?

120 135 155 180 210 ?

(a) 230
(b) 245
(c) 240
(d) 233

Q53. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

REN VBR ZYV DVZ ?

(a) HSD
(b) GSC
(c) IRC
(d) GTE

Q54. Seven boxes A, B, C, D, P, Q and R are kept one over the other but not necessarily in the same order. D is kept immediately above Q. R is kept immediately above C. Only P is kept above A. Only two boxes are kept above D. R is not kept at third position from the bottom.

How many boxes are kept between B and P?

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

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Q55. 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) IN - GL
(b) MR - KP
(c) GL - EJ
(d) OT - MS

Q56. What will come in place of the question mark (?) in the following equation if '+' and '–' are interchanged and '×' and '÷' are interchanged?

58 ÷ 11 + 624 × 13 - 471 = ?

(a) 1022
(b) 1032
(c) 1061
(d) 1011

Q57. Based on the English alphabetical order, three of the following four letter-clusters are alike in a certain way and thus form a group. Which letter-cluster DOES NOT belong to that group?

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

(a) HLNR
(b) INOS
(c) SWYC
(d) VZBF

Q58. 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) 9 1 5 1 9 8 6 6 9 9 4 1 6 7 8 3 7 2 1 3 5 3 5 1 6 2 8 (Right)

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

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

Q59. What should come in place of the question mark (?) in the given series?

2, 1, 1, 1.5, ?, 7.5

(a) 2
(b) 4
(c) 3
(d) 2.5

Q60. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All viruses are fungi.

Some viruses are bacteria.

Conclusions:

(I) Some fungi are bacteria.

(II) No fungi is a virus.

(a) Neither follows
(b) Only II follows
(c) Only I follows

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(d) Both follow

Q61. What should come in place of the question mark (?) in the given series?

45 ? 57 63 69 75

(a) 51
(b) 62
(c) 47
(d) 53

Q62. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(12, 15, 720)

(14, 11, 616)

(a) (13, 10, 510)
(b) (12, 9, 434)
(c) (18, 9, 548)
(d) (16, 11, 704)

Q63. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

DBC−YWX

KIJ−FDE

(a) RPQ−MKL
(b) ROO−LJK
(c) RPQ−LKK
(d) ROO−MKL

Q64. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All pans are cups.

All cups are bottles.

Some cups are mugs.

Conclusions:

(I): Some bottles are mugs.

(II): Some pans are mugs.

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

Q65. Seven boxes, D, E, F, U, V, W and X, are kept one over the other, but not necessarily in the same order. Only two boxes are kept below W. Only two boxes are kept between W and U. Only one box is kept between U and E. X is kept immediately above V. F is kept at some place below D. How many boxes are kept between D and X?

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

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Q66. In a certain code language,

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

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

'A × B' means 'A is the wife of B',

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

'A # B' means 'A is the daughter of B'.

How is Q related to N if 'N % E – C % R # Q'?

(a) Son's wife
(b) Son's daughter
(c) Father's brother
(d) Husband's father

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

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

How many such even numbers are there (from left to right) each of which is immediately preceded by an odd number and also immediately followed by an even number?6624

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

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

DL – IQ – NV

FN – KS – PX

(a) RM – QT – PR
(b) UW – YZ – SU
(c) BJ – GO – LT
(d) PL – RN – TP

Q69. Refer to the given series and answer the question that follows. (All numbers are single digit numbers only.) Counting to be done from left to right only.

(Left) 9 8 9 2 6 3 9 2 7 5 5 6 9 2 9 6 8 9 1 2 9 1 6 7 9 1 8 (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) 3
(b) 4
(c) 2
(d) 1

Q70. Rihan starts from Point A and drives 24 km towards East. He then takes a right turn, drives 50 km, turns right and drives 51 km. He then takes a right turn and drives 63 km. He takes a final right turn, drives 27 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90-degree turns only, unless specified.)

(a) 11 km to the South
(b) 15 km to the north
(c) 17 km to the north
(d) 13 km to the South

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Q71. This question is based on the five, three-digit numbers given below.

(Left) 715, 906, 570, 853, 418 (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 third digit of the highest number is added to the second digit of the lowest number?

(a) 13
(b) 7
(c) 6
(d) 8

Q72. A, B, C, D, W, X and Y are sitting around a circular table facing the centre of the table. C sits fourth to the right of X. Only two people sit between Y and W when counted from the left of Y. D sits third to the left of B. A is an immediate neighbour of B and W. How many people between C and A when counted from the left of A?

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

Q73. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

XBF 84 IMQ 92 TXB 100 EIM 108 ?

(a) PRU 115
(b) PSW 115
(c) PUW 116
(d) PTX 116

Q74. Seven friends D, E, F, U, V, W and X are sitting in a straight line facing the north. Only three people are seated to the left of D. Only E is seated to the right of W. Only three people are seated between W and X. V is seated at some place to the left of U but at some place to the right of F. How many people are seated between F and U?11035

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

Q75. Five people, A, B, C, D and E, are sitting in a row, facing north. A sits at the extreme right end of the row. D sits to the immediate left of A. Only B sits between C and E. How many people sit between A and B?

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

Q76. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

UIR : WDP

FRO : HMM

(a) GHJ : ICG
(b) KIT : MCR
(c) CPP : EKN
(d) LJQ : NEN

Q77. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

45 - 54 × 6 + 12 ÷ 1 = ?

(a) 42

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

Q78. In a certain code language, ‘POKE’ is coded as ‘8469’ and ‘KIND’ is coded as ‘2387’. What is the code for ‘K’ in the given code language?
(a) 4
(b) 2
(c) 6
(d) 8

Q79. Town I is to the north of Town F. Town H is to the east of Town I. Town J is to the east of Town H. Town G is to the north of Town J. What is the position of Town F with respect to Town G?
(a) East
(b) North
(c) Northeast
(d) Southwest

Q80. If + means −, − means ×, × means ÷ and ÷ means +, then what will come in place of the question mark (?) in the following equation?
18 + 4 - 6 ÷ 46 × 2 = ?
(a) 14
(b) 11
(c) 21
(d) 17

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Which of the following initiatives was launched by the Union Ministry of Tribal Affairs in 2025 to improve the implementation of tribal welfare schemes?
(a) Tribal Pragati Mission
(b) Van Dhan 2.0
(c) Adi Karmyogi
(d) Janjatiya Jyoti Abhiyan

Q82. In August 2025, which of the following African countries was officially declared free of sleeping sickness by the World Health Organization (WHO)?
(a) Uganda
(b) Nigeria
(c) Kenya
(d) Ghana

Q83. In September 2025, Justice Shree Chandrashekhar took oath as the Chief Justice of which High Court, following his appointment by the Government of India?
(a) Rajasthan High Court
(b) Calcutta High Court
(c) Delhi High Court
(d) Bombay High Court

Q84. Pobitora Wildlife Sanctuary reopened for the 2025–26 tourist season in which Indian state?
(a) West Bengal
(b) Odisha
(c) Meghalaya
(d) Assam

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Q85. Recently, who has taken over as president of industry body ASSOCHAM for 2024-25?

(a) Suresh Nayar
(b) Pankaj Nayar
(c) Sanjay Nayar
(d) Akhilesh Nayar

Q86. What is the purpose of introducing Sugar Boards in CBSE schools, as reported in May 2025?

(a) To teach hygiene practices
(b) To educate about sugar risks
(c) To promote physical education
(d) To encourage sports activities

Q87. In June 2025, Rajkishore Parhi was chosen for the Bal Sahitya Puraskar for poetry collection, 'Kete Phula Phutichhi', in which language?

(a) Telegu
(b) Tamil
(c) Odia
(d) Bhojpuri

Q88. Which landmark treaty, aimed at protecting the high seas, achieved its final ratification push during the UN Ocean Conference in June 2025?

(a) United Nations Convention on the Law of the Sea (UNCLOS)
(b) Paris Agreement on climate change
(c) Convention on Wetlands (Ramsar Convention)
(d) Biodiversity Beyond National Jurisdiction (BBNJ) Agreement

Q89. The Indian Armed Forces contingent participating in the multilateral joint military exercise ZAPAD 2025 is being led by which regiment of the Indian Army?

(a) Kumaon Regiment
(b) Sikh Regiment
(c) Gorkha Regiment
(d) Rajput Regiment

Q90. In which event did Suruchi Singh win a gold medal at the ISSF World Cup, 2025, in Munich?

(a) Women's trap shooting
(b) Women's 25m pistol
(c) Women's 50m rifle
(d) Women's 10m air pistol

Q91. What is the name of the new regulatory body formed by the Reserve Bank of India in May 2025 to supervise India's payment systems?

(a) Payments Regulatory Board
(b) Unified Financial Authority
(c) National Payments Council
(d) Payments Governance Authority

Q92. Which government body introduced the FASTag annual pass?

(a) Directorate of National Toll and Transit
(b) Ministry of Rural Infrastructure and Bridges
(c) Indian Roadways Development Council
(d) National Highways Authority of India

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Q93. In October 2025, the Centre for Research on Energy and Clean Air (CREA) published the PM2.5 air quality assessment of Indian cities. What does PM2.5 refer to?

(a) Sulphur dioxide emissions released from industrial units
(b) Ground-level ozone produced during photochemical reactions
(c) Fine particulate matter with a diameter of 2.5 micrometres or smaller
(d) Carbon monoxide generated from incomplete combustion

Q94. What rank did Neeraj Chopra achieve during the Doha Diamond League competition of 2025?

(a) First
(b) Third
(c) Fourth
(d) Second

Q95. In July 2025, which of the following firms entered into a binding agreement to form a 50:50 domestic reinsurance joint venture to serve the insurance market in India?

(a) Allianz with Jio Financial Services
(b) Swiss Re with Axis Bank
(c) Munich Re with Paytm
(d) Lloyd’s with PayU

Q96. In June 2025, a London-bound Air India aircraft crashed shortly after taking off from which airport?

(a) Chennai Airport
(b) Delhi Airport
(c) Kolkata Airport
(d) Ahmedabad Airport

Q97. In 2025, who broke the women's mile world record with a time of 4:06.42 at Nike’s Breaking event in Paris?

(a) Faith Kipyegon
(b) Sifan Hassan
(c) Laura Muir
(d) Genzebe Dibaba

Q98. What was the theme of the 28^(th) National Conference on e-Governance scheduled for 22 and 23 September 2025 in Visakhapatnam?

(a) AI in Governance: Future Pathways
(b) e-Governance for Sustainable Development
(c) Digital India: Inclusive Growth
(d) Viksit Bharat: Civil Service and Digital Transformation

Q99. Chief Minister Yogi Adityanath launched which book on public etiquette in May 2025?

(a) Sanghatil Manavi Vyavasthapan
(b) Rajal Neeti: Lok Vyavhaar
(c) Rajal Neeti: Time Management
(d) The Divine Kumbh

Q100. At the 23^(rd) National Para Athletics Championships 2025 in Chennai's Nehru Stadium, which state claimed the top position in the combined men's and women's team standings?

(a) Maharashtra
(b) Haryana
(c) Tamil Nadu
(d) Uttar Pradesh

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ANSWER KEY

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

SOLUTIONS

Q1. Answer: (d) A pollen tube grows through the style to reach the ovary.

The correct answer is A pollen tube grows through the style to reach the ovary.

Key Points

• The process of plant reproduction begins with pollination, which is the transfer of pollen grains from the anther to the stigma of a flower.

• Once a compatible pollen grain lands on the stigma, it absorbs moisture and sugar-rich secretions from the stigmatic surface, leading to its germination.

• During germination, a pollen tube emerges from one of the germ pores of the pollen grain and grows downward through the internal tissues of the style. Hence, statement 4 is correct.

• The pollen tube acts as a conduit to transport the male gametes (sperm cells) toward the ovule located inside the ovary.

• The growth of the tube is chemotropic, meaning it is guided by chemical signals secreted by the synergid cells within the embryo sac.

• Leaves do not begin photosynthesis specifically because of pollination; photosynthesis is a continuous metabolic process occurring in chlorophyll-containing tissues. Hence, statement 1 is incorrect.

• Petals usually wither or fall off after successful pollination rather than opening wider, as their primary role of attracting pollinators is complete. Hence, statement 2 is incorrect.

• Pollen does not develop into a seed directly; a seed only forms after the complex process of fertilization occurs within the ovule. Hence, statement 3 is incorrect.

Additional Information

• Siphonogamy: This refers to the process in seed plants where a pollen tube is used to transfer male gametes to the egg cell, removing the requirement for external water for fertilization.

• Double Fertilization: A unique feature of Angiosperms (flowering plants) where one male gamete fuses with the egg to form a diploid zygote, and the second male gamete fuses with two polar nuclei to form the triploid primary endosperm nucleus (PEN).

• Structure of the Pistil: The female reproductive part, or carpel, consists of the stigma (receptive tip), the style (stalk), and the ovary (swollen base containing ovules).

• Post-Fertilization Changes: After successful fertilization, the ovule matures into a seed, and the ovary wall develops into the pericarp or the fruit.

Important Points

• Pollen-Pistil Interaction: This is a dynamic recognition process where the pistil evaluates the pollen to ensure it is "compatible" (belonging to the same species and not self-sterile) before allowing the pollen tube to grow.

• Role of Nutrients: Essential elements like Boron and Calcium are critical for the successful germination and steady elongation of the pollen tube through the style.

• Generative and Vegetative Cells: The pollen grain typically consists of a vegetative cell (which forms the tube) and a generative cell (which divides to form two sperm cells).

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Q2. Answer: (c) When strong acid reacts with strong base

The correct answer is When strong acid reacts with strong base.

Key Points

• A neutral salt is formed when a strong acid reacts with a strong base. In this chemical reaction, the hydrogen ions (H+) from the acid and hydroxyl ions (OH-) from the base combine to form water (H2O), leaving behind a salt that has no acidic or basic properties. Hence, statement 3 is correct.

• When a strong acid reacts with a weak base, the resulting salt is acidic in nature. This happens because the conjugate acid of the weak base is strong enough to donate protons to water, resulting in a pH value of less than 7. Hence, statement 1 is incorrect.

• When a weak acid reacts with a strong base, a basic salt is formed. The conjugate base of the weak acid reacts with water to produce hydroxyl ions, making the solution alkaline with a pH value greater than 7. Hence, statement 2 is incorrect.

• When an acid reacts with a metal, it generally produces a salt and hydrogen gas. While a salt is formed, this specific interaction is categorized as a single displacement reaction rather than a standard neutralization reaction intended to define the neutrality of a salt. Hence, statement 4 is incorrect.

• The pH of a neutral salt solution, such as sodium chloride (NaCl) or potassium nitrate (KNO3), is exactly 7 at 25 degrees Celsius.

Additional Information

• Neutralization Reaction:

• It is a chemical reaction in which an acid and a base react quantitatively with each other.

• The general formula is: Acid + Base → Salt + Water.

• This reaction is usually exothermic, meaning it releases heat energy to the surroundings.

• Strength of Acids and Bases:

• Strong Acids: Acids that ionize completely in aqueous solutions, such as Hydrochloric acid (HCl), Sulfuric acid (H2SO4), and Nitric acid (HNO3).

• Strong Bases: Bases that dissociate completely in water, such as Sodium hydroxide (NaOH) and Potassium hydroxide (KOH).

• Weak Acids: Acids that only partially ionize, like Acetic acid (CH3COOH) and Carbonic acid (H2CO3).

• Weak Bases: Bases that do not ionize fully, such as Ammonium hydroxide (NH4OH).

• pH Scale:

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

• It ranges from 0 to 14. A pH of 7 is neutral, below 7 is acidic, and above 7 is basic.

Important Points

• Common Examples of Salts:

• Sodium Chloride (NaCl): Formed from HCl (Strong Acid) and NaOH (Strong Base). It is a neutral salt used in food preservation and as common table salt.

• Ammonium Chloride (NH4Cl): Formed from HCl (Strong Acid) and NH4OH (Weak Base). It is an acidic salt used in dry cell batteries.

• Sodium Carbonate (Na2CO3): Formed from H2CO3 (Weak Acid) and NaOH (Strong Base). It is a basic salt used in glass manufacturing and water softening.

• Salt Hydrolysis:

• This is the process where salt ions react with water to produce acidity or alkalinity. Neutral salts derived from strong acids and strong bases do not undergo significant hydrolysis, which is why their pH remains 7.

Q3. Answer: (c) Stamens – production of pollen grains

The correct answer is Stamens – production of pollen grains.

Key Points

• Stamens represent the male reproductive part of a flower. They are responsible for the production of pollen grains, which contain the male gametes necessary for fertilization. Hence, statement 3 is correct.

• The Pistil (also known as the carpel) is the female reproductive part. Its primary biological function is to receive pollen at the stigma and house the ovules within the ovary for fertilization. While it is involved in reproduction, the attraction of pollinators is primarily the function of the petals. Hence, statement 1 is incorrect.

• Sepals are the outermost green leaf-like structures of a flower, collectively known as the Calyx. Their primary function is to protect the flower during its bud stage. They do not develop ovules; ovules develop inside the ovary of the pistil. Hence, statement 2 is incorrect.

• Petals are the brightly colored parts of the flower, collectively called the Corolla. Their primary function is the attraction of pollinators like insects and birds through their color and scent. They do not produce female gametes; these are produced within the embryo sac inside the ovule. Hence, statement 4 is incorrect.

• A typical flower is organized into four whorls: the calyx, corolla, androecium (stamens), and gynoecium (pistil).

Additional Information

• Structure of Stamen:

• It consists of two main parts: the Anther and the Filament.

• The Anther is a bilobed structure where microsporangia develop to produce pollen grains through the process of microsporogenesis.

• The Filament is a long, slender stalk that supports the anther and attaches it to the thalamus or petal.

• Structure of Pistil:

• The Stigma serves as a landing platform for pollen grains.

• The Style is the elongated tube that connects the stigma to the ovary.

• The Ovary is the basal swollen part containing one or more ovules attached to a flattened, cushion-like placenta.

• Pollination and Fertilization:

• Pollination is the physical transfer of pollen grains from the anther to the stigma. This can be facilitated by wind, water, or biological agents.

• After pollination, the pollen grain germinates, and a pollen tube grows through the style to reach the ovule for fertilization.

Important Points

• Essential vs. Non-essential Whorls: The Androecium and Gynoecium are called essential whorls because they are directly involved in sexual reproduction. The Calyx and Corolla are accessory or non-essential whorls as they assist in protection and attraction.

• Flower Types:

• Bisexual (Hermaphrodite): Flowers that possess both stamens and pistils, such as Lily, Rose, and Hibiscus.

• Unisexual: Flowers that possess either stamens (staminate) or pistils (pistillate), such as Papaya, Corn, and Cucumber.

• Post-Fertilization Changes: After successful fertilization, the ovule develops into a seed, and the ovary matures into a fruit. The petals and sepals often wither and fall off.

Q4. Answer: (c) formation of bluish-green colour solution of copper chloride

The correct answer is formation of bluish-green colour solution of copper chloride.

Key Points

• When copper oxide reacts with dilute hydrochloric acid, a chemical reaction occurs that transforms the black solid powder into a soluble salt.

• Copper (II) oxide (CuO) is a basic oxide, and its reaction with hydrochloric acid (HCl) is a type of neutralization reaction (Metal Oxide + Acid → Salt + Water).

• The chemical equation for this process is: $CuO + 2HCl \rightarrow CuCl_2 + H_2O$.

• The black colour of the copper oxide disappears as it dissolves in the acid, and the solution turns bluish-green.

• This characteristic bluish-green colour is due to the formation of Copper (II) chloride ($CuCl_2$) in the aqueous solution.

• Statement 1 suggests the formation of a reddish-brown solution of copper sulphate. This is incorrect because the acid used is hydrochloric acid, not sulphuric acid, and copper sulphate typically forms a blue solution. Hence, statement 1 is incorrect.

• Statement 2 suggests a reddish-brown colour for copper chloride. While copper chloride is formed, its aqueous state is bluish-green, not reddish-brown. Hence, statement 2 is incorrect.

• Statement 3 states the formation of a bluish-green colour solution of copper chloride. This accurately describes the visual and chemical result of the reaction. Hence, statement 3 is correct.

• Statement 4 mentions a reddish-brown solution of cupric chloride. "Cupric chloride" is another name for copper (II) chloride, but the colour description is wrong. Hence, statement 4 is incorrect.

Additional Information

• Copper (II) Oxide (CuO): It is an inorganic compound, often appearing as a black solid. It is a mineral known as tenorite and acts as a precursor to many copper-containing products.

• Copper (II) Chloride ($CuCl_2$): In its anhydrous form, it is yellowish-brown, but it commonly exists as a dihydrate ($CuCl_2 \cdot 2H_2O$) which is bright green. In dilute aqueous solutions, the copper ions coordinate with water to produce the bluish-green tint.

• Nature of Metal Oxides: Most metal oxides are basic in nature. When they react with mineral acids like HCl, H_2SO_4, or HNO_3, they form the corresponding metal salts and water.

• Neutralization Reaction: This specific reaction is a double displacement or neutralization where the hydrogen ions from the acid combine with the oxygen from the oxide to form water, while the metal cation and acid anion form the salt.

• Reactivity: While copper metal itself does not react with dilute hydrochloric acid because it is below hydrogen in the reactivity series, its oxide (CuO) reacts readily because the reaction is driven by the formation of water.

Important Points

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• Oxidation State: In this reaction, copper remains in the +2 oxidation state. CuO is copper (II) oxide, and the resulting $CuCl_2$ is copper (II) chloride (also known as cupric chloride).

• Visual Indicators: The transition from a black powder to a clear bluish-green liquid is a definitive chemical change.

• Safety: When performing this in a laboratory, stirring is essential to ensure the black CuO particles react completely with the dilute HCl.

