RRB Group D Official Paper (Held On: 14 Dec, 2025 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. According to Archimedes' principle, what is the magnitude of the upward force (buoyant force)?

(a) It is equal to the pressure exerted by the fluid.
(b) It is equal to the volume of the fluid.
(c) It is equal to the weight of the fluid displaced by the body.
(d) It is equal to the weight of the immersed body.

Q2. In some reptiles, the sex of the offspring is determined by:

(a) Temperature at which eggs are incubated
(b) Presence or absence of a Y chromosome
(c) Sex chromosomes
(d) Hormonal levels in the mother

Q3. Which of the following nutrients in plants is generally supplied by soil?

(a) Oxygen
(b) Hydrogen
(c) Carbon
(d) Boron

Q4. Which property is shown by ethanol?

(a) It has a sweet smell and is volatile
(b) It forms scum with hard water
(c) It is solid at room temperature
(d) It is basic in nature

Q5. Which of the following is NOT true about an object in non-uniform motion?

(a) The change in velocity is zero over time interval
(b) It moves unequal distances in unequal time intervals
(c) It has different speeds at different points
(d) Its velocity changes with time

Q6. Xylem is a complex permanent tissue. Which of the following is correct regarding its composition?

(a) Tracheids, xylem parenchyma and xylem fibres
(b) Companion cells, tracheids and xylem fibres
(c) Vessels, xylem collenchyma and xylem fibres
(d) Tracheids, sieve cells and phloem parenchyma

Q7. Which of the following statement is correct regarding 'property of Gaseous state'?

(a) In gaseous state, intermolecular attraction and intermolecular distance are very large
(b) In gaseous state, intermolecular distance is very low and intermolecular attraction is very large.
(c) In gaseous state, intermolecular distance is very large and intermolecular attraction is very low.

(d) In gaseous state, intermolecular distance and intermolecular attraction are very low.

Q8. A metallic conductor obeys Ohm's law at room temperature. When the applied potential difference across it is increased from V to 2V, and the temperature is kept constant, the current through the conductor:

(a) Remains unchanged because current depends only on resistance
(b) Doubles because resistance is constant
(c) More than doubles due to increased electron drift velocity
(d) Less than doubles due to heating effects

Q9. Which of the following is an example of basic salt?

(a) Sodium chloride
(b) Ammonium chloride
(c) Sodium bicarbonate
(d) Hydrogen chloride

Q10. Which of the following allotropes of carbon conducts electricity?

(a) Graphite
(b) Fullerene
(c) Charcoal
(d) Diamond

Q11. When we pour acetone (nail polish remover) on our palm, we feel cold because:

(a) it releases cold vapours
(b) it blocks nerve signals on the skin
(c) it evaporates rapidly, absorbing heat from the palm
(d) it reacts with water present on the palm

Q12. A car starts from rest and accelerates uniformly at 2 m/sec² for 5 seconds. What is the velocity at the end of 5 seconds?

(a) 20 m/sec
(b) 5 m/sec
(c) 15 m/sec
(d) 10 m/sec

Q13. The metal which will NOT displace lead from its salt solution is:

(a) Aluminium
(b) Calcium
(c) Magnesium
(d) Copper

Q14. Which of the following characteristics is correct about magnetic field lines?

(a) They always form closed loops.
(b) They intersect each other.
(c) They always start and end at the same pole.
(d) They are open curves.

Q15. An object is placed at the centre of curvature of a concave mirror. The image formed is:

(a) At the centre of curvature, same size
(b) At infinity, highly magnified
(c) Behind the mirror, virtual
(d) Between focus and pole, diminished

Q16. Which energy change is generally associated with decomposition reactions?

(a) Endothermic energy change
(b) No energy change
(c) Exothermic energy change

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(d) Reversible energy change

Q17. Which of the following is NOT an application of ultrasound?

(a) Cooking food
(b) Cleaning delicate machinery parts
(c) Detecting cracks in metal blocks
(d) Imaging of internal organs

Q18. What happens when we dissolve sugar in water?

(a) The particles of sugar will float on top of water.
(b) A colloidal solution is formed.
(c) The particles of sugar get into the spaces between particles of water.
(d) The particles of sugar and water do not mix.

Q19. Which of the following best describes the process of sexual maturation in humans?

(a) It begins after adulthood and leads to immediate readiness for parenthood
(b) It occurs only in females and stops once menstruation begins
(c) It is a gradual process during adolescence involving physical and hormonal changes
(d) It occurs suddenly and marks the end of body growth

Q20. Which part of the brain directly controls the movement of voluntary muscles?

(a) Medulla oblongata
(b) Motor area
(c) Sensory area
(d) Association area

Q21. What does the seed contain that is essential for the growth of a new plant?

(a) Chlorophyll
(b) Embryo
(c) Sepal
(d) Nectar

Q22. What is the function of salivary amylase present in human saliva?

(a) It converts amino acids into protein.
(b) It converts simple sugars into starch.
(c) It converts starch into simple sugars.
(d) It converts proteins into amino acids.

Q23. When Newton placed a second inverted prism after the first one, the emergent beam obtained was:

(a) a rainbow of colours
(b) only violet light
(c) white light
(d) only red light

Q24. Which of the following cell organelles do NOT have their own DNA?

(a) Nucleus
(b) Plastids
(c) Mitochondria
(d) Lysosomes

Q25. The mechanical energy of a body can be expressed as the sum of _____.

(a) potential energy and kinetic energy
(b) chemical energy and electrical energy
(c) heat energy and light energy
(d) sound energy and light energy

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MATHEMATICS

Q26. A positive number when increased by 14, equals 176 times its reciprocal. What is the number?

(a) 14
(b) 12
(c) 22
(d) 8

Q27. The average of 12 numbers is 58. The average of the first 5 numbers is 55, and the average of the next 4 numbers is 62. If the 10^(th) number is 10 less than the 11^(th) number and is 5 more than the 12^(th) number, then the average of the 11^(th) and 10^(th) numbers is:

(a) 60
(b) 61
(c) 61.5
(d) 60.5

Q28. Simplify:

$(9x^2 - 4y^2)/(3x - 2y) \times 3x/(3x + 2y)$

(a) x/3
(b) x
(c) 3x
(d) x/9

Q29. In triangle ABC, BD perpendicular to AC at D and angle DBC = 42°. E is a point on BC such that angle CAE = 24°. What is the measure of angle AEB ?

(a) 72°
(b) 67°
(c) 59°
(d) 58°

Q30. Anmol and Ayushi together invested Rs. 41,400 in a business. At the end of the year, out of a total profit of Rs. 5,000, Anmol's share was Rs. 2,300. How much was Anmol's investment?

(a) Rs. 20,105
(b) Rs. 18,630
(c) Rs. 17,095
(d) Rs. 19,044

Q31. A train travels 180 km in 3 hours. How long will it take to travel 420 km at the same speed?3014

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

Q32. In an election between two candidates, 2% of the voters did not cast their votes. Out of the polled votes, 5% were declared invalid. One candidate secured 65% of the valid votes. If the total number of voters was 25,20,000, how many valid votes did the losing candidate receive?

(a) 8,21,142
(b) 8,21,124
(c) 8,22,114
(d) 8,24,112

Q33. Arrange the following schemes in the ascending order of their discounts.

A. Buy 1 get 5 free

B. A single discount of 64%

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C. Two successive discounts of 3% and 37%

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

Q34. From the top of a 45 m high building, the angle of depression of a car on the ground is 30°. How far is the car from the base of the building? (Take √3 = 1.732 and round off the answer to two decimal places.)

(a) 77.94 m
(b) 71.94 m
(c) 81.94 m
(d) 89.94 m

Q35. The diagonals of a rhombus are 24 cm and 7 cm. The perimeter of the rhombus is:

(a) 50 cm
(b) 52 cm
(c) 46 cm
(d) 48 cm

Q36. The amount on a sum of Rs. 6000 at 5% per annum compound interest, compounded annually, in 2 years, will be:

(a) Rs. 7047
(b) Rs. 6615
(c) Rs. 5722
(d) Rs. 6385

Q37. Two trains, 165 m and 195 m in length, are running in opposite directions. The first runs at the rate of 83 km/hr and the second at the rate of 79 km/hr. How long will they take to cross each other?

(a) 15 seconds
(b) 8 seconds
(c) 5 seconds
(d) 13 seconds

Q38. An item is sold to C by B, and then to D by C. Both B and C earn an equal profit of 12%, and the selling price to D is Rs. 313.60. What is the cost price (in Rs.) of the item to B?

(a) 200
(b) 240
(c) 280
(d) 250

Q39. B's age is 5 times the difference in ages of C and D. D's age is 10 years more than the age of B. If the age of C is 30 years, then the minimum age of D is _____ years.

(a) 35
(b) 50/3
(c) 80/3
(d) 30

Q40. The income of Raman is Rs. 34,000. He saves 5.5% of his income. If his income increases by 17% and expenditure increases by 50%, then his savings will:

(a) decrease by Rs. 10,288
(b) decrease by Rs. 10,285
(c) increase by Rs. 10,284
(d) increase by Rs. 10,283

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Q41. What is the third proportional to $16x^2$ and $20xy$?

(a) $25y^2$
(b) 27y2
(c) 22y2
(d) 28y2

Q42. Find the value of the expression $(0.079^2 + 0.25^2 + 3.37^2)/(0.0079^2 + 0.025^2 + 0.337^2)$.

(a) 100
(b) 3.699
(c) 0.3699
(d) 10000

Q43. The average age of 40 students of a class is 18 years. If the age of the teacher is also included, the average age of the whole group becomes 19 years. The age (in years) of the teacher is:

(a) 56
(b) 59
(c) 62
(d) 58

Q44. 5 men can complete a piece of work in 16 days while 9 women can do it in 8 days. In how many days can 3 women and 2 men complete it?

(a) 13 days
(b) 22 days
(c) 15 days
(d) 24 days

Q45. 1/20 is what percentage of 2/100 ?

(a) 265%
(b) 250%
(c) 500%
(d) 260%

Q46. The simplified value of $4 \times (17 \times (3^2)) \div 12 + 26 - 41$ is:

(a) 30
(b) 32
(c) 36
(d) 44

Q47. The length, breadth and height of a cuboid are in the ratio of 8 : 5 : 3. If its diagonal length is $21\sqrt{2}$ m, then find the total surface area of the cuboid.

(a) 1,250 m2
(b) 1,422 m^2
(c) 1,622 m2
(d) 1,388 m2

Q48. A, B and C can do a piece of work in 2, 20 and 20 days respectively. How long (in days) will they take to do thrice the same work, working together?

(a) 6
(b) 15
(c) 10
(d) 5

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Q49. The marked price of a sofa is Rs. 331, which is 41% above the cost price. If the profit percent is 22%, find the discount percentage. (Rounded off to two decimal places)

(a) 11.23%
(b) 13.48%
(c) 12.02%
(d) 16.1%

Q50. If the three digit number 7n4 is divisible by 6, then find the least possible value for n.

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

GENERAL INTELLIGENCE & REASONING

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

PCR45, MGO41, JKL37, ?

(a) GOI33
(b) HNJ32
(c) GNJ33
(d) HOI32

Q52. In a certain code language,

A + B means ‘A is the sister of B’,

A @ B means ‘A is the brother of B’,

A - B means ‘A is the wife of B’,

A # B means ‘A is the father of B’.

How is O related to V if ‘O @ P # T + G - V’?

(a) Wife's father's father
(b) Wife's brother
(c) Wife's father
(d) Wife's father's brother

Q53. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

RV23, QU32, PT41, OS50, ?

(a) NS58
(b) NR58
(c) NS59
(d) NR59

Q54. If 2 is added to each odd digit and 2 is subtracted from each even digit in the number 3267451, what will be the difference between the highest and lowest digits in the new number thus formed?

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

Q55. This question is based on the five, three-digit numbers given below.

(Left) 604 895 469 742 307 (Right)

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

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

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

(a) 5
(b) 16
(c) 9
(d) 12

Q56. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one which follows the same logic.

KEPT - ETPK - TPEK

SAIL - ALIS - LIAS

(a) TURN - UTRN - NURT
(b) MOPS - OSPM - SPOM
(c) HOPE - HPOE - EPOH
(d) PACK - APCK - KACP

Q57. UPNF is related to YLPD in a certain way based on the English alphabetical order. In the same way, CHRB is related to GDTZ. To which of the following is KZVX related to, following the same logic?

