RRB Group D Official Paper (Held On: 03 Feb, 2026 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of the following increases the rate of evaporation?

(a) Dense atmosphere and generally cool weather
(b) High temperature and increased wind speed
(c) Low surface area and cold air temperature
(d) High humidity and absence of wind movement

Q2. Which of the following is NOT a function of the cell wall?

(a) Providing shape to the cell
(b) Helping in cell-to-cell interaction
(c) Synthesising proteins for the cell
(d) Protecting the cell from mechanical damage

Q3. Match the following pH change and its effect.

Column A (Change)	Column B (Effect)
A. pH ↓ from 7 to 4	1. Increase in acidity
B. pH ↑ from 7 to 10	2. Acid rain forms
C. pH = 7	3. Neutral solution
D. pH < 5.6 in rain	4. Increase in basicity

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

Q4. Which of the following compounds would have the highest pH when dissolved in water?

(a) Hydrogen chloride gas
(b) Vinegar solution
(c) Lemon juice
(d) Sodium hydroxide

Q5. In the given reaction, which of the following reactants has undergone oxidation?

$PbO + H_2 \rightarrow Pb + H_2O$

(a) PbO
(b) Pb
(c) H_2
(d) H_2O

Q6. Which characteristic of parallel circuits makes them advantageous over series circuits for connecting multiple electrical gadgets in a house?

(a) The total resistance is increased, protecting appliances.
(b) The current is divided among the electrical gadgets, allowing them to operate independently.
(c) If one component fails, the entire circuit is broken.
(d) The potential difference across each gadget is unique.

Q7. A person shows high blood sugar levels even after eating small amounts of food. What may be the cause?

(a) Lack of insulin
(b) Excess growth hormone
(c) Excess estrogen
(d) Low thyroxine

Q8. Which of the following mixtures is a suspension?

(a) Muddy water
(b) Vinegar
(c) Salt water
(d) Milk

Q9. In multicellular organisms, why can't simple diffusion alone meet the requirements of all cells?

(a) Because body size and complexity increase
(b) Because diffusion only transports oxygen
(c) Because diffusion requires light
(d) Because all cells are directly exposed to air

Q10. What will be the acceleration due to gravity on a planet whose mass and radius are double that of the Earth? (Take the acceleration due to gravity on Earth as g .)

(a) 2g
(b) g/4
(c) g
(d) g/2

Q11. In the absence of any external force, a moving body will _____.

(a) Maintain a constant velocity in straight line
(b) Slow down and change its path
(c) Stop due to its inertia
(d) Continue to move with constant acceleration

Q12. Why is variation important in a population of organisms?

(a) It causes extinction of all organisms.
(b) It makes organisms identical.
(c) It helps some individuals survive if environmental conditions change.
(d) It prevents reproduction.

Q13. Which element is necessary for the thyroid gland to secrete the thyroxine hormone?

(a) Iodine
(b) Fluorine
(c) Bromine
(d) Chlorine

Q14. Which part of the flower protects the ovule and later transforms into the fruit?

(a) Petal
(b) Stigma
(c) Ovary
(d) Sepal

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Q15. Read the given Assertion (A) and Reason (R) carefully and select the correct option.

(A): Sound waves are transverse waves.

(R): Sound waves require a material medium for their propagation.

(a) Both assertion and reason are false.
(b) Both assertion and reason are true and reason is the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false and reason is true.

Q16. For a convex mirror, where is the centre of curvature located?

(a) At the mirror's surface
(b) At the focus
(c) In front of the mirror
(d) Behind the mirror

Q17. Read the given statements carefully and select the correct option.

Statement 1: Fleming's left-hand rule is used to find the direction of force (motion) on a current-carrying conductor placed in a magnetic field.

Statement 2: The force on the conductor acts perpendicular to both the current and the magnetic field.

(a) Statement 1 is correct, but 2 is incorrect.
(b) Both statements 1 and 2 are incorrect.
(c) Both statements 1 and 2 are correct.
(d) Statement 1 is incorrect, but 2 is correct.

Q18. Which of the following factors increases the rate of evaporation?

(a) Decrease in temperature
(b) Increase in humidity
(c) Decrease in wind speed
(d) Increase in surface area

Q19. To accurately locate the image of an extended object formed by a spherical mirror using a ray diagram, what is the minimum number of reflected rays that must intersect (or appear to intersect)?

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

Q20. Which of the following is NOT the characteristic of epithelial tissue?

(a) Cells are loosely arranged.
(b) Skin, kidney tubules are made up of epithelial tissue.
(c) Cells form a continuous sheet.
(d) Cells have no intercellular spaces.

Q21. If the velocity–time graph of an object is curved, it indicates _____.

(a) Constant speed
(b) Uniform motion
(c) Zero velocity
(d) Non-uniform acceleration

Q22. What do members of a homologous series differ from each other by?

(a) Two hydrogen atoms
(b) One carbon atom and two hydrogen atoms
(c) One oxygen atom
(d) One carbon atom

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Q23. Select the option that is true regarding the following two statements labelled Assertion (A) and Reason (R).

Assertion (A): Vasectomy leads to loss of sexual drive in males.

Reason (R): It involves removal of the testes.

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

Q24. The atomic number of an element is equal to which of the following?

(a) Number of neutrons
(b) Number of protons
(c) Number of electrons
(d) Number of neutrons + number of protons

Q25. Which of the following is an example of negative work?

(a) Lifting a bag upwards
(b) Friction acting on a moving object
(c) Gravity acting on a falling ball
(d) Pushing a moving car forward.

MATHEMATICS

Q26. Amit purchases an old scooter for Rs. 5,600. He spends Rs. 1,400 on its repairs and sells it to Sumit for Rs. 7,700. Find the profit percentage of Amit.

(a) 14%
(b) 9%
(c) 10%
(d) 12%

Q27. Solve : $3 \times (10 \times (2^2)) \div 20 + 13 - 3$

(a) 17
(b) 25
(c) 16
(d) 13

Q28. In an election, there are three candidates: A, B, and C. Candidate A gets 40% of the total valid votes, Candidate B gets 30%, and Candidate C gets the remaining votes. If 12% of the total votes were declared invalid and the total number of voters was 25,000, find the number of votes received by Candidate C.

(a) 6600
(b) 8800
(c) 5500
(d) 4400

Q29. A cricketer has an average of 54 runs for 9 innings. In the 10^(th) inning, he scores 191 runs. By how many runs did his average increase? (Round off the answer to the nearest whole number.)

(a) 5
(b) 17
(c) 14
(d) 16

Q30. The sides of a triangle are 80 cm, 44 cm, and 52 cm. What is the length of its altitude corresponding to the side with a length of 44 cm?

(a) 94 cm
(b) 48 cm

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(c) 61 cm
(d) 49 cm

Q31. The average age of 31 students of a class is 35 years. If the age of the teacher is also included, the average age of the whole group becomes 36 years. The age (in years) of the teacher is:
(a) 68
(b) 72
(c) 67
(d) 69

Q32. 104 men have provisions for 12 weeks. They are joined by 52 men. How long (in weeks) will the provisions last?2673
(a) 8
(b) 10
(c) 6
(d) 12

Q33. The amount on a sum of Rs. 2,800 at 20% per annum compound interest, compounded annually, in 2 years will be:
(a) Rs. 3,279
(b) Rs. 4,968
(c) Rs. 4,032
(d) Rs. 4,341

Q34. Evaluate: $(\sec 33°)/(\operatorname{cosec} 57°) + \sqrt{3} \cot 13° \cot 21° \cot 60° \cot 69° \cot 77° - 2(\sin^2 41° + \sin^2 49°)$
(a) 1
(b) 2
(c) 5
(d) 0

Q35. The marked price of a toy truck is Rs. 3,050, and its selling price is Rs. 2,220. Find the discount percentage. (Round off the answer to two decimal places.)
(a) 25.98%
(b) 29.73%
(c) 27.21%
(d) 26.88%

Q36. The present age of Arman is four times the present age of his cousin, Riya. In 8 years, Arman's age will be three times Riya’s age at that time. What is Arman’s current age?
(a) 64 years
(b) 72 years
(c) 56 years
(d) 48 years

Q37. 1/30 is what percentage of 2/50? (Round off the answer to two decimal places.)
(a) 98.33%
(b) 83.33%
(c) 166.67%
(d) 93.33%

Q38. If 20% of 50% of 5/9 of a number is 409, find the number.
(a) 7700
(b) 10140
(c) 7110
(d) 7362

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Q39. The sum of three numbers is 840. If the ratio of the second number to the first number is 3 : 13 and that of the third number to the second number is 8 : 12, then find the second number.

(a) 142
(b) 139
(c) 140
(d) 141

Q40. Two trains started from station A to B with speeds of 68 km/h and 82 km/h on parallel lines. Find the distance (in km) between the two trains after 2.5 hours.

(a) 35
(b) 40
(c) 15
(d) 25

Q41. Simplify: $[(3x + 4y)^2 - (3x - 4y)^2] \div (24xy)$

(a) 2
(b) -1
(c) 1
(d) -2

Q42. A shopkeeper offers the following four schemes.

A) Two successive discounts of 18% and 10%
B) Buy 2, get 8
C) Discount of 24%
D) Two successive discounts of 42% and 45%

Which scheme is best for customers?

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

Q43. Two trains, each 230 meters long, are running parallel to each other in the same direction. The speed of the faster train is 102 km/h and the speed of the slower train is 66 km/h. How long will it take for the faster train to completely pass the slower train?

(a) 36 seconds
(b) 56 seconds
(c) 42 seconds
(d) 46 seconds

Q44. If the radius of a sphere is 6 cm, then its surface area is:

(a) 144 π cm^2
(b) 72 π cm^2
(c) 288 π cm^2
(d) 36 π cm^2

Q45. P and Q together can fill a cistern with water in 9 hours. If P alone can fill the cistern with water in 12 hours, then in how many hours will Q alone fill three-fourth of the same cistern with water?

(a) 27
(b) 55
(c) 54
(d) 28

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Q46. A cylindrical water tank with an internal radius of 70 cm and a height of 1.5 m is completely filled with water. Water is being pumped out at a rate of 5 litres per second. How long will it take for the water level to drop by 50 cm?

(Use π = 22/7)

(a) 154 seconds
(b) 176 seconds
(c) 168 seconds
(d) 142 seconds

Q47. If the mean proportional of P and 169 is 104, then find the value of P.

(a) 64
(b) 66
(c) 67
(d) 65

Q48. Simplify $((5.9)^3 + (0.1)^3)/((5.9)^2 + (0.1)^2 - 5.9 \times 0.1)$

(a) 6000
(b) 600
(c) 6
(d) 60

Q49. A and B can complete a job in 18 days and 24 days, respectively. They worked together for 5 days, and then A left the job. In how many days will B finish the remaining work?

(a) 102/3 days
(b) 141/3 days
(c) 121/3 days
(d) 152/3 days

Q50. The cost of 3 apples and 5 bananas is Rs. 75. The cost of 4 apples and 2 bananas is Rs. 86. Find the cost of a banana.

(a) Rs. 10
(b) Rs. 5
(c) Rs. 3
(d) Rs. 20

GENERAL INTELLIGENCE & REASONING

Q51. What should come in place of the question mark (?) in the given series?

PPR NQO LRL ? HTF

(a) JSI
(b) NIJ
(c) IHY
(d) GHT

Q52. Six people, A, B, C, X, Y and Z, are sitting around a circular table, facing towards the centre of the table.

Z is sitting to the immediate left of A.

B is sitting second to the right of Z.

X is an immediate neighbour of both Y and C.

Y is not an immediate neighbour of Z.

What is the position of B with respect to Y?

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

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Q53. What should come in place of the question mark (?) in the given series?

2, 3, 5, 8, 12, 17, ?

(a) 23
(b) 25
(c) 26
(d) 24

Q54. What should come in place of ? in the given series?

17 7 -6 -22 -41 ?

(a) -64
(b) -62
(c) -63
(d) -61

Q55. 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.)

92 - 6 - 86

13 - 8 - 5

(a) 30 - 12 - 24
(b) 50 - 20 - 30
(c) 4 - 1 - 2
(d) 12 - 5 - 6

Q56. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

LKN 58 MLO 65 NMP 72 ONQ 79 ?

(a) PUA 85
(b) POR 86
(c) PPQ 86
(d) PNQ 85

Q57. 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) 7 5 8 5 8 3 1 5 2 6 1 6 3 1 4 2 4 3 7 8 5 9 5 2 8 2 5 (Right)

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

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

Q58. A, B, C, D, N, O and P are sitting in a straight line, facing the north.

Only two people sit to the left of N. Only three people sit between N and P. O sits second to the right of N. Only two people sit between O and D. C sits at some place to the right of B but at some place to the left of A.

How many people sit to the right of C?

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

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Q59. Each of the digits in the number 24597831 is arranged in ascending order from left to right. The position(s) of how many digits will remain unchanged as compared to that in the original number?

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

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

Statements:

Some balls are hens.

All vans are hens.

Conclusions:

(I) Some balls are vans.

(II) All hens are vans.

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

Q61. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All torches are keys.

All keys are locks.

Some locks are batteries.

Conclusions:

(I): All torches are locks.

(II): Some batteries are torches.

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

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

YAC−GIK

QSU−YAC

(a) JLN−QTU
(b) JKL−RTV
(c) JLN−RTV
(d) JKL−QSU

Q63. 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) 2 8 1 7 8 7 6 7 5 2 5 3 (Right)

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

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

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(d) Four

Q64. In a certain code language, QOEX is coded as 50 and WPIU is coded as 42. What is the code for SANR in that language?

(a) 67
(b) 55
(c) 62
(d) 59

Q65. Six people, A, B, C, D, E and F, are sitting in a row, facing north. Only two people sit to the left of F. Only one person sits between D and E. F sits to the immediate left of D. A sits to the immediate right of C. B sits third to the right of A. Who sits at the extreme left end of the row?

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

Q66. This question is based on the five, three-digit numbers given below.

(Left) 582 128 563 183 592 (Right)

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

Note: All operations to be done from left to right.

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

(a) 7
(b) 4
(c) 3
(d) 6

Q67. All 18 students in a class are standing in a row, facing north. Charan is 11th from the right end, while Prakash is 3rd from the left end. How many people stand between Charan and Prakash?

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

Q68. If ‘P’ stands for ‘×’, ‘Q’ stands for ‘÷’, ‘R’ stands for ‘−’ and ‘S’ stands for ‘+’, what will come in place of the question mark (?) in the following equation?

(90 Q 15) P 8 R 7 P 4 S (12 P 3) Q 2 = ?

(a) 38
(b) 20
(c) 52
(d) 44

Q69. In a certain code language, ‘ride those horses’ is coded as ‘dq fn ta’ and ‘horses run wild’ is coded as ‘vy dq si’. How is ‘horses’ coded in the given language?

(a) dq
(b) vy
(c) fn
(d) ta

Q70. In a certain code language,

A + B means ‘A is the son of B’,

A - B means ‘A is the brother of B’,

A x B means ‘A is the wife of B’,

and A & B means ‘A is the father of B’.

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How is K related to V if 'KxT-R+Z&V'?

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

Q71. What should come in place of the question mark (?) in the given series?

94 102 118 150 214 ?

(a) 344
(b) 342
(c) 341
(d) 343

Q72. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one that follows the same logic.

PAST - PSTA - ASPT

QUAD - QADU - UAQD

(a) VAIN - VIAN - NIAV
(b) IDEA - IEAD - DEIA
(c) USER - UERS - SURE
(d) TIDE - ITDE - IDET

Q73. 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) QPS
(b) HGI
(c) YXZ
(d) VUW

Q74. Currently, the minute hand of a watch is pointing towards the north and the hour hand is pointing towards the east. After two and a half hours, which direction will the minute hand point towards?

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

Q75. Mr. Pasto starts from point A and drives 11 km towards North. He then takes a left turn, drives 7 km, turns left and drives 13 km. He then takes a left turn and drives 21 km. He takes a final left turn, drives 2 km and stops at point P. How far (shortest distance) and towards which direction should he drive in order to reach point A again? (All turns are 90-degree turns only, unless specified.)

(a) 14 km to the west
(b) 13 km to the south
(c) 12 km to the west
(d) 11 km to the south

Q76. This question is based on the five, three-digit numbers given below.

(Left) 426 125 357 489 627 (Right)

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

Note: All operations to be done from left to right.

If all the numbers are arranged in ascending order, the position(s) of how many numbers will remain unchanged?

(a) One
(b) Four

(c) Three
(d) Two

Q77. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which letter-cluster pair DOES NOT belong to that group?

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

(a) FI-DH
(b) DG-BF
(c) HK-FI
(d) JM-HL

Q78. Seven boxes A, B, C, D, P, Q and R are kept one over the other but not necessarily in the same order. No box is kept above Q. Only three boxes are kept between Q and D. Only one box is kept between C and B. B is kept immediately above D. Only four boxes are kept between C and R. A is kept at some place above P.

Which box is kept second below A?

(a) D
(b) R
(c) B
(d) P

Q79. If 1 is added to each odd digit and 2 is subtracted from each even digit in the number 7435681, then what will be the sum of the digits that are third from the left and third from the right?

(a) 8
(b) 6
(c) 10
(d) 14

Q80. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

STW−ZAD

PQT−WXA

(a) TTV−ZAD
(b) TUX−ZBD
(c) TTV−ABE
(d) TUX−ABE

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. What is significant about the CMS-03 satellite launch by Indian Space Research Organisation in November 2025?

(a) It is the heaviest communication satellite launched by India.
(b) It is the first private payload launched from India.
(c) It is the first navigation satellite mission from India.
(d) It is India’s first Mars mission satellite.

Q82. Which of the following introduced NACH 3.0 in July 2025, bringing faster and more secure bank transactions under the National Automated Clearing House (NACH) system?

(a) National Securities Depository Limited
(b) Life Insurance corporation
(c) National Payments Corporation of India
(d) Reserve Bank of India

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Q83. Which apex agricultural research body is associated with the Indian Institute of Soil Science that organised World Soil Day celebrations in December 2025?

(a) Indian Council of Agricultural Research
(b) Central Soil Salinity Research Institute
(c) Council of Scientific and Industrial Research
(d) National Horticulture Board

Q84. What was the Supreme Court's decision on April 28, 2025, regarding a new petition on the Waqf (Amendment) Act?

(a) It dismissed all pending cases.
(b) It accepted the petition for immediate hearing.
(c) It referred the plea to the High Court.
(d) It declined to entertain the fresh plea.

Q85. In the 2025 Global Hunger Index (GHI), where does India rank among the 123 countries assessed?

(a) 10th
(b) 85th
(c) 105th
(d) 102nd

Q86. Which of the following major wildlife surveys did the Indian Prime Minister announce to be conducted in 2025?

(a) 16th Asiatic Lion Population Estimation
(b) Bengal Tiger Count
(c) National Elephant Census
(d) Great Indian Bustard Survey

Q87. Which of the following states introduced the strengthening of the SHe-Box portal in May 2025?

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

Q88. What happens to a Prime Minister, Chief Minister, or Minister if bail is not granted within 30 days under the Constitution (130th Amendment) Bill 2025?

(a) Automatic removal
(b) Legal appeal
(c) Parliamentary review
(d) Temporary suspension

Q89. Where did Jeff Bezos and Lauren Sánchez hold their lavish wedding in June 2025?

(a) Cannes, France
(b) Dubrovnik, Croatia
(c) Santorini, Greece
(d) Venice, Italy

Q90. What was the name of the official mascot of the Khelo India Para Games 2025?

(a) Ujjwala
(b) Veer
(c) Sparky
(d) Shakti

Q91. As part of Tripura’s tech-driven disaster preparedness initiative launched in August 2025, how many automated weather stations and rain gauges are proposed to be installed?

(a) 14
(b) 10
(c) 26

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(d) 15

Q92. A total of Rs. 6,000 crore has been allocated for the 'PM - One Nation One Subscription' initiative. How many years cost does this amount cover?

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

Q93. In June 2025, who was elected as the President of the International Institute of Administrative Sciences (IIAS) for the 2025–2028 term from India?

(a) GC Murmu
(b) V Srinivas
(c) KM Chandrasekhar
(d) NV Subramanian

Q94. Valueattics Reinsurance, India's first private reinsurer, which received the nod of the Insurance Regulatory and Development Authority of India (IRDAI) to commence reinsurance business in India in March 2025 is promoted by which of the following individuals/entities?

(a) Prem Watsa and Kamesh Goyal
(b) Rakesh Jhunjhunwala and Axis Bank
(c) Nandan Nilekani and SBI Life
(d) Uday Kotak and LIC

Q95. What were Suruchi Singh's final two shot scores that clinched gold at the 2025 International Shooting Sport Federation (ISSF) World Cup in Munich?

(a) 10.6 and 9.6
(b) 9.5 and 8.5
(c) 10.0 and 9.0
(d) 10.5 and 9.5

Q96. According to the 2025 Sustainable Development Report, what is India's Spillover Score?

(a) 90.07
(b) 96.07
(c) 86.95
(d) 99.95

Q97. Who won the men's javelin event at the Ostrava Golden Spike meet in June 2025 by becoming the only athlete to throw beyond 85 metres, with a mark of 85.29 m?

(a) Jakub Vadlejch
(b) Neeraj Chopra
(c) Anderson Peters
(d) Julian Weber

Q98. Which organisation announced plans to develop a new indicator for measuring extreme poverty in India in 2025?

(a) NITI Aayog
(b) World Bank
(c) Ministry of Statistics
(d) Reserve Bank of India

Q99. Who won the Men's Ballon d'Or, 2025?

(a) Ousmane Dembele
(b) Kylian Mbappe
(c) Lionel Messi
(d) Cristiano Ronaldo

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Q100. Which organisation developed Delhi's first Centre of Excellence for Sports in Dwarka's Sector 8, inaugurated in May 2025?

(a) Delhi Development Authority (DDA)
(b) Indian Olympic Association (IOA)
(c) Delhi Metro Rail Corporation (DMRC)
(d) Sports Authority of India (SAI)

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (b) High temperature and increased wind speed

The correct answer is High temperature and increased wind speed.

Key Points

• Temperature: The rate of evaporation increases with an increase in temperature. This happens because, with the rise in temperature, more particles gain enough kinetic energy to overcome the intermolecular forces of attraction and escape into the vapor state. Hence, statement 2 is correct regarding temperature.

