RRB Group D Official Paper (Held On: 23 Dec, 2025 Shift 3) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of the following is classified as an element?

(a) Copper
(b) Salt
(c) Air
(d) Water

Q2. Two objects of mass 100 kg each are separated by a distance of 1 m. What will be the magnitude of the gravitational force between the two objects? (Take the value of G as 6.67 × 10^(-11) Nm²/kg²)

(a) 6.67 × 10^(-7) N
(b) 6.67 × 10^(-9) N
(c) 6.67 × 10^7 N
(d) 6.67 × 10^9 N

Q3. In a metallic wire obeying Ohm's Law, if the resistance remains constant, reducing the potential difference across its terminals to one-half of its former value will result in what change in the current flowing through it?

(a) The current reduces to one-half of its former value.
(b) The current doubles.
(c) The current remains constant.
(d) The current reduces to one-fourth of its former value.

Q4. Select the option that balances the following reaction.

$CaCO3 + x\ HCl \rightarrow y\ CaCl2 + CO2 + z\ H2O$

(a) x=1, y=1, z=1
(b) x=2, y=2, z=1
(c) x=1, y=1, z=2
(d) x=2, y=1, z=1

Q5. Which of the following statements is INCORRECT about regeneration?

(a) In complex animals, regeneration is limited to repair of tissues, not formation of a whole organism.
(b) Dogs can regrow lost body parts and form whole new individuals.
(c) Fragmentation occurs in simple multicellular organisms like Spirogyra.
(d) Regeneration involves specialised cells and requires cell division.

Q6. The blue colour of the sky appears due to:

(a) refraction of light by air molecules
(b) scattering of shorter wavelength of sunlight by air molecules
(c) absorption of blue light by air molecules
(d) reflection of light by air molecules

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Q7. Which of the following is NOT correct?

(a) In the electrical circuit, the voltmeter is connected in series with the component.
(b) A bulb glows only in a closed circuit.
(c) In the electrical circuit, if the switch is open, no current flows.
(d) In the electrical circuit, the direction of current is taken from the positive to the negative terminal.

Q8. Why are ceilings of concert halls often made curved?

(a) To completely stop reverberation
(b) To reduce the speed of sound in air
(c) To reflect sound uniformly in all directions
(d) To absorb sound and reduce loudness

Q9. Which of the following conditions is essential for rusting of iron?

(a) Only water
(b) Both air and water
(c) Only air
(d) Dry air only

Q10. How is the work done by a force calculated?

(a) Work = displacement ÷ force
(b) Work = force ÷ displacement
(c) Work = force + displacement
(d) Work = force × displacement

Q11. The Chipko Andolan refers to which of the following?

(a) Government-sponsored environmental protection schemes
(b) Active participation of local communities in protecting forests
(c) Use of advanced technologies for reducing environmental pollution
(d) Government-sponsored water harvest schemes

Q12. Which of the following best describes the function of nervous tissue?

(a) It provides rigidity and strength to the body framework.
(b) It protects internal organs from mechanical injury.
(c) It stores energy in the form of fat globules.
(d) It transmits information rapidly from one body part to another.

Q13. Which of the following metals, according to the reactivity series, is the most reactive?

(a) Copper
(b) Zinc
(c) Iron
(d) Potassium

Q14. In which of the following plants, seed is dispersed by the bursting of fruits?

(a) Xanthium
(b) Castor
(c) Sunflower
(d) Urena

Q15. Newton's third law of motion deals with the nature of _____.

(a) a single object resisting a change in motion
(b) forces always occurring in pairs
(c) the relationship between mass and acceleration
(d) the force of gravity acting on a falling object

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Q16. The reaction between sodium sulphate and barium chloride is an example of double displacement reaction. This is also an example of:

(a) combination reaction
(b) precipitation reaction
(c) decomposition reaction
(d) displacement reaction

Q17. The sign of acceleration depends on its direction relative to velocity. Which of the following is correct?

(a) Acceleration is positive if it is opposite to the direction of velocity.
(b) Acceleration is always positive, irrespective of direction.
(c) Acceleration is negative if it is in the direction of velocity.
(d) Acceleration is positive if it is in the direction of velocity, and negative if it is opposite.

Q18. Formula unit mass is:

(a) the sum of the atomic number of all atoms in a formula unit of a compound
(b) the sum of the number of protons of all atoms in a formula unit of a compound
(c) the sum of the atomic masses of all atoms in a formula unit of a compound
(d) the sum of the number of electrons of all atoms in a formula unit of a compound

Q19. What is the function of plasma in human blood?

(a) It carries oxygen from lungs to all parts of the body.
(b) It maintains the oxygen-rich blood supply to tissues.
(c) It transports food, carbon dioxide and waste materials.
(d) It helps in clotting blood during injuries.

Q20. An object is placed 10 cm from a concave lens of focal length 15 cm. Which statement about the image is correct?

(a) Image is real, inverted and smaller than the object.
(b) Image is virtual, erect and larger than the object.
(c) Image is virtual, erect and smaller than the object.
(d) Image is real, inverted and larger than the object.

Q21. Which statement correctly defines the process of evaporation?

(a) It changes solids directly into vapors upon heating strongly
(b) It takes place only at the boiling temperature of a liquid
(c) It changes a liquid to gas from the surface below boiling point
(d) It requires the liquid to freeze before changing to the gas form

Q22. Which of the following is a physical property of metals?

(a) Highly ductile and malleable
(b) Soft and break with light force
(c) Poor conductor of heat and brittle
(d) Form gases at room temperature

Q23. What determines the sex of a child in humans?

(a) Number of autosomes
(b) Mitochondrial DNA
(c) Mother’s ovum
(d) Father’s sperm

Q24. Which of the following breeds of cows is resistant to diseases?

(a) Jersey
(b) Red Sindhi
(c) Brown Swiss
(d) Aseel

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Q25. Who first described the nucleus as a cell organelle in 1831?

(a) Rudolf Virchow
(b) Robert Hooke
(c) Anton van Leeuwenhoek
(d) Robert Brown

MATHEMATICS

Q26. Two trains 259 m and 431 m long are running in opposite directions at a speed of 52 km/h and 56 km/h, respectively. They cross each other in:

(a) 22 seconds
(b) 34 seconds
(c) 23 seconds
(d) 18 seconds

Q27. In an election between two candidates, one candidate secured 42% of the votes and was defeated by the other candidate with a margin of 416 votes. If all the votes cast were valid, what was the total number of votes polled?

(a) 2615
(b) 2590
(c) 2595
(d) 2600

Q28. The price of fuel decreases by 40%, 25% and 45% in three successive months, but increases by 55% in the fourth month. What is the percentage increase/decrease in the price of fuel in the fourth month as compared to its original price? (Round off your answer to two decimal places)

(a) Increases by 67.66%
(b) Increases by 64.75%
(c) Decreases by 63.14%
(d) Decreases by 61.64%

Q29. Which of the following numbers is divisible by both 6 and 9, but not divisible by 12?

126, 252, 72, 108

(a) 108
(b) 126
(c) 72
(d) 252

Q30. A, B and C can do a piece of work in 3, 15 and 10 days, respectively. How long (in days) will they take to do twice the same work, working together?

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

Q31. The amount on a sum of Rs. 2,000 at 5% per annum compound interest, compounded annually, in 2 years will be:

(a) Rs. 3,039
(b) Rs. 2,886
(c) Rs. 2,880
(d) Rs. 2,205

Q32. Saloni's age is 7 years more than twice her sister Emma's age. If the sum of their ages is 25 years, how old is Emma?

(a) 5 years
(b) 7 years
(c) 6 years

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(d) 8 years

Q33. An agent sells a pan with a marked price of Rs. 6,420 at a discount of 30%. What is the selling price (in Rs.) of the pan?

(a) 4,494
(b) 5,136
(c) 4,935
(d) 4,449

Q34. The prices of articles P, Q and R are Rs. 280, Rs. 180 and Rs. 100, respectively. Subrata buys these articles in the ratio 3 : 4 : 5, spending a total of Rs. 26,780. How many articles of type Q did he buy?

(a) 76
(b) 52
(c) 84
(d) 40

Q35. Simplify ((3²)^6)^5 and express it as a power of 9. What is the exponent of 9?

(a) 10
(b) 30
(c) 60
(d) 90

Q36. The total cost of 10 mangoes and 13 apples is Rs. 134 and the cost of 4 apples is Rs. 13 less than that of 15 mangoes. Then find the price (in rupees) of a mango and an apple, respectively.

(a) 3, 8
(b) 3.50, 5
(c) 4, 5.60
(d) 2.7

Q37. Find the value of (sin 30° + cos 60°)/(cot 45°).

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

Q38. The average of 8 numbers is 121. If the first 7 numbers are 35, 35, 49, 83, 102, 80 and 20, then the eighth number is:

(a) 567
(b) 564
(c) 557
(d) 566

Q39. The salaries of X, Y and Z are in the ratio 4:18:21. If the increments of 90%, 90% and 40% are allowed, respectively, in their salaries, then what will be the new ratio of their salaries?

(a) 35:172:153
(b) 36:172:149
(c) 38:171:147
(d) 41:173:154

Q40. The arithmetic mean of the observations 35, 53, 38, 89, 71, 69, 86, 40 and 41 is:

(a) 66
(b) 60
(c) 58
(d) 65

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Q41. A shopkeeper offers the following four schemes:

A) Two successive discounts of 39% and 8%

B) Buy 8, get 4 free

C) A single discount of 16%

D) Two successive discounts of 38% and 34%

Which scheme is best for the shopkeeper?

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

Q42. Two pipes can fill a cistern, individually, in 96 min and 64 min, respectively. There is a pipe located at the bottom of the cistern to empty it. If all the three pipes are opened simultaneously, then the empty cistern gets filled in 48 min. How long will the pipe at the bottom of the tank take to empty the completely filled cistern if no other pipe is then open?

(a) 175 min
(b) 192 min
(c) 207 min
(d) 201 min

Q43. In a quadrilateral MNST, angle M = 63° and angle N = 99°. The bisectors of angle S and angle T meet at O. What is the measure of angle TOS?

(a) 94°
(b) 81°
(c) 73°
(d) 87°

Q44. What is the least number which should be added to 539, so that the number obtained is exactly divisible by 10, 15 and 3?

(a) 1
(b) 5
(c) 2
(d) 3

Q45. A park, in the shape of a quadrilateral ABCD, has angle C = 90°, AB = 36 m, BC = 42 m, CD = 40 m and AD = 36 m. What is the area (in m^2, rounded off to 1 decimal place) of the park?

(a) 1485.6
(b) 1548.6
(c) 1458.6
(d) 1584.6

Q46. A man has to cover a distance of 168 km in 18 hours. If he covers two-thirds of this distance in 2/6 of the time, then what should be his speed (in km/hr, rounded off to one decimal place) to cover the remaining distance in the time left ?

(a) 4.7
(b) 4.6
(c) 8.8
(d) 8.2

Q47. In a test, B got 50 marks while A got 75 marks, out of 120 maximum marks. What percentage of A's marks was B's marks? (Round off your answer to two decimal places)

(a) 62.25%
(b) 66.67%
(c) 150.33%
(d) 120.73%

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Q48. If a solid sphere of radius 14 cm is moulded into 8 spherical solid balls of equal radius, then find the surface area of each ball.

(Use π = 22/7)

(a) 650 cm2
(b) 598 cm2
(c) 600 cm2
(d) 616 cm²

Q49. Given a + b + c = 15 and a² + b² + c² = 83, find ab + bc + ca.

(a) 20
(b) 11
(c) 71
(d) 25

Q50. A person sells an article for Rs. 3,450 and earns a profit of 15%. Find the cost price of the article.

(a) Rs. 2,860
(b) Rs. 2,900
(c) Rs. 2,980
(d) Rs. 3,000

GENERAL INTELLIGENCE & REASONING

Q51. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

RUS 36 PSQ 40 NQO 44 LOM 48 ?

(a) JNJ 52
(b) JLJ 51
(c) JMK 52
(d) JLO 51

Q52. JFBC is related to GCYZ in a certain way based on the English alphabetical order. In the same way, WSOP is related to TPLM. To which of the given options is IEAB related, following the same logic?

(a) FBXY
(b) FAWY
(c) FBWY
(d) FCWF

Q53. Six friends, G, H, I, Q, R and S, are sitting around a circular table facing the centre of the table. Only two people sit between G and S when counted from the right of G. Only one person sits between S and I when counted from the right of I. Only three people sit between G and R. H sits to the immediate left of Q. Who sits third to the left of R?1603

(a) Q
(b) G
(c) H
(d) I

Q54. Z ranked 21^(st) from the top and 39^(th) from the bottom in his class. How many students are there in his class?

(a) 60
(b) 57
(c) 56
(d) 59

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Q55. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only.

(Left) # € % # 6 & 4 * 9 6 @ 5 % @ # © 8 # % * £ 2 (Right)

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

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

Q56. 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) LOH
(b) VYP
(c) CFY
(d) ZCV

Q57. 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) 3 1 3 2 8 2 1 2 4 6 1 3 1 8 8 6 1 1 9 5 8 4 1 8 9 6 9 (Right)

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

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

Q58. ABHL is related to FFMP in a certain way based on the English alphabetical order. In the same way, URBB is related to ZVGF. To which of the given options is JDQN related, following the same logic?10119

(a) OHNJ
(b) OHVR
(c) OBHY
(d) OVBH

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

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

Q60. 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) SYDG
(b) UAEI
(c) HNRV
(d) XDHL

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

123 124 127 132 139 ?1182

(a) 151
(b) 147
(c) 148
(d) 145

Q62. Manish starts from Point Y and drives 37 km towards North. He then takes a left turn, drives 75 km, turns left and drives 69 km. He then takes a left turn and drives 52 km. He takes a left turn, drives 32 km to stop at Point Z. How far (shortest distance) and towards which direction should he drive in order to reach Point Y again? (All turns are 90-degree turns only, unless specified.)

(a) 24 km towards west
(b) 25 km towards east
(c) 23 km towards east
(d) 21 km towards west

Q63. In a certain code language,

A ± B means ‘A is the wife of B’,

A * B means ‘A is the son of B’,

A Rs. B means ‘A is the father of B’,

and A # B means ‘A is the sister of B’.

How is D related to O if 'D * R ± A Rs. C # O’?

(a) Husband
(b) Brother
(c) Son
(d) Father

Q64. Jason went on a business trip in his car. He drove west from his house for a distance of 30 km. He turned right and drove 20 km. Then, he turned left and drove 10 km, took another left and drove 40 km. He took a last left and drove 40 km before stopping. How far and in which direction should he drive to reach his house? (All turns are 90-degree turns only, unless specified.)

(a) 10 km towards the south
(b) 20 km towards the south
(c) 10 km towards the north
(d) 20 km towards the north

Q65. A, B, C, D, E and F are sitting around a circular table facing the centre. B sits second to the left of C. D is an immediate neighbour of E. F sits to the immediate left of E. F sits second to the right of A. What is the position of C with respect to E?

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

Q66. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

GKI JNL MQO PTR ?

(a) SWE
(b) SEW
(c) SWU
(d) SUW

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

(Note: Operations should be performed on the whole numbers, without breaking down the numbers into their constituent digits. E.g. 13 – Operations on 13 such as adding/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.)

(158, 568, 726)

(123, 402, 525)

(a) (172, 263, 436)
(b) (170, 382, 554)
(c) (142, 265, 409)
(d) (180, 203, 383)

Q68. What should come in place of the question mark (?) in the given series?

13, 38, 74, 123, ?, 268

(a) 183
(b) 181
(c) 185
(d) 187

Q69. If 'A' stands for '÷', 'B' stands for '×', 'C' stands for '+' and 'D' stands for '−', then what will come in place of the question mark (?) in the following equation?

120 B 15 A 5 D 18 C 22 = ?

(a) 360
(b) 364
(c) 366
(d) 362

Q70. What will come in place of the question mark (?) in the following equation, if '+' and '-' are interchanged and 'x' and '÷' are interchanged?

77 ÷ 12 + 252 x 14 - 177 = ?

(a) 1097
(b) 1083
(c) 1055
(d) 1023

Q71. Select the triad which follows the same pattern as that followed by the two triads given below. Both triads follow the same pattern.

HQ-JS-MO

FO-HQ-KM

(a) DM-FO-IK
(b) CM-FP-IL
(c) DM-FO-IL
(d) CM-FO-IL

Q72. 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) 8 6 1 3 4 1 8 9 6 8 8 6 5 7 1 9 6 9 8 1 7 8 3 8 3 3 8 (Right)

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

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

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Q73. If ‘A’ stands for ‘÷’, ‘B’ stands for ‘×’, ‘C’ stands for ‘+’ and ‘D’ stands for ‘−’, then what will come in place of the question mark (?) in the following equation?

(56 A 7) B 9 D (14 A 7) B 5 C 36 A 4 D 11 = ?

(a) 42
(b) 51
(c) 79
(d) 60

Q74. In a certain code language, ‘live with truth’ is coded as ‘xf je ak’ and ‘truth guides life’ is coded as ‘ub mr je’. How is ‘truth’ coded in that language?

(a) ub
(b) ak
(c) mr
(d) je

Q75. In a certain code language, ‘work fosters growth’ is coded as ‘hw mq pc’ and ‘growth with effort’ is coded as ‘yv ju mq’. How is ‘growth’ coded in that language?

(a) yv
(b) pc
(c) mq
(d) hw

Q76. What should come in place of the question mark (?) in the given series?

115 95 77 61 47 ?

(a) 32
(b) 38
(c) 31
(d) 35

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

Statements:

Some lamps are bulbs.

No bulb is a torch.

No bulb is a candle.

Conclusions:

(I) No lamp is a torch.

(II) Some candles are torches.

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

Q78. In a row of 38 students facing north, Z is 12th from the left end. If G is 3rd to the right of Z, what is G's position from the right end of the line?

(a) 25th
(b) 24th
(c) 22th
(d) 27th

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Q79. 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) 1 3 9 3 2 6 8 3 9 6 2 2 7 7 7 7 3 3 7 3 8 3 5 6 5 9 6 (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) 2
(b) 4
(c) 3
(d) 1

Q80. 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:

No Fictions are Nonfictions.

All Nonfictions are Poetries.

Some Poetries are Dramas.

Conclusions:

(I): Some Fictions are Poetries.

(II): Some Nonfictions are Dramas.

(a) Both conclusions (I) and (II) are true
(b) Only conclusion (II) is true
(c) Neither conclusion (I) nor (II) is true
(d) Only conclusion (I) is true

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. What was the theme of World Tuberculosis Day, 2025, observed in India on 24 March?

(a) Yes! We Can End TB: Commit, Invest, Deliver
(b) Unite to End TB: Fund, Innovate, Act
(c) TB Free by 2030: Global Pact
(d) End TB Now: Diagnose, Treat, Prevent

Q82. Which new legislation replaced outdated regulatory bodies for healthcare professions (MCI) in India, as reported in June 2025?

(a) National Medical Commission
(b) National Drug Council
(c) Indian Medical Commission
(d) National Health Commission

Q83. Which of the following summits in 2025 will be co-hosted by World Health Organization (WHO) and the Ministry of Ayush, Government of India in New Delhi, aiming to strengthen traditional medicine globally?

(a) Second WHO Global Summit on Traditional Medicine 2025
(b) International Summit on Integrative Health 2025
(c) Global Health and Traditional Medicine Summit 2025
(d) World Traditional Medicine Congress 2025

Q84. Which of the following DRDO-executed schemes under the ‘Make in India’ initiative provides grants-in-aid to Indian industries (MSMEs/start-ups) for developing defence and dual-use technologies?

(a) Technology Development Fund (TDF)
(b) Defence Testing Infrastructure Scheme (DTIS)
(c) Aatmanirbhar Defence Innovation & Technology Initiative (ADITI)
(d) Innovations for Defence Excellence (iDEX)

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Q85. Nag Mk 2 Missile has been developed by which organisation?

(a) Centre for Development of Telematics
(b) Indian Space Research Organisation
(c) Defence Research and Development Organisation
(d) Hindustan Aeronautics Limited

Q86. What is India's rank in the Global Innovation Index, 2025, published by the World Intellectual Property Organization (WIPO)?

(a) 49th
(b) 38th
(c) 44th
(d) 30th

Q87. Which theme was celebrated for World Malaria Day on 25 April 2025?

(a) Time to Beat Malaria: Reinvest, Reimagine, Reignite
(b) Malaria Ends with Us: Reinvest, Reimagine, Reignite
(c) Invest in Malaria-Free Future: Reinvest, Reimagine, Reignite
(d) Zero Malaria Starts with Me: Reinvest, Reimagine, Reignite

Q88. Which Ministry of the Government of India carried out the Management Effectiveness Evaluation (MEE) for 2020-2025?

(a) Ministry of Jal Shakti
(b) Ministry of Agriculture
(c) Ministry of Environment, Forest and Climate Change
(d) Ministry of Rural Development

Q89. The FIFA Women's World Cup 2027 will be held in:

(a) Uruguay
(b) Japan
(c) Portugal
(d) Brazil

Q90. As announced in the April 2025 Monetary Policy Committee meeting, the Reserve Bank of India aims to keep liquidity surplus close to what percentage of deposits?

(a) 1.5%
(b) 1%
(c) 2%
(d) 0.5%

Q91. As of 1 March 2025, who became the Chairman of the Securities and Exchange Board of India?

(a) Ananth Narayan G
(b) Tuhin Kanta Pandey
(c) Madhabi Puri Buch
(d) Ashwani Bhatia

Q92. Which Indian city hosted the first ever three-day Fit India Carnival, a holistic health and fitness gathering festival, in March 2025?

(a) Dehradun
(b) New Delhi
(c) Bhopal
(d) Mumbai

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Q93. During 2025-26, India's overall goods and services exports are expected to reach _____.

(a) $1.5 trillion
(b) $0.5 trillion
(c) $2 trillion
(d) $1 trillion

Q94. Which of the following organisations won the Forward Faster Sustainability Award 2025 for Water Resilience?

(a) Defence Research and Development Organisation
(b) National Thermal Power Corporation
(c) Council of Scientific and Industrial Research
(d) Oil and Natural Gas Corporation

Q95. In which of the following Indian cities was the India–Sri Lanka Joint Military Exercise 'MITRA SHAKTI-2025' conducted?

(a) Chennai (Tamil Nadu)
(b) Pune (Maharashtra)
(c) Jaipur (Rajasthan)
(d) Belagavi (Karnataka)

Q96. In 2025, which of the following Bills was passed by Karnataka to strengthen child protection by outlawing not only child marriage but also betrothal of minors?

(a) Child Rights Enhancement Bill, 2025
(b) Karnataka Minor Marriage Protection Bill, 2025
(c) Prohibition of Child Marriage (Karnataka Amendment) Bill, 2025
(d) Karnataka Child Welfare Bill, 2025

Q97. What is the rank of India in the Global Firepower Index 2025?

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

Q98. Which tennis veteran became the first Asian male with 450 career wins by April 2025?

(a) Yuki Bhambri
(b) Prajnesh Gunneswaran
(c) Somdev Devvarman
(d) Kei Nishikori

Q99. According to the UN Sustainable Development Report (SDR) 2025, what is India's SDG Index Rank and Score?

(a) Rank 109 with score 64.10
(b) Rank 95 with score 70.50
(c) Rank 100 with score 66.95
(d) Rank 99 with score 66.95

Q100. Where was the 2025 Senior National Table Tennis Championships held?