(a) PWXU
(b) NVWV
(c) OVXV
(d) NUYW

Q58. 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 conclusion(s) logically follow(s) from the statement(s).

Statements:

No father is a mother.

No mother is a son.

Conclusions:

(I) All mothers are fathers.

(II) No father is a son.11667

(a) Neither follows
(b) Both follow
(c) Only II follows
(d) Only I follows

Q59. 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) WSV
(b) UQT
(c) PLO
(d) IFH

Q60. Pavan ranked 13^(th) from the top and 3^(rd) from the bottom in his class. How many students are there in the class?

(a) 19
(b) 17
(c) 15
(d) 13

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Q61. What will come in place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

172 ÷ 4 + 183 × 3 - 164 = ?

(a) 652
(b) 791
(c) 739
(d) 681

Q62. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only.

(Left) @ 4 6 8 * $ $ $ £ % 4 6 7 1 5 * 4 * 4 4 2 $ (Right)

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

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

Q63. Refer to the number series given below and answer the question that follows. Counting to be done from left to right only.

(NOTE: All numbers are single-digit numbers only.)

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

How many such prime numbers are there which are immediately followed by an odd number?

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

Q64. Mr. Akai starts from Point A and drives 10 km towards east. He then takes a left turn, drives 11 km, turns left and drives 19 km. He then takes a left turn and drives 21 km. He takes a final left turn, drives 9 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) 12 km to the east
(b) 10 km to the south
(c) 10 km to the north
(d) 12 km to the south

Q65. What should come in place of the question mark (?) in the given series?

0, -2, -3, 8, 95, ?

(a) 380
(b) 684
(c) 140
(d) 810

Q66. In a certain code language, 'the birds sings' is coded as 'ly gn ws' and 'birds have beak' is coded as 'ie ly nt'. How is 'birds' coded in that language?

(a) nt
(b) ws
(c) ly
(d) gn

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Q67. M, N, O, P, W, X and Y are sitting around a circular table facing the centre of the table. Only two people sit between X and W when counted from the right of X. Only two people sit between W and M when counted from the right of W. Only three people sit between X and N when counted from the right of X. P sits to the immediate left of Y. Who sits third to the left of O?

(a) Y
(b) M
(c) X
(d) P

Q68. 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) QT-XS
(b) EH-LG
(c) IL-PJ
(d) MP-TO

Q69. Seven boxes D, E, F, U, V, W and X are kept one over the other but not necessarily in the same order. Only five boxes are kept below X. Only three boxes are kept between F and X. V is kept at one of the positions below F. Only E is kept between X and W. D is kept at one of the positions above X. How many boxes are kept between V and D?11064

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

Q70. What should come in place of the question mark (?) in the given series?

131, 132, 135, 140, 147, ?

(a) 155
(b) 156
(c) 154
(d) 157

Q71. What will come in place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

36 × 6 - 2 ÷ 13 + 9 = ?

(a) 25
(b) 23
(c) 21
(d) 22

Q72. FGNE is related to KDSB in a certain way based on the English alphabetical order. In the same way, PAXY is related to UXCV. To which of the following is ZUHS related, following the same logic?6417

(a) ESLQ
(b) DSNQ
(c) ERMP
(d) FQLO

Q73. In a certain code language, 'music is life' is coded as 'cd jk rs' and 'life is precious' is coded as 'ap cd jk'. How is 'music' coded in that language?

(a) jk
(b) cd
(c) rs
(d) ap

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

264, 239, 216, 195, 176, ?

(a) 158
(b) 159
(c) 160
(d) 155

Q75. Eight people – A, B, C, D, E, F, G and H are sitting around a circular table facing the centre. Only one person sits between A and B when counted from the right of A. E sits to the immediate left of A. Only three people sit between E and C when counted from the left of E. F sits third to the right of C. D sits to the immediate right of H. Who sits second to the right of G?

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

Q76. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(15, 90, 6)

(13, 65, 5)553

(a) (16, 32, 2)
(b) (11, 55, 6)
(c) (17, 24, 2)
(d) (14, 46, 4)

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

Statements:

All pouches are trunks.

All bags are trunks.

Conclusions:

(I) Some pouches are bags.

(II) Some trunks are bags.

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

Q78. Tarun starts from Point Y and drives 36 km towards west. He then takes a left turn, drives 83 km, turns right and drives 68 km. He then takes a right turn and drives 55 km. He takes a right turn, drives 41 km. He then turns left, drives 28 km to stop at Point Z. How far (shortest distance) and towards which direction should he drive in order to reach Point Y again?

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

(a) 65 km towards west
(b) 61 km towards west
(c) 63 km towards east
(d) 66 km towards east

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Q79. 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) 5 2 7 4 1 9 3 2 7 6 4 5 8 2 9 7 2 8 5 1 6 8 4 2 9 5 2 (Right)

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

(a) Three
(b) Two
(c) One
(d) More than three

Q80. A, B, C, D, W, X and Y are sitting around a circular table facing the centre of the table.

Only four people sit between B and A when counted from the right of B. B sits third to the left of X. W sits third to the left of Y. C is an immediate neighbour of both A and X. How many people sit between D and C when counted from the right of D?

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

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. What is the threshold amount for complaints to be auto-converted into an e-Zero FIR?

(a) Rs. 50 lakh
(b) Rs. 10 lakh
(c) Rs. 1 lakh
(d) Rs. 5 lakh

Q82. The Indian Prime Minister introduced a significant programme in the farming sector in October 2025 with a fund of Rs. 24,000 crore, named _____.

(a) PM Dhan Dhaanya Krishi Yojana
(b) PM Fasal Bima Yojana
(c) PM Krishi Sinchai Yojana
(d) PM Kisan Samman Yojana

Q83. As notified on 20 June 2025, the Defence Research and Development Organisation (DRDO) will soon begin manufacturing new variants of the Pinaka rocket system with extended ranges of _____.

(a) 170 km and 400 km
(b) 90 km and 225 km
(c) 100 km and 260 km
(d) 120 km and 300 km

Q84. Who among the following was re-appointed as the Prime Minister of Portugal in 2025?

(a) Pedro Nuno Santos
(b) Andre Ventura
(c) Luis Montenegro
(d) Antonio Costa

Q85. Which of the following is the most polluted city in India as per the IQ Air Report 2024-25?

(a) Faridabad
(b) Gurugram
(c) Delhi
(d) Byrnihat

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Q86. In 2025, Aman Sehrawat was honoured with the Arjuna Award; what sport does he compete in?

(a) Weightlifting
(b) Wrestling
(c) Boxing
(d) Shooting

Q87. Which Indian footballer was honoured as the Promising Men's Player of the Year at the AIFF Awards 2025?

(a) Subhasish Bose
(b) Vishal Kaith
(c) Khalid Jamil
(d) Brison Fernandes

Q88. What is the name of the affordable insurance scheme launched by India Post Payments Bank (pilot launch was done in July 2023) for unorganised sector workers on 1 May 2025?

(a) Ayushman Bima Shramik Yojana
(b) Shramik Suraksha Yojana
(c) Suraksha Sathi Yojana
(d) Antyodaya Shramik Suraksha Yojana

Q89. What is the rank of India in the Hurun Global Unicorn Index 2025, published by the Hurun Research Institute, which marks a significant milestone in the global startup ecosystem?

(a) 2nd
(b) 10th
(c) 8th
(d) 3rd

Q90. Who earned the 'Game Changer' award at the Women's Football Awards 2025?

(a) Bethany England
(b) Anita Asante
(c) Keira Walsh
(d) Viviane Asseyi

Q91. Which pair won the gold in the Men's Doubles SL3–SL4 at the 2025 Asia Para Badminton Championship?

(a) Sukant Kadam and Umesh Vikram Kumar
(b) Nitesh Kumar and Sukant Kadam
(c) Nitesh Kumar and Pramod Bhagat
(d) Pramod Bhagat and Sukant Kadam

Q92. What was the theme of the 17^(th) Civil Services Day?

(a) Global Governance Integration
(b) Digital Governance for Urban Development
(c) Holistic Development of India
(d) Economic Reforms for Rural Areas

Q93. India has banned jute imports from which country through all land and sea ports except Nhava Sheva in June 2025?

(a) Bangladesh
(b) Pakistan
(c) Nepal
(d) China

Q94. The Green Hydrogen Certification Scheme launched in 2025 is part of which key national programme?

(a) Green India Initiative
(b) India Clean Energy Movement
(c) National Green Hydrogen Mission
(d) National Solar Energy Mission

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Q95. Which Chinese city hosted the 2025 Asian Winter Games from 7 to 14 February?

(a) Guangzhou
(b) Shanghai
(c) Harbin
(d) Beijing

Q96. Which of the following was inducted in the UNESCO World Network of Biosphere Reserves in September 2025?

(a) Cold Desert Biosphere Reserve
(b) Kachchh Biosphere Reserve
(c) Pachmarhi Biosphere Reserve
(d) Achanakmar–Amarkantak Biosphere Reserve

Q97. Which award did President Murmu present to the Indian Bureau of Mines (IBM) in 2025?

(a) Sahitya Akademi Award
(b) National Sports Awards
(c) E-Governance Award
(d) Bharat Ratna

Q98. Which company unveiled Dragon Copilot, AI voice assistant for healthcare in March 2025?

(a) SpaceX
(b) Microsoft
(c) Apple
(d) Infosys

Q99. What is the estimated fiscal deficit for the financial year 2025–26 as per Union Budget, 2025–26?

(a) 4.4% of GDP
(b) 3.9% of GDP
(c) 5.1% of GDP
(d) 6.2% of GDP

Q100. Which of the following schemes was launched by the Gujarat government in May 2025 that sends real-time SMS alerts to citizens about their police case progress?

(a) FIR-Alert System
(b) e-Alert Gujarat
(c) Citizen Police Update
(d) I-Pragati

ANSWER KEY

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

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SOLUTIONS

Q1. Answer: (c) It is equal to the weight of the fluid displaced by the body.

The correct answer is It is equal to the weight of the fluid displaced by the body.

Key Points

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

• The upward force mentioned in the principle is known as the buoyant force or upthrust.

• The magnitude of this force depends on the density of the fluid and the volume of the immersed part of the body. Hence, statement 3 is correct.

• While pressure exerted by the fluid increases with depth and contributes to the upward force (due to the pressure difference between the top and bottom of the object), the force itself is not numerically equal to the pressure. Hence, statement 1 is incorrect.

• The magnitude of the force is equal to the weight (a force measured in Newtons), not the volume (measured in cubic meters). Volume determines how much fluid is moved, but the force is the weight of that volume. Hence, statement 2 is incorrect.

• The weight of the immersed body only equals the buoyant force when the object is floating in equilibrium. If the object sinks, its weight is greater than the buoyant force. Hence, statement 4 is incorrect.

Additional Information

• Buoyancy: It is the property of a fluid to exert an upward force on any object immersed in it. This phenomenon is why objects feel lighter when submerged in water.

• Density: It is defined as the mass per unit volume of a substance. The SI unit of density is kg/m^3. An object will float if its density is less than the density of the liquid.

• Relative Density: This is the ratio of the density of a substance to the density of water at 4 degrees Celsius. Since it is a ratio of similar quantities, it has no units.

• Applications of Archimedes' Principle:

• Designing Ships and Submarines: Used to ensure they displace enough water to stay afloat or submerge as needed.

• Lactometers: These instruments are used to determine the purity of a sample of milk based on its density.

• Hydrometers: These are used for determining the density of liquids.

Important Points

• Apparent Weight: When an object is in a fluid, its apparent weight is its actual weight minus the buoyant force. This explains why heavy stones are easier to lift while they are still under the water.

• Sinking vs. Floating:

• If the buoyant force is less than the weight of the object, the object will sink.

• If the buoyant force is equal to or greater than the weight of the object, the object will float.

• The principle applies to all fluids, which include both liquids and gases. For example, a hot air balloon rises because the weight of the air it displaces is greater than the weight of the balloon itself.

• The discovery is attributed to Archimedes, a Greek mathematician and inventor from Syracuse, in the 3rd century BC.

Q2. Answer: (a) Temperature at which eggs are incubated

The correct answer is Temperature at which eggs are incubated.