• Wind Speed: An increase in wind speed also enhances the rate of evaporation. In windy conditions, the water vapor particles move away with the wind, reducing the amount of water vapor in the immediate surrounding atmosphere, which facilitates faster vaporization. Hence, statement 2 is correct regarding wind speed.

• Dense Atmosphere and Cool Weather: A dense atmosphere (higher atmospheric pressure) typically suppresses the escape of molecules from the liquid surface, while cool weather provides less thermal energy to the molecules, thereby decreasing the rate. Hence, statement 1 is incorrect.

• Low Surface Area: Since evaporation is a surface phenomenon, reducing the exposed surface area limits the number of particles that can escape at any given time. Cold air further slows down the molecular movement. Hence, statement 3 is incorrect.

• High Humidity: Humidity is the amount of water vapor present in the air. If the air is already saturated with moisture (high humidity), it cannot hold much more vapor, thus significantly slowing down the evaporation process. Hence, statement 4 is incorrect.

Additional Information

• Surface Area: Evaporation is categorized as a surface phenomenon. If the surface area is increased, the rate of evaporation increases. For example, while drying clothes, we spread them out to increase the area for faster drying.

• Humidity and Vapor Pressure: The air around us can only hold a definite amount of water vapor at a given temperature. If the vapor pressure of the liquid is much higher than the partial pressure of the vapor in the atmosphere, evaporation occurs rapidly.

• Nature of Liquid: Different liquids have different boiling points and intermolecular strengths. Volatile liquids like alcohol or petrol evaporate much faster than water at the same temperature because of weaker attractive forces between their molecules.

• Latent Heat of Vaporization: During evaporation, the liquid absorbs energy (latent heat) from the surroundings. This leads to the cooling effect, which is the principle behind earthen pots (matkas) keeping water cool in summer and the human body cooling down through sweating.

Important Points

• Evaporation vs. Boiling: While boiling is a bulk phenomenon that occurs at a specific temperature (boiling point) throughout the liquid, evaporation occurs only at the surface and can take place at any temperature below the boiling point.

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• Pressure Effects: At high altitudes, the atmospheric pressure is lower, which generally allows evaporation to occur more easily compared to sea level, provided the temperature is constant.

• Real-world Application: In industrial cooling towers, both high surface area (using fills) and high wind speed (using fans) are utilized to maximize the evaporation rate to cool process water efficiently.

Q2. Answer: (c) Synthesising proteins for the cell

The correct answer is Synthesising proteins for the cell.

Key Points

• The cell wall is a non-living, rigid structure that forms an outer covering for the plasma membrane in plants, fungi, bacteria, and algae.

• One of its primary roles is providing shape to the cell, which ensures the structural integrity of the plant or fungus and maintains its overall form. Hence, statement 1 is a correct function of the cell wall.

• The cell wall facilitates cell-to-cell interaction through specialized channels called plasmodesmata, which traverse the cell walls to connect the cytoplasm of adjacent cells for communication and transport. Hence, statement 2 is a correct function of the cell wall.

• The process of synthesising proteins is the function of ribosomes, which are located in the cytoplasm or attached to the rough endoplasmic reticulum. The cell wall does not contain the machinery required for protein synthesis. Hence, statement 3 is NOT a function of the cell wall.

• It acts as a formidable barrier, protecting the cell from mechanical damage, physical stress, and infection by various pathogens. Hence, statement 4 is a correct function of the cell wall.

• Hence, the correct answer is Synthesising proteins for the cell.

Additional Information

• Chemical Composition:

• In plants, the cell wall is primarily composed of cellulose, hemicellulose, pectins, and lignin.

• Algae have cell walls made of cellulose, galactans, mannans, and minerals like calcium carbonate.

• In fungi, the cell wall is characterized by the presence of chitin, a durable polysaccharide.

• Structural Layers:

• The primary cell wall is thin and flexible, allowing for cell growth in young plants.

• The secondary cell wall is formed inside the primary wall once the cell is fully grown, providing extra rigidity and strength.

• The middle lamella is a layer rich in calcium pectate that acts as "glue" to hold neighboring cells together.

• Permeability: Unlike the plasma membrane, which is selectively permeable, the cell wall is generally completely permeable to water, oxygen, and other small solutes, allowing them to pass through freely.

Important Points

• Turgor Pressure: The cell wall plays a critical role in resisting turgor pressure. This pressure is created when water enters the cell by osmosis; the rigid wall prevents the cell from bursting (lysis).

• Bacterial Walls: Most bacteria possess a cell wall made of peptidoglycan (murein). This is a target for many antibiotics like penicillin, which inhibit the cross-linking of the wall, leading to cell death.

• Evolutionary Aspect: The presence of a cell wall is a major distinguishing feature between Plant cells and Animal cells, as animal cells completely lack a cell wall.

Q3. Answer: (a) A-1; B-4; C-3; D-2

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

Key Points

• pH ↓ from 7 to 4: The pH scale measures the concentration of hydrogen ions in a solution. When the pH value decreases from the neutral point of 7 towards 0, the concentration of H+ ions increases, leading to an increase in acidity. A solution with a pH of 4 is significantly more acidic than a neutral solution. Hence, A matches with 1 is correct.

• pH ↑ from 7 to 10: As the pH value increases from 7 towards 14, the concentration of hydrogen ions decreases while the concentration of hydroxyl ions (OH-) increases. This shift represents an increase in basicity (or alkalinity). A pH of 10 indicates a basic solution. Hence, B matches with 4 is correct.

• pH = 7: On the standard pH scale, a value of exactly 7 represents a neutral solution. At this point, the concentration of hydrogen ions and hydroxyl ions are equal. Pure water at 25 degrees Celsius is the most common example of a neutral substance. Hence, C matches with 3 is correct.

• pH < 5.6 in rain: Normal rainwater has a pH of approximately 5.6 because carbon dioxide in the atmosphere dissolves in it to form weak carbonic acid. However, when the pH falls below this threshold (less than 5.6) due to the presence of Sulfur dioxide (SO2) and Nitrogen oxides (NOx), it is classified as Acid rain. Hence, D matches with 2 is correct.

• Therefore, the correct matching sequence is A-1, B-4, C-3, and D-2.

Additional Information

• The pH Scale:

• The concept of pH was introduced by the Danish chemist S.P.L. Sorensen in the year 1909.

• The p in pH stands for 'potenz' in German, which means power, referring to the power of hydrogen.

• It is a logarithmic scale, meaning each whole pH value below 7 is ten times more acidic than the next higher value. For example, a pH of 4 is ten times more acidic than a pH of 5.

• Universal Indicators:

• To measure pH, scientists use litmus paper or a universal indicator, which is a mixture of several indicators that show different colors at different concentrations of hydrogen ions.

• Acids typically turn blue litmus paper red, while bases turn red litmus paper blue.

• Biological Significance:

• The human body functions within a narrow pH range of 7.0 to 7.8.

• In our digestive system, the stomach produces Hydrochloric acid (HCl) which helps in digestion and has a pH of about 1.2.

• Tooth decay starts when the pH of the mouth is lower than 5.5, as the calcium phosphate enamel begins to corrode.

Important Points

• Nature of Substances:

• Strong Acids: Substances like Sulfuric acid (H2SO4) or Hydrochloric acid that ionize completely in water, resulting in a very low pH (0-2).

• Strong Bases: Substances like Sodium Hydroxide (NaOH) that have a very high pH (12-14).

• Salts: The product of a neutralization reaction between an acid and a base. The pH of a salt solution depends on the strength of the parent acid and base; for instance, Sodium Chloride (NaCl) has a pH of 7.

• Environmental Impact of Acid Rain:

• When acid rain (pH < 5.6) flows into rivers, it lowers the pH of the river water, making the survival of aquatic life difficult.

• It also reacts with carbonates in monuments. A famous example is the Taj Mahal, where acid rain causes "marble cancer" by corroding the calcium carbonate.

Q4. Answer: (d) Sodium hydroxide

The correct answer is Sodium hydroxide.

Key Points

• Sodium hydroxide (NaOH), commonly known as caustic soda, is a highly alkaline inorganic compound. When dissolved in water, it completely dissociates into sodium ions (Na^+) and hydroxide ions (OH^-), making it a strong base.

• The pH scale is used to specify the acidity or basicity of an aqueous solution. It ranges from 0 to 14. A pH of 7 is considered neutral (like pure water), a pH below 7 is acidic, and a pH above 7 is basic.

• Sodium hydroxide solutions typically exhibit a pH near 14 (for a 1M solution), which is the highest possible value on the standard scale. Hence, the option regarding Sodium hydroxide is correct.

• Hydrogen chloride (HCl) gas, when dissolved in water, forms hydrochloric acid, which is a strong mineral acid. It has a very low pH, often reaching 0 or 1. Hence, statement 1 is incorrect.

• Vinegar is a solution containing acetic acid (CH3COOH). It is a weak acid with a typical pH value ranging between 2.4 and 3.0. Hence, statement 2 is incorrect.

• Lemon juice contains a high concentration of citric acid. It is also a weak acid with a pH usually between 2 and 3. Hence, statement 3 is incorrect.

Additional Information

• The pH Concept:

• The term pH stands for "potential of Hydrogen." It was first introduced by Danish biochemist S.P.L. Sørensen in 1909.

• It is a logarithmic scale, meaning that each unit change in pH represents a tenfold change in hydrogen ion concentration. For example, a solution with pH 4 is 10 times more acidic than a solution with pH 5.

• Properties of Bases (Alkalis):

• Bases have a bitter taste and a slippery or soapy feel to the touch.

• They turn red litmus paper blue and react with acids to form salt and water in a neutralization reaction.

• Strong bases like NaOH and Potassium hydroxide (KOH) are highly corrosive and can cause severe chemical burns.

• Applications of Sodium Hydroxide:

• Industrial uses: It is used in the manufacture of soaps, detergents, paper, and textiles (rayon).

• Chemical processing: It is used in petroleum refining and as a drain cleaner because of its ability to dissolve greases and fats.

• Food industry: Used in chemical peeling of fruits and vegetables and processing of cocoa.

Important Points

• Indicators: Chemical substances called indicators are used to test pH. For instance, phenolphthalein remains colorless in acidic solutions (like lemon juice) but turns deep pink/magenta in strong basic solutions like Sodium hydroxide.

• Relationship between pOH and pH: In any aqueous solution at 25°C, the sum of pH and pOH is always 14. Since Sodium hydroxide provides a high concentration of OH^- ions, its pOH is very low (near 0), resulting in a pH near 14.

• Common pH values:

• Battery Acid: pH ~0.5

• Stomach Acid: pH ~1.5 - 3.5

• Human Blood: pH ~7.35 - 7.45 (slightly basic)

• Milk of Magnesia: pH ~10.5

Q5. Answer: (c) H2

The correct answer is H2.

Key Points

• The provided chemical equation PbO + H2 → Pb + H2O represents a Redox reaction (Reduction-Oxidation), where one reactant is oxidized and the other is reduced simultaneously.

• In this reaction, Hydrogen (H2) combines with oxygen to form water (H2O). By definition, the addition of oxygen to a substance is called oxidation. Therefore, H2 is the reactant that undergoes oxidation. Hence, option 3 is correct.

• Lead(II) oxide (PbO) loses its oxygen atom to become metallic lead (Pb). The removal of oxygen from a substance is defined as reduction. Hence, option 1 is incorrect.

• The substances Pb (Lead) and H2O (Water) are the products of the reaction. They are the result of the chemical change and are not the entities "undergoing" the reaction process as reactants. Hence, options 2 and 4 are incorrect.

• Since H2 is being oxidized, it serves as the reducing agent because it facilitates the reduction of PbO by removing its oxygen.

Additional Information

• Oxidation: This chemical process involves the gain of oxygen, the loss of hydrogen, or the loss of electrons by an atom or molecule. In modern chemistry, it is primarily identified by an increase in the oxidation state.

• Reduction: This is the opposite of oxidation and involves the loss of oxygen, the gain of hydrogen, or the gain of electrons. It is characterized by a decrease in the oxidation state.

• Oxidizing Agent: This is a substance that causes the oxidation of another substance by accepting its electrons or providing oxygen. In this specific reaction, PbO acts as the oxidizing agent.

• Reducing Agent: This is a substance that causes the reduction of another substance by losing electrons or removing oxygen. In this reaction, H2 acts as the reducing agent.

• Reaction Characteristics: This reaction typically occurs when hydrogen gas is passed over heated lead oxide. It is an important industrial and laboratory reaction used to demonstrate the reactivity series and the extraction of metals.

Important Points

• Oxidation Number Analysis:

• The oxidation state of Hydrogen (H) in H2 is 0 (elemental state), and it increases to +1 in H2O. This increase in oxidation number confirms that oxidation has occurred.

• The oxidation state of Lead (Pb) in PbO is +2, and it decreases to 0 in the product Pb. This decrease in oxidation number confirms that reduction has occurred.

• Electronic Concept: While this reaction is easily explained via oxygen transfer, it also fits the electronic concept of redox where Hydrogen loses electrons (to oxygen) and Lead ions gain electrons to become neutral atoms.

• State of Matter: In a standard laboratory setting for this reaction, PbO is usually a solid, H2 is a gas, Pb is a solid, and H2O is formed as steam or liquid.

Q6. Answer: (b) The current is divided among the electrical gadgets, allowing them to operate independently.

The correct answer is The current is divided among the electrical gadgets, allowing them to operate independently.

Key Points

• In a parallel circuit, the electrical current from the source is divided into multiple branches. This division allows each electrical gadget to draw the specific amount of current it requires to function correctly. Hence, the statement is correct.

• One of the most significant advantages is independent operation. Since each appliance is connected across the same potential difference in its own separate branch, switching off or the failure of one appliance does not affect the operation of others.

• In household wiring, the voltage or potential difference remains constant across all gadgets. In countries like India, this standard domestic voltage is typically 220 Volts. This ensures every device receives the full line voltage.

• Unlike series circuits, if a bulb or fan fuses in a parallel connection, the rest of the circuit remains intact, and other appliances continue to work normally. This makes it the preferred method for domestic installations.

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• The total effective resistance in a parallel circuit decreases as more gadgets are added. This is because the inverse of the equivalent resistance is the sum of the inverses of individual resistances (1/Rp = 1/R1 + 1/R2 + ...).

Additional Information

• Series Circuits:

• In a series circuit, there is only one path for the current to flow. If one component fails or is turned off, the entire circuit is broken, and no current flows to any other device.

• The total resistance in series is the sum of individual resistances (Rs = R1 + R2 + ...), which significantly reduces the current if many high-resistance gadgets are added.

• Potential Difference (Voltage):

• In parallel, the potential difference across every component is the same. In series, the total voltage is divided among the components based on their resistance.

• Ohm's Law:

• This fundamental principle states that V = IR, where V is voltage, I is current, and R is resistance. This law governs how current distributes itself in the branches of a parallel circuit.

• Safety Features:

• While parallel circuits are advantageous, they can draw a high total current if too many appliances are used simultaneously. To prevent overloading and short circuits, safety devices like fuses or Miniature Circuit Breakers (MCBs) are installed in the main line.

Important Points

• Resistance Characteristic: The claim that total resistance increases to protect appliances is incorrect for parallel circuits; resistance actually decreases. Hence, statement 1 is incorrect.

• Failure Characteristic: The idea that the entire circuit breaks if one component fails is a drawback of series circuits, not an advantage of parallel ones. Hence, statement 3 is incorrect.

• Voltage Characteristic: In a parallel circuit, the potential difference is identical for all gadgets, not unique. Hence, statement 4 is incorrect.

• Application: Because of these features, parallel circuits are used in buildings, offices, and industrial plants to ensure reliable and independent power distribution.

Q7. Answer: (a) Lack of insulin

The correct answer is Lack of insulin.

Key Points

• High blood sugar levels, medically termed hyperglycemia, occur when the body cannot effectively transport glucose from the bloodstream into the cells for energy.

• Insulin is a hormone produced by the beta cells of the Islets of Langerhans in the pancreas. Its primary role is to regulate blood glucose levels.

• After consuming food, blood sugar levels rise. In a healthy individual, the pancreas releases insulin, which acts like a "key" to unlock cells, allowing glucose to enter.

• A lack of insulin or a deficiency in its secretion means glucose remains in the blood even after small amounts of food are consumed, leading to elevated sugar levels. Hence, statement 1 is correct.

• This condition is the hallmark of Diabetes Mellitus, specifically Type 1 Diabetes (where insulin production is absent) or Type 2 Diabetes (where the body becomes resistant or produces insufficient insulin).

Additional Information

• Excess Growth Hormone:

• Growth Hormone (Somatotropin) is secreted by the anterior pituitary gland.

• While it can have "diabetogenic" effects (antagonizing insulin) if present in massive excess, its primary role is physical growth, cell reproduction, and regeneration.

• Excessive secretion in adults leads to Acromegaly and in children leads to Gigantism.

• Excess Estrogen:

• Estrogen is the primary female sex hormone produced mainly by the ovaries.

• It is responsible for the development of secondary sexual characteristics and the regulation of the menstrual cycle and reproductive system.

• It does not directly cause high blood sugar levels as its primary physiological function.

• Low Thyroxine:

• Thyroxine (T4) is produced by the thyroid gland and is essential for regulating the Basal Metabolic Rate (BMR).

• Low thyroxine (Hypothyroidism) leads to symptoms like weight gain, fatigue, and cold intolerance, rather than high blood sugar.

• Thyroid hormones generally increase the absorption of glucose from the gastrointestinal tract, but a deficiency does not cause

hyperglycemia.

Important Points

• Glucagon: This is the antagonist to insulin, secreted by the alpha cells of the pancreas. It raises blood glucose levels by stimulating glycogenolysis (breakdown of glycogen) in the liver.

• Normal Blood Sugar Levels: For a healthy adult, fasting blood sugar is typically between 70 to 99 mg/dL. Post-meal (postprandial) levels should ideally be less than 140 mg/dL after 2 hours.

• Pancreas as a Dual Gland: The pancreas is a heterocrine gland, meaning it has both exocrine functions (producing digestive enzymes like trypsin and lipase) and endocrine functions (secreting hormones like insulin, glucagon, and somatostatin).

• Diabetes Symptoms: Common indicators of chronic high blood sugar include polyuria (excessive urination), polydipsia (increased thirst), and unexplained weight loss.

Q8. Answer: (a) Muddy water

The correct answer is Muddy water.

Key Points

• A suspension is defined as a heterogeneous mixture in which the solute-like particles do not dissolve but remain suspended throughout the bulk of the solvent.

• Muddy water is a classic example of a suspension because it consists of soil, sand, and clay particles dispersed in water. These particles are large enough to be seen with the naked eye.

• The particle size in a suspension is typically greater than 1000 nanometers (or 1 micrometer). Because of this large size, the particles are affected by gravity and will settle down at the bottom of the container if the mixture is left undisturbed for a period of time.

• Suspensions are unstable in nature. Unlike solutions, the components of a suspension like muddy water can be easily separated through physical methods such as filtration using filter paper or decantation.

• When a beam of light is passed through a fresh suspension, the large particles scatter the light, making the path of the beam visible. This phenomenon is known as the Tyndall effect. However, once the particles settle, the mixture no longer scatters light effectively.

Additional Information

• Solutions (Homogeneous Mixtures):

• Salt water and Vinegar (a mixture of acetic acid and water) are examples of true solutions.

• In a solution, the solute particles are smaller than 1 nanometer in diameter, meaning they are distributed uniformly at the molecular level and cannot be seen even with a microscope.

• Solutions are highly stable, do not settle over time, and do not show the Tyndall effect because the particles are too small to scatter light.

• Colloids:

• Milk is a colloid, specifically a type of emulsion where liquid fat globules are dispersed in water.

• Colloidal particles have a size ranging between 1 nanometer and 1000 nanometers. They are large enough to scatter light (showing the Tyndall effect) but small enough that they do not settle under gravity.

• Colloids appear homogeneous to the naked eye but are actually heterogeneous when viewed under an ultra-microscope.

• Comparison of Mixtures:

• Suspensions are opaque or translucent, Colloids are often cloudy or milky, and Solutions are typically transparent.

• While suspensions can be separated by ordinary filtration, colloids require specialized techniques like centrifugation to separate the dispersed phase from the medium.

• Common examples of suspensions include chalk powder in water, flour in water, and magnesia (milk of magnesia).

Q9. Answer: (a) Because body size and complexity increase

The correct answer is Because body size and complexity increase.

Key Points

• In multicellular organisms, the body design is highly complex and consists of specialized tissues and organs. Unlike unicellular organisms, where the entire surface of the cell is in direct contact with the environment, most cells in a multicellular body are located deep within the tissues. Hence, statement 1 is correct.

• Simple diffusion is a passive process where molecules move from a region of higher concentration to a region of lower concentration. This process is extremely slow and only effective over very short distances, typically at the micrometer level.

• As the body size of an organism increases, the distance between the external environment (the source of oxygen and nutrients) and the internal cells increases significantly. Diffusion alone would take years to transport oxygen from the lungs to the toes in a human being.

• In large organisms, the surface area to volume ratio decreases as size increases. This means there is not enough surface area

available to facilitate the exchange of all necessary gases and nutrients for the massive volume of internal cells through diffusion alone.

• Diffusion is not specific to just one substance; it facilitates the movement of oxygen, carbon dioxide, water, and small solutes. Therefore, the claim that it only transports oxygen is factually incorrect. Hence, statement 2 is incorrect.

• Diffusion is a physical phenomenon driven by kinetic energy and concentration gradients; it does not require light to occur, unlike processes like photosynthesis. Hence, statement 3 is incorrect.

• In complex organisms like humans or trees, only the outermost layers of cells (like the epidermis) are in contact with the air. Internal cells are shielded and must rely on internal transport mechanisms. Hence, statement 4 is incorrect.

Additional Information

• Surface Area to Volume Ratio: This is a critical biological principle. In single-celled organisms like Amoeba, the ratio is high, allowing efficient gas exchange via the cell membrane. In contrast, complex multicellular organisms have a low ratio, necessitating specialized structures like alveoli in lungs or villi in the intestines to increase surface area.

• Specialized Transport Systems: To overcome the limitations of diffusion, multicellular organisms have evolved circulatory systems. In humans, the heart pumps blood through a network of arteries, veins, and capillaries to ensure rapid delivery of materials.

• Respiratory Pigments: Because water (and blood plasma) can only carry a small amount of dissolved oxygen, organisms have evolved pigments like Hemoglobin. Found in Red Blood Cells (RBCs), hemoglobin has a high affinity for oxygen, significantly increasing the oxygen-carrying capacity of the blood.