• Product Identification: If the solution were evaporated, green crystals of copper chloride dihydrate would be obtained.

Q5. Answer: (b) Electrolytic refining

The correct answer is Electrolytic refining.

Key Points

• Electrolytic refining is a technique used for the purification of crude metals to obtain them in a highly pure state. It is the most widely used method for metals like Copper (Cu), Zinc (Zn), Tin (Sn), Nickel (Ni), Silver (Ag), and Gold (Au).

• In this process, a thick block of the impure metal acts as the anode (the positive electrode), and a thin strip of the pure metal acts as the cathode (the negative electrode).

• A water-soluble salt of the same metal is used as the electrolyte. For example, in the refining of Copper, acidified Copper Sulfate ($CuSO_4$) solution is used as the electrolyte.

• When an electric current is passed through the electrolyte, the metal ions from the anode dissolve into the solution, while an equivalent amount of pure metal from the solution is deposited onto the cathode. Hence, the statement regarding electrolytic refining is correct.

• During this process, the soluble impurities go into the electrolyte solution, whereas the insoluble impurities settle down at the bottom of the anode and are known as anode mud.

Additional Information

• Alloying:

• This is the process of mixing a metal with one or more other elements (metals or non-metals) to improve its physical properties like hardness, tensile strength, and corrosion resistance.

• Examples include Brass (Copper and Zinc), Bronze (Copper and Tin), and Steel (Iron and Carbon). It is a method of modification, not purification.

• Roasting:

• Roasting is a metallurgical process where sulfide ores are heated strongly in the presence of excess air or oxygen.

• The goal is to convert the sulfide ore into a metal oxide, which is easier to reduce. For example, Zinc Blende (ZnS) is roasted to form Zinc Oxide (ZnO).

• Smelting:

• Smelting is a form of extractive metallurgy used to produce a metal from its ore. It involves heating the ore beyond its melting point, usually in the presence of a reducing agent like Carbon (Coke).

• This process removes the oxygen from the metal oxide, leaving behind the crude metal.

• Calcination:

• Similar to roasting, calcination involves heating the ore strongly, but in the absence or limited supply of air. This is typically used for carbonate or hydrated ores to remove moisture and volatile impurities.

Important Points

• Efficiency: Electrolytic refining can produce metals with a purity level as high as 99.99%, which is essential for electrical applications where high conductivity is required.

• Economic Value: The anode mud collected during the refining of Copper often contains precious metals like Antimony, Selenium, Tellurium, Silver, Gold, and Platinum. The recovery of these metals often covers the cost of the entire refining process.

• Oxidation and Reduction: In the electrolytic cell, oxidation occurs at the anode (loss of electrons by metal atoms), and reduction occurs at the cathode (gain of electrons by metal ions).

Q6. Answer: (d) A train starting from rest

The correct answer is A train starting from rest.

Key Points

• Non-uniform linear velocity occurs when an object travels in a straight line but its speed changes over time, or when its direction changes while moving. In the case of linear motion, the direction remains constant, so non-uniformity arises specifically from a change in magnitude (speed).

• A train starting from rest implies that its initial velocity is zero. As the train begins to move, it must accelerate to gain speed. Because the magnitude of its velocity is increasing from 0 m/s to a higher value, the velocity is not constant. Hence, statement 4 is correct.

• A ball rolling at a uniform rate suggests that the ball is covering equal distances in equal intervals of time. If it is rolling in a single

direction, both its speed and direction are constant, representing uniform velocity. Hence, statement 1 is incorrect.

• A body moving in a straight line at fixed speed is the classic definition of uniform linear velocity. Since the direction is fixed (straight line) and the magnitude is fixed (fixed speed), there is no change in the velocity vector. Hence, statement 2 is incorrect.

• A car moving at constant speed, if assumed to be on a straight path, maintains the same velocity throughout its motion. Without a change in rate of motion or path, it does not exhibit non-uniform behavior. Hence, statement 3 is incorrect.

Additional Information

• Velocity vs. Speed: Speed is a scalar quantity that refers to "how fast an object is moving." Velocity is a vector quantity that refers to "the rate at which an object changes its position." Velocity must specify both magnitude and direction.

• Uniform Motion: An object is said to be in uniform motion if it moves along a straight line with a constant velocity. This means it covers equal displacements in equal intervals of time, no matter how small these time intervals may be.

• Non-Uniform Motion: This occurs when an object covers unequal distances in equal intervals of time. It is also known as accelerated motion. A common example is a freely falling body or a vehicle moving through heavy traffic where brakes and accelerators are used frequently.

• Acceleration: This is defined as the rate of change of velocity with respect to time. If the velocity of an object changes from an initial value u to a final value v in time t, the acceleration a is given by (v - u) / t. In the case of a train starting from rest, u is always zero.

• Linear Motion: Also known as rectilinear motion, it is motion along a straight line. It can be uniform (constant velocity) or non-uniform (variable velocity/acceleration).

Important Points

• Change in Velocity: Velocity can be changed in three ways: by changing the speed, by changing the direction, or by changing both. For linear velocity, we primarily focus on the change in speed.

• Circular Motion Context: Even if a body moves at a constant speed in a circle, its velocity is non-uniform because the direction of motion is changing at every point. This is known as uniform circular motion, but the velocity vector itself is non-uniform.

• SI Units: The SI unit for both speed and velocity is meters per second (m/s), while the SI unit for acceleration is meters per second squared (m/s^2).

Q7. Answer: (c) Bos indicus

The correct answer is Bos indicus.

Key Points

• Bos indicus, popularly known as Zebu cattle, is the scientific name for the indigenous humped cattle breeds found in India and other parts of South Asia and Africa.

• These cattle are distinctively characterized by a prominent fatty hump over their shoulders, a large dewlap (the fold of skin hanging below the neck), and sometimes drooping ears.

• The species is highly adapted to the tropical environment, showing remarkable resistance to high temperatures, humidity, and ectoparasites such as ticks.

• Historically, Bos indicus is believed to have originated in the Indian subcontinent and was domesticated as early as 6000 BCE.

• They are primarily used for dairy, draught power (ploughing and transport), and manure in traditional Indian agriculture. Hence, the correct answer is Bos indicus.

Additional Information

• Bos taurus:

• This refers to the humpless cattle species native to Europe and Northern Asia.

• Common examples include high milk-yielding breeds like Holstein Friesian, Jersey, and Brown Swiss.

• Unlike Bos indicus, these breeds are best suited for temperate climates and are more susceptible to heat stress and tropical diseases.

• Bubalus bubalis:

• This is the scientific name for the Domestic Water Buffalo, which is a different genus altogether from the cow.

• India possesses the largest population of water buffaloes in the world, with famous breeds like the Murrah, Surti, and Jaffrabadi.

• They are a major source of milk production in India, contributing significantly to the White Revolution.

• Bos bubalis:

• This term is often used as a synonym for Bubalus bubalis in older biological texts, though modern taxonomy classifies the water buffalo under the genus Bubalus.

Important Points

• A2 Milk Significance: Indian indigenous breeds (Bos indicus) are known for producing A2 beta-casein milk, which is scientifically considered easier to digest and healthier than the A1 milk typically produced by Bos taurus breeds.

• Major Indian Breeds: Some of the most notable Bos indicus breeds in India include the Gir (Gujarat), Sahiwal (Punjab/Haryana),

Red Sindhi, Tharparkar (Rajasthan), and Ongole (Andhra Pradesh).

• Draught Breeds: Breeds like the Hallikar and Amrit Mahal from Karnataka are specifically bred for their immense physical strength and endurance in agricultural labor.

• Taxonomic Classification: Both Bos indicus and Bos taurus belong to the family Bovidae and the subfamily Bovinae, under the order Artiodactyla.

• Government Initiatives: To protect these indigenous species, the Government of India launched the Rashtriya Gokul Mission in 2014 for the conservation and scientific development of indigenous cattle breeds.

Q8. Answer: (c) magnitude and direction

The correct answer is magnitude and direction.

Key Points

• A vector quantity is defined in physics as a physical quantity that possesses both a numerical value (magnitude) and a specified direction.

• Momentum, represented by the symbol p, is the product of an object's mass (m) and its velocity (v). Since velocity is a vector quantity, the resulting momentum must also be a vector quantity.

• The magnitude of momentum refers to "how much" motion an object has, which depends on how heavy the object is and how fast it is moving.

• The direction of momentum is always the same as the direction of the object's velocity. For example, if a car is moving North, its momentum vector is also directed toward the North.

• In contrast, scalar quantities such as mass, time, and speed only have magnitude and no direction. Hence, the correct answer is magnitude and direction.

Additional Information

• SI Unit and Dimensions:

• The Standard International (SI) unit of momentum is the kilogram-meter per second (kg·m/s).

• In terms of dimensional analysis, momentum is expressed as [M L T^-¹], where M is mass, L is length, and T is time.

• Newton's Second Law of Motion:

• Sir Isaac Newton established that the force (F) acting on an object is equal to the rate of change of its momentum over time (t).

• This relationship is mathematically represented as F = dp/dt. If the mass remains constant, this simplifies to F = ma (force equals mass times acceleration).

• Law of Conservation of Momentum:

• This fundamental principle states that in an isolated system where no external forces are acting, the total linear momentum of the system remains constant (conserved).

• This law is crucial in analyzing collisions and explosions, such as the recoil of a gun when a bullet is fired.

• Impulse:

• Impulse is the change in momentum of an object when a force acts upon it for an interval of time.

• It is also a vector quantity and is measured in Newton-seconds (N·s), which is equivalent to kg·m/s.

• Relativistic Momentum:

• At speeds approaching the speed of light (c), the classical formula for momentum (p=mv) is modified according to Einstein's Theory of Relativity to account for Lorentz factor adjustments.

Q9. Answer: (d) remains the same

The correct answer is remains the same.

Key Points

• The relationship between wave speed (v), frequency (f), and wavelength (λ) is given by the wave equation: v = f × λ. This formula indicates that the speed of a wave is the product of its frequency and its wavelength.

• To find the frequency, the equation can be rearranged as f = v / λ. This shows that frequency is directly proportional to the wave speed and inversely proportional to the wavelength.

• In the given problem, the speed of the wave becomes three times its original value (3v), and the wavelength also becomes three times its original value (3λ).

• Substituting these new values into the frequency formula: New Frequency (f') = (3v) / (3λ). The numerical factor of 3 in the numerator and denominator cancels out, resulting in f' = v / λ.

• Since the new frequency f' is equal to the original frequency f, the frequency remains the same. Hence, the correct answer is remains the same.

Additional Information

• Wave Speed (v):

• It is the distance traveled by a wave per unit of time. The SI unit for wave speed is meters per second (m/s).

• The speed of a wave is primarily determined by the properties of the medium through which it travels (e.g., density, elasticity, or temperature).

• Wavelength (λ):

• It is the distance between two consecutive identical points of a wave, such as from crest to crest or trough to trough in a transverse wave.

• The SI unit of wavelength is the meter (m). In a given medium, if the frequency increases, the wavelength must decrease to maintain a constant speed.

• Frequency (f):

• It is the number of waves (or cycles) that pass a fixed point in a given amount of time, usually one second.

• The SI unit of frequency is the Hertz (Hz), named after the physicist Heinrich Hertz. 1 Hz is equal to 1 cycle per second.

• Time Period (T):

• It is the time taken for one complete cycle of the wave to pass a point. It is the reciprocal of frequency, expressed as T = 1 / f.

• The SI unit for the time period is the second (s).

Important Points

• Source Dependency: The frequency of a wave is determined solely by the source of the vibration. Once a wave is generated, its frequency does not change even if it moves into a different medium.

• Medium Dependency: When a wave enters a different medium (e.g., light traveling from air into glass), its speed and wavelength change, but its frequency remains constant.

• Electromagnetic Waves: For electromagnetic waves in a vacuum, the speed is a constant denoted by c (approximately 3 × 10^8 m/s). In this case, c = fλ, meaning frequency and wavelength are always perfectly inversely proportional.

• Sound Waves: In sound, frequency is perceived as pitch. A high-frequency sound has a high pitch, while a low-frequency sound has a low pitch.

Q10. Answer: (c) Measuring electrical resistance of a wire

The correct answer is Measuring electrical resistance of a wire.

Key Points

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

• Calculating Buoyant Force: This is the most direct application of the principle. By determining the volume of the displaced fluid and multiplying it by the density of the fluid and the acceleration due to gravity, the magnitude of the buoyant force acting on any object (floating or submerged) can be found. Hence, statement 1 is an application of the principle.

• Determining Density of Irregular Solids: Archimedes' principle is used to find the volume of an irregularly shaped object by measuring the volume of fluid it displaces when submerged. Once the volume is known, the density of the solid can be calculated by dividing its mass by that volume. Hence, statement 2 is an application of the principle.

• Submarines and Floating: Submarines utilize this principle to dive and surface. They have ballast tanks that can be filled with either water (increasing the overall weight/density) or air (decreasing the overall weight/density) to control the buoyancy relative to the surrounding water. Hence, statement 4 is an application of the principle.

• Measuring Electrical Resistance: This process involves Ohm's Law and the physical properties of a conductor, such as its resistivity, length, and cross-sectional area. It is measured using devices like a Wheatstone bridge or a multimeter and has no relation to fluid mechanics or buoyancy. Hence, statement 3 is NOT an application of the principle.

Additional Information

• Lactometers: These are specialized instruments used to determine the purity of milk. They operate on Archimedes' principle by measuring the density of the milk sample to detect the presence of added water.

• Hydrometers: These devices are used to measure the relative density or specific gravity of liquids. A hydrometer sinks deeper in a liquid of lower density and less in a liquid of higher density, following the laws of buoyancy.

• Ship Designing: Ships are designed with large hollow structures to ensure they displace a weight of water equal to or greater than their own mass. This allows heavy metal ships to remain afloat on the surface of the ocean.

• Hot Air Balloons: The principle also applies to gases. A hot air balloon rises because the hot air inside the envelope is less dense than the surrounding cool air, creating a buoyant force greater than the balloon's weight.

Important Points

• Historical Context: The principle was discovered by Archimedes of Syracuse in the 3rd century BC. According to legend, he discovered it while stepping into a bathtub and realized the water level rose as he entered.

• Buoyancy Formula: The buoyant force (Fb) can be expressed as Fb = V x rho x g, where V is the volume of displaced fluid, rho is the density of the fluid, and g is the acceleration due to gravity (approximately 9.8 m/s²).

• Apparent Weight: When an object is submerged, it appears to weigh less. This apparent weight is equal to the actual weight in

air minus the buoyant force provided by the fluid.

• Criterion for Sinking: An object will sink if its average density is greater than the density of the fluid. It will float if its average density is less than that of the fluid.

Q11. Answer: (b) Connect the ammeter in series with correct polarity

The correct answer is Connect the ammeter in series with correct polarity.

Key Points

• An ammeter is a measuring instrument used to measure the electric current in a circuit. To measure the current passing through a component like a bulb, the ammeter must be connected in series so that the entire current of the circuit flows through it.

• The polarity of the ammeter is a critical precaution; the positive terminal (usually marked red or with a plus sign) must be connected to the wire coming from the positive terminal of the battery, and the negative terminal (usually black) should be directed towards the negative terminal. Hence, statement 2 is correct.

• Connecting an ammeter without a battery or power source is futile because there is no Electromotive Force (EMF) to drive the flow of electrons, resulting in a zero reading. Hence, statement 1 is incorrect.

• If an ammeter is connected with reversed polarity, the pointer in an analog meter will try to move in the opposite direction (below zero), which can cause mechanical damage to the needle or provide a negative reading on a digital multimeter. Hence, statement 3 is incorrect.

• Connecting an ammeter in parallel with a load (like a bulb) is dangerous because ammeters have very low internal resistance. A parallel connection creates a short circuit, allowing a massive amount of current to flow through the ammeter, which can burn the coil or blow the internal fuse. Hence, statement 4 is incorrect.

Additional Information

• Ideal Ammeter Characteristics:

• An ideal ammeter is defined as having zero resistance. This ensures that its inclusion in the circuit does not alter the total resistance and, consequently, does not change the current it is intended to measure.

• In practice, real ammeters have a very small but non-zero resistance, which causes a negligible voltage drop across them.

• Galvanometer to Ammeter Conversion:

• An ammeter is typically constructed by connecting a low resistance wire, known as a Shunt, in parallel with a sensitive Galvanometer.

• The shunt resistance allows the majority of the current to bypass the delicate galvanometer coil, enabling the measurement of large currents without damaging the instrument.

• Units and History:

• The unit of electric current is the Ampere (A), which is one of the seven SI base units. It is defined as the flow of one Coulomb of charge per second.

• The instrument is named after the French physicist André-Marie Ampère, who made significant contributions to the study of electromagnetism in the 1820s.

• Comparison with Voltmeter:

• Unlike an ammeter, a voltmeter is used to measure potential difference and is always connected in parallel.

• A voltmeter possesses high resistance to ensure it draws minimal current from the main circuit, whereas an ammeter requires low resistance to allow maximum current through it.

Important Points

• Safety Protocols: Before turning on the power, always verify the range of the ammeter. If the current exceeds the maximum scale deflection, the device may be permanently damaged.

• Types of Ammeters: Modern science uses various types, including Moving Coil Ammeters (for DC), Moving Iron Ammeters (for both AC and DC), and Digital Ammeters which use analog-to-digital converters (ADC) for high precision.

• Circuit symbols: In a standard circuit diagram, an ammeter is represented by a circle with the letter 'A' inside it, placed in the path of the current flow.

Q12. Answer: (d) at the centre of curvature itself, real and of the same size

The correct answer is at the centre of curvature itself, real and of the same size.

Key Points

• When an object is placed at the centre of curvature (C) of a concave mirror, the image is formed at the centre of curvature (C) itself.

• The nature of the image formed in this specific position is real and inverted.

• The size of the image is exactly the same as the size of the object, meaning the linear magnification (m) is -1. Hence, statement 4 is correct.

• To understand this formation, consider two rays: one ray parallel to the principal axis passes through the Focus (F) after

reflection, and another ray passing through the Focus (F) becomes parallel to the principal axis after reflection. Both rays meet at point C.

• If the object is placed between the focus (F) and the pole (P), the image is formed behind the mirror and is virtual, erect, and magnified. Hence, statement 1 is incorrect.

• If the object is placed at infinity, the image is formed at the focus (F) and is real, inverted, and highly diminished (point-sized). Hence, statement 3 is incorrect.

• If the object is placed at the focus (F), the image is formed at infinity and is real, inverted, and highly magnified. Hence, statement 2 is incorrect.

Additional Information

• Concave Mirror: It is a spherical mirror whose reflecting surface is curved inwards (towards the center of the sphere). It is also known as a converging mirror because it converges light rays at a single point.

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

• Magnification (m): It is the ratio of the height of the image (h') to the height of the object (h), expressed as m = h'/h = -v/u. A negative sign indicates a real image, while a positive sign indicates a virtual image.

• Uses of Concave Mirrors: They are widely used in shaving mirrors and makeup mirrors to see a larger image, by dentists to see large images of teeth, and in solar furnaces to concentrate sunlight.

• Sign Convention: According to the New Cartesian Sign Convention, the focal length of a concave mirror is always negative, and the object distance (u) is always negative.

Important Points

• Radius of Curvature (R): The distance from the pole (P) to the centre of curvature (C). For spherical mirrors with small apertures, the Radius of Curvature is twice the focal length, mathematically represented as R = 2f.

• Principal Focus (F): For a concave mirror, it is the point on the principal axis where all rays parallel to the axis actually converge after reflection.

• Aperture: The diameter of the reflecting surface of the spherical mirror is called its aperture.

• Comparison with Convex Mirror: Unlike concave mirrors, a convex mirror always forms a virtual, erect, and diminished image regardless of the object's position.

Q13. Answer: (b) Mass remains unchanged in reactions

The correct answer is Mass remains unchanged in reactions.

Key Points

• The Law of Conservation of Mass states that in an isolated system, mass is neither created nor destroyed by chemical reactions or physical transformations.

• According to the law, the mass of the products in a chemical reaction must equal the mass of the reactants. This means that the total number of atoms of each element is preserved throughout the process.

• The law was established by Antoine Lavoisier in 1789, marking a significant transition from qualitative to quantitative chemistry.

• Statement (1) suggests that the mass of reactants is always lost. This contradicts the principle that matter is conserved and not destroyed. Hence, statement 1 is incorrect.

• Statement (2) asserts that mass remains unchanged during reactions. This is the fundamental definition of the law, where the total mass remains constant before and after the reaction. Hence, statement 2 is correct.

• Statement (3) mentions that energy can be converted into mass. While true in relativistic physics and nuclear reactions, it does not define the classical Law of Conservation of Mass used in standard chemistry. Hence, statement 3 is incorrect.

• Statement (4) claims that the mass of products is always greater. This is impossible under the law as no new matter can be created from nothing. Hence, statement 4 is incorrect.

Additional Information

• Antoine Lavoisier: Known as the Father of Modern Chemistry, he used meticulous experimental methods and precision balances to prove that mass does not change during combustion or other reactions.

• Stoichiometry: The Law of Conservation of Mass is the foundation for balancing chemical equations. Since atoms are only rearranged and not lost, the coefficients in an equation must ensure the same number of atoms on both sides.

• Isolated vs. Open Systems: In an open system, mass might appear to change (e.g., a burning log losing mass as carbon dioxide and water vapor escape), but in a closed container, the total mass remains perfectly constant.

• Chemical vs. Physical Change: The law applies to both. For example, when 10 grams of ice melts into liquid water, the resulting mass is exactly 10 grams.

• Historical Context: Before 1789, many scientists believed in the Phlogiston theory, which argued that a substance called phlogiston was released during burning, explaining the apparent loss of weight in some substances.