Key Points

• In many reptiles, the sex of the offspring is not determined by sex chromosomes at the time of fertilization, but rather by the environmental temperature during egg incubation. This biological phenomenon is known as Temperature-dependent Sex Determination (TSD).

• This process occurs during a specific window of embryonic development known as the thermosensitive period (TSP). This period typically falls within the middle third of the total incubation time.

• The temperature experienced by the developing embryo during the TSP triggers physiological changes that determine whether the gonads will develop into testes or ovaries. Hence, the statement regarding temperature at which eggs are incubated is correct.

• While most mammals and birds rely on Genotypic Sex Determination (GSD) involving X, Y or Z, W chromosomes, TSD is prevalent among various species of turtles, crocodilians (alligators and crocodiles), tuataras, and some species of lizards.

• Unlike GSD, where the sex ratio is usually 50:50, TSD can lead to highly skewed sex ratios in a population depending on the nesting environment and seasonal temperatures.

Additional Information

• Types of TSD Patterns:

• Pattern Ia (MF): In many turtles, lower temperatures during incubation produce males, while higher temperatures produce

females.

• Pattern Ib (FM): In some lizards and crocodilians, the pattern is reversed, where lower temperatures result in females and higher temperatures result in males.

• Pattern II (FMF): In some species like snapping turtles and crocodiles, females are produced at both extreme low and extreme high temperatures, while males are produced at intermediate temperatures.

• Biological Mechanism:

• The conversion of androgens into estrogens is mediated by the enzyme aromatase. In species with TSD, the activity of this enzyme is often temperature-sensitive. High temperatures in certain species increase aromatase activity, leading to ovary development and female offspring.

• Comparison with GSD:

• In Genotypic Sex Determination (GSD), sex is fixed by DNA. For example, in humans, the presence of the Y chromosome (specifically the SRY gene) determines maleness. In some reptiles like snakes, GSD is the primary method, often using the ZZ/ZW system where females are the heterogametic sex (ZW).

• Environmental and Evolutionary Impact:

• Climate change poses a significant threat to species with TSD. Rising global temperatures can lead to an overproduction of one sex (e.g., nearly all female sea turtles), which could eventually lead to population collapse due to a lack of reproductive partners.

• Ecological factors such as nest depth, shading from vegetation, and soil moisture also play critical roles in regulating the incubation temperature within the nest.

Important Points

• The pivotal temperature is defined as the specific incubation temperature that produces an equal ratio (50%) of males and females. Even a small change of 1-2 degrees Celsius can completely flip the sex ratio of a clutch.

• It is important to note that hormonal levels in the mother do not directly determine the genomic or environmental sex of the offspring in the same way incubation temperature does, although they can influence egg quality.

• Reptiles like Green Sea Turtles are classic examples where warming sands due to global warming are currently resulting in extreme female bias in hatchlings.

Q3. Answer: (d) Boron

The correct answer is Boron.

Key Points

• Plants require various essential nutrients for their growth, metabolism, and reproductive cycles, which are categorized based on the quantity required into macronutrients and micronutrients.

• Oxygen is primarily obtained by plants from the atmosphere during respiration and is also derived from water during the process of photosynthesis. Hence, statement 1 is incorrect.

• Hydrogen is derived almost exclusively from water (H_2O) absorbed by the roots from the environment. Hence, statement 2 is incorrect.

• Carbon is taken up by plants from the atmosphere in the form of carbon dioxide (CO_2) to build organic molecules through carbon fixation. Hence, statement 3 is incorrect.

• Boron is a vital mineral micronutrient that is generally supplied to the plant by the soil. It is absorbed by plant roots primarily in the form of undissociated boric acid. Hence, statement 4 is correct.

Additional Information

• Classification of Nutrients:

• Mineral Nutrients: These are elements like Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), and Sulfur (S), along with micronutrients like Iron (Fe) and Boron (B), which are primarily sourced from the soil.

• Non-Mineral Nutrients: These include Carbon, Hydrogen, and Oxygen. They are considered non-mineral because they are supplied by air and water rather than soil minerals.

• Role of Boron in Plants:

• Boron is essential for cell wall formation and maintaining the structural integrity of plasma membranes.

• It plays a critical role in reproductive growth, specifically facilitating pollen germination and pollen tube growth.

• It is also involved in sugar transport and calcium utilization within the plant tissues.

• Micronutrients from Soil:

• Apart from Boron, other micronutrients supplied by the soil include Manganese (Mn), Copper (Cu), Molybdenum (Mo), Zinc (Zn), Iron (Fe), Chlorine (Cl), and Nickel (Ni).

• These elements are required in very small quantities, typically less than 10 mmole per kg of dry matter, but their deficiency can lead to significant physiological disorders.

Important Points

• Nutrient Uptake Mechanism:

• Plants absorb mineral nutrients from the soil solution through their root hairs. This process involves both passive transport (diffusion) and active transport (utilizing ATP energy).

• The availability of Boron in the soil is highly dependent on the soil pH; it is most readily available to plants in acidic to neutral soils (pH 5.0 to 7.0).

• Source Summary:

• Air provides Carbon and Oxygen.

• Water provides Hydrogen and Oxygen.

• Soil provides all other 13 essential mineral nutrients, including Nitrogen, Phosphorus, and Boron.

Q4. Answer: (a) It has a sweet smell and is volatile

The correct answer is It has a sweet smell and is volatile.

Key Points

• Ethanol, also known as ethyl alcohol, is a colorless liquid that possesses a distinct, pleasant sweet smell and a characteristic burning taste.

• It is a highly volatile substance, which means it evaporates rapidly at standard temperature and pressure due to its relatively low boiling point of 78.37°C (351.5 K). Hence, statement 1 is correct.

• The formation of scum (insoluble precipitates) is a property of soap reacting with calcium and magnesium ions in hard water. Ethanol is a covalent organic compound and does not react with these ions to form scum. Hence, statement 2 is incorrect.

• Ethanol has a very low melting point of -114.1°C (159 K). Consequently, it exists in a liquid state at room temperature (approx 25°C) and does not solidify under normal environmental conditions. Hence, statement 3 is incorrect.

• Chemically, ethanol is neutral in nature. Although its formula C2H5OH contains a hydroxyl group, it does not ionize in water to release hydroxide ions (OH-), nor does it change the color of litmus paper. Hence, statement 4 is incorrect.

• Hence, the correct answer is It has a sweet smell and is volatile.

Additional Information

• Chemical Nature and Formula: Ethanol is a primary alcohol with the chemical formula C2H5OH. It is the second member of the homologous series of alcohols.

• Solubility: It is highly soluble in water in all proportions. This solubility is due to the ability of the hydroxyl group in ethanol to form hydrogen bonds with water molecules.

• Combustion: It is a flammable liquid that burns with a clean blue flame. The reaction produces carbon dioxide and water vapor, releasing a significant amount of energy.

• Applications as Fuel: Because it is a renewable source of energy (often produced from biomass), it is used as an additive in petrol. In India, the Ethanol Blended Petrol (EBP) Programme aims to increase the blend percentage to 20% (E20) by the year 2025.

• Industrial Uses: It serves as a versatile solvent in the manufacture of paints, varnishes, perfumes, and medicines like tincture of iodine and cough syrups.

Important Points

• Reaction with Sodium: When ethanol reacts with sodium metal, it evolves hydrogen gas and forms sodium ethoxide. This reaction is often used as a chemical test for the presence of the alcoholic group.

• Oxidation: Upon heating with alkaline potassium permanganate or acidified potassium dichromate, ethanol undergoes oxidation to form ethanoic acid (acetic acid).

• Denatured Alcohol: To prevent the illegal consumption of industrial-grade ethanol, it is made unfit for drinking by adding poisonous substances like methanol or pyridine and dyes like copper sulphate to give it a blue color. This is known as denaturation.

• Medical Use: In a concentration of 70%, it is an effective antiseptic used in hand sanitizers to kill microorganisms by denaturing their proteins and dissolving their lipid membranes.

Q5. Answer: (a) The change in velocity is zero over time interval

The correct answer is The change in velocity is zero over time interval.

Key Points

• Non-uniform motion is defined as the motion of an object in which the object travels with varied speed and does not cover the same distance in equal time intervals.

• In non-uniform motion, the velocity of the object does not remain constant. Since velocity is a vector quantity, it changes if either the speed (magnitude) or the direction of motion changes.

• The statement "The change in velocity is zero over time interval" implies that the initial velocity and final velocity are identical, which means the acceleration is zero. This is a characteristic of Uniform Motion, not non-uniform motion. Hence, statement 1 is

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NOT true.

• An object in non-uniform motion covers unequal distances in equal intervals of time. By extension, the relationship between distance and time is not linear, meaning it can move unequal distances in unequal time intervals depending on the rate of acceleration. Hence, statement 2 is correct in the context of non-uniformity.

• Because the rate of motion is constantly fluctuating, the object will possess different speeds at different points or instances along its path. Hence, statement 3 is correct.

• The core definition of non-uniform motion is that the velocity changes with time. This change indicates the presence of acceleration (positive or negative). Hence, statement 4 is correct.

Additional Information

• Acceleration: In non-uniform motion, the acceleration of the body is non-zero. Acceleration is the measure of the rate of change of velocity with respect to time. If the velocity increases, it is called acceleration; if it decreases, it is called retardation or deceleration.

• Types of Non-Uniform Motion:

• Uniformly Accelerated Motion: The velocity changes by equal amounts in equal intervals of time (e.g., a ball rolling down an inclined plane).

• Non-uniformly Accelerated Motion: The velocity changes by unequal amounts in equal intervals of time (e.g., a car moving in heavy city traffic).

• Average Speed: For an object in non-uniform motion, the average speed is calculated by dividing the total distance traveled by the total time taken. Unlike uniform motion, the instantaneous speed at any given point is usually different from the average speed.

• Examples: Common real-world examples include a train pulling out of a station, a person jogging in a crowded park, or a pendulum swinging back and forth.

Important Points

• Graphical Representation:

• In a Distance-Time Graph, non-uniform motion is represented by a curved line (parabola or zig-zag), indicating that the slope (speed) is changing.

• In a Velocity-Time Graph, non-uniform motion is represented by any line that is not horizontal. A horizontal line would indicate constant velocity (uniform motion).

• Uniform Motion vs. Non-Uniform Motion:

• Uniform Motion: Covers equal distance in equal time; zero acceleration; constant velocity.

• Non-Uniform Motion: Covers unequal distance in equal time; variable acceleration; changing velocity.

• Directional Change: It is important to note that even if an object moves at a constant speed in a circle (Uniform Circular Motion), it is considered non-uniform motion because its direction is constantly changing, resulting in a change in velocity.

Q6. Answer: (a) Tracheids, xylem parenchyma and xylem fibres

The correct answer is Tracheids, xylem parenchyma and xylem fibres.

Key Points

• Xylem is defined as a complex permanent tissue in plants, primarily responsible for the conduction of water and dissolved minerals from the roots to the rest of the plant parts.

• It is termed a complex tissue because it consists of more than one type of cell that coordinates to perform a common function. The four main components of xylem in angiosperms are Tracheids, Vessels, Xylem Parenchyma, and Xylem Fibres.

• Tracheids, xylem parenchyma, and xylem fibres are all integral parts of the xylem tissue. While vessels are also a key component in flowering plants, the provided option correctly identifies three valid xylem constituents. Hence, statement 1 is correct.

• Companion cells are a component of Phloem, not xylem. They help in the loading and unloading of sugars into sieve tubes. Hence, statement 2 is incorrect.

• Collenchyma is a simple permanent tissue that provides mechanical support to young stems and petioles; it is not a sub-type of xylem tissue. Xylem has its own supporting tissue known as Xylem Fibres (or sclerenchyma). Hence, statement 3 is incorrect.

• Sieve cells and phloem parenchyma are specialized cells belonging to the Phloem, which is the vascular tissue responsible for transporting organic nutrients (food). Hence, statement 4 is incorrect.

Additional Information

• Components of Xylem:

• Tracheids: These are elongated, tube-like dead cells with thick, lignified walls and tapering ends. They are the primary water-conducting elements in Gymnosperms and lower vascular plants.

• Vessels: Long, cylindrical structures formed by several cells called vessel members. They have perforated end walls and are much more efficient at water transport than tracheids. They are characteristic features of Angiosperms.