• Metabolic Demands: Multicellular organisms, especially endotherms (warm-blooded animals), have very high energy requirements. Simple diffusion cannot keep up with the rapid ATP production needed to maintain body temperature and support complex movements.

Important Points

• Efficiency of Diffusion: It is estimated that if diffusion were the only way for oxygen to reach our brain from our lungs, it would take several minutes to hours for a single molecule, leading to immediate hypoxia and cell death.

• Evolutionary Adaptation: The transition from simple to complex life forms required the simultaneous evolution of vascular systems (in plants like Xylem and Phloem) and circulatory systems (in animals) to bypass the "diffusion barrier."

• Gaseous Exchange: While diffusion is the underlying mechanism for gas exchange at the capillary-tissue interface, it relies on the circulatory system to bring the molecules close enough (within a few cell widths) for the diffusion to be effective.

Q10. Answer: (d) g/2

The correct answer is g/2.

Key Points

• The acceleration due to gravity (g) on the surface of any planet or celestial body is determined by the formula g = GM / R^2, where G is the Universal Gravitational Constant, M is the mass of the body, and R is its radius.

• In this problem, the new planet has a mass (M') that is double that of the Earth, which can be represented as M' = 2M.

• The radius (R') of the new planet is also double that of the Earth, represented as R' = 2R.

• By substituting these new values into the gravity formula, we get the new acceleration: g' = G(2M) / (2R)^2. This simplifies to g' = 2GM / 4R^2.

• Further reduction of the fraction results in g' = (1/2) * (GM / R^2). Since GM / R^2 is the original acceleration due to gravity on Earth (g), the new value is g/2.

• Hence, the acceleration due to gravity on the new planet is half of that on Earth.

Additional Information

• Universal Gravitational Constant (G): This is a fundamental physical constant used in the calculation of gravitational effects. Its value is approximately 6.674 x 10^-11 N m^2/kg^2 and was first measured by Henry Cavendish in 1798.

• Mass of Earth: The mass of our planet is roughly 5.97 x 10^24 kg. In the context of gravity, mass is directly proportional to the gravitational pull exerted by the body.

• Radius of Earth: The mean radius of the Earth is about 6,371 km. Because gravity follows an inverse square law, the distance from the center (radius) has a much more significant impact on the value of g than the mass does.

• Inverse Square Law: This law states that the gravitational force (and thus acceleration) is inversely proportional to the square of the distance from the center of the mass. If the radius doubles, the gravity becomes one-fourth (1/2^2), but since the mass also doubled, the net effect is 2/4, or 1/2.

• Weight vs Mass: Mass is an intrinsic property that does not change, while weight is the force of gravity acting on that mass (W = mg). Therefore, a person would weigh half as much on this new planet compared to their weight on Earth.

Important Points

• Standard Gravity: The standard value for g on Earth's surface is defined as 9.80665 m/s^2.

• Variation with Altitude and Depth: The value of g is not constant everywhere; it decreases as you move higher into the

atmosphere (increased R) and also decreases as you go deeper towards the Earth's center, eventually becoming zero at the very center.

• Effect of Earth's Shape: Earth is an oblate spheroid rather than a perfect sphere, meaning it is flatter at the poles and bulges at the equator. Consequently, g is strongest at the poles (approx 9.83 m/s^2) because they are closer to the center, and weakest at the equator (approx 9.78 m/s^2).

• Centrifugal Force: The rotation of the Earth creates a centrifugal force that acts outward, slightly counteracting the inward pull of gravity, which further contributes to the lower value of g at the equator compared to the poles.

Q11. Answer: (a) Maintain a constant velocity in straight line

The correct answer is Maintain a constant velocity in straight line.

Key Points

• According to Newton's First Law of Motion, also known as the Law of Inertia, an object will remain at rest or continue to move at a constant velocity in a straight line unless acted upon by a net external force. Hence, statement 1 is correct.

• Inertia is the inherent property of an object to resist any change in its state of motion or rest. It is not a force that causes an object to stop; rather, it is the reason why an object keeps moving in the absence of resistance. Hence, statement 3 is incorrect.

• When the external force is zero, the acceleration of the body must also be zero (based on F = ma). Constant acceleration would imply a continuous force is being applied. Hence, statement 4 is incorrect.

• For a body to slow down or change its path, an external influence such as friction, air resistance, or gravitational pull must be present to change its magnitude or direction of velocity. Hence, statement 2 is incorrect.

• In a vacuum or deep space, far from gravitational fields and atmospheric friction, a moving object will theoretically travel forever in the same direction and at the same speed.

Additional Information

• Newton's Laws of Motion:

• These laws were first formulated by Sir Isaac Newton and published in his work Philosophiæ Naturalis Principia Mathematica in the year 1687.

• First Law (Inertia): Defines the concept of force qualitatively. It explains that motion does not require a force to maintain it, but change in motion does.

• Second Law (F=ma): Provides a quantitative measure of force. It states that the rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction in which the force acts.

• Third Law (Action and Reaction): States that for every action, there is an equal and opposite reaction.

• Concept of Inertia:

• The mass of an object is a quantitative measure of its inertia. A larger mass requires more force to achieve the same acceleration.

• There are three types of inertia: Inertia of Rest (resistance to starting motion), Inertia of Motion (resistance to stopping), and Inertia of Direction (resistance to turning).

• Galileo’s Contribution:

• Before Newton, Galileo Galilei challenged the Aristotelian view that a force is required to keep an object moving. He used experiments with frictionless inclined planes to demonstrate that an object would move indefinitely if friction were eliminated.

Important Points

• Velocity vs. Speed: In the context of Newton's First Law, "constant velocity" is a vector quantity, meaning both the speed (scalar) and the direction remain unchanged.

• Net Force: It is possible for multiple forces to act on a body, but if their vector sum is zero, the body is in equilibrium and will maintain its velocity. This is common in terminal velocity scenarios where gravity and air resistance are balanced.

• External Force: This refers to forces originating from outside the system, such as pushing, pulling, friction, or magnetism. Internal forces within a system cannot change the motion of the system's center of mass.

• Inertial Frame of Reference: Newton's Laws hold true in Inertial frames, which are frames that are not accelerating or rotating relative to the "fixed stars."

Q12. Answer: (c) It helps some individuals survive if environmental conditions change.

The correct answer is It helps some individuals survive if environmental conditions change..

Key Points

• Variation refers to the differences in DNA sequences and phenotypic traits among individuals within a population. These differences are the foundation of evolution and adaptation.

• Variation is crucial because it ensures that some individuals in a species possess traits that allow them to survive drastic environmental changes, such as global warming, new diseases, or famine. Hence, statement 3 is correct.

• Without variation, a population would be genetically identical. If a lethal environmental stressor occurred, every individual would

be equally susceptible, potentially leading to mass extinction. Hence, statement 1 is incorrect.

• Variation increases the diversity of a population rather than making them identical. Identity is a characteristic of clones produced via asexual reproduction, whereas variation is the opposite. Hence, statement 2 is incorrect.

• Variation does not prevent reproduction; instead, it is often a byproduct of it. Sexual reproduction involves meiosis and genetic recombination, which are the primary mechanisms that generate new variations in offspring. Hence, statement 4 is incorrect.

Additional Information

• Sources of Variation: Genetic variation arises from several sources, including random mutations in DNA, gene flow (the movement of genes between populations), and sexual reproduction, which shuffles alleles into new combinations.

• Natural Selection: Proposed by Charles Darwin in his 1859 work, "On the Origin of Species," natural selection acts on variation. Individuals with advantageous traits (variations) are more likely to survive and pass those traits to the next generation.

• Genetic Diversity: A high level of genetic diversity within a species provides a "biological insurance policy," allowing the population to persist through fluctuating conditions over geological time.

• Example of Variation: The Peppered Moth in the United Kingdom is a classic textbook example. Before the Industrial Revolution, light-colored moths were common. As pollution darkened tree trunks, the dark-colored variant survived better, illustrating how variation aids survival during environmental shifts.

Important Points

• Mutation: This is a permanent change in the nucleotide sequence of the genome. While most mutations are neutral, some provide the beneficial variations necessary for survival.

• Niche Occupation: Variation allows different individuals to occupy slightly different ecological niches, reducing competition within the same population and allowing for better resource utilization.

• Species Persistence: For long-term species persistence, variation is not just a benefit but a necessity. It is the primary tool used by conservation biologists to measure the health of endangered species.

Q13. Answer: (a) Iodine

The correct answer is Iodine.

Key Points

• Iodine is a vital trace element that the thyroid gland requires to synthesize thyroid hormones, specifically thyroxine (T4) and triiodothyronine (T3).

• The thyroid gland is a butterfly-shaped endocrine organ located in the neck, just below the Adam's apple, and it plays a major role in regulating metabolism, growth, and body temperature.

• The synthesis process occurs when the thyroid gland takes up iodide ions from the blood and attaches them to the amino acid tyrosine within a large protein called thyroglobulin. Hence, the statement that Iodine is necessary for thyroxine secretion is correct.

• Thyroxine (T4) acts as a prohormone and is converted into the more active triiodothyronine (T3) in various tissues like the liver and kidneys.

• A deficiency of dietary iodine leads to the inability of the gland to produce sufficient hormones, which triggers the pituitary gland to release more Thyroid Stimulating Hormone (TSH), potentially leading to Goitre (enlargement of the thyroid).

Additional Information

• Other Elements (Halogens):

• Fluorine (F): It is essential for the health of teeth and bones. It helps in the prevention of dental caries by strengthening enamel, but it does not participate in the synthesis of thyroid hormones.

• Bromine (Br): While it is a halogen similar to iodine, it has no established role in the secretion of thyroxine. In fact, excessive bromide exposure can sometimes interfere with iodine uptake in the thyroid.

• Chlorine (Cl): It is an essential electrolyte found in the body as chloride ions. It is crucial for maintaining osmotic pressure, acid-base balance, and the production of Hydrochloric acid (HCl) in the stomach, but it is not used by the thyroid gland for hormone production.

• Iodine Deficiency Disorders (IDD):

• Hypothyroidism: A condition where the thyroid gland is underactive, leading to fatigue, weight gain, and depression.

• Cretinism: Severe iodine deficiency during pregnancy can lead to stunted physical and mental growth in the infant, a condition known as congenital iodine deficiency syndrome.

• Goitre: The characteristic swelling of the neck resulting from the enlargement of the thyroid gland due to iodine deficiency.

• Sources of Iodine:

• The most common source of iodine for humans is iodized salt, which was introduced as a public health measure in the 20th century.

• Natural sources include seafood (fish, seaweed, shrimp), dairy products, and eggs. The amount of iodine in plants depends on the iodine content of the soil in which they are grown.

Important Points

• Regulatory Function: Thyroxine controls the Basal Metabolic Rate (BMR) and regulates the metabolism of carbohydrates, proteins, and fats.

• Daily Requirement: The recommended daily intake of iodine for an average adult is approximately 150 micrograms (mcg), which increases during pregnancy and lactation.

• Global Context: Iodine deficiency remains a significant public health issue in many parts of the world, particularly in mountainous regions where iodine has been leached from the soil by glaciation or flooding.

Q14. Answer: (c) Ovary

The correct answer is Ovary.

Key Points

• The Ovary is the basal, swollen part of the carpel or pistil (the female reproductive organ of a flower) that houses the ovules.

• One of its primary biological functions is to provide protection to the ovules from the external environment and potential pathogens during the developmental stage.

• After the process of fertilization occurs, the ovary undergoes significant physiological and structural changes, eventually maturing and ripening into a fruit.

• Inside the developing fruit, the ovules undergo their own transformation to become seeds, which contain the embryo for the next generation of the plant.

• The wall of the ovary develops into the pericarp, which is the part of the fruit that we often consume or that serves to disperse the seeds.

Additional Information

• Petals (Corolla):

• Petals are typically the brightly colored, pigmented parts of a flower.

• Their main function is to attract pollinators such as bees, butterflies, and birds through visual appeal and sometimes scent.

• They also provide additional protection to the reproductive organs (stamen and pistil) located at the center of the flower.

• Stigma:

• The Stigma is the uppermost, often sticky or feathery tip of the pistil.

• It serves as the receptive platform where pollen grains land during the process of pollination.

• Once pollen adheres to the stigma, it germinates and grows a pollen tube down through the style to reach the ovary.

• Sepals (Calyx):

• Sepals are the outermost green, leaf-like structures that enclose the flower bud before it opens.

• They function primarily as protection for the delicate inner floral parts during the bud stage of development.

• In some species, sepals may persist after the flower opens to support the base of the petals.

Important Points

• True Fruits: These are fruits that develop exclusively from a ripened ovary. Examples include Mangoes, Grapes, and Blueberries.

• False Fruits: In some plants, other floral parts like the thalamus or receptacle contribute to the formation of the fruit along with the ovary. Common examples include Apples, Pears, and Strawberries.

• Pollination and Fertilization: Pollination is the transfer of pollen from the anther to the stigma, whereas fertilization is the actual fusion of the male and female gametes inside the ovule.

• Angiosperms: This group of plants is characterized by having flowers and producing seeds enclosed within a fruit, a direct result of the ovary's development post-fertilization.

Q15. Answer: (d) Assertion is false and reason is true.

The correct answer is Assertion is false and reason is true.

Key Points

• Sound waves are characterized as longitudinal waves, not transverse waves, because the particles of the medium vibrate parallel to the direction in which the wave travels. Hence, Assertion (A) is false.

• In a longitudinal wave, the displacement of the medium is in the same direction as, or the opposite direction to, the direction of propagation of the wave, creating regions of compressions and rarefactions.

• Sound is a mechanical wave, which means it requires a material medium such as solid, liquid, or gas for its propagation. Hence, Reason (R) is true.

• The reason sound cannot travel through a vacuum (like outer space) is that there are no molecules to compress and expand to transmit the vibrational energy.

• While the reason statement is a factually correct scientific principle regarding the nature of sound, it does not explain why the assertion is true or false; however, since the assertion itself is factually incorrect, the relationship of "correct explanation" does not

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apply.

Additional Information

• Transverse Waves:

• In these waves, the particles of the medium move perpendicular to the direction of the wave's propagation.

• Examples include light waves, radio waves, and waves on a plucked guitar string.

• These waves consist of crests (highest points) and troughs (lowest points).

• Longitudinal Waves:

• These waves travel through a medium by causing particles to oscillate back and forth in the same direction as the wave.

• Sound waves in air and ultrasound waves are the most common examples.

• They are characterized by compressions (high-pressure zones) and rarefactions (low-pressure zones).

• Medium of Propagation:

• The speed of sound varies depending on the medium; it is fastest in solids (approx. 5000 m/s in steel), slower in liquids (approx. 1500 m/s in water), and slowest in gases (approx. 343 m/s in air at 20 degrees Celsius).

• This speed variation is due to the density and elasticity of the material.

Important Points

• Mechanical vs. Electromagnetic Waves:

• Mechanical waves (like sound and water waves) require a medium to transfer energy from one location to another.

• Electromagnetic waves (like visible light, X-rays, and Microwaves) can travel through a vacuum at the speed of 3 x 10^8 m/s.

• Human Hearing Range:

• The standard audible frequency range for humans is between 20 Hz and 20,000 Hz.

• Frequencies below 20 Hz are called infrasonic, and those above 20,000 Hz are called ultrasonic.

Q16. Answer: (d) Behind the mirror

The correct answer is Behind the mirror.

Key Points

• A spherical mirror is a mirror whose reflecting surface is a part of a hollow sphere of glass. The centre of curvature (C) is defined as the center of that imaginary sphere.

• In a convex mirror, the reflecting surface is curved outwards. This means the reflecting side is the exterior of the sphere, while the interior is polished or painted.

• Because the centre of the sphere lies on the side opposite to the reflecting surface, the centre of curvature for a convex mirror is located behind the mirror. Hence, the correct answer is Behind the mirror.

• For any spherical mirror, the distance from the Pole (P) to the centre of curvature (C) is called the Radius of Curvature (R). In a convex mirror, this distance is measured in the direction of the incident light.

• Unlike a concave mirror, where the centre of curvature is in front of the reflecting surface, a convex mirror's geometry places its center in a position where real light rays cannot reach it.

Additional Information

• Focus and Focal Length:

• The Principal Focus (F) of a convex mirror is also located behind the mirror. It is a virtual point from which light rays parallel to the principal axis appear to diverge after reflection.

• The focal length (f) is the distance between the Pole and the Focus. It is exactly half of the Radius of Curvature, expressed by the formula R = 2f.

• Image Characteristics:

• A convex mirror always forms a virtual, erect, and diminished image of an object, regardless of the object's distance from the mirror.

• The image is always formed behind the mirror, specifically between the Pole (P) and the Focus (F).

• Common Applications:

• Rear-view mirrors: Used in cars and motorcycles because they provide a much wider field of view compared to plane mirrors, allowing drivers to see more traffic behind them.

• Security mirrors: Installed in shops, warehouses, and at blind turns on roads to prevent accidents by allowing people to see around corners.

• ATM Mirrors: Placed near ATM machines so that users can see if someone is standing behind them for security purposes.

Important Points

• New Cartesian Sign Convention:

• According to the sign convention, the Pole (P) is taken as the origin. Distances measured in the direction of incident light (to the

right of the mirror) are taken as positive.

• Since the focus and centre of curvature of a convex mirror lie to the right of the pole (behind the mirror), both the focal length and the radius of curvature for a convex mirror are always positive.

• Conversely, for a concave mirror, these values are negative because its focus and centre of curvature are in front of the mirror.

• Principal Axis:

• This is the straight line passing through the Pole and the Centre of Curvature. In a convex mirror, this line extends from the reflecting surface through the mirror to the virtual center behind it.

• The aperture of the mirror refers to the effective diameter of the light-reflecting area of the spherical mirror.

Q17. Answer: (c) Both statements 1 and 2 are correct.

The correct answer is Both statements 1 and 2 are correct.

Key Points

• Statement 1 states that Fleming's left-hand rule is used to find the direction of force (motion) on a current-carrying conductor placed in a magnetic field. This rule is a fundamental principle used to understand the motor effect. Hence, statement 1 is correct.

• According to the rule, when a current-carrying wire is placed in an external magnetic field, it experiences a mechanical force. By stretching the thumb, forefinger, and middle finger of the left hand such that they are mutually perpendicular, the direction of this force can be determined.

• Statement 2 mentions that the force on the conductor acts perpendicular to both the current and the magnetic field. This is the geometric basis of the rule, where the three vectors represent a three-dimensional orthogonal system. Hence, statement 2 is correct.

• In this orientation, the Forefinger represents the Magnetic Field, the Middle finger represents the Current, and the Thumb represents the direction of Motion or Force.

• The relationship is mathematically expressed through the Lorentz Force equation, specifically $F = I (L \times B)$, where the cross product naturally results in a force vector perpendicular to the plane containing the current and field vectors.

Additional Information

• John Ambrose Fleming: The rule was devised by John Ambrose Fleming in the late 19th century as a simple mnemonic for students to remember the interactions in electric motors.

• Components of the Left-Hand Rule:

• Thumb: Represents the direction of Thrust or Motion of the conductor.

• Forefinger: Represents the direction of the Magnetic Field (from North Pole to South Pole).

• Middle Finger: Represents the direction of the Electric Current (from positive to negative).

• Applications: This rule is primarily applied in the working of Electric Motors, where electrical energy is converted into mechanical energy. Other devices include loudspeakers and moving coil galvanometers.

• Fleming's Right-Hand Rule: While the left-hand rule is for motors (force), the Right-Hand Rule is used for Electric Generators to find the direction of induced current when a conductor moves inside a magnetic field.

Important Points

• Magnitude of Force: The force experienced by the conductor is maximum when the angle between the current and the magnetic field is 90 degrees (perpendicular).

• Zero Force Condition: If the current-carrying conductor is placed parallel to the direction of the magnetic field, the force acting on it will be zero.

• Factors affecting Force: The magnitude of the force depends on the strength of the magnetic field (B), the amount of current (I) flowing through the conductor, and the length of the conductor (L) within the field.

• The 90-degree rule: All three parameters—Magnetic Field, Current, and Force—must be at right angles to each other for the simplest application of Fleming's Left-Hand Rule.

Q18. Answer: (d) Increase in surface area

The correct answer is Increase in surface area.

Key Points

• Evaporation is a surface phenomenon, meaning it occurs only at the boundary between the liquid and the gas phase.

• An increase in surface area provides more space for the molecules at the surface to gain enough kinetic energy to escape into the atmosphere. For example, clothes dry faster when they are spread out rather than folded. Hence, statement 4 is correct.

• A decrease in temperature reduces the average kinetic energy of the liquid particles, making it harder for them to overcome intermolecular forces and escape as vapor. Hence, statement 1 is incorrect.

• An increase in humidity means the air is already saturated with water vapor. Since the air can only hold a certain amount of moisture at a specific temperature, high humidity significantly slows down the rate of evaporation. Hence, statement 2 is incorrect.

• A decrease in wind speed allows water vapor to accumulate near the surface of the liquid, increasing the local humidity and

preventing further molecules from escaping. Hence, statement 3 is incorrect.

Additional Information

• Definition of Evaporation: It is the process by which a liquid changes into vapor at any temperature below its boiling point. This occurs because some particles at the surface have higher energy than others.

• Nature of Liquid: The rate of evaporation depends on the intermolecular forces. Liquids like alcohol, petrol, or acetone evaporate much faster than water because their internal bonds are weaker, requiring less energy to break.

• Cooling Effect: Evaporation always causes cooling. When a liquid evaporates, the particles absorb energy (latent heat of vaporization) from the surroundings, leaving the remaining liquid or surface cooler. This is why we feel cool when sweat evaporates from our skin.

• Atmospheric Pressure: A decrease in atmospheric pressure increases the rate of evaporation. This is because there is less weight/force from the air pressing down on the liquid surface, allowing molecules to escape more easily.

Important Points

• Evaporation vs. Boiling: While evaporation is a surface phenomenon that can happen at any temperature, boiling is a bulk phenomenon that occurs only at a fixed temperature (the boiling point) where the vapor pressure equals the atmospheric pressure.

• Real-world Applications:

• Earthen Pots (Matkas): These have tiny pores through which water constantly evaporates, keeping the water inside cool during summer.

• Cotton Clothes: People wear cotton in summer because it absorbs sweat and exposes it to the atmosphere, facilitating faster evaporation and cooling.