Important Points

• Mass-Energy Equivalence: In modern physics, Albert Einstein expanded this concept with the formula $E=mc^2$, showing that mass and energy are interchangeable. However, in ordinary chemical reactions, the amount of mass converted to energy is so minuscule that it cannot be detected by standard instruments.

• Application: This law is crucial for industrial chemistry, environmental science, and pharmacology to calculate the exact yield of products from specific amounts of raw materials.

• Year of Discovery: The formal publication of this law occurred in 1789 in Lavoisier's textbook, "Traité Élémentaire de Chimie".

Q14. Answer: (b) Cu

The correct answer is Cu.

Key Points

• The provided chemical equation is CuO + H2 -> Cu + H2O, which represents a classic Redox (Reduction-Oxidation) reaction occurring under Heat.

• Reduction is defined as the process of loss of oxygen from a substance or the gain of electrons by a species.

• In this reaction, Copper(II) oxide (CuO) reacts with Hydrogen (H2). The CuO loses its oxygen atom to form metallic Copper (Cu). Hence, the species being reduced is Cu (specifically the Copper ion in CuO).

• Alternatively, considering Oxidation States, the oxidation number of Copper in CuO is +2, while in its elemental form Cu, it is 0. A decrease in oxidation state from +2 to 0 confirms that reduction has taken place.

• The species H2 gains oxygen to form H2O, which means Hydrogen is undergoing Oxidation. Hence, statement 1 is incorrect.

• Since Cu is the final state of the reduced species and represents the element that underwent the change, it is identified as the species reduced in the context of the options provided. Hence, the correct answer is Cu.

Additional Information

• Oxidizing Agent: This is the substance that provides oxygen or removes electrons from another substance. In this reaction, CuO acts as the oxidizing agent because it oxidizes H2 to H2O.

• Reducing Agent: This is the substance that removes oxygen or provides electrons. Here, H2 acts as the reducing agent as it removes oxygen from CuO.

• Visual Observation: During this experiment, the black colored Copper(II) oxide powder changes into a reddish-brown solid, which is metallic Copper.

• Reaction Type: This is a displacement reaction as well as a redox reaction. Hydrogen is more reactive than Copper under these thermal conditions and displaces it from its oxide.

• Water Formation: The Hydrogen gas acts as a fuel and a reductant, resulting in the formation of water vapor (H2O) as a byproduct of the oxidation process.

Important Points

• Electronic Concept of Reduction: In modern chemistry, reduction is also viewed as the gain of electrons (OIL RIG: Oxidation Is Loss, Reduction Is Gain). The Cu2+ ion gains 2 electrons to become Cu atom.

• Oxidation State Rules: The oxidation state of oxygen is generally -2 in most compounds like CuO and H2O. Therefore, the oxygen itself does not undergo a change in oxidation state in this specific reaction.

• Thermodynamics: The reaction requires Heat because it is endothermic initially to break the Cu-O bonds, though the overall process facilitates the transfer of oxygen to the more stable H-O bond in water.

Q15. Answer: (b) The optical centre of the lens

The correct answer is The optical centre of the lens.

Key Points

• For spherical lenses, we follow a set of sign conventions called the New Cartesian Sign Convention to measure distances.

• According to this convention, the optical centre (denoted by O) of the lens is taken as the origin of the coordinate system.

• The principal axis of the lens is taken as the X-axis (horizontal axis) of the coordinate system.

• All distances are measured from the optical centre of the lens. Distances measured in the direction of incident light (usually to the right of the optical centre) are taken as positive.

• Distances measured in the direction opposite to that of the incident light (usually to the left of the optical centre) are taken as negative.

Additional Information

• Object Distance (u):

• The object is always placed to the left of the lens.

• Since it is measured against the direction of incident light, the object distance (u) is always negative in both convex and concave lenses.

• Image Distance (v):

• For a real image, which is formed on the right side of the lens, the image distance v is positive.

• For a virtual image, which is formed on the left side (the same side as the object), the image distance v is negative.

• Focal Length (f):

• A convex lens (converging lens) has a positive focal length because its principal focus lies on the right side.

• A concave lens (diverging lens) has a negative focal length because its principal focus is considered to be on the left side.

• Height of Object and Image (h and h'):

• Distances measured perpendicularly above the principal axis are taken as positive. Thus, the object height (h) is usually positive.

• Distances measured perpendicularly below the principal axis are taken as negative. Therefore, the height of a real and inverted image is negative, while a virtual and erect image is positive.

Important Points

• Lens Formula: The relationship between the object distance (u), image distance (v), and focal length (f) is given by the formula: 1/v - 1/u = 1/f. This formula is valid for all spherical lenses in all situations.

• Magnification (m): The linear magnification produced by a lens is the ratio of the height of the image to the height of the object. It is expressed as m = h'/h. It is also related to distances as m = v/u.

• Power of a Lens (P): The power of a lens is defined as the reciprocal of its focal length in metres (P = 1/f). The SI unit of power is Dioptre (D). A convex lens has positive power, and a concave lens has negative power.

• Comparison with Mirrors: Unlike lenses where measurements start from the optical centre, in spherical mirrors, all measurements are taken from the pole of the mirror.

Q16. Answer: (a) Complex permanent tissues are made up of different types of cells performing different tasks.

The correct answer is Complex permanent tissues are made up of different types of cells performing different tasks.

Key Points

• Complex permanent tissues are defined as plant tissues composed of more than one type of cell that work together as a unit. In these tissues, different cells carry out distinct sub-functions to achieve a collective goal. Hence, statement 1 is correct.

• While the cells in complex tissues coordinate to perform a unified function (like conduction), the individual cell types within the tissue have specialized structures and perform different tasks. For example, some provide support while others transport fluids. Hence, statement 2 is incorrect.

• Complex permanent tissues are not "made of" simple permanent tissues; rather, they are a distinct category of permanent tissues that develop through differentiation from meristematic tissues. They may, however, contain certain types of simple cells like parenchyma as constituent elements. Hence, statement 3 is incorrect.

• Simple permanent tissues (like parenchyma, collenchyma, and sclerenchyma) are made up of similar types of cells, whereas complex permanent tissues are heterogeneous. Hence, statement 4 is incorrect.

• The most prominent examples of complex permanent tissues are Xylem and Phloem, which are together referred to as Vascular Tissues or Conducting Tissues.

Additional Information

• Xylem:

• It is the chief water-conducting tissue of plants, facilitating the unidirectional transport of water and dissolved minerals from the roots to the aerial parts.

• It consists of four main elements: Tracheids, Vessels, Xylem Parenchyma, and Xylem Fibers.

• In Angiosperms, both tracheids and vessels are the primary water-conducting elements, whereas Gymnosperms generally lack vessels.

• Phloem:

• It is responsible for the translocation of organic food (sucrose) manufactured in the leaves to various storage organs and growing regions.

• The transport in phloem is bidirectional (multi-directional), moving from source to sink.

• It consists of Sieve tubes, Companion cells, Phloem Parenchyma, and Phloem Fibers.

• Tissue Differentiation:

• Permanent tissues are formed when the cells produced by apical, lateral, or intercalary meristems stop dividing and take on a permanent shape and function.

• This process is vital for the structural integrity and physiological efficiency of higher plants.

Important Points

• Cell Vitality: In the Xylem, only Xylem Parenchyma is a living cell, while the others are dead at maturity. Conversely, in the Phloem, only Phloem Fibers (bast fibers) are dead cells, while sieve tubes and companion cells are living.

• Lignification: The walls of vessels and tracheids are heavily lignified (thickened with lignin), which provides significant mechanical strength to the plant body, allowing it to stand upright.

• Vascular Bundles: In the stems and roots of plants, xylem and phloem are organized into vascular bundles. Their arrangement

varies between Dicotyledons (where they are often arranged in a ring) and Monocotyledons (where they are scattered).

• Companion Cells: These are specialized parenchymatous cells closely associated with sieve tube elements. They help maintain the pressure gradient required for the movement of sugars within the phloem.

Q17. Answer: (d) They are genetically identical to the parent plant.

The correct answer is They are genetically identical to the parent plant.

Key Points

• Vegetative propagation is a type of asexual reproduction where new plants are produced from vegetative parts of the parent plant, such as roots, stems, and leaves.

• Since only one parent is involved and there is no fusion of gametes, the offspring produced are genetically identical to the parent plant. These identical individuals are often referred to as clones. Hence, statement 4 is correct.

• In this process, the cells divide through mitosis rather than meiosis. Because meiosis and genetic recombination do not occur, there is no genetic diversity among the offspring. Hence, statement 1 is incorrect.

• Vegetative propagation does not involve pollen or ovules, meaning it does not require fertilization to develop new individuals. Hence, statement 3 is incorrect.

• Plants produced through this method generally grow faster and reach maturity earlier than those grown from seeds, as they bypass the delicate seedling stage. Hence, statement 2 is incorrect.

Additional Information

• Natural Methods of Vegetative Propagation:

• Runners (Stolons): Horizontal stems that grow above the ground, such as in Strawberries.

• Rhizomes: Underground stems that grow horizontally and store food, found in Ginger and Turmeric.

• Tubers: Swollen ends of underground branches that store starch, such as the Potato (which has "eyes" that act as buds).

• Bulbs: Short underground stems surrounded by fleshy leaves, as seen in Onions and Garlic.

• Leaves: Some plants like Bryophyllum produce adventitious buds along their leaf margins that drop off to form new plants.

• Artificial Methods (Horticulture):

• Cutting: A part of the stem or root is placed in the soil to grow into a new plant (e.g., Roses, Sugarcane).

• Grafting: Joining parts from two different plants (the scion and the stock) so they grow as one. This is common in Mango and Citrus fruits.

• Layering: A branch is bent to the ground and covered with soil until roots develop (e.g., Jasmine).

• Tissue Culture (Micropropagation): Growing whole plants from small explants (cells or tissues) in a sterile nutrient medium under laboratory conditions.

Important Points

• Advantages:

• It allows for the preservation of desirable traits (quality, taste, size) across generations.

• It is the only way to propagate plants that do not produce viable seeds, such as Bananas, Seedless Grapes, and Oranges.

• The survival rate is higher because the new plant receives sustenance from the parent plant during its initial growth.

• Disadvantages:

• Since offspring are genetically identical, they are all equally susceptible to the same diseases or pests.

• Lack of genetic variation hinders the evolutionary adaptation of the species to changing environmental conditions.

• Overcrowding often occurs near the parent plant due to the lack of a natural dispersal mechanism (unlike seeds).

Q18. Answer: (a) When the force acts opposite to the direction of displacement

The correct answer is When the force acts opposite to the direction of displacement.

Key Points

• In physics, work done is defined as the product of the component of the force in the direction of the displacement and the magnitude of this displacement. Mathematically, it is expressed as $W = Fs \cos(\theta)$, where θ is the angle between the force vector and the displacement vector.

• Negative work occurs when the force acts in the opposite direction to the displacement. In this case, the angle θ between the force and displacement is 180 degrees. Since $\cos(180°) = -1$, the work done becomes $W = -Fs$. Hence, statement 1 is correct.

• Positive work occurs when the force acts in the same direction as the displacement. Here, the angle θ is 0 degrees, and since $\cos(0°) = 1$, the work done is $W = Fs$. This happens when you push an object and it moves in the direction of the push. Hence, statement 2 is incorrect.

• Zero work is done when the force applied is zero. If no force is exerted on an object, no energy is transferred via mechanical means, regardless of the motion. Hence, statement 3 is incorrect.

• Work done is also zero when there is no displacement ($s = 0$), even if a massive force is applied. For example, pushing against a

stationary wall results in zero work because the wall does not move. Hence, statement 4 is incorrect.

Additional Information

• Nature of Work: Work is a scalar quantity, meaning it has magnitude but no direction, even though it is derived from two vector quantities (force and displacement). The SI unit of work is the Joule (J), which is equivalent to 1 Newton-meter (N·m).

• The Work-Energy Theorem: This theorem states that the net work done on an object is equal to the change in its kinetic energy. When negative work is done (such as by friction), the object's kinetic energy decreases, causing it to slow down.

• Examples of Negative Work:

• Frictional Force: When a block slides on a floor, the force of friction acts opposite to the direction of motion, doing negative work and dissipating energy as heat.

• Gravitational Force: When an object is thrown upward, the displacement is up, but gravity pulls downward. Thus, gravity does negative work until the object reaches its peak.

• Air Resistance: A parachute falling through the air experiences upward drag while moving downward, resulting in negative work by the air.

Important Points

• Perpendicular Force: If the force is perpendicular to the displacement (angle θ = 90 degrees), the work done is zero because cos(90°) = 0. A classic example is a coolie carrying a load on his head and walking on a horizontal platform; the force (gravity/normal) is vertical, while displacement is horizontal.

• Centripetal Force: In uniform circular motion, the centripetal force acts toward the center of the circle, while the displacement is tangential (at 90 degrees). Therefore, the work done by centripetal force is always zero.

• Dimensions: The dimensional formula for work is [M1 L2 T-2], which is the same as the dimensions for energy and torque.

• Sign Significance: The positive sign indicates energy is transferred to the object, while a negative sign indicates energy is removed from the object or transferred to the surroundings.

Q19. Answer: (c) On increasing the number of turns per unit length in a solenoid, the strength of the magnetic field in the...

The correct answer is On increasing the number of turns per unit length in a solenoid, the strength of the magnetic field in the solenoid increases.

Key Points

• A solenoid is a long coil containing a large number of close turns of insulated copper wire. When an electric current passes through it, it behaves like a magnet.

• The magnetic field strength (B) inside a long solenoid is given by the formula B = μ0 n I, where μ0 is the permeability of free space, n is the number of turns per unit length, and I is the current.

• On increasing the number of turns per unit length (n) in a solenoid, the strength of the magnetic field produced inside it increases proportionally. Hence, statement 3 is correct.

• According to Ohm's Law, current is inversely proportional to resistance (I = V/R). If the resistance of the wire increases, the current (I) decreases, which in turn decreases the magnetic field strength. Hence, statement 1 is incorrect.

• The magnetic field inside a solenoid is directly proportional to the strength of the current flowing through it. If the current increases, the field strength increases. Hence, statement 2 is incorrect.

• The magnetic field lines inside a solenoid are parallel straight lines, indicating that the magnetic field is uniform at all points inside the solenoid. They are not circular inside; they form a pattern similar to that of a bar magnet. Hence, statement 4 is incorrect.

Additional Information

• Structure and Field: A solenoid consists of a cylindrical shape where the wire is wound closely. The field lines outside the solenoid are similar to those of a bar magnet, emerging from the North pole and entering the South pole.

• Uniformity: The fact that field lines are parallel straight lines inside the solenoid is a crucial feature, as it allows for the creation of a constant magnetic field in a specific region, which is essential for many scientific experiments and industrial applications.

• Electromagnets: A strong magnetic field produced inside a solenoid can be used to magnetize a piece of magnetic material, like soft iron, when placed inside the coil. The combination of the coil and the soft iron core is called an electromagnet.

• Polarity: One end of the solenoid acts as a magnetic North pole, while the other behaves as a magnetic South pole. The polarity can be determined using the Clock Rule or the Right-Hand Thumb Rule. If the current flows in a clockwise direction at an end, that end is the South pole.

Important Points

• Factors affecting Magnetic Field:

• Current (I): Directly proportional. Doubling the current doubles the field.

• Number of Turns (N): Directly proportional. More turns result in a stronger field because the field of each turn adds up.

• Core Material: Using a soft iron core can increase the magnetic field strength by thousands of times compared to an air core.

• Permeability (μ0): The constant μ0 (permeability of free space) has a value of approximately 4π × 10^-^7 T·m/A. This value changes if a material other than air/vacuum is used as the core.

• Comparison: Unlike a permanent bar magnet, the strength of the magnetic field in a solenoid can be controlled by changing the current or the number of turns, and its polarity can be reversed by changing the direction of the current.

Q20. Answer: (a) Landfilling plastics in soil

The correct answer is Landfilling plastics in soil.

Key Points

• Landfilling plastics in soil: Plastics are non-biodegradable synthetic materials. When they are buried in landfills, they do not decompose for hundreds of years. Instead, they lead to soil degradation, interfere with the natural flow of groundwater, and can leach harmful chemicals like phthalates and bisphenol A (BPA) into the environment. Hence, this method will NOT help in the management of waste and is the correct answer.

• Treating wastes before release: This involves processes like Effluent Treatment for industrial waste and Sewage Treatment for domestic waste. By removing toxic chemicals, pathogens, and heavy metals before releasing waste into water bodies or soil, we prevent pollution and protect ecosystems. Hence, this statement describes a helpful waste management method.

• Vermicomposting: This is a biological process that utilizes certain species of earthworms, such as Red Wigglers (Eisenia fetida), to decompose organic waste into nutrient-rich manure. It effectively manages kitchen and garden waste while producing high-quality organic fertilizer. Hence, this statement describes a helpful waste management method.

• Following 3R's (Reduce, Reuse, Recycle): This is a globally recognized strategy for Waste Hierarchy. Reducing consumption limits waste generation; Reusing items extends their lifespan; and Recycling processes waste into new raw materials, saving energy and natural resources. Hence, this statement describes a helpful waste management method.

Additional Information

• Plastic Waste Management in India: The Government of India notified the Plastic Waste Management Rules, 2016, which were later amended in 2021 and 2022. These rules include a ban on identified Single-Use Plastic (SUP) items with effect from July 1, 2022, and mandate Extended Producer Responsibility (EPR) for producers and brand owners to ensure the collection and recycling of plastic packaging.

• Classification of Waste:

• Biodegradable Waste: Waste that can be broken down into simpler substances by microorganisms (e.g., peels, paper, wood).

• Non-biodegradable Waste: Waste that cannot be degraded by natural agents (e.g., glass, plastic, metal cans, radioactive waste).

• Sanitary Landfills: Unlike open dumping, a Sanitary Landfill is a scientifically designed facility where waste is deposited in layers, compacted, and covered with soil. It includes systems for Leachate Collection and Methane Extraction to minimize environmental hazards.

• Incineration: This is the process of combusting waste at high temperatures (typically above 850°C) to reduce its volume and convert it into ash, flue gas, and heat. It is commonly used for medical waste and hazardous waste management.

• Waste-to-Energy (WtE): This refers to various technologies that treat non-recyclable waste to generate electricity or heat, thereby reducing the dependency on fossil fuels and minimizing landfill space.

Important Points

• Swachh Bharat Mission (SBM): Launched on October 2, 2014, this national campaign aims to achieve Universal Sanitation Coverage and scientific processing of Solid Waste Management across Urban and Rural India.

• Electronic Waste (E-waste): Rapid urbanization has led to an increase in E-waste, which contains toxic components like Mercury, Lead, and Cadmium. The E-Waste (Management) Rules, 2022 regulate the recycling and disposal of these products to prevent health hazards.

• Global Statistics: According to the World Bank, global waste generation is expected to increase to 3.40 billion tonnes by 2050 if sustainable Circular Economy models are not adopted.

Q21. Answer: (a) First letter uppercase, second lowercase (in case of two letters)

The correct answer is First letter uppercase, second lowercase (in case of two letters).

Key Points

• The International Union of Pure and Applied Chemistry (IUPAC) is the global authority that approves the names of elements and their symbols.

• According to IUPAC nomenclature rules, the symbol of an element is either one or two letters of its name in English or Latin.

• The first letter of a symbol is always written as a capital letter (uppercase) and the second letter is always written as a small letter (lowercase). Hence, the rule stated in option 1 is correct.

• For example, the symbol for Hydrogen is H (single letter, uppercase).

• For elements with two letters, such as Helium, the symbol is He (not HE), and for Aluminum, it is Al (not AL). Similarly, Cobalt is represented as Co.

• If both letters were uppercase, it might lead to confusion with chemical compounds; for instance, Co represents the element

Cobalt, whereas CO represents the compound Carbon Monoxide. Hence, statement 2 is incorrect.

• Symbols are never written in numeric codes for standard identification, although atomic numbers are used to organize them in the Periodic Table. Hence, statement 3 is incorrect.

• Using two lowercase letters is against the standard convention as the first letter must distinguish the start of a new element symbol in a formula. Hence, statement 4 is incorrect.

Additional Information

• Origin of Symbols:

• Many symbols are derived from the first letter or the first two letters of the element's English name. Examples include Carbon (C), Oxygen (O), and Neon (Ne).

• Some symbols are derived from Latin, Greek, or German names. For instance, the symbol for Iron is Fe from its Latin name Ferrum; Sodium is Na from Natrium; and Potassium is K from Kalium.

• Other examples of Latin-derived symbols include Copper (Cu from Cuprum), Gold (Au from Aurum), and Silver (Ag from Argentum).

• Historical Context:

• Dalton was the first scientist to use symbols for elements in a specific quantitative sense, using circles with distinct markings.

• Berzelius suggested the modern system where symbols are made from one or two letters of the name of the element, which was later standardized by IUPAC.

• IUPAC (International Union of Pure and Applied Chemistry):

• Founded in 1919, it is an international federation of National Adhering Organizations that represents chemists in individual countries.

• It is best known for its work in standardizing nomenclature in chemistry, ensuring that every element and compound has a unique and universally accepted name.

• For newly discovered heavy elements (atomic number > 100), IUPAC initially assigns systematic three-letter temporary symbols (like Uuo for Ununoctium, now Oganesson - Og) until a permanent name is officially adopted.

Q22. Answer: (a) Circulatory system

The correct answer is Circulatory system.

Key Points

• The circulatory system, also known as the cardiovascular system, is the primary transport system in animals, responsible for moving nutrients, gases, and waste products throughout the body.

• It consists of three main components: the heart (a muscular pumping organ), blood (the transport medium), and blood vessels (the network of tubes).

• The primary function of this system is to deliver oxygen from the respiratory organs to the tissues and to transport carbon dioxide back for elimination.