• Xylem Parenchyma: These are the only living cells in the xylem tissue. They have thin cellulosic walls and function mainly in the

storage of food (starch or fat) and the lateral conduction of water.

• Xylem Fibres: These are dead cells with highly thickened lignified walls and obliterated central lumens. Their primary function is to provide mechanical strength and support to the plant body.

• Direction of Flow: Unlike phloem, which exhibits bidirectional transport, the flow in xylem is strictly unidirectional (from roots upwards to the leaves).

• Wood: In botanical terms, the secondary xylem produced during the secondary growth of a plant is what we commonly refer to as wood.

Important Points

• Evolutionary Fact: In Gymnosperms (like pines and cedars), vessels are absent; water is conducted almost entirely through tracheids.

• Primary Xylem: It is categorized into Protoxylem (first formed) and Metaxylem (later formed). In stems, the protoxylem lies towards the center (Endarch condition), while in roots, it lies towards the periphery (Exarch condition).

• Lignification: The deposition of lignin in the cell walls of tracheids and vessels provides the structural rigidity necessary to withstand the negative pressure generated during transpiration.

Q7. Answer: (c) In gaseous state, intermolecular distance is very large and intermolecular attraction is very low.

The correct answer is In gaseous state, intermolecular distance is very large and intermolecular attraction is very low.

Key Points

• Matter exists in three primary physical states: Solid, Liquid, and Gas. The state of matter is determined by the balance between intermolecular forces and thermal energy.

• In the gaseous state, the particles (atoms or molecules) possess high kinetic energy, which overcomes the forces of attraction between them.

• The intermolecular distance in gases is very large. In fact, the distance between gas molecules is much greater than the actual size of the molecules themselves. Hence, the statement regarding large intermolecular distance is correct.

• The intermolecular attraction (cohesive forces) between gas particles is very low or negligible. This lack of attraction allows gas particles to move independently and expand to fill any container. Hence, the statement regarding low intermolecular attraction is correct.

• Regarding the other options:

• Statement 1 suggests both distance and attraction are very large; this is contradictory as large distance usually results in weak attraction. Hence, statement 1 is incorrect.

• Statement 2 describes the Solid state, where particles are close together (low distance) and strongly bonded (large attraction). Hence, statement 2 is incorrect.

• Statement 4 suggests both distance and attraction are very low; while attraction is low, the distance is actually very high in gases. Hence, statement 4 is incorrect.

Additional Information

• Characteristics of Gases:

• Compressibility: Due to the large intermolecular distances, gases are highly compressible. Applying pressure reduces the empty space between molecules.

• Shape and Volume: Gases have no definite shape and no definite volume. They take the shape and volume of the container they occupy.

• Diffusion: Because of weak intermolecular forces and high speed of particles, gases diffuse very rapidly into each other.

• Density: Gases have very low density compared to solids and liquids because the same mass occupies a much larger volume.

• Kinetic Molecular Theory (KMT):

• This theory explains that gas particles are in constant, random motion.

• The collisions between gas particles and the walls of the container are perfectly elastic, which exerts pressure.

• The average kinetic energy of the particles is directly proportional to the absolute temperature (measured in Kelvin).

• Comparison with other states:

• Solids: Have fixed shape and volume, strongest intermolecular forces, and minimum intermolecular space.

• Liquids: Have fixed volume but no fixed shape, intermediate intermolecular forces, and moderate intermolecular space compared to gases.

Important Points

• Van der Waals Forces: In real gases, there are slight attractive forces known as Van der Waals forces. However, in an Ideal Gas model, these attractions are assumed to be zero.

• Boyle's Law: States that at constant temperature, the volume of a gas is inversely proportional to its pressure (P prop. to 1/V).

• Charles's Law: States that at constant pressure, the volume of a gas is directly proportional to its absolute temperature (V prop.

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to T).

• The transition from liquid to gas is called vaporization or boiling, which occurs when thermal energy is sufficient to break the intermolecular attractions of the liquid phase.

Q8. Answer: (b) Doubles because resistance is constant

The correct answer is Doubles because resistance is constant.

Key Points

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

• The mathematical expression for this relationship is V = I * R, where R represents the Electrical Resistance of the conductor.

• In this scenario, since the temperature is kept constant, the resistance (R) of the metallic conductor remains unchanged regardless of the change in voltage.

• When the potential difference is increased from V to 2V, the new current (I') can be calculated using the formula I' = (2V) / R. Since I = V / R, it follows that I' = 2 * I.

• The current doubles because it maintains a linear relationship with the potential difference in an ohmic conductor. Hence, statement 2 is correct.

• Statement 1 is incorrect because while current does depend on resistance, it is also a function of the applied potential difference.

• Statement 3 is incorrect because at a constant temperature, the drift velocity of electrons increases proportionally with the electric field (and thus voltage), leading exactly to a doubling of current, not "more than double."

• Statement 4 is incorrect because the question explicitly specifies that the temperature is kept constant, which implies any heating effects (Joule heating) are either neglected or compensated for to keep R stable.

Additional Information

• Electrical Resistance (R): It is the property of a material to oppose the flow of electric current. The SI unit of resistance is the Ohm (represented by the Greek letter Ω).

• Factors Affecting Resistance: The resistance of a conductor depends on its length (directly proportional), area of cross-section (inversely proportional), the nature of the material (resistivity), and temperature.

• Drift Velocity: This is the average velocity attained by charged particles (such as electrons) in a material due to an electric field. The current (I) is defined as I = n * A * e * Vd, where Vd is the drift velocity. Since Vd is proportional to V, current is also proportional to V.

• Ohmic and Non-Ohmic Devices:

• Ohmic Conductors: Materials like Copper, Silver, and Aluminum that follow Ohm's law, showing a straight-line V-I graph passing through the origin.

• Non-Ohmic Conductors: Devices like semiconductors, diodes, and transistors where the resistance changes as the voltage or current changes, resulting in a non-linear V-I characteristic.

• Temperature Coefficient: For pure metals, resistance increases with an increase in temperature. This is because the thermal vibrations of metal ions increase, leading to more frequent collisions with drifting electrons. However, in this specific problem, the constant temperature constraint ensures Ohm's Law is strictly followed.

Important Points

• Ohm's Law Discovery: The law was named after the German physicist Georg Simon Ohm, who published his findings in 1827.

• Power Dissipation: When current flows through a resistor, electrical energy is converted into heat. This is known as Joule Heating, given by P = I^2 * R or P = V^2 / R. In real-world applications, if the voltage doubles, the power dissipation increases four times, which would normally raise the temperature unless cooled.

• Conductance: The reciprocal of resistance is called conductance (G), measured in Siemens (S) or mho. G = 1 / R.

Q9. Answer: (c) Sodium bicarbonate

The correct answer is Sodium bicarbonate.

Key Points

• Sodium bicarbonate (NaHCO3), commonly known as baking soda, is a basic salt. It is formed by the neutralization reaction between a strong base, Sodium hydroxide (NaOH), and a weak acid, Carbonic acid (H2CO3). Since the base is stronger than the acid, the resulting salt retains basic characteristics.

• Sodium chloride (NaCl) is a neutral salt. It is produced from the reaction of Sodium hydroxide (NaOH), which is a strong base, and Hydrochloric acid (HCl), which is a strong acid. In an aqueous solution, it typically maintains a pH of around 7.

• Ammonium chloride (NH4Cl) is an example of an acidic salt. It is formed through the reaction of a strong acid, Hydrochloric acid (HCl), and a weak base, Ammonium hydroxide (NH4OH). Due to the dominance of the strong acid, the salt exhibits acidic properties in water.

• Hydrogen chloride (HCl) is not a salt at all; it is a strong mineral acid. In its gaseous form, it is hydrogen chloride, and when

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dissolved in water, it becomes hydrochloric acid, which is highly corrosive and has a very low pH.

• A basic salt is generally defined as a salt that reacts with water to produce a solution with a pH greater than 7. This occurs because the anion of the weak acid undergoes hydrolysis to produce hydroxide ions (OH-).

Additional Information

• Chemical Nature of Salts:

• Neutral Salts: Formed from a strong acid and a strong base (e.g., KNO3, NaCl).

• Acidic Salts: Formed from a strong acid and a weak base (e.g., (NH4)2SO4, NH4Cl).

• Basic Salts: Formed from a weak acid and a strong base (e.g., CH3COONa, Na2CO3).

• Properties of Sodium Bicarbonate:

• It is a white crystalline solid but often appears as a fine powder.

• It has a slightly salty, alkaline taste.

• The pH of a 0.1 M solution of Sodium bicarbonate is approximately 8.3 at 25 degrees Celsius.

• Applications:

• Baking: It reacts with acidic components in batters to release Carbon dioxide (CO2), causing the dough to rise.

• Medical: Used as an antacid to treat acid indigestion and heartburn by neutralizing excess stomach acid.

• Industrial: Used in soda-acid fire extinguishers and as a mild abrasive in cleaning products.

Important Points

• Salt Hydrolysis: This is the process where the salt reacts with water to give back the acid and base. In the case of Sodium bicarbonate, the bicarbonate ion (HCO3-) reacts with water to form undissociated carbonic acid and hydroxide ions, leading to alkalinity.

• Solubility: Sodium bicarbonate is sparingly soluble in water compared to other sodium salts, but its solubility increases with temperature.

• Safety and Storage: While generally safe, it should be stored in a cool, dry place as moisture can cause it to clump or lose its leavening effectiveness over time.

Q10. Answer: (a) Graphite

The correct answer is Graphite.

Key Points

• Graphite is a crystalline allotrope of carbon that is widely recognized for its ability to conduct electricity, which is an exception among non-metals.

• In the structure of graphite, each carbon atom is covalently bonded to three other carbon atoms in the same plane, creating a series of hexagonal rings arranged in layers.

• The carbon atoms in graphite undergo sp2 hybridization. This leaves one valence electron per carbon atom unbonded and "free" within the layers.

• These delocalized electrons are mobile and can move throughout the graphite sheet, allowing it to act as an efficient electrical conductor.

• Due to this property, graphite is extensively used in the production of electrodes in batteries and industrial electrolysis processes.

Additional Information

• Diamond:

• It is another major allotrope of carbon where each atom is bonded to four other carbon atoms in a rigid tetrahedral structure.

• This involves sp3 hybridization, meaning all four valence electrons are tightly held in covalent bonds.

• Because there are no free or delocalized electrons, diamond acts as an electrical insulator.

• Fullerenes (C60):

• Discovered in 1985, these are spherical allotropes of carbon, often called Buckminsterfullerene or buckyballs.

• While they possess pi-electron systems, pure fullerenes are generally insulators or semiconductors under normal conditions rather than conductors.

• Charcoal:

• This is an amorphous allotrope of carbon obtained by the destructive distillation of wood.

• Unlike graphite, its structure is highly disordered and porous, which prevents the effective flow of electrons, making it a poor conductor of electricity.

• Allotropy:

• This is the phenomenon where a single chemical element exists in multiple physical forms that differ in their atomic arrangement.

• Other allotropes of carbon include graphene, carbon nanotubes, and coke.

Important Points

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• Lubrication: Beyond conductivity, the weak Van der Waals forces between the hexagonal layers of graphite allow them to slide over each other, making it an excellent dry lubricant.

• Thermal Stability: Graphite has a very high melting point (above 3600 degrees Celsius), which allows it to be used in high-temperature crucibles and nuclear reactors as a neutron moderator.

• Comparison: While diamond is the hardest known natural substance due to its 3D bonding, graphite is soft and slippery due to its 2D layered bonding.

Q11. Answer: (c) it evaporates rapidly, absorbing heat from the palm

The correct answer is it evaporates rapidly, absorbing heat from the palm.

Key Points

• Evaporation is a surface phenomenon where molecules in the liquid state gain enough energy to enter the gaseous state. This process inherently causes a cooling effect because the escaping high-energy molecules take thermal energy away from the surface.

• Acetone, commonly known as nail polish remover, is a highly volatile liquid. Volatile substances are those that have a high vapor pressure and a low boiling point, meaning they transition from liquid to vapor very easily at room temperature.

• When acetone is poured onto the palm, the molecules use the latent heat of vaporization required for the phase change. They absorb this necessary thermal energy directly from the skin of the palm. Hence, the statement that it evaporates rapidly, absorbing heat from the palm is correct.