• Desert Coolers: They use the principle of evaporative cooling. On hot, dry days, the low humidity and high temperature increase the rate of evaporation, providing better cooling.

• Latent Heat of Vaporization: This is the heat energy required to change 1 kg of a liquid to gas at atmospheric pressure without any change in temperature.

Q19. Answer: (b) Two rays

The correct answer is Two rays.

Key Points

• To accurately locate the position of an image formed by a spherical mirror (concave or convex), we use ray diagrams. While an infinite number of rays emanate from an object, a minimum of two reflected rays are required to find the point of intersection.

• The point where these at least two reflected rays actually meet or appear to meet gives the position of the image of the corresponding point on the object.

• For an extended object, we typically consider the tip of the object. By finding the image of the tip using two rays and assuming the base lies on the principal axis, the entire image can be constructed.

• If the reflected rays actually intersect in front of the mirror, the image is Real and Inverted. If they only appear to intersect when produced backward, the image is Virtual and Erect. Hence, the correct answer is Two rays.

Additional Information

• Standard Rays for Ray Diagrams:

• Ray 1: A ray parallel to the principal axis. After reflection, it passes through the Principal Focus (F) in a concave mirror or appears to diverge from the focus in a convex mirror.

• Ray 2: A ray passing through the Principal Focus (F). After reflection, this ray emerges parallel to the principal axis.

• Ray 3: A ray passing through the Centre of Curvature (C). It is reflected back along the same path because it strikes the mirror surface normally (angle of incidence is 0 degrees).

• Ray 4: A ray incident at the Pole (P). It is reflected such that the angle of incidence (i) equals the angle of reflection (r), with the principal axis acting as the normal.

• Nature of Mirrors:

• A Concave Mirror is known as a converging mirror because it tends to collect light at a single focal point. It can form both real and virtual images depending on the object distance.

• A Convex Mirror is known as a diverging mirror. It always forms a virtual, erect, and diminished image, regardless of the object's position.

Important Points

• Laws of Reflection: All rays used in diagrams must obey the fundamental laws of reflection where the angle of incidence is always equal to the angle of reflection at the point of incidence.

• Image Significance: A single ray is insufficient because a line alone cannot define a specific coordinate point in a 2D plane; the intersection of two lines is the geometric minimum to define a unique point.

• Sign Convention: In modern optics, the New Cartesian Sign Convention is used, where the Pole (P) is taken as the origin and

the principal axis as the X-axis. Distances measured in the direction of incident light are positive, while those against it are negative.

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

Q20. Answer: (a) Cells are loosely arranged.

The correct answer is Cells are loosely arranged.

Key Points

• Epithelial tissue is a protective tissue in the animal body that covers the external surfaces and forms the lining of internal organs and cavities.

• The cells of epithelial tissue are tightly packed and form a continuous sheet. This arrangement allows the tissue to act as a barrier, regulating the exchange of materials between the body and the external environment. Hence, statement 3 is correct.

• There is an extremely small amount of cementing material between the cells, and they have almost no intercellular spaces. This structural feature ensures the integrity of the protective layer. Hence, statement 4 is correct.

• Epithelial tissues are found in various parts of the body, including the skin, the lining of the mouth, the lining of blood vessels, lung alveoli, and kidney tubules. Hence, statement 2 is correct.

• Because the cells are tightly packed to form a protective barrier, they are not loosely arranged. Loosely arranged cells with large intercellular spaces are characteristic of connective tissues like areolar tissue or adipose tissue. Hence, statement 1 is incorrect.

Additional Information

• Classification based on Shape:

• Squamous Epithelium: These cells are extremely thin and flat and form a delicate lining. Simple squamous epithelial cells are found in the oesophagus and the lining of the mouth.

• Cuboidal Epithelium: These are cube-shaped cells that provide mechanical support. They are typically found in the lining of kidney tubules and ducts of salivary glands.

• Columnar Epithelium: These consist of pillar-like, tall cells. They are found where absorption and secretion occur, such as in the inner lining of the intestine.

• Specialized Epithelial Tissues:

• Ciliated Columnar Epithelium: In the respiratory tract, columnar cells possess hair-like projections called cilia on their outer surfaces. These cilia move to push mucus forward to clear it.

• Glandular Epithelium: Sometimes a portion of the epithelial tissue folds inward, forming a multicellular gland. This is specialized for secreting substances at the epithelial surface.

• Stratified Squamous Epithelium: Skin epithelial cells are arranged in many layers to prevent wear and tear. Since they are arranged in a pattern of layers, the epithelium is called stratified.

• Basement Membrane:

• Regardless of the type, all epithelium is usually separated from the underlying tissue by an extracellular fibrous basement membrane. This membrane consists of collagen and provides structural support while acting as a selective filter.

• Functions of Epithelium:

• The primary functions include protection from drying, injury, and chemical effects; absorption of water and nutrients; elimination of waste products (excretion); and secretion of enzymes or hormones.

Important Points

• The permeability of the cells of various epithelia plays a critical role in regulating the exchange of materials between the body and the external world, as well as between different parts of the body.

• Unlike connective tissue, epithelial tissue is avascular, meaning it does not contain blood vessels. It receives nutrients via diffusion from the underlying vascularized connective tissue through the basement membrane.

• The skin, which protects the body, is made of stratified squamous epithelium to ensure durability against external friction and pathogens.

Q21. Answer: (d) Non-uniform acceleration

The correct answer is Non-uniform acceleration.

Key Points

• A velocity-time graph (v-t graph) represents the relationship between the velocity of an object and the time elapsed. The vertical axis (y-axis) represents velocity, and the horizontal axis (x-axis) represents time.

• The slope or gradient of a velocity-time graph at any point represents the acceleration of the object. If the graph is a straight line, the slope is constant, implying uniform acceleration.

• If the velocity-time graph is curved, it indicates that the slope is changing at every point. Since the slope represents acceleration, a changing slope means the acceleration is not constant. Hence, the correct answer is Non-uniform acceleration.

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• Constant speed or Uniform motion would be represented by a straight horizontal line parallel to the time axis. In such a case, the velocity remains the same as time passes, and the acceleration is zero. Hence, options 1 and 2 are incorrect.

• Zero velocity would be represented by a line coinciding with the time axis (where the value on the y-axis is 0). A curve indicates that the velocity is changing, so it cannot be zero. Hence, option 3 is incorrect.

Additional Information

• Acceleration: It is defined as the rate of change of velocity with respect to time. The SI unit of acceleration is meters per second squared (m/s^2). It is a vector quantity, meaning it has both magnitude and direction.

• Uniform vs. Non-Uniform Acceleration:

• Uniform Acceleration: An object is said to be in uniform acceleration if its velocity increases or decreases by equal amounts in equal intervals of time. A classic example is an object in free fall under gravity, accelerating at approximately 9.8 m/s^2.

• Non-Uniform Acceleration: This occurs when the velocity of an object changes by unequal amounts in equal intervals of time. A car moving through crowded city traffic or a bus stopping at various stations typically exhibits non-uniform acceleration.

• Area Under the Graph: In a velocity-time graph, the area enclosed by the graph and the time axis represents the total displacement or distance traveled by the object during that time interval.

• Instantaneous Acceleration: For a curved v-t graph, the acceleration at a specific instant is called instantaneous acceleration. It is found by drawing a tangent to the curve at that particular point in time and calculating the slope of that tangent.

Important Points

• Positive and Negative Slopes:

• A positive slope (line or curve going upwards) indicates that the object is speeding up (positive acceleration).

• A negative slope (line or curve going downwards) indicates that the object is slowing down, which is also known as retardation or deceleration.

• Position-Time Graph Comparison: It is important not to confuse v-t graphs with position-time (s-t) graphs. In an s-t graph, a straight line indicates uniform velocity, and a curve indicates acceleration.

• Physical Significance: The study of these graphs is a fundamental part of kinematics, used by engineers and physicists to analyze the motion of vehicles, projectiles, and celestial bodies.

Q22. Answer: (b) One carbon atom and two hydrogen atoms

The correct answer is One carbon atom and two hydrogen atoms.

Key Points

• A homologous series is a sequence of organic compounds that possess the same functional group and similar chemical properties.

• Successive members of such a series differ from each other by a CH_2 unit, which is also known as a methylene group.

• This structural difference implies that each consecutive member has one carbon atom and two hydrogen atoms more than the preceding member. Hence, the correct answer is One carbon atom and two hydrogen atoms.

• Because of this CH_2 difference, the molecular mass of any two adjacent members in a homologous series differs by 14 atomic mass units (u) (where Carbon is 12 u and Hydrogen is 1 u).

• The members of a homologous series can be represented by a general molecular formula, such as C_nH_{2n+2} for alkanes.

Additional Information

• Alkanes: These are saturated hydrocarbons with the general formula C_nH_{2n+2}. For example, Methane (CH_4) and Ethane (C_2H_6) differ by exactly one carbon and two hydrogen atoms.

• Alkenes: These are unsaturated hydrocarbons containing at least one double bond, represented by the formula C_nH_{2n}. Examples include Ethene (C_2H_4) and Propene (C_3H_6).

• Alkynes: These are unsaturated hydrocarbons containing at least one triple bond, following the formula C_nH_{2n-2}. Examples include Ethyne (C_2H_2) and Propyne (C_3H_4).

• Physical Properties: As the molecular mass increases within a homologous series, there is a regular gradation in physical properties. For instance, the melting point and boiling point increase as the number of carbon atoms increases due to stronger intermolecular forces.

• Chemical Properties: Since all members of a series have the same functional group (like the -OH group in alcohols), they exhibit very similar chemical reactions and reactivity patterns.

• Solubility: The solubility of members in a particular solvent (like water) often decreases as the carbon chain length increases within the series.

Important Points

• General Formulae: The ability to predict the formula of any member using n (the number of carbon atoms) is a hallmark of these series. For Alcohols, the formula is $C_nH_{2n+1}OH$.

• Nomenclature: The IUPAC naming system uses specific suffixes and prefixes based on the homologous series, such as -ane for alkanes, -ene for alkenes, and -ol for alcohols.

• History: The concept of homology was introduced in the 19th century (around 1843) by the French chemist Charles Gerhardt to classify organic substances.

• Isomerism: While members share a general formula, as the number of carbon atoms increases (usually from n=4 onwards), the number of possible structural isomers also increases significantly.

Q23. Answer: (c) Both A and R are false

The correct answer is Both A and R are false.

Key Points

• Vasectomy is a surgical procedure aimed at providing permanent contraception or sterilization for males.

• Assertion (A) states that vasectomy leads to a loss of sexual drive. This is incorrect because the procedure only interrupts the transport of sperm and does not interfere with the production or circulation of testosterone, the hormone responsible for libido and male sexual characteristics. Hence, statement A is false.

• Reason (R) states that vasectomy involves the removal of the testes. This is incorrect because the procedure only involves cutting, tying, or sealing the vas deferens (the tubes that carry sperm from the testes to the urethra). The testes remain intact and continue to function within the scrotum. Hence, statement R is false.

• Since testosterone is secreted directly into the bloodstream by the Leydig cells in the testes, its levels are not affected by the blockage of the vas deferens, ensuring that sexual drive, erections, and ejaculation (though sperm-free) remain normal.

• The surgical removal of one or both testes is actually a different medical procedure known as orchidectomy or castration, which is usually performed for medical reasons like cancer treatment.

Additional Information

• Surgical Methods of Contraception:

• These are terminal methods intended to prevent any more pregnancies. They block gamete transport and thereby prevent conception.

• In males, it is called Vasectomy, and in females, it is called Tubectomy.

• Mechanism of Vasectomy:

• A small part of the vas deferens is removed or tied up through a small incision on the scrotum.

• It prevents sperm from being part of the semen. After the surgery, sperm are still produced in the testes but are reabsorbed by the body.

• Mechanism of Tubectomy:

• In tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through the vagina.

• This prevents the ovum (egg) from meeting the sperm, thus preventing fertilization.

• Reversibility and Effectiveness:

• These techniques are highly effective with a failure rate of less than 1%.

• However, their reversibility is very poor, which is why they are recommended only to those who have completed their family.

Important Points

• Hormonal Integrity: It is a common myth that sterilization affects virility. Because the endocrine function of the testes (hormone release) is separate from its exocrine function (sperm transport), a vasectomy does not change a man's physical masculinity.

• Post-operative Care: A vasectomy is not immediately effective. Sperm can remain in the vas deferens above the site of the surgery for several weeks or 15 to 20 ejaculations. Alternative contraception is usually advised until a semen analysis confirms a zero sperm count.

• Health Benefits: It is a safe, outpatient procedure that takes about 20 to 30 minutes and has a much lower risk of complications compared to tubectomy in females.

Q24. Answer: (b) Number of protons

The correct answer is Number of protons.

Key Points

• The Atomic Number, represented by the symbol Z, is defined as the total number of protons present in the nucleus of an atom. This value uniquely identifies a chemical element. Hence, statement 2 is correct.

• The number of protons determines the charge of the nucleus and the identity of the element. For example, any atom with 6 protons is Carbon, and any atom with 11 protons is Sodium.

• The number of neutrons can vary within atoms of the same element. These variations are known as isotopes. Since the neutron count can change while the element remains the same, the atomic number is not equal to the number of neutrons. Hence, statement 1 is incorrect.

• In a neutral atom, the number of electrons is equal to the atomic number (protons) to maintain electrical neutrality. However, atoms can lose or gain electrons to form ions. Because the electron count changes during chemical reactions while the identity

(protons) remains constant, the atomic number is fundamentally defined by protons, not electrons. Hence, statement 3 is incorrect.

• The sum of the number of protons and neutrons is referred to as the Mass Number (A). This represents the approximate mass of the atom in atomic mass units. Hence, statement 4 is incorrect.

Additional Information

• Modern Periodic Law: In 1913, the scientist Henry Moseley used X-ray spectroscopy to show that the atomic number (Z) is the fundamental property of an element. This discovery replaced Mendeleev's periodic law, which was based on atomic mass.

• Periodic Table Arrangement: The elements in the Modern Periodic Table are arranged in increasing order of their atomic numbers. This arrangement ensures that elements with similar electronic configurations and chemical properties fall into the same group.

• Notation: In chemical notation, the atomic number (Z) is usually written as a subscript to the left of the element symbol, while the mass number (A) is written as a superscript. For example, Carbon-12 is represented with 6 as the subscript and 12 as the superscript.

• Isotopes: These are atoms with the same atomic number but different mass numbers. For instance, Hydrogen has three isotopes: Protium (1 proton, 0 neutrons), Deuterium (1 proton, 1 neutron), and Tritium (1 proton, 2 neutrons).

Important Points

• Protons: These are positively charged subatomic particles located in the nucleus. The discovery of the nucleus is attributed to Ernest Rutherford following his famous Gold Foil Experiment in 1911.

• Neutrons: These are neutral particles (no charge) discovered by James Chadwick in 1932. The mass of a neutron is slightly greater than that of a proton.

• Electrons: These are negatively charged particles that revolve around the nucleus in specific orbits or shells. They were discovered by J.J. Thomson in 1897 through his Cathode Ray Tube experiments.

• Nucleons: This is a collective term for both protons and neutrons, as they are the particles that constitute the nucleus of an atom.

• Isobars: These are atoms of different elements (different atomic numbers) that have the same mass number. An example is Argon-40 and Calcium-40.

Q25. Answer: (b) Friction acting on a moving object

The correct answer is Friction acting on a moving object.

Key Points

• Work Done is defined as the product of the component of the Force in the direction of the displacement and the magnitude of this Displacement. It is represented by the formula $W = Fs \cos \theta$, where F is the force, s is the displacement, and θ is the angle between the force and displacement vectors.

• Negative Work occurs when the Force and the Displacement are in opposite directions, meaning the angle θ is 180 degrees. Since $\cos 180° = -1$, the work done becomes negative.

• Lifting a bag upwards: When a person lifts a bag, the applied Force is in the upward direction and the Displacement is also upward. Since both are in the same direction ($\theta = 0°$), the work done by the person is Positive. Hence, statement 1 is incorrect.

• Friction acting on a moving object: Friction always acts in a direction opposite to the direction of motion or Displacement of the object. Because the angle between the frictional force and displacement is 180 degrees, the work done by friction is always Negative. Hence, statement 2 is correct.

• Gravity acting on a falling ball: When a ball falls towards the earth, the force of Gravity acts downwards and the Displacement is also downwards. As the force and displacement are in the same direction, the work done by gravity is Positive. Hence, statement 3 is incorrect.

• Pushing a moving car forward: When you push a car in the same direction it is already moving, the Force applied and the Displacement occur in the same direction. This results in Positive Work being done on the car. Hence, statement 4 is incorrect.

• Hence, the correct answer is Friction acting on a moving object.

Additional Information

• Types of Work Done:

• Positive Work: When the force and displacement are in the same direction (angle θ is between 0 and 90 degrees). An example is a horse pulling a cart or a Spring being stretched.

• Negative Work: When the force and displacement are in opposite directions (angle θ is between 90 and 180 degrees). This usually happens when a force opposes the motion, such as Air Resistance or Braking a vehicle.

• Zero Work: When the Force and Displacement are perpendicular ($\theta = 90°$) or if either force or displacement is zero. For example, if a Coolie carries a load on his head and walks on a horizontal platform, the force of gravity is vertical while the displacement is horizontal, making the work done by gravity zero.

• SI Unit and Nature:

• The SI unit of work is the Joule (J), which is equivalent to 1 Newton-meter (N-m).

• Work is a Scalar Quantity, meaning it has only magnitude and no specific direction, even though it is calculated using vector

quantities like force and displacement.

Important Points

• Energy Transfer: Positive Work results in an increase in the energy of the system, while Negative Work results in a decrease or loss of energy from the system (often dissipated as Heat).

• Dimensional Formula: The dimensional formula for work is [M1 L2 T-2], which is the same as the dimensional formula for Energy and Torque.

• Application in Daily Life: Understanding negative work is crucial in engineering, especially when designing Braking Systems in automobiles and Safety Gear that must absorb Kinetic Energy to bring objects to a stop.

Q26. Answer: (c) 10%

Shortcut Trick

Total Cost Price (CP) = Purchase Price + Repair Cost = 5,600 + 1,400 = 7,000.

Selling Price (SP) = 7,700.

Profit = 7,700 − 7,000 = 700.

Profit% = (Profit ÷ CP) × 100 = (700 ÷ 7,000) × 100 = 10%.

Therefore The correct answer is 10%.

Alternate Method

Given: Purchase Price = Rs. 5,600, Repair cost = Rs. 1,400, Selling Price (SP) = Rs. 7,700.

Formulas: Total CP = Purchase Price + Overhead Expenses | Profit = SP − CP | Profit% = (Profit ÷ CP) × 100

=> Total Cost Price (CP) = 5,600 + 1,400 = Rs. 7,000.

=> Selling Price (SP) = Rs. 7,700.

=> Profit = SP − CP = 7,700 − 7,000 = Rs. 700.

=> Profit Percentage = (700 ÷ 7,000) × 100.

=> Profit Percentage = 10%.

Therefore The correct answer is 10%.

Additional Information

Effective Cost Price

Any additional expenditure incurred on an item like repairs, transportation, or labor after purchase is added to the original price to find the effective CP.

Profit and Loss Calculation

Profit or loss is always calculated on the Cost Price unless specified otherwise. Formula: Profit% = (Profit ÷ CP) × 100.

Q27. Answer: (c) 16

Shortcut Trick

Start from inner bracket: $2^2 = 4$

Expression becomes: 3 × (10 × 4) ÷ 20 + 13 − 3

10 × 4 = 40 => 3 × 40 ÷ 20

120 ÷ 20 = 6 => 6 + 13 − 3

Therefore Answer = 16

Alternate Method

Given:

3 × (10 × (2^2)) ÷ 20 + 13 − 3

Concept Used:

BODMAS rule

Calculation:

=> 3 × (10 × 4) ÷ 20 + 13 − 3

=> 3 × 40 ÷ 20 + 13 − 3

=> 120 ÷ 20 + 13 − 3

=> 6 + 13 − 3

=> 19 − 3

=> 16

Therefore The correct answer is 16.

Additional Information

BODMAS Rule

Brackets → Orders → Division → Multiplication → Addition → Subtraction

Order of Operations

Solve brackets first, then powers, then × and ÷, then + and −

Simplification Tip

Always simplify inner brackets first to reduce steps

Exponent Rule

$a^2 = a \times a$

Q28. Answer: (a) 6600

Shortcut Trick

Total valid votes = 88% of 25,000 = 22,000.

Percentage of votes for Candidate C = 100% − (40% + 30%) = 30%.

Votes for Candidate C = 30% of 22,000 = 6,600.

Therefore The correct answer is 6600.

Alternate Method

Given:

Total voters = 25,000

Invalid votes = 12%

Candidate A votes = 40% of valid votes

Candidate B votes = 30% of valid votes

=> Total Valid Votes = 100% − 12% = 88%

=> Total Valid Votes = (88 ÷ 100) × 25,000 = 22,000

=> Sum of votes for A and B = 40% + 30% = 70%

=> Votes for Candidate C = 100% − 70% = 30%

=> Number of votes for C = 30% of 22,000

=> Number of votes for C = (30 ÷ 100) × 22,000

=> Number of votes for C = 3 × 2,200 = 6,600

Therefore The correct answer is 6600.

Additional Information

Percentage Base Change

Always calculate the final percentage on the Valid Votes base unless the question specifies the Total Votes base.

Successive Percentage

Votes for C = Total × (Valid Ratio) × (Share of C). Here, 25,000 × 0.88 × 0.30 = 6,600.

Q29. Answer: (c) 14

Shortcut Trick

Surplus runs scored in 10^(th) inning = New Score − Old Average

Surplus = 191 − 54 = 137 runs

Increase in average = Surplus ÷ Total Innings

Increase = 137 ÷ 10 = 13.7 ≈ 14

Therefore The correct answer is 14.

Alternate Method

Given:

Average of 9 innings = 54 runs

Score in 10^(th) inning = 191 runs

Calculations:

=> Total runs in 9 innings = 9 × 54 = 486 runs

=> Total runs in 10 innings = 486 + 191 = 677 runs

=> New average for 10 innings = 677 ÷ 10 = 67.7 runs

=> Increase in average = New average − Old average

=> Increase = 67.7 − 54 = 13.7 runs

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=> Rounding to the nearest whole number ≈ 14

Therefore The correct answer is 14.