(a) Pandit Dindayal Upadhyay Indoor Stadium, Surat
(b) Jawaharlal Nehru Indoor Stadium, Chennai
(c) Thyagaraj Stadium, Delhi
(d) Kalinga Stadium, Bhubaneswar

ANSWER KEY

1	a	2	a	3	a	4	d	5	b	6	b	7	a	8	c	9	b	10	d
11	b	12	d	13	d	14	b	15	b	16	b	17	d	18	c	19	c	20	c

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

SOLUTIONS

Q1. Answer: (a) Copper

The correct answer is Copper.

Key Points

• An element is a pure substance that consists entirely of one type of atom and cannot be broken down into simpler substances by chemical means.

• Copper is a chemical element represented by the symbol Cu and carries the atomic number 29. It exists as a pure substance in its metallic form, making it a classic example of an element found in the periodic table. Hence, statement 1 is correct.

• Salt, commonly known as table salt, is a chemical compound called Sodium Chloride with the formula NaCl. It is formed by the chemical bonding of Sodium (Na) and Chlorine (Cl) in a fixed 1:1 ratio. Hence, statement 2 is incorrect.

• Air is not a single substance but a homogeneous mixture of various gases. It primarily consists of Nitrogen (78%) and Oxygen (21%), along with traces of Argon, Carbon Dioxide, and water vapor. These gases are physically mixed but not chemically bonded. Hence, statement 3 is incorrect.

• Water is a compound composed of two different elements: Hydrogen and Oxygen. Its chemical formula is H2O, indicating that two atoms of hydrogen are chemically bonded to one atom of oxygen. Hence, statement 4 is incorrect.

• Hence, the correct answer is Copper.

Additional Information

• Characteristics of Elements:

• There are 118 confirmed elements known to science, of which 94 occur naturally on Earth.

• Elements are categorized into Metals, Non-metals, and Metalloids based on their physical and chemical properties.

• Copper is classified as a transition metal, located in Group 11 and Period 4 of the periodic table.

• Compounds vs. Mixtures:

• Compounds (like Water or Salt) have a fixed composition and properties that differ significantly from their constituent elements. They can only be separated by chemical methods.

• Mixtures (like Air) do not have a fixed ratio and retain the individual properties of their components. They can be separated by physical methods such as filtration or distillation.

• Properties and Uses of Copper:

• Copper is highly valued for its excellent electrical conductivity and thermal conductivity, ranking second only to Silver among pure metals.

• It is widely used in electrical wiring, telecommunications, electronics, and plumbing.

• Historically, it was the first metal to be smelted from its ore around 5000 BC and the first metal to be cast into a shape in a mold around 4000 BC.

Important Points

• Atomic Structure: The identity of an element is determined by the number of protons in its nucleus, known as the atomic number. For Copper, every atom contains exactly 29 protons.

• State of Matter: At standard temperature and pressure (STP), Copper is a reddish-orange solid, Water is a liquid, and Air consists of gases.

• Abundance: While Copper is an essential trace mineral for all living organisms, it is found in the Earth's crust at a concentration of about 50 parts per million (ppm).

• Common Alloys: Because it is an element, Copper can be mixed with other elements to form alloys. For example, Brass is an alloy of Copper and Zinc, while Bronze is primarily Copper and Tin.

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Q2. Answer: (a) 6.67 × 10^(-7) N

The correct answer is 6.67 x 10^-7 N.

Key Points

• Newton's Law of Universal Gravitation states that the gravitational force between two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

• The mathematical formula for this force is F = G (m1 * m2) / r^2, where F is the force, G is the gravitational constant, m1 and m2 are the masses, and r is the distance.

• In this problem, the given values are: mass m1 = 100 kg, mass m2 = 100 kg, and distance r = 1 m.

• The Universal Gravitational Constant (G) is provided as 6.67 x 10^-11 Nm^2/kg^2.

• By substituting the values into the formula: F = (6.67 x 10^-11) * (100 * 100) / (1)^2.

• Solving the calculation: 100 * 100 = 10,000 (which is 10^4). Therefore, F = 6.67 x 10^-11 * 10^4.

• Adding the exponents (-11 + 4 = -7), we get the final magnitude of force as 6.67 x 10^-7 Newtons.

Additional Information

• Sir Isaac Newton: He formulated the Law of Universal Gravitation and published it in his work Philosophiae Naturalis Principia Mathematica in 1687.

• Inverse Square Law: The force of gravity follows an inverse-square relationship. If the distance between two objects is doubled, the gravitational force becomes one-fourth (1/4) of its original strength.

• Universal Constant (G): Unlike the acceleration due to gravity (g), which changes depending on location (like on Earth vs. the Moon), the value of G remains constant throughout the universe.

• Henry Cavendish: The value of G was first measured accurately in a laboratory by the English scientist Henry Cavendish in 1798 using a torsion balance.

• Always Attractive: Gravitational force is always attractive in nature and acts along the line joining the centers of the two bodies. It is one of the four fundamental forces of nature.

Important Points

• Weakness of Gravity: Despite being the force that keeps planets in orbit, gravity is the weakest of the fundamental forces. It only becomes significant when dealing with massive bodies like stars, planets, or moons.

• Mass vs. Weight: Mass is the amount of matter in an object and is measured in kilograms (kg), while weight is the gravitational force acting on that mass and is measured in Newtons (N).

• Medium Independence: The gravitational force between two masses does not depend on the medium (water, air, or glass) placed between them. It remains the same regardless of the environment.

• Range: The range of gravitational force is infinite, meaning every object in the universe exerts some amount of gravitational pull on every other object, no matter how far apart they are.

Q3. Answer: (a) The current reduces to one-half of its former value.

The correct answer is The current reduces to one-half of its former value.

Key Points

• Ohm's Law states that the electric current (I) flowing through a metallic conductor is directly proportional to the potential difference (V) applied across its terminals, provided that physical conditions like temperature and pressure remain constant.

• The relationship is mathematically expressed as V = IR, where R is the resistance of the conductor.

• When the resistance (R) remains constant, the current can be calculated using the formula I = V / R. This implies that the current is linearly dependent on the voltage.

• If the potential difference is reduced to one-half (1/2) of its original value, the new current (I') becomes (V/2) / R, which is equivalent to 1/2 * (V/R). Hence, the statement that the current reduces to one-half of its former value is correct.

• This proportionality means that any factor by which the voltage is scaled will result in the current being scaled by that same factor, as long as the metallic wire obeys Ohm's Law and its resistance does not change.

Additional Information

• Electric Current (I):

• It is defined as the rate of flow of electric charge through a cross-section of a conductor.

• The SI unit of current is the Ampere (A), named after André-Marie Ampère.

• It is measured using an instrument called an ammeter, which is always connected in series in an electrical circuit to ensure the full current flows through it.

• Potential Difference (V):

• Also known as voltage, it is the work done to move a unit charge from one point to another in an electric field.

• The SI unit is the Volt (V), named after Alessandro Volta.

• It is measured using a voltmeter, which is connected in parallel across the points where the potential difference is to be

determined.

• Resistance (R):

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

• The SI unit is the Ohm (Ω). One Ohm is defined as the resistance of a conductor such that a potential difference of 1 Volt causes a current of 1 Ampere to flow.

• The resistance of a wire depends on its length (L), cross-sectional area (A), and the resistivity (ρ) of the material.

Important Points

• Discovery of Ohm's Law: The law was determined experimentally by the German physicist Georg Simon Ohm and published in his 1827 treatise, "The Galvanic Circuit Investigated Mathematically."

• Ohmic and Non-Ohmic Conductors:

• Materials that strictly follow V = IR are called Ohmic conductors (e.g., copper, silver, and most metals at constant temperature).

• Materials that do not follow this linear relationship are Non-Ohmic, such as diodes, transistors, and semiconductors, where the resistance changes with the applied voltage or current.

• V-I Graph: For a conductor obeying Ohm's Law, a graph of Voltage (V) versus Current (I) is a straight line passing through the origin (0,0). The slope of this line represents the resistance (R) of the conductor.

• Power Dissipation: In a circuit where the potential difference is halved and resistance is constant, the power ($P = V^2/R$) dissipated by the wire actually reduces to one-fourth (1/4) of its original value.

Q4. Answer: (d) x=2, y=1, z=1

The correct answer is x=2, y=1, z=1.

Key Points

• The provided chemical equation involves the reaction between Calcium Carbonate (CaCO3) and Hydrochloric Acid (HCl) to produce Calcium Chloride (CaCl2), Carbon Dioxide (CO2), and Water (H2O).

• To balance the equation, we apply the Law of Conservation of Mass, which states that the number of atoms of each element must be equal on both the reactant and product sides.

• Balancing Calcium (Ca): There is 1 atom of Ca on the reactant side. To balance this, the product side must also have 1 atom of Ca. Since Ca is in CaCl2, the coefficient y must be 1. Hence, the statement for y=1 is correct.

• Balancing Oxygen (O): There are 3 Oxygen atoms in CaCO3 on the left. On the right, there are 2 atoms in CO2 and z atoms in H2O. The equation 3 = 2 + z gives z = 1. Hence, the statement for z=1 is correct.

• Balancing Hydrogen (H): There are x atoms of Hydrogen on the left in HCl. On the right, there are 2 atoms in H2O (since z=1, 2 × 1 = 2). Therefore, x must be 2. Hence, the statement for x=2 is correct.

• Balancing Chlorine (Cl): On the left, we have x = 2 atoms of Chlorine. On the right, there are 2y atoms in CaCl2. Since y = 1, 2(1) = 2. This confirms that the Chlorine atoms are balanced.

• The final balanced chemical equation is CaCO3 + 2 HCl -> CaCl2 + CO2 + H2O.

Additional Information

• Calcium Carbonate (CaCO3): This is a white, insoluble solid widely found in nature as limestone, marble, and chalk. It is a major component of eggshells and seashells.

• Hydrochloric Acid (HCl): A strong, colorless, highly pungent solution of hydrogen chloride in water. It is a primary gastric acid found in the human stomach and is used industrially for metal cleaning and pH regulation.

• Reaction Products: The reaction results in Calcium Chloride (CaCl2), which is a salt commonly used for de-icing roads and as a firming agent in food. The Carbon Dioxide (CO2) gas produced causes visible effervescence (fizzing).

• Carbon Dioxide Test: The identity of the evolved gas can be confirmed using the limewater test. When CO2 is bubbled through Calcium Hydroxide (limewater), it forms a white precipitate of CaCO3, turning the solution milky.

• Reaction Type: This is an acid-carbonate reaction. General chemistry dictates that an acid reacting with a metal carbonate will always yield a salt, water, and carbon dioxide gas.

Important Points

• Stoichiometry: According to the balanced equation, 1 mole of Calcium Carbonate reacts with 2 moles of Hydrochloric Acid. This 1:2 molar ratio is essential for calculating reactant quantities in a laboratory setting.

• Conservation of Mass: Formulated by Antoine Lavoisier in 1789, this principle is the foundation for all chemical equation balancing, ensuring that no matter is lost during the process.

• State Symbols: In a formal setting, the reaction is written as CaCO3 (s) + 2 HCl (aq) -> CaCl2 (aq) + CO2 (g) + H2O (l), indicating the physical states of the reactants and products.

• Practical Application: This reaction is the fundamental mechanism behind antacid tablets (containing CaCO3) neutralizing stomach acid (HCl) to relieve heartburn and indigestion.

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Q5. Answer: (b) Dogs can regrow lost body parts and form whole new individuals.

The correct answer is Dogs can regrow lost body parts and form whole new individuals.

Key Points

• Regeneration is a process by which some organisms can regrow a lost body part or even form a whole new individual from a small fragment of their body.

• In complex animals such as mammals (including humans and dogs), the ability to regenerate is strictly limited to the repair of tissues and specific organs rather than the creation of entire new individuals or complex limbs. Hence, statement 1 is correct.

• Dogs are highly complex multicellular organisms with specialized organ systems; they do not possess the biological capability to regrow lost limbs or regenerate a whole new dog from a body part. Hence, statement 2 is incorrect and is the correct answer.

• Fragmentation is a form of asexual reproduction seen in simple multicellular organisms like Spirogyra, where the body simply breaks into smaller pieces upon maturation, and each piece grows into a new filament. Hence, statement 3 is correct.

• Regeneration is carried out by specialised cells that proliferate to make a large number of cells; from this mass of cells, different cells undergo changes to become various cell types and tissues through cell division and differentiation. Hence, statement 4 is correct.

Additional Information

• Organisms with High Regenerative Capacity:

• Simple animals like Hydra and Planaria (flatworms) exhibit remarkable regenerative powers. If they are cut into any number of pieces, each piece can grow into a complete organism.

• This process is not the same as reproduction, as most organisms would not normally depend on being cut up to be able to reproduce.

• Mechanism of Regeneration:

• It involves morphallaxis (remodeling of existing tissues) or epimorphosis (growth of new tissue via a blastema).

• In Planaria, the process is driven by pluripotent stem cells called neoblasts, which can transform into any cell type required by the organism.

• Difference between Fragmentation and Regeneration:

• Fragmentation occurs in organisms with relatively simple body designs where every cell/part has the potential to become a new individual spontaneously.

• Regeneration is a more complex mechanism where specialized cells respond to an injury to restore lost anatomy.

Important Points

• Regeneration in Vertebrates:

• While Dogs cannot regenerate limbs, some Amphibians like Salamanders and Axolotls can regrow entire limbs, tails, and even parts of their hearts and brains.

• Lizards exhibit autotomy, where they can shed their tail to escape a predator and subsequently regrow it, although the new tail is often different in structure (cartilage instead of bone).

• Human Limitations:

• In Humans, the Liver is the only internal organ capable of significant natural regeneration; as little as 25% of the original liver mass can regenerate back to its full size within weeks.

• Other human tissues, like skin and blood, are constantly being renewed through cell division, but this is categorized as physiological turnover rather than whole-body regeneration.

Q6. Answer: (b) scattering of shorter wavelength of sunlight by air molecules

The correct answer is scattering of shorter wavelength of sunlight by air molecules.

Key Points

• The blue color of the sky is a result of a phenomenon known as Rayleigh scattering. As Sunlight reaches the Earth's atmosphere, it is scattered in all directions by the gases and particles present in the air.

• Light travels as waves of different wavelengths. Blue light travels in shorter, smaller waves, whereas red light travels in longer, larger waves.

• According to the Rayleigh Law of Scattering, the intensity of scattered light is inversely proportional to the fourth power of the wavelength of light. This means that shorter wavelengths (like blue and violet) are scattered much more strongly than longer wavelengths (like red and yellow) when they strike the molecules of nitrogen and oxygen in the atmosphere. Hence, statement 2 is correct.

• While violet light has an even shorter wavelength than blue light and is scattered even more, the sky appears blue to us because the Sun emits much more blue light than violet, and the human eye is significantly more sensitive to blue than to violet.

• Refraction of light is the bending of light as it passes from one medium to another. While it causes phenomena like twinkling of stars, it is not responsible for the blue color of the sky. Hence, statement 1 is incorrect.

• Absorption would involve the air molecules taking in the light energy and not re-emitting it, which would make the sky appear

dark rather than bright blue. Hence, statement 3 is incorrect.

• Reflection usually occurs on larger surfaces or particles (like mirrors or water droplets) and does not explain the uniform color distribution of the clear sky. Hence, statement 4 is incorrect.

Additional Information

• The Visible Spectrum:

• The visible light spectrum consists of colors ranging from Violet (shortest wavelength, approx 400 nm) to Red (longest wavelength, approx 700 nm).

• In the vacuum of space, where there is no atmosphere to scatter light, the sky appears completely black, and the Sun looks like a bright white disk.

• Red Appearance of Sunset and Sunrise:

• During sunrise and sunset, sunlight has to travel through a much thicker layer of the atmosphere to reach our eyes.

• By the time the light reaches us, most of the shorter wavelengths (blue and violet) have been scattered away, leaving primarily the longer wavelengths like red and orange to pass through.

• Tyndall Effect:

• The Tyndall effect is the scattering of light by much larger colloidal particles or very fine suspensions (like dust or smoke in a room).

• This is different from Rayleigh scattering, which occurs when the scattering particles (molecules) are much smaller than the wavelength of the light.

• Atmospheric Composition:

• The Earth's atmosphere is composed of approximately 78% Nitrogen and 21% Oxygen. These gas molecules are the primary agents for the Rayleigh scattering that creates the blue sky.

• If the Earth had no atmosphere, the sky would look as dark as it does on the Moon.

Important Points

• Lord Rayleigh: The phenomenon was theoretically explained by the British physicist Lord Rayleigh in the year 1871. He formulated the mathematical relationship showing how scattering varies with wavelength.

• Scattering Intensity: The relationship is expressed as Intensity (I) prop. to 1 / λ^4, where λ is the wavelength. This confirms that shorter wavelengths are scattered with exponentially greater intensity.

• Sky on Other Planets: On Mars, the sky can appear pinkish-red during the day due to the presence of iron-rich dust in its thin atmosphere, which scatters light differently than Earth's gas-heavy atmosphere.

Q7. Answer: (a) In the electrical circuit, the voltmeter is connected in series with the component.

The correct answer is In the electrical circuit, the voltmeter is connected in series with the component.

Key Points

• In an electrical circuit, a voltmeter is always connected in parallel with the component across which the potential difference is to be measured. This is because a voltmeter has a very high resistance so that it takes a negligible current from the circuit. If it were connected in series, it would significantly increase the total resistance of the circuit and reduce the current flow. Hence, statement 1 is incorrect.

• A bulb glows only when there is a continuous and unbroken path for the flow of electricity, which is known as a closed circuit. In an open circuit, the path is broken, preventing the movement of electrons. Hence, statement 2 is correct.

• A switch is a device used to either break the circuit or complete it. When the switch is in the "open" position, it creates an air gap that acts as an insulator, ensuring that no current flows through the circuit. Hence, statement 3 is correct.

• By convention, the direction of electric current is taken as the direction of the flow of positive charges. Therefore, it flows from the positive terminal of the battery to the negative terminal through the external circuit. This is known as conventional current. Hence, statement 4 is correct.

• Hence, the incorrect statement (and the correct answer) is that the voltmeter is connected in series.

Additional Information

• Voltmeter and Ammeter:

• A voltmeter is used to measure voltage or potential difference between two points. It must have infinite resistance ideally to avoid drawing current from the main branch.

• An ammeter is used to measure electric current in a circuit. Unlike a voltmeter, it is always connected in series and must have a very low resistance so that it does not change the current it is supposed to measure.

• Flow of Electrons vs. Conventional Current:

• While conventional current is defined as flowing from positive to negative, the actual physical flow of electrons (negative charges) is from the negative terminal to the positive terminal.

• This distinction is historical, as the concept of current was established before the discovery of the electron by J.J. Thomson in 1897.

• Circuit Components:

• A simple circuit consists of a source (like a cell or battery), conductors (connecting wires), a load (like a bulb or resistor), and a control device (switch).

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

Important Points

• Resistance: It is the property of a conductor to resist the flow of charges through it. Its SI unit is the Ohm (Ω).

• Galvanometer: This is an instrument used to detect the presence and direction of a small electric current in a circuit. It can be converted into a voltmeter by connecting a high resistance in series or into an ammeter by connecting a low resistance (shunt) in parallel.

• Safety Devices: A fuse is a safety device connected in series with the circuit. It has a low melting point and breaks the circuit if the current exceeds a safe limit, preventing short circuits or overloading.

Q8. Answer: (c) To reflect sound uniformly in all directions

The correct answer is To reflect sound uniformly in all directions.

Key Points

• The ceilings of concert halls, conference halls, and cinema halls are designed with a curved shape so that sound, after reflection from the ceiling, reaches all corners of the hall.

• This design ensures the uniform distribution of sound waves, allowing the audience to hear the performance clearly regardless of their seating position. Hence, statement 3 is correct.

• A curved ceiling acts like a large concave reflector. When sound waves hit the curved surface, they are reflected back toward the floor in a spreading pattern, covering a larger area than a flat ceiling would.

• The curvature does not stop reverberation; in fact, controlled reverberation is often desirable in music halls for a richer sound. Hence, statement 1 is incorrect.

• The speed of sound is a physical property of the medium (air) and is affected by temperature and humidity, not by the shape of the ceiling. Hence, statement 2 is incorrect.

• While certain materials are used to absorb sound to prevent echoes, the specific purpose of the curved shape itself is reflection and distribution rather than absorption. Hence, statement 4 is incorrect.

Additional Information

• Soundboard: In many large auditoriums, a curved soundboard is placed behind the speaker or the stage. The source of sound is placed at the focus of the board, so the reflected sound travels as a parallel beam toward the audience.

• Reverberation: This is the persistence of sound in a hall due to repeated reflections. If the reverberation time is too long, sound overlaps and becomes distorted. To control this, sound-absorbent materials like compressed fiberboard or heavy draperies are used on walls.

• Multiple Reflection of Sound: This principle is utilized in various instruments and devices. For example, in a stethoscope, the sound of the patient's heartbeat reaches the doctor's ears by multiple reflections inside the tube.

• Echo: An echo is the sound heard after reflection from a distant obstacle. To hear a distinct echo, the time interval between the original sound and the reflected one must be at least 0.1 seconds. At a standard temperature of 22 degrees Celsius, the minimum distance required for an echo is 17.2 meters.

• Acoustics: The branch of science that deals with the production, control, transmission, reception, and effects of sound is known as Acoustics. Proper acoustic engineering is vital for the construction of theaters and stadiums.

Important Points

• Reflection Laws: Sound follows the same laws of reflection as light, where the angle of incidence is equal to the angle of reflection, and all rays lie in the same plane.

• Intensity: Curved surfaces help in maintaining the intensity of the sound over long distances by preventing the sound energy from scattering into the upper atmosphere of the building.

• Shape: While ceilings are often parabolic or spherical in curve to optimize focus, the general cylindrical or curved design is the most common standard for architectural acoustics.

Q9. Answer: (b) Both air and water

The correct answer is Both air and water.

Key Points

• Rusting is a specific type of corrosion that occurs when iron or iron-based alloys are exposed to oxygen and moisture for a prolonged period.

• For rusting to occur, the presence of both air (oxygen) and water (moisture) is absolutely essential. If either of these components is missing, the chemical reaction cannot proceed. Hence, the statement "Both air and water" is correct.

• The process is an oxidation reaction where iron reacts with oxygen in the presence of water to form hydrated iron (III) oxide, which is commonly known as rust.

• The chemical equation representing this process is: $4Fe + 3O_2 + 6H_2O \rightarrow 2Fe_2O_3.3H_2O$. This shows that iron, oxygen, and water are the primary reactants.

• If iron is kept in dry air (air without moisture), it does not rust. Similarly, if iron is kept in boiled distilled water (water without dissolved air/oxygen) and sealed, it does not rust. Hence, the options "Only air", "Only water", and "Dry air only" are incorrect.

Additional Information

• Chemical Nature of Rust: Rust is a reddish-brown flaky substance. Unlike the protective oxide layer on aluminum, rust is porous and crumbles easily, exposing fresh layers of iron to further oxidation, eventually leading to the structural failure of the object.

• Factors Accelerating Rusting:

• Salinity: The presence of salt in water (like seawater) increases the speed of rusting because ions in the saltwater conduct electricity better, accelerating the electrochemical reaction.

• Acidity: Low pH levels (acidic environments) increase the rate of corrosion.