• As the palm loses heat to the acetone, the temperature of the skin surface drops. This physical change is detected by thermoreceptors (nerve endings) in the skin, which send signals to the brain, resulting in the sensation of coldness.

• Regarding the other options: Statement 1 is incorrect as the cold sensation is due to heat loss from the hand, not the "release" of cold vapors. Statement 2 is incorrect because acetone does not act as an anesthetic to block nerve signals in this context. Statement 4 is incorrect because the effect is a physical phase change, not a chemical reaction with water.

Additional Information

• Latent Heat of Vaporization: This is the amount of heat energy required to change 1 kg of a liquid into a gas at its boiling point without any change in temperature. For acetone, this value is approximately 518 kJ/kg at its boiling point.

• Boiling Point of Acetone: Acetone has a relatively low boiling point of about 56.05°C (329.2 K) compared to water, which boils at 100°C. This low boiling point is why it feels much colder than water when placed on the skin, as it evaporates much faster.

• Intermolecular Forces: The reason acetone is volatile is due to its weak intermolecular forces. While it has dipole-dipole interactions, it lacks the strong hydrogen bonding present in water, making it easier for acetone molecules to break away from the liquid surface.

• Comparison with Alcohol: Similar to acetone, isopropyl alcohol (rubbing alcohol) and ethanol also produce a cooling sensation. These are also volatile liquids frequently used in sanitizers and medical swabs.

• Factors Affecting Evaporation: The rate at which a liquid like acetone evaporates depends on the surface area (spreading it on the palm increases the rate), temperature, and humidity. Higher temperatures and lower humidity levels accelerate the evaporation process.

Important Points

• Chemical Formula: Acetone is the simplest ketone with the chemical formula (CH3)2CO. It is a colorless, flammable liquid.

• Industrial Uses: Beyond nail polish remover, acetone is used as a solvent for plastics, synthetic fibers, and in the manufacture of methyl methacrylate.

• Biological Context: Small amounts of acetone are produced in the human body through metabolic processes (ketosis). Excessive levels can be found in the breath of individuals with diabetes mellitus.

• Safety: While it provides a cooling sensation, prolonged skin contact with acetone can cause defatting of the skin, leading to irritation or dermatitis, as it dissolves the natural oils present on the skin surface.

Q12. Answer: (d) 10 m/sec

The correct answer is 10 m/sec.

Key Points

• The problem involves a car moving with uniform acceleration, which allows the use of the equations of motion derived by Sir Isaac Newton.

• According to the question, the car starts from rest. In physics, when an object starts from rest, its initial velocity (u) is always considered to be 0 m/sec.

• The acceleration (a) provided is 2 m/sec². This means the velocity of the car increases by 2 meters per second every single second.

• The time (t) duration for which the acceleration is applied is 5 seconds.

• To find the final velocity (v), we use the first equation of motion: $v = u + at$.

• By substituting the given values: $v = 0 + (2 \times 5)$. Therefore, $v = 10$ m/sec.

• The final velocity at the end of 5 seconds is 10 m/sec. Hence, the calculation confirms that the fourth option is correct.

Additional Information

• Uniform Acceleration:

• This occurs when the velocity of an object changes by an equal amount in every equal time interval.

• In a Velocity-Time graph, uniform acceleration is represented by a straight line. The slope of this line gives the value of the acceleration.

• Equations of Motion:

• There are three primary equations for constant acceleration:

1. $v = u + at$: Relates velocity, acceleration, and time.

2. $s = ut + \frac{1}{2}at^2$: Relates displacement (s), initial velocity, time, and acceleration.

3. $v^2 = u^2 + 2as$: Relates final velocity, initial velocity, acceleration, and displacement.

• Scalar and Vector Quantities:

• Velocity is a vector quantity because it has both magnitude and direction. Its S.I. unit is m/s.

• Acceleration is also a vector quantity, representing the rate of change of velocity. Its S.I. unit is m/s^2.

• Speed is the scalar counterpart of velocity, representing only the magnitude of motion.

• Real-world Application:

• These kinematic equations are fundamental in engineering and automotive safety to calculate braking distances and engine performance. For example, if a car is decelerating (negative acceleration), the same formulas apply by using a negative value for a.

Important Points

• Initial State: Always identify if the object starts from rest (u=0) or comes to a stop (v=0), as these are critical numerical cues in physics problems.

• Units: Ensure all parameters are in S.I. units (meters and seconds) before calculation. If the speed was given in km/hr, it would need to be multiplied by 5/18 to convert to m/sec.

• Direction: Since acceleration is a vector, if the acceleration is in the opposite direction of the velocity, it is termed retardation or deceleration, and its value is taken as negative in the equations.

• Displacement Calculation: If the question asked for the distance traveled in those 5 seconds, we would use $s = ut + \frac{1}{2}at^2$, resulting in $s = 0 + \frac{1}{2}(2)(5)^2 = 25$ meters.

Q13. Answer: (d) Copper

The correct answer is Copper.

Key Points

• The ability of one metal to displace another from its salt solution depends on the Reactivity Series of metals. This series ranks metals based on their chemical reactivity, primarily their ability to lose electrons and form positive ions.

• A displacement reaction is a type of chemical reaction where a more reactive element displaces a less reactive element from its compound. In the context of metals, a metal higher in the reactivity series will displace any metal placed below it from its aqueous salt solution.

• Aluminium is significantly more reactive than Lead. In the reactivity series, Aluminium (Al) is positioned much higher than Lead (Pb). Therefore, if Aluminium is added to a lead salt solution, it will displace the lead. Hence, the statement regarding Aluminium is incorrect for this question.

• Calcium and Magnesium are highly reactive metals belonging to the Alkaline Earth Metals group. Both Calcium (Ca) and Magnesium (Mg) sit high up in the reactivity series, well above Lead (Pb). They can easily displace Lead from its salt solution. Hence, the statements regarding Calcium and Magnesium are incorrect for this question.

• Copper (Cu) is placed below Lead (Pb) in the reactivity series. Since Copper is less reactive than Lead, it does not possess the chemical potential to displace Lead ions from a solution. Hence, the statement regarding Copper is correct as it will NOT displace lead.

Additional Information

• The Reactivity Series:

• The series follows a general order: Potassium (K) > Sodium (Na) > Calcium (Ca) > Magnesium (Mg) > Aluminium (Al) > Zinc (Zn) > Iron (Fe) > Tin (Sn) > Lead (Pb) > Hydrogen (H) > Copper (Cu) > Mercury (Hg) > Silver (Ag) > Gold (Au).

• Metals like Potassium and Sodium are so reactive they are often stored in kerosene to prevent reaction with moisture in the air.

• Metals at the bottom, such as Gold and Platinum, are known as noble metals because they are extremely unreactive and do not easily corrode or react with acids.

• Displacement Reaction Mechanism:

• In these reactions, the more reactive metal undergoes oxidation (loses electrons), while the less reactive metal ion in the solution

undergoes reduction (gains electrons).

• For example, if Magnesium is put into Lead Nitrate solution, the Magnesium atoms turn into ions, and Lead ions turn into solid metallic Lead.

• Since Copper is lower than Lead, it cannot force its electrons onto Lead ions; therefore, no reaction occurs when Copper is placed in a Lead salt solution.

• Lead (Pb):

• Lead has the atomic number 82. It is a heavy metal that is denser than most common materials.

• It is relatively resistant to corrosion but is placed above Hydrogen in the reactivity series, meaning it can theoretically displace hydrogen from dilute acids, though the reaction is often slowed by the formation of insoluble coatings.

• Copper (Cu):

• Copper has the atomic number 29. It is a transition metal known for high thermal and electrical conductivity.

• It is one of the few metals that occur in nature in a directly usable metallic form (native metals). Because it is below Hydrogen and Lead, it is considered a relatively stable and unreactive metal in many environments.

Important Points

• Electrochemical Context: The reactivity series is fundamentally linked to Standard Reduction Potentials. Metals with a more negative reduction potential are more reactive and act as stronger reducing agents.

• Practical Application: This principle is used in Galvanization, where Zinc (more reactive) is used to coat Iron to prevent rusting. The Zinc displaces the corrosive action from the Iron by acting as a sacrificial anode.

• Metal Extraction: The reactivity of a metal determines the method used to extract it from its ore. Highly reactive metals like Aluminium are extracted via electrolysis, while less reactive metals like Lead or Iron can be extracted by reduction with Carbon.

Q14. Answer: (a) They always form closed loops.

The correct answer is They always form closed loops.

Key Points

• Magnetic field lines are imaginary lines used to represent the magnetic field around a magnet. They are continuous and form closed loops. Externally, they emerge from the North pole and enter the South pole, while internally, they travel from the South pole back to the North pole. Hence, statement 1 is correct.

• It is a fundamental property that magnetic field lines never intersect or cross each other. If they were to intersect at a certain point, it would imply that a magnetic compass placed at that point would show two different directions for the magnetic field simultaneously, which is physically impossible. Hence, statement 2 is incorrect.

• Magnetic field lines do not start and end at the same pole. They exist as a continuous flow from the North pole to the South pole outside the magnet and complete the circuit inside. This distinguishes them from electric field lines, which can start on a positive charge and end on a negative charge. Hence, statement 3 is incorrect.

• Because magnetic poles always exist in dipoles (North and South), these field lines must return to their source, making them closed curves rather than open curves. There are no isolated magnetic monopoles in nature that would allow for open field lines. Hence, statement 4 is incorrect.

• Hence, the correct answer is they always form closed loops.

Additional Information

• Nature of Magnetic Field:

• The magnetic field is a vector quantity, meaning it possesses both magnitude and direction.

• The SI unit of magnetic field strength is the Tesla (T), named after Nikola Tesla. Another common unit used is the Gauss, where 1 Tesla equals 10,000 Gauss.

• Field Strength and Density:

• The relative strength of the magnetic field is shown by the degree of closeness of the field lines.

• Where the lines are crowded (near the poles), the magnetic field is strongest. As the lines spread apart, the field becomes weaker.

• Directionality:

• The tangent drawn to a magnetic field line at any given point indicates the direction of the magnetic field at that specific location.

• The direction is determined by the way the North pole of a magnetic needle would point when placed in the field.

Important Points

• Gauss's Law for Magnetism: This law states that the net magnetic flux through any closed surface is always zero. This mathematical principle confirms that magnetic monopoles do not exist and that field lines must be closed loops.

• Discovery: The concept of lines of force or field lines was first introduced by the 19th-century scientist Michael Faraday to visualize electromagnetic induction and magnetic interactions.

• Earth's Magnetic Field: The Earth acts as a giant bar magnet. Its magnetic field lines emerge from the magnetic South Pole (near

the geographic North) and enter the magnetic North Pole (near the geographic South). This property is essential for navigation using a magnetic compass.

• Solenoids: In a current-carrying solenoid, the magnetic field pattern is remarkably similar to that of a bar magnet, where the lines form parallel and uniform paths inside the coil, reinforcing the concept of closed loops.

Q15. Answer: (a) At the centre of curvature, same size

The correct answer is At the centre of curvature, same size.

Key Points

• When an object is placed at the centre of curvature (C) of a concave mirror, the light rays reflecting from the object converge at the same point C.

• According to the laws of reflection, a ray parallel to the principal axis passes through the focus (F) after reflection, and a ray passing through the focus becomes parallel to the principal axis.

• These reflected rays intersect exactly at the centre of curvature, forming the image at that location. Hence, the statement that the image is formed at the centre of curvature is correct.

• The nature of the image formed in this specific case is real and inverted because the light rays actually meet at the point of image formation.

• The size of the image is exactly the same as the size of the object, which is a unique property of this position in concave mirrors. Hence, the correct answer is At the centre of curvature, same size.

Additional Information

• Concave Mirror Characteristics:

• A concave mirror is also known as a converging mirror because it tends to collect light that falls on it, refocusing parallel incoming rays to a single focus.

• It has a reflective surface that is curved inward, resembling a portion of the inner surface of a hollow sphere.

• The uses of concave mirrors include shaving mirrors, dentist's mirrors to see enlarged images of teeth, and reflectors in car headlights and searchlights.

• Other Image Positions in Concave Mirrors:

• At Infinity: If the object is at infinity, the image is formed at the focus (F) and is highly diminished and point-sized.