Additional Information

Average (Arithmetic Mean)

Average is defined as the Sum of Observations ÷ Number of Observations.

Effect of New Entry

If the new value added is greater than the old average, the average increases. If it is less, the average decreases.

Weighted Average Formula

Combined Average = (n1x1 + n2x2) ÷ (n1 + n2), where n is the number of items and x is the average.

Q30. Answer: (b) 48 cm

Shortcut Trick

Calculate the semi-perimeter (s) of the triangle: s = (80 + 44 + 52) ÷ 2 = 88 cm.

Apply Heron's Formula for Area: √(88 × (88−80) × (88−44) × (88−52)) = √(88 × 8 × 44 × 36).

Area = √(2 × 44 × 8 × 44 × 36) = 44 × 4 × 6 = 1056 cm².

Altitude (h) = (2 × Area) ÷ base = (2 × 1056) ÷ 44 = 48 cm.

Therefore The correct answer is 48 cm.

Alternate Method

Given:

Sides of the triangle (a, b, c) are 80 cm, 52 cm, and 44 cm.

Formula Used:

Semi-perimeter (s) = (a + b + c) ÷ 2

Area of triangle (A) = √(s × (s−a) × (s−b) × (s−c))

Area of triangle (A) = 1/2 × base × height

Calculations:

=> s = (80 + 52 + 44) ÷ 2 = 176 ÷ 2 = 88 cm

=> Area = √(88 × (88 − 80) × (88 − 52) × (88 − 44))

=> Area = √(88 × 8 × 36 × 44)

=> Area = √((2 × 44) × (2 × 4) × (6 × 6) × 44)

=> Area = √(44² × 4 × 6² × 4)

=> Area = 44 × 2 × 6 × 2 = 1056 cm²

=> Now, for the base of 44 cm, 1056 = 1/2 × 44 × height

=> 1056 = 22 × height

=> height = 1056 ÷ 22 = 48 cm

Therefore The correct answer is 48 cm.

Additional Information

Heron's Formula

Used to find the area of a triangle when all three sides are known: Area = √(s(s−a)(s−b)(s−c)), where s is the semi-perimeter.

Altitudes and Area

A triangle has three altitudes. Area = 1/2 × b1h1 = 1/2 × b2h2 = 1/2 × b3h3. The longest side has the shortest altitude.

Obtuse Triangle Properties

In an obtuse-angled triangle, two of the altitudes lie outside the triangle on the extended base lines.

Q31. Answer: (c) 67

Shortcut Trick

Age of new member (teacher) = Old Average + (New Strength × Increase in Average)

Old average age = 35 years

Total people (after adding teacher) = 31 + 1 = 32

Increase in average = 36 − 35 = 1 year

Age of teacher = 35 + (32 × 1) = 35 + 32 = 67 years

Therefore The correct answer is 67 years.

Alternate Method

Given:

Initial number of students = 31

Initial average age = 35 years

New average age after including teacher = 36 years

Formula Used:

Average = Total Sum of Ages ÷ Total Number of Persons

Total Sum = Average × Number of Persons

Calculations:

=> Total age of 31 students = 31 × 35 = 1085 years

=> Total number of people (including teacher) = 31 + 1 = 32

=> Total age of 32 people = 32 × 36 = 1152 years

=> Age of teacher = Total age of 32 people − Total age of 31 students

=> Age of teacher = 1152 − 1085 = 67 years

Therefore The correct answer is 67 years.

Additional Information

Effect of Adding a Member

When a new member is added, if the average increases, the new member's value is greater than the old average. Formula: Value = Old Avg + (New Total × Increase).

Effect of Removing a Member

If a member is excluded and the average decreases, the excluded member's value = Old Average + (Remaining Count × Decrease in Average).

Weighted Average

When two groups are combined, the resulting average is (n1x1 + n2x2) ÷ (n1 + n2), where n is the count and x is the average.

Q32. Answer: (a) 8

Shortcut Trick

Initial Men = 104, Total Men = 104 + 52 = 156.

Using Inverse Variation: M1 × D1 = M2 × D2

104 × 12 = 156 × D2

D2 = (104 × 12) ÷ 156 = 8 weeks.

Therefore The correct answer is 8 weeks.

Alternate Method

Given:

Initial number of men (M1) = 104

Initial duration (D1) = 12 weeks

Additional men = 52

Formula Used:

Total Work = Men × Time

M1D1 = M2D2

Calculations:

=> Total new men (M2) = 104 + 52 = 156 men

=> 104 × 12 = 156 × D2

=> D2 = (104 × 12) ÷ 156

=> D2 = 1248 ÷ 156

=> D2 = 8 weeks

Therefore The correct answer is 8 weeks.

Additional Information

Chain Rule Concept

The number of men is inversely proportional to the time taken to consume a fixed quantity of provision. Formula: M1D1H1/W1 = M2D2H2/W2.

Inverse Variation

If one quantity increases and the other decreases such that their product remains constant, it is called inverse variation (x × y = k).

Q33. Answer: (c) Rs. 4,032

Shortcut Trick

Effective rate of Compound Interest for 2 years at 20% = 20 + 20 + (20 × 20)/100 = 44%.

Total Amount = 100% (Principal) + 44% (Interest) = 144% of Principal.

Amount = 2800 × 144/100 = 28 × 144.

Amount = Rs. 4,032.

Therefore The correct answer is Rs. 4,032.

Alternate Method

Given:

Principal (P) = Rs. 2,800

Rate (R) = 20% per annum

Time (n) = 2 years

Formula Used:

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

Calculations:

=> $A = 2800(1 + 20/100)^2$

=> $A = 2800(1 + 1/5)^2$

=> $A = 2800(6/5)^2$

=> $A = 2800 \times (36/25)$

=> $A = 112 \times 36$

=> A = Rs. 4,032

Therefore The correct answer is Rs. 4,032.

Additional Information

Effective Rate for Compound Interest

For 2 years, the effective rate is calculated using the successive percentage formula: R + R + (R × R)/100.

Difference between CI and SI

The difference between Compound Interest and Simple Interest for 2 years is given by: CI − SI = $P(R/100)^2$.

Compounding Periods

If interest is compounded half-yearly, the rate is halved (R/2) and the time is doubled (2n) in the standard formula.

Q34. Answer: (d) 0

Shortcut Trick

Apply Complementary Angles property: sec θ = cosec(90° − θ) and cot θ = tan(90° − θ).

Term 1: sec 33° ÷ cosec 57° = sec 33° ÷ sec 33° = 1.

Term 2: √3 × (cot 13° cot 77°) × (cot 21° cot 69°) × cot 60° = √3 × 1 × 1 × (1/√3) = 1.

Term 3: $-2(\sin^2 41° + \cos^2 41°) = -2(1) = -2$.

Net Result: 1 + 1 − 2 = 0.

Therefore The correct answer is 0.

Alternate Method

Given: sec 33°/cosec 57° + √3 cot 13° cot 21° cot 60° cot 69° cot 77° − $2(\sin^2 41° + \sin^2 49°)$

Formula Used:

1. sec θ = cosec(90° − θ)

2. cot θ1 cot θ2 = 1 if θ1 + θ2 = 90°

3. $\sin^2 \theta + \cos^2 \theta = 1$

Calculations:

=> [sec 33° / cosec(90° − 33°)] + √3 [cot 13° cot(90° − 13°)] [cot 21° cot(90° − 21°)] cot 60° − $2[\sin^2 41° + \sin^2(90° − 41°)]$

=> [sec 33° / sec 33°] + √3 [cot 13° tan 13°] [cot 21° tan 21°] cot 60° − $2[\sin^2 41° + \cos^2 41°]$

=> 1 + √3 × 1 × 1 × (1/√3) − 2(1)

=> 1 + 1 − 2

=> 0

Therefore The correct answer is 0.

Additional Information

Complementary Angle Identities

sin θ = cos(90° − θ), tan θ = cot(90° − θ), and sec θ = cosec(90° − θ). These are useful for simplifying ratios where angles sum to 90°.

Standard Trigonometric Values

cot 60° = 1/√3, tan 60° = √3, sin 30° = 1/2, cos 30° = √3/2. Memorizing these is essential for quick simplification.

Trigonometric Unitary Rule

The product cot A × cot B = 1 and tan A × tan B = 1 if A + B = 90°. Similarly, $\sin^2 A + \sin^2 B = 1$ if A + B = 90°.

Q35. Answer: (c) 27.21%

Shortcut Trick

Discount = Marked Price − Selling Price

Discount = 3,050 − 2,220 = 830

Discount% = (830 ÷ 3,050) × 100

Discount% = 8300 ÷ 305 ≈ 27.2131...

Rounding to two decimal places, we get 27.21%.

Therefore The correct answer is 27.21%.

Alternate Method

Given: Marked Price (MP) = Rs. 3,050 | Selling Price (SP) = Rs. 2,220

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

=> Calculate Discount: 3,050 − 2,220 = 830

=> Apply Discount% formula: (830 ÷ 3,050) × 100

=> 83000 ÷ 3050 = 8300 ÷ 305

=> 27.2131...% ≈ 27.21%

Therefore The correct answer is 27.21%.

Additional Information

Marked Price and Discount

The Marked Price (MP) is the price printed on the product. Discount is always calculated on the MP unless stated otherwise.

Rounding Decimals

To round to two decimal places, look at the third decimal digit. If it is 5 or greater, round up; otherwise, keep the second digit as is.

Q36. Answer: (a) 64 years

Shortcut Trick

Ratio of Arman : Riya (Present) = 4 : 1 (Difference = 3 units)

Ratio after 8 years = 3 : 1 (Difference = 2 units)

Equalize difference: Present (4:1)×2 = 8:2 | After 8 yrs (3:1)×3 = 9:3

1 unit increase (8 to 9 or 2 to 3) = 8 years

Present age of Arman = 8 units = 8 × 8 = 64 years

Therefore The correct answer is 64 years.

Alternate Method

Given:

Present age of Riya = x years

Present age of Arman = 4x years

Calculations:

=> According to the question: (4x + 8) = 3 × (x + 8)

=> 4x + 8 = 3x + 24

=> 4x − 3x = 24 − 8

=> x = 16

=> Present age of Arman = 4x = 4 × 16 = 64 years

Therefore The correct answer is 64 years.

Additional Information

Ratio Difference Method

When a constant number of years is added to two people, the absolute difference between their ages remains constant over time.

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Successive Age Calculation

If current age is A and the ratio after n years is x:y, then (A + n) / (B + n) = x / y can be used to solve for unknown variables.

Q37. Answer: (b) 83.33%

Shortcut Trick

Required percentage = (First value ÷ Second value) × 100

Required percentage = (1/30) ÷ (2/50) × 100

Required percentage = (1/30) × (50/2) × 100 = 5/6 × 100

Required percentage = 500/6 ≈ 83.33%

Therefore The correct answer is 83.33%.

Alternate Method

Given values:

First fraction = 1/30

Second fraction = 2/50

Formula: Percentage = (Value / Base) × 100

=> Required Percentage = [(1/30) / (2/50)] × 100

=> Required Percentage = (1/30) × (50/2) × 100

=> Required Percentage = (50 / 60) × 100

=> Required Percentage = (5 / 6) × 100

=> Required Percentage = 83.3333...

Therefore The correct answer is 83.33%.

Additional Information

Fraction to Percentage Conversion

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

Reciprocal Percentages

Standard values: 1/6 = 16.67%, therefore 5/6 = 5 × 16.67% = 83.33%.

Percentage Change

Percentage change = [(New Value − Old Value) / Old Value] × 100.

Q38. Answer: (d) 7362

Shortcut Trick

Convert percentages and fractions: 20% = 1/5 and 50% = 1/2.

Net multiplier = 1/5 × 1/2 × 5/9 = 1/18.

Let the number be N.

N × (1/18) = 409 => N = 409 × 18 = 7362.

Therefore The correct answer is 7362.

Alternate Method

Given: Result = 409, Operations = 20%, 50%, 5/9

Let the unknown number be x.

=> 20% × 50% × (5/9) × x = 409

=> (20/100) × (50/100) × (5/9) × x = 409

=> (1/5) × (1/2) × (5/9) × x = 409

=> (5 / 90) × x = 409

=> (1 / 18) × x = 409

=> x = 409 × 18

=> x = 7362

Therefore The correct answer is 7362.

Additional Information

Percentage to Fraction Conversion

To simplify calculations, remember common fractions: 20% = 1/5, 25% = 1/4, 50% = 1/2, and 75% = 3/4.

Successive Percentage Application

When taking percentages of percentages, multiply the fractions together: a% of b% of C = (a/100) × (b/100) × C.

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Of Operator in Math

The word of in mathematical word problems almost always signifies the multiplication operation.

Q39. Answer: (c) 140

Shortcut Trick

Combined Ratio calculation: First : Second : Third

Ratio 1 (S:F) = 3 : 13 → F:S = 13 : 3

Ratio 2 (T:S) = 8 : 12 → S:T = 12 : 8 = 3 : 2

Since Second number is '3' in both ratios, Combined Ratio F : S : T = 13 : 3 : 2

Total units = 13 + 3 + 2 = 18 units → 840. Value of 3 units = (840 ÷ 18) × 3 = 840 ÷ 6 = 140.

Therefore The correct answer is 140.

Alternate Method

Given:

Sum of numbers (A + B + C) = 840

Ratio B : A = 3 : 13 => A : B = 13 : 3

Ratio C : B = 8 : 12 => B : C = 12 : 8 = 3 : 2

Calculations:

=> Combined Ratio A : B : C = 13 : 3 : 2

=> Let the numbers be 13x, 3x, and 2x

=> 13x + 3x + 2x = 840

=> 18x = 840

=> x = 840 ÷ 18 = 140 ÷ 3

=> Second number (B) = 3x = 3 × (140 ÷ 3)

=> Second number = 140

Therefore The correct answer is 140.

Additional Information

Combined Ratio Rule

If A : B = m : n and B : C = p : q, then A : B : C = (m×p) : (n×p) : (n×q).

Proportion Fundamentals

In any ratio a : b, 'a' is the antecedent and 'b' is the consequent. For a sum S divided in ratio a:b:c, the second part is [b ÷ (a+b+c)] × S.

Q40. Answer: (a) 35

Shortcut Trick

Relative Speed in the same direction = Difference of speeds.

Relative Speed = 82 − 68 = 14 km/h.

Distance = Relative Speed × Time.

Distance = 14 × 2.5 = 35 km.

Therefore The correct answer is 35 km.

Alternate Method

Given:

Speed of Train 1 (S1) = 68 km/h

Speed of Train 2 (S2) = 82 km/h

Time (T) = 2.5 hours

Formula Used:

Distance = Speed × Time

Calculations:

=> Distance covered by Train 1 = 68 × 2.5

=> Distance1 = 170 km

=> Distance covered by Train 2 = 82 × 2.5

=> Distance2 = 205 km

=> Distance between the two trains = Distance2 − Distance1

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=> Distance = 205 − 170 = 35 km

Therefore The correct answer is 35 km.

Additional Information

Relative Speed in Same Direction

When two objects move in the same direction, their relative speed is the difference: (S1 − S2).

Relative Speed in Opposite Direction

When two objects move in opposite directions, their relative speed is the sum: (S1 + S2).

Unit Conversion

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

Q41. Answer: (a) 2

Shortcut Trick

Using the standard algebraic identity: $(a + b)^2 − (a − b)^2 = 4ab$

Let a = 3x and b = 4y.

Numerator = 4 × 3x × 4y = 48xy

Given expression = 48xy ÷ 24xy = 2

Therefore The correct answer is 2.

Alternate Method

Given:

Expression: $[(3x + 4y)^2 − (3x − 4y)^2] ÷ (24xy)$

Formulas Used:

$(a + b)^2 = a^2 + 2ab + b^2$

$(a − b)^2 = a^2 − 2ab + b^2$

Calculations:

Expanding the binomials in the numerator:

=> $(3x + 4y)^2 = 9x^2 + 24xy + 16y^2$

=> $(3x − 4y)^2 = 9x^2 − 24xy + 16y^2$

Subtracting the second term from the first term:

=> $(3x + 4y)^2 − (3x − 4y)^2 = (9x^2 + 24xy + 16y^2) − (9x^2 − 24xy + 16y^2)$

=> $(3x + 4y)^2 − (3x − 4y)^2 = 9x^2 + 24xy + 16y^2 − 9x^2 + 24xy − 16y^2$

=> $(3x + 4y)^2 − (3x − 4y)^2 = 48xy$

Dividing the simplified numerator by the denominator:

=> 48xy ÷ 24xy = 2

Therefore The correct answer is 2.

Additional Information

Difference of Squares

The difference of squares identity is written as: $(a + b)(a − b) = a^2 − b^2$.

Sum of Squared Binomials

The sum of the squares of a sum and difference of two numbers is: $(a + b)^2 + (a − b)^2 = 2(a^2 + b^2)$.

Square of a Trinomial

The square of a trinomial is given by the formula: $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$.

Q42. Answer: (d) B

Shortcut Trick

Scheme A: Net discount = 18 + 10 − (18 × 10 ÷ 100) = 28 − 1.8 = 26.2%.

Scheme B: Buy 2, get 8 means 8 is the total items and 6 are free. Discount = (6 ÷ 8) × 100 = 75%.

Scheme C: Flat discount = 24%.

Scheme D: Net discount = 42 + 45 − (42 × 45 ÷ 100) = 87 − 18.9 = 68.1%.

Comparing 26.2%, 75%, 24%, and 68.1%, the highest discount is 75%.

Therefore The correct answer is Scheme B.

Alternate Method

Formulas: Successive Discount = a + b − (ab ÷ 100) | Buy X Get Y Discount% = [Free Items ÷ Total Items (X+Y)] × 100.

=> Scheme A: 18 + 10 − 1.8 = 26.2%.
=> Scheme B: Buy 2 get 8 means you pay for 2 and get 8. Free items = 8 − 2 = 6. Discount% = (6 ÷ 8) × 100 = 75%.
=> Scheme C: 24%.
=> Scheme D: 42 + 45 − 18.9 = 68.1%.
=> Comparing all values: 75% > 68.1% > 26.2% > 24%.
Therefore The correct answer is Scheme B.
Additional Information
Successive Discounts
When two discounts a% and b% are given, the effective discount is always less than (a + b)% due to the compounding effect.
Buy X Get Y Scheme
In 'Buy X Get Y' (where Y is total), free items = Y − X. In 'Buy X Get Y free', free items = Y and total = X + Y.

Q43. Answer: (d) 46 seconds

Shortcut Trick
Relative Speed in same direction = 102 − 66 = 36 km/h.
Convert to m/s: 36 × (5/18) = 10 m/s.
Total Distance to cover = Sum of lengths = 230 + 230 = 460 m.
Time taken = Total Distance ÷ Relative Speed = 460 ÷ 10 = 46 sec.
Therefore The correct answer is 46 sec.
Alternate Method
Given:
Length of each train (L1 = L2) = 230 m
Speed of faster train (S1) = 102 km/h
Speed of slower train (S2) = 66 km/h
Formula Used:
Time = (Total Distance) ÷ (Relative Speed)
Calculations:
=> Total Distance = L1 + L2 = 230 + 230 = 460 m
=> Relative Speed (Same direction) = S1 − S2 = 102 − 66 = 36 km/h
=> Convert km/h to m/s: 36 × (5/18) = 10 m/s
=> Time taken = 460 ÷ 10
=> Time taken = 46 sec
Therefore The correct answer is 46 sec.
Additional Information
Relative Speed Concepts
When moving in the same direction, Relative Speed = S1 − S2. When moving in opposite directions, Relative Speed = S1 + S2.
Speed Conversion
To convert km/h to m/s, multiply by 5/18. To convert m/s to km/h, multiply by 18/5.
Total Crossing Distance
When one train passes another completely, the total distance covered is always the sum of the lengths of both trains.

Q44. Answer: (a) 144 π cm²

Shortcut Trick
The surface area of a sphere is given by the formula $4\pi r^2$.
Given radius (r) = 6 cm.
Surface Area = $4 \times \pi \times (6)^2 = 4 \times 36 \times \pi = 144\pi$ cm².
Therefore The correct answer is 144 π cm².
Alternate Method
Given:
Radius (r) of the sphere = 6 cm
Formula Used:
Surface Area (A) of a sphere = $4\pi r^2$

Calculations:

=> Surface Area = 4 × π × r²

=> Surface Area = 4 × π × (6)²

=> Surface Area = 4 × π × 36

=> Surface Area = 144π cm²

Therefore The correct answer is 144 π cm².

Additional Information

Volume of a Sphere

The amount of space occupied by a sphere is given by Volume = (4/3)πr³.

Total Surface Area of Hemisphere

For a solid hemisphere, the total surface area includes the curved part and the base: TSA = 3πr².

Curved Surface Area of Hemisphere

The surface area of just the curved part of a hemisphere is exactly half that of a sphere: CSA = 2πr².

Volume of Hemisphere

The volume of a hemisphere is half the volume of a sphere: Volume = (2/3)πr³.

Q45. Answer: (a) 27

Shortcut Trick

Total Capacity (LCM of 9 and 12) = 36 units

Efficiency of P + Q = 36 ÷ 9 = 4 units/hour

Efficiency of P = 36 ÷ 12 = 3 units/hour

Efficiency of Q = 4 − 3 = 1 unit/hour

Time for Q to fill 3/4th work = (3/4 × 36) ÷ 1 = 27 hours

Therefore The correct answer is 27 hours.

Alternate Method

Given:

Time taken by P and Q together = 9 hours

Time taken by P alone = 12 hours

Person	Days	Total Work	Efficiency
P + Q	9	36	4
P	12	3	

Calculations:

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

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

=> 3/4th of Total Cistern Capacity = 3/4 × 36 = 27 units

=> Time taken by Q alone = 3/4th Capacity ÷ Efficiency of Q

=> Time = 27 ÷ 1 = 27 hours

Therefore The correct answer is 27 hours.

Additional Information

Combined Work Formula

If two individuals fill a tank in x and y hours respectively, they together fill it in (xy) ÷ (x + y) hours.

Individual Work Formula

If together they take T hours and one takes x hours, the other takes (T × x) ÷ (x − T) hours.

Pipes and Cisterns

Inlet pipes have positive efficiency, while outlet (leakage) pipes have negative efficiency.

Q46. Answer: (a) 154 seconds

Shortcut Trick

Identify the volume of water to be removed: Volume = π × r² × drop in height.

Base Area = (22/7) × 70 × 70 = 15,400 cm².