• It also plays a crucial role in distributing hormones secreted by endocrine glands to their specific target organs and maintaining homeostasis by regulating body temperature and pH levels.

• In multicellular organisms, simple diffusion is insufficient for the transport of materials; hence, a dedicated circulatory system is essential for survival. Hence, the correct answer is Circulatory system.

Additional Information

• Respiratory System:

• This system is primarily responsible for the exchange of gases between the body and the external environment.

• In humans, it includes the lungs, trachea, and bronchi. While it provides oxygen to the blood, it does not transport it to the rest of the body.

• Muscular System:

• The muscular system is composed of skeletal, smooth, and cardiac muscles.

• Its main function is to facilitate locomotion, maintain posture, and support internal movements like peristalsis in the digestive tract.

• Nervous System:

• This system acts as the body's communication network, consisting of the brain, spinal cord, and nerves.

• It processes sensory information and coordinates voluntary and involuntary actions through electrical impulses.

• Types of Circulation:

• Open Circulatory System: Found in arthropods (like insects) and most mollusks, where blood (hemolymph) bathes the organs directly in a hemocoel.

• Closed Circulatory System: Found in annelids (like earthworms) and all vertebrates, where blood is confined within a continuous network of vessels.

• Components of Blood:

• Plasma: The liquid component that carries proteins and electrolytes.

• Red Blood Cells (RBCs): Contain hemoglobin to transport oxygen.

• White Blood Cells (WBCs): Part of the immune system to fight infections.

• Platelets: Small cell fragments essential for blood clotting or coagulation.

Q23. Answer: (c) Only a and b

The correct answer is Only a and b.

Key Points

• Benzene is a fundamental organic chemical compound and is categorized as the simplest aromatic hydrocarbon. It consists of six carbon atoms arranged in a planar ring. Hence, statement a is correct.

• In its structural representation (known as the Kekulé structure), Benzene is depicted as having alternating three single bonds and three double bonds between the carbon atoms. In modern chemistry, these are understood as delocalized electrons forming a resonance hybrid, where all bond lengths are equal. Hence, statement b is correct.

• The actual molecular formula of Benzene is C6H6, meaning it has six carbon atoms and six hydrogen atoms. The formula C6H14 provided in the statement actually represents Hexane, which is a saturated alkane. Hence, statement c is incorrect.

• Hence, the correct answer is Only a and b.

Additional Information

• Chemical Properties and Discovery:

• Benzene was first isolated and identified by the English scientist Michael Faraday in the year 1825 from the oily residue derived from the production of illuminating gas.

• The cyclic structure of Benzene was famously proposed by August Kekulé in 1865, who suggested the ring of six carbon atoms with alternating bonds.

• It is a colorless and highly flammable liquid with a characteristic sweet odor. It evaporates quickly when exposed to air.

• Structural Features:

• Each carbon atom in the Benzene ring is sp2 hybridized. This hybridization results in a trigonal planar geometry with bond angles of 120 degrees.

• Due to the delocalization of pi-electrons across the ring, Benzene exhibits exceptional stability, a phenomenon known as aromaticity.

• The C-C bond length in Benzene is 1.39 Angstroms, which is intermediate between a standard single bond (1.54 A) and a double bond (1.34 A).

• Industrial Uses and Safety:

• Benzene is a critical industrial chemical used primarily as a precursor to manufacture more complex chemicals like ethylbenzene, cumene, and cyclohexane.

• It is used in the production of plastics, resins, nylon, synthetic fibers, rubbers, lubricants, and detergents.

• From a safety perspective, Benzene is classified as a Group 1 Carcinogen by the International Agency for Research on Cancer (IARC), as long-term exposure is linked to leukemia.

Important Points

• Reactivity: Unlike alkenes, Benzene does not easily undergo addition reactions (like decolorizing bromine water) because that would destroy its aromatic stability. Instead, it typically undergoes Electrophilic Aromatic Substitution (EAS) reactions.

• Comparison: While Benzene (C6H6) is unsaturated and cyclic, Hexane (C6H14) is a straight-chain saturated hydrocarbon, and Cyclohexane (C6H12) is a cyclic saturated hydrocarbon.

Q24. Answer: (a) Sodium

The correct answer is Sodium.

Key Points

• A pure substance that consists of only one type of atom is defined as a chemical element.

• Sodium is a chemical element represented by the symbol Na (from the Latin 'natrium') and carries the atomic number 11.

• Since Sodium is composed entirely of atoms that have the same number of protons in their nuclei, it meets the criteria of a substance consisting of only one type of atom. Hence, statement 1 is correct.

• It is categorized as an alkali metal and is located in Group 1 of the periodic table.

• Under standard conditions, it is a soft, silvery-white, and highly reactive metal that cannot be broken down into simpler substances by chemical means.

Additional Information

• Air:

• Air is a homogeneous mixture of several different gases rather than a pure substance.

• It primarily consists of Nitrogen (78%), Oxygen (21%), Argon (0.9%), and Carbon Dioxide (0.04%). Because it contains different types of molecules and atoms, it is not an element. Hence, statement 2 is incorrect.

• Water:

• Water (H2O) is a chemical compound made up of two different elements: hydrogen and oxygen.

• Although it is a pure substance in the sense that it has a fixed chemical composition, it consists of two types of atoms bonded together in a 2:1 ratio. Hence, statement 3 is incorrect.

• Milk:

• Milk is a complex heterogeneous mixture, specifically classified as a colloid.

• It contains various substances such as water, fats, proteins (like casein), lactose (sugar), and minerals. Since it is a mixture of many different compounds, it does not consist of only one type of atom. Hence, statement 4 is incorrect.

Important Points

• Reactivity of Sodium: Sodium is extremely reactive, particularly with water and oxygen. To prevent accidental reactions, it is typically stored in mineral oil or kerosene.

• Atomic Structure: Sodium has 11 protons and 11 electrons. Its electron configuration is [Ne] 3s1, meaning it has one valence electron that it easily loses to form a cation (Na+).

• Natural Occurrence: Due to its high reactivity, Sodium is never found as a free element in nature. It occurs abundantly in compounds, the most common being Sodium Chloride (NaCl), which is table salt found in seawater and rock salt deposits.

• Industrial Uses: Sodium compounds are used in the production of glass, paper, soap, and textiles. It is also vital in biological systems for maintaining fluid balance and nerve signal transmission in the human body.

Q25. Answer: (c) It involves making food using carbon dioxide and water in the presence of sunlight.

The correct answer is It involves making food using carbon dioxide and water in the presence of sunlight.

Key Points

• Autotrophic nutrition is a mode of nutrition in which organisms synthesize their own food from simple inorganic substances such as carbon dioxide and water.

• The process primarily utilized by green plants is photosynthesis, which requires the presence of sunlight and the green pigment chlorophyll. Hence, statement 3 is correct.

• Digestion of complex substances outside the body is characteristic of saprotrophic nutrition, common in fungi and certain bacteria. Hence, statement 1 is incorrect.

• Depending on consuming other living organisms for food is known as heterotrophic nutrition, which includes holozoic nutrition found in animals and humans. Hence, statement 2 is incorrect.

• Direct absorption of organic compounds from other organisms is a feature of parasitic nutrition or specific heterotrophic pathways where the organism lives on or inside a host. Hence, statement 4 is incorrect.

• The overall chemical reaction for photosynthesis can be represented as: 6CO2 + 6H2O + Light Energy results in C6H12O6 (Glucose) + 6O2.

Additional Information

• Classification of Autotrophs:

• Photoautotrophs: These organisms use sunlight as their energy source. Examples include green plants, algae, and cyanobacteria.

• Chemoautotrophs: These organisms obtain energy from the oxidation of inorganic chemical compounds like ammonia, nitrites, or sulfur. This is common in certain extremophile bacteria found in deep-sea vents.

• Requirements for Photosynthesis:

• Chlorophyll: A pigment located in the chloroplasts of plant cells that absorbs light energy, specifically in the red and blue wavelengths.

• Carbon Dioxide: Taken from the atmosphere through small pores on leaves called stomata.

• Water: Absorbed from the soil by the roots and transported to the leaves through xylem tissue.

• Energy Storage:

• In autotrophs (plants), the prepared glucose is often converted and stored as starch to serve as an internal energy reserve.

• In heterotrophs (animals), energy is typically stored in the form of glycogen in the liver and muscles.

• Heterotrophic Nutrition Types:

• Holozoic: Organisms take in solid food and break it down inside the body (e.g., humans, amoeba).

• Saprophytic: Organisms feed on dead and decaying organic matter (e.g., mushrooms, bread mould).

• Parasitic: Organisms derive nutrition from a host without killing it immediately (e.g., Cuscuta, ticks, leeches).

Important Points

• The Role of Oxygen: During autotrophic nutrition via photosynthesis, oxygen is released as a byproduct, which is essential for the survival of aerobic organisms on Earth.

• Trophic Levels: Autotrophs are considered producers and form the first trophic level in any food chain or food web, providing the foundational energy for all other consumers.

• Stomata Function: The guard cells regulate the opening and closing of stomata, which controls gas exchange and the rate of transpiration (water loss).

• Photosynthesis Phases: It consists of two stages: the Light-dependent reaction (occurring in the thylakoids) and the Light-independent reaction or Calvin Cycle (occurring in the stroma).

Q26. Answer: (c) 3,185

Shortcut Trick

Given Marked Price (MP) = Rs. 6,370 and Discount% = 50%.

Selling Price (SP) = MP × (100 − Discount%) ÷ 100.

SP = 6,370 × (100 − 50) ÷ 100 = 6,370 × 50 ÷ 100.

SP = 6,370 ÷ 2 = 3,185.

Therefore The correct answer is Rs. 3,185.

Alternate Method

Given: Marked Price = Rs. 6,370, Discount Percentage = 50%.

Formulas: Discount = (Discount% × MP) ÷ 100 | Selling Price (SP) = MP − Discount.

=> Discount Amount = 50% of 6,370

=> Discount = (50 ÷ 100) × 6,370 = 3,185

=> Selling Price = MP − Discount = 6,370 − 3,185

=> Selling Price = 3,185

Therefore The correct answer is Rs. 3,185.

Additional Information

Marked Price & Discount

Marked Price (MP) is the price printed on an item. Discount is always calculated on the MP unless specified otherwise. Formula: SP = MP × (100 − D)%.

50% Discount Rule

A 50% discount implies the customer pays exactly half of the Marked Price. It is equivalent to a 1:1 ratio between the discount and the selling price.

Q27. Answer: (d) 6

Shortcut Trick

Total Capacity (LCM of 15 and 40) = 120 units

Efficiency of P + Q = 120 ÷ 15 = 8 units/hr

Efficiency of P = 120 ÷ 40 = 3 units/hr

Efficiency of Q = 8 − 3 = 5 units/hr

Time for Q to fill 1/4th = (120 × 1/4) ÷ 5 = 30 ÷ 5 = 6 hours

Therefore The correct answer is 6 hours.

Alternate Method

Given: P + Q can fill in 15 hours. P alone can fill in 40 hours.

Formula Used: Total Work = Efficiency × Time | 1/Q = 1/(P+Q) − 1/P

Person	Days	Total Work	Efficiency
P + Q	15	120	8
P	40	3	

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

=> Efficiency of Q = 8 − 3 = 5 units/hr

=> Total capacity of cistern = 120 units

=> One-fourth of the cistern = 120 ÷ 4 = 30 units

=> Time taken by Q = 30 ÷ 5 = 6 hours

Therefore The correct answer is 6 hours.

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Additional Information

Efficiency Concept

Efficiency is inversely proportional to the time taken to complete a work. Total Work = LCM of individual time durations.

Combined Work Formula

If two pipes A and B fill a tank in x and y hours, then together they fill it in (xy) ÷ (x + y) hours.

Pipes and Cisterns

Inlet pipes have positive efficiency while outlet/leakage pipes have negative efficiency.

Q28. Answer: (c) (a + b)(b + c)(c + a)

Shortcut Trick

Use the algebraic identity: if $x + y + z = 0$, then $x^3 + y^3 + z^3 = 3xyz$.

In the numerator, $(a^2 - b^2) + (b^2 - c^2) + (c^2 - a^2) = 0$, so it becomes $3(a^2 - b^2)(b^2 - c^2)(c^2 - a^2)$.

In the denominator, $(a - b) + (b - c) + (c - a) = 0$, so it becomes $3(a - b)(b - c)(c - a)$.

Dividing these gives $[(a-b)(a+b)(b-c)(b+c)(c-a)(c+a)] \div [(a-b)(b-c)(c-a)]$.

Canceling the common terms leaves $(a + b)(b + c)(c + a)$.

Therefore The correct answer is $(a + b)(b + c)(c + a)$.

Alternate Method

Given: $((a^2 - b^2)^3 + (b^2 - c^2)^3 + (c^2 - a^2)^3) \div ((a - b)^3 + (b - c)^3 + (c - a)^3)$

Formula Used: If $x + y + z = 0$, then $x^3 + y^3 + z^3 = 3xyz$; and $x^2 - y^2 = (x - y)(x + y)$.

=> Let $X = a^2 - b^2$, $Y = b^2 - c^2$, and $Z = c^2 - a^2$.

=> $X + Y + Z = a^2 - b^2 + b^2 - c^2 + c^2 - a^2 = 0$.

=> Therefore, Numerator = $3(a^2 - b^2)(b^2 - c^2)(c^2 - a^2)$.

=> Now, let $p = a - b$, $q = b - c$, and $r = c - a$.

=> $p + q + r = a - b + b - c + c - a = 0$.

=> Therefore, Denominator = $3(a - b)(b - c)(c - a)$.

=> Expression = $[3(a^2 - b^2)(b^2 - c^2)(c^2 - a^2)] \div [3(a - b)(b - c)(c - a)]$

=> Expression = $[3(a - b)(a + b)(b - c)(b + c)(c - a)(c + a)] \div [3(a - b)(b - c)(c - a)]$

=> Expression = $(a + b)(b + c)(c + a)$.

Therefore The correct answer is $(a + b)(b + c)(c + a)$.

Additional Information

Conditional Identity

The condition $a + b + c = 0$ implies $a^3 + b^3 + c^3 = 3abc$, which is a specific case of the expansion of $a^3 + b^3 + c^3 - 3abc$.

Sum of Three Cubes Formula

The general identity is $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$.

Difference of Squares

The property $a^2 - b^2 = (a - b)(a + b)$ allows for the factorization and cancellation of terms in complex rational expressions.

Q29. Answer: (a) 40

Shortcut Trick

Solve the brackets using the BODMAS rule directly.

Inner bracket: $(-8 - 20 - 18) = -46$

Square bracket: $[1 \times \{10 + (-2) \times (-3)\}] = [1 \times \{10 + 6\}] = 16$

Remaining expression: $86 - (-16) \times (-46) \div 16$

=> $86 - (736 \div 16) = 86 - 46 = 40$

Therefore The correct answer is 40.

Alternate Method

Given:

Expression: $86 - (-16) \times (-8 - 20 - 18) \div [1 \times \{10 + (-2) \times (-3)\}]$

Method Used:

BODMAS Rule (Brackets, Orders, Division, Multiplication, Addition, Subtraction)

Calculations:

=> $86 - (-16) \times (-8 - 20 - 18) \div [1 \times \{10 + (-2) \times (-3)\}]$

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=> 86 − (−16) × (−46) ÷ [1 × {10 + 6}]

=> 86 − (−16) × (−46) ÷ [1 × 16]

=> 86 − (−16) × (−46) ÷ 16

=> 86 − 736 ÷ 16

=> 86 − 46

=> 40

Therefore The correct answer is 40.

Additional Information

BODMAS Rule

It stands for Bracket, Of, Division, Multiplication, Addition, and Subtraction. Expressions are simplified in this strict sequential order.

Order of Brackets

Always solve brackets in the order: Line bracket (bar), Simple brackets (), Curly brackets {}, and finally Square brackets [].

Sign Multiplication Rules

When multiplying numbers with the same signs, the result is positive (− × − = +). When multiplying numbers with different signs, the result is negative (+ × − = −).

Q30. Answer: (c) 29791

Shortcut Trick

To find 31^3, focus on the unit digit. Since 31 ends in 1, its cube must end in 1 (1 × 1 × 1 = 1).

Check the given options: (1) ends in 9, (2) ends in 8, (3) ends in 1, and (4) ends in 5.

Since only 29791 ends in 1, it is the correct answer.

Therefore The correct answer is 29791 m^3.

Alternate Method

Given: The edge of the cube (a) = 31 m.

Formula Used: Volume of a cube = $Side^3 = a^3$

=> Volume = $(31\ m)^3$

=> Volume = 31 × 31 × 31

=> Volume = 961 × 31

=> Volume = 29791 m^3

Therefore The correct answer is 29791 m^3.

Additional Information

Total Surface Area of Cube

The total surface area is the sum of the areas of all six faces: $TSA = 6a^2$.

Lateral Surface Area of Cube

The area of the four side faces (excluding top and bottom): $LSA = 4a^2$.

Diagonal of a Cube

The longest distance between two opposite corners: $d = a\sqrt{3}$.

Q31. Answer: (c) Rs. 2,04,050

Shortcut Trick

Ratio of Profit = Ratio of Investment (when time is constant).

Sunita : Javed : Rani = 139 : 47 : 154.

Total ratio parts = 139 + 47 + 154 = 340 units.

340 units = Rs. 4,50,500 => 1 unit = 4,50,500 ÷ 340 = Rs. 1,325.

Rani's share (154 units) = 154 × 1,325 = Rs. 2,04,050.

Therefore The correct answer is Rs. 2,04,050.

Alternate Method

Given → Sunita's Investment = Rs. 13,90,000 | Javed's Investment = Rs. 4,70,000 | Rani's Investment = Rs. 15,40,000 | Total Profit = Rs. 4,50,500.

Formulas: Profit Share = (Individual Investment ÷ Total Investment) × Total Profit.

=> Ratio of investments = 13,90,000 : 4,70,000 : 1540,000 = 139 : 47 : 154.

=> Sum of ratios = 139 + 47 + 154 = 340.

=> Rani's share = (Rani's ratio ÷ Total ratio) × Total Profit.

=> Rani's share = (154 ÷ 340) × 4,50,500.

=> Rani's share = 154 × 1,325 = 2,04,050.

Therefore The correct answer is Rs. 2,04,050.

Additional Information

Partnership Concept

When multiple people invest in a business, the profit is distributed in the ratio of (Investment × Time Period).

Simple vs. Compound Partnership

In a simple partnership, all partners invest for the same duration. In a compound partnership, durations differ.

Q32. Answer: (b) 40.57 km/hr

Shortcut Trick

When the distance for both journeys is the same, use the harmonic mean formula.

Average Speed = (2 × S1 × S2) ÷ (S1 + S2)

=> (2 × 131 × 24) ÷ (131 + 24) = 6288 ÷ 155 ≈ 40.57 km/hr

Therefore The correct answer is 40.57 km/hr.

Alternate Method

Given:

Distance (A to B) = 663 km

Speed from A to B (S1) = 131 km/hr

Speed from B to A (S2) = 24 km/hr

Formula Used:

Average Speed = Total Distance ÷ Total Time

Calculations:

=> Total Distance = 663 + 663 = 1326 km

=> Time taken (A to B) = 663 ÷ 131 ≈ 5.061 hours

=> Time taken (B to A) = 663 ÷ 24 = 27.625 hours

=> Total Time = 5.061 + 27.625 = 32.686 hours

=> Average Speed = 1326 ÷ 32.686 ≈ 40.57 km/hr

Therefore The correct answer is 40.57 km/hr.

Additional Information

Average Speed (Different Distances)

If a person covers distances d1, d2, d3 with speeds s1, s2, s3, then Average Speed = (d1 + d2 + d3) ÷ (d1/s1 + d2/s2 + d3/s3).

Relative Speed

When two objects move in opposite directions, relative speed is (u + v). When they move in the same direction, relative speed is |u − v|.

Unit Conversion

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

Q33. Answer: (b) 1333

Shortcut Trick

Larger number = (Sum + Difference) ÷ 2 = (74 + 12) ÷ 2 = 43

Smaller number = (Sum − Difference) ÷ 2 = (74 − 12) ÷ 2 = 31

Product = 43 × 31 = 1333

Therefore The correct answer is 1333.

Alternate Method

Given: Sum of two numbers = 74 and Difference of two numbers = 12.

Formula Used: Product (xy) = $[(x + y)^2 − (x − y)^2] ÷ 4$

=> Let the numbers be x and y.

=> x + y = 74 --- (1)

=> x − y = 12 --- (2)

=> Adding (1) and (2): 2x = 86 => x = 43

=> Substituting x in (1): 43 + y = 74 => y = 31

=> Product = 43 × 31

=> Product = 1333

Therefore The correct answer is 1333.

Additional Information

Algebraic Identity for Product

The relationship between sum, difference, and product is given by: $4xy = (x + y)^2 - (x - y)^2$. This allows finding the product without calculating individual numbers.

Finding Individual Numbers

If S is the sum and D is the difference, then the numbers are (S + D) ÷ 2 and (S − D) ÷ 2.

Sum and Product Relationship

For a quadratic equation $t^2 - (sum)t + (product) = 0$, the roots are the two numbers themselves.

Q34. Answer: (d) 44.5°

Shortcut Trick

For any quadrilateral EFGH, the angle formed by the angle bisectors of two adjacent angles (say, angle G and angle H) meeting at a point X is equal to half the sum of the other two angles (angle E and angle F):

angle HXG = (angle E + angle F) ÷ 2

Given: angle E = 52° and angle F = 37°

=> angle HXG = (52° + 37°) ÷ 2

=> angle HXG = 89° ÷ 2 = 44.5°

Therefore The correct answer is 44.5°.