• Impure Iron: Pure iron rusts slowly, but impurities in the metal can create small electrochemical cells that speed up the process.

• Prevention Methods:

• Galvanization: This is the process of applying a protective zinc coating to iron or steel. Zinc is more reactive than iron and acts as a sacrificial anode.

• Alloying: Mixing iron with elements like chromium and nickel creates stainless steel, which is highly resistant to rusting.

• Barrier Protection: Painting, oiling, or greasing the surface of iron prevents direct contact with air and moisture.

Important Points

• Redox Reaction: Rusting is a redox reaction where iron acts as a reducing agent (loses electrons) and oxygen acts as an oxidizing agent (gains electrons).

• Economic Impact: Rusting causes significant economic loss globally every year by damaging infrastructure such as bridges, ships, pipelines, and automobiles.

• Environmental Factor: High humidity (above 50%) in coastal areas makes iron objects much more susceptible to rapid rusting compared to arid regions.

Q10. Answer: (d) Work = force × displacement

The correct answer is Work = force × displacement.

Key Points

• Work is defined in physics as the measure of energy transfer that occurs when an object is moved over a distance by an external force at least part of which is applied in the direction of the displacement.

• The mathematical formula for work is Work (W) = Force (F) × Displacement (s). This formula applies when the force is constant and acting in the same direction as the displacement. Hence, statement 4 is correct.

• In Statement 1, work is defined as displacement divided by force. This is mathematically incorrect as it does not represent any standard physical quantity in this context. Hence, statement 1 is incorrect.

• Statement 2 suggests that work equals force divided by displacement. This ratio (Force/Displacement) is actually related to the stiffness or spring constant in Hooke's Law, not work. Hence, statement 2 is incorrect.

• Statement 3 proposes that work is the sum of force and displacement. Physical quantities with different dimensions (Newton and Meter) cannot be added together. Hence, statement 3 is incorrect.

• The SI unit of work is the Joule (J), which is equivalent to 1 Newton-meter (N·m). It is named after the English physicist James Prescott Joule.

Additional Information

• Nature of Work: Work is a scalar quantity, meaning it has magnitude but no direction, even though both force and displacement are vector quantities.

• Angle Dependency: If the force is applied at an angle (θ) to the displacement, the formula becomes $W = Fs\cos(\theta)$.

• If $\theta = 0°$, work is maximum and positive.

• If $\theta = 90°$ (force is perpendicular to displacement), the work done is zero.

• If $\theta = 180°$ (force is opposite to displacement), the work done is negative.

• Work-Energy Theorem: This theorem states that the net work done on an object is equal to the change in its kinetic energy. This is a fundamental concept in classical mechanics.

• Power: Power is the rate at which work is performed. It is calculated as Power = Work / Time. The SI unit for power is the Watt (W), where 1 Watt = 1 Joule per second.

• Examples of Zero Work: A person holding a heavy load and standing still does no work because the displacement is zero. Similarly, a satellite orbiting Earth in a circular path does no work because the gravitational force is perpendicular to its velocity.

Important Points

• Dimensions: The dimensional formula for work is [M^1 L^2 T^-2], which is the same as the dimensions for energy and torque.

• CGS Unit: In the Centimetre-Gram-Second system, the unit of work is the erg. One Joule is equal to 10^7 ergs.

• Conservative Forces: Work done by conservative forces (like gravity or electrostatic force) depends only on the initial and final positions of the object, not the path taken.

• Non-Conservative Forces: Work done by non-conservative forces (like friction or air resistance) depends on the actual path traveled. Friction always does negative work as it opposes motion.

Q11. Answer: (b) Active participation of local communities in protecting forests

The correct answer is Active participation of local communities in protecting forests.

Key Points

• The Chipko Andolan, also known as the Chipko Movement, was a non-violent social and ecological movement by rural villagers, particularly women, in India during the 1970s.

• The movement originated in the Reni village of Chamoli district, Uttarakhand (which was then part of Uttar Pradesh) in 1973.

• It was aimed at protecting trees and forests from being cut down by government-backed logging contractors. The term "Chipko" translates to "to hug" or "to stick" in Hindi, reflecting the protestors' primary tactic of hugging trees to prevent them from being felled.

• This movement is a classic example of the active participation of local communities in environmental conservation, proving that decentralized, grassroots efforts can successfully challenge industrial exploitation of natural resources.

• Prominent leaders of this movement included Sunderlal Bahuguna, who gave the slogan "Ecology is permanent economy," and Chandi Prasad Bhatt, who was a pioneer in organizing the local community through the Dasholi Gram Swarajya Sangh.

Additional Information

• Historical Roots (Bishnoi Movement):

• The Chipko movement found its inspiration in a much older event from 1730 in Rajasthan, where Amrita Devi and 363 other members of the Bishnoi community sacrificed their lives to protect Khejri trees from the King's soldiers.

• Role of Women (Eco-feminism):

• The movement is often celebrated as a landmark in Eco-feminism. Women like Gaura Devi played a decisive role; in March 1974, she led 27 women to confront loggers when the village men were away, successfully protecting the Reni forest.

• Legislative Impact:

• As a direct result of the movement's widespread appeal and success, the then Prime Minister Indira Gandhi enforced a 15-year ban on felling green trees in the Himalayan region in 1980 to allow the forest cover to regenerate.

• Awards and Recognition:

• The Chipko Movement was awarded the Right Livelihood Award (often called the Alternative Nobel Prize) in 1987 for its dedication to the conservation, restoration, and ecologically responsible use of India's natural resources.

• Regional Variations (Appiko Movement):

• Inspired by the success in the north, the Appiko Movement was launched in September 1983 in the Uttara Kannada district of Karnataka to protect the Western Ghats from commercial deforestation.

Important Points

• Significance: The movement shifted the perspective of forest management from revenue generation to ecological stability. It highlighted that local communities depend on forests for fuel, fodder, and water, and are thus the best custodians of these resources.

• Non-Violence: Much like the Satyagraha methods of Mahatma Gandhi, the movement relied entirely on peaceful resistance and moral persuasion rather than physical conflict.

• Forest Policy: The movement influenced the Forest Conservation Act of 1980 and the National Forest Policy of 1988, which began to acknowledge the role of tribal and local communities in forest protection.

Q12. Answer: (d) It transmits information rapidly from one body part to another.

The correct answer is It transmits information rapidly from one body part to another.

Key Points

• Nervous tissue is a specialized tissue found in the nervous system that is responsible for the rapid transmission of signals throughout the body.

• It is composed of neurons (nerve cells) and neuroglial cells (support cells) that work together to detect stimuli and coordinate physiological responses.

• The brain, spinal cord, and peripheral nerves are the primary locations where this tissue is found.

• It functions by converting external or internal stimuli into electrical impulses (nerve impulses) and conducting them to different parts of the body. Hence, statement 4 is correct.

• Statement 1 is incorrect because providing rigidity and strength is the primary function of skeletal connective tissue, such as bones.

• Statement 2 is incorrect because protecting internal organs from mechanical injury is primarily done by epithelial tissue and structural connective tissues like the rib cage or adipose cushions.

• Statement 3 is incorrect because storing energy in the form of fat globules is the specific function of adipose tissue.

Additional Information

• Structure of a Neuron:

• A neuron consists of three main parts: the cell body (soma or cyton), dendrites, and an axon.

• The cell body contains the nucleus and cytoplasm, managing the metabolic activities of the cell.

• Dendrites are short, branched extensions that receive incoming signals from other neurons or receptors.

• The axon is a single, long fiber that carries the nerve impulse away from the cell body toward a synapse or an effector organ (like a muscle).

• Types of Nervous Systems:

• The Central Nervous System (CNS) consists of the brain and the spinal cord, acting as the control center for processing information.

• The Peripheral Nervous System (PNS) consists of cranial and spinal nerves that connect the CNS to the rest of the body parts.

• Neuroglia (Glial Cells):

• These are non-neuronal cells that do not produce electrical impulses.

• Their functions include providing structural support, insulation (myelin sheath), and nutrients to the neurons.

• They outnumber neurons in the nervous system and are crucial for homeostasis.

Important Points

• Communication Method: Nervous tissue communicates via electrochemical signals. When a neuron is stimulated, an action potential travels down the axon.

• Synapse: The functional junction between two neurons is called a synapse, where chemical messengers called neurotransmitters (like acetylcholine or dopamine) bridge the gap.

• Myelination: Many axons are covered by a myelin sheath, which acts as an electrical insulator and significantly increases the speed of nerve impulse transmission.

• Irritability and Conductivity: These are the two most distinctive features of nervous tissue. Irritability is the ability to respond to a stimulus, while conductivity is the ability to transmit that response.

Q13. Answer: (d) Potassium

The correct answer is Potassium.

Key Points

• Potassium (K) is placed at the very top of the reactivity series among the given options, making it the most reactive. It is an alkali metal belonging to Group 1 of the Periodic Table with an atomic number of 19. It reacts violently with water and oxygen even at room temperature. Hence, statement 4 is correct.

• Zinc (Zn) is a transition metal with an atomic number of 30. In the reactivity series, it is positioned below magnesium and aluminum but above iron. It reacts with steam and dilute acids but is significantly less reactive than potassium. Hence, statement 2 is incorrect.

• Iron (Fe) has an atomic number of 26 and is located further down the series than zinc. It does not react with cold water but reacts slowly with steam to form iron oxide and hydrogen gas. It is commonly found in the form of ores like haematite and magnetite. Hence, statement 3 is incorrect.

• Copper (Cu) is a noble-like metal with an atomic number of 29. It is placed near the bottom of the reactivity series, specifically below hydrogen. Due to its low reactivity, it does not react with water or dilute hydrochloric acid, making it useful for electrical wiring and plumbing. Hence, statement 1 is incorrect.

• The overall order of reactivity for these four metals from most to least reactive is Potassium (K) > Zinc (Zn) > Iron (Fe) > Copper (Cu).

Additional Information

• The Reactivity Series:

• It is an arrangement of metals in descending order of their chemical reactivity. This series helps in predicting the behavior of metals in displacement reactions, where a more reactive metal displaces a less reactive metal from its salt solution.

• Highly reactive metals like Potassium (K), Sodium (Na), and Calcium (Ca) are found at the top, while least reactive metals like Silver (Ag), Gold (Au), and Platinum (Pt) are at the bottom.

• Storage of Highly Reactive Metals:

• Metals like Potassium and Sodium are so reactive that they catch fire if exposed to moist air. To prevent accidental fires, they

are stored submerged in kerosene oil.

• This safety protocol is essential in laboratories and industrial settings to handle these Group 1 elements.

• Reaction with Acids:

• Metals above Hydrogen (H) in the series can displace hydrogen from dilute acids (like HCl or H_2SO_4) to form metal salts and hydrogen gas.

• Metals like Copper, Mercury, and Gold do not react with dilute acids under standard conditions because they cannot lose electrons as easily as hydrogen.

• Extraction Processes:

• The position of a metal in the reactivity series determines its extraction method. Metals at the top are extracted via electrolysis of their molten chlorides or oxides.

• Metals in the middle (like Zinc and Iron) are reduced using carbon or carbon monoxide in a blast furnace.

Important Points

• Standard Reactivity Sequence: The general sequence from highest to lowest reactivity is Potassium (K) > Sodium (Na) > Lithium (Li) > Calcium (Ca) > Magnesium (Mg) > Aluminium (Al) > Zinc (Zn) > Iron (Fe) > Tin (Sn) > Lead (Pb) > [Hydrogen (H)] > Copper (Cu) > Mercury (Hg) > Silver (Ag) > Gold (Au).

• Chemical Nature: Reactivity is linked to the ease with which an atom loses electrons to form positive ions (cations). Potassium has only one electron in its outermost shell, which it loses very easily, explaining its high electropositivity.

• Displacement Example: If a piece of Iron is placed in a Copper Sulphate ($CuSO_4$) solution, the iron will displace the copper because Iron is more reactive than Copper, resulting in Iron Sulphate ($FeSO_4$) and Copper metal.

Q14. Answer: (b) Castor

The correct answer is Castor.

Key Points

• Seed dispersal by the bursting of fruits is a mechanical process known as Autochory or explosive dehiscence.

• In plants like Castor (Ricinus communis) and Balsam, the fruits act as the primary agent for scattering seeds.

• As the Castor fruit matures and undergoes dehydration, the internal tissues experience a buildup of mechanical tension.

• When the fruit dries completely, it bursts open with a sudden jerk, effectively scattering the seeds several feet away from the parent plant. Hence, the correct option is Castor.

• The fruit of the Castor plant is specifically called a regma, which is a type of schizocarpic capsule that splits into three one-seeded parts called cocci during the bursting process.

• This mechanism ensures that the young seedlings do not have to compete with the parent plant for essential resources such as sunlight, water, and minerals.

Additional Information

• Dispersal by Animals (Zoochory):

• Certain plants produce seeds with specialized structures like hooks, spines, or stiff hairs to facilitate movement.

• Xanthium seeds are equipped with numerous hooked spines that easily attach to the fur of animals or the clothing of humans.

• Similarly, Urena fruits have hooked bristles that help them cling to passing organisms, allowing the seeds to be transported to distant locations.

• Dispersal by Wind (Anemochory):

• Lightweight seeds often use wind as a medium for transport.

• In the Sunflower, the seeds (achenes) are often dispersed by the wind. Some members of this family possess a pappus, a modified calyx that acts like a parachute to catch air currents.

• Other examples include Dandelion and Maple (which has winged seeds).

• Dispersal by Water (Hydrochory):

• Plants found near aquatic environments, such as the Coconut palm, produce fruits with a fibrous or spongy outer coat.

• This adaptation allows the fruit to float on water surfaces, enabling it to travel across rivers or oceans to reach new habitats.

Important Points

• Ecological Significance: Seed dispersal is vital for the survival and evolution of plant species. It prevents overcrowding in a single geographical area.

• Variety in Bursting Mechanisms: While Castor uses dehydration to trigger bursting, some plants like Squirting Cucumber use turgor pressure (liquid pressure) to eject seeds.

• Seed Characteristics: The seeds of Castor are rich in oil and contain a toxic protein called ricin, which serves as a defense mechanism against herbivores in their natural environment.

• Global Distribution: Due to efficient dispersal and human cultivation for industrial oil, Castor plants are now found in many tropical and subtropical regions across the world.

Q15. Answer: (b) forces always occurring in pairs

The correct answer is forces always occurring in pairs.

Key Points

• Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction. This principle fundamentally defines the nature of forces as interactions between objects.

• This law implies that forces never exist in isolation; they always occur in pairs. If Object A exerts a force on Object B, then Object B simultaneously exerts a force of equal magnitude and opposite direction back on Object A.

• The two forces in these pairs are often referred to as action and reaction forces. It is important to note that these forces act on different objects, which is why they do not cancel each other out to produce a zero net force on a single body.

• The interaction is simultaneous; there is no time delay between the action and the reaction. Both forces appear and disappear at the exact same moment.

• Option (1) describes the Law of Inertia, option (3) describes the Law of Acceleration, and option (4) is a specific application of Universal Gravitation. Therefore, the statement regarding pairs is the only one describing the Third Law.

Additional Information

• Sir Isaac Newton: He formulated the three laws of motion, which were first published in his work Philosophiæ Naturalis Principia Mathematica in the year 1687. These laws form the basis of classical mechanics.

• Real-world Examples:

• Recoil of a gun: When a bullet is fired (action), the gun pushes the bullet forward, and the bullet pushes the gun backward (reaction), causing recoil.

• Swimming: A swimmer pushes the water backward with their hands, and the water pushes the swimmer forward with an equal force.

• Propulsion: In a rocket, hot gases are expelled downward (action), and these gases exert an upward force on the rocket (reaction), allowing it to lift off.

• Newton's First Law: Also known as the Law of Inertia, it states that an object will remain at rest or in uniform motion in a straight line unless acted upon by an external unbalanced force. This relates to an object resisting a change in motion.

• Newton's Second Law: This law provides a quantitative description of force. It states that the force acting on an object is equal to the mass of that object times its acceleration (F = ma).

• Distinction between Third Law and Equilibrium: While equilibrium involves multiple forces acting on the same object that sum to zero, Newton's Third Law involves forces acting on two different objects. For example, a book resting on a table involves gravity and normal force (equilibrium on the book), but the Third Law pair is the book pushing the table down and the table pushing the book up.

Important Points

• Nature of Force: In physics, a force is not a property of an object but a result of an interaction. This means you cannot "have" force; you can only "exert" or "experience" it through contact or field interactions like gravity or magnetism.

• Vector Quantity: Force is a vector quantity, meaning it has both magnitude and direction. The Third Law emphasizes the directional relationship (exactly 180 degrees apart) of the force pairs.

• Universal Application: This law applies to all types of forces, including frictional forces, tension, gravitational pull, and electrostatic forces. Even when the Earth pulls an apple down, the apple pulls the Earth up with the same amount of force.

Q16. Answer: (b) precipitation reaction

p data-end="57" data-start="0">The correct answer is precipitation reaction.

Key Points

• A precipitation reaction is a type of chemical reaction where two aqueous solutions react to form an insoluble solid, known as a precipitate, which settles out of the solution.

• In the reaction between Sodium Sulphate (Na2SO4) and Barium Chloride (BaCl2), both substances are initially in an aqueous state. When mixed, they undergo a chemical change.

• The chemical equation for this process is: Na2SO4 (aq) + BaCl2 (aq) -> BaSO4 (s) + 2NaCl (aq). The (s) denotes that Barium Sulphate is formed as a solid.

• This reaction is primarily a double displacement reaction because the Sulphate ions (SO4 2-) and Chloride ions (Cl-) exchange their respective cations (Sodium and Barium).

• The white precipitate formed in this specific reaction is Barium Sulphate, which is insoluble in water. This makes it a classic example of a precipitation reaction.

• The other product, Sodium Chloride, remains dissolved in the water as an aqueous solution.

Additional Information

• Combination Reaction:

• A reaction where two or more reactants combine to form a single product.

• Example: The burning of magnesium ribbon in oxygen to form magnesium oxide (2Mg + O2 -> 2MgO).

• In the given question, there are two products formed, so it cannot be a combination reaction.

• Decomposition Reaction:

• A reaction in which a single compound breaks down into two or more simpler substances.

• This usually requires energy in the form of heat, light, or electricity.

• Example: Calcium Carbonate decomposing into Calcium Oxide and Carbon Dioxide (CaCO3 -> CaO + CO2).

• Displacement Reaction (Single Displacement):

• A reaction in which a more reactive element displaces a less reactive element from its compound.

• Example: Iron reacting with Copper Sulphate solution (Fe + CuSO4 -> FeSO4 + Cu), where iron displaces copper.

• In the given reaction, two ions are exchanging places, not just one element displacing another.

• Double Displacement Reaction:

• A reaction where there is an exchange of ions between the reactants to form new compounds.

• The reaction between Sodium Sulphate and Barium Chloride is a prime example of this, as the Sodium and Barium cations switch their anion partners.

Important Points

• Observation: The most distinct feature of the Sodium Sulphate-Barium Chloride reaction is the instantaneous appearance of a milky white solid.

• Applications: Precipitation reactions are widely used in analytical chemistry to identify specific ions present in a solution and in water treatment to remove heavy metals or contaminants.

• Barium Sulphate is specifically used in medical imaging (Barium meal) because it is radio-opaque and insoluble, making it safe for X-ray examinations of the digestive system.

Q17. Answer: (d) Acceleration is positive if it is in the direction of velocity, and negative if it is opposite.

The correct answer is Acceleration is positive if it is in the direction of velocity, and negative if it is opposite..

Key Points

• Acceleration is a vector quantity defined as the rate of change of velocity of an object with respect to time. Because it is a vector, it has both magnitude and direction.

• The sign of acceleration (positive or negative) is determined by the direction of the acceleration vector relative to the velocity vector and the chosen coordinate system.

• When an object is speeding up, the acceleration acts in the same direction as the velocity. In standard physical conventions, if the velocity is moving in the positive direction, this acceleration is considered positive. Hence, statement 4 is correct.

• If the acceleration is directed opposite to the direction of motion (velocity), the object slows down. This is known as negative acceleration or retardation. Hence, statement 1 is incorrect.

• Acceleration is not always positive; it can be zero (constant velocity), positive (increasing speed in a positive direction), or negative (decreasing speed or increasing speed in a negative direction). Hence, statement 2 is incorrect.

• If acceleration were negative while being in the same direction as velocity, it would imply the entire coordinate system is flipped, but fundamentally, matching directions result in an increase in speed, which is the definition of positive acceleration in that frame of reference. Hence, statement 3 is incorrect.

• Hence, the correct answer is Acceleration is positive if it is in the direction of velocity, and negative if it is opposite.

Additional Information

• Mathematical Formula: The average acceleration (a) is calculated using the formula a = (v - u) / t, where v is the final velocity, u is the initial velocity, and t is the time interval.

• SI Units: The Standard International (SI) unit for acceleration is meters per second squared (m/s2). It describes how many meters per second the velocity changes every second.

• Retardation/Deceleration: These terms specifically refer to acceleration that opposes velocity, leading to a decrease in speed. For example, when a driver applies brakes to a car, the acceleration is negative relative to the car's forward velocity.

• Uniform vs. Non-Uniform Acceleration:

• Uniform Acceleration: This occurs when the velocity changes by equal amounts in equal time intervals. An example is an object in free fall, which experiences a constant gravitational acceleration of approximately 9.8 m/s2 on Earth.

• Non-Uniform Acceleration: This occurs when the velocity changes at a variable rate over time, such as a bus moving through heavy traffic with frequent starts and stops.

• Directional Context: It is important to note that a negative acceleration does not always mean slowing down. If an object is moving in the negative direction (velocity is negative) and the acceleration is also negative, the object is actually speeding up in that negative direction.

Important Points

• Velocity-Time Graphs: On a velocity-time (v-t) graph, the slope represents the acceleration. A positive slope indicates positive acceleration, while a negative slope indicates negative acceleration.

• Instantaneous Acceleration: This refers to the acceleration of an object at a specific moment in time, calculated as the derivative of velocity with respect to time (dv/dt).

• Newton's Second Law: Acceleration is directly proportional to the net force acting on an object and inversely proportional to its mass, represented by the law F = ma, established by Isaac Newton in 1687.

Q18. Answer: (c) the sum of the atomic masses of all atoms in a formula unit of a compound

The correct answer is the sum of the atomic masses of all atoms in a formula unit of a compound.

Key Points

• The formula unit mass of a substance is the sum of the atomic masses of all atoms in a formula unit of a compound. Hence, statement 3 is correct.

• It is calculated by adding the atomic masses of all the atoms present in the chemical formula of the substance. This is conceptually similar to molecular mass, but the terminology "formula unit" is preferred for ionic compounds.

• The atomic number (Statement 1) represents only the number of protons in an atom and does not account for the neutrons, which contribute significantly to the total mass. Hence, statement 1 is incorrect.

• The number of protons (Statement 2) is equivalent to the atomic number and does not define the mass of the entire formula unit. Hence, statement 2 is incorrect.

• The number of electrons (Statement 4) has a negligible contribution to the total mass of an atom compared to protons and neutrons, and thus their sum does not constitute the formula unit mass. Hence, statement 4 is incorrect.

• The unit used to express formula unit mass is the unified atomic mass unit, represented by the symbol u.

Additional Information

• Ionic Compounds and Formula Units:

• Unlike covalent compounds, ionic compounds do not exist as individual molecules. Instead, they form a three-dimensional crystal lattice structure consisting of many positive and negative ions.