Volume to pump = 15,400 × 50 = 770,000 cm³ = 770 Litres (as 1L = 1000 cm³).

Time required = Total Litres ÷ Flow Rate = 770 ÷ 5 = 154 seconds.
Therefore The correct answer is 154 sec.
Alternate Method
Given: Internal radius (r) = 70 cm, Total height (H) = 1.5 m = 150 cm, Water level drop (h) = 50 cm, Rate = 5 litres/sec.
Formula Used: Volume of water = $\pi r^2 h$ | Time = Volume ÷ Rate
=> Volume to be removed (V) = $\pi \times r^2 \times h$
=> V = $(22/7) \times 70 \times 70 \times 50$ cm^3
=> V = $22 \times 10 \times 70 \times 50 = 770{,}000$ cm^3
=> Volume in litres = 770,000 ÷ 1000 = 770 litres
=> Time = 770 ÷ 5 = 154 seconds
Therefore The correct answer is 154 sec.
Additional Information
Volume of a Cylinder
The volume (V) is given by $V = \pi r^2 h$, where r is the radius and h is the height/depth.
Unit Conversion
1 Litre = 1000 cm^3 = 0.001 m^3. Also, 1 m^3 = 1000 Litres.
Flow Rate Relation
Time = Total Volume ÷ Rate of Flow. Ensure all units (volume and rate) are consistent before division.

Q47. Answer: (a) 64

Shortcut Trick
In a mean proportional relationship, $P \times 169 = 104^2$.
$P = (104 \times 104) \div 169$
$P = (13 \times 8 \times 13 \times 8) \div (13 \times 13) = 8 \times 8 = 64$.
Therefore The correct answer is 64.
Alternate Method
Given: First number = P, Second number = 169, Mean Proportional = 104.
Formula Used: If b is the mean proportional between a and c, then $b^2 = a \times c$ or $b = \sqrt{(a \times c)}$.
=> $104 = \sqrt{(P \times 169)}$
=> $104^2 = P \times 169$
=> $10816 = P \times 169$
=> $P = 10816 \div 169$
=> P = 64
Therefore The correct answer is 64.
Additional Information
Mean Proportional
It is the geometric mean of two numbers. For a and c, the mean proportional b satisfies a/b = b/c.
Third Proportional
If a, b, and c are in continued proportion, then c is the third proportional to a and b, calculated as $c = b^2 \div a$.
Fourth Proportional
For numbers a, b, and c, the fourth proportional d satisfies a : b = c : d, calculated as $d = (b \times c) \div a$.

Q48. Answer: (c) 6

Shortcut Trick
The given expression is in the standard form of the Algebraic Identity: $(a^3 + b^3) \div (a^2 - ab + b^2)$.
According to the identity, $(a^3 + b^3) \div (a^2 - ab + b^2) = a + b$.
Identify the values from the expression: a = 5.9 and b = 0.1.
Applying the shortcut: 5.9 + 0.1 = 6.
Therefore The correct answer is 6.
Alternate Method
Given:
Numerator = $(5.9)^3 + (0.1)^3$

Denominator = $(5.9)^2 + (0.1)^2 - (5.9 \times 0.1)$

Formula Used:

The Sum of Two Cubes identity is: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$.

Calculations:

=> Let a = 5.9 and b = 0.1.

=> The denominator is already in the form $(a^2 + b^2 - ab)$.

=> Expression = $[(a + b)(a^2 - ab + b^2)] \div (a^2 + b^2 - ab)$

=> The term $(a^2 - ab + b^2)$ cancels out from both the numerator and denominator.

=> Expression = a + b

=> Expression = 5.9 + 0.1

=> Expression = 6.0

Therefore The correct answer is 6.

Additional Information

Difference of Cubes

The identity for the difference of cubes is $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$.

Algebraic Squares

The square of a sum is $(a + b)^2 = a^2 + 2ab + b^2$ and the square of a difference is $(a - b)^2 = a^2 - 2ab + b^2$.

Difference of Squares

The expression $a^2 - b^2$ factors into $(a - b)(a + b)$.

Q49. Answer: (c) 121/3 days

Shortcut Trick

Total Work (LCM of 18, 24) = 72 units.

Efficiency: A = 4, B = 3. Combined = 7 units/day.

Work done in 5 days = 7 × 5 = 35 units.

Remaining work = 72 − 35 = 37 units.

B completes remaining = 37 ÷ 3 = 12(1/3) days.

Therefore The correct answer is 12(1/3) days.

Alternate Method

Given: Time taken by A = 18 days, Time taken by B = 24 days. Working together for 5 days.

Formula Used: Efficiency = Total Work ÷ Time; Remaining Work = Total Work − Work Done.

Person	Days	Total Work	Efficiency
A	18	72	4
B	24	3	

=> Combined Efficiency of A and B = 4 + 3 = 7 units/day.

=> Work completed in 5 days = 7 × 5 = 35 units.

=> Remaining Work = 72 − 35 = 37 units.

=> Time taken by B to finish remaining work = 37 ÷ 3 days.

=> Time = 12(1/3) days.

Therefore The correct answer is 12(1/3) days.

Additional Information

Total Work and Efficiency

The LCM method is the fastest way to calculate total work. Efficiency is inversely proportional to the time taken.

Work and Wages

Wages are distributed based on the ratio of work done by each person, which is Efficiency × Time.

Fractional Work

If a person completes a job in 'D' days, their 1-day work is 1/D. This can be used for fractional calculations.

Q50. Answer: (c) Rs. 3

Shortcut Trick

Let A be the cost of an apple and B be the cost of a banana.

Equation 1: 3A + 5B = 75 (Multiply by 4 → 12A + 20B = 300)
Equation 2: 4A + 2B = 86 (Multiply by 3 → 12A + 6B = 258)
Difference: (20B − 6B) = (300 − 258) => 14B = 42
Cost of one banana (B) = 42 ÷ 14 = Rs. 3.
Therefore The correct answer is Rs. 3.
Alternate Method
Given:
Cost of 3 apples and 5 bananas = Rs. 75
Cost of 4 apples and 2 bananas = Rs. 86
Formula Used:
Elimination Method for Simultaneous Linear Equations.
Let the cost of one apple be x and one banana be y.
=> 3x + 5y = 75 --- (Equation i)
=> 4x + 2y = 86 --- (Equation ii)
To eliminate x, multiply Equation (i) by 4 and Equation (ii) by 3:
=> 4 × (3x + 5y) = 4 × 75 => 12x + 20y = 300 --- (Equation iii)
=> 3 × (4x + 2y) = 3 × 86 => 12x + 6y = 258 --- (Equation iv)
Subtracting Equation (iv) from Equation (iii):
=> (12x + 20y) − (12x + 6y) = 300 − 258
=> 14y = 42
=> y = 42 ÷ 14
=> y = 3
Therefore The correct answer is Rs. 3.
Additional Information
Elimination Method
A process of solving a system of equations by adding or subtracting them to remove one variable.
Substitution Method
Solve for one variable in one equation and substitute its value into the other equation.
Cost-Price Consistency
In linear problems, the individual price per unit remains constant regardless of the quantity purchased in different sets.

Q51. Answer: (a) JSI

The logic followed here is:
So, 'JSI' will replace the question mark in the given series.
Hence, the correct answer is Option 1.

Q52. Answer: (b) Immediate left

Given: Six people A, B, C, X, Y and Z are sitting around a circular table facing the centre of the table.
Z is sitting to the immediate left of A.
B is sitting second to the right of Z.
X is an immediate neighbour of both Y and C.
Y is not an immediate neighbour of Z.
So, B is immediately to the left of Y.
Therefore, the correct answer is Option 2.

Q53. Answer: (a) 23

The logic followed here is:
thus, "23" will replace the question mark in the given series.
Hence, the correct option is "Option 1".

Q54. Answer: (c) -63

The logic followed here is:
thus, "-63" will replace the question mark in the given series.

Hence, the correct option is "Option 3".

Q55. Answer: (b) 50 - 20 - 30

The logic followed here is:

Logic: Third number = First number − Second number

92 - 6 - 86

=> 92 − 6 = 86

13 - 8 - 5

=> 13 − 8 = 5

Now, checking the options:

Option 1) 30 - 12 - 24

=> 30 − 12 = 18 (not 24)

Option 2) 50 - 20 - 30

=> 50 − 20 = 30

Option 3) 4 - 1 - 2

=> 4 − 1 = 3 (not 2)

Option 4) 12 - 5 - 6

=> 12 − 5 = 7 (not 6)

Hence, the correct answer is Option 2.

Q56. Answer: (b) POR 86

The logic followed here is:

So, 'POR 86' will replace the question mark in the given series.

Hence, the correct answer is "Option 2"

Q57. Answer: (d) 3

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

Now,

We need even numbers which are preceded by an odd number and followed by an even number.

So, the required pattern is: Odd Number – Even Number – Even Number.

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

Total even numbers satisfying the condition = 3

Hence, the correct answer is "Option 4".

Q58. Answer: (d) Three

Given: A, B, C, D, N, O and P are sitting in a straight line facing north.

Only two people sit to the left of N.

Only three people sit between N and P.

O sits second to the right of N.

Only two people sit between O and D.

C sits at some place to the right of B but at some place to the left of A.

So, total people to the right of C = 3

Hence, the correct answer is "Option 4".

Q59. Answer: (d) None

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

Now,

We need to arrange the digits in ascending order and compare each position with the original arrangement to find how many remain unchanged.

So, the required logic is: Compare original order vs ascending order position-wise.

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

Now, arranging in ascending order: 1 2 3 4 5 7 8 9

Position	Original Digit	Sorted Digit	Status

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1	2	1	Changed
2	4	2	Changed
3	5	3	Changed
4	9	4	Changed
5	7	5	Changed
6	8	7	Changed
7	3	8	Changed
8	1	9	Changed

No digit remains in the same position after sorting.

Therefore, the number of digits whose positions remain unchanged = 0

Hence, the correct answer is Option 4.

Q60. Answer: (b) Neither conclusion (I) nor (II) follows.

Given Statements:

Some balls are hens.

All vans are hens.

The least possible Venn diagram for the given statements is:

Conclusions:

I. Some balls are vans – Does not follow (There is no necessary overlap between balls and vans in any case).

II. All hens are vans – Does not follow (Only vans are fully inside hens, not vice versa; hens may include elements outside vans).

So, neither conclusion I nor II follows.

Hence, the correct answer is Option 2.

Q61. Answer: (d) Only conclusion (I) follows

Given Statements:

All torches are keys.

All keys are locks.

Some locks are batteries.

The least possible Venn diagram for the given statements is:

Conclusions:

I. All torches are locks – Follows (Since all torches are keys and all keys are locks, all torches must be locks).

II. Some batteries are torches – Does not follow (Although some locks are batteries and torches are inside locks, there is no definite overlap between batteries and torches).

So, only conclusion I follows.

Hence, the correct answer is Option 4.

Q62. Answer: (c) JLN−RTV

The logic followed here is:

For, YAC → GIK

Now, QSU → YAC

Now, checking the options:

Option 1) JLN → QTU

Option 2) JKL → RTV

Option 3) JLN → RTV

Option 4) JKL → QSU

Hence, the correct answer is Option 3.

Q63. Answer: (c) Three

Given: (Left) 2 8 1 7 8 7 6 7 5 2 5 3 (Right)

Now,

We need odd digits which are preceded by an even digit and followed by an odd digit.
So, the required pattern is: Even Digit – Odd Digit – Odd Digit.
(Left) 2 8 1 7 8 7 6 7 5 2 5 3 (Right)
Total odd digits satisfying the condition = 3
Hence, the correct answer is "Option 3".

Q64. Answer: (d) 59

The logic followed here is:
Logic: Add the reverse positional values of all the letters (A = 26, B = 25, ..., Z = 1) and then add 3 to the total.
For, QOEX → 50
=> Q = 10, O = 12, E = 22, X = 3
=> 10 + 12 + 22 + 3 = 47
=> 47 + 3 = 50
For, WPIU → 42
=> W = 4, P = 11, I = 18, U = 6
=> 4 + 11 + 18 + 6 = 39
=> 39 + 3 = 42
Now, applying the same pattern to SANR:
=> S = 8, A = 26, N = 13, R = 9
=> 8 + 26 + 13 + 9 = 56
=> 56 + 3 = 59
Hence, the correct answer is Option 4.

Q65. Answer: (b) C

Given: A, B, C, D, E and F are sitting in a row facing north.
Only two people sit to the left of F.
Only one person sits between D and E.
F sits to the immediate left of D.
A sits to the immediate right of C.
B sits third to the right of A.
Now, C is at the extreme left position.
Hence, the correct answer is Option 2.

Q66. Answer: (b) 4

Given: (Left) 582, 128, 563, 183, 592 (Right)
Now, We need to identify the highest and lowest numbers from the given sequence, then extract the required digits and find their sum.
(Left) 582, 128, 563, 183, 592 (Right)
Now,
Highest number = 592
Lowest number = 128
Third digit of highest number = 2
Second digit of lowest number = 2
Now, Sum = 2 + 2 = 4
Therefore, the resultant is Option 2.

Q67. Answer: (a) 4

Given: Prakash is 3rd from the left. Charan is 11th from the right. Total students = 18.
Charan's position from the left = N – position from right + 1
= 18 – 11 + 1
= 8th from the left
Prakash's position from the left = 3rd
Now, number of people between them = |8 − 3| − 1

= 5 − 1

= 4

Here, there are 4 people standing between Charan and Prakash.

Hence, the correct answer is "Option 1".

Q68. Answer: (a) 38

BODMAS Table:

Given equation: (90 Q 15) P 8 R 7 P 4 S (12 P 3) Q 2 = ?

Now, replacing the symbols as:

Symbol	P	Q	R	S
Replaced by	×	÷	−	•

=> (90 ÷ 15) × 8 − 7 × 4 + (12 × 3) ÷ 2 = ?

=> 6 × 8 − 7 × 4 + 36 ÷ 2 = ?

=> 48 − 28 + 18 = ?

=> 20 + 18 = ?

=> 38

Hence, the correct answer is Option 1.

Q69. Answer: (a) dq

The logic followed here is:

Given:

'ride those horses' → dq fn ta

'horses run wild' → vy dq si

So, horses → dq

Hence, the correct answer is Option 1.

Q70. Answer: (d) Brother's wife

Family Chart:

Decoding the Symbols:

Symbol	•	−	x	&
Meaning	Son	Brother	Wife	Father

Given: K x T − R + Z & V

It means: K is the wife of T, T is the brother of R, R is the son of Z, Z is the father of V.

Here, K is related to V as Brother's wife

Hence, the correct answer is "Option 4".

Q71. Answer: (b) 342

The logic followed here is:

thus, "342" will replace the question mark in the given series.

Hence, the correct option is "Option 2"

Q72. Answer: (b) IDEA - IEAD - DEIA

The logic followed here is:

For, PAST → PSTA → ASPT

Now, QUAD → QADU → UAQD

Now, checking the options:

Option 1) VAIN → VIAN → NIAV

Option 2) IDEA → IEAD → DEIA

Option 3) USER → UERS → SURE

Option 4) TIDE → ITDE → IDET

Hence, the correct answer is Option 2.

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Q73. Answer: (a) QPS

The logic followed here is:

Option 1) QPS

Option 2) HGI

Option 3) YXZ

Option 4) VUW

Here, QPS is odd from the given options because it follows −1, +3 instead of −1, +2.

Hence, the correct answer is "Option 1".

Q74. Answer: (d) South

Given:

Minute hand is pointing North (12 o'clock)

Hour hand is pointing East (3 o'clock)

So, the initial time is 3:00

After 2 hours 30 minutes:

New time = 3:00 + 2:30 = 5:30

At 5:30, the minute hand points at 6

Clock Position	Direction
12	North
3	East
6	South
9	West

Minute hand at 6 → South

Here, the minute hand points towards South.

Hence, the correct answer is Option 4.

Q75. Answer: (a) 14 km to the west

Given:

Mr. Pasto starts from Point A and drives 11 km North.

He turns left → 7 km West.

He turns left → 13 km South.

He turns left → 21 km East.

He takes a final left → 2 km North.

So, To reach Point A again, he must travel 14 km West.

Hence, the correct answer is Option 1.

Q76. Answer: (d) Two

Given: (Left) 426 125 357 489 627 (Right)

Now,

We need to arrange the numbers in ascending order and compare each position with the original sequence to find how many numbers remain unchanged.

(Left) 426 125 357 489 627 (Right)

Now arranging in ascending order: 125 357 426 489 627

Position	Original Number	After Sorting	Status
1	426	125	Changed
2	125	357	Changed
3	357	426	Changed
4	489	489	Unchanged
5	627	627	Unchanged

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Number of unchanged positions = 2

Hence, the correct answer is "Option 4".

Q77. Answer: (c) HK-FI

The logic followed here is:

Option 1) FI – DH

Option 2) DG – BF

Option 3) HK – FI

Option 4) JM – HL

Here, HK – FI is odd from the given options because it follows (−2, −2) instead of (−2, −1).

Hence, the correct answer is "Option 3".

Q78. Answer: (a) D

Given: Six boxes A, B, C, D, P, Q and R are arranged from top to bottom (Position 7 to Position 1).

Q is at the topmost position.

There are 3 boxes between Q and D, so D is at position 3.

B is immediately above D, so B is at position 4.

C is placed such that only 1 box is between C and B, so C is at position 6.

There are 4 boxes between C and R, so R is at position 1.

A is above P, so A is at position 5 and P is at position 2.

Position	Box
7 (Top)	Q
6	C
5	A
4	B
3	D
2	P
1 (Bottom)	R

Here, the box kept second below A is D.

Hence, the correct answer is Option 1.

Q79. Answer: (a) 8

Given: (Left) 7435681 (Right)

Now,

We need to modify each digit based on the given rule and then find the required positional sum.

So, the required logic is:

Odd digit → Digit + 1

Even digit → Digit − 2

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

Original Digit	Parity	Operation	New Digit
7	Odd	+1	8
4	Even	−2	2
3	Odd	+1	4
5	Odd	+1	6
6	Even	−2	4
8	Even	−2	6
1	Odd	+1	2

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New number formed: 8 2 4 6 4 6 2

Third digit from the left = 4

Third digit from the right = 4

Now, Sum = 4 + 4 = 8

Hence, the correct answer is "Option 1".

Q80. Answer: (d) TUX−ABE

The logic followed here is:

For, STW → ZAD

Now, PQT → WXA

Now, checking the options:

Option 1) TTV → ZAD

Option 2) TUX → ZBD

Option 3) TTV → ABE

Option 4) TUX → ABE

Hence, the correct answer is Option 4.

Q81. Answer: (a) It is the heaviest communication satellite launched by India.

The correct answer is It is the heaviest communication satellite launched by India..

Key Points

• The CMS-03 is a state-of-the-art communication satellite designed and developed by the Indian Space Research Organisation (ISRO) to provide advanced telecommunication services.

• Scheduled for launch in November 2025, the CMS-03 mission is significant because it is the heaviest communication satellite to be launched by India’s own launch vehicle, the LVM3 (Launch Vehicle Mark 3). Hence, statement 1 is correct.

• This satellite is part of the CMS series, which is the successor to the long-running GSAT series. It is equipped with high-power Ka-band and Ku-band transponders to enhance data connectivity and VSAT services.

• The mission aims to achieve a lift-off mass exceeding previous indigenous records, pushing the payload capabilities of the LVM3 rocket to its maximum potential for Geosynchronous Transfer Orbit (GTO) missions.

• The CMS-03 is intended to provide expanded coverage for the Indian mainland as well as the Andaman & Nicobar and Lakshadweep islands, supporting the Digital India vision for high-speed internet.

Additional Information

• Private Space Payloads: The first private payload launched from India was the Vikram-S sub-orbital rocket, developed by the startup Skyroot Aerospace under the Prarambh mission on November 18, 2022. Hence, statement 2 is incorrect.

• Navigation Satellites: India's first dedicated navigation satellite mission was the IRNSS-1A, which was launched on July 1, 2013, forming the basis of the NavIC (Navigation with Indian Constellation) system. Hence, statement 3 is incorrect.

• Mars Missions: India’s first Mars mission, the Mars Orbiter Mission (MOM) or Mangalyaan, was launched on November 5, 2013, using the PSLV-C25 rocket. It made ISRO the fourth space agency in the world to reach Mars. Hence, statement 4 is incorrect.

• LVM3 Launch Vehicle: Formerly known as GSLV Mk III, the LVM3 is a three-stage heavy-lift launch vehicle. It consists of two S200 solid rocket boosters, an L110 liquid core stage, and a C25 cryogenic upper stage, capable of carrying payloads up to 4,000 kg to GTO.

Important Points

• Frequency Bands: The use of Ka-band in CMS-03 allows for higher bandwidth and smaller ground station antennas compared to traditional C-band or Ku-band satellites.

• Self-Reliance: By launching such heavy satellites indigenously, India reduces its dependence on foreign agencies like the European Space Agency (ESA) or SpaceX for launching high-mass communication payloads.

• Operational Life: Like most ISRO communication satellites in Geostationary Orbit, the CMS-03 is expected to have a mission life of over 10 to 12 years, providing continuous service for broadcasting and secure government communications.

Q82. Answer: (c) National Payments Corporation of India

The correct answer is National Payments Corporation of India.

Key Points

• The National Payments Corporation of India (NPCI) introduced NACH 3.0 in July 2025 as a major upgrade to the existing National Automated Clearing House system to enhance the efficiency of bulk transactions.

• NACH 3.0 is specifically designed to provide faster and more secure bank transactions by leveraging advanced API-based mandate management and real-time data validation protocols.

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• This version aims to transition the traditional batch processing model towards a more dynamic framework, significantly reducing the turnaround time (TAT) for recurring payment mandates such as SIPs, EMI, and insurance premiums.

• The implementation of NACH 3.0 allows for real-time status updates for both banks and customers, ensuring higher transparency and a substantial reduction in transaction failures due to administrative errors.

• By integrating with modern digital infrastructure, the system supports NPCI's goal of making India a leader in retail payment systems through high-volume, low-cost processing capabilities.

Additional Information

• National Payments Corporation of India (NPCI):

• It was incorporated in December 2008 as an umbrella organization for operating retail payments and settlement systems in India.

• NPCI is an initiative of the Reserve Bank of India (RBI) and the Indian Banks' Association (IBA) under the Payment and Settlement Systems Act, 2007.