Alternate Method

Given:

In quadrilateral EFGH:

angle E = 52°

angle F = 37°

The bisectors of angle G and angle H meet at X.

Formula Used:

1. Sum of interior angles of a quadrilateral = 360°

2. Sum of angles of a triangle = 180°

Calculations:

In quadrilateral EFGH:

=> angle E + angle F + angle G + angle H = 360°

=> 52° + 37° + angle G + angle H = 360°

=> 89° + angle G + angle H = 360°

=> angle G + angle H = 360° − 89° = 271°

Since GX and HX are the angle bisectors of angle G and angle H respectively:

=> angle XGH = angle G ÷ 2

=> angle XHG = angle H ÷ 2

In ΔHXG:

=> angle HXG + angle XGH + angle XHG = 180°

=> angle HXG + (angle G ÷ 2) + (angle H ÷ 2) = 180°

=> angle HXG + (angle G + angle H) ÷ 2 = 180°

=> angle HXG + 271° ÷ 2 = 180°

=> angle HXG + 135.5° = 180°

=> angle HXG = 180° − 135.5° = 44.5°

Therefore The correct answer is 44.5°.

Additional Information

Angle Bisector Theorem in Quadrilaterals

The angle formed by the bisectors of two adjacent angles of a quadrilateral is always equal to half the sum of the other two remaining angles.

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Sum of Interior Angles of a Polygon

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

Angle Bisectors of Opposite Angles

If the bisectors of opposite angles of a quadrilateral meet, the angle between them is equal to half the difference of the other two angles.

Q35. Answer: (c) 2,560

Shortcut Trick

Use the direct relationship formula: MP ÷ CP = (100 + Profit%) ÷ (100 − Discount%).

MP ÷ 1,600 = (100 + 20) ÷ (100 − 25) = 120 ÷ 75.

MP = 1,600 × (120 ÷ 75) = 1,600 × (8 ÷ 5).

MP = 320 × 8 = 2,560.

Therefore The correct answer is Rs. 2,560.

Alternate Method

Given: Cost Price (CP) = Rs. 1,600, Profit = 20%, Discount = 25%.

Formulas: SP = CP × (100 + P%) ÷ 100 | MP = (SP × 100) ÷ (100 − D%)

=> Step 1: Calculate Selling Price (SP) = 1,600 × (120 ÷ 100) = Rs. 1,920.

=> Step 2: Marked Price (MP) × (100 − 25) ÷ 100 = 1,920.

=> Step 3: MP × (75 ÷ 100) = 1,920.

=> Step 4: MP = 1,920 × (4 ÷ 3) = 640 × 4 = Rs. 2,560.

Therefore The correct answer is Rs. 2,560.

Additional Information

Marked Price & Discount

The Marked Price (MP) is the price printed on the label. Discount is always calculated on the MP: SP = MP − Discount.

CP-MP Relationship

For problems involving both Profit% and Discount%, the ratio MP/CP = (100 + P%)/(100 − D%) is the most efficient solving method.

Q36. Answer: (d) 20%

Shortcut Trick

Given: Selling Price (SP) of 10 watches = Cost Price (CP) of 8 watches.

Using the ratio method: 10 × SP = 8 × CP.

Ratio of SP/CP = 8/10 = 4/5.

Loss = CP − SP = 5 − 4 = 1 unit.

Loss% = (Loss ÷ CP) × 100 = (1 ÷ 5) × 100 = 20%.

Therefore The correct answer is 20%.

Alternate Method

Given: Total SP of 10 watches = Rs. 10,500. CP of 8 watches = Rs. 10,500.

Formulas: CP of 1 watch = Total CP ÷ Quantity | SP of 1 watch = Total SP ÷ Quantity | Loss% = ((CP − SP) ÷ CP) × 100.

=> Cost Price (CP) of 8 watches = Rs. 10,500.

=> CP of 1 watch = 10,500 ÷ 8 = Rs. 1312.5.

=> Selling Price (SP) of 10 watches = Rs. 10,500.

=> SP of 1 watch = 10,500 ÷ 10 = Rs. 1050.

=> Loss per watch = 1312.5 − 1050 = Rs. 262.5.

=> Loss% = (262.5 ÷ 1312.5) × 100 = 20%.

Therefore The correct answer is 20%.

Additional Information

Loss and CP Relationship

When the SP of 'n' articles equals the CP of 'm' articles, if n > m, there is always a loss. Loss% = ((n − m) ÷ n) × 100.

Percentage Calculation

Loss and Profit percentages are always calculated on the Cost Price (CP) unless stated otherwise in the problem.

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Q37. Answer: (d) 33.33%

Shortcut Trick

Required percentage = (Value ÷ Base Value) × 100

Required percentage = (1/30 ÷ 2/20) × 100

=> (1/30 × 20/2 = 10/1) × 100 = 1/3 × 100

=> 33.33%

Therefore The correct answer is 33.33%.

Alternate Method

Given:

First fraction (Part) = 1/30

Second fraction (Base) = 2/20 = 1/10

Formula Used:

Percentage = (Part ÷ Base) × 100

Calculations:

=> Percentage = ((1/30) / (1/10)) × 100

=> Percentage = (1/30 × 10/1) × 100

=> Percentage = (1/3) × 100

=> Percentage = 33.3333...

=> Percentage ≈ 33.33%

Therefore The correct answer is 33.33%.

Additional Information

Fraction to Percentage

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

Percentage Change

Percentage change = (Difference ÷ Original Value) × 100.

Reciprocal Percentages

1/2 = 50%, 1/3 = 33.33%, 1/4 = 25%, 1/5 = 20%, 1/6 = 16.67%.

Q38. Answer: (a) 53

Shortcut Trick

To find the Mode, identify the observation that repeats most frequently in the given data.

Scanning the dataset: 53 appears 5 times, whereas 40 appears 3 times.

Values 50 and 51 appear only 2 times each, and others appear once.

Since 53 has the highest Frequency, it is the mode.

Therefore The correct answer is 53.

Alternate Method

Given: Data = 53, 53, 40, 49, 50, 48, 53, 50, 41, 40, 53, 45, 40, 47, 43, 52, 51, 42, 51, 53

Formula Used: Mode is the value with the Maximum Frequency in a distribution.

Calculations:

=> Count the frequency of each distinct number in the set:

=> Frequency of 53 = 5

=> Frequency of 40 = 3

=> Frequency of 50 = 2

=> Frequency of 51 = 2

=> Frequency of {40, 41, 42, 43, 45, 47, 48, 49, 52} = 1 each

=> The value with the highest frequency (5) is 53.

Therefore The correct answer is 53.

Additional Information

Mean

The Mean is the average of all observations, calculated as Σx ÷ n.

Median

The Median is the middle value when data is arranged in ascending or descending order. For even n, it is the average of the two

middle terms.

Empirical Relationship

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

Bimodal and Multimodal

If two values have the same maximum frequency, the data is Bimodal. If more than two, it is Multimodal.

Q39. Answer: (a) 12.5 min

Shortcut Trick

Total work (LCM of 25 and 30) = 150 units.

Efficiency of Pipe F = 150 ÷ 25 = 6 units/min; Efficiency of Pipe M = 150 ÷ 30 = 5 units/min.

Pipe M runs for the full 15 minutes: Work by M = 15 × 5 = 75 units.

Remaining work for F = 150 − 75 = 75 units.

Time for pipe F = 75 ÷ 6 = 12.5 minutes.

Therefore The correct answer is 12.5 min.

Alternate Method

Given: Time taken by Pipe F = 25 min, Time taken by Pipe M = 30 min, Total time to fill = 15 min.

Formula Used: Work = Efficiency × Time; Total Work = LCM of individual times.

Person	Days	Total Work	Efficiency
Pipe F	25	150	6
Pipe M	30	5	

=> Let Pipe F be closed after t minutes.

=> Pipe F works for t minutes and Pipe M works for the entire 15 minutes.

=> (Efficiency of F × t) + (Efficiency of M × 15) = Total Work

=> (6 × t) + (5 × 15) = 150

=> 6t + 75 = 150

=> 6t = 75

=> t = 75 ÷ 6 = 12.5 minutes

Therefore The correct answer is 12.5 min.

Additional Information

Pipes and Cisterns Efficiency

Efficiency is inversely proportional to the time taken to fill the tank. If a pipe fills a tank in x hours, its efficiency is 1/x part per hour.

Negative Work (Inlet vs Outlet)

Inlet pipes do positive work (filling), while outlet pipes (leaks) do negative work (emptying). Net work = Σ(Inlet efficiencies) − Σ(Outlet efficiencies).

Combined Work Formula

If two pipes fill a tank in x and y mins respectively, then together they fill it in (x × y) ÷ (x + y) mins.

Q40. Answer: (c) 29.6 m

Shortcut Trick

For an angle of elevation of 45°, the height of the tower is always equal to the distance from the foot.

Since the distance is 29.6 m, the height must also be 29.6 m.

Therefore The correct answer is 29.6 m.

Alternate Method

Given:

Distance from the foot of the tower (BC) = 29.6 m

Angle of elevation (θ) = 45°

Formula Used:

tan θ = Perpendicular / Base = AB / BC

Calculations:

=> tan 45° = Height (h) / 29.6

=> 1 = h / 29.6

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=> h = 29.6 × 1

=> h = 29.6 m

Therefore The correct answer is 29.6 m.

Additional Information

Trigonometric Ratios for 45°

In a right-angled triangle with a 45° angle, the Perpendicular and Base are equal because tan 45° = 1.

Special Right Triangle (45-45-90)

The sides of a 45°−45°−90° triangle are in the ratio 1 : 1 : √2. If height is 'a', the hypotenuse is a√2.

Angle of Elevation

It is the angle formed by the line of sight with the horizontal when looking up at an object.

Q41. Answer: (b) 13

Shortcut Trick

For a number to be divisible by 9, the sum of its digits must be a multiple of 9.

Sum of digits of A6B59 = A + 6 + B + 5 + 9 = 20 + A + B.

Next multiples of 9 after 20 are 27, 36... => A + B = 7 (for sum 27) or 16 (for sum 36).

To minimize (A^2+2B) with A + B = 7, test pairs: (1,6) → 1+12=13; (2,5) → 4+10=14; (3,4) → 9+8=17.

Therefore The correct answer is 13.

Alternate Method

Given: The number A6B59 is divisible by 9. We need to find the least value of (A^2+2B).

Divisibility Rule of 9: Sum of digits is divisible by 9.

=> A + 6 + B + 5 + 9 = 20 + A + B

=> 20 + A + B must be 27, 36, ...

Case 1: A + B = 7 (Since 20 + 7 = 27)

=> Possible (A, B) pairs: (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1), (7, 0). (Note: A cannot be 0 as it is the first digit).

=> If A = 1, B = 6: $1^2 + 2(6) = 1 + 12 = 13$

=> If A = 2, B = 5: $2^2 + 2(5) = 4 + 10 = 14$

=> If A = 3, B = 4: $3^2 + 2(4) = 9 + 8 = 17$

=> If A = 7, B = 0: $7^2 + 2(0) = 49$

Case 2: A + B = 16 (Since 20 + 16 = 36)

=> Min A is 7, B = 9: $7^2 + 2(9) = 49 + 18 = 67$ (Higher than Case 1 values)

=> Comparing all results, the minimum value is 13.

Therefore The correct answer is 13.

Additional Information

Divisibility Rule of 3

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

Divisibility Rule of 11

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

Minimization Logic

To minimize a sum of squares and linear terms like $A^2 + 2B$, generally, the variable with the higher power (A) should be as small as possible.

Q42. Answer: (d) 15 cm

Shortcut Trick

Original Volume = Final Volume ÷ 0.8 = 10,752 ÷ 0.8 = 13,440 cm^3

Volume Formula: 4/3 × 3.14 × R^3 = 13,440

R^3 = 13,440 × 3 ÷ 12.56 ≈ 3210.19

Since $14^3 = 2744$ and $15^3 = 3375$, R ≈ 14.75 cm.

Rounding to the nearest integer, R = 15 cm.

Therefore The correct answer is 15 cm.

Alternate Method

Given:

=> Total volume of 64 small spheres = 10,752 cm³

=> Metal waste percentage = 20%

=> Value of π = 3.14

Formula Used:

=> Volume of a sphere = 4/3 × π × R³

Calculations:

=> Let the radius of the original sphere be R.

=> Effective metal percentage after loss = 100% − 20% = 80%

=> Total volume of original sphere × 80% = Total volume of 64 spheres

=> Original Volume × 0.8 = 10,752

=> Original Volume = 10,752 ÷ 0.8 = 13,440 cm³

=> 4/3 × 3.14 × R³ = 13,440

=> 12.56 ÷ 3 × R³ = 13,440

=> R³ = (13,440 × 3) ÷ 12.56

=> R³ = 40,320 ÷ 12.56 = 3210.19

=> R = ∛3210.19 ≈ 14.75 cm

=> Nearest integer to 14.75 is 15.

Therefore The correct answer is 15 cm.

Additional Information

Volume Conservation in Recasting

When a solid is melted and recast into other shapes, the total volume remains constant if there is no loss. If loss occurs, Final Volume = Initial Volume − Waste.

Sphere Properties

Volume = (4/3)πr³ and Surface Area = 4πr². If the radius is scaled by factor k, the volume is scaled by k³.

Approximate Cube Roots

Memorizing basic cubes like 10³ = 1000, 15³ = 3375, and 20³ = 8000 helps in estimating the radius during exams without full calculation.

Q43. Answer: (a) 85,000

Shortcut Trick

Incomes ratio = 5 : 9 and Expenditures ratio = 1 : 3.

Since savings are equal (??51,000), the difference between income and expenditure parts must be equal.

Difference in income parts (9 − 5) = 4; Difference in expenditure parts (3 − 1) = 2.

Make differences equal: Multiply expenditure ratio by 2 → 2 : 6.

Now, Savings = 5 − 2 = 3 units. => 3 units = Rs. 51,000 => 1 unit = Rs. 17,000.

Chetan monthly income = 5 units = 5 × Rs. 17,000 = Rs. 85,000.

Therefore The correct answer is Rs. 85,000.

Alternate Method

Given: Ratio of Monthly Incomes = 5 : 9 | Monthly Savings = Rs. 51,000 each | Ratio of Expenditures = 1 : 3.

Formula: Income − Savings = Expenditure

Let the incomes be 5x and 9x.

=> (5x − 51,000) / (9x − 51,000) = 1 / 3

=> 3 × (5x − 51,000) = 1 × (9x − 51,000)

=> 15x − 1,53,000 = 9x − 51,000

=> 6x = 1,02,000

=> x = 17,000

=> Chetan monthly income = 5x = 5 × 17,000 = 85,000

Therefore The correct answer is Rs. 85,000.

Additional Information

Income, Expenditure, and Saving Relation

The basic governing formula for these problems is Income = Expenditure + Savings.

Ratio Equalization Method

When a constant value is added or subtracted from both terms of a ratio, the difference between the ratio parts should be made equal to maintain proportionality.

Cross Multiplication Method

For two ratios a:b and c:d with a constant change k: x = |(bk − dk) / (ad − bc)| helps in finding the variable value quickly.

Q44. Answer: (c) 18

Shortcut Trick

Ratio of numbers = 12 : 14 : 4

25% of 1st number (12 units) = 3 units

Given: 3 units = 18 => 1 unit = 6

Difference between 2nd and 3rd = 14 − 4 = 10 units = 60

30% of 60 = 18

Therefore The correct answer is 18.

Alternate Method

Given: Ratio of numbers = 12 : 14 : 4, 25% of the first number = 18.

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

=> Let the numbers be 12x, 14x, and 4x.

=> According to question: 25% of 12x = 18

=> (25/100) × 12x = 18

=> 3x = 18 => x = 6

=> Second number = 14 × 6 = 84

=> Third number = 4 × 6 = 24

=> Difference = 84 − 24 = 60

=> Required value = 30% of 60 = (30/100) × 60 = 18

Therefore The correct answer is 18.

Additional Information

Ratio and Proportion

A ratio compares two quantities; if a:b = c:d, then product of extremes equals product of means (a × d = b × c).

Percentage Conversion

To find x% of a number N, use the formula: (x/100) × N. Common fractions: 25% = 1/4, 50% = 1/2.

Q45. Answer: (b) 24, 28

Shortcut Trick

Sum of ages after 20 years = 92 years.

Present sum of ages = 92 − (2 × 20) = 52 years.

Ratio of Wife : Husband = 6 : 7 (Total parts = 13).

Value of 1 part = 52 ÷ 13 = 4 years.

Present ages = 6 × 4 and 7 × 4 = 24 and 28 years.

Therefore The correct answer is 24, 28 years.

Alternate Method

Given: Present ratio = 6 : 7; Sum after 20 years = 92.

Formula: Let Present Age of Wife = 6x and Husband = 7x.

=> Age after 20 years: (6x + 20) and (7x + 20)

=> Sum: (6x + 20) + (7x + 20) = 92

=> 13x + 40 = 92

=> 13x = 52

=> x = 4

=> Wife's present age = 6 × 4 = 24 years

=> Husband's present age = 7 × 4 = 28 years

Therefore The correct answer is 24, 28 years.

Additional Information

Age Sum Property

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If the sum of ages of 'n' persons is 'S' now, then after 't' years, the sum will be S + (n × t).

Ratio & Proportion

If ages are in ratio a:b and sum is S, individual ages are S × [a/(a+b)] and S × [b/(a+b)].

Age Difference Property

The difference between the ages of two people remains constant regardless of the number of years passed.

Q46. Answer: (a) 42.9

Shortcut Trick

Direct formula for Median: Median = (Mode + 2 × Mean) ÷ 3

Substitute values: Median = (88.7 + 2 × 20) ÷ 3

Median = (88.7 + 40) ÷ 3 = 128.7 ÷ 3

Median = 42.9

Therefore The correct answer is 42.9.

Alternate Method

Given:

Mean of data = 20

Mode of data = 88.7

Formula Used:

The empirical relationship between central tendencies is:

Mode = 3 × Median − 2 × Mean

Calculations:

=> 88.7 = 3 × Median − 2 × 20

=> 88.7 = 3 × Median − 40

=> 3 × Median = 88.7 + 40

=> 3 × Median = 128.7

=> Median = 128.7 ÷ 3

=> Median = 42.9

Therefore The correct answer is 42.9.

Additional Information

Empirical Relationship

This formula is applicable for moderately asymmetrical distributions. It was suggested by Karl Pearson.

Symmetrical Distribution

In a perfectly symmetrical distribution (like the Normal Distribution), the values of Mean, Median, and Mode are all equal (Mean = Median = Mode).

Skewness Property

If Mode > Median > Mean, the distribution is negatively skewed (skewed to the left). If Mean > Median > Mode, it is positively skewed.

Q47. Answer: (d) 23, 46, 69

Shortcut Trick

Given HCF = 23 and Ratio = 1 : 2 : 3.

Numbers = Ratio Parts × HCF.

First number = 1 × 23 = 23.

Second number = 2 × 23 = 46.

Third number = 3 × 23 = 69.

Therefore The correct answer is 23, 46, 69.

Alternate Method

Given: Ratio of three numbers = 1 : 2 : 3 and Highest Common Factor (HCF) = 23.

Let the three numbers be 1x, 2x, and 3x.

The HCF of 1x, 2x, and 3x is the common variable x.

=> x = 23

=> First number = 1 × 23 = 23

=> Second number = 2 × 23 = 46

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=> Third number = 3 × 23 = 69

Therefore The correct answer is 23, 46, 69.

Additional Information

HCF and LCM Relation

For two numbers a and b, Product of numbers = HCF × LCM.

Ratio and Multiples

If numbers are in ratio a:b:c, then the actual numbers are a×H, b×H, and c×H where H is the HCF.

LCM Formula

LCM of numbers in ratio a:b:c is equal to (a × b × c × HCF) if a, b, c are co-prime.

Q48. Answer: (c) Rs. 7,488

Shortcut Trick

Successive rate for 2 years at 20% = 20 + 20 + (20 × 20)/100 = 44%.

Total Amount (%) = 100% (Principal) + 44% (Interest) = 144%.

Amount = 144% of Rs. 5,200 = 1.44 × 5200 = Rs. 7,488.

Therefore The correct answer is Rs. 7,488.

Alternate Method

Given:

Principal (P) = Rs. 5,200

Rate of Interest (R) = 20% per annum

Time (n) = 2 years (Compounded Annually)

Formula Used:

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

Calculations:

=> $A = 5200(1 + 20/100)^2$

=> $A = 5200(1 + 1/5)^2$

=> $A = 5200 \times (6/5) \times (6/5)$

=> $A = 5200 \times 36 / 25$

=> $A = 208 \times 36$

=> A = Rs. 7,488

Therefore The correct answer is Rs. 7,488.

Additional Information

Effective Rate for Compound Interest

For 2 years, the effective rate is calculated as R + R + (R × R)/100.

Compound Interest (CI)

CI is the difference between the total Amount and the Principal: CI = A − P.

Difference between CI and SI

For a period of 2 years, the difference (D) between Compound Interest and Simple Interest is $D = P \times (R/100)^2$.

Q49. Answer: (d) 7.14 seconds

Shortcut Trick

Total distance = Length of A + Length of B = 150 + 100 = 250 m.

Relative speed (opposite direction) = Speed of A + Speed of B = 72 + 54 = 126 km/h.

Convert speed to m/s: 126 × (5/18) = 35 m/s.

Time = Distance ÷ Relative Speed = 250 ÷ 35 ≈ 7.14 sec.

Therefore The correct answer is 7.14 sec.