• Beyond C: When the object is beyond the centre of curvature, the image is formed between F and C, and it is diminished and real.

• Between C and F: If the object is placed between the centre of curvature and the focus, the image is formed beyond C and is magnified.

• At Focus (F): When the object is at the focus, the image is formed at infinity and is highly magnified.

• Between F and Pole (P): This is the only case where a virtual and erect image is formed behind the mirror, which is also magnified.

Important Points

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

• Magnification (m): It is defined as the ratio of the height of the image (h') to the height of the object (h), expressed as $m = h'/h = -v/u$. For an object at C, the magnification is -1, indicating a same-sized, inverted image.

• Radius of Curvature (R): The distance from the pole to the centre of curvature is called the radius of curvature. In spherical mirrors, the focal length is exactly half of the radius of curvature ($f = R/2$).

• Sign Convention: According to the New Cartesian Sign Convention, the distances measured in the direction of incident light are positive, while those measured against it are negative. For a concave mirror, the focal length and radius of curvature are always negative.

Q16. Answer: (a) Endothermic energy change

The correct answer is Endothermic energy change.

Key Points

• Decomposition reactions are chemical processes where a single reactant breaks down into two or more simpler products.

• For a decomposition reaction to occur, the chemical bonds within the reactant molecule must be broken. Breaking these bonds requires an input of energy from the external environment.

• Because these reactions involve the absorption of energy (in the form of heat, light, or electricity), they are generally characterized by an Endothermic energy change. Hence, option 1 is correct.

• An Exothermic energy change is the opposite, where energy is released into the surroundings; this is typically seen in combination or combustion reactions rather than decomposition. Hence, option 3 is incorrect.

• The general representation of this reaction is AB + Energy → A + B, indicating that the energy is a necessary "reactant" for the

process to proceed.

Additional Information

• Types of Decomposition Reactions:

• Thermal Decomposition: This occurs when heat energy is utilized for the reaction. For example, when Calcium Carbonate ($CaCO_3$) is heated, it decomposes into Calcium Oxide (CaO) and Carbon Dioxide (CO_2). This process is vital in the cement industry.

• Electrolytic Decomposition (Electrolysis): This involves passing an electric current through a compound in a liquid or molten state. A well-known example is the electrolysis of water, which decomposes H_2O into Hydrogen (H_2) and Oxygen (O_2) gases.

• Photolytic Decomposition (Photolysis): This is triggered by light energy. For instance, Silver Chloride (AgCl) turns grey in sunlight because it decomposes into Silver metal and Chlorine gas. This principle was historically used in black and white photography.

• Energy Dynamics:

• In an Endothermic reaction, the total energy of the products is higher than the total energy of the reactants because energy has been "stored" in the system during the reaction.

• In contrast, Exothermic reactions (like respiration or burning of natural gas) result in products with lower energy than the reactants, with the excess being released as Heat.

Important Points

• The Law of Conservation of Energy states that energy cannot be created or destroyed, only transformed. In decomposition, kinetic or thermal energy from the environment is transformed into chemical potential energy within the products.

• Activation Energy: Even if a reaction is overall endothermic, it requires a specific amount of activation energy to initiate the bond-breaking process.

• Digestive System: In the human body, the digestion of food is a series of decomposition reactions where complex substances like carbohydrates and proteins are broken down into simpler molecules like glucose and amino acids, often aided by enzymes.

Q17. Answer: (a) Cooking food

The correct answer is Cooking food.

Key Points

• Ultrasound refers to sound waves with frequencies higher than the upper audible limit of human hearing, which is typically 20,000 Hz (20 kHz).

• Cleaning delicate machinery parts: This is a major application where objects like electronic components, watch parts, or surgical instruments are placed in a cleaning solution. High-frequency ultrasound waves are sent through the liquid, causing high-pressure bubbles to form and collapse (cavitation), which dislodges dust, grease, and dirt from hard-to-reach surfaces. Hence, this is a correct application.

• Detecting cracks and flaws in metal blocks: In large constructions like bridges and machines, ultrasound is used to detect internal defects. The waves are passed through the metal block and detected by sensors; if there is a crack, the waves are reflected back, revealing the flaw. Hence, this is a correct application.

• Imaging of internal organs: Ultrasonography is a diagnostic medical technique used to visualize internal organs such as the liver, kidneys, and uterus. It helps doctors detect abnormalities like stones or tumors. Hence, this is a correct application.

• Cooking food: This is not an application of ultrasound. Cooking generally utilizes thermal energy (conduction, convection, radiation) or Microwaves, which are electromagnetic waves that vibrate water molecules to produce heat. Ultrasound is a mechanical wave and does not possess the thermal properties required for standard cooking. Hence, statement 1 is the correct answer as it is NOT an application.

Additional Information

• Medical Applications (Echocardiography):

• Echocardiography is a specific use of ultrasound to capture images of the heart and its movements, used to diagnose cardiac diseases.

• Another medical use is Lithotripsy, where high-energy ultrasound waves are employed to break kidney stones into small grains that can be passed out through urine.

• Industrial and Marine Uses (SONAR):

• SONAR (Sound Navigation and Ranging) utilizes ultrasound to measure the depth of the ocean and to locate underwater objects like submarines, icebergs, or sunken ships.

• The echo-ranging principle is used here, where the time interval between transmission and reception of the pulse is recorded to calculate distance.

• Biological Use (Echolocation):

• Animals like bats, dolphins, and porpoises emit ultrasound waves to navigate and detect prey in the dark.

• Bats can produce frequencies up to 100 kHz to create a "sound map" of their surroundings.

• Physical Properties:

• Ultrasound waves have a short wavelength, allowing them to penetrate deep into materials and reflect off very small surfaces, making them ideal for non-destructive testing and high-resolution imaging.

Q18. Answer: (c) The particles of sugar get into the spaces between particles of water.

The correct answer is The particles of sugar get into the spaces between particles of water.

Key Points

• Everything around us is made of matter, which is composed of extremely tiny particles. These particles are so small that they cannot be seen with the naked eye.

• One of the fundamental characteristics of matter is that there are intermolecular spaces between the particles. In liquids like water, these spaces are larger than in solids but smaller than in gases.

• When sugar (the solute) is added to water (the solvent) and stirred, the sugar crystals break down into individual molecules.

• These sugar molecules then distribute themselves uniformly throughout the liquid by occupying the empty spaces or voids between the water particles. Hence, the statement that particles of sugar get into the spaces between particles of water is correct.

• The sugar particles do not simply float on top because they are denser than water and, once dissolved, they form a uniform mixture. Hence, statement 1 is incorrect.

• A colloidal solution is a mixture where the particle size is between 1 to 1000 nanometers and exhibits the Tyndall effect. Sugar in water forms a true solution, where particles are smaller than 1 nm. Hence, statement 2 is incorrect.

• Sugar is highly soluble in water due to the formation of hydrogen bonds between sugar molecules and water molecules, meaning they mix thoroughly. Hence, statement 4 is incorrect.

Additional Information

• True Solution: A true solution is a homogeneous mixture of two or more substances. In this case, the sugar solution is clear, transparent, and the components cannot be separated by filtration.

• Solute and Solvent: In a solution, the substance that is dissolved is called the solute (e.g., sugar), and the substance in which it is dissolved is the solvent (e.g., water).

• Conservation of Volume: Interestingly, when a small amount of sugar is dissolved in water, the overall volume of the liquid does not increase significantly. This is a classic experiment used in General Science to prove that matter has spaces between its particles.

• Saturation: A solution is called a saturated solution when no more solute can be dissolved in the solvent at a specific temperature. If more sugar is added beyond this point, it will settle at the bottom.

• Kinetic Theory: The particles of matter are in continuous motion. This constant movement helps the sugar particles diffuse and spread evenly throughout the water.

Important Points

• Effect of Temperature: The solubility of sugar in water increases with an increase in temperature. This is because higher temperatures provide more kinetic energy, which increases the vibration of water molecules and expands the intermolecular spaces, allowing more sugar to fit in.

• Physical Change: Dissolving sugar in water is considered a physical change because no new chemical substance is formed; the sugar can be recovered by the process of evaporation or crystallization.

• Particle Size: In a sugar solution, the particles are less than 10^-^9 meters (or 1 nm) in diameter, which is why they do not scatter a beam of light.

• Concentration: The amount of sugar present in a given amount of solution is known as its concentration, which can be expressed in terms of molarity, molality, or mass percentage.

Q19. Answer: (c) It is a gradual process during adolescence involving physical and hormonal changes

The correct answer is It is a gradual process during adolescence involving physical and hormonal changes.

Key Points

• Sexual maturation, commonly known as puberty, is the biological process by which a child's body matures into an adult body capable of sexual reproduction.

• Sexual maturation does not begin after adulthood; rather, it is the bridge that leads to adulthood, typically starting between the ages of 10 and 12 years. Hence, statement 1 is incorrect.

• This process occurs in both males and females. While the specific physical changes differ between the sexes, both undergo significant hormonal and physiological shifts. Hence, statement 2 is incorrect.

• It is characterized as a gradual process that spans several years during the period of adolescence. It involves the complex interaction of the nervous system and the endocrine system to trigger growth and development. Hence, statement 3 is correct.

• Sexual maturation is not a sudden or overnight event. It involves a series of stages (often measured by the Tanner scale) and does not mark the immediate end of body growth; in fact, a significant growth spurt occurs during this phase. Hence, statement 4 is incorrect.

• During this period, the gonads (testes in males and ovaries in females) begin to produce gametes and secrete sex hormones,

leading to the development of secondary sexual characteristics.

Additional Information

• Hormonal Regulation:

• The process is initiated by the hypothalamus, which releases Gonadotropin-Releasing Hormone (GnRH).

• This stimulates the pituitary gland to secrete Luteinizing Hormone (LH) and Follicle-Stimulating Hormone (FSH).

• In males, these hormones stimulate the testes to produce testosterone and sperm.

• In females, they stimulate the ovaries to produce estrogen and progesterone, leading to ovulation.

• Changes in Females:

• The first sign is usually breast development (thelarche), followed by the growth of pubic hair.

• Menarche, the first menstrual period, typically occurs about two years after the start of breast development, usually around age 12 to 13.

• There is also a widening of the pelvis and increased deposition of fat in the hips and thighs.

• Changes in Males:

• The first sign is the enlargement of the testes, followed by the growth of pubic hair and facial hair.

• The larynx (voice box) enlarges, causing the voice to deepen.

• Males experience increased muscle mass and a significant increase in height during their growth spurt.

Important Points

• Adolescence: The World Health Organization (WHO) defines adolescence as the period of life between 10 and 19 years of age. It is a critical phase of physical, psychological, and social transition.

• Secondary Sexual Characteristics: These are features that appear during puberty which distinguish the two sexes of a species, but which are not directly part of the reproductive system (e.g., facial hair in men, breasts in women).

• Primary Sexual Characteristics: These refer to the genitals and internal reproductive organs (testes, ovaries, uterus) that are present at birth but mature during sexual maturation.

• Environmental Factors: The timing of sexual maturation can be influenced by genetics, nutrition, and overall health. Improved nutrition globally has led to a historical trend of earlier onset of puberty.

Q20. Answer: (b) Motor area

The correct answer is Motor area.

Key Points

• The Motor area, specifically known as the Primary Motor Cortex, is the region of the brain responsible for the direct control and execution of voluntary movements.

• It is located in the frontal lobe of the cerebral cortex, specifically along a ridge called the precentral gyrus.

• This area generates neural impulses that travel down the spinal cord to stimulate skeletal muscles, allowing for conscious actions like walking, writing, or speaking.

• The Motor area is organized somatotopically, meaning different parts of the cortex correspond to different parts of the body; this mapping is often referred to as the Motor Homunculus.

• Control is contralateral, which means the motor area in the left hemisphere of the brain controls the voluntary muscles on the right side of the body, and vice versa.

Additional Information

• Medulla Oblongata:

• This structure is located in the brainstem and is primarily responsible for autonomic (involuntary) functions.

• It regulates vital life processes such as heartbeat, breathing, blood pressure, and reflex actions like sneezing or swallowing.

• Sensory Area:

• Located in the parietal lobe (specifically the postcentral gyrus), the primary somatosensory cortex processes incoming signals from the body.

• It is responsible for perceiving sensations such as touch, pressure, temperature, and pain.