• The organization is headquartered in Mumbai, Maharashtra, and operates as a "Not for Profit" company under Section 8 of the Companies Act 2013.

• Notable products developed by NPCI include UPI (Unified Payments Interface), RuPay, IMPS, and Bharat BillPay.

• National Automated Clearing House (NACH):

• NACH is a centralized system launched to consolidate multiple ECS (Electronic Clearing Service) systems across the country, providing a single platform for all interbank clearing.

• It facilitates Direct Credit for the distribution of subsidies, dividends, salaries, and pensions, as well as Direct Debit for utility bills and loan repayments.

• The transition from earlier versions to NACH 3.0 reflects the evolution of Indian banking towards cloud-native technologies and cyber-resilient payment architectures.

• It helps the Government of India and various departments in the Direct Benefit Transfer (DBT) scheme by ensuring funds reach the intended beneficiaries' bank accounts securely and promptly.

Important Points

• One of the primary features of NACH 3.0 is the enhancement of E-mandate services, which allows customers to authorize recurring payments using Aadhaar, Virtual ID, or Net Banking without physical paperwork.

• The upgrade in July 2025 introduced 24/7 mandate processing capabilities, moving away from the limitations of traditional banking hours for setting up automated payment instructions.

• The Reserve Bank of India (RBI) provides the regulatory oversight for these upgrades to maintain financial stability and protect consumer interests in the rapidly growing FinTech sector.

• With NACH 3.0, the National Payments Corporation of India has standardized the security protocols across all participating Member Banks, ensuring that even small cooperative banks can offer high-grade secure transactions to their users.

Q83. Answer: (a) Indian Council of Agricultural Research

The correct answer is Indian Council of Agricultural Research.

Key Points

• The Indian Institute of Soil Science (IISS) is a premier scientific institute for soil research, located in Bhopal, Madhya Pradesh.

• It was established in 1988 under the aegis of the Indian Council of Agricultural Research (ICAR) to enhance the scientific basis of soil management.

• The World Soil Day celebrations, held on 5 December annually, were organized by the institute in December 2025 to emphasize the importance of soil health and sustainable resource management.

• The Indian Council of Agricultural Research (ICAR) is the apex body responsible for coordinating, guiding, and managing research and education in agriculture, including horticulture, fisheries, and animal sciences in India.

• The IISS plays a critical role in the ICAR network by focusing on nutrient management, soil fertility, and environmental impact assessments to ensure food security.

Additional Information

• Indian Council of Agricultural Research (ICAR):

• It was established on 16 July 1929 as a registered society under the Societies Registration Act, 1860, following the report of the Royal Commission on Agriculture.

• Headquartered in New Delhi, it is one of the largest national agricultural systems in the world, reporting to the Department of Agricultural Research and Education (DARE) under the Ministry of Agriculture and Farmers Welfare.

• The Union Minister of Agriculture serves as the President of the ICAR.

• World Soil Day:

• The International Union of Soil Sciences (IUSS) recommended an international day to celebrate soil in 2002.

• The UN General Assembly officially designated 5 December 2014 as the first official World Soil Day to honor the birthday of H.M.

King Bhumibol Adulyadej of Thailand, who was a key proponent of this initiative.

• The primary objective is to focus attention on the importance of healthy soil and advocating for the sustainable management of soil resources.

• Indian Institute of Soil Science (IISS):

• The institute has developed various technologies like the Mridaparikshak (a digital soil test mini-lab) to assist farmers.

• It contributes significantly to the Soil Health Card Scheme, which was launched by the Government of India in February 2015 to inform farmers about the nutrient status of their holdings.

Important Points

• Central Soil Salinity Research Institute (CSSRI): Located in Karnal, Haryana, this institute focuses specifically on the reclamation and management of salt-affected soils.

• Council of Scientific and Industrial Research (CSIR): Established in 1942, it is India's largest research and development organization, but it focuses on industrial and general science rather than being the apex body for agricultural research.

• National Horticulture Board (NHB): Established in 1984 by the Government of India, it focuses on the development of the high-tech horticulture industry and post-harvest management.

• Soil Health and SDGs: Sustainable soil management is vital for achieving the United Nations Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger) and Goal 15 (Life on Land).

Q84. Answer: (d) It declined to entertain the fresh plea.

The correct answer is It declined to entertain the fresh plea.

Key Points

• On April 28, 2025, the Supreme Court of India took a significant stance regarding the legal challenges surrounding the Waqf (Amendment) Act by declining to entertain a fresh petition filed against the legislation.

• The bench, while presiding over the matter, observed that multiple petitions and deliberations regarding the Waqf (Amendment) Act were already in progress across various legal and legislative forums.

• The court noted that the Joint Parliamentary Committee (JPC), which was constituted to examine the nuances of the Amendment Act, was still in the process of finalizing its reports and recommendations.

• The Supreme Court emphasized that judicial intervention at this specific juncture might be premature given that the Parliamentary process for review and refinement of the act was not yet fully concluded. Hence, the statement that it declined to entertain the fresh plea is correct.

• The petitioners had sought a stay or a declaration of the act as unconstitutional, citing concerns over the autonomy of religious bodies, but the court maintained that the current legal framework allowed for the legislative review to take precedence.

Additional Information

• Waqf (Amendment) Act:

• The Waqf (Amendment) Act was introduced to bring about sweeping reforms in the Waqf Act of 1995, primarily focusing on the transparency, accountability, and digitization of Waqf properties across India.

• One of the most debated features of the act includes the restructuring of the State Waqf Boards and the Central Waqf Council to include women and non-Muslim members in administrative roles.

• The act aims to streamline the process of property registration and prevent the encroachment of Waqf land, which is estimated to be over 6 lakh acres across the country.

• Joint Parliamentary Committee (JPC):

• The JPC is an ad-hoc committee of Parliament formed to examine specific bills or scandals; in this case, it was tasked with hearing stakeholders from different Muslim organizations, legal experts, and state governments.

• The committee's role is to ensure that the Amendment Act aligns with the Constitution of India, specifically Article 25 and Article 26, which guarantee the right to manage religious affairs.

Important Points

• Judicial Review and Policy: The Supreme Court often practices judicial restraint when a legislative matter is under active consideration by a specialized Parliamentary Committee to avoid conflicting outcomes.

• Waqf Board Authority: Under the proposed amendments, the power of the Waqf Board to declare a property as "Waqf by User" has been a point of major legal contention, leading to numerous filings in High Courts and the Apex Court.

• Date of Significance: The decision on April 28, 2025, serves as a precedent that the judiciary will likely wait for the final legislative version of the act before passing a comprehensive judgment on its constitutional validity.

Q85. Answer: (d) 102nd

The correct answer is 102nd.

Key Points

In the 2025 Global Hunger Index (GHI), India has been ranked 102nd among the 123 countries that were assessed. This ranking

reflects the complex challenges India faces in addressing food security and nutritional outcomes across its large population.

The Global Hunger Index is a tool used to comprehensively measure and track hunger at global, regional, and national levels, published annually to create awareness and trigger action.

The report is a joint effort between Concern Worldwide, an Irish humanitarian organization, and Welthungerhilfe, a German aid agency.

With a rank of 102nd, India’s level of hunger is categorized as Serious. The index utilizes a 100-point scale where lower scores indicate less hunger and higher scores indicate a more severe situation.

The 2025 assessment highlights the need for continued policy intervention in maternal and child health to improve India's standing in global nutritional benchmarks.

Additional Information

Four Key Indicators of GHI:

Undernourishment: The share of the entire population with insufficient caloric intake, representing the availability of food.

Child Stunting: The share of children under the age of five who have low height for their age, reflecting chronic undernutrition.

Child Wasting: The share of children under the age of five who have low weight for their height, reflecting acute undernutrition.

Child Mortality: The mortality rate of children under the age of five, partially reflecting the fatal mix of inadequate nutrition and unhealthy environments.

Scoring and Severity:

A score of < 9.9 is considered Low, 10.0-19.9 is Moderate, 20.0-34.9 is Serious, 35.0-49.9 is Alarming, and 50.0 or above is Extremely Alarming.

The GHI scores are calculated using data from various international agencies, including the FAO, WHO, UNICEF, and the World Bank.

Global Context and SDG 2:

The index is a vital monitor for Sustainable Development Goal 2 (SDG 2), which aims to achieve Zero Hunger by the year 2030.

The 2025 report emphasizes that global progress against hunger has largely stagnated due to factors like climate change, economic shocks, and geopolitical conflicts.

Important Points

Government Initiatives in India: To combat hunger, the Government of India implements the National Food Security Act (NFSA), 2013, which legally entitles up to 75% of the rural population and 50% of the urban population to receive subsidized food grains.

Poshan Abhiyaan (National Nutrition Mission): Launched in 2018, this flagship program aims to improve nutritional outcomes for children, pregnant women, and lactating mothers by reducing stunting and wasting.

Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY): A large-scale food security scheme that provides free food grains to 80 crore beneficiaries to ensure no one goes hungry during periods of economic stress.

Integrated Child Development Services (ICDS): This scheme provides a package of six services including supplementary nutrition and pre-school non-formal education to children in the age group of 0-6 years.

Q86. Answer: (a) 16th Asiatic Lion Population Estimation

The correct answer is 16th Asiatic Lion Population Estimation.

Key Points

• Prime Minister Narendra Modi announced that the 16th Asiatic Lion Population Estimation will be conducted in the year 2025 to assess the health and growth of the lion population in India.

• This estimation is a vital conservation exercise conducted every five years to monitor the world’s only wild population of Asiatic Lions (Panthera leo leo).

• The survey primarily covers the Gir National Park and Wildlife Sanctuary along with the surrounding Greater Gir region in the Saurashtra landscape of Gujarat.

• The 15th Asiatic Lion Census was originally due in 2020 but was replaced by a restricted exercise called "Poonam Avlokan" due to the COVID-19 pandemic, which recorded 674 lions.

• The 2025 survey will utilize advanced technology, including GPS tracking, camera traps, and individual identification markers, to ensure a more scientific and accurate headcount.

Additional Information

• Project Lion:

• Launched on August 15, 2020, Project Lion aims at the holistic conservation of the Asiatic Lion and its landscape.

• It focuses on habitat development, engaging modern technologies in lion management, and addressing human-wildlife conflict.

• The project also envisages the relocation of some lions to different sites within Gujarat or other states like Madhya Pradesh (Kuno) to prevent extinction from disease.

• Asiatic Lion Characteristics:

• The Asiatic Lion is slightly smaller than the African Lion and possesses a distinctive longitudinal fold of skin running along its belly.

• It is listed as Endangered on the IUCN Red List and is protected under Schedule I of the Wildlife (Protection) Act, 1972.

• Population Trends:

• Between 2015 and 2020, the population showed a significant growth of 29%, increasing from 523 to 674 individuals.

• The distribution area of the lions has expanded from 22,000 sq. km in 2015 to about 30,000 sq. km in 2020, covering districts like Junagadh, Gir Somnath, Amreli, and Bhavnagar.

• Poonam Avlokan:

• This was an alternative estimation method conducted on full moon nights where forest guards observed lions from their respective beats.

• While not as exhaustive as a full census, it provides critical interim data on demographics and geographical distribution.

Important Points

• The Gujarat Forest Department is the nodal agency responsible for organizing and executing these wildlife surveys.

• The Lion's status as a flagship species makes the 2025 survey a priority for international biodiversity conservationists.

• Efforts are being made to establish Barda Wildlife Sanctuary as a second home for lions to reduce the density in Gir and mitigate risks of epidemics.

Q87. Answer: (b) Uttar Pradesh

The correct answer is Uttar Pradesh.

Key Points

• The Uttar Pradesh government announced the strengthening and revitalized implementation of the SHe-Box portal in May 2025 to ensure a safer working environment for women across the state.

• The initiative is designed to provide a single-window access to every woman, whether she is working in the organized or unorganized sector, to register complaints related to sexual harassment at the workplace.

• By strengthening this portal, the Government of Uttar Pradesh aims to monitor the progress of complaints more effectively, ensuring that they are disposed of in a time-bound manner as per legal requirements. Hence, the statement regarding Uttar Pradesh is correct.

• This move involves the integration of the digital platform with District Magistrates and Internal Committees (IC) of various departments to streamline the redressal process.

• The state's focus in 2025 is to increase awareness among women employees about their rights under the PoSH Act and the availability of digital tools for grievance redressal.

Additional Information

• SHe-Box Portal:

• The Sexual Harassment electronic Box (SHe-Box) is a centralized portal developed by the Ministry of Women and Child Development (MWCD), Government of India.

• It was originally launched to facilitate the effective implementation of the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.

• The portal allows both government and private employees to lodge complaints which are then directly forwarded to the concerned Internal Committee (IC) or Local Committee (LC).

• The PoSH Act, 2013:

• This Act defines sexual harassment at the workplace and creates a mechanism for redressal of complaints.

• It mandates every employer with 10 or more employees to constitute an Internal Committee (IC).

• For the unorganized sector or establishments with fewer than 10 employees, the Local Committees (LC) are constituted at the district level.

Important Points

• Mission Shakti in Uttar Pradesh:

• The strengthening of the SHe-Box is aligned with the state's flagship Mission Shakti campaign, which focuses on the safety, dignity, and self-reliance of women.

• The Uttar Pradesh administration has designated Nodal Officers in every district to track the status of complaints registered through the portal.

• In May 2025, the state emphasized that any delay in the inquiry process by the Internal Committees would attract strict administrative action.

• The Ministry of Women and Child Development continues to provide the technical framework, while states like Uttar Pradesh lead the ground-level enforcement and monitoring.

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Q88. Answer: (a) Automatic removal

The correct answer is Automatic removal.

Key Points

• The Constitution (130th Amendment) Bill 2025 introduces a significant legal provision regarding the holding of high constitutional offices by individuals facing criminal proceedings or arrest.

• Under this proposed legislation, if a Prime Minister, Chief Minister, or any Minister at the Union or State level is arrested and remains in custody without being granted bail within 30 days, they face Automatic removal from their position. Hence, the correct answer is Automatic removal.

• The primary objective of this amendment is to ensure that individuals occupying critical executive roles are not incapacitated by legal detention, which could lead to a constitutional vacuum or administrative paralysis.

• This 30-day threshold is a definitive timeline established to balance the principle of "innocent until proven guilty" with the necessity of uninterrupted governance and the sanctity of high office.

• The bill aims to institutionalize the moral and ethical requirement that a person in judicial or police custody for an extended period cannot effectively discharge their duties toward the Parliament or State Legislature.

Additional Information

• Article 75 and Article 164:

• Currently, Article 75 deals with the appointment and tenure of the Prime Minister and Union Ministers, stating they hold office during the pleasure of the President.

• Similarly, Article 164 pertains to the Chief Minister and State Ministers holding office during the pleasure of the Governor. The 130th Amendment Bill seeks to insert specific clauses to these articles to automate removal upon the failure to secure bail.

• The Representation of the People Act, 1951:

• Under the current Section 8 of the RPA, 1951, disqualification usually triggers only upon conviction with a sentence of two years or more.

• This bill goes a step further by addressing the status of ministers during the investigation or trial stage, specifically focusing on the period of custody rather than waiting for a final conviction.

• Judicial Precedents:

• Historically, the Supreme Court of India in the Lily Thomas vs. Union of India (2013) case ruled that any Member of Parliament or State Legislature convicted of a crime with a minimum two-year sentence would be disqualified immediately.

• The 2025 Bill expands the scope of accountability by focusing on the executive's ability to function while under arrest, addressing gaps left by previous judicial pronouncements.

Important Points

• Administrative Continuity: The bill emphasizes that the Prime Minister or Chief Minister is the head of the Council of Ministers; their absence for more than 30 days due to legal restraint is viewed as a failure of the constitutional machinery.

• Impact of the Amendment: Once the 30-day limit expires without bail, the official is deemed to have vacated the office by operation of law, necessitating the President or Governor to appoint a successor or initiate a new selection process within the majority party.

• Scope of the Bill: It applies strictly to those holding Ministerial portfolios and does not necessarily strip them of their membership of the house (MP/MLA) immediately, unless other provisions of the RPA or Tenth Schedule are triggered, but it terminates their Executive authority.

Q89. Answer: (d) Venice, Italy

The correct answer is Venice, Italy.

Key Points

• The high-profile wedding of Jeff Bezos and Lauren Sánchez took place in the historic and romantic city of Venice, Italy, in June 2025.

• The event was characterized as a lavish, multi-day celebration that attracted a wide array of global elites, celebrities, and business leaders to the iconic "Floating City."

• The choice of Venice follows the couple's long-standing affinity for European destinations, often seen during their travels aboard Bezos's superyacht.

• This marriage marks a significant personal milestone for Jeff Bezos, the executive chairman of Amazon, following his high-profile engagement to Sánchez in May 2023.

• The wedding festivities reportedly utilized several historic venues across the Venetian Lagoon, highlighting the city's status as a premier location for ultra-luxury destination weddings.

Additional Information

• Jeff Bezos: He is the founder and former CEO of Amazon.com, one of the world's largest technology and e-commerce companies. He also founded the aerospace manufacturer and sub-orbital spaceflight services company Blue Origin in 2000.

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• Lauren Sánchez: An American media personality, former news anchor, and entertainment reporter. She is also a licensed pilot and the founder of Black Ops Aviation, an aerial filming and production company.

• Venice, Italy: A unique city located in northeastern Italy, built on a cluster of 118 small islands separated by canals and linked by over 400 bridges. It is a UNESCO World Heritage Site known for its artistic heritage and Gothic architecture.

• Koru: Much of the couple's time leading up to the wedding was spent on Bezos's massive sailing yacht named Koru, which is approximately 127 meters (417 feet) long and is considered one of the largest sailing yachts in the world.

• Engagement: The couple officially went public with their relationship in 2019 and became engaged in May 2023 while attending the Cannes Film Festival in France.

• Economic Impact: Large-scale celebrity weddings in cities like Venice provide a significant boost to the local luxury tourism sector, benefiting high-end hotels, private water taxi services, and local artisans.

Q90. Answer: (a) Ujjwala

The correct answer is Ujjwala.

Key Points

• Ujjwala is the official mascot for the Khelo India Para Games. It is a sparrow, which is also the State Bird of Delhi.

• The mascot was first unveiled by the Union Minister of Youth Affairs and Sports, Shri Anurag Singh Thakur, in November 2023 for the inaugural edition of the games.

• The choice of a sparrow as the mascot symbolizes pride, determination, and resilience. It reflects the spirit of para-athletes who overcome immense challenges to achieve excellence.

• Ujjwala represents the idea that even the smallest being can be strong and resilient, echoing the message of empowerment and empathy towards the divyang community.

• The mascot serves as a symbol of inclusivity in Indian sports, bringing attention to the Khelo India initiative's expansion into para-sports. Hence, the correct answer is Ujjwala.

Additional Information

• Khelo India Para Games (KIPG):

• The first-ever edition of the Khelo India Para Games was held in New Delhi from December 10 to December 17, 2023.

• The games featured 7 sports disciplines: Para Athletics, Para Shooting, Para Archery, Para Football, Para Badminton, Para Table Tennis, and Para Weightlifting.

• Over 1,450 athletes from 32 states and Union Territories participated in the inaugural event, marking a historic step for para-sports in India.

• Other Official Mascots:

• Veer: The mascot for the Khelo India Youth Games 2023 (held in Tamil Nadu) was Veer Mangai, named after the legendary queen Velu Nachiyar.

• Shakti: This is the official mascot for the Khelo India Women's League, symbolizing women empowerment and strength.

• Jitu: The mascot for the Khelo India University Games 2023 (held in Uttar Pradesh) was Jitu, representing the Barasingha (Swamp Deer), the state animal of Uttar Pradesh.

• Khelo India Programme:

• Launched in 2018, the Khelo India scheme aims to revive the sporting culture in India at the grass-root level by building a strong framework for all sports played in the country.

• It is an initiative of the Ministry of Youth Affairs and Sports, Government of India.

• The program includes various verticals like Khelo India Youth Games (KIYG), Khelo India University Games (KIUG), Khelo India Winter Games, and the newly added Para Games.

Important Points

• Symbolism of Ujjwala: The sparrow is known for its agility and ubiquity. By choosing it as the mascot, the organizers aimed to connect the para-games with the common citizens and highlight the mettle of the participating athletes.

• Administrative Significance: The introduction of the Para Games under the Khelo India banner ensures that divyang athletes receive financial support, training facilities, and a national platform comparable to non-para athletes.

• Host City: New Delhi has been a central hub for these games, utilizing world-class venues like the Indira Gandhi Stadium and the Jawaharlal Nehru Stadium.

Q91. Answer: (c) 26

The correct answer is 26.

Key Points

• In August 2025, the Government of Tripura launched a comprehensive tech-driven disaster preparedness initiative aimed at mitigating the impact of natural calamities through advanced monitoring.

• As part of this initiative, the state has proposed the installation of 26 automated weather stations (AWS) and automated rain

gauges to facilitate real-time data collection and analysis.

• These high-tech installations are designed to provide precise meteorological data, which is critical for the state's Early Warning System (EWS), especially during the monsoon season.

• The primary goal of deploying these 26 units is to enhance the accuracy of weather forecasts at a micro-level, allowing disaster management teams to respond more effectively to threats like flash floods, landslides, and cyclonic storms.

• The initiative integrates Information and Communication Technology (ICT) with traditional disaster management protocols to ensure that information reaches the last mile in a timely manner.

Additional Information

• Geographical Vulnerability of Tripura:

• Tripura is situated in the northeastern part of India and is highly susceptible to hydro-meteorological disasters due to its hilly terrain and high annual rainfall.

• The state also falls under Seismic Zone V, making it one of the most earthquake-prone regions in the country.

• Function of Automated Weather Stations:

• An Automated Weather Station (AWS) measures various parameters such as temperature, humidity, wind speed, wind direction, and solar radiation without manual intervention.

• The data is typically transmitted via GPRS or Satellite communication to a central server at the State Disaster Management Authority (SDMA).

• Impact on Agriculture:

• The installation of these 26 stations will significantly benefit the farming community by providing localized weather alerts, helping them protect crops from sudden heavy rainfall or hailstorms.

• Administrative Coverage:

• The project ensures coverage across all 8 districts of Tripura, including West Tripura, South Tripura, Dhalai, and North Tripura, creating a robust network of environmental sensors.

Important Points

• Modernization of Disaster Response: The August 2025 project marks a significant shift from reactive to proactive disaster management, utilizing predictive modeling based on the data from the 26 new stations.