Alternate Method

Given:

Length of Train A (L1) = 150 m | Length of Train B (L2) = 100 m

Speed of Train A (S1) = 72 km/h | Speed of Train B (S2) = 54 km/h

Formula Used:

Time taken to cross = (L1 + L2) ÷ (S1 + S2)

Calculations:

=> Total Distance = 150 + 100 = 250 m

=> Relative Speed = 72 + 54 = 126 km/h

=> Relative Speed in m/s = 126 × (5/18) = 7 × 5 = 35 m/s

=> Time taken = 250 ÷ 35

=> Time taken = 50 ÷ 7 ≈ 7.1428... sec

Therefore The correct answer is 7.14 sec.

Additional Information

Relative Speed Concept

When two objects move in opposite directions, their speeds are added (S1 + S2). If they move in the same direction, the speeds are subtracted (|S1 − S2|).

Unit Conversion

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

Crossing Distance

When a train crosses another train or a bridge/platform, the total distance covered is always the sum of the lengths of both objects.

Q50. Answer: (a) Decreases by 61.92%

Shortcut Trick

Using the Multiplying Factor method: Let original price be 100.

New Price = 100 × 0.85 × 0.70 × 0.40 × 1.60

New Price = 100 × 0.595 × 0.64 = 38.08

Net change = 100 − 38.08 = 61.92% decrease.

Therefore The correct answer is Decreases by 61.92%.

Alternate Method

Given: Successive changes are −15%, −30%, −60% and +60%.

Formula Used: Final Price = Initial Price × (1 ± r1/100) × (1 ± r2/100) × ...

=> Let original price = 100

=> Price after 1st month = 100 − 15% of 100 = 85

=> Price after 2nd month = 85 − 30% of 85 = 85 − 25.5 = 59.5

=> Price after 3rd month = 59.5 − 60% of 59.5 = 59.5 − 35.7 = 23.8

=> Price after 4th month = 23.8 + 60% of 23.8 = 23.8 + 14.28 = 38.08

=> Total Decrease = 100 − 38.08 = 61.92

=> Percentage Decrease = (61.92 / 100) × 100 = 61.92%

Therefore The correct answer is Decreases by 61.92%.

Additional Information

Successive Percentage Change Formula

For two successive changes of a% and b%, the net change is (a + b + ab/100)%.

Base Value Stability

In successive changes, the base for the next percentage calculation is the resultant value of the previous calculation.

Multiplying Factor (MF)

For x% increase, MF = (1 + x/100); for x% decrease, MF = (1 − x/100). Net Result = Initial × MF1 × MF2...

Q51. Answer: (c) 7

Given:

‘ELMS’ is coded as ‘4892’

‘ALES’ is coded as ‘7428’

Common letter analysis:

Therefore, ‘A’ is coded as ‘7’.

Hence, the correct answer is "Option 3".

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Q52. Answer: (b) 245

Logic followed here is: The series follows an addition pattern where the difference between consecutive numbers increases by 5 at each step.

For the given series progression:

Therefore, the code for the question mark (?) is 245.

Hence, the correct answer is "Option 2".

Q53. Answer: (a) HSD

Logic followed here is: Each letter in the word follows a specific sequence of addition or subtraction based on its position in the English alphabetical order.

Therefore, the missing term in the series is HSD.

Hence, the correct answer is "Option 1".

Q54. Answer: (d) Three

Given:

Seven boxes A, B, C, D, P, Q and R are kept one above the other.

• D is kept immediately above Q.

• R is kept immediately above C.

• Only P is kept above A.

• Only two boxes are kept above D.

• R is not at the third position from the bottom.

Find the number of boxes kept between B and P.

Final Arrangement (Top to Bottom)

Position	Box
1	P
2	A
3	D
4	Q
5	B
6	R
7	C

P is at Position 1 and B is at Position 5.

Boxes between them are: A, D and Q

Number of boxes between B and P = 3.

Hence, the correct answer is Option 4 (Three).

Q55. Answer: (d) OT - MS

The logic followed here is: Logic: In each pair, the second letter-cluster is obtained by subtracting 2 from the positional values of the letters of the first letter-cluster (Cluster 1 Letter - 2 = Cluster 2 Letter).

(1) IN - GL →

(2) MR - KP →

(3) GL - EJ →

(4) OT - MS →

In all pairs except 'OT - MS', the pattern followed is a subtraction of 2 from both letters. In 'OT - MS', the second letter is obtained by subtracting 1.

Therefore, the odd letter-cluster pair is OT - MS.

Henvce, the correct answer is "Option 4".

Q56. Answer: (c) 1061

Shortcut Trick

Interchange the signs as per the logic: (÷ → ×), (+ → −), (× → ÷), (− → +).

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New expression: 58 × 11 − 624 ÷ 13 + 471
Step 1: 58 × 11 = 638 and 624 ÷ 13 = 48
Step 2: 638 − 48 + 471 = 590 + 471 = 1061
Therefore The correct answer is 1061.
Alternate Method
Given:
Expression: 58 ÷ 11 + 624 × 13 − 471
Conditions: + ↔ − and × ↔ ÷
Calculations:
After interchanging the signs, the new equation is:
=> 58 × 11 − 624 ÷ 13 + 471
Applying BODMAS rule (Division first):
=> 58 × 11 − 48 + 471
Applying BODMAS rule (Multiplication):
=> 638 − 48 + 471
Applying BODMAS rule (Addition and Subtraction):
=> 590 + 471
=> 1061
Therefore The correct answer is 1061.
Additional Information
BODMAS Rule
It defines the order of operations: Brackets, Of (orders/powers), Division, Multiplication, Addition, and Subtraction.
Mathematical Sign Interchange
In these problems, always rewrite the full expression with new signs before starting any calculation to avoid errors.
Multiplication Trick for 11
To multiply a two-digit number AB by 11, the result is A | (A+B) | B. For 58 × 11: 5 | (5+8) | 8 → 5 | 13 | 8 → 638.

Q57. Answer: (b) INOS

Logic followed here is: Three clusters follow the pattern (+4, +2, +4), while one does not.
1) HLNR →
2) INOS →
3) SWYC →
4) VZBF →
Therefore, the letter-cluster 'INOS' does not belong to the group as it follows a different pattern.
Hence, the correct answer is "Option 2".

Q58. Answer: (c) 4

Given:
(Left) 9 1 5 1 9 8 6 6 9 9 4 1 6 7 8 3 7 2 1 3 5 3 5 1 6 2 8 (Right)
We need to find even numbers that are:
→ Immediately preceded by an odd number
→ Immediately followed by an odd number
Pattern:
Odd Number → Even Number → Odd Number
Checking the series:
(Left) 9 1 5 1 9 8 6 6 9 9 4 1 6 7 8 3 7 2 1 3 5 3 5 1 6 2 8 (Right)
The required even numbers are:
4 in (9 4 1)
6 in (1 6 7)
8 in (7 8 3)
2 in (7 2 1)
Therefore, there are 4 such even numbers.

Hence, the correct answer is "Option 3".

Q59. Answer: (c) 3

Shortcut Trick

The series follows a multiplication pattern with factors increasing by 0.5 each time.

Pattern: ×0.5, ×1, ×1.5, ×2, ×2.5

Missing term = 1.5 × 2 = 3

Check: 3 × 2.5 = 7.5 (Matches the last term)

Therefore The correct answer is 3.

Alternate Method

Given Series: 2, 1, 1, 1.5, ?, 7.5

2 ×0.5 → 1 ×1.0 → 1 ×1.5 → 1.5 ×2.0 → 3 ×2.5 → 7.5

The logic of the series is multiplying each term by an arithmetic progression (0.5, 1.0, 1.5, 2.0, 2.5...).

=> 2 × 0.5 = 1

=> 1 × 1.0 = 1

=> 1 × 1.5 = 1.5

=> 1.5 × 2.0 = 3

=> 3 × 2.5 = 7.5

Therefore The correct answer is 3.

Additional Information

Multiplication Series

In this type, each term is multiplied by a fixed or a varying number to get the next term. Common varying factors include AP (0.5, 1, 1.5...) or squares/cubes.

Decimal Multiplication Pattern

Often used in exams, this pattern usually starts with ×0.5 or ×1.5, resulting in numbers decreasing once then increasing rapidly.

Arithmetic-Geometric Series

A complex series where both addition and multiplication (or division) occur in a single step, such as (n × 1) + 1, (n × 2) + 2, etc.

Q60. Answer: (c) Only I follows

Statements:

1. All viruses are fungi.

2. Some viruses are bacteria.

Conclusions:

(I) Some fungi are bacteria: Follows (Because, some viruses are bacteria and all viruses are fungi. Therefore, those viruses which are bacteria are also fungi. Hence, some fungi are bacteria.)

(II) No fungi is a virus: Does not follows (Because, the statement clearly says that all viruses are fungi. Therefore, viruses are a part of fungi, so it is wrong to say that no fungi is a virus.)

So, only conclusion (I) follows.

Hence, the correct answer is "Option 3".

Q61. Answer: (a) 51

Logic followed here is:

The series follows an arithmetic progression where each subsequent term is obtained by adding a constant value of 6 to the previous term.

Therefore, the number that should come in place of the question mark is 51.

Hence, the correct answer is "Option 1".

Q62. Answer: (d) (16, 11, 704)

Logic followed here is: (First number × Second number) × 4 = Third number

For (12, 15, 720) →

Calculation: (12 × 15) × 4 = 180 × 4 = 720

For (14, 11, 616) →

Calculation: (14 × 11) × 4 = 154 × 4 = 616

Similarly, Option 4) (16, 11, 704):

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Calculation: (16 × 11) × 4 = 176 × 4 = 704

Therefore, the related set is (16, 11, 704).

Hence, the correct answer is "Option 4".

Q63. Answer: (a) RPQ−MKL

Logic followed here is: (Positional value of each letter) - 5.

DBC is coded as YWX →

KIJ is coded as FDE →

Similarly, Option 1) RPQ:

Therefore, the pair following the same pattern is RPQ - MKL.

Hence, the correct answer is "Option 1".

Q64. Answer: (d) Only conclusion (I) follows

Statements:

1. All pans are cups.
2. All cups are bottles.
3. Some cups are mugs.

Conclusions:

(I) Some bottles are mugs: Follows (Because, some cups are mugs and all cups are bottles. Therefore, those cups which are mugs are also bottles. Hence, some bottles are mugs.)

(II) Some pans are mugs: Does not follows (Because, all pans are cups and some cups are mugs, but it is not definite that the cups which are mugs are also pans. So, no definite relation exists between pans and mugs.)

So, only conclusion (I) follows.

Hence, the correct answer is "Only conclusion (I) follows".

Q65. Answer: (b) Four

Given:

Seven boxes: D, E, F, U, V, W and X are kept one above the other.

Conditions:

1. Only two boxes are kept below W.
2. Only two boxes are kept between W and U.
3. Only one box is kept between U and E.
4. X is kept immediately above V.
5. F is kept somewhere below D.

Final Arrangement:

Position	Box
1	D
2	U
3	F
4	E
5	W
6	X
7	V

D is at position 1 and X is at position 6.

Boxes between them are:

U, F, E, W → 4 boxes

Therefore, the answer is Four.

Hence, the correct answer is "Option 2".

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Q66. Answer: (a) Son’s wife

Given:

A is					
Symbol	**•**	**•**	**×**	**%**	**#**
Meaning	mother	brother	wife	father	daughter

to B

Expression:

N % E – C % R # Q: N is the father of E. E is the brother of C. C is the father of R. R is the daughter of Q.

So, Q is the son’s wife of N.

Hence, the correct answer is "Option 1".

Q67. Answer: (c) 4

Given:

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

Logic followed here is: We need to find even numbers that are immediately preceded by an odd number and immediately followed by an even number.

Pattern: Odd Number → Even Number → Even Number

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

The required even numbers are:

• 4 in (9 4 2)

• 8 in (5 8 8)

• 8 in (9 8 8)

• 2 in (5 2 8)

Therefore, there are 4 such even numbers.

Hence, the correct answer is "Option 3".

Q68. Answer: (c) BJ – GO – LT

Logic followed here is: Each letter in the triad is obtained by adding 5 to the positional value of the corresponding letter in the previous pair.

For DL – IQ – NV →

For FN – KS – PX →

Similarly,Option 3) BJ – GO – LT:

Therefore, the triad following the same pattern is BJ – GO – LT.

Hence, the correct answer is "Option 3".

Q69. Answer: (c) 2

Given:

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

Logic followed here is: We need to find even numbers that are immediately preceded by an odd number and immediately followed by an even number.

Pattern: Odd Number → Even Number → Even Number

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

The required even numbers are:

• 2 in (9 2 6)

• 6 in (9 6 8)

Therefore, there are 2 such even numbers.

Hence, the correct answer is "Option 3".

Q70. Answer: (d) 13 km to the South

Given:

Rihan starts from Point A and drives:

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→ 24 km towards East
→ Turns right and drives 50 km
→ Turns right and drives 51 km
→ Turns right and drives 63 km
→ Turns right and drives 27 km to reach Point P
To reach Point A again, Rihan must travel 13 km towards South.
Hence, the correct answer is "Option 4".

Q71. Answer: (b) 7

Given:
The five three-digit numbers are:
(Left) 715, 906, 570, 853, 418 (Right)
We need to find:
→ Third digit of the highest number
→ Second digit of the lowest number
→ Add both digits
Step 1: Find the highest number
Highest number = 906
Third digit of 906 = 6
Step 2: Find the lowest number
Lowest number = 418
Second digit of 418 = 1
Step 3: Add the digits
6 + 1 = 7
Therefore, the resultant is 7.
Hence, the correct answer is "Option 2".

Q72. Answer: (d) Four

Given:
A, B, C, D, W, X and Y are sitting around a circular table facing the centre.
Conditions:
1. C sits fourth to the right of X.
2. Only two people sit between Y and W when counted from the left of Y.
3. D sits third to the left of B.
4. A is an immediate neighbour of B and W.
From the left of A:
A → W → D → X → Y → C
People between A and C are:
→ W
→ D
→ X
→ Y
Therefore, there are 4 people between C and A.
Hence, the correct answer is "Option 4".

Q73. Answer: (d) PTX 116

Logic followed here is:
The pattern observed is: (Letter + 11) and (Number + 8).
Therefore, the code for the question mark (?) is PTX 116.
Hence, the correct answer is "Option 4".

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Q74. Answer: (c) Three

Given:

1. Seven friends D, E, F, U, V, W, and X are sitting in a straight line facing the North.
2. Only three people are seated to the left of D.
3. Only E is seated to the right of W.
4. Only three people are seated between W and X.
5. V is seated at some place to the left of U but at some place to the right of F.

People between F (pos 1) and U (pos 5) are: X, V, and D.

Total count = 3.

Therefore, three people are seated between F and U.

Hence, the correct answer is "Option 3".

Q75. Answer: (d) 2

Given:

Five people A, B, C, D and E are sitting in a row facing north.

Conditions:

1. A sits at the extreme right end of the row.
2. D sits immediately left of A.
3. Only B sits between C and E.

B is at position 2 and A is at position 5.

People between them are:

→ Position 3

→ Position 4

So, there are 2 people between A and B.

Hence, the correct answer is "Option 4".

Q76. Answer: (c) CPP : EKN

Logic followed here is: (+2, -5, -2) applied to the positional values of the letters.

For

UIR is related to WDP →

FRO is related to HMM →

Similarly, Option 3) CPP: EKN

Therefore, the pair 'CPP : EKN' follows the same pattern.

Hence, the correct answer is "Option 3".

Q77. Answer: (a) 42

Signs interchange:

•	–	×	÷
↓	↓	↓	↓
–	•	÷	×

Given equation:

45 − 54 × 6 + 12 ÷ 1 = ?

After interchanging the signs:

=> 45 + 54 ÷ 6 − 12 × 1

=> 45 + 9 − 12 × 1

=> 45 + 9 − 12

=> 54 − 12

=> 42

Therefore, the value in place of the question mark is 42.

Hence, the correct answer is "Option 1".

Q78. Answer: (d) 8

Given:

'POKE' is coded as '8469'

'KIND' is coded as '2387'

Therefore, the code for K is 8.

Hence, the correct answer is "Option 4".

Q79. Answer: (d) Southwest

Given:

→ Town I is to the north of Town F.

→ Town H is to the east of Town I.

→ Town J is to the east of Town H.

→ Town G is to the north of Town J.

From Town G, Town F is towards the Southwest.

Hence, the correct answer is "Option 4".

Q80. Answer: (d) 17

Logic followed here is: Mathematical signs are changed according to the given conditions and then solved using the BODMAS rule.

Given replacements:

Original Sign	Means
•	–
–	×
×	÷
÷	•

Given equation:

18 + 4 − 6 ÷ 46 × 2 = ?

After replacing the signs:

=> 18 − 4 × 6 + 46 ÷ 2

=> 18 − 4 × 6 + 23

=> 18 - 24 + 23

=> 41 - 17

=> 24

Hence, the correct answer is "Option 4".

Q81. Answer: (c) Adi Karmyogi

The correct answer is Adi Karmyogi.

Key Points

• The Union Ministry of Tribal Affairs launched the Adi Karmyogi initiative in 2025 to enhance the administrative efficiency and service delivery of tribal welfare schemes across India.

• The primary objective of Adi Karmyogi is the capacity building and sensitization of officials and personnel working at various levels of the tribal developmental administration, including those in Integrated Tribal Development Agencies (ITDAs).

• The program is designed to provide specialized training to government employees to better understand the unique cultural, social, and geographical challenges faced by tribal communities.

• By fostering a "citizen-centric" approach, the initiative aims to bridge the gap between policy formulation and ground-level implementation of schemes like PM-JANMAN and Eklavya Model Residential Schools (EMRS).

• It focuses on leveraging digital tools and e-learning modules to ensure that the personnel remain updated with the latest guidelines and statutory provisions related to Scheduled Tribes (ST).

Additional Information

• Mission Karmayogi (NPCSCB):

• Adi Karmyogi is an extension of the National Programme for Civil Services Capacity Building (NPCSCB), popularly known as Mission Karmayogi, which was launched in September 2020.

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• The broader mission aims to transform Indian civil services from "Rule-based" to "Role-based" governance, ensuring civil servants are creative, proactive, and technology-enabled.

• Tribal Population in India:

• According to the 2011 Census, the tribal population constitutes approximately 8.6% of India's total population.

• There are over 700 recognized Scheduled Tribes, with states like Madhya Pradesh, Odisha, and Maharashtra having significant tribal concentrations.

• Part IX-A and Schedules V and VI of the Constitution of India provide specific administrative frameworks for tribal-dominated areas.

• Other Significant Tribal Schemes:

• PM-JANMAN: Launched to focus on Particularly Vulnerable Tribal Groups (PVTGs), covering 75 such groups across 18 States and 1 Union Territory.

• Van Dhan Vikas Kendras: An initiative targeting livelihood generation for tribal gatherers through value addition of Minor Forest Produce (MFP).

• Eklavya Model Residential Schools (EMRS): Started in 1997-98 to provide quality middle and high-level education to ST students in remote areas.

Important Points

• Training and Sensitization: The Adi Karmyogi initiative emphasizes understanding Tribal Rights, the Forest Rights Act (2006), and the PESA Act (1996) to protect tribal interests during administrative processes.

• Data-Driven Governance: The initiative encourages the use of the Gati Shakti portal and other GIS-based mapping tools to identify infrastructure gaps in tribal hamlets.

• Implementing Agency: The National Institute of Tribal Research (NITR) often plays a pivotal role in designing the curriculum for such capacity-building programs in collaboration with the Capacity Building Commission (CBC).

• Focus on PVTGs: A core component of the 2025 rollout is to ensure that welfare reaches the most marginalized sections within the tribal community who have historically been excluded from mainstream developmental benefits.

Q82. Answer: (c) Kenya

The correct answer is Kenya.

Key Points

• In August 2025, the World Health Organization (WHO) officially declared Kenya free of Human African Trypanosomiasis (HAT), popularly known as sleeping sickness.

• This certification marks Kenya as a leader in the East African region for successfully eliminating the disease as a public health problem through decades of sustained surveillance and vector control.

• The disease is caused by parasites of the genus Trypanosoma, which are transmitted to humans through the bite of infected tsetse flies (genus Glossina).

• Kenya predominantly dealt with the rhodesiense form of the parasite (Trypanosoma brucei rhodesiense), which is the more acute form found in Eastern and Southern Africa.

• The WHO verification process involved an independent commission that reviewed epidemiological data and surveillance reports covering several years to ensure no new local cases were reported.

Additional Information

• Types of Sleeping Sickness:

• Trypanosoma brucei gambiense: This form is found in 24 countries in West and Central Africa. It accounts for more than 95% of reported cases and causes a chronic infection.

• Trypanosoma brucei rhodesiense: This form is found in 13 countries in Eastern and Southern Africa. It represents less than 5% of cases and causes an acute infection that can lead to death within months.

• Transmission and Symptoms:

• The tsetse fly inhabits vegetation along riverbanks and savannah woodlands.

• In the first stage, patients experience fever, headaches, and joint pains. In the second stage, the parasite crosses the blood-brain barrier, leading to neurological disorders, confusion, and disrupted sleep cycles, which gives the disease its name.

• Global Health Context:

• The elimination of sleeping sickness is part of the WHO’s Roadmap for Neglected Tropical Diseases (NTDs) 2021–2030.

• Kenya joins other African nations like Togo, Côte d'Ivoire, and Ghana, which have been previously recognized for eliminating various forms of the disease.

Important Points

• The Ministry of Health in Kenya utilized innovative tools such as Tiny Targets (insecticide-impregnated screens) and mobile diagnostic clinics to reach remote populations.

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• The Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC), launched in 2000, played a crucial role in coordinating efforts across borders to manage tsetse fly populations.

• Successful elimination requires multi-sectoral collaboration involving animal health departments, as the rhodesiense form is a zoonotic disease, meaning it can be transmitted from animals to humans.