• The formula unit represents the simplest whole-number ratio of these ions. For instance, in Sodium Chloride, the ratio of Na+ to Cl- ions is 1:1, so the formula unit is NaCl.

• Calculation Examples:

• Sodium Chloride (NaCl): The atomic mass of Sodium (Na) is 23 u and Chlorine (Cl) is 35.5 u. The formula unit mass is 23 + 35.5 = 58.5 u.

• Calcium Chloride (CaCl2): The atomic mass of Calcium (Ca) is 40 u and Chlorine (Cl) is 35.5 u. The mass is 40 + (2 x 35.5) = 40 + 71 = 111 u.

• Zinc Oxide (ZnO): The atomic mass of Zinc (Zn) is 65 u and Oxygen (O) is 16 u. The formula unit mass is 65 + 16 = 81 u.

• The Unified Atomic Mass Unit (u):

• This is the standard unit used to measure the relative mass of atoms. It is defined as exactly 1/12th of the mass of a single Carbon-12 atom.

• Previously, it was denoted as amu, but it was changed to u (unified mass) as per IUPAC recommendations.

Important Points

• Difference between Molecular Mass and Formula Unit Mass:

• Molecular mass is used specifically for substances that exist as discrete molecules (e.g., H2O, CH4).

• Formula unit mass is used for substances that consist of ions or giant covalent structures where discrete molecules are not present.

• Numerically, both are calculated using the same method: summing the atomic masses of all atoms in the given chemical formula.

• Molar Mass Connection:

• The molar mass of a substance is numerically equal to its formula unit mass but is expressed in grams per mole (g/mol).

• One mole of any substance contains 6.022 x 10^23 formula units, a constant known as Avogadro's Number.

Q19. Answer: (c) It transports food, carbon dioxide and waste materials.

The correct answer is It transports food, carbon dioxide and waste materials..

Key Points

• Blood Plasma is a pale yellow liquid component of blood that holds the blood cells in whole blood in suspension. It makes up about 55% of the body's total blood volume.

• The primary function of plasma is to transport nutrients (food), hormones, and proteins to the parts of the body that need them. It also carries waste products like urea and carbon dioxide from the cells to the excretory organs. Hence, statement 3 is correct.

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• Red Blood Cells (RBCs), or erythrocytes, contain a protein called hemoglobin, which binds to oxygen. The primary role of carrying oxygen from the lungs to all body parts is performed by RBCs, not the plasma itself. Hence, statement 1 is incorrect.

• Maintaining an oxygen-rich blood supply to tissues is the physiological responsibility of the circulatory system driven by the heart and mediated by hemoglobin in red blood cells. Hence, statement 2 is incorrect.

• While plasma contains clotting factors (like fibrinogen), the primary cellular component that helps in clotting blood during injuries to prevent excessive bleeding is the platelets (thrombocytes). Hence, statement 4 is incorrect.

Additional Information

• Composition of Plasma:

• Water: Approximately 90-92% of plasma is water, which acts as a solvent for transporting various substances.

• Plasma Proteins: These include Albumin (maintains osmotic pressure), Globulins (involved in immunity/antibodies), and Fibrinogen (essential for blood coagulation).

• Electrolytes: Ions like Sodium (Na^+), Chloride (Cl^-), and Bicarbonate (HCO_3^-) help maintain pH balance and osmotic pressure.

• Functions in Homeostasis:

• Plasma plays a critical role in maintaining a constant body temperature by absorbing and distributing heat throughout the body.

• It helps in maintaining the acid-base balance (pH) of the body, which is vital for various biochemical reactions.

• Transport Mechanism:

• Carbon dioxide is transported in the plasma mainly in the form of bicarbonate ions (about 70%), while a small amount is dissolved directly in the plasma.

• Nutrients absorbed from the digestive tract, such as glucose, amino acids, and lipids, are dissolved in the plasma to be delivered to tissues.

Important Points

• Serum vs. Plasma: Serum is the liquid part of blood that remains after blood clotting has occurred. It is essentially plasma without the clotting factors (like fibrinogen).

• Blood pH: The pH of human blood is slightly alkaline, typically ranging between 7.35 and 7.45. Plasma acts as a buffer to keep this range stable.

• Discovery: The technique for plasma storage and its use for transfusions was significantly advanced by Dr. Charles Drew in the 1940s.

Q20. Answer: (c) Image is virtual, erect and smaller than the object.

The correct answer is Image is virtual, erect and smaller than the object.

Key Points

• A concave lens is also known as a diverging lens because it diverges the light rays that pass through it. It is thinner at the center than at the edges.

• For a concave lens, the focal length (f) is always taken as negative. In this case, f = -15 cm.

• The object distance (u) is always negative according to the sign convention. Here, u = -10 cm.

• Using the Lens Formula, $1/v - 1/u = 1/f$, where v is the image distance:

• $1/v = 1/f + 1/u$

• $1/v = 1/(-15) + 1/(-10)$

• $1/v = -1/15 - 1/10$

• $1/v = (-2 - 3) / 30 = -5/30 = -1/6$

• Therefore, v = -6 cm.

• The negative sign of v indicates that the image is virtual and formed on the same side as the object. All virtual images formed by a single lens are erect.

• The magnification (m) is calculated as $m = v/u$. Substituting the values: $m = -6 / -10 = 0.6$. Since the magnitude of m is less than 1, the image is smaller than the object (diminished).

• Statement 1: Image is real, inverted and smaller than the object. Hence, statement 1 is incorrect.

• Statement 2: Image is virtual, erect and larger than the object. Hence, statement 2 is incorrect.

• Statement 3: Image is virtual, erect and smaller than the object. Hence, statement 3 is correct.

• Statement 4: Image is real, inverted and larger than the object. Hence, statement 4 is incorrect.

Additional Information

• Nature of Images in Concave Lenses:

• Regardless of the position of the object, a concave lens always produces a virtual, erect, and diminished image.

• The image is always formed between the optical center and the principal focus (F1) on the same side as the object.

• Magnification (m):

• If m is positive, the image is virtual and erect.

• If m is negative, the image is real and inverted.

• If |m| < 1, the image is diminished. If |m| > 1, the image is enlarged.

• Sign Convention (New Cartesian):

• The optical center (O) is taken as the origin.

• Distances measured in the direction of incident light are positive; opposite to it are negative.

• Height measured upwards and perpendicular to the principal axis is positive.

Important Points

• Power of a Lens: The power (P) is the reciprocal of the focal length in meters (P = 1/f). For a concave lens, since f is negative, the power is also negative.

• Applications of Concave Lenses:

• Used in spectacles to correct myopia (short-sightedness).

• Used in peepholes of house doors to provide a wide-angle view of people outside.

• Used in flashlights to spread the light beam over a wider area.

• Comparison with Convex Lenses: Unlike concave lenses, convex lenses can form both real and virtual images, which can be enlarged, diminished, or same-sized depending on the object's distance from the lens.

Q21. Answer: (c) It changes a liquid to gas from the surface below boiling point

The correct answer is It changes a liquid to gas from the surface below boiling point.

Key Points

• Evaporation is a type of vaporization that occurs on the surface of a liquid as it changes into the gas phase. It is fundamentally different from boiling because it occurs only at the surface and can happen at any temperature below the boiling point of the liquid.

• Statement 1 suggests that it changes solids directly into vapors. This process is actually known as sublimation (e.g., dry ice or camphor) and does not involve the liquid phase at all. Hence, statement 1 is incorrect.

• Statement 2 claims it takes place only at the boiling temperature. This is the definition of boiling, which is a bulk phenomenon where the entire mass of the liquid transitions to gas. Evaporation, conversely, happens continuously even at room temperature. Hence, statement 2 is incorrect.

• Statement 3 defines the process correctly as the transition from liquid to gas from the surface at temperatures below the boiling point. In this process, particles at the surface gain enough kinetic energy to overcome the intermolecular forces of attraction. Hence, statement 3 is correct.

• Statement 4 mentions that the liquid must freeze first. Freezing is the transition from liquid to solid, which is the opposite direction of the energy change required for gas formation. Hence, statement 4 is incorrect.

Additional Information

• Factors Affecting Evaporation:

• Surface Area: Since evaporation is a surface phenomenon, increasing the surface area (e.g., spreading out wet clothes) increases the rate of evaporation.

• Temperature: An increase in temperature provides more kinetic energy to the particles, allowing a greater number of them to escape into the vapor state.

• Humidity: It is the amount of water vapor present in the air. If the humidity is high, the air cannot hold much more moisture, thus decreasing the rate of evaporation.

• Wind Speed: Higher wind speeds move water vapor particles away from the surface, making room for more molecules to evaporate, thus increasing the rate.

• Cooling Effect:

• Evaporation causes cooling. During the process, the particles of the liquid absorb energy (the Latent Heat of Vaporization) from the surroundings to regain the energy lost during evaporation.

• Common examples include sweating in humans to regulate body temperature and the cooling of water stored in earthen pots (matkas) during summer.

• Comparison with Boiling:

• While boiling is a fast process that occurs throughout the bulk of the liquid at a fixed temperature, evaporation is a slow and silent process occurring only at the surface at variable temperatures.

Important Points

• The Latent Heat of Vaporization is the heat energy required to change 1 kg of a liquid into gas at atmospheric pressure at its boiling point.

• In the context of the Water Cycle, evaporation from oceans, seas, and lakes is the primary pathway for water to move from the liquid state back into the atmosphere as water vapor.

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• Vapor Pressure: Evaporation continues until the partial pressure of the vapor in the air reaches the equilibrium vapor pressure of the liquid.

Q22. Answer: (a) Highly ductile and malleable

The correct answer is Highly ductile and malleable.

Key Points

• Metals are characterized by their physical property of being ductile, which means they can be drawn into thin wires without breaking. Gold is considered the most ductile metal; a single gram can be stretched into a wire nearly 2 kilometers long. Hence, statement 1 is correct.

• Malleability is another defining physical property of metals, allowing them to be hammered or rolled into thin sheets. Metals like silver and aluminium exhibit high malleability, which is why they are used in making foils and decorative leaves. Hence, statement 1 is also supported by this fact.

• Most metals are hard and possess high tensile strength, meaning they can support heavy loads without snapping. In contrast, it is the non-metals that are generally soft or brittle and break when force is applied. Hence, statement 2 is incorrect.

• Metals are excellent conductors of heat and electricity due to the presence of free electrons. While silver and copper are the best conductors, materials that are poor conductors or brittle are typically classified as non-metals or metalloids. Hence, statement 3 is incorrect.

• At room temperature, almost all metals exist in a solid state because of the strong metallic bonding between atoms. The only exception is mercury (Hg), which is a liquid. Non-metals like hydrogen, nitrogen, and oxygen are the elements that typically form gases at room temperature. Hence, statement 4 is incorrect.

Additional Information

• Metallic Lustre: Metals in their pure state have a shining surface. This property is known as metallic lustre. Metals like gold, silver, and platinum are highly valued for their ability to retain this shine, making them ideal for jewelry.

• Sonority: Metals are sonorous, meaning they produce a ringing sound when struck by a hard object. This property is utilized in making church bells, musical instruments, and school bells.

• Melting and Boiling Points: Metals generally have high melting points and boiling points. For example, Tungsten (W) has the highest melting point (approximately 3422°C), which is why it is used in bulb filaments. However, metals like Gallium and Cesium have very low melting points and can melt if kept on a palm.

• Density: Most metals have a high density, making them heavy. Osmium is known to be the densest naturally occurring element. Conversely, alkali metals like lithium, sodium, and potassium have low densities and are soft enough to be cut with a knife.

• Alloy Formation: Metals can be mixed with other metals or non-metals to form alloys to enhance their properties. For instance, Steel (an alloy of iron and carbon) is much stronger than pure iron and is resistant to corrosion.

Important Points

• Exceptions in Metals: While most metals are hard solids, Mercury is a liquid at room temperature. Sodium and Potassium are so soft that they can be cut with a knife, which is a rare physical trait for metals.

• Chemical Reactivity: Metals typically react with oxygen to form basic oxides (e.g., Magnesium Oxide). They are electropositive elements because they lose electrons to form cations during chemical reactions.

• Periodic Table Placement: On the Modern Periodic Table, metals are located on the left side and in the center. The s-block, d-block, and f-block consist entirely of metals, while the p-block contains a mix of metals, non-metals, and metalloids.

Q23. Answer: (d) Father’s sperm

The correct answer is Father’s sperm.

Key Points

• In humans, the biological sex of an individual is determined by the chromosomal makeup established at the moment of fertilization.

• Human cells contain 23 pairs of chromosomes, for a total of 46. The first 22 pairs are known as autosomes, which carry genes for general body traits and are identical in both males and females.

• The 23rd pair consists of the sex chromosomes (allosomes). Females possess two X chromosomes (XX), while males possess one X and one Y chromosome (XY).

• During gametogenesis, females produce ova (eggs) that only carry an X chromosome. Males, being the heterogametic sex, produce two types of sperm: approximately 50% carry an X chromosome and 50% carry a Y chromosome.

• If a sperm carrying an X chromosome fertilizes the egg, the zygote will be XX (female). If a sperm carrying a Y chromosome fertilizes the egg, the zygote will be XY (male). Hence, the correct answer is Father’s sperm.

Additional Information

• Sex Chromosomes (Allosomes):

• These are distinct from autosomes and are responsible for the development of primary and secondary sexual characteristics. The Y chromosome is significantly smaller than the X chromosome and contains fewer genes.

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• Mitochondrial DNA (mtDNA):

• Unlike nuclear DNA, mitochondrial DNA is inherited maternally. This is because the mitochondria in a developing embryo are derived almost entirely from the cytoplasm of the mother's ovum, as the sperm contributes only its nuclear genetic material during fusion. It does not determine the sex of the child.

• Autosomes:

• Humans have 44 autosomes. Any variation in the number of autosomes (such as Trisomy 21 or Down Syndrome) leads to genetic disorders but does not change the biological sex of the offspring.

• Spermatogenesis vs. Oogenesis:

• Spermatogenesis in the male testes results in four viable sperm from one primary spermatocyte, maintaining the X and Y ratio. Oogenesis in the female ovaries results in one functional ovum and polar bodies, all containing X chromosomes.

Important Points

• The SRY Gene: The Sex-determining Region Y (SRY) gene is located on the short arm of the Y chromosome. This gene acts as the "master switch" for testis-determining factor (TDF), which triggers the development of male gonads in an embryo.

• Probability: Since the segregation of X and Y chromosomes during male meiosis occurs randomly, there is a theoretical 50% probability for a child to be born male or female in every single pregnancy.

• Genetic Inheritance: The concept that the father determines the sex was scientifically solidified in the early 20th century (around 1905) through the independent work of Nettie Stevens and Edmund Beecher Wilson, who discovered the role of X and Y chromosomes in insects and humans.

• Biological Determination: It is important to note that the mother’s ovum is passive regarding sex determination, as it can only provide an X chromosome; the outcome depends entirely on whether the paternal gamete introduces a second X or a Y.

Q24. Answer: (b) Red Sindhi

The correct answer is Red Sindhi.

Key Points

• Red Sindhi is a premier indigenous dairy breed of cattle that originated in the Sindh province (now in Pakistan), but is extensively found and reared across India.

• This breed is world-renowned for its high resistance to diseases and its remarkable ability to tolerate tropical heat and high humidity, which are common in South Asian environments. Hence, the correct answer is Red Sindhi.

• Physically, the Red Sindhi is characterized by its deep reddish-brown color, ranging from light red to dark brown. They possess a large udder and are considered one of the best milch breeds among the Zebu cattle (humped cattle).

• The average milk yield for this breed is approximately 1100 to 2600 kg per lactation. Because of its hardy nature and strong immune system, it is frequently used in crossbreeding programs globally to improve the disease resistance of high-yielding exotic breeds.

• Unlike exotic breeds, Red Sindhi cattle are less susceptible to ectoparasites like ticks and the various vector-borne diseases they carry, making them economically viable for small-scale farmers in developing nations.

Additional Information

• Jersey:

• This is an exotic breed originating from the Island of Jersey, United Kingdom.

• While it is famous for having the highest fat content (about 5.3%) in its milk, it is highly sensitive to heat stress and lacks the natural immunity to tropical diseases found in Indian breeds.

• Brown Swiss:

• Originating from Switzerland, this exotic breed is one of the oldest in the world.

• It is a dual-purpose breed used for both milk and meat production. However, it requires a temperate climate to thrive and is prone to many tropical ailments.

• Aseel:

• It is important to note that Aseel is not a breed of cattle; it is a famous indigenous breed of poultry (chicken).

• Native to the Andhra Pradesh and Chhattisgarh regions, it is known for its stamina, aggressive behavior (used in cockfighting), and high-quality meat.

• Classification of Indian Cattle:

• Milch Breeds: High milk producers like Sahiwal, Gir, and Red Sindhi.

• Draught Breeds: Used for agricultural labor and transport, such as Amritmahal and Hallikar.

• Dual-purpose Breeds: Serving both milk and labor needs, such as Haryana and Tharparkar.

Important Points

• Zebu Cattle (Bos indicus): These are humped cattle found in India and Africa. They possess a dewlap and a hump, which help in thermoregulation (cooling the body) and provide natural resistance to various pathogens.

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• National Dairy Research Institute (NDRI): Located in Karnal, Haryana, this research institute plays a vital role in the genetic improvement and conservation of indigenous breeds like Red Sindhi.

• Disease resistance in indigenous breeds: Breeds like Red Sindhi and Sahiwal have evolved over centuries to develop innate immunity against Foot and Mouth Disease (FMD) and Rinderpest, compared to their European counterparts.

Q25. Answer: (d) Robert Brown

The correct answer is Robert Brown.

Key Points

• Robert Brown, a prominent Scottish botanist, is credited with the discovery and description of the cell nucleus in the year 1831.

• While examining the epidermis of orchids under a microscope, he noticed an opaque area within the cells, which he termed the nucleus (derived from the Latin word for "kernel" or "nut").

• This discovery was a fundamental milestone in the field of cytology (cell biology), as it challenged the previous notion that the cell wall was the only significant part of a cell.

• His observations helped scientists understand that cells have internal organization and specialized organelles responsible for various biological processes.

• Brown's work paved the way for the later formulation of the Cell Theory, as it highlighted a consistent internal structure across different types of plant cells.

Additional Information

• Robert Hooke:

• In 1665, he discovered the cell for the first time while observing a thin slice of cork.

• He used a primitive compound microscope and observed box-like structures that reminded him of small rooms occupied by monks, hence the name "cell".

• Hooke’s discovery was limited to dead plant cells, specifically the cell walls of the cork tissue.

• Anton van Leeuwenhoek:

• In 1674, he was the first to observe living cells using his own high-quality single-lens microscopes.

• He discovered bacteria, protozoa, spermatozoa, and red blood cells, referring to them as "animalcules."

• His work expanded the understanding of microscopic life and the diversity of cellular organisms.

• Rudolf Virchow:

• In 1855, he made a crucial addition to the Cell Theory by proposing the concept of "Omnis cellula e cellula".

• This phrase translates to "all cells arise from pre-existing cells," refuting the theory of spontaneous generation.

• His contribution shifted the focus of pathology to the cellular level, suggesting that diseases arise in individual cells.

• Matthias Schleiden and Theodore Schwann:

• In 1838 and 1839, respectively, they proposed that all plants and animals are composed of cells.

• Together, they established the first two tenets of the Cell Theory: that the cell is the basic unit of life and that all living things are made of cells.

Important Points

• The nucleus is often described as the control center or brain of the cell because it houses the genetic material (DNA).

• It is surrounded by a nuclear envelope, which is a double-layered membrane that regulates the transport of materials via nuclear pores.

• The primary functions of the nucleus include DNA replication, transcription (production of RNA), and maintaining the integrity of genes.

• In eukaryotic cells, the nucleus contains the nucleolus, which is the site of ribosome biogenesis.

• While most cells have one nucleus, certain cells like human erythrocytes (mature red blood cells) are enucleated (lack a nucleus), while others like skeletal muscle cells are multinucleated.

Q26. Answer: (c) 23 seconds

Shortcut Trick

Total Distance = Sum of lengths = 259 + 431 = 690 m

Relative Speed (Opposite) = 52 + 56 = 108 km/h

Convert to m/s: 108 × (5/18) = 30 m/s

Time = Distance ÷ Relative Speed = 690 ÷ 30 = 23 sec

Therefore The correct answer is 23 sec.

Alternate Method

Given:

Length of first train (L1) = 259 m

Length of second train (L2) = 431 m

Speed of first train (S1) = 52 km/h

Speed of second train (S2) = 56 km/h

Formula Used:

Time = (L1 + L2) ÷ (S1 + S2)

Calculations:

=> Total Distance = 259 + 431 = 690 m

=> Relative Speed = 52 + 56 = 108 km/h

=> Relative Speed in m/s = 108 × (5/18) = 30 m/s

=> Time taken = 690 ÷ 30

=> Time = 23 sec

Therefore The correct answer is 23 sec.

Additional Information

Relative Speed Concept

When two objects move in opposite directions, their speeds are added (S1 + S2). In the same direction, they are subtracted (S1 − S2).

Unit Conversion

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

Train Crossing Logic

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

Q27. Answer: (d) 2600

Shortcut Trick

Let the total votes be 100%.

Candidate 1 = 42% | Candidate 2 = 100% − 42% = 58%.

Margin = 58% − 42% = 16%.

Given 16% = 416 votes.

100% = (416 ÷ 16) × 100 = 26 × 100 = 2600.

Therefore The correct answer is 2600 votes.

Alternate Method

Given: Votes of losing candidate = 42%, Defeat margin = 416 votes.

Formula: Total Votes = (Margin × 100) ÷ (Difference in % share).

=> Let Total Votes = V.

=> Winning Candidate Share = 100% − 42% = 58%.

=> Difference in share = 58% − 42% = 16%.

=> 16% of V = 416.

=> (16 ÷ 100) × V = 416.

=> V = (416 × 100) ÷ 16.

=> V = 26 × 100 = 2600.

Therefore The correct answer is 2600 votes.

Additional Information

Percentage Change

To calculate the percentage change between two values: [(New Value − Old Value) ÷ Old Value] × 100.

Invalid Votes Concept

If invalid votes are present: Total Valid Votes = Total Cast Votes − Invalid Votes. The winner/loser percentages are usually calculated on valid votes.

Base Change Rule

If a candidate gets x% of the total votes, the other gets (100 − x)% provided there are only two candidates and no invalid votes.

Q28. Answer: (d) Decreases by 61.64%

Shortcut Trick

Using the Multiplying Factor method for successive changes:

Final Price = 100 × 0.60 × 0.75 × 0.55 × 1.55
Final Price = 100 × 0.383625 = 38.3625
Net change = 38.3625 − 100 = −61.6375%
Therefore The correct answer is Decreases by 61.64%.
Alternate Method
Given: Original Price = 100 units. Changes: −40%, −25%, −45%, +55%.
=> Price after 1st month = 100 − (40% of 100) = 60
=> Price after 2nd month = 60 − (25% of 60) = 60 − 15 = 45
=> Price after 3rd month = 45 − (45% of 45) = 45 − 20.25 = 24.75
=> Price after 4th month = 24.75 + (55% of 24.75) = 24.75 + 13.6125 = 38.3625
=> Percentage Change = (38.3625 − 100) / 100 × 100 = −61.6375%
=> Approximately 61.64% decrease.
Therefore The correct answer is Decreases by 61.64%.
Additional Information
Successive Percentage Formula
For two successive changes of a% and b%, net change = (a + b + ab/100)%.
Multiplying Factor (MF)
For an x% increase, MF = (1 + x/100). For an x% decrease, MF = (1 − x/100).
Order of Operations
In successive percentage changes, the order in which increases or decreases are applied does not affect the final result.