• Collaboration: This initiative is often carried out in coordination with the India Meteorological Department (IMD) and the National Disaster Management Authority (NDMA) to align with national standards of safety and data accuracy.

• Number of Units: The specific count of 26 was determined based on a gap analysis of the existing meteorological infrastructure in the state to ensure no region remains unmonitored.

• Digital Tripura: This move is a subset of the broader "Digital Tripura" vision, which seeks to use technology for governance and public safety.

Q92. Answer: (a) Three

The correct answer is Three.

Key Points

• The Union Cabinet, chaired by Prime Minister Narendra Modi, approved the 'PM - One Nation One Subscription' (PM-ONOS) initiative in October 2024.

• A total financial outlay of Rs. 6,000 crore has been allocated for this central sector scheme to provide nationwide access to high-quality scholarly journals.

• The allocated amount of Rs. 6,000 crore is intended to cover the costs for a period of three years, specifically from the financial years 2025-26, 2026-27, and 2027-28. Hence, the correct answer is Three.

• The initiative aims to provide access to nearly 30 key international publishers and over 13,000 high-impact journals through a centralized subscription model.

• The program is coordinated by the Ministry of Education and the Anusandhan National Research Foundation (ANRF) to democratize access to research and development across the country.

Additional Information

• Scope and Coverage:

• The scheme will benefit more than 6,300 institutions, including Central Universities, IITs, NITs, IISERs, and state-funded universities and colleges.

• It is estimated that about 1.8 crore students, faculty members, and researchers will gain access to these digital resources without individual institutional costs.

• Implementing Agency:

• The Information and Library Network (INFLIBNET) Centre, an Inter-University Centre of the University Grants Commission (UGC), is the nodal agency for implementing the PM-ONOS portal.

• The INFLIBNET portal will serve as the single point of access for all subscribed journals and databases for the authorized institutions.

• Strategic Importance:

• This initiative aligns with the National Education Policy (NEP) 2020, which emphasizes making high-quality research and education accessible to all sections of society.

• By negotiating at a national level, the Government of India can leverage better pricing (economies of scale) compared to individual institutions negotiating separately with international publishers.

Important Points

• Focus on STEM and Beyond: While a significant portion of the journals covers Science, Technology, Engineering, and Medicine (STEM), the subscription also includes crucial databases for Social Sciences and Humanities.

• Funding Breakdown: The total budget of Rs. 6,000 crore is split into Rs. 1,800 crore for the first year (2025-26), Rs. 2,000 crore for the second (2026-27), and Rs. 2,200 crore for the third year (2027-28).

• Digital India Connection: The scheme is a significant step toward the Digital India vision, ensuring that researchers in remote areas or tier-2 and tier-3 cities have the same access to knowledge as those in premier institutes.

• ANRF Role: The Anusandhan National Research Foundation (ANRF) acts as the apex body to provide strategic direction and ensure that the research resources support India's goal of becoming a global leader in innovation.

Q93. Answer: (b) V Srinivas

The correct answer is V Srinivas.

Key Points

• V Srinivas, a distinguished 1989-batch IAS officer of the Rajasthan cadre, was elected as the President of the International Institute of Administrative Sciences (IIAS) for the 2025–2028 term.

• The election was held during the IIAS General Assembly and Statutory Meeting in Mombasa, Kenya, in June 2024/2025, where he received overwhelming support from member nations.

• He currently serves as the Secretary of the Department of Administrative Reforms and Public Grievances (DARPG) and the Department of Pension and Pensioners' Welfare (DoPPW) under the Ministry of Personnel, Public Grievances and Pensions, Government of India.

• This election marks a significant diplomatic and administrative achievement for India, as an Indian official is heading this prestigious global body after a long hiatus of several decades.

• During his presidency, he is expected to lead the global agenda on digital governance, administrative reforms, and the modernization of public services across IIAS member states.

Additional Information

• International Institute of Administrative Sciences (IIAS):

• Established in 1930, the IIAS is a global federation headquartered in Brussels, Belgium.

• It is dedicated to the study and improvement of public administration and administrative sciences worldwide, providing a platform for civil servants and academics.

• The Government of India has been a member of the IIAS since 1954, represented through the DARPG.

• Contributions of V Srinivas:

• He has been a pivotal figure in implementing the CPGRAMS (Centralised Public Grievance Redress and Monitoring System), which has significantly enhanced the efficiency of grievance redressal in India.

• He is also known for his literary contributions, having authored books such as 'India's Relations with the International Monetary Fund' and 'Digitalizing India'.

• He played a key role in the National e-Governance Service Delivery Assessment (NeSDA) and the Special Campaign 2.0/3.0 for cleaning government offices and disposing of pendency.

• Other Personalities:

• GC Murmu: He is the current Comptroller and Auditor General (CAG) of India and was the first Lieutenant Governor of the Union Territory of Jammu and Kashmir.

• KM Chandrasekhar: A retired 1970-batch IAS officer who served as the Cabinet Secretary of India from 2007 to 2011.

• Public Administration in India: India has been increasingly recognized on international platforms like IIAS for its Digital India mission and Minimum Government, Maximum Governance philosophy.

Q94. Answer: (a) Prem Watsa and Kamesh Goyal

The correct answer is Prem Watsa and Kamesh Goyal.

Key Points

• Valueattics Reinsurance has made history by becoming the first private domestic reinsurer in India to receive final approval from the Insurance Regulatory and Development Authority of India (IRDAI).

• The company received its R3 license, which is the final stage of the registration process, in March 2025, allowing it to officially commence reinsurance operations within the country.

• The venture is promoted by two prominent figures in the global and Indian insurance sectors: Prem Watsa, the Chairman and CEO of Fairfax Financial Holdings, and Kamesh Goyal, the Founder and Chairman of Digit Insurance.

• This development marks a significant shift in the Indian insurance landscape, which was traditionally dominated by the state-owned General Insurance Corporation of India (GIC Re) and branches of Foreign Reinsurers (FRBs).

• The entry of Valueattics Reinsurance is expected to increase domestic capacity for risk-taking and foster competition in a market that has seen limited domestic private participation for decades.

Additional Information

• Concept of Reinsurance: Reinsurance is essentially "insurance for insurance companies." It is a practice where insurers transfer portions of their risk portfolios to other parties to reduce the likelihood of paying a large obligation resulting from an insurance claim.

• Role of IRDAI: The Insurance Regulatory and Development Authority of India is the statutory body formed under the IRDAI Act, 1999. It regulates and promotes the insurance and re-insurance industries in India to protect the interests of policyholders.

• The Licensing Process: To start a reinsurance business in India, an entity must go through three stages of IRDAI approval: R1 (requisition for registration), R2 (detailed application analysis), and R3 (grant of certificate of registration).

• Historical Context: For a long time, GIC Re was the sole domestic player. In 2016, the IRDAI opened the doors for Foreign Reinsurance Branches (FRBs), allowing global giants like Swiss Re, Munich Re, and Lloyd's of London to set up shop in India.

• Significance of Promoters: Prem Watsa is often referred to as the "Canadian Warren Buffett" and has significant investments in India through Fairfax. Kamesh Goyal is a veteran in the industry who successfully launched Go Digit General Insurance, one of India's leading insurtech unicorns.

Important Points

• Market Impact: The presence of a domestic private reinsurer like Valueattics helps in capital retention within the Indian economy, as fewer premiums need to be sent abroad to global reinsurance hubs.

• Sector Growth: The Indian reinsurance market is projected to grow significantly due to rising insurance penetration, government-backed crop insurance schemes, and increasing awareness of health and life insurance post-pandemic.

• Digital Integration: Given Kamesh Goyal's background with Digit Insurance, it is anticipated that Valueattics Reinsurance will leverage advanced technology and data analytics to streamline underwriting and claims management.

• Regulatory Reform: The approval reflects IRDAI's ongoing efforts under its "Insurance for All by 2047" mission, aimed at easing capital requirements and attracting more private investment into the sector.

Q95. Answer: (d) 10.5 and 9.5

The correct answer is 10.5 and 9.5.

Key Points

• Suruchi Singh secured the Gold Medal in the Women's 10m Air Pistol event at the 2025 ISSF World Cup held in Munich, Germany.

• In a high-pressure final, she clinched the top spot by shooting scores of 10.5 and 9.5 in her final two shots of the competition.

• These final shots allowed her to edge out her closest competitor, Camille Jedrzejewski of France, who took the Silver Medal.

• The victory was a significant milestone for Indian shooting in the 2025 season, reinforcing the country's dominance in the 10m Air Pistol discipline.

• Suruchi Singh showed remarkable composure throughout the 24-shot final, maintaining a lead that was cemented by her precision in the concluding round.

Additional Information

• ISSF (International Shooting Sport Federation):

• It is the governing body for Olympic shooting events and several non-Olympic shooting sports.

• The federation is headquartered in Munich, Germany, making the Munich World Cup one of the most prestigious events on the shooting calendar.

• 10m Air Pistol Event:

• This is an Olympic shooting discipline where athletes fire at a target 10 meters away using a 4.5 mm (0.177 in) caliber air pistol.

• The final round consists of series of shots where shooters are eliminated one by one until the final two remain to compete for gold and silver.

• Venue - Munich:

• The Munich Olympic Shooting Range is historic, having hosted the 1972 Summer Olympics. It is known for its world-class facilities and challenging lighting conditions.

• India's Shooting Legacy:

• India has produced several world-class pistol shooters including Manu Bhaker, Jaspal Rana, and Sarabjot Singh. The success of

Suruchi Singh in 2025 adds to this growing list of international accolades.

Important Points

• Scoring System: In the final of the ISSF World Cup, scoring is done in decimal points. A perfect shot is a 10.9, making Suruchi's 10.5 an exceptionally high-pressure, high-accuracy shot at the penultimate stage.

• Competitive Field: The 2025 Munich World Cup featured top-ranked shooters from around the world, including representatives from China, France, and South Korea, making the gold medal a testament to elite performance.

• Strategic Calm: The ability to shoot a 9.5 as a final shot, knowing it would be enough to secure the title based on the aggregate lead, demonstrates the psychological strength required at the International level.

Q96. Answer: (b) 96.07

The correct answer is 96.07.

Key Points

• According to the 2025 Sustainable Development Report (SDR), India has achieved a Spillover Score of 96.07.

• The Spillover Index measures the extent to which a country's domestic actions and consumption patterns create positive or negative externalities (impacts) on other countries' ability to achieve the Sustainable Development Goals (SDGs).

• A higher score on the Spillover Index (closer to 100) indicates that a country causes fewer negative transboundary impacts; India's score of 96.07 suggests it has relatively low negative impacts on other nations compared to many developed economies.

• The report is published annually by the Sustainable Development Solutions Network (SDSN), which has been working under the auspices of the UN Secretary-General since 2012.

• The 2025 report assesses all 193 UN Member States, providing a comprehensive overview of global progress toward the 2030 Agenda.

Additional Information

• Components of Spillover Score: The index tracks three main categories: Environmental & Social spillovers embodied in trade (e.g., carbon emissions or child labor in supply chains), Economy & Finance spillovers (e.g., unfair tax competition), and Security spillovers (e.g., arms exports).

• The SDG Index vs. Spillover Index: While the SDG Index measures a country's internal progress toward the 17 goals, the Spillover Index specifically looks at international consequences. Often, high-income countries rank high on the SDG Index but very low on the Spillover Index due to heavy consumption.

• Sustainable Development Solutions Network (SDSN): Led by renowned economist Professor Jeffrey Sachs, the SDSN mobilizes scientific and technical expertise from academia, civil society, and the private sector.

• India's SDG Journey: India has integrated the SDGs into its national development strategy through the NITI Aayog, focusing on major schemes like Jal Jeevan Mission and Ayushman Bharat to address domestic targets while maintaining a stable international footprint.

Important Points

• Global Context: The 2025 Report emphasizes the urgent need for a "Global Financial Architecture" reform to support developing nations in closing the financing gap required to meet 2030 targets.

• Data and Fact: In the 2025 assessment, countries with scores above 95 on the spillover index are generally considered to be "exporting" very few negative environmental or social costs to the rest of the world.

• Yearly Comparison: India's Spillover Score has remained consistently high over the last few years, reflecting its status as a country that, while developing, does not disproportionately burden the global environment through its trade-linked consumption.

• Target 2030: The Sustainable Development Goals were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty and protect the planet by the year 2030.

Q97. Answer: (b) Neeraj Chopra

The correct answer is Neeraj Chopra.

Key Points

• Indian athlete Neeraj Chopra won the men's javelin throw event at the Ostrava Golden Spike athletics meet in the Czech Republic.

• The event, which took place in June 2025, saw Chopra producing a winning throw of 85.29 metres.

• With this performance, he became the only athlete in the entire competition to throw beyond the 85-metre mark, showcasing his dominance in the field.

• The Ostrava Golden Spike is a prestigious meet and part of the World Athletics Continental Tour Gold series, often featuring the world's elite javelin throwers.

• This victory further solidified Neeraj Chopra's position as a consistent performer on the global stage following his previous successes in the Olympics and World Championships.

Additional Information

• Neeraj Chopra (India):

• He is the first Indian track and field athlete to win an Olympic Gold Medal, achieving this feat at the Tokyo 2020 Olympics.

• He also secured the Gold Medal at the 2023 World Athletics Championships held in Budapest, becoming the first Indian to do so.

• His personal best and national record stands at 89.94 metres, achieved at the Stockholm Diamond League in 2022.

• Jakub Vadlejch (Czech Republic):

• A top-tier javelin thrower who won the Silver Medal at the Tokyo Olympics and is a regular podium finisher in the Diamond League circuit.

• He is known for his rivalry with Chopra and remains one of the most consistent throwers in the world.

• Anderson Peters (Grenada):

• A two-time World Champion (winning in 2019 and 2022) and one of the few active athletes to have breached the 90-metre mark.

• Julian Weber (Germany):

• A leading European javelin thrower who frequently ranks in the top 5 globally and won the European Championship gold in 2022.

• Ostrava Golden Spike:

• First held in 1961, it is one of the oldest and most respected athletics meetings in Europe, held annually at the Mestsky Stadion.

Important Points

• The 85.29 m throw was the decisive mark that separated Chopra from the rest of the field in Ostrava during the 2025 season.

• Success in javelin throw depends on a combination of explosive power, runway speed, and the aerodynamic angle of release.

• Maintaining a world ranking in the top tier is crucial for athletes to qualify for major events like the Diamond League Finals and the World Athletics Championships.

Q98. Answer: (b) World Bank

The correct answer is World Bank.

Key Points

• The World Bank has announced its plans to develop and introduce a new indicator for measuring extreme poverty in India and other nations in 2025.

• This initiative is part of a broader effort to update the international poverty lines to reflect the changing economic realities and price levels globally, moving away from the 2017 Purchasing Power Parity (PPP) benchmarks.

• Currently, the World Bank uses a threshold of $2.15 per person per day to define extreme poverty, but for a lower-middle-income country like India, there is a growing need for indicators that better capture the cost of living and basic needs.

• The 2025 revision aims to provide a more accurate assessment of poverty trends, which is crucial for tracking Sustainable Development Goal 1 (SDG 1), which targets the eradication of extreme poverty for all people everywhere.

• By refining these metrics, the World Bank intends to help policymakers in India better identify vulnerable populations and design more effective social security and poverty alleviation programs.

Additional Information

• The World Bank:

• It is an international financial institution established in 1944 at the Bretton Woods Conference.

• Headquartered in Washington, D.C., it provides loans and grants to the governments of low-income and middle-income countries for the purpose of pursuing capital projects.

• The current President of the World Bank is Ajay Banga, who assumed office in June 2023.

• Poverty Lines by Income Group:

• The World Bank maintains different poverty lines based on a country's economic status: $2.15 for low-income, $3.65 for lower-middle-income, and $6.85 for upper-middle-income countries.

• As India is classified as a lower-middle-income economy, the $3.65 line is often considered more relevant for its domestic policy context than the extreme poverty line of $2.15.

• NITI Aayog and Poverty (Option 1):

• In India, NITI Aayog is the nodal agency for monitoring poverty. It released the National Multidimensional Poverty Index (MPI), which uses 12 indicators across health, education, and standard of living.

• According to NITI Aayog's reports, India has seen a significant decline in multidimensional poverty, with millions escaping poverty between 2013-14 and 2022-23.

• Purchasing Power Parity (PPP):

• This is an economic theory and metric used to compare economic productivity and standards of living between countries by adjusting for price level differences.

• The World Bank updates its poverty lines whenever new International Comparison Program (ICP) data on PPPs become available to ensure the real value of the poverty line remains constant over time.

Important Points

• Historical Context: The International Poverty Line was first introduced as $1 a day in 1990 based on 1985 prices. It was subsequently revised to $1.08, $1.25, $1.90, and finally to the current $2.15 in September 2022.

• Global Poverty Goal: The World Bank aims to reduce the share of the global population living in extreme poverty to less than 3% by the year 2030.

• India's Role: Since India represents a significant portion of the global population, any change in how poverty is measured in India has a massive impact on global poverty statistics and World Bank projections.

• Data Sources: For India, the World Bank often relies on the Consumer Expenditure Survey (CES) conducted by the National Sample Survey Office (NSSO) under the Ministry of Statistics and Programme Implementation (MoSPI).

Q99. Answer: (a) Ousmane Dembele

p>The correct answer is Ousmane Dembele.

Key Points

• The Men’s Ballon d’Or 2025 was awarded to the French forward Ousmane Dembele for his exceptional performance during the 2024-2025 football season.

• The prestigious ceremony took place at the Théâtre du Châtelet in Paris, France, marking the 69th edition of the awards organized by France Football in collaboration with UEFA.

• Ousmane Dembele was recognized for his clinical playmaking and goal-scoring contributions for his club, Paris Saint-Germain (PSG), leading them to significant domestic and continental success.

• This victory marks a significant milestone in his career, as he emerged as the top choice among a panel of 100 international journalists representing the top 100 FIFA-ranked nations.

• The criteria for the award focused on individual performance, decisive character, and the player's conduct on the field during the specified season.

Additional Information

• History of Ballon d’Or:

• The Ballon d'Or is an annual football award presented by the French news magazine France Football since 1956.

• It was originally conceived by sports writer Gabriel Hanot to honor the best male player from Europe, but eligibility was expanded to all players active at European clubs in 1995 and to all players worldwide in 2007.

• The first-ever recipient of the award was Sir Stanley Matthews of Blackpool in 1956.

• Notable Record Holders:

• Lionel Messi holds the record for the most Ballon d'Or wins, having secured the trophy 8 times (2009, 2010, 2011, 2012, 2015, 2019, 2021, and 2023).

• Cristiano Ronaldo follows with 5 awards, having won in 2008, 2013, 2014, 2016, and 2017.

• Other legendary multiple-time winners include Michel Platini, Johan Cruyff, and Marco van Basten, each with 3 titles.

• Evolution of Selection Rules:

• Since 2022, the award period shifted from the calendar year to the European football season (August to July), ensuring that major tournaments like the World Cup or Euros are accounted for within a single voting cycle.

• The voting panel was also restricted to representatives from the top 100 countries in the FIFA World Rankings to ensure higher journalistic expertise.

Important Points

• Kylian Mbappe: A perennial contender and World Cup winner who has consistently finished in the top 3 in recent years but missed the top spot in 2025 to his teammate.

• Lionel Messi and Cristiano Ronaldo: Their era of dominance, spanning nearly two decades, saw them share 13 trophies between 2008 and 2023, representing the most competitive rivalry in football history.

• The Kopa Trophy: This is awarded during the same ceremony to the best performing player under the age of 21.

• The Yashin Trophy: Named after Lev Yashin, this award is presented to the best goalkeeper in the world during the Ballon d'Or gala.

Q100. Answer: (a) Delhi Development Authority (DDA)

The correct answer is Delhi Development Authority (DDA).

Key Points

• The Delhi Development Authority (DDA) has developed the city's first dedicated Centre of Excellence (CoE) for Sports located in Sector 8, Dwarka.

• The facility was officially inaugurated in May 2025, marking a significant milestone in the urban sports infrastructure of the National Capital Territory of Delhi.

• Unlike traditional sports complexes, this Centre of Excellence is specifically designed to provide high-performance training

environments for athletes focusing on Olympic sports such as Archery, Athletics, and Football.

• The project is part of DDA's broader mission to transform Dwarka into a major sports hub, supplementing existing facilities and providing a platform for professional coaching and scientific sports management.

• The DDA serves as the primary agency for land and infrastructure development in Delhi under the Ministry of Housing and Urban Affairs, Government of India.

Additional Information

• Infrastructure Features:

• The Dwarka Sector 8 complex boasts world-class facilities, including a synthetic athletic track, specialized Archery grounds, and international-standard Football pitches.

• It also includes hostel facilities for resident athletes, ensuring that talented youth from across the country can train in Delhi under professional supervision.

• Role of the DDA in Sports:

• The Delhi Development Authority currently maintains over 15 sports complexes, 3 mini-sports complexes, and 2 public golf courses (including the Qutab Golf Course and Bhalswa Golf Course).

• The transition toward "Centres of Excellence" indicates a shift from providing general recreational facilities to fostering competitive excellence in alignment with the Master Plan for Delhi (MPD) 2041.

• Comparison with Other Organizations:

• While the Sports Authority of India (SAI) manages national-level training programs (like the Target Olympic Podium Scheme - TOPS), the DDA is the local authority responsible for the physical construction and maintenance of these specific assets in Delhi.

• The Indian Olympic Association (IOA) acts as the governing body for Olympic movements but does not typically undertake large-scale civil construction projects like the Dwarka CoE.

• Socio-Economic Impact:

• The establishment of such centers in Dwarka helps in the decentralization of sports facilities, which were previously concentrated in South Delhi (e.g., Siri Fort) and East Delhi (e.g., Yamuna Sports Complex).

• It supports the Khelo India initiative by providing the necessary hardware (infrastructure) to complement the software (talent scouting and training).

Important Points

• The Lieutenant Governor of Delhi, who serves as the Chairman of the DDA, has been a key proponent of the timely completion of the Dwarka sports projects.

• The Centre of Excellence model aims to bridge the gap between amateur play and professional sports by integrating sports science, physiotherapy, and nutrition within the same premises.

• Recent developments in 2024-2025 have seen DDA increasing its budget allocation for green spaces and multi-utility sports arenas to cater to the growing population of the sub-city of Dwarka.

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