• By achieving this status in 2025, Kenya has demonstrated the effectiveness of integrating satellite mapping and community-based surveillance in public health strategies.

Q83. Answer: (d) Bombay High Court

The correct answer is Bombay High Court.

Key Points

• In September 2025, Justice Shree Chandrashekhar was officially sworn in as the Chief Justice of the Bombay High Court, following his appointment by the Government of India.

• Prior to this elevation, Justice Shree Chandrashekhar served as a Judge of the Jharkhand High Court and was later transferred to the Rajasthan High Court, where he also served as the Acting Chief Justice.

• The appointment was finalized by the President of India, exercising powers conferred under Article 217 of the Constitution of India, based on the recommendations of the Supreme Court Collegium headed by the Chief Justice of India.

• The oath of office was administered by the Governor of Maharashtra during a formal ceremony held at the Raj Bhavan in Mumbai.

• As the Chief Justice of the Bombay High Court, he leads one of the oldest and most prestigious judicial institutions in the country, which has a sanctioned strength of 94 judges.

Additional Information

• The Bombay High Court:

• It was established on August 14, 1862, under the High Courts Act, 1861. It is one of the three Chartered High Courts in India, along with Calcutta and Madras.

• The jurisdiction of the Bombay High Court extends over the states of Maharashtra and Goa, and the Union Territories of Dadra and Nagar Haveli and Daman and Diu.

• The court has permanent benches located at Nagpur and Aurangabad in Maharashtra, and Panaji, the capital of Goa.

• Constitutional Provisions for High Courts:

• Article 214: Stipulates that there shall be a High Court for each State.

• Article 217: States that every Judge of a High Court shall be appointed by the President by warrant under his hand and seal after consultation with the Chief Justice of India and the Governor of the State.

• Article 219: Requires every person appointed to be a Judge of a High Court to make and subscribe an oath or affirmation before the Governor of the State.

• Retirement Age: The judges of the High Court hold office until they attain the age of 62 years.

Important Points

• The Collegium System: The selection and transfer of judges in the High Courts and Supreme Court are governed by the Collegium System, a forum of the Chief Justice of India and the four senior-most judges of the Supreme Court.

• Judicial Qualifications: To be eligible for appointment as a High Court Judge, a person must be a citizen of India and must have held a judicial office in the territory of India for at least ten years or been an advocate of a High Court for at least ten years.

• Significance of the Bombay High Court: It is renowned for its historical architecture (a UNESCO World Heritage Site part of the Victorian Gothic and Art Deco Ensembles of Mumbai) and for delivering landmark judgments that have shaped Indian Jurisprudence.

• Acting Chief Justice: When the office of Chief Justice is vacant, the President may appoint one of the other judges of the court to perform the duties of the office under Article 223.

Q84. Answer: (d) Assam

The correct answer is Assam.

Key Points

• The Pobitora Wildlife Sanctuary, a premier destination for wildlife enthusiasts, officially reopened for the 2025–26 tourist season (following the usual schedule starting in October/November) in the state of Assam.

• It is located in the Morigaon district of Assam and is situated on the southern bank of the Brahmaputra River.

• The sanctuary is world-renowned for having the highest density of the Greater One-horned Rhinoceros (Rhinoceros unicornis). Although Kaziranga National Park has a larger total population, Pobitora holds more rhinos per square kilometer.

• Due to its similar landscape of grasslands and wetlands and its significant rhino population, it is popularly known as 'Mini Kaziranga'. Hence, the correct answer is Assam.

• The reopening ceremony is a significant annual event for Assam Tourism, involving local forest officials, traditional Assamese

rituals, and the commencement of Jeep and Elephant safaris for visitors.

Additional Information

• Geography and Habitat:

• The sanctuary covers an area of approximately 38.81 square kilometers, out of which the core rhino habitat is only about 16 square kilometers.

• The terrain consists of alluvial grasslands and swamps, which are ideal for the survival and breeding of the Indian rhinoceros.

• Biodiversity:

• Apart from rhinos, it provides shelter to other mammals such as the Wild water buffalo, Leopard, Golden Jackal, and Wild boar.

• It is also an Important Bird Area (IBA), hosting over 2000 migratory birds and various resident species like the Greater Adjutant Stork, Whistling Teal, and Grey-panting Lapwing.

• Conservation History:

• It was first declared a Reserved Forest in 1971 and later upgraded to a Wildlife Sanctuary in 1987 to protect the burgeoning rhino population.

• The sanctuary serves as a critical "backup" habitat; during heavy monsoons when Kaziranga floods, animals often find refuge in the highland areas of Pobitora.

Important Points

• Tourism and Accessibility:

• Pobitora is highly accessible, located only about 45 to 50 kilometers from Guwahati, the gateway to Northeast India.

• The tourist season typically runs from November to April, coinciding with the dry winter months when visibility in the grasslands is highest.

• Other Major Parks in Assam:

• Kaziranga National Park: A UNESCO World Heritage Site famous for rhinos and tigers.

• Manas National Park: Known for its Project Tiger reserve and the Pygy Hog.

• Orang National Park: Another rhino habitat located on the northern bank of the Brahmaputra.

• Raimona and Dehing Patkai: The newest additions to Assam's list of National Parks, established in 2021.

Q85. Answer: (c) Sanjay Nayar

The correct answer is Sanjay Nayar.

Key Points

• Sanjay Nayar has officially taken over as the President of the industry body ASSOCHAM (Associated Chambers of Commerce and Industry of India) for the 2024-25 term.

• He succeeded Ajay Singh, the Chairman and Managing Director of SpiceJet, after the completion of his tenure in March 2024.

• Sanjay Nayar is the Founder and Chairman of Sorin Investments, an early-stage technology-focused fund.

• Before his leadership role at ASSOCHAM, he served as the Senior Vice-President of the chamber, as per the tradition of the organization's succession planning.

• With a career spanning over four decades, he is well-known for his extensive experience in the global financial markets, having served as the CEO of KKR India for 14 years and holding various senior positions at Citigroup for 25 years.

Additional Information

• ASSOCHAM (Associated Chambers of Commerce and Industry of India):

• It is one of the oldest apex trade associations in India, established in 1920.

• The organization is headquartered in New Delhi and represents the interests of more than 4.5 lakh members across diverse sectors.

• It serves as a critical interface between the Government of India and the industry to shape policy and foster a conducive environment for trade and commerce.

• New Office Bearers:

• Along with the President, Sunil Vachani, who is the Executive Chairman of Dixon Technologies, has been appointed as the Senior Vice-President of ASSOCHAM for 2024-25.

• Role in Indian Economy:

• The chamber plays a pivotal role in promoting MSMEs, sustainable development, and innovation through its various councils and initiatives.

Important Points

• Professional Background:

• Sanjay Nayar is a prominent figure in the Private Equity and Banking landscape in India.

• He is a member of the Board of Trade under the Ministry of Commerce and Industry, which advises the government on

Export-Import (EXIM) policies.

• He is also a member of the National Startup Advisory Council, which is tasked with advising the government on building a strong startup ecosystem in India.

• Focus Areas for 2024-25:

• Under his presidency, ASSOCHAM is expected to focus on digitization, ESG (Environmental, Social, and Governance) standards, and enhancing the global competitiveness of Indian manufacturing.

Q86. Answer: (b) To educate about sugar risks

The correct answer is To educate about sugar risks.

Key Points

• The Central Board of Secondary Education (CBSE) introduced the concept of Sugar Boards in schools as reported in May 2025 to raise awareness regarding the high sugar content in processed foods and beverages.

• The primary purpose of these boards is to educate students about sugar risks, specifically focusing on the dangers of excessive consumption that leads to childhood obesity and Type 2 diabetes. Hence, the correct answer is To educate about sugar risks.

• These boards serve as a visual educational tool, often displaying the amount of hidden sugar in popular snacks and soft drinks in terms of teaspoons or grams, making it easier for children to understand nutritional labels.

• The initiative is part of a broader health and wellness mandate to encourage health literacy from a young age, helping students make informed dietary choices during their formative years.

• By highlighting the risks associated with sucrose and high-fructose corn syrup, the CBSE aims to reduce the dependency on "junk food" within the school premises and surrounding areas.

Additional Information

• Impact on Health:

• Excessive sugar intake is directly linked to metabolic syndrome, dental caries (tooth decay), and cardiovascular diseases later in life.

• The World Health Organization (WHO) recommends that free sugars should ideally make up less than 5% to 10% of the total daily energy intake for both adults and children.

• FSSAI Guidelines:

• The Food Safety and Standards Authority of India (FSSAI) has previously introduced the "Eat Right School" initiative, which complements the Sugar Board strategy by promoting safe and nutritious food.

• Regulations often prohibit the sale of foods high in fat, sugar, and salt (HFSS foods) within 50 meters of school campuses in India.

• Visual Learning in Nutrition:

• Studies show that visual aids, like the Sugar Boards, are significantly more effective in changing eating habits among school-going children (ages 6 to 18) compared to traditional textbook warnings.

• These boards often compare the sugar in a 300ml carbonated drink (roughly 35-40 grams of sugar) to the recommended daily limit of 25 grams for children.

Important Points

• Context of May 2025: The reporting in May 2025 emphasizes a proactive shift in the Indian education system toward holistic well-being, integrating physical health with academic learning.

• Role of CBSE: As a national-level board of education in India for public and private schools, CBSE's implementation of such policies sets a benchmark for State Boards to follow in the fight against non-communicable diseases (NCDs).

• Parental Involvement: The initiative also encourages parents to monitor sugar intake at home, creating a collaborative environment between educational institutions and households to combat malnutrition and obesity.

Q87. Answer: (c) Odia

The correct answer is Odia.

Key Points

• The Sahitya Akademi announced the Bal Sahitya Puraskar in June 2025, recognizing excellence in children's literature across various Indian languages.

• Rajkishore Parhi was selected for this prestigious honor in the Odia language category for his notable contribution to poetry.

• The award-winning work is a poetry collection titled ‘Kete Phula Phutichhi’ (which translates to "How many flowers have bloomed").

• This recognition highlights the importance of Odia literature in the national landscape, specifically targeting the creative development and engagement of younger readers.

• The selection was made based on books first published during the five years immediately preceding the year of the award, following a rigorous selection process by a three-member jury.

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Additional Information

• Sahitya Akademi:

• Established on 12 March 1954, it is India's National Academy of Letters and functions as an autonomous organization under the Ministry of Culture.

• It recognizes literary merit in 24 languages, including the 22 languages listed in the Eighth Schedule of the Constitution of India, plus English and Rajasthani.

• Bal Sahitya Puraskar:

• This annual award was instituted in 2010 to encourage and honor writers who contribute significantly to children's literature.

• The award consists of a casket containing an engraved copper-plaque and a cash prize of Rs. 50,000.

• It aims to promote reading habits among children and ensure the availability of high-quality literary content in regional languages.

• Odia Language:

• Odia is one of the six classical languages of India, a status it received in 2014 due to its ancient heritage and rich literary tradition.

• The state of Odisha is the primary home to this language, which has a long history of poetry and prose dating back centuries.

Important Points

• The Sahitya Akademi also confers the Yuva Puraskar alongside the Bal Sahitya Puraskar to recognize young writers under the age of 35.

• The selection criteria for the Bal Sahitya Puraskar include the literary merit of the book, its appeal to the target age group, and the originality of the work.

• In 2025, several authors across different states were honored, showcasing India's linguistic diversity and the vibrant culture of storytelling in languages like Tamil, Telugu, Bhojpuri, and Hindi.

• Rajkishore Parhi's achievement is significant as it brings Odia children's poetry to the forefront of the national literary stage, encouraging other writers in the Eastern Indian region.

Q88. Answer: (d) Biodiversity Beyond National Jurisdiction (BBNJ) Agreement

The correct answer is Biodiversity Beyond National Jurisdiction (BBNJ) Agreement.

Key Points

• The Biodiversity Beyond National Jurisdiction (BBNJ) Agreement, often referred to as the "High Seas Treaty," is a landmark international legally binding instrument under the United Nations Convention on the Law of the Sea (UNCLOS).

• The treaty achieved its critical final ratification push during the UN Ocean Conference held in June 2025 in Nice, France. This conference served as a global platform to urge member states to reach the 60-ratification threshold required for the treaty to enter into force.

• The primary objective of the BBNJ Agreement is the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction, which cover nearly two-thirds of the global ocean and 95% of its volume.

• It is a vital component for achieving the "30x30" target, an international commitment to protect 30% of the world's land and oceans by the year 2030, as established under the Kunming-Montreal Global Biodiversity Framework.

• The treaty addresses four main pillars: Marine Genetic Resources (MGRs) including benefit-sharing, Area-Based Management Tools (ABMTs) like Marine Protected Areas (MPAs), Environmental Impact Assessments (EIAs), and Capacity Building and Transfer of Marine Technology.

Additional Information

• United Nations Convention on the Law of the Sea (UNCLOS):

• Adopted in 1982, UNCLOS defines the rights and responsibilities of nations in their use of the world's oceans. While it established the legal framework for maritime zones, it lacked specific mechanisms for biodiversity conservation in the High Seas, a gap now filled by the BBNJ Agreement.

• Marine Protected Areas (MPAs):

• Under the BBNJ, the international community can establish MPAs in international waters. These are essential for shielding marine life from overfishing, shipping traffic, and the emerging threat of deep-sea mining.

• Marine Genetic Resources (MGRs):

• This refers to the genetic material of marine plants, animals, and microbes. The treaty ensures that the economic benefits and scientific discoveries derived from these resources in the High Seas are shared fairly between developed and developing nations.

• Comparison with Other Treaties:

• The Paris Agreement (2015) focuses primarily on climate change and limiting global warming to 1.5 degrees Celsius.

• The Ramsar Convention (1971) is specifically dedicated to the conservation and sustainable use of wetlands, rather than the open ocean.

Important Points

• The High Seas: These are ocean areas beyond 200 nautical miles from the shore, outside the Exclusive Economic Zones (EEZs) of any country. Before the BBNJ, only about 1% of these waters were under any form of protection.

• Environmental Impact Assessments (EIAs): The agreement mandates that any planned activity in the High Seas that may cause substantial pollution or significant harmful changes to the marine environment must undergo a rigorous impact assessment.

• Significance of the 2025 Deadline: The UN Ocean Conference 2025 was strategically positioned as the "make or break" moment for the treaty, as 60 countries needed to deposit their instruments of ratification to ensure the treaty became legally binding before the 2030 biodiversity targets.

• Role of the COP: The BBNJ Agreement establishes a Conference of the Parties (COP), which will meet periodically to make decisions on the management and conservation of the global commons.

Q89. Answer: (a) Kumaon Regiment

p data-end="57" data-start="0">The correct answer is Kumaon Regiment.

Key Points

• The Indian Armed Forces contingent for the ZAPAD 2025 exercise is led by the Kumaon Regiment of the Indian Army. This regiment was selected due to its rich heritage and operational expertise in diverse terrains.

• ZAPAD 2025 is a multilateral joint military exercise hosted by Russia. It brings together several nations to practice counter-terrorism strategies and enhance multinational military cooperation.

• The exercise focuses on the interoperability of different military wings, including mechanized infantry, artillery, and air support, to handle complex security threats. Hence, the correct option is Kumaon Regiment.

• The Indian Army participation in ZAPAD typically involves a battalion-strength contingent. In the 2025 edition, the Kumaon Regiment represents the professional standards and tactical proficiency of the Indian Infantry.

• Participation in such global drills allows the Indian Armed Forces to refine their Standard Operating Procedures (SOPs) in a coalition environment, ensuring readiness for peacekeeping or combat missions.

Additional Information

• The Kumaon Regiment:

• The Kumaon Regiment is one of the most decorated infantry regiments of the Indian Army, with its origins dating back to the 18th century. It has produced three Army Chiefs: General S.M. Srinagesh, General K.S. Thimayya, and General T.N. Raina.

• The regiment's motto is "Parakramo Vijayate" (Valour Triumphs), and its war cry is "Kalika Mata Ki Jai". The Regimental Centre is located at Ranikhet in the state of Uttarakhand.

• The regiment played a pivotal role in the Battle of Rezang La during the 1962 Indo-China War, where Major Shaitan Singh was posthumously awarded the Param Vir Chakra.

• Exercise ZAPAD (West):

• ZAPAD (which means "West" in Russian) is part of a four-year cycle of strategic military exercises conducted by the Russian Armed Forces, alongside Vostok (East), Tsentr (Centre), and Kavkaz (Caucasus).

• These exercises are designed to test the preparedness of the Russian military and its allies against conventional and asymmetric warfare.

• In previous years, such as 2021, the Indian Army contingent was led by the Naga Regiment. The change in the leading unit for 2025 to the Kumaon Regiment reflects the Army's policy of rotating exposure among different units.

Important Points

• Strategic Significance:

• Participating in ZAPAD 2025 reinforces India's strategic autonomy and its commitment to multilateral military diplomacy. It provides a platform to interact with the Shanghai Cooperation Organisation (SCO) member states.

• The use of Indian Army weaponry and indigenous technology in these exercises serves as a demonstration of Aatmanirbhar Bharat (Self-reliant India) on a global stage.

• Geopolitics and Security:

• The ZAPAD 2025 exercise helps in building mutual trust and confidence-building measures (CBMs) among participating nations, which is essential for regional stability in Eurasia.

• It involves the simulation of urban warfare, electronic warfare, and cyber-defense, reflecting the changing nature of modern battlefields in the 21st century.

Q90. Answer: (d) Women’s 10m air pistol

The correct answer is Women’s 10m air pistol.

Key Points

• Indian shooter Suruchi Singh achieved a significant milestone by winning the gold medal in the Women’s 10m air pistol event at the ISSF World Cup 2025.

• The prestigious tournament was held in Munich, Germany, which is globally recognized as one of the primary hubs for

international shooting competitions.

• Suruchi Singh displayed exceptional precision and composure during the final round to secure the top spot on the podium, contributing to India's success in the global shooting circuit.

• The ISSF World Cup serves as a crucial platform for elite shooters to earn ranking points and prepare for major championships like the Olympics and World Championships.

• Her victory in the 10m air pistol category highlights the growing depth of talent in India's pistol shooting contingent. Hence, the correct answer is Women's 10m air pistol.

Additional Information

• International Shooting Sport Federation (ISSF):

• The ISSF is the governing body for Olympic shooting events in rifle, pistol, and shotgun disciplines.

• It was founded in 1907 and is currently headquartered in Munich, Germany.

• The federation organizes the ISSF World Cup series annually across different countries to provide international exposure to athletes.

• 10m Air Pistol Event:

• This is an Olympic shooting discipline where athletes use 4.5 mm (0.177 in) caliber air pistols.

• Shooters fire at a distance of 10 meters from the target, which has a bullseye diameter of just 11.5 mm.

• In the qualification round, participants typically fire 60 shots within a time limit of 75 minutes.

• India's Performance in Shooting:

• India has emerged as a powerhouse in the 10m Air Pistol and 10m Air Rifle categories over the last decade.

• Shooters like Manu Bhaker, Saurabh Chaudhary, and now Suruchi Singh have consistently brought laurels to the country at the World Cup and Asian Games level.

Important Points

• Scoring and Technology:

• Modern shooting events use Electronic Scoring Targets (EST), which provide instantaneous results with high precision up to decimal points (e.g., a perfect shot is 10.9).

• The Munich leg of the ISSF World Cup is often considered the most competitive due to the high number of participants from across the globe.

• Venue Significance:

• The Olympic Shooting Range in Munich-Hochbrück is one of the largest and most advanced facilities in the world, having hosted events since the 1972 Summer Olympics.

Q91. Answer: (a) Payments Regulatory Board

The correct answer is Payments Regulatory Board.

Key Points

• The Payments Regulatory Board (PRB) is the newly constituted body under the Reserve Bank of India (RBI) established to regulate and supervise the payment and settlement systems in India.

• Formed in May 2025, the board was created to provide a more focused and specialized regulatory framework for the rapidly evolving digital payments landscape, ensuring financial stability and consumer trust.

• The PRB replaces the erstwhile Board for Regulation and Supervision of Payment and Settlement Systems (BPSS), which previously functioned as a sub-committee of the Central Board of the RBI.

• The board is chaired by the Governor of the Reserve Bank of India and includes members such as the Deputy Governor in charge of payment systems and other officials nominated by the Central Government.

• The primary mandate of the Payments Regulatory Board involves the oversight of various platforms such as UPI, NEFT, RTGS, and prepaid payment instruments (PPIs), ensuring they adhere to cybersecurity and operational standards.

Additional Information

• Legal Framework: The foundation for the board lies in the Payment and Settlement Systems Act, 2007. Recent amendments have been introduced to empower the PRB with greater autonomy and enforcement powers to penalize non-compliant entities.

• Role in Fintech: The PRB plays a crucial role in fostering innovation within the FinTech sector while mitigating risks associated with shadow banking and unregulated payment intermediaries.

• Financial Inclusion: By standardizing payment protocols, the PRB supports the Government of India's vision of a Cashless Economy and helps in expanding financial services to rural and semi-urban areas through AePS (Aadhaar Enabled Payment System).

• Regulatory Sandbox: The board often utilizes a regulatory sandbox approach, allowing startups to test new payment technologies in a live environment under RBI supervision before a full-scale launch.

• Consumer Protection: One of the core pillars of the PRB is the enhancement of grievance redressal mechanisms and the

implementation of the Integrated Ombudsman Scheme for payment-related disputes.

Important Points

• Structure: The Payments Regulatory Board consists of six members in total, ensuring a balanced representation of regulatory expertise and administrative oversight.

• Impact on NPCI: While the National Payments Corporation of India (NPCI) operates systems like RuPay and UPI, the PRB acts as the ultimate regulator to which NPCI is accountable.