Q29. Answer: (b) 126

Shortcut Trick
Check LCM of 6 and 9 → LCM(6, 9) = 18. All numbers must be multiples of 18.
Numbers divisible by 12 are also divisible by 4 (since 12 = 3 × 4).
For 126: Last two digits (26) are not divisible by 4, so it is not divisible by 12.
For 72, 108, 252: All are divisible by 12 (72/12=6, 108/12=9, 252/12=21).
Therefore The correct answer is 126.
Alternate Method
Given: Numbers 126, 252, 72, 108.
Conditions: Divisible by 6 AND 9 (meaning divisible by 18) AND NOT divisible by 12.
=> 126 ÷ 6 = 21 (Yes)
=> 126 ÷ 9 = 14 (Yes)
=> 126 ÷ 12 = 10.5 (No - Not Divisible)
=> 252 ÷ 12 = 21 (Divisible)
=> 72 ÷ 12 = 6 (Divisible)
=> 108 ÷ 12 = 9 (Divisible)
Therefore The correct answer is 126.
Additional Information
Divisibility Rule of 6
A number is divisible by 6 if it is divisible by both 2 (even number) and 3 (sum of digits is a multiple of 3).
Divisibility Rule of 9
A number is divisible by 9 if the sum of its digits is divisible by 9.
Divisibility Rule of 12
A number is divisible by 12 if it is divisible by both 3 and 4 (last two digits divisible by 4).

Q30. Answer: (a) 4

Shortcut Trick
Combined efficiency of A, B, and C = (1/3 + 1/15 + 1/10) of work per day.
LCM of 3, 15, 10 is 30. Combined efficiency = (10 + 2 + 3)/30 = 15/30 = 1/2 work per day.
Time for single work = 2 days. For twice the work = 2 × 2 = 4 days.
Therefore The correct answer is 4 days.

Alternate Method

Given: Time taken by A = 3 days, B = 15 days, C = 10 days.

Formula Used: Efficiency = Total Work ÷ Time taken

Person	Days	Total Work	Efficiency
A	3	30 (LCM)	10
B	15	2	
C	10	3	

=> Total Efficiency of (A + B + C) = 10 + 2 + 3 = 15 units/day.

=> Total Work to be done = 2 × 30 = 60 units.

=> Required Time = Total Work ÷ Combined Efficiency = 60 ÷ 15 = 4 days.

Therefore The correct answer is 4 days.

Additional Information

Total Work (LCM Method)

The most efficient way to solve Time & Work problems is to assume Total Work as the LCM of given days, making efficiency an integer.

Work & Time Relationship

Time taken is directly proportional to the amount of Work and inversely proportional to Efficiency (T = W/E).

Pipes & Cisterns

Same logic applies where Filling Pipe has positive efficiency and Leaking/Emptying Pipe has negative efficiency.

Q31. Answer: (d) Rs. 2,205

Shortcut Trick

Convert Rate 5% to fraction: 5/100 = 1/20.

For 2 years, the ratio of Principal to Amount is $20^2 : 21^2 = 400 : 441$.

Given 400 units = Rs. 2,000 => 1 unit = Rs. 5.

Amount = 441 units × Rs. 5 = Rs. 2,205.

Therefore The correct answer is Rs. 2,205.

Alternate Method

Given: Principal (P) = Rs. 2,000, Rate (R) = 5%, Time (n) = 2 years.

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

Calculations:

=> $A = 2000 \times (1 + 5/100)^2$

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

=> $A = 2000 \times (21/20) \times (21/20)$

=> $A = 2000 \times (441/400)$

=> $A = 5 \times 441$

=> A = Rs. 2,205

Therefore The correct answer is Rs. 2,205.

Additional Information

Effective Rate of Interest

For 2 years, the effective Compound Interest rate can be calculated as R + R + (R×R)/100.

Difference between CI and SI

The difference between Compound Interest and Simple Interest for 2 years is $P(R/100)^2$.

Compounding Half-Yearly

If interest is compounded half-yearly, the Rate is halved (R/2) and the Time is doubled (2n).

Q32. Answer: (c) 6 years

Shortcut Trick

Assume Emma's age is 1 unit.

Saloni's age = 2 × 1 unit + 7 = 2 units + 7.

Total age = 1 unit + (2 units + 7) = 3 units + 7 = 25 years.

3 units = 25 − 7 = 18 → 1 unit = 6 years.

Therefore The correct answer is 6 years.

Alternate Method

Given:

Sum of Saloni and Emma's ages = 25 years.

Saloni's age = 2 × (Emma's age) + 7.

Let Emma's age be x years.

Then Saloni's age = 2x + 7.

=> x + (2x + 7) = 25

=> 3x + 7 = 25

=> 3x = 25 − 7

=> 3x = 18

=> x = 18 ÷ 3

=> x = 6

Therefore The correct answer is 6 years.

Additional Information

Linear Equations in One Variable

An equation of the form ax + b = c, where x is the unknown variable to be solved by isolating it.

Age Relation Problems

Always define the independent age (usually the younger person) as 'x' to simplify the mathematical expression for the older person.

Verification Method

Plug the result back: if Emma is 6, Saloni is (2×6)+7 = 19. Sum = 6 + 19 = 25. The answer is consistent with the data.

Q33. Answer: (a) 4,494

Shortcut Trick

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

SP = 6,420 × (100 − 30) ÷ 100

SP = 6,420 × 0.7

SP = 4,494

Therefore The correct answer is Rs. 4,494.

Alternate Method

Given: Marked Price (MP) = Rs. 6,420 and Discount = 30%.

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

=> Discount Amount = (30 ÷ 100) × 6,420

=> Discount Amount = 0.3 × 6,420 = 1,926

=> Selling Price = 6,420 − 1,926

=> Selling Price = 4,494

Therefore The correct answer is Rs. 4,494.

Additional Information

Marked Price & Discount

The Marked Price (MP) is the price printed on an item. Discount is always calculated on the MP to arrive at the Selling Price (SP).

Relationship Formula

SP = MP × (100 − D%) / 100. If multiple discounts are given, they are applied successively.

Q34. Answer: (b) 52

Shortcut Trick

Ratio of articles P : Q : R = 3 : 4 : 5

Cost of one set = (3 × 280) + (4 × 180) + (5 × 100) = 840 + 720 + 500 = Rs. 2060

Number of sets = Total expenditure ÷ Cost of one set = 26780 ÷ 2060 = 13

Articles of type Q = 4 × 13 = 52

Therefore The correct answer is 52.

Alternate Method

Given: Prices of P, Q, R are Rs. 280, Rs. 180, Rs. 100. Ratio of quantity = 3 : 4 : 5. Total = Rs. 26,780.

Formula Used: Total Cost = ∑(Price × Quantity)

=> Let the quantities be 3x, 4x, and 5x respectively.

=> Total Cost = (280 × 3x) + (180 × 4x) + (100 × 5x) = 26780

=> 840x + 720x + 500x = 26780

=> 2060x = 26780

=> x = 26780 ÷ 2060 = 13

=> Number of articles of type Q = 4x = 4 × 13 = 52

Therefore The correct answer is 52.

Additional Information

Ratio and Proportion

When items are bought in a ratio a : b : c, the actual quantities are ax, bx, and cx where x is the common multiplier.

Weighted Average Logic

Total value is the sum of products of individual values and their respective weights (quantities). Total = ∑(v_i × w_i).

Q35. Answer: (b) 30

Shortcut Trick

((3²)^6)^5 => multiply powers

= 3^(2×6×5) = 3^(60)

Now 9 = 3²

=> 3^(60) = (3²)^(30) = 9^(30)

Therefore Exponent = 30

Alternate Method

Given:

((3²)^6)^5

Concept Used:

Laws of exponents

Calculation:

=> (3²)^6 = 3¹²

=> (3¹²)^5 = 3^(60)

=> 9 = 3²

=> 3^(60) = (3²)^(30) = 9^(30)

Therefore The correct answer is 30.

Additional Information

Power Rule

(a^m)ⁿ = a^(mn)

Base Conversion

Express numbers in same base to compare powers

Exponent Simplification

Multiply exponents when powers are raised again

Q36. Answer: (a) 3, 8

Shortcut Trick

Use the options substitution method for rapid verification.

From Option (1): Price of mango = 3, Price of apple = 8.

Check first condition: (10 × 3) + (13 × 8) = 30 + 104 = 134. (True)

Check second condition: (15 × 3) − (4 × 8) = 45 − 32 = 13. (True)

Since both conditions are satisfied, Option (1) is the correct pair.

Therefore The correct answer is 3, 8.

Alternate Method

Given → Let cost of one mango be m and one apple be a.

Formulas: Total Cost = (Quantity1 × Price1) + (Quantity2 × Price2)

=> Multiply Eq 1 by 4 and Eq 2 by 13 to eliminate 'a'.

=> (40m + 52a = 536) + (195m − 52a = 169)

=> 235m = 705

=> m = 705 ÷ 235 = 3

=> Substitute m = 3 in Eq 1: 10(3) + 13a = 134

=> 30 + 13a = 134 => 13a = 104 => a = 8

Therefore The correct answer is 3, 8.

Additional Information

Linear Equations in Two Variables

Equations of the form ax + by = c can be solved using the Elimination Method or Substitution Method to find the unique values of variables.

Verification of Roots

Always plug the values back into the original constraints to ensure both logical conditions are satisfied simultaneously.

Q37. Answer: (c) 1

Shortcut Trick

Substitute standard trigonometric values directly.

sin 30° = 1/2, cos 60° = 1/2, cot 45° = 1.

Expression = (1/2 + 1/2) ÷ 1 = 1 ÷ 1 = 1.

Therefore The correct answer is 1.

Alternate Method

Given: sin 30°, cos 60°, cot 45°

Formula Used: Values of trigonometric ratios at specific angles.

=> sin 30° = 1/2

=> cos 60° = 1/2

=> cot 45° = 1

=> Value = (sin 30° + cos 60°) ÷ cot 45°

=> Value = (1/2 + 1/2) ÷ 1

=> Value = 1 ÷ 1 = 1

Therefore The correct answer is 1.

Additional Information

Complementary Angles

For any angle θ, sin θ = cos(90° − θ). Therefore, sin 30° = cos(90° − 30°) = cos 60°.

Reciprocal Identities

cot θ is the reciprocal of tan θ. Since tan 45° = 1, cot 45° = 1/1 = 1.

Pythagorean Identity

$\sin^2\theta + \cos^2\theta = 1$ is the fundamental identity for all trigonometric calculations.

Q38. Answer: (b) 564

Shortcut Trick

Total sum of 8 numbers = 121 × 8 = 968.

Sum of 7 numbers = 35 + 35 + 49 + 83 + 102 + 80 + 20 = 404.

Eighth number = Total Sum − Sum of 7 numbers.

8th number = 968 − 404 = 564.

Therefore The correct answer is 564.

Alternate Method

Given:

Average of 8 numbers = 121

Value of 7 numbers = 35, 35, 49, 83, 102, 80, 20

Formula Used:

Average = Sum of all observations ÷ Total number of observations

Calculations:
=> Sum of 8 numbers = 121 × 8 = 968
=> Sum of 7 numbers = 35 + 35 + 49 + 83 + 102 + 80 + 20
=> Sum of 7 numbers = 404
=> Let the eighth number be x.
=> Sum of 8 numbers = (Sum of 7 numbers) + x
=> 968 = 404 + x
=> x = 968 − 404
=> x = 564
Therefore The correct answer is 564.
Additional Information
Arithmetic Mean
The average or arithmetic mean is calculated by adding all the values and dividing by the count of values: Average = $\Sigma x_i \div n$.
Sum of Observations
Total sum can always be found if the average and total count are known: Sum = Average × Count.
Deviation Method
For larger numbers, the sum of deviations of all observations from the average is always zero.

Q39. Answer: (c) 38:171:147

Shortcut Trick
Multiply initial ratio parts by their respective percentage growth factors.
New Ratio = (4 × 190) : (18 × 190) : (21 × 140)
Simplify: (4 × 19) : (18 × 19) : (21 × 14) => 76 : 342 : 294
Divide by 2: 38 : 171 : 147.
Therefore The correct answer is 38:171:147.
Alternate Method
Given: Initial ratio of salaries X : Y : Z = 4 : 18 : 21. Let salaries be 400, 1800, and 2100.
Formula: New Value = Original Value × (100 + Increment %)/100
=> New Salary of X = 400 + (90% of 400) = 400 + 360 = 760
=> New Salary of Y = 1800 + (90% of 1800) = 1800 + 1620 = 3420
=> New Salary of Z = 2100 + (40% of 2100) = 2100 + 840 = 2940
=> New Ratio = 760 : 3420 : 2940
=> New Ratio = 76 : 342 : 294 (Dividing by 10)
=> New Ratio = 38 : 171 : 147 (Dividing by 2)
Therefore The correct answer is 38:171:147.
Additional Information
Compound Ratio
The ratio obtained by multiplying the corresponding terms of two or more ratios (a:b and c:d becomes ac:bd).
Percentage Increment
When a value increases by r%, the new value is (100 + r)/100 times the original value.
Ratio Simplification
A ratio remains unchanged if all its terms are multiplied or divided by the same non-zero constant.

Q40. Answer: (c) 58

Shortcut Trick
Assume a base mean of 50 and calculate deviations: (−15, +3, −12, +39, +21, +19, +36, −10, −9).
Net sum of deviations = 72.
Average deviation = 72 ÷ 9 = 8.
Actual Arithmetic Mean = 50 + 8 = 58.
Therefore The correct answer is 58.
Alternate Method
Given: Observations are 35, 53, 38, 89, 71, 69, 86, 40, and 41.

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

Step 1: Calculate the Sum of Observations

=> Sum = 35 + 53 + 38 + 89 + 71 + 69 + 86 + 40 + 41

=> Sum = 522

Step 2: Identify Total Number of Observations

=> n = 9

Step 3: Calculate the Mean

=> Mean = 522 ÷ 9

=> Mean = 58

Therefore The correct answer is 58.

Additional Information

Arithmetic Mean Property

The sum of the deviations of all observations from their arithmetic mean is always zero. If each observation is increased by a constant k, the mean also increases by k.

Sum of Observations Formula

Total Sum = Average × Total Number of Terms. This is used to find missing values in a data set when the mean is known.

Assumed Mean Method

Useful for large numbers: Actual Mean = A + (∑d ÷ n), where A is the assumed mean and d is the deviation (Value − A).

Q41. Answer: (c) C

Shortcut Trick

The best scheme for the shopkeeper is the one that offers the minimum discount to the customer.

Compare total discounts: A (39+8−3.12=43.88%), B (4/12 × 100=33.33%), C (16%), D (38+34−12.92=59.08%).

Comparing the values 43.88%, 33.33%, 16%, and 59.08%, the minimum discount is 16%.

Therefore, Scheme C is the most profitable for the shopkeeper.

Therefore The correct answer is C.

Alternate Method

Formulas: Successive Discount = a + b − (a × b) ÷ 100 | Buy x get y free Discount% = [y ÷ (x + y)] × 100

=> Scheme A: 39 + 8 − (39 × 8)/100 = 47 − 3.12 = 43.88%

=> Scheme B: (4 ÷ 12) × 100 = 1/3 × 100 = 33.33%

=> Scheme C: Single discount = 16%

=> Scheme D: 38 + 34 − (38 × 34)/100 = 72 − 12.92 = 59.08%

=> For a shopkeeper, the scheme with the lowest discount percentage results in the highest Selling Price (SP) and thus the most profit.

Therefore The correct answer is C.

Additional Information

Customer vs Shopkeeper Preference

A customer always looks for the Maximum Discount (Scheme D), while the shopkeeper looks for the Minimum Discount (Scheme C).

Buy x Get y Free Concept

In 'Buy x Get y Free', the total items given to the customer is (x + y). The discount is calculated on the total items: Discount % = [Free Items ÷ Total Items] × 100.

Q42. Answer: (b) 192 min

Shortcut Trick

Let the pipes be A, B, and C (outlet).

Combined efficiency (A + B − C) = Total Work ÷ Time = 192 ÷ 48 = 4.

Individual efficiencies: A = 192 ÷ 96 = 2; B = 192 ÷ 64 = 3.

Outlet efficiency (C) = (A + B) − Combined efficiency = (2 + 3) − 4 = 1.

Time taken by pipe C = Total Work ÷ Efficiency = 192 ÷ 1 = 192 min.

Therefore The correct answer is 192 min.

Alternate Method

Given: Filling time of Pipe 1 = 96 min, Pipe 2 = 64 min, and Combined time (with outlet) = 48 min.

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Pipe	Time (min)	Total Work (LCM)	Efficiency
Pipe A (+)	96	192	2
Pipe B (+)	64	3	
A + B − C	48	4	

Calculations:
=> Efficiency of Pipe A = 192 ÷ 96 = 2 units/min
=> Efficiency of Pipe B = 192 ÷ 64 = 3 units/min
=> Combined Efficiency (A + B − C) = 192 ÷ 48 = 4 units/min
=> Efficiency of Outlet Pipe C = (Efficiency of A + Efficiency of B) − Combined Efficiency
=> Efficiency of Pipe C = (2 + 3) − 4 = 1 unit/min
=> Time taken by Pipe C to empty the cistern = Total Work ÷ Efficiency of C
=> Time = 192 ÷ 1 = 192 min
Therefore The correct answer is 192 min.
Additional Information
Inlet and Outlet Pipes
An inlet pipe fills a tank (positive work), while an outlet pipe empties it (negative work).
Net Efficiency Formula
Net efficiency = ∑(Efficiencies of Inlet pipes) − ∑(Efficiencies of Outlet pipes).
Work and Time Relationship
Time taken to complete a task is inversely proportional to efficiency: Time = Work ÷ Efficiency.

Q43. Answer: (b) 81°

Shortcut Trick
In a quadrilateral, the angle formed by the bisectors of two adjacent angles is equal to half the sum of the other two angles.
angle TOS = (angle M + angle N) ÷ 2
angle TOS = (63° + 99°) ÷ 2
angle TOS = 162° ÷ 2 = 81°
Therefore The correct answer is 81°.
Alternate Method
Given: angle M = 63°, angle N = 99°
Formula Used: Sum of interior angles of a quadrilateral = 360°; Sum of angles in a triangle = 180°.
In quadrilateral MNST:
=> angle M + angle N + angle S + angle T = 360°
=> 63° + 99° + angle S + angle T = 360°
=> 162° + angle S + angle T = 360°
=> angle S + angle T = 360° − 162° = 198°
Since TO and SO are angle bisectors of angle T and angle S respectively:
=> angle OTS = angle T ÷ 2 and angle OST = angle S ÷ 2
In triangle ΔTOS:
=> angle TOS + angle OTS + angle OST = 180°
=> angle TOS + (angle T ÷ 2) + (angle S ÷ 2) = 180°
=> angle TOS + (angle T + angle S) ÷ 2 = 180°
=> angle TOS + 198° ÷ 2 = 180°
=> angle TOS + 99° = 180°
=> angle TOS = 180° − 99° = 81°
Therefore The correct answer is 81°.
Additional Information
Angle Sum Property of Polygons
The sum of all interior angles of an n-sided polygon is (n − 2) × 180°.
Angle Between Opposite Bisectors

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

Q44. Answer: (a) 1

Shortcut Trick

LCM of 10, 15, and 3 is 30.

Divide 539 by 30 to find the remainder: 539 ÷ 30 => Remainder = 29.

Number to be added = Divisor − Remainder = 30 − 29 = 1.

Therefore The correct answer is 1.

Alternate Method

Given: Number = 539, Divisors = 10, 15, 3.

Formula: Least number to be added = LCM(divisors) − (Number % LCM(divisors)).

=> LCM of 10, 15, and 3:

=> 10 = 2 × 5

=> 15 = 3 × 5

=> 3 = 3

=> LCM = 2 × 3 × 5 = 30.

=> Divide 539 by 30:

=> 539 = 30 × 17 + 29.

=> Remainder = 29.

=> Required number to be added = 30 − 29 = 1.

Therefore The correct answer is 1.

Additional Information

LCM (Least Common Multiple)

The smallest positive integer that is divisible by each of the given numbers. For divisibility problems involving multiple numbers, always find the LCM first.

Divisibility Rule of 10

A number is divisible by 10 if its last digit is 0. Since 539 ends in 9, the next number ending in 0 is 540, requiring 1 to be added.

Least Number to Subtract

To find the least number to subtract to make a number perfectly divisible, the answer is simply the Remainder obtained after division.

Q45. Answer: (c) 1458.6

Shortcut Trick

Area of quadrilateral ABCD = Area(ΔBCD) + Area(ΔABD)

In right-angled triangle BCD, Area = 0.5 × 42 × 40 = 840 m²

Hypotenuse BD = √(42² + 40²) = 58 m

In isosceles triangle ABD (sides 36, 36, 58), height h = √(36² − 29²) = √455 ≈ 21.33 m

Area(ΔABD) = 0.5 × 58 × 21.33 ≈ 618.6 m²

Total Area = 840 + 618.6 = 1458.6 m²

Therefore The correct answer is 1458.6 m².

Alternate Method

Given: AB = 36 m, BC = 42 m, CD = 40 m, AD = 36 m, and angle C = 90°.

Formula Used: Area of right triangle = 0.5 × base × height; Pythagoras theorem: a² + b² = c²; Heron's formula: Area = √[s(s−a)(s−b)(s−c)].

A

B

C

D

36 m

42 m

40 m

Q46. Answer: (a) 4.7

Shortcut Trick

Remaining distance = 1/3 of 168 = 56 km

Remaining time = (1 − 2/6) of 18 = 4/6 × 18 = 12 hours

Required Speed = 56 ÷ 12 = 4.66...

Therefore The correct answer is 4.7 km/hr.

Alternate Method

Given:

Total distance = 168 km

Total time = 18 hours

Calculations:

=> Distance covered = 2/3 × 168 = 112 km

=> Remaining distance = 168 − 112 = 56 km

=> Time taken = 2/6 × 18 = 6 hours

=> Remaining time = 18 − 6 = 12 hours

=> Required speed = Remaining distance ÷ Remaining time

=> Speed = 56 ÷ 12

=> Speed = 4.666... ≈ 4.7 km/hr

Therefore The correct answer is 4.7 km/hr.

Additional Information

Average Speed Formula

Average Speed = Total Distance ÷ Total Time. For two equal distances, Avg Speed = 2xy/(x+y).

Relative Speed

Same direction: S1 − S2 | Opposite direction: S1 + S2.

Unit Conversion

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

Q47. Answer: (b) 66.67%

Shortcut Trick

Required percentage = (Marks of B / Marks of A) × 100

Required percentage = (50 / 75) × 100 = (2 / 3) × 100

2/3 of 100 is approximately 66.67%.

Therefore The correct answer is 66.67%.

Alternate Method

Given:

Marks obtained by B = 50

Marks obtained by A = 75

Maximum marks = 120 (Note: This is redundant for the specific ratio requested)

Formula Used:

Percentage of X relative to Y = (X / Y) × 100

Calculations:

=> Required % = (Marks of B / Marks of A) × 100

=> Required % = (50 / 75) × 100

=> Required % = (2 / 3) × 100

=> Required % = 200 / 3

=> Required % = 66.666...