• Association Area:

• These areas are found throughout the cerebral cortex and are not involved in primary motor or sensory functions.

• They function to integrate information from multiple sources, facilitating complex mental processes such as learning, memory, thought, and decision-making.

Important Points

• Voluntary Muscles: These are striated muscles (skeletal muscles) that are under conscious control of the somatic nervous system.

• Role of the Cerebellum: While the motor area initiates the signal for movement, the cerebellum is crucial for coordinating those

movements, maintaining balance, and ensuring posture.

• Frontal Lobe Functions: In addition to the motor area, the frontal lobe houses areas responsible for executive function, personality, and speech production (Broca's area).

• Neural Pathway: Motor signals descend from the cerebral cortex through the corticospinal tract, which is the primary pathway for voluntary motor control in humans.

Q21. Answer: (b) Embryo

The correct answer is Embryo.

Key Points

• The Embryo is the most vital part of a seed as it is the "baby plant" that contains the potential to grow into a new individual. It consists of the plumule (the embryonic shoot) and the radicle (the embryonic root). Hence, statement 2 is correct.

• Chlorophyll is the green pigment located in the chloroplasts of plant cells, primarily in the leaves and stems. While it is essential for photosynthesis, it is not the structural component within a seed that initiates the growth of a new plant; rather, it is synthesized as the seedling develops. Hence, statement 1 is incorrect.

• A Sepal is a part of the flower whorl (the calyx) that functions to protect the flower bud before it blooms. It is an external floral organ and is not a component found inside a seed. Hence, statement 3 is incorrect.

• Nectar is a sugar-rich liquid secreted by plants in nectaries to attract pollinators such as bees, birds, and bats. It plays a role in pollination and reproduction but is not stored inside the seed for the growth of the new plant. Hence, statement 4 is incorrect.

• A seed essentially consists of three main parts: the seed coat, the embryo, and the endosperm (or cotyledons) which provides nutrition during the initial stages of germination.

Additional Information

• Structure of the Seed Embryo:

• The Radicle is the first part of the embryo to emerge during germination, eventually forming the primary root system to absorb water and nutrients.

• The Plumule develops into the shoot system, producing the first true leaves of the plant.

• The Hypocotyl is the region of the embryo between the radicle and the cotyledons, which helps push the seed upward through the soil.

• Nutritional Support:

• Cotyledons, also known as seed leaves, store food (starch, proteins, and fats) to sustain the embryo until it can perform photosynthesis.

• In monocots (like Maize), there is only one cotyledon, while in dicots (like Beans), there are two cotyledons.

• Seed Coat (Testa):

• The seed coat is the hard outer covering that protects the delicate embryo from mechanical injury, desiccation, and pathogens.

Important Points

• Germination Factors: For the embryo to begin growing, specific environmental conditions must be met, including the presence of moisture (water), oxygen for respiration, and a suitable temperature.

• Dormancy: Many seeds undergo a period of dormancy, a state of metabolic inactivity that prevents the embryo from germinating until conditions are favorable for survival, often triggered by seasonal changes or hormonal levels like Abscisic Acid.

• Seed Dispersal: Plants have evolved various mechanisms to disperse seeds, such as wind (Anemochory), water (Hydrochory), and animals (Zoochory), ensuring the embryo can find a suitable location to grow away from the parent plant.

Q22. Answer: (c) It converts starch into simple sugars.

The correct answer is It converts starch into simple sugars.

Key Points

• Salivary amylase, also known as ptyalin, is a digestive enzyme present in human saliva that initiates the process of chemical digestion in the mouth.

• The primary function of this enzyme is to catalyze the hydrolysis of starch (a complex polysaccharide) into smaller, simpler sugars like maltose, maltotriose, and limit dextrins. Hence, statement 3 is correct.

• Statement 1 suggests the conversion of amino acids into protein. This is a synthetic (anabolic) process known as translation that occurs within the ribosomes of cells, not in the digestive tract. Hence, statement 1 is incorrect.

• Statement 2 refers to the conversion of simple sugars into starch. This is a process of polymerization typically performed by plants to store energy; humans store excess sugar as glycogen in the liver and muscles. Hence, statement 2 is incorrect.

• Statement 4 describes the conversion of proteins into amino acids. This task is performed by proteolytic enzymes such as pepsin in the stomach and trypsin or chymotrypsin in the small intestine. Hence, statement 4 is incorrect.

• About 30% of starch is hydrolyzed in the oral cavity by salivary amylase before the food is swallowed into the esophagus.

Additional Information

• Composition of Saliva: Human saliva is composed of approximately 99.5% water and 0.5% solutes, including electrolytes (sodium, potassium, chloride), mucus, antibacterial agents (lysozyme), and digestive enzymes.

• Salivary Glands: There are three major pairs of salivary glands: the parotid (located near the ears), submandibular (below the jaw), and sublingual (under the tongue). These glands produce between 1 and 1.5 liters of saliva every day.

• Enzymatic Action: Salivary amylase requires chloride ions as activators to function effectively. It specifically targets the alpha-1,4-glycosidic bonds in starch molecules.

• pH Sensitivity: The enzyme works best at an optimum pH of 6.8. When the food (bolus) reaches the stomach, the highly acidic gastric juice (pH 1.5 to 3.5) denatures the salivary amylase, halting carbohydrate digestion until it reaches the small intestine.

• Digestion Stages: Digestion is broadly divided into mechanical digestion (mastication or chewing) and chemical digestion (enzymatic breakdown). Saliva facilitates both by lubricating the food and providing the necessary enzymes.

Important Points

• Pancreatic Amylase: Since food spends very little time in the mouth, most starch digestion is completed in the small intestine by pancreatic amylase, which is secreted by the pancreas into the duodenum.

• Role of Lysozyme: Saliva also contains lysozyme, which acts as an antimicrobial agent by attacking the cell walls of certain bacteria, helping to prevent infections and tooth decay.

• Glucose Absorption: The end product of total carbohydrate digestion is glucose, which is absorbed into the bloodstream through the villi of the small intestine to provide ATP (energy) to the body cells.

• Biological Catalyst: Enzymes like amylase are biological catalysts that speed up chemical reactions without being consumed in the process, allowing digestion to occur rapidly at body temperature (37°C).

Q23. Answer: (c) white light

The correct answer is white light.

Key Points

• Sir Isaac Newton was the first to use a glass prism to obtain the spectrum of sunlight. He observed that when a narrow beam of sunlight falls on a prism, it splits into a band of seven colors.

• In his experiment, Newton placed a second identical prism in an inverted position with respect to the first prism. He found that the second prism allowed all the colors of the spectrum to pass through it and recombine them.

• The light emerging from the second, inverted prism was a beam of white light. This observation led Newton to the conclusion that sunlight is made up of seven colors.

• The first prism causes dispersion, which is the splitting of white light into its constituent colors (VIBGYOR), while the second prism, being inverted, reverses the effect by refracting the colored rays back together.

• Newton’s experiment was crucial in proving that the prism itself does not "create" colors but rather separates the colors already present in white light.

Additional Information

• Dispersion of Light: This is the phenomenon where white light splits into its component colors when passing through a transparent medium like a glass prism. The band of colored components is called a spectrum.

• VIBGYOR: The acronym stands for Violet, Indigo, Blue, Green, Yellow, Orange, and Red. These represent the sequence of colors in the spectrum, where Violet bends the most and Red bends the least.

• Refraction: The process of recombination and dispersion occurs because different colors of light travel at different speeds in glass. Since each color has a different wavelength, they bend at different angles when entering or exiting the prism.

• Natural Examples: The most common natural phenomenon based on dispersion is the rainbow. It is formed by the dispersion, refraction, and internal reflection of sunlight by tiny water droplets in the atmosphere.

• Wave Nature: The wavelength of Red light is the longest (approximately 700 nm), while the wavelength of Violet light is the shortest (approximately 400 nm) in the visible spectrum.

Important Points

• Historical Context: Newton performed these experiments around 1665-1666. His findings were later published in his famous work titled "Opticks" in 1704.

• Prism Geometry: For successful recombination, the two prisms must be identical and placed parallel to each other but in opposite (inverted) orientations. If the second prism is not inverted, it would simply disperse the light further.

• Visible Spectrum: The visible spectrum is only a small part of the Electromagnetic Spectrum. Human eyes are sensitive to this specific range of frequencies that combine to form white light.

• Angle of Deviation: The total deviation produced by the first prism is canceled out by the second inverted prism, allowing the emergent beam to be parallel to the incident beam, much like light passing through a rectangular glass slab.

Q24. Answer: (d) Lysosomes

The correct answer is Lysosomes.

Key Points

• Lysosomes are membrane-bound vesicular structures formed by the process of packaging in the Golgi apparatus. They contain hydrolytic enzymes but do not possess their own DNA or ribosomes.

• The Nucleus is the most essential part of a eukaryotic cell, acting as the control center. It contains the majority of the cell's genetic material in the form of DNA molecules organized into chromosomes.

• Mitochondria are known as semi-autonomous organelles because they contain their own circular DNA, RNA, and 70S ribosomes, allowing them to synthesize some of their own proteins.

• Plastids, found in all plant cells and euglenoids, also possess their own double-stranded circular DNA and ribosomes. Similar to mitochondria, they can replicate independently of the nucleus.

• Among the given options, only Lysosomes lack a genome, as their primary function is intracellular digestion rather than energy production or genetic storage.

Additional Information

• Lysosomes:

• These are often referred to as the "suicidal bags" of the cell because if the cell gets damaged, lysosomes may burst and the enzymes digest their own cell.

• They are rich in almost all types of hydrolytic enzymes (hydrolases – lipases, proteases, carbohydrases) optimally active at the acidic pH.

• Mitochondria:

• Commonly called the "Powerhouse of the cell," they are the sites of aerobic respiration and produce cellular energy in the form of ATP (Adenosine Triphosphate).

• The presence of mtDNA (Mitochondrial DNA) supports the Endosymbiotic Theory, which suggests they originated from prokaryotic cells.

• Plastids:

• Based on the type of pigments, plastids can be classified into chloroplasts, chromoplasts, and leucoplasts.

• Chloroplasts contain chlorophyll and carotenoid pigments which are responsible for trapping light energy essential for photosynthesis.

• Organelle Autonomy:

• Organelles like the Nucleus, Mitochondria, and Chloroplasts (a type of plastid) are double-membrane bound, whereas Lysosomes are single-membrane bound.

• The DNA found in mitochondria and plastids is circular, resembling bacterial DNA, while nuclear DNA is typically linear.

Important Points

• Genetic Material Location: In a typical animal cell, DNA is strictly confined to the nucleus and the mitochondria. In plant cells, it is found in the nucleus, mitochondria, and plastids.

• Ribosomes: While ribosomes themselves contain RNA, they are not considered organelles that "have" DNA; rather, they are the machinery that translates genetic information.

• Prokaryotic Cells: Unlike eukaryotes, prokaryotes do not have membrane-bound organelles like mitochondria or lysosomes; their DNA is found in a region called the nucleoid.

Q25. Answer: (a) potential energy and kinetic energy

The correct answer is potential energy and kinetic energy.

Key Points

• Mechanical energy is defined as the energy possessed by an object due to its motion or its stored energy of position. It is a macroscopic form of energy.

• It is mathematically expressed as the sum of kinetic energy and potential energy. Hence, option 1 is correct.

• Kinetic Energy (KE): This is the energy of an object resulting from its motion. The amount of kinetic energy depends on the mass of the object and the square of its velocity (K.E. = 1/2 mv^2).

• Potential Energy (PE): This is the stored energy an object has because of its position or state. Common forms include gravitational potential energy (based on height) and elastic potential energy (stored in a stretched spring).

• In the absence of non-conservative forces like friction or air resistance, the total mechanical energy of a system remains constant, which is known as the principle of conservation of mechanical energy.

Additional Information

• Other Forms of Energy:

• Chemical Energy: Energy stored in the bonds of chemical compounds. It is released during a chemical reaction, often in the form

of heat.

• Electrical Energy: Energy caused by the movement of electrons through a conductor, such as a wire.

• Heat Energy (Thermal Energy): Energy that comes from the temperature of the matter, related to the vibration of atoms and molecules.

• Light Energy: A form of electromagnetic radiation that is visible to the human eye, traveling in waves.