• Global Alignment: The formation of the PRB aligns India with international best practices as recommended by the Bank for International Settlements (BIS) regarding the oversight of payment infrastructures.

• Data Localization: The PRB is responsible for enforcing data sovereignty rules, requiring all payment service providers to store transaction data on servers located within the territory of India.

Q92. Answer: (d) National Highways Authority of India

The correct answer is National Highways Authority of India.

Key Points

• The National Highways Authority of India (NHAI) is the primary body responsible for the introduction and management of the FASTag system, which includes the provision for annual and monthly passes for frequent commuters.

• The FASTag initiative was launched to enable Electronic Toll Collection (ETC) on National Highways, aimed at reducing bottle-necks at toll plazas and ensuring a seamless flow of traffic.

• The annual pass facility is specifically designed for local residents and frequent users who reside within a 20-kilometer radius of a specific toll plaza, allowing them to pay a concessional fixed rate for unlimited trips.

• This system operates using Radio Frequency Identification (RFID) technology, where a tag affixed to the vehicle's windshield is read by a sensor, and the toll amount is automatically debited from a linked prepaid account or bank account.

• The implementation is carried out through the Indian Highway Management Company Limited (IHMCL), an entity promoted by NHAI, in collaboration with over 30 member banks and the National Payments Corporation of India (NPCI).

Additional Information

• Establishment of NHAI: The National Highways Authority of India was constituted by an Act of Parliament, the NHAI Act, 1988. It became operational in 1995 and works under the administrative control of the Ministry of Road Transport and Highways (MoRTH).

• Mandatory Implementation: The Government of India made FASTag mandatory for all M and N category vehicles (four-wheelers and above) from February 15, 2021. Vehicles entering the FASTag lane without a functional tag are liable to pay double the toll amount as a penalty.

• One Vehicle One FASTag Initiative: To improve the efficiency of the Electronic Toll Collection system, NHAI introduced the 'One Vehicle One FASTag' norm to discourage the use of multiple tags for one vehicle or using one tag for multiple vehicles.

• Economic and Environmental Benefits: The adoption of FASTag significantly reduces fuel consumption by minimizing idling time at toll booths and reduces air pollution. It also provides data-driven insights for traffic management and infrastructure planning.

• Recharge and Validity: A FASTag is valid for a period of 5 years. Users can recharge their accounts through various digital modes including UPI, BBPS, Net Banking, and Debit/Credit cards.

Important Points

• Local Pass Eligibility: The annual pass or monthly pass for local vehicles is subject to verification of residence (via Aadhar or Electricity bill). The NHAI guidelines specify that this concession is available to non-commercial vehicles registered in the local district.

• Technological Integration: The FASTag system is integrated with the Vahan database to verify vehicle details, which helps in preventing toll evasion and tracking stolen vehicles across the national highway network.

• Global Context: India's FASTag system is similar to electronic tolling systems used in other countries, such as E-ZPass in the United States and Salik in Dubai, representing a shift towards Intelligent Transport Systems (ITS).

Q93. Answer: (c) Fine particulate matter with a diameter of 2.5 micrometres or smaller

The correct answer is Fine particulate matter with a diameter of 2.5 micrometres or smaller.

Key Points

• PM2.5 refers to particulate matter that consists of fine particles or droplets in the air that are 2.5 micrometres or less in width.

• These particles are extremely tiny; for perspective, the average human hair is about 70 micrometres in diameter, making PM2.5 approximately 30 times smaller than the width of a hair.

• In October 2025, the Centre for Research on Energy and Clean Air (CREA) assessment highlighted the levels of these pollutants across Indian cities, focusing on the National Clean Air Programme (NCAP) targets.

• Because of their microscopic size, these particles can bypass the nose and throat to reach deep into the alveoli of the lungs and even enter the circulatory system.

• The composition of PM2.5 can vary but often includes organic compounds, heavy metals, nitrates, and sulfates.

Additional Information

• Sources of PM2.5:

• Primary Sources: These are emitted directly into the air from vehicle exhausts, power plants, forest fires, stubble burning (common in Northern India), and industrial processes.

• Secondary Sources: These form in the atmosphere through chemical reactions of gases such as sulfur dioxide (SO2) and nitrogen oxides (NOx).

• Health and Environmental Impact:

• Exposure to high levels of PM2.5 is linked to increased rates of chronic bronchitis, reduced lung function, asthma, and heart disease.

• Environmentally, it is the primary cause of reduced visibility (haze) in parts of the world, including national parks and urban centers.

• Regulatory Standards:

• The National Ambient Air Quality Standards (NAAQS) in India set the permissible annual limit for PM2.5 at 40 µg/m³ and the 24-hour limit at 60 µg/m³.

• In contrast, the World Health Organization (WHO) guidelines are stricter, recommending an annual mean of no more than 5 µg/m³ to protect public health.

Important Points

• Measurement: Air quality is monitored using the Air Quality Index (AQI), where PM2.5 is a critical sub-index component. Equipment like Continuous Ambient Air Quality Monitoring Systems (CAAQMS) are deployed in cities like Delhi, Mumbai, and Patna to provide real-time data.

• CREA (Centre for Research on Energy and Clean Air): It is an independent research organization that tracks air pollution trends and the impact of fossil fuel consumption globally. Its reports often serve as a basis for policy recommendations in South Asia.

• Comparison with PM10: While PM2.5 is "fine" particulate matter, PM10 refers to particles with a diameter between 2.5 and 10 micrometres (coarse particles), such as dust from roads and construction sites. PM2.5 is considered more hazardous due to its ability to penetrate deeper into the body.

• Seasonal Variation: In India, PM2.5 levels often spike during the winter months due to temperature inversion, which traps pollutants near the ground, combined with agricultural residue burning.

Q94. Answer: (d) Second

The correct answer is Second.

Key Points

• Neeraj Chopra, the reigning Olympic and World Champion, achieved the Second rank at the Doha Diamond League 2025.

• The prestigious track and field event was held at the Suhaim bin Hamad Stadium in Doha, Qatar, which is a traditional stop for the elite Diamond League circuit.

• In this competition, Neeraj Chopra competed against a world-class field of athletes, including top contenders like Jakub Vadlejch from the Czech Republic and Anderson Peters from Grenada.

• By finishing in the top three, he secured significant Diamond League points, which are crucial for qualifying for the Diamond League Final held at the end of the season.

• His performance at the 2025 event showcased his trademark consistency, as he has frequently occupied the podium in international meets since his historic Gold Medal win in 2021. Hence, the correct answer is Second.

Additional Information

• About Neeraj Chopra:

• Neeraj Chopra was born on December 24, 1997, in Khandra village, Panipat district, Haryana.

• He made history by becoming the first Indian track and field athlete to win a Gold Medal at the Olympics during the Tokyo 2020 games.

• He holds the National Record for India in Javelin Throw with a distance of 89.94 meters, achieved at the Stockholm Diamond League in 2022.

• He was honored with the Major Dhyan Chand Khel Ratna Award in 2021 and the Padma Shri in 2022 for his exceptional contributions to Indian sports.

• The Diamond League Format:

• The Wanda Diamond League is an annual series of elite track and field athletic competitions comprising 15 meetings across the globe.

• Athletes compete for points at the 14 series meetings to qualify for the Diamond League Final.

• The Doha leg is often one of the season openers, providing athletes a platform to test their early-season form in the Middle East.

Important Points

• Career Achievements:

• Apart from the Olympics, he won the Gold Medal at the 2023 World Athletics Championships in Budapest.

• He is also a Gold Medalist at the Asian Games (2018, 2022) and the Commonwealth Games (2018).

• Competition Dynamics:

• The Javelin Throw event in the Diamond League usually consists of six rounds of throws for the top participants.

• Consistency in the 88m to 90m range has established Neeraj Chopra as one of the most dominant athletes in the modern era of the sport.

• His Second place finish in 2025 reinforces his position as a perennial title contender on the global stage.

Q95. Answer: (a) Allianz with Jio Financial Services

The correct answer is Allianz with Jio Financial Services.

Key Points

• In July 2025, Jio Financial Services (JFS) and the German insurance major Allianz SE entered into a binding agreement to form a 50:50 domestic reinsurance joint venture.

• This partnership marks a significant entry into the reinsurance sector, aiming to provide a localized platform for managing risks within the Indian insurance market.

• The 50:50 structure ensures that both entities have equal ownership and decision-making power in the newly formed entity, combining Allianz's global technical expertise with Jio's massive digital reach.

• The primary objective of this joint venture is to serve the domestic market by offering reinsurance capacity to primary insurers in India, thereby strengthening the financial infrastructure of the country's insurance ecosystem.

• This move follows a broader trend of Reliance Industries-backed JFS expanding its financial services portfolio, which already includes segments like asset management, lending, and payment services.

Additional Information

• Allianz SE: A German multinational financial services company headquartered in Munich. It is one of the world's largest insurers and asset managers, with a presence in over 70 countries.

• Jio Financial Services (JFS): De-merged from Reliance Industries Limited in 2023, JFS has quickly moved to establish itself as a major player in India's financial sector through strategic partnerships, including a high-profile tie-up with BlackRock for asset management.

• Reinsurance Defined: It is essentially "insurance for insurance companies." Reinsurers take on a portion of the risks held by primary insurance companies to help them remain solvent, especially in the event of large-scale claims or disasters.

• Market Dynamics: The Indian reinsurance market has traditionally been led by the state-owned General Insurance Corporation of India (GIC Re). The entry of a powerful joint venture like Allianz-Jio is expected to increase competition and capacity in the domestic market.

• Regulatory Oversight: All such joint ventures and insurance operations in India are governed and regulated by the Insurance Regulatory and Development Authority of India (IRDAI), which ensures compliance with capital requirements and consumer protection laws.

Important Points

• The collaboration leverages Jio's data-driven approach and Allianz's sophisticated underwriting and risk-modelling capabilities.

• The deal signifies Allianz's renewed and deeper commitment to India, reflecting the long-term growth potential of the Indian economy and its under-penetrated insurance sector.

• By operating as a domestic reinsurer, the venture can offer more competitive pricing and tailored products specifically designed for Indian risks, such as agricultural fluctuations, infrastructure projects, and natural catastrophes.

• This partnership is expected to create numerous employment opportunities in the high-end financial services and data analytics sectors within India.

Q96. Answer: (d) Ahmedabad Airport

The correct answer is Ahmedabad Airport.

Key Points

• The specific aviation incident mentioned involves a London-bound Air India aircraft that crashed shortly after takeoff in June 2025.

• The flight originated from Ahmedabad Airport, formally known as Sardar Vallabhbhai Patel International Airport (SVPIA), which serves the state of Gujarat.

• Air India, the national carrier owned by the Tata Group, operates several direct international flights from Ahmedabad to major global hubs, including London Heathrow and London Gatwick.

• The crash occurred during the initial climb phase, a critical stage of flight shortly after leaving the runway at Ahmedabad.

• As per the question, the departure point was neither Delhi, Chennai, nor Kolkata, but specifically the international terminal at

Ahmedabad. Hence, the correct answer is Ahmedabad Airport.

Additional Information

• Sardar Vallabhbhai Patel International Airport (SVPIA):

• Located in Hansol, it is the busiest airport in Gujarat and serves both Ahmedabad and the state capital, Gandhinagar.

• It features two main terminals: Terminal 1 for domestic flights and Terminal 2 for international operations.

• The airport is named after Sardar Vallabhbhai Patel, the first Deputy Prime Minister of India.

• Air India International Operations:

• Air India maintains a significant presence in the United Kingdom market due to the large Gujarati diaspora residing there.

• Direct connectivity between Ahmedabad and London is a high-demand route, often utilizing long-haul aircraft like the Boeing 787 Dreamliner or Boeing 777.

• Under the Tata Group's ownership since January 2022, the airline has been undergoing a massive transformation project named Vihaan.AI.

• Aviation Safety and Investigation:

• In India, any major aircraft accident is investigated by the Aircraft Accident Investigation Bureau (AAIB), which operates under the Ministry of Civil Aviation.

• The Directorate General of Civil Aviation (DGCA) is the regulatory body that oversees safety standards and pilot licensing in the country.

• Takeoff and landing are statistically the most vulnerable phases of flight, accounting for a high percentage of aviation incidents globally.

Important Points

• Airport Codes: The IATA code for Ahmedabad Airport is AMD, while the ICAO code is VAAH.

• Geographical Significance: The airport is situated approximately 9 kilometers from the city center of Ahmedabad.

• Historical Context: Air India has a long history of flying to the United Kingdom, dating back to its first international flight to London in June 1948.

• Emergency Protocols: In the event of a crash shortly after takeoff, airports activate the Airport Emergency Plan (AEP), involving the Airport Fire Service and local medical teams for immediate rescue operations.

Q97. Answer: (a) Faith Kipyegon

The correct answer is Faith Kipyegon.

Key Points

• Faith Kipyegon made history in 2025 by breaking the women’s Mile world record during a specialized athletic event in Paris.

• She clocked a remarkable time of 4:06.42, surpassing the previous world record mark and further cementing her legacy as the greatest middle-distance runner of all time.

• The record was set at Nike’s Breaking event, an elite competition designed to push the limits of human speed and endurance through optimized conditions and cutting-edge technology.

• Faith Kipyegon, representing Kenya, has consistently dominated the 1500m and Mile distances, holding multiple world records simultaneously across different track categories.

• The performance in Paris highlighted her exceptional pacing and finishing kick, which allowed her to shave significant time off her own previous global standards.

Additional Information

• Faith Kipyegon (Athlete Profile):

• Born on January 10, 1994, in Bomet, Kenya, she is a specialist in the 1500 meters.

• She is a three-time Olympic Gold Medalist (Rio 2016, Tokyo 2020, and Paris 2024) in the 1500m event, becoming the first woman to win three consecutive Olympic titles in that discipline.

• In 2023, she achieved a historic "triple" by breaking world records in the 1500m, 5000m, and the Mile within a single season.

• The Mile Run:

• The Mile (approx. 1,609.34 meters) is a classic middle-distance race. While the 1500m is the standard Olympic distance (the "metric mile"), the full mile remains a prestigious record-breaking event in professional athletics.

• Kipyegon's previous record was 4:07.64, set at the Monaco Diamond League in July 2023.

• Other Notable Athletes:

• Sifan Hassan: A versatile Dutch athlete who formerly held the mile record (4:12.33) and is known for winning medals in distances ranging from 1500m to the Marathon.

• Genzebe Dibaba: An Ethiopian runner who held the 1500m world record for eight years until Faith Kipyegon broke it in 2023.

• Laura Muir: A prominent British middle-distance runner and Olympic silver medalist who has frequently competed against Kipyegon at the highest level.

Important Points

• Technological Impact: High-performance events like the Nike Breaking event often utilize Wavelight technology (pacing lights on the track) and advanced carbon-plated spikes to help athletes maintain a precise record-breaking tempo.

• Location Significance: Paris has remained a focal point for world-class athletics following the 2024 Summer Olympics, hosting various elite meets at the Stade de France and other venues.

• Historical Context: The sub-4:10 barrier in the women's mile was long considered a daunting milestone, much like the 4-minute mile for men, until the recent era of specialized training and shoe technology led by athletes like Kipyegon.

Q98. Answer: (d) Viksit Bharat: Civil Service and Digital Transformation

The correct answer is Viksit Bharat: Civil Service and Digital Transformation.

Key Points

• The 28th National Conference on e-Governance (NCeG) is scheduled to be held on 22 and 23 September 2025 in Visakhapatnam, Andhra Pradesh.

• The primary theme for this edition of the conference is "Viksit Bharat: Civil Service and Digital Transformation", reflecting the nation's focus on modernization and the role of the bureaucracy in achieving a developed India status.

• The event is organized by the Department of Administrative Reforms and Public Grievances (DARPG) in collaboration with the Ministry of Electronics and Information Technology (MeitY) and the Government of Andhra Pradesh.

• The conference serves as a major platform for policymakers, practitioners, and industry experts to discuss the latest trends in digital governance and the integration of technology into public service delivery.

• A significant highlight of the conference is the presentation of the National Awards for e-Governance, which recognize and promote excellence in the implementation of e-Governance initiatives across various sectors.

Additional Information

• Viksit Bharat 2047: This is the Government of India's roadmap to transform the nation into a completely developed country by the 100th year of Independence in 2047. The theme emphasizes that digital transformation is a core pillar of this vision.

• Civil Service Reforms: The conference highlights how Civil Services are being revamped through initiatives like Mission Karmayogi (National Programme for Civil Services Capacity Building) to make them more tech-savvy and citizen-centric.

• Digital Transformation: This involves the adoption of emerging technologies such as Artificial Intelligence (AI), Blockchain, and Data Analytics to enhance the efficiency of government operations and reduce red-tapism.

• Digital Public Infrastructure (DPI): India has emerged as a global leader in DPI with systems like Aadhaar, UPI, and DigiLocker, which are often central themes in these national conferences to showcase "India Stack."

• Visakhapatnam: Often referred to as the 'City of Destiny' and a rising IT hub in the state of Andhra Pradesh, it provides a strategic location for discussing the intersection of urban growth and digital services.

Important Points

• Historical Context: The National Conference on e-Governance has been held annually since 1997 to provide a forum for Central and State Governments to exchange ideas and share success stories in the field of Information Technology.

• 27th NCeG: The previous edition, the 27th National Conference, was held in Mumbai, Maharashtra, with the theme "Viksit Bharat: Empowering Citizens", showing a progression towards the current theme of civil service transformation.

• Stakeholder Engagement: The 2025 conference aims to bridge the gap between administrative efficiency and technological advancement, ensuring that the digital divide is bridged and inclusive growth is achieved.

• National Awards Categories: These awards typically cover categories like Excellence in Government Process Re-engineering, Digital Transformation by PSUs, and e-Governance initiatives by academic and research institutions.

Q99. Answer: (b) Rajal Neeti: Lok Vyavhaar

The correct answer is Rajal Neeti: Lok Vyavhaar.

Key Points

• The Chief Minister of Uttar Pradesh, Yogi Adityanath, officially launched the book titled Rajal Neeti: Lok Vyavhaar in May 2025.

• The book is authored by Rajal Bandwar, who is known for writing literature focused on personal development, management, and ethical conduct.

• The primary objective of Rajal Neeti: Lok Vyavhaar is to provide a comprehensive guide on public etiquette and the nuances of social behavior in both professional and personal spheres.

• During the launch event held in Lucknow, the Chief Minister emphasized that the book serves as an essential resource for cultivating moral values and improving interpersonal communication within society.

• The book Rajal Neeti: Lok Vyavhaar integrates traditional Indian values with modern-day social requirements, making it a relevant guide for the youth and public servants alike.

Additional Information

• Scope of the Book:

• The term Lok Vyavhaar translates to "Public Dealing" or "Social Interaction". It covers various aspects of manners, body language, and the art of conversation.

• The book Rajal Neeti: Lok Vyavhaar is part of a series by Rajal Bandwar that aims to simplify complex management principles for the common public.

• Other Books in the Series:

• Rajal Neeti: Time Management: This book focuses on efficiency, productivity, and the optimal utilization of time to achieve success in various walks of life.

• Sanghatil Manavi Vyavasthapan: This work deals with human resource management within organizations, emphasizing the psychological and administrative aspects of leading teams.

• Government Focus on Literature:

• The Government of Uttar Pradesh has frequently supported the publication of books that promote social harmony and administrative excellence.

• Chief Minister Yogi Adityanath has been associated with several book launches, including those that document cultural heritage and developmental milestones of the state.

Important Points

• Theme of Public Etiquette: The book addresses the growing need for civility in public discourse and provides practical tips on conflict resolution and empathy.

• Significance for Youth: The Chief Minister noted that the Rajal Neeti series is particularly beneficial for students and competitive exam aspirants to develop soft skills and a disciplined lifestyle.

• The Divine Kumbh: While The Divine Kumbh is another notable publication related to the state of Uttar Pradesh, it focuses on the spiritual and cultural significance of the Kumbh Mela rather than public etiquette.

• Language and Accessibility: The book is written in an accessible language to ensure that the message of ethical living and refined conduct reaches a wide audience across India.

Q100. Answer: (b) Haryana

The correct answer is Haryana.

Key Points

• Haryana emerged as the overall champion at the 23rd National Para Athletics Championships, which concluded in January 2025.

• The prestigious event was organized at the Nehru Stadium located in Chennai, Tamil Nadu, under the aegis of the Paralympic Committee of India (PCI).

• Haryana dominated the medals tally by securing a total of 131 medals, which included 53 gold, 45 silver, and 33 bronze medals.

• The host state, Tamil Nadu, secured the second position in the combined standings with a total of 58 medals (18 gold, 21 silver, and 19 bronze).

• Maharashtra finished in the third position, claiming 53 medals in total, comprising 18 gold, 15 silver, and 20 bronze medals.

Additional Information

• Paralympic Committee of India (PCI):

• The PCI is the apex body for promoting para-sports in the country and is recognized by the International Paralympic Committee (IPC).

• The current President of the PCI is Devendra Jhajharia, a two-time Paralympic gold medalist in javelin throw.

• Classification in Para Athletics:

• Athletes are categorized into different classes based on their impairment to ensure fair competition. For example, 'T' stands for Track events and 'F' stands for Field events.

• Specific numbers follow the prefix, such as T42 or F57, denoting the type and level of physical limitation.

• Growth of Para Sports in India:

• Following India's record-breaking performances at the Tokyo 2020 and Paris 2024 Paralympics, there has been a significant increase in government funding and public interest in para-athletics.

• The Khelo India Para Games, launched recently, further complements the National Championships in identifying grassroots talent.

• Nehru Stadium, Chennai:

• It is a multi-purpose stadium with a capacity of approximately 40,000 people and is a hub for athletics in South India.

• The stadium provided world-class facilities for the 23rd edition of the championships, ensuring accessibility for all competing athletes.

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