=> Rounding off to two decimal places, we get 66.67%.

Therefore The correct answer is 66.67%.

Additional Information

Percentage Change

Percentage change = (Difference / Original Value) × 100. Used to find how much a value increased or decreased.

Base Value Identification

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The value following the word 'than' or 'of' in a comparison is usually taken as the Base Value (denominator).

Fraction to Percentage Conversion

Common fractions: 1/2 = 50%, 1/3 = 33.33%, 2/3 = 66.67%, 1/4 = 25%, 3/4 = 75%.

Q48. Answer: (d) 616 cm²

Shortcut Trick

Ratio of Volumes = n = 8

Ratio of Radii (R/r) = $\sqrt[3]{(n)} = \sqrt[3]{(8)} = 2$

New radius (r) = 14 ÷ 2 = 7 cm

Surface Area = 4 × (22/7) × 7 × 7 = 616 cm²

Therefore The correct answer is 616 cm².

Alternate Method

Given:

Radius of large sphere (R) = 14 cm

Number of solid balls (n) = 8

Formula Used:

Volume of Sphere = (4/3) × π × r³

Surface Area of Sphere = 4 × π × r²

Calculations:

=> Total Volume of large sphere = 8 × Volume of each small ball

=> (4/3) × π × (14)³ = 8 × (4/3) × π × r³

=> 14 × 14 × 14 = 8 × r³

=> 2744 = 8 × r³

=> r³ = 2744 ÷ 8

=> r³ = 343

=> r = $\sqrt[3]{(343)}$ = 7 cm

=> Surface area of each ball = 4 × π × r²

=> Surface area = 4 × (22/7) × 7 × 7

=> Surface area = 4 × 22 × 7

=> Surface area = 88 × 7 = 616 cm²

Therefore The correct answer is 616 cm².

Additional Information

Curved Surface Area of Hemisphere

The CSA of a hemisphere is exactly half of the sphere's surface area, given by 2 × π × r².

Total Surface Area of Hemisphere

The TSA of a solid hemisphere includes the base area, resulting in 3 × π × r².

Volume of Hemisphere

The Volume of a hemisphere is (2/3) × π × r³, which is half the volume of a full sphere.

Q49. Answer: (c) 71

Shortcut Trick

The Algebraic Identity used is: (Sum)² = (Sum of Squares) + 2 × (Sum of Products).

Substituting the given values: 15² = 83 + 2(ab + bc + ca)

225 = 83 + 2(ab + bc + ca)

2(ab + bc + ca) = 225 − 83 = 142

ab + bc + ca = 142 ÷ 2 = 71

Therefore The correct answer is 71.

Alternate Method

Given:

a + b + c = 15

a² + b² + c² = 83

Formula Used:

The standard expansion of the square of a trinomial:

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

Calculations:

$\Rightarrow (15)^2 = 83 + 2(ab + bc + ca)$

$\Rightarrow 225 = 83 + 2(ab + bc + ca)$

$\Rightarrow 225 - 83 = 2(ab + bc + ca)$

$\Rightarrow 142 = 2(ab + bc + ca)$

$\Rightarrow ab + bc + ca = 142 \div 2$

$\Rightarrow ab + bc + ca = 71$

Therefore The correct answer is 71.

Additional Information

Trinomial Square Identity

The formula $(a+b+c)^2 = a^2+b^2+c^2+2(ab+bc+ca)$ relates the sum of three numbers, the sum of their squares, and the sum of their products taken in pairs.

Cubic Identity

A related identity is $a^3+b^3+c^3 - 3abc = (a+b+c)(a^2+b^2+c^2 - ab - bc - ca)$, which is frequently used in algebraic simplifications.

Value of ab+bc+ca

If $a+b+c = 0$, then $a^2+b^2+c^2 = -2(ab+bc+ca)$, implying the sum of squares is twice the negative sum of the cyclic products.

Q50. Answer: (d) Rs. 3,000

Shortcut Trick

Profit = 15% => Fraction = 3/20.

Let Cost Price (CP) = 20 units and Profit = 3 units.

Then, Selling Price (SP) = 20 + 3 = 23 units.

Given: 23 units = Rs. 3,450 => 1 unit = 3,450 ÷ 23 = Rs. 150.

CP = 20 units = 20 × 150 = Rs. 3,000.

Therefore The correct answer is Rs. 3,000.

Alternate Method

Given: Selling Price (SP) = Rs. 3,450, Profit Percentage = 15%.

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

$\Rightarrow CP = (3,450 \times 100) \div (100 + 15)$

$\Rightarrow CP = (3,450 \times 100) \div 115$

$\Rightarrow CP = 30 \times 100$

$\Rightarrow CP = Rs. 3,000.$

Therefore The correct answer is Rs. 3,000.

Additional Information

Cost Price & Selling Price

Cost Price (CP) is the price at which an article is purchased. Selling Price (SP) is the price at which it is sold.

Profit and Loss Percentage

Profit % = (Profit ÷ CP) × 100. Loss % = (Loss ÷ CP) × 100. Both are always calculated on the Cost Price unless stated otherwise.

Q51. Answer: (c) JMK 52

Given Series: RUS 36 PSQ 40 NQO 44 LOM 48 ?

The pattern followed here is:

Therefore According to the pattern followed here JMK 52 will replace the (?) mark.

Hence, the correct answer is "Option 3".

Q52. Answer: (a) FBXY

Logic followed here is:

Each letter in the given cluster is shifted backward by 3 positions in the English alphabetical series to obtain the corresponding letter of the related cluster.

For

JFBC is related to GCYZ →

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WSOP is related to TPLM →

The pattern observed is: (Positional value of the letter) - 3.

Similarly, let's find the related cluster for IEAB:

Therefore, the related cluster for 'IEAB' is FBXY.

Hence, the correct answer is "Option 1".

Q53. Answer: (a) Q

Given:

• Only two people sit between G and S when counted from the right of G.

• Only one person sits between S and I when counted from the right of I.

• Only three people sit between G and R.

• H sits to the immediate left of Q.

Find: Who sits third to the left of R?

Starting from R and moving left:

R → I → G → Q

Therefore, the person sitting third to the left of R is Q.

Hence, the correct answer is Option 1 — Q.

Q54. Answer: (d) 59

Given:

Z ranked 21^(st) from the top and 39^(th) from the bottom.

Formula:

Total students = Rank from top + Rank from bottom − 1

Calculation:

= 21 + 39 − 1

= 60 − 1

= 59

Therefore, the total number of students in the class is 59.

Hence, the correct answer is Option 4 — 59.

Q55. Answer: (a) 4

Given Series:

(Left) # € % # 6 & 4 * 9 6 @ 5 % @ # © 8 # % * £ 2 (Right)

Required pattern: Symbol → Number → Symbol

Checking the series:

(Left) # € % # 6 & 4 * 9 6 @ 5 % @ # © 8 # % * £ 2 (Right)

Numbers satisfying the condition:

→ 6 in (# 6 &)

→ 4 in (& 4 *)

→ 5 in (@ 5 %)

→ 8 in (© 8 #)

Therefore, there are 4 such numbers.

Hence, the correct answer is Option 1 — 4.

Q56. Answer: (b) VYP

Logic followed here is:

Each letter-cluster follows a pattern based on the addition and subtraction of positional values in alphabetical order.

The pattern is: 1st letter + 3 = 2nd letter; 2nd letter - 7 = 3rd letter.

For (1) LOH →

For (2) VYP →

For (3) CFY →

For (4) ZCV →

Therefore, the letter-cluster 'VYP' is the odd one out.

Hence, the correct answer is "Option 2".

Q57. Answer: (c) 4

Given Series:

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

Required pattern: Odd → Odd → Odd

Checking the series:

3 1 3 2 8 2 1 2 4 6 1 3 1 8 8 6 1 1 9 1 9 5 8 4 1 8 9 6 9

Odd numbers satisfying the condition:

→ 1 in (3 1 3)

→ 3 in (1 3 1)

→ 1 in (1 1 9)

→ 9 in (1 9 5)

Therefore, there are 4 such odd numbers.

Hence, the correct answer is Option 3 — 4.

Q58. Answer: (b) OHVR

Logic followed here is:

The letters in the first word are shifted by +5 and +4 alternatively to get the corresponding letters in the second word based on their positional values in the English alphabetical order.

For

ABHL is related to FFMP →

URBB is related to ZVGF →

The pattern observed is: (Letter Positional Value) + 5, + 4, + 5, + 4.

Similarly, let's find the related term for JDQN:

Therefore, 'JDQN' is related to 'OHVR'.

Hence, the correct answer is "Option 2".

Q59. Answer: (c) A

Given:

• Only two people sit between A and B when counted from the left of A.

• G sits to the immediate left of A.

• Only three people sit between E and G when counted from the left of E.

• C sits to the immediate right of D.

• F is not an immediate neighbour of G.

Starting from H and moving right:

H → G → A

So, the person sitting second to the right of H is A.

Hence, the correct answer is Option 3 — A.

Q60. Answer: (a) SYDG

Logic followed here is:

The difference between the positional values of consecutive letters in each cluster follows a specific pattern (e.g., +6, +4, +4), except for the odd cluster.

1) SYDG:

2) UAEI:

3) HNRV:

4) XDHL:

Therefore, the letter-cluster 'SYDG' is the odd one out as it does not follow the +6, +4, +4 pattern.

Hence, the correct answer is "Option 1".

Q61. Answer: (c) 148

Logic followed here is.

Logic: The series is formed by adding consecutive odd numbers starting from 1 to each preceding term to obtain the next term.

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The sequence of differences is 1, 3, 5, 7, which are consecutive odd numbers.

Therefore, the number that should come in place of the question mark is 148.

Hence, the correct answer is "Option 3".

Q62. Answer: (c) 23 km towards east

Given:

Manish starts from Point Y.

Movement details:

37 km North

Left turn → 75 km West

Left turn → 69 km South

Left turn → 52 km East

Left turn → 32 km North

If Point Z is 23 km West of Point Y, then to reach Point Y again he must travel:

23 km towards East

Hence, the correct answer is "Option 3".

Q63. Answer: (b) Brother

Given Code Language:

We draw the following table from given conditions:

A is | ± | * | Rs. | # | | --- | --- | --- | --- | | wife | son | father | sister | of B	**±**	**•**	**Rs.**	**#**	**wife**	**son**	**father**	**sister**
±	•	Rs.	#					
wife	son	father	sister					

Given Expression:

D * R ± A Rs. C # O: D is the son of R. R is the wife of A. A is the father of C. C is the sister of D.

Family Structure:

• So, D is the brother of O.

Hence, the correct answer is "Option 2".

Q64. Answer: (d) 20 km towards the north

Given:

Jason starts from his house.

Movement details:

30 km West

Right turn → 20 km North

Left turn → 10 km West

Left turn → 40 km South

Left turn → 40 km East

If Jason is 20 km South of his house, then he must travel:

20 km towards North

Hence, the correct answer is "Option 4".

Q65. Answer: (b) Second to the left

Given:

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

B sits second to the left of C.

D is an immediate neighbour of E.

F sits to the immediate left of E.

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F sits second to the right of A.

Find position of C with respect to E

From E, moving anti-clockwise two places reaches C.

Therefore, C is second to the left of E.

Hence, the correct answer is "Option 2".

Q66. Answer: (c) SWU

Given Series : GKI JNL MQO PTR ?

The logic followed here is:

Therefore According to the logic followed here SWU will replace (?) mark.

Hence, the correct answer is "Option 3".

Q67. Answer: (d) (180, 203, 383)

Logic followed here is: (1st Number + 2nd Number) = 3rd Number.

For

(158, 568, 726) →

Sum = 158 + 568 = 726

(123, 402, 525) →

Sum = 123 + 402 = 525

Similarly, Option 4):

Checking (180, 203, 383):

Sum = 180 + 203 = 383

Therefore, the set that follows the same logic is (180, 203, 383).

Hence, the correct answer is "Option 4".

Q68. Answer: (d) 187

Shortcut Trick

Identify the logic: The differences between consecutive terms are squares of consecutive natural numbers starting from 5.

Differences: $38-13 = 25\ (5^2)$ | $74-38 = 36\ (6^2)$ | $123-74 = 49\ (7^2)$

Following the pattern, the next difference must be $8^2 = 64$.

Missing number = 123 + 64 = 187.

Verification: $187 + 9^2 = 187 + 81 = 268$.

Therefore The correct answer is 187.

Alternate Method

Given series: 13, 38, 74, 123, ?, 268

13 +25 → 38 +36 → 74 +49 → 123 +64 → 187 +81 → 268

The pattern follows the addition of consecutive perfect squares:

=> $13 + 5^2 = 13 + 25 = 38$

=> $38 + 6^2 = 38 + 36 = 74$

=> $74 + 7^2 = 74 + 49 = 123$

=> $123 + 8^2 = 123 + 64 = 187$

=> $187 + 9^2 = 187 + 81 = 268$

Therefore The correct answer is 187.

Additional Information

Square Series

A series where the difference between terms is based on perfect squares (n^2) like 1, 4, 9, 16, 25, 36, etc.

Difference Series

The most common method to solve number series is checking the first difference; if no pattern is found, check the second difference (double difference).

Arithmetic Progression (AP)

A sequence of numbers such that the difference between the consecutive terms is constant (d). Term $T_n = a + (n-1)d$.

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Q69. Answer: (b) 364

Given Mapping:

A	B	C	D
÷	×	•	–

Applying the logic to the given equation:

120 B 15 A 5 D 18 C 22 = ?

By replacing the letters with their respective signs, we get:

120 × 15 ÷ 5 − 18 + 22

Following BODMAS rule:

=> 120 × (15 ÷ 5) - 18 + 22 = ?

=> 120 × 3 - 18 + 22 = ?

=> 360 - 18 + 22 = ?

=> 382 -18 = ?

=> 364 = ?

Therefore The value that will come in place of the question mark is 364.

Hence, the correct answer is "Option 2".

Q70. Answer: (b) 1083

Given:

'+' and '–' are interchanged

'×' and '÷' are interchanged

Given Equation:

77 ÷ 12 + 252 x 14 - 177 = ?

After interchanging the signs:

Original Sign	Changed To
÷	×
•	–
x	÷
–	•

So the equation becomes:

77 × 12 − 252 ÷ 14 + 177

Applying BODMAS Rule:

= 77 × 12 − 18 + 177

= 924 − 18 + 177

= 906 + 177

= 1083

Therefore, the value of the question mark is 1083.

Hence, the correct answer is Option 2.

Q71. Answer: (a) DM-FO-IK

Logic followed here is:

In each triad, the first letters of the pairs follow a pattern of +2 and +3 positional shifts, while the second letters of the pairs follow a pattern of +2 and -4 positional shifts.

For HQ - JS - MO

For FO - HQ - KM

Similarly, Option 1) DM - FO - IK:

Therefore, the triad that follows the same pattern is 'DM-FO-IK'.

Hence, the correct answer is "Option 1".

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Q72. Answer: (c) 2

Given Series:
(Left) 8 6 1 3 4 1 8 9 6 8 8 6 5 7 1 9 6 9 8 1 7 8 3 8 3 3 8 (Right)
Required pattern: Odd → Odd → Odd
Checking the series:
(Left) 8 6 1 3 4 1 8 9 6 8 8 6 5 7 1 9 6 9 8 1 7 8 3 8 3 3 8 (Right)
Odd numbers satisfying the condition:
→ 1 in (7 1 9)
→ 7 in (5 7 1)
Therefore, there are 2 such odd numbers.
Hence, the correct answer is Option 3.

Q73. Answer: (d) 60

Given Mapping:

Letter	Operation
A	÷
B	×
C	•
D	−

Given Equation:
(56 A 7) B 9 D (14 A 7) B 5 C 36 A 4 D 11
Replace letters with symbols:
(56 ÷ 7) × 9 − (14 ÷ 7) × 5 + 36 ÷ 4 − 11
Applying BODMAS Rule:
= (8) × 9 − (2) × 5 + 9 − 11
= 72 − 10 + 9 − 11
= 62 + 9 − 11
= 71 − 11
= 60
Therefore, the value of the question mark is 60.
Hence, the correct answer is Option 4.

Q74. Answer: (d) je

Given Codes:
‘live with truth’ → ‘xf je ak’
‘truth guides life’ → ‘ub mr je’
Therefore, the code for ‘truth’ is je.
Hence, the correct answer is "Option 4".

Q75. Answer: (c) mq

Given Codes:
‘work fosters growth’ → ‘hw mq pc’
‘growth with effort’ → ‘yv ju mq’
Therefore, the code for ‘growth’ is mq.
Hence, the correct answer is "Option 3".

Q76. Answer: (d) 35

Given Series: 115 95 77 61 47 ?
The pattern followed here is:
The numbers are decreasing by consecutive even numbers:
20, 18, 16, 14, 12

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Therefore According to the pattern followed, 35 will replace the (?) mark.

Hence, the correct answer is "Option 4".

Q77. Answer: (d) Neither conclusion (I) nor (II) follows.

Given Statements:

• Some lamps are bulbs.

• No bulb is a torch.

• No bulb is a candle.

Conclusion I: No lamp is a torch: Does not follows (We know only that some lamps are bulbs, and no bulb is a torch.)

Conclusion II: Some candles are torches: Does not follow (because,The statements provide no direct relationship between candles and torches.)

Therefore, neither Conclusion I nor Conclusion II follows.

Hence, the correct answer is: Neither I nor II follows.

Q78. Answer: (b) 24th

Given:

Total students = 38

Z is 12th from the left end.

G is 3rd to the right of Z.

Step 1: Find G's position from the left end

Z's position from left = 12

G is 3 places to the right of Z:

12 + 3 = 15

So, G is 15th from the left end.

Step 2: Find G's position from the right end

Formula:

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

= 38 − 15 + 1

= 24

So, G is 24th from the right end.

Hence, the correct answer is "Option 2".

Q79. Answer: (a) 2

Given Series:

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

Required pattern: Odd → Even → Odd

Checking the series: (Left) 1 3 9 3 2 6 8 3 9 6 2 2 7 7 7 7 3 3 7 3 8 3 5 6 5 9 6 (Right)

The even numbers satisfying the condition are:

→ 8 in (3 8 3)

→ 6 in (5 6 5)

Therefore, there are 2 such even numbers.

Hence, the correct answer is "Option 1".

Q80. Answer: (c) Neither conclusion (I) nor (II) is true

Given Statements:

No Fictions are Nonfictions.

All Nonfictions are Poetries.

Some Poetries are Dramas.

Checking Conclusions:

(I) Some Fictions are Poetries: Follows (because, No direct relation is given between Fictions and Poetries.)

(II) Some Nonfictions are Dramas: Does not follows (because Nonfictions subset of Poetries, Some Poetries are Dramas. But it is not fixed that those Poetries which are Dramas are also Nonfictions.)

Therefore, neither conclusion (I) nor (II) follows.

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Hence, the correct answer is "Neither conclusion (I) nor (II) follows".

Q81. Answer: (a) Yes! We Can End TB: Commit, Invest, Deliver

The correct answer is Yes! We Can End TB: Commit, Invest, Deliver.

Key Points

• World Tuberculosis (TB) Day is observed annually on March 24 to raise public awareness about the devastating health, social, and economic consequences of TB and to step up efforts to end the global TB epidemic.

• The theme for World TB Day 2025 is "Yes! We Can End TB: Commit, Invest, Deliver". This theme builds on previous years' messages of hope but adds a specific call to action regarding political commitment, financial investment, and the delivery of care.

• The theme emphasizes that ending TB is possible through high-level leadership, increased funding, and faster uptake of new World Health Organization (WHO) recommendations to ensure that every patient receives the best standard of care.

• The date of March 24 commemorates the day in 1882 when Dr. Robert Koch announced that he had discovered Mycobacterium tuberculosis, the bacterium that causes tuberculosis. This discovery was the first step toward diagnosing and curing the disease.

• In India, the observation of this day is significant as the country has set an ambitious target to eliminate TB by 2025, five years ahead of the global Sustainable Development Goal (SDG) target of 2030.

Additional Information

• National TB Elimination Program (NTEP): Formerly known as the Revised National Tuberculosis Control Program (RNTCP), the NTEP is the specialized agency under the Ministry of Health and Family Welfare responsible for TB control in India.

• Ni-kshay Poshan Yojana: This scheme provides a monthly financial incentive of Rs. 500 to all TB patients for nutritional support. The payment is made through Direct Benefit Transfer (DBT) to the patient's bank account throughout the duration of their treatment.

• Pradhan Mantri TB Mukt Bharat Abhiyaan: Launched by the President of India, this initiative aims to bring together all community stakeholders to support those on TB treatment. It introduces the concept of Ni-kshay Mitras, who are donors (individuals, NGOs, or corporates) that adopt TB patients to provide nutritional and vocational support.

• Disease Characteristics: TB is an infectious disease that primarily affects the lungs (pulmonary TB), but can also affect other organs such as the brain, kidneys, and spine (extra-pulmonary TB). It spreads through the air when people with lung TB cough, sneeze, or spit.

• Drug-Resistant TB: One of the biggest challenges in TB elimination is MDR-TB (Multi-Drug Resistant Tuberculosis), where the bacteria do not respond to at least Isoniazid and Rifampicin, the two most powerful first-line anti-TB drugs. This requires longer and more complex treatment regimens.

• BCG Vaccine: The Bacillus Calmette-Guérin (BCG) vaccine is widely used in India as part of the Universal Immunization Programme to protect infants and children from severe forms of tuberculosis.

Q82. Answer: (a) National Medical Commission

The correct answer is National Medical Commission.

Key Points

• The National Medical Commission (NMC) was established as the primary regulatory body for medical education and professionals in India, replacing the decades-old Medical Council of India (MCI).

• This transition was formalized under the National Medical Commission Act, 2019, which received presidential assent on August 8, 2019, and officially came into force on September 25, 2020.

• The primary objective of the NMC is to improve access to quality and affordable medical education, ensure the availability of adequate and high-quality medical professionals, and promote equitable and universal healthcare.

• It oversees the regulation of medical institutions and practitioners, as well as the conduct of the National Eligibility cum Entrance Test (NEET) for admission to undergraduate and postgraduate medical courses.

• The commission is also tasked with implementing the National Exit Test (NEXT), which will serve as a common final-year undergraduate medical examination, a licentiate exam to practice medicine, and a basis for admission to postgraduate courses.

Additional Information

• Structure of the NMC:

• The commission consists of 33 members, including a Chairperson (who must be a medical professional), 10 ex-officio members, and 22 part-time members.

• The members include representatives from the Ministry of Health and Family Welfare, the Directorate General of Health Services (DGHS), and various State Medical Councils.

• Autonomous Boards:

• The NMC functions through four distinct autonomous boards: the Under-Graduate Medical Education Board (UGMEB), the Post-Graduate Medical Education Board (PGMEB), the Medical Assessment and Rating Board (MARB), and the Ethics and Medical Registration Board (EMRB).

• The MARB has the authority to grant permission for establishing new medical colleges and increasing seat capacity, significantly

streamlining the MCI's previous cumbersome inspection processes.

• Regulatory Scope:

• The NMC has the power to frame guidelines for determination of fees and all other charges in respect of 50% of seats in private medical institutions and deemed universities.