• Sound Energy: Energy produced by vibrations as they travel through a medium (like air or water).

• While these other forms are important in thermodynamics and electromagnetism, they are not categorized under the mechanical energy of a physical body in classical mechanics.

Important Points

• SI Unit: The standard unit for measuring mechanical energy is the Joule (J), named after the physicist James Prescott Joule. One Joule is equal to 1 kg?m²/s².

• Scalar Quantity: Energy, including mechanical energy, is a scalar quantity, meaning it has magnitude but no direction.

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

• Conservative vs. Non-conservative Forces: Forces like gravity and spring forces are conservative because the work done by them depends only on the initial and final positions. Friction is a non-conservative force because it converts mechanical energy into heat, reducing the total mechanical energy available.

Q26. Answer: (d) 8

Shortcut Trick

Use Option Verification method to find the Positive Number quickly.

Check Option (4): Number = 8. Increase by 14 => 8 + 14 = 22.

Reciprocal of 8 is 1/8. Now, 176 × (1/8) = 22.

Since 22 = 22, the condition is satisfied.

Therefore The correct answer is 8.

Alternate Method

Given: A positive number increased by 14 equals 176 times its reciprocal.

Formula Used: Let the positive number be x. Equation: x + 14 = 176 × (1/x)

Calculations:

=> x + 14 = 176/x

=> x2 + 14x = 176

=> x2 + 14x − 176 = 0

=> x2 + 22x − 8x − 176 = 0

=> x(x + 22) − 8(x + 22) = 0

=> (x − 8)(x + 22) = 0

=> x = 8 or x = −22

=> Since the number must be positive, x = 8.

Therefore The correct answer is 8.

Additional Information

Quadratic Equations

A quadratic equation of the form ax2 + bx + c = 0 can be solved using the factorization method or the formula x = [−b ± √(b2 − 4ac)] / 2a.

Reciprocal Property

The reciprocal of a non-zero number n is 1/n. The product of a number and its reciprocal is always 1.

Nature of Roots

For the equation x2 + 14x − 176 = 0, the discriminant D = b2 − 4ac = 142 − 4(1)(−176) = 196 + 704 = 900. Since D > 0 and a perfect square, roots are real and rational.

Q27. Answer: (b) 61

Shortcut Trick

Net deviation for the first 9 numbers = 5 × (55 − 58) + 4 × (62 − 58) = 5 × (−3) + 4 × (+4) = −15 + 16 = +1.

To balance the overall average, the sum of the 10^(th), 11^(th), and 12^(th) numbers = (3 × 58) − 1 = 174 − 1 = 173.

Let 10^(th) number = x, then 11^(th) = x + 10 and 12^(th) = x − 5.

Sum: x + x + 10 + x − 5 = 173 => 3x + 5 = 173 => 3x = 168 => x = 56.

Average of 10^(th) (56) and 11^(th) (66) = (56 + 66) ÷ 2 = 61.

Therefore The correct answer is 61.

Alternate Method

Given: Average of 12 numbers = 58; First 5 numbers avg = 55; Next 4 numbers avg = 62.

Relation: 10^(th) = 11^(th) − 10; 10^(th) = 12^(th) + 5.

=> Sum of all 12 numbers = 12 × 58 = 696

=> Sum of first 5 numbers = 5 × 55 = 275

=> Sum of next 4 numbers = 4 × 62 = 248

=> Sum of 10^(th), 11^(th), and 12^(th) numbers = 696 − (275 + 248) = 696 − 523 = 173

=> Let 10^(th) number be x. Then 11^(th) number = x + 10 and 12^(th) number = x − 5

=> x + (x + 10) + (x − 5) = 173

=> 3x + 5 = 173 => 3x = 168 => x = 56

=> 10^(th) number = 56 and 11^(th) number = 56 + 10 = 66

=> Average of 10^(th) and 11^(th) = (56 + 66) ÷ 2 = 122 ÷ 2 = 61

Therefore The correct answer is 61.

Additional Information

Sum of Observations

The sum of any number of observations is equal to the product of their average and the total number of observations (Sum = Average × n).

Net Deviation Method

In any data set, the sum of deviations of all observations from the arithmetic mean is always zero (Σ(x_i − Mean) = 0).

Combined Average Formula

If two groups have sizes n1, n2 and averages a1, a2, their combined average = (n1a1 + n2a2) ÷ (n1 + n2).

Q28. Answer: (c) 3x

Shortcut Trick

Identify $9x^2 - 4y^2$ as $(3x)^2 - (2y)^2$ which factors into $(3x - 2y)(3x + 2y)$.

The term $(3x - 2y)$ cancels out with the first denominator.

The term $(3x + 2y)$ cancels out with the second denominator.

Only the numerator 3x remains as the final result.

Therefore The correct answer is 3x.

Alternate Method

Given: $((9x^2 - 4y^2) \div (3x - 2y)) \times (3x \div (3x + 2y))$

Formula Used: $a^2 - b^2 = (a - b)(a + b)$

=> Factorizing the numerator: $9x^2 - 4y^2 = (3x)^2 - (2y)^2 = (3x - 2y)(3x + 2y)$

=> Substituting the factorized form: $[(3x - 2y)(3x + 2y) \div (3x - 2y)] \times [3x \div (3x + 2y)]$

=> Canceling $(3x - 2y)$ from the first part: $(3x + 2y) \times [3x \div (3x + 2y)]$

=> Canceling $(3x + 2y)$ from the product: 3x

Therefore The correct answer is 3x.

Additional Information

Algebraic Identity: Difference of Squares

The identity $a^2 - b^2 = (a - b)(a + b)$ is used to simplify rational expressions and factorize polynomials efficiently.

Rational Expression Multiplication

To multiply algebraic fractions, factorize all terms and cancel common factors from the numerator and denominator before multiplying.

Perfect Square Identity

Another related identity is $(a + b)^2 = a^2 + 2ab + b^2$, which is often used in quadratic simplification.

Q29. Answer: (a) 72°

Shortcut Trick

In right-angled triangle BDC, the angle at C is 90° − 42° = 48°.

For triangle AEC, the exterior angle angle AEB is equal to the sum of the two opposite interior angles.

Therefore angle AEB = angle CAE + angle C = 24° + 48° = 72°.

Therefore The correct answer is 72°.

Alternate Method

Given:

In ΔABC, BD perpendicular to AC at D, angle DBC = 42°, and angle CAE = 24°.

Formula Used:

1. Sum of angles in a triangle = 180°

2. Exterior Angle Theorem: The exterior angle of a triangle is equal to the sum of the two opposite interior angles.

Calculations:

In right-angled ΔBDC:

=> angle BDC = 90°

=> angle DBC + angle BDC + angle C = 180°

=> 42° + 90° + angle C = 180°

=> angle C = 180° − 132° = 48°

Now, in ΔAEC, E is a point on BC, so angle AEB is the exterior angle at vertex E:

=> angle AEB = angle CAE + angle C

=> angle AEB = 24° + 48°

=> angle AEB = 72°

Option Analysis:

=> Option 1 (72°): Correct, as calculated using the exterior angle theorem.

=> Option 2 (67°): Incorrect, as it does not satisfy the angle sum property of ΔAEC.

=> Option 3 (59°): Incorrect, as it deviates from the geometric properties of the given triangle.

=> Option 4 (58°): Incorrect, as it is mathematically inconsistent with the given angle values.

Therefore The correct answer is 72°.

Additional Information

Exterior Angle Theorem

The measure of an exterior angle of a triangle is equal to the sum of the measures of its two remote interior angles.

Angle Sum Property

The sum of all interior angles of any triangle is always equal to 180°.

Right-Angled Triangle Properties

In a right-angled triangle, the two acute angles are complementary, meaning their sum is always 90°.

Q30. Answer: (d) Rs. 19,044

Shortcut Trick

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

Total profit = Rs. 5,000 | Anmol's share = Rs. 2,300 | Ayushi's share = 5,000 − 2,300 = Rs. 2,700.

Ratio of Profit (Anmol : Ayushi) = 2,300 : 2,700 = 23 : 27.

Total ratio parts = 23 + 27 = 50 units → Rs. 41,400.

1 unit = 41,400 ÷ 50 = Rs. 828.

Anmol's investment = 23 × 828 = Rs. 19,044.

Therefore The correct answer is Rs. 19,044.

Alternate Method

Given: Total Investment = Rs. 41,400, Total Profit = Rs. 5,000, Anmol's Profit = Rs. 2,300.

Formula: Investment_(Anmol) = (Profit_(Anmol) ÷ Total Profit) × Total Investment

=> Calculate Anmol's share of profit as a fraction of total profit: 2,300 ÷ 5,000.

=> Simplify the fraction: 23 ÷ 50.

=> Multiply this fraction by the Total Investment to find Anmol's contribution.

=> Anmol's Investment = (23 ÷ 50) × 41,400.

=> Anmol's Investment = 23 × 828 = 19,044.

Therefore The correct answer is Rs. 19,044.

Additional Information

Partnership Principles

When the period of investment is the same for all partners, the profit is distributed in the direct ratio of their investments.

Compound Partnership

If investments are for different time periods, Profit Ratio = (Capital1 × Time1) : (Capital2 × Time2).

Q31. Answer: (b) 7 hours

Shortcut Trick

Since speed is constant, distance is directly proportional to time (D1/T1 = D2/T2).

180 km → 3 hours

1 km → 3/180 hours = 1/60 hours

420 km → 420 × (1/60) = 7 hours

Therefore The correct answer is 7 hr.

Alternate Method

Given:

Initial Distance (D1) = 180 km

Initial Time (T1) = 3 hours

New Distance (D2) = 420 km

Formula Used:

Speed = Distance ÷ Time

Calculations:

=> Speed = 180 ÷ 3 = 60 kmph

=> Time required for 420 km = Distance ÷ Speed

=> Time = 420 ÷ 60

=> Time = 7 hours

Therefore The correct answer is 7 hr.

Additional Information

Speed-Distance-Time Relationship

When time is constant, distance is proportional to speed. When distance is constant, speed is inversely proportional to time.

Unit Conversion

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

Average Speed

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

Q32. Answer: (a) 8,21,142

Shortcut Trick

Total Voters = 25,20,000

Valid Votes = 25,20,000 × 0.98 × 0.95

Losing candidate % = 100% − 65% = 35%

Losing candidate votes = 25,20,000 × 98/100 × 95/100 × 35/100 = 8,21,142

Therefore The correct answer is 8,21,142.

Alternate Method

Given: Total voters = 25,20,000 | Voter turnout = 98% | Valid votes = 95% of polled | Winner = 65% of valid.

=> Total Polled Votes = 25,20,000 × (98/100) = 24,69,600

=> Total Valid Votes = 24,69,600 × (95/100) = 23,46,120

=> Losing Candidate Share = 100% − 65% = 35%

=> Votes for Loser = 23,46,120 × (35/100)

=> Final Calculation = 23,46,120 × 0.35 = 8,21,142

Therefore The correct answer is 8,21,142.

Additional Information

Election Base Change

Always calculate the next percentage on the reduced base (e.g., valid votes are a % of polled votes, not total voters).

Valid vs Invalid Votes

Valid Votes = (Total Votes − Non-voters) − Invalid Votes. The winner and loser percentages are usually calculated on Valid Votes.

Successive Percentage Formula

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Final Value = Initial Value × (1 ± r1/100) × (1 ± r2/100) × ...

Q33. Answer: (c) C, B, A

Shortcut Trick

Scheme A discount% = [Free Items ÷ Total Items] × 100 = [5 ÷ (1 + 5)] × 100 = 83.33%.

Scheme B discount% = 64%.

Scheme C discount% = a + b − ab ÷ 100 = 3 + 37 − (3 × 37) ÷ 100 = 40 − 1.11 = 38.89%.

Comparing 38.89% (C) < 64% (B) < 83.33% (A).

Ascending order is C, B, A.

Therefore The correct answer is C, B, A.

Alternate Method

Given → Scheme A: Buy 1 Get 5 Free; Scheme B: 64% Single Discount; Scheme C: Successive 3% and 37%.

Formulas: Discount% = (Free ÷ Total) × 100 | Successive = a + b − ab ÷ 100

=> Scheme A: Buy 1 get 5 free means customer gets 6 articles for the price of 1. Discount = 5 ÷ 6 × 100 = 83.33%.

=> Scheme