• It maintains a National Register containing the name, address, and all recognized qualifications of licensed medical practitioners in India.

• Historical Context:

• The Medical Council of India (MCI) was originally established in 1933 under the Indian Medical Council Act, 1933. It was later reconstituted under the Indian Medical Council Act, 1956.

• The transition to NMC was recommended by a high-level committee chaired by Arvind Panagariya and the Ranjit Roy Chaudhury Committee, following reports of corruption and lack of accountability within the MCI.

Important Points

• Community Health Providers: The NMC Act includes a provision for granting limited licenses to Community Health Providers to practice medicine at mid-level in the primary healthcare sector, aimed at addressing the shortage of doctors in rural areas.

• Accountability: Unlike the MCI, which was an elected body of doctors, the NMC is a government-nominated body, which was intended to increase government oversight and reduce the conflict of interest inherent in a self-regulatory body.

• Uniform Standards: The commission works to ensure uniform standards of medical education in India, aligning them with global benchmarks to facilitate better mobility for Indian medical graduates.

Q83. Answer: (a) Second WHO Global Summit on Traditional Medicine 2025

The correct answer is Second WHO Global Summit on Traditional Medicine 2025.

Key Points

• The Second WHO Global Summit on Traditional Medicine is scheduled to be held in 2025 in New Delhi, India, marking a significant milestone in global healthcare collaboration.

• This high-level event is co-hosted by the World Health Organization (WHO) and the Ministry of Ayush, Government of India, reflecting a strong partnership to promote traditional healing systems.

• The summit aims to strengthen the evidence-based integration of traditional, complementary, and integrative medicine (TCIM) into national health systems and global health policies.

• It serves as a follow-up to the First WHO Global Summit on Traditional Medicine, which took place in Gandhinagar, Gujarat, in August 2023.

• The 2025 summit will focus on innovation, digital health, and the application of modern science to validate traditional knowledge for the benefit of human health and the planet.

Additional Information

• Ministry of Ayush:

• The Ministry of Ayush was established on 9th November 2014 by the Government of India to ensure the development and propagation of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homoeopathy.

• It plays a pivotal role in positioning India as a global leader in traditional medicine through research, education, and international partnerships.

• WHO Global Centre for Traditional Medicine (GCTM):

• Located in Jamnagar, Gujarat, the GCTM is the first and only global center of its kind established by the World Health Organization.

• It acts as a knowledge hub to catalyze ancient wisdom and modern science for the health of people and the planet, focusing on evidence, data, and sustainability.

• Gujarat Declaration:

• Following the first summit in 2023, the Gujarat Declaration was released, highlighting the global commitment to scaling up the scientific validation of traditional medicine.

• It emphasizes the role of traditional medicine in achieving Universal Health Coverage (UHC) and Sustainable Development Goal 3 (SDG 3).

• Global Prevalence:

• According to WHO data, approximately 80% of the world’s population uses traditional medicine, and it is a major part of the health economy in many countries.

• Nearly 40% of approved pharmaceutical products today are derived from natural substances, underlining the importance of biodiversity and traditional knowledge.

Important Points

• International Classification: The WHO has integrated traditional medicine modules into the ICD-11 (International Classification of Diseases) to enable standardized clinical documentation and global data collection.

• Strategic Goals: The 2025 summit in New Delhi is expected to address the regulatory frameworks required for the quality, safety, and efficacy of traditional medicinal products.

• Biodiversity and Sustainability: A key theme involves the sustainable sourcing of medicinal plants and protecting the intellectual property rights of indigenous communities who hold traditional health knowledge.

• Technology Integration: The summit will likely explore how Artificial Intelligence (AI) and Genomics can be used to study the multi-component nature of traditional formulations.

Q84. Answer: (a) Technology Development Fund (TDF)

The correct answer is Technology Development Fund (TDF).

Key Points

• The Technology Development Fund (TDF) is a flagship program of the Ministry of Defence, executed specifically by the Defence Research and Development Organisation (DRDO) under the 'Make in India' initiative.

• The primary objective of the TDF scheme is to provide grants-in-aid to Indian industries, including MSMEs and start-ups, to encourage the design and development of indigenous defence and dual-use technologies.

• The scheme aims to bridge the gap between R&D and commercialization by supporting the development of prototypes or upgrading existing systems to meet the requirements of the Indian Armed Forces.

• Under this program, the DRDO provides financial support up to 90% of the total project cost. In June 2022, the funding limit was significantly enhanced from Rs. 10 crore to Rs. 50 crore per project to accommodate high-value technology development.

• The program is designed to foster a culture of innovation and self-reliance (Aatmanirbharta) in the defence sector by involving private sector players in cutting-edge technology domains.

Additional Information

• Innovations for Defence Excellence (iDEX):

• Launched in April 2018, iDEX is aimed at creating an ecosystem to foster innovation and technology development in Defence and Aerospace.

• It is funded and managed by the Defence Innovation Organisation (DIO), not directly by DRDO.

• It provides a platform for start-ups, individual innovators, and MSMEs to solve challenges posed by the Services through the Defence India Start-up Challenge (DISC).

• Defence Testing Infrastructure Scheme (DTIS):

• Launched in May 2020 with an outlay of Rs. 400 crore, this scheme focuses on creating state-of-the-art testing facilities in partnership with the private sector.

• It aims to promote indigenous production by providing Greenfield Testing Infrastructure, particularly in the Defence Industrial Corridors of Uttar Pradesh and Tamil Nadu.

• Aatmanirbhar Defence Innovation & Technology Initiative (ADITI):

• Launched in March 2024, ADITI is a specialized scheme under the iDEX framework to promote deep-tech innovations in the defence sector.

• It offers grants-in-aid up to Rs. 25 crore to eligible start-ups for research and development in critical and strategic technology areas.

Important Points

• Eligibility for TDF: Only Indian companies incorporated under the Companies Act 2013 or LLP Act 2008 are eligible. The majority stake (at least 51%) must be held by Indian citizens.

• Dual-use Technology: These are technologies like advanced sensors, AI-based surveillance, and drones that have applications in both military warfare and civilian sectors (e.g., disaster management or logistics).

• Project Duration: The maximum development period for a project under the TDF is generally 2 years, ensuring a fast-track approach to technology indigenization.

• Nodal Agency: While the Ministry of Defence provides the mandate, the Directorate of TDF within DRDO acts as the nodal agency for evaluation and implementation.

Q85. Answer: (c) Defence Research and Development Organisation

The correct answer is Defence Research and Development Organisation.

Key Points

• The Nag Mk 2 is a third-generation Anti-Tank Guided Missile (ATGM) that has been indigenously designed and developed to strike enemy tanks with high precision.

• It is developed by the Defence Research and Development Organisation (DRDO), specifically through its premier lab, the Defence Research and Development Laboratory (DRDL), located in Hyderabad.

• The missile is equipped with Fire-and-Forget capability, which means that once the missile is locked onto a target and launched, it guides itself automatically without further intervention from the operator.

• It uses an advanced Imaging Infra-Red (IIR) seeker to track and hit targets during both day and night, ensuring operational efficiency in diverse weather conditions.

• The development of the Nag Mk 2 version focuses on enhanced performance, including improved seeker technology and a more efficient propulsion system compared to its predecessors. Hence, the correct answer is Defence Research and Development Organisation.

Additional Information

• DRDO (Defence Research and Development Organisation):

• Established in 1958, it is the R&D wing of the Ministry of Defence, Government of India.

• It aims to empower India with cutting-edge defense technologies and achieve self-reliance in critical military systems and platforms.

• It was formed by merging the Technical Development Establishment (TDEs) and the Directorate of Technical Development & Production (DTDP) with the Defence Science Organisation (DSO).

• Variants of Nag Missile:

• NAMICA (Nag Missile Carrier): This is a modified BMP-2 infantry combat vehicle designated as a "tank destroyer," equipped with a thermal sight and a launcher for Nag missiles.

• Helina: It is the helicopter-launched version of the Nag missile, boasting a range of 7 to 10 kilometers. It is designed to be launched from the HAL Rudra and Light Combat Helicopter (LCH).

• Dhruvastra: This is the Air Force version of the Helina missile, recently tested for integration with Advanced Light Helicopters (ALH).

• Integrated Guided Missile Development Programme (IGMDP):

• The Nag missile was one of the five missile systems envisioned under the IGMDP, spearheaded by Dr. A.P.J. Abdul Kalam in 1983.

• The other four missiles under this program are Prithvi (Surface-to-surface), Agni (Ballistic missile), Trishul (Short-range surface-to-air), and Akash (Medium-range surface-to-air).

Important Points

• Operational Capabilities: The Nag missile features a top-attack capability, allowing it to strike the turret of a tank, which is typically the most vulnerable part with the thinnest armor.

• Range: The land-based version has a minimum range of 500 meters and an effective maximum range of up to 4 kilometers.

• Strategic Significance: The successful induction of such indigenous systems strengthens India’s Atmanirbhar Bharat initiative in the Defence Sector and reduces dependency on foreign imports for anti-tank weaponry.

Q86. Answer: (b) 38th

The correct answer is 38th.

Key Points

• India has achieved the 38th rank in the Global Innovation Index (GII) 2025, marking a significant milestone in its journey toward becoming a global innovation hub. Hence, the correct option is 38th.

• The index is published annually by the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations headquartered in Geneva, Switzerland.

• This ranking represents a steady rise for India, which moved up from the 39th position in 2024 and the 40th position in 2023. Over the last decade, India has climbed remarkably from its 81st rank in 2015.

• India continues to lead the lower-middle-income economy group and maintains its top position in the Central and Southern Asia region for innovation.

• The 2025 edition of the GII highlights India’s strengths in key indicators such as ICT services exports, Venture Capital (VC) received, and the number of Science and Engineering graduates.

Additional Information

• Global Innovation Index (GII) Framework:

• The GII ranks 133 economies based on their innovation capabilities and results.

• It is calculated using the average of two sub-indices: the Innovation Input Sub-Index (which measures elements of the economy that enable innovation) and the Innovation Output Sub-Index (which measures the actual results of innovation).

• The index relies on 7 pillars: Institutions, Human capital and research, Infrastructure, Market sophistication, Business sophistication, Knowledge and technology outputs, and Creative outputs.

• World Intellectual Property Organization (WIPO):

• Established in 1967, WIPO is the global forum for intellectual property (IP) services, policy, information, and cooperation.

• It currently has 193 member states and is led by Director General Daren Tang (as of 2025).

• The organization aims to lead the development of a balanced and effective international IP system that enables innovation and

creativity for the benefit of all.

• India's Innovation Ecosystem:

• The government’s focus on the Startup India initiative and the Atmanirbhar Bharat (Self-Reliant India) mission has significantly bolstered the domestic innovation landscape.

• India’s performance is particularly strong in Knowledge and technology outputs, where it ranks high in software exports and domestic market scale.

Important Points

• Global Leaders: Switzerland has consistently topped the GII for several years, followed by Sweden and the United States of America.

• Regional Performance: In the 2025 report, China remains the only middle-income economy among the top 30, while India is the most improved large economy over the long term.

• Indicator Specifics: India ranks 1st globally in ICT services exports as a percentage of total trade, highlighting its dominance in the global technology sector.

• Policy Impact: The improvement in ranking is attributed to the National Education Policy (2020) and increased spending on Research and Development (R&D) by the private and public sectors.

Q87. Answer: (b) Malaria Ends with Us: Reinvest, Reimagine, Reignite

The correct answer is Malaria Ends with Us: Reinvest, Reimagine, Reignite.

Key Points

• World Malaria Day is an international observance commemorated every year on 25 April to recognize global efforts to control and eventually eliminate malaria.

• For the year 2025, the theme is "Malaria Ends with Us: Reinvest, Reimagine, Reignite". This theme serves as a clarion call for the global community to bolster its commitment toward a malaria-free world.

• The "Reinvest" aspect of the theme emphasizes the critical need for increased domestic and international funding to close the gap in malaria financing, which has stagnated in recent years.

• The "Reimagine" component encourages the development and deployment of innovative tools, such as next-generation insecticide-treated nets, gene-drive mosquitoes, and more effective vaccines.

• The "Reignite" pillar focuses on restoring political will and community engagement to get the world back on track toward the 2030 targets of the Global Technical Strategy for Malaria.

• This observance provides an opportunity for affected countries to share their experiences and for international partners to showcase progress in research and development.

Additional Information

• Historical Context:

• World Malaria Day was established by the 60th World Health Assembly in May 2007. It replaced Africa Malaria Day, which had been observed since 2001 by African governments.

• The transition to a "World" day was intended to reflect the global nature of the disease and to encourage participation from all continents, as malaria affects regions in Southeast Asia, Latin America, and the Middle East, in addition to Africa.

• Disease Profile:

• Malaria is a life-threatening disease caused by Plasmodium parasites. These parasites are transmitted to humans through the bites of infected female Anopheles mosquitoes.

• The most lethal of these parasites is Plasmodium falciparum, which is most prevalent on the African continent. Plasmodium vivax is another common species that can cause relapsing infections.

• In 2022, there were an estimated 249 million cases of malaria worldwide across 85 countries, resulting in approximately 608,000 deaths.

• Prevention and Treatment:

• Core prevention methods include the use of Insecticide-Treated Nets (ITNs) and Indoor Residual Spraying (IRS).

• In recent years, the World Health Organization (WHO) has recommended the use of two malaria vaccines: RTS,S/AS01 (Mosquirix) and R21/Matrix-M. These are specifically designed for children living in regions with moderate to high malaria transmission.

• Effective treatment usually involves Artemisinin-based Combination Therapy (ACT), which is the gold standard for treating uncomplicated malaria caused by P. falciparum.

• Global Initiatives:

• The Global Fund to Fight AIDS, Tuberculosis and Malaria and the U.S. President's Malaria Initiative (PMI) are major contributors to the international response.

• The WHO Global Technical Strategy for Malaria 2016–2030 aims to reduce malaria mortality rates and case incidence by at least 90% by the year 2030.

Important Points

• Vulnerable Groups: Children under the age of 5 are the most vulnerable group affected by malaria; in 2022, they accounted for about 80% of all malaria deaths in the WHO African Region.

• Elimination Status: Countries that achieve at least 3 consecutive years of zero indigenous cases can apply for a WHO certification of malaria elimination. Recent examples include Azerbaijan, Tajikistan, and Belize in 2023.

• Climate Change Impact: Rising temperatures and changing rainfall patterns are expanding the habitats of Anopheles mosquitoes, potentially introducing malaria to previously unaffected high-altitude or temperate regions.

Q88. Answer: (c) Ministry of Environment, Forest and Climate Change

The correct answer is Ministry of Environment, Forest and Climate Change.

Key Points

• The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the Central Government for the planning, promotion, coordination, and overseeing the implementation of India's environmental and forestry policies and programmes.

• The Management Effectiveness Evaluation (MEE) for the cycle 2020-2025 represents the 5th cycle of assessment for National Parks and Wildlife Sanctuaries in India.

• This evaluation process is conducted by the MoEFCC with technical support from the Wildlife Institute of India (WII), an autonomous institution based in Dehradun.

• The primary objective of MEE is to assess how well Protected Areas are being managed and whether they are achieving the goals for which they were established.

• For the 2020-2025 cycle, the evaluation framework involves a set of 30 indicators categorized under six elements: Context, Planning, Inputs, Process, Outputs, and Outcomes.

Additional Information

• Management Effectiveness Evaluation (MEE):

• It is a global tool adopted from the IUCN World Commission on Protected Areas (WCPA) framework to evaluate the management efficiency of conservation sites.

• India is one of the few countries in the world that has institutionalized the MEE process for its network of Protected Areas since 2006.

• The evaluation helps in identifying gaps in management and provides a roadmap for future conservation strategies at both the state and national levels.

• Wildlife Institute of India (WII):

• Established in 1982, WII provides scientific knowledge and personnel for the conservation of wildlife in the country.

• It plays a critical role in developing the MEE scorecard and training the independent expert committees that visit the field sites for data collection.

• Tiger Reserves and MEE-TR:

• Apart from general Protected Areas, the National Tiger Conservation Authority (NTCA) also carries out a separate Management Effectiveness Evaluation of Tiger Reserves (MEE-TR) every four years.

• The MEE of Tiger Reserves follows a similar methodology but focuses specifically on the 54 Tiger Reserves currently present in India.

Important Points

• Rating Scale: The sites evaluated under MEE are given scores and categorized into four ratings: Very Good (75% and above), Good (60-74%), Satisfactory (50-59%), and Poor (less than 50%).

• MEE of Zoos (MEE-ZOO): Recently, the MoEFCC also extended this evaluation framework to Zoos in India, aiming to improve the standards of animal housing, healthcare, and conservation breeding.

• Data Facts: India has a network of over 900 Protected Areas, including 106 National Parks and 573 Wildlife Sanctuaries. The 5th cycle aims to provide a comprehensive look at the health of these ecosystems following the Wildlife (Protection) Amendment Act, 2022.

• Global Commitments: These evaluations assist India in meeting its international obligations under the Convention on Biological Diversity (CBD) and the Kunming-Montreal Global Biodiversity Framework.

Q89. Answer: (d) Brazil

The correct answer is Brazil.

Key Points

• The FIFA Women’s World Cup 2027 is officially set to be hosted by Brazil. This landmark decision was announced during the 74th FIFA Congress held in Bangkok, Thailand, on May 17, 2024.

• Brazil won the hosting rights through an open vote, receiving 119 votes from the FIFA member associations, surpassing the joint

bid from Belgium, Germany, and the Netherlands, which received 78 votes.

• This marks a historic milestone as it will be the first time the FIFA Women's World Cup is hosted in South America. This achievement is expected to significantly boost the development of women's football across the continent.

• The 2027 edition will be the 10th iteration of the tournament. Brazil has proposed using 10 stadiums that were previously renovated or built for the 2014 FIFA Men's World Cup, including the iconic Maracanã Stadium in Rio de Janeiro for the opening and final matches.

• The selection of Brazil followed a rigorous evaluation process where their bid scored higher in technical aspects such as stadiums, accommodation, and fan zones compared to the joint European bid.

Additional Information

• History of the FIFA Women's World Cup:

• The tournament was first inaugurated in 1991, with China serving as the host nation. The United States became the first-ever champions.

• Since its inception, the event has grown from 12 teams in 1991 to 32 teams in the 2023 edition, reflecting the global expansion of the sport.

• Recent Editions:

• The 2023 FIFA Women's World Cup was co-hosted by Australia and New Zealand. It was the first time the tournament was held in the Southern Hemisphere and co-hosted by two nations from different confederations.

• Spain emerged as the champions of the 2023 edition after defeating England in the final held in Sydney.

• Brazil's Footballing Legacy:

• Brazil has a storied history with FIFA, having hosted the Men's World Cup twice, in 1950 and 2014.

• The Brazilian Women's National Team, often led by legendary players like Marta (the all-time leading goalscorer in World Cup history with 17 goals), has been a powerhouse in the sport, though they are still seeking their first World Cup title.

• Tournament Significance:

• The FIFA Women's World Cup is now considered one of the most-watched single-sport events in the world. The 2023 tournament broke records with nearly 2 million fans attending matches in person and billions watching via broadcast.

• The 2027 event in Brazil is expected to leverage the nation's deep-rooted football culture to set new benchmarks for commercial success and social impact in women's sports.

Q90. Answer: (b) 1%

The correct answer is 1%.

Key Points

• During the Monetary Policy Committee (MPC) meeting held in April 2025, the Reserve Bank of India (RBI) emphasized its commitment to fine-tuning liquidity management to ensure economic stability.

• The RBI aims to keep the liquidity surplus (or deficit) in the banking system close to 1% of the Net Demand and Time Liabilities (NDTL), which represent the total deposits held by banks.

• This 1% target is crucial because it helps the Weighted Average Call Rate (WACR) stay aligned with the Policy Repo Rate, preventing extreme volatility in the short-term money market.

• To achieve this, the central bank employs various tools under the Liquidity Adjustment Facility (LAF), primarily through Variable Rate Repo (VRR) and Variable Rate Reverse Repo (VRRR) auctions.

• The strategy reflects the RBI's shift towards a more nimble liquidity management approach, moving away from the massive surpluses seen during the COVID-19 pandemic era to a more balanced "neutral" stance.

Additional Information

• Net Demand and Time Liabilities (NDTL):

• NDTL is the sum of demand liabilities (like current deposits and demand drafts) and time liabilities (like fixed deposits and recurring deposits) minus the deposits held with other banks.

• It serves as the fundamental metric for determining the Cash Reserve Ratio (CRR) and Statutory Liquidity Ratio (SLR) requirements for commercial banks in India.

• Monetary Policy Committee (MPC):

• The MPC is a six-member body constituted by the Central Government under Section 45ZB of the RBI Act, 1934.

• It is chaired by the Governor of the Reserve Bank of India and meets at least four times a year to decide on benchmark interest rates to maintain inflation within the target range of 4% (+/- 2%).

• Liquidity Adjustment Facility (LAF) Corridor:

• The LAF corridor is defined by the Marginal Standing Facility (MSF) rate at the upper end and the Standing Deposit Facility (SDF) rate at the lower end.

• In 2022, the SDF replaced the fixed-rate reverse repo as the floor of the corridor to absorb liquidity without the need for

collateral.

Important Points

• Weighted Average Call Rate (WACR): This is the operating target of the RBI's monetary policy. It represents the rate at which banks lend to each other in the overnight call money market.

• Frictional vs. Structural Liquidity: The RBI distinguishes between frictional liquidity (temporary fluctuations due to tax payments or government spending) and structural liquidity (long-term trends influenced by foreign exchange flows or currency in circulation).

• Price Stability and Growth: The primary mandate of the RBI is to maintain price stability while simultaneously supporting the objective of economic growth. Managing the liquidity surplus at 1% ensures there is enough credit available for the productive sectors of the economy without fueling inflationary pressures.

• Financial Year 2025-26: The April 2025 meeting sets the tone for the financial year, influencing how commercial banks set their MCLR (Marginal Cost of Funds Based Lending Rate) and external benchmark-linked lending rates.

Q91. Answer: (b) Tuhin Kanta Pandey

The correct answer is Tuhin Kanta Pandey.

Key Points

• Tuhin Kanta Pandey, a 1987-batch Indian Administrative Service (IAS) officer of the Odisha cadre, assumed the role of Chairman of the Securities and Exchange Board of India (SEBI) on 1 March 2025.

• He succeeded Madhabi Puri Buch, whose tenure as the first woman chairperson of the regulatory body concluded in February 2025.

• The Appointments Committee of the Cabinet (ACC) approved his appointment for a period of three years or until further orders, whichever is earlier.

• Prior to this prestigious appointment, Tuhin Kanta Pandey served as the Finance Secretary and Secretary of the Department of Investment and Public Asset Management (DIPAM) under the Ministry of Finance.

• His vast experience in disinvestment, public asset management, and financial regulation is expected to guide the Indian capital markets through evolving global economic landscapes.

Additional Information

• Securities and Exchange Board of India (SEBI):

• It was established on April 12, 1988, and was initially a non-statutory body. It gained statutory powers on January 30, 1992, following the enactment of the SEBI Act, 1992.

• The headquarters of SEBI is located in the business district of Bandra Kurla Complex in Mumbai, with regional offices in New Delhi, Kolkata, Chennai, and Ahmedabad.

• The primary functions of SEBI include protecting the interests of investors in securities, promoting the development of the securities market, and regulating the market through various guidelines and Acts.

• Important Personalities in SEBI:

• Madhabi Puri Buch: Appointed in March 2022, she was the first woman to lead SEBI and the first person from the private sector to hold the post.

• Ananth Narayan G and Ashwani Bhatia: They serve as Whole-Time Members (WTM) of SEBI, contributing to the decision-making process alongside the Chairman.

Important Points

• The Chairman of SEBI is appointed by the Government of India on the recommendation of the Financial Sector Regulatory Appointments Search Committee (FSRASC).

• The structure of the SEBI Board typically consists of the Chairman, two members from the Union Finance Ministry, one member from the Reserve Bank of India (RBI), and five other members, of whom at least three shall be whole-time members.

• During his tenure at DIPAM, Tuhin Kanta Pandey played a crucial role in high-profile disinvestments, including the privatization of Air India and the Initial Public Offering (IPO) of the Life Insurance Corporation (LIC) in 2022.

Q92. Answer: (b) New Delhi

The correct answer is New Delhi.

Key Points

• The city of New Delhi hosted the inaugural Fit India Carnival in March 2025. This three-day event was conceptualized as a premier holistic health and fitness gathering to celebrate and promote physical well-being among citizens.

• The carnival served as a massive community festival, bringing together fitness experts, nutritionists, athletes, and the general public to participate in various health-centric activities and workshops.

• The primary objective of the Fit India Carnival was to provide a platform for holistic health, covering aspects of mental health, physical fitness, and balanced nutrition through interactive sessions.

• The event featured diverse segments, including yoga marathons, fitness challenges, live cooking demonstrations for healthy

recipes, and exhibitions of modern sports technology.

• By hosting this event in New Delhi, the government aimed to solidify the national capital as a hub for the Fit India Movement, encouraging urban populations to adopt more active lifestyles to combat non-communicable diseases.

Additional Information

• Fit India Movement:

• The Fit India Movement is a nation-wide campaign in India that was launched by the Prime Minister, Narendra Modi, on August 29, 2019.

• The launch date coincides with the National Sports Day, which is celebrated to commemorate the birth anniversary of the legendary hockey player Major Dhyan Chand.

• The movement aims to encourage people to inculcate physical activity and sports in their everyday lives to improve their overall health and longevity.

• Governance and Implementation:

• The initiative is spearheaded by the Ministry of Youth Affairs and Sports, often working in coordination with the Ministry of Education and the Ministry of Health and Family Welfare.

• A national committee was formed to provide leadership and guidance, comprising government officials, members of the Indian Olympic Association (IOA), national sports federations, and fitness promoters.

• Key Components and Initiatives:

• Fit India School Week: An initiative to encourage schools to integrate fitness into the daily routine of students and staff.

• Fit India Freedom Run: A popular event organized annually (often around Independence Day) to promote the habit of running and walking among the masses.

• Fit India Quiz: The first-ever national-level fitness and sports quiz for school students, designed to spread awareness about India's sporting history and fitness culture.

Important Points

• Significance of the 2025 Carnival: The 2025 Fit India Carnival in New Delhi represents an evolution of the movement from awareness-based activities to experiential community festivals. It emphasizes the holistic approach, integrating Traditional Indian medicine (Ayurveda) and Yoga with modern cardiovascular exercises.

• Location Advantage: New Delhi, with its vast infrastructure such as the Indira Gandhi Stadium and Jawaharlal Nehru Stadium, provides the ideal location for large-scale gatherings and sports festivals of this nature.

• Health Data Impact: The movement is a strategic response to data showing a rise in lifestyle-related ailments in India. By promoting a culture of fitness, the government seeks to reduce the economic burden of healthcare and improve the Productivity Index of the Indian workforce.

Q93. Answer: (d) $1 trillion

The correct answer is $1 trillion.

Key Points

• India has set an ambitious target to reach $1 trillion in total exports of goods and services by the fiscal year 2025-26.

• This goal is a significant milestone in the country's journey toward becoming a $5 trillion economy. The Ministry of Commerce and Industry is the primary body overseeing the strategies to achieve this growth.

• The target reflects a robust growth trajectory, building upon the momentum gained when India crossed the $750 billion mark in total exports during the 2022-23 period.

• Achieving $1 trillion involves a concerted effort to boost both merchandise exports (physical goods) and services exports (IT, consultancy, etc.), leveraging India’s competitive advantages in global markets.

• The government is focusing on enhancing export competitiveness by improving infrastructure, reducing logistical costs, and fostering innovation through various industrial policies.

Additional Information

• Foreign Trade Policy (FTP) 2023:

• The FTP 2023 was launched to provide a dynamic and long-term framework for India's trade. Unlike previous five-year policies, this policy is open-ended and updated based on feedback.

• Its ultimate vision is to take India's exports to $2 trillion by the year 2030, with $1 trillion coming from merchandise and $1 trillion from services.

• Production Linked Incentive (PLI) Scheme:

• The PLI scheme, covering 14 key sectors such as electronics, pharmaceuticals, and telecom, is a major driver for export-oriented manufacturing.

• It encourages domestic manufacturing and attracts Foreign Direct Investment (FDI), ensuring that India creates a surplus of high-quality goods for the global market.

• Districts as Export Hubs:

• Under this initiative, the government identifies products with export potential in every district of India to promote local businesses and MSMEs.

• This decentralized approach helps in diversifying the export basket and ensuring that the benefits of trade reach the grassroots level.

• Free Trade Agreements (FTAs):

• India is actively negotiating and signing FTAs with countries and blocs like the UAE, Australia, the UK, and the European Union.

• These agreements are crucial for gaining preferential market access and reducing tariff barriers for Indian exporters.

Important Points

• Services Sector Strength: India remains a global leader in IT and Business Process Management (BPM) services, which contribute heavily to the services portion of the $1 trillion target.

• Logistics Performance Index (LPI): To support the 2025-26 goal, the National Logistics Policy (NLP) aims to bring down India's logistics cost from 13-14% of GDP to single digits, improving global LPI rankings.

• Export Diversification: Beyond traditional exports like textiles and gems and jewelry, India is now seeing high growth in engineering goods, chemicals, and defense equipment.

• Data Fact: In April 2023, India's combined exports (Merchandise and Services) were estimated to exhibit a positive growth of nearly 14% compared to the previous year, signaling the feasibility of the $1 trillion milestone.

Q94. Answer: (b) National Thermal Power Corporation

The correct answer is National Thermal Power Corporation.

Key Points

• NTPC Limited, India's largest integrated power utility, has been honored with the prestigious Forward Faster Sustainability Award 2025 in the category of Water Resilience.

• The award was presented by the United Nations Global Compact (UNGC) Network, recognizing NTPC's exceptional efforts in sustainable water management and its commitment to the CEO Water Mandate.

• This recognition highlights NTPC's proactive approach toward the Forward Faster initiative, which aims to accelerate corporate action to achieve the 17 Sustainable Development Goals (SDGs) by the year 2030.

• The Water Resilience award specifically acknowledges NTPC's success in implementing Zero Liquid Discharge (ZLD) systems across its power plants and significantly reducing its specific water consumption.

• NTPC has integrated water sustainability into its core business operations, ensuring that water is treated as a shared and precious resource, particularly in water-stressed regions of India.

Additional Information

• NTPC Limited (National Thermal Power Corporation):

• Established in the year 1975, NTPC is a central public sector undertaking under the Ministry of Power, Government of India.

• It was granted Maharatna status in May 2010, allowing it greater financial and operational autonomy.

• The company is headquartered in New Delhi and plays a pivotal role in meeting India's massive power requirements.

• Forward Faster Initiative:

• Launched by the UN Global Compact, this initiative focuses on five transformative areas: Gender Equality, Climate Action, Living Wage, Water Resilience, and Sustainable Finance.

• It calls on business leaders globally to take measurable, credible, and ambitious actions to deliver on the 2030 Agenda.

• Water Resilience and SDG 6:

• Water Resilience refers to the capacity of an organization to withstand and recover from water-related risks such as scarcity, flooding, or pollution.

• These efforts are directly aligned with Sustainable Development Goal 6 (SDG 6), which seeks to ensure the availability and sustainable management of water and sanitation for all.

Important Points

• CEO Water Mandate: NTPC is a signatory to this UN Global Compact initiative, which mobilizes business leaders on water, sanitation, and the SDGs. By joining, NTPC committed to identifying and reducing critical water risks within its supply chain and operations.

• Water Policy 2021: NTPC formulated a comprehensive Water Policy in 2021, which serves as a directive for water stewardship, emphasizing the 3Rs (Reduce, Reuse, and Recycle).

• Environmental Targets: Beyond water, NTPC has set an ambitious target to achieve 60 GW of Renewable Energy capacity by the year 2032 and aims to become a Net-Zero emission company by 2050.

• Technology Integration: The company utilizes advanced technologies such as Air Cooled Condensers (ACC) in its new plants (like the North Karanpura project) to save massive amounts of water compared to conventional Water Cooled Condensers.

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Q95. Answer: (d) Belagavi (Karnataka)

The correct answer is Belagavi (Karnataka).

Key Points

• The 10th edition of the India–Sri Lanka Joint Military Exercise, MITRA SHAKTI, was conducted at Belagavi, Karnataka.

• The exercise took place from 12th August to 25th August 2024, aimed at enhancing the interoperability and synergy between the two neighboring nations' armed forces. Hence, the correct option is Belagavi (Karnataka).

• The Indian Army contingent, comprising 120 personnel, was represented primarily by a Battalion of the MARATHA LIGHT INFANTRY Regimental Centre, along with personnel from other arms and services.

• The Sri Lankan Army contingent was represented by 120 personnel from the Gajaba Regiment.

• The joint exercise focused on counter-insurgency and counter-terrorism operations in a semi-urban environment under Chapter VII of the United Nations Mandate.

Additional Information

• History of Mitra Shakti:

• The Mitra Shakti exercise series started in 2012 as a part of the military diplomacy between India and Sri Lanka.

• It is conducted annually, alternating between India and Sri Lanka to foster strong bilateral relations.

• The 9th edition of this exercise was held in November 2023 at Aundh, Pune (Maharashtra).

• Scope and Training:

• The exercise involves tactical-level operations, including joint planning, raid operations, and search and rescue missions.

• A significant aspect of the 10th edition included the integration of drones and Counter Unmanned Aerial Systems (CUAS) to reflect modern warfare dynamics.

• It provides a platform for both armies to share their combat experiences and best practices in a sub-conventional scenario.

• Other Indo-Sri Lanka Exercises:

• SLINEX: This is a bilateral maritime exercise between the Indian Navy and the Sri Lanka Navy to enhance maritime security.

• Dosti: A trilateral coast guard exercise involving India, Sri Lanka, and the Maldives, focusing on search and rescue and oil spill response.

Important Points

• Strategic Location: Belagavi (formerly Belgaum) is a major military hub in India, housing the Maratha Light Infantry Regimental Centre and the Commando Training Wing.

• UN Mandate: The training modules are specifically designed to align with UN peacekeeping standards, ensuring that both nations are ready for international deployments.

• Objectives: The primary objective remains the promotion of close relations between the two armies and the development of mutual trust and understanding through joint training and cultural exchange.

• Equipment and Drills: The exercise involves heliborne operations, combat conditioning, and the rehearsal of tactical drills to neutralize terrorist threats effectively.

Q96. Answer: (c) Prohibition of Child Marriage (Karnataka Amendment) Bill, 2025

The correct answer is Prohibition of Child Marriage (Karnataka Amendment) Bill, 2025.

Key Points

• The Karnataka Legislative Assembly passed the Prohibition of Child Marriage (Karnataka Amendment) Bill, 2025, to provide a more stringent legal framework to eradicate the practice of child marriage within the state.

• A landmark provision of this 2025 Amendment is that it explicitly outlaws the betrothal (engagement) of minors. By criminalizing the formal promise of marriage involving a child, the state aims to intervene at an earlier stage before the actual marriage ceremony takes place.

• The bill mandates that every child marriage performed in the state shall be void ab initio (legally null and void from the beginning). This removes the previous legal ambiguity where some marriages were considered "voidable" rather than automatically void.

• It significantly enhances the punishment for those who perform, abet, or promote child marriages or betrothals. The offense is categorized as cognizable and non-bailable, allowing the police to make arrests without a warrant and making it harder for offenders to secure immediate bail.

• The bill empowers Child Marriage Prohibition Officers and local authorities with more administrative teeth to act upon reports of planned child marriages or betrothals effectively.

Additional Information

• The Prohibition of Child Marriage Act, 2006 (Central Act):

• This is the parent legislation enacted by the Parliament of India to replace the Child Marriage Restraint Act of 1929.

• Under the 2006 Act, the minimum age for marriage is 18 years for females and 21 years for males.

• While the central act focuses on the ceremony, the Karnataka Amendment of 2025 expands this scope to include pre-marriage rituals like betrothal to ensure comprehensive protection.

• Socio-Legal Implications:

• The inclusion of betrothal in the law targets deep-rooted social customs where children are "promised" to families at a young age, which often leads to school dropouts and early pregnancies.

• According to NFHS-5 (National Family Health Survey) data, while child marriage rates have declined, certain districts in North Karnataka still show higher-than-average incidences, necessitating state-specific amendments.

• Constitutional and International Context:

• The bill aligns with Article 21 (Right to Life and Personal Liberty) and Article 39(f) of the Constitution of India, which directs the state to ensure children are protected against exploitation.

• It also serves Sustainable Development Goal (SDG) 5.3, which aims to eliminate all harmful practices, such as child, early, and forced marriage, by the year 2030.

Important Points

• Betrothal Defined: In the context of this bill, betrothal refers to any ceremony or contract where a child is pledged in marriage. This is now a punishable offense in Karnataka.

• Role of Gram Panchayats: The state government has integrated Panchayati Raj Institutions to monitor and report child marriage cases, making the village-level officers accountable for prevention.

• Legal Age: Despite various debates, the legal age for marriage remains 18 for girls and 21 for boys. Any violation of this age criteria, even for an engagement, attracts the provisions of the 2025 Bill.

• Child Rights Protection: The Karnataka State Commission for Protection of Child Rights (KSCPCR) played a pivotal role in recommending these amendments to address the safety, health, and education of the girl child.

Q97. Answer: (c) Fourth

The correct answer is Fourth.

Key Points

• India has secured the fourth position in the Global Firepower (GFP) Index 2025, maintaining its status as one of the most powerful militaries in the world.

• The Global Firepower Index evaluates the military strength of 145 nations based on over 60 individual factors to determine a country's PowerIndex (PwrIndx) score.

• The ranking is based on a nation's potential war-making capability across land, sea, and air fought by conventional means; notably, nuclear capabilities are not factored into the score, though recognized.

• In the 2025 rankings, India follows the United States (1st), Russia (2nd), and China (3rd), rounding out the top four global military powers.

• A perfect PwrIndx score is 0.0000, which is realistically unattainable; the closer a country is to this number, the more powerful its conventional military capability is considered.

Additional Information

• Top 5 Global Powers:

• The United States maintains the top spot due to its vast technological advancements, massive defense budget, and global logistics reach.

• Russia retains the second spot, largely due to its significant land power and armored vehicle units.

• China ranks third, showcasing rapid modernization in its naval fleet and air force capabilities.

• South Korea has seen a significant rise in recent years, holding the fifth position in 2025, surpassing several European nations.

• Measurement Parameters:

• The index considers Manpower (available population for military service), Airpower (fighters, interceptors, and transport aircraft), and Land Power (tanks and artillery).

• Naval Power (submarines, aircraft carriers, and destroyers) and Logistics (labor force and port accessibility) are also critical components of the final score.

• Financial factors like defense budget, external debt, and purchasing power parity are analyzed to assess the sustainability of a prolonged conflict.

• Geographical features such as shared borders and coastline length are factored in as they impact defensive and offensive strategies.

Important Points

• India's Military Assets: India boasts one of the world's largest active military personnel counts and possesses significant tank strength and a versatile Air Force.

• Regional Comparison: In the South Asian context, India remains the most dominant force, followed by Pakistan, which has consistently appeared in the Top 10 of the Global Firepower Index in recent years.

• Exclusions: The GFP Index does not take into account nuclear stockpiles, political leadership, or current diplomatic relations, focusing purely on statistical military data.

• Report Year: The 2025 report reflects the modernization efforts and procurement shifts of nations following recent global geopolitical tensions.

Q98. Answer: (d) Kei Nishikori

The correct answer is Kei Nishikori.

Key Points

• Kei Nishikori, the veteran tennis star from Japan, etched his name in history by becoming the first Asian male player to reach the milestone of 450 career wins on the ATP Tour by April 2025.

• This achievement highlights his longevity and dominance in professional tennis, particularly as he remains the most successful male singles player representing an Asian nation in the Open Era.

• The milestone was reached following a determined comeback from a series of debilitating injuries, including hip surgery in 2022 and subsequent knee and ankle issues that kept him out of consistent competition for much of 2023 and 2024.

• Nishikori's 450th victory serves as a testament to his resilience, further extending his record lead over other notable Asian players like Vijay Amritraj and Paradorn Srichaphan.

• Known for his exceptional return of serve and backhand down the line, Nishikori has maintained a high winning percentage throughout his career, which began professionally in 2007.

Additional Information

• Kei Nishikori (Japan):

• Born on December 29, 1989, in Shimane, Japan, he moved to the United States at age 14 to train at the IMG Academy.

• He reached a career-high ranking of World No. 4 in March 2015 and became the first Asian-born man to reach a Grand Slam singles final at the 2014 US Open.

• He has won 12 ATP singles titles and earned an Olympic Bronze Medal for Japan at the 2016 Rio Olympics.

• Yuki Bhambri (India):

• A former Junior World No. 1 and winner of the 2009 Australian Open Junior championship.

• While a top-tier talent for India, his singles career faced interruptions due to tendonitis. In recent years, he has successfully transitioned to the ATP Doubles circuit, achieving a top 50 ranking. Hence, statement 1 is incorrect regarding the 450 singles wins.

• Prajnesh Gunneswaran (India):

• He reached a career-high ranking of 75 in 2019 and has been a key player for India in the Davis Cup.

• His career wins at the ATP main draw level are far below the 450 mark compared to Nishikori. Hence, statement 2 is incorrect.

• Somdev Devvarman (India):

• A three-time NCAA finalist and two-time champion, he is one of India's most decorated collegiate and professional players.

• He won Gold Medals at both the Commonwealth Games and Asian Games in 2010 before retiring in 2017. Hence, statement 3 is incorrect.

Important Points

• Winning Percentage: Nishikori is famously ranked among the all-time leaders in winning percentage in fifth sets, showcasing his mental toughness in long matches.

• Project 45: Early in his career, he was nicknamed "Project 45" as he aimed to beat the record of Shuzo Matsuoka, who was the highest-ranked Japanese male player at World No. 46. Nishikori surpassed this in 2011.

• ATP Milestone Context: Reaching 450 wins puts a player in an elite bracket of the ATP Tour, usually occupied by Grand Slam champions and consistent Top 10 mainstays over a decade-long span.

Q99. Answer: (d) Rank 99 with score 66.95

The correct answer is Rank 99 with score 66.95.

Key Points

• According to the Sustainable Development Report (SDR) 2025, India has achieved a global Rank of 99.

• The country has attained an overall SDG Index Score of 66.95, which indicates its cumulative progress toward achieving the 17 Sustainable Development Goals.

• The Sustainable Development Report is an annual global assessment that tracks the performance of all 193 UN Member States on the SDGs.

• The report is produced by the Sustainable Development Solutions Network (SDSN), which has been operating since 2012 under the auspices of the UN Secretary-General and is led by Professor Jeffrey Sachs.

• The SDG Index score can be interpreted as the percentage of SDG achievement; a score of 66.95 suggests India is roughly 67% of the way to the optimal target (100).

Additional Information

• Sustainable Development Goals (SDGs):

• The SDGs, also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty and protect the planet by 2030.

• There are 17 specific goals, including SDG 1 (No Poverty), SDG 5 (Gender Equality), and SDG 13 (Climate Action).

• The Sustainable Development Solutions Network (SDSN):

• This organisation mobilizes scientific and technical expertise from academia, civil society, and the private sector to support practical problem-solving for sustainable development.

• The SDR is the first worldwide study to assess where each country stands with regard to achieving the Sustainable Development Goals.

• India's Domestic Monitoring:

• In India, the NITI Aayog is the nodal agency responsible for overseeing the implementation of SDGs.

• It releases the SDG India Index annually to track the progress of States and Union Territories, ensuring competitive federalism in achieving global targets.

• Global Leaders:

• Historically, Nordic countries such as Finland, Sweden, and Denmark consistently rank at the top of the SDG Index due to robust social safety nets and environmental policies.

Important Points

• Decade of Action: The United Nations has termed the period from 2020 to 2030 as the Decade of Action, urging all countries to accelerate sustainable solutions to all the world’s biggest challenges.

• Performance Indicators: The SDG Index uses a wide range of data points, including health outcomes, economic growth, educational attainment, and carbon emissions, to provide a holistic view of national development.

• SDR 2025 Context: The 2025 report emphasizes the need for International Financial Architecture reform to provide developing nations with the necessary liquidity and investment to reach the 2030 goals.

Q100. Answer: (a) Pandit Dindayal Upadhyay Indoor Stadium, Surat

The correct answer is Pandit Dindayal Upadhyay Indoor Stadium, Surat.

Key Points

• The 86th Senior National Table Tennis Championships were scheduled to be held at the Pandit Dindayal Upadhyay Indoor Stadium in Surat, Gujarat in January 2025.

• This event is the premier domestic competition organized by the Table Tennis Federation of India (TTFI), featuring the highest level of competition for Indian paddlers.

• The choice of Surat as the host city underscores Gujarat’s status as a growing sports hub in India, having successfully hosted major events like the 36th National Games and previous editions of the national championships.

• The tournament serves as a crucial platform for players to improve their national rankings and secure spots in the national squad for international events like the ITTF World Championships and Asian Games.

• The competition features top-tier athletes including Olympic participants and Commonwealth Games medalists such as Achanta Sharath Kamal, Manika Batra, and Sreeja Akula.

Additional Information

• Pandit Dindayal Upadhyay Indoor Stadium:

• Located in the Ghod Dod Road area of Surat, it is a state-of-the-art indoor arena inaugurated in 1998.

• It was the first of its kind in Western India to be fully air-conditioned and has a seating capacity of approximately 7,000 spectators.

• The stadium frequently hosts diverse events ranging from badminton, volleyball, and table tennis to cultural programs and international conventions.

• Table Tennis Federation of India (TTFI):

• Established in 1926, it is the governing body for table tennis in India and is a founder member of the International Table Tennis Federation (ITTF).

• Headquartered in New Delhi, it oversees the development of the sport through various age-category nationals and the Ultimate Table Tennis (UTT) league.

• Key Players in Indian Table Tennis:

• Achanta Sharath Kamal: A legendary figure who holds the record for the most Senior National titles (10) and was awarded the Major Dhyan Chand Khel Ratna in 2022.

• Manika Batra: The first Indian woman to win a common-wealth individual gold in table tennis and a recipient of the Arjuna Award and Khel Ratna.

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• Tournament Structure:

• The Senior Nationals typically include Men's Singles, Women's Singles, Men's Doubles, Women's Doubles, and Mixed Doubles events.

• It also includes Inter-State Team Championships where various states and institutional teams like Petroleum Sports Promotion Board (PSPB) and Railways (RSPB) compete for top honors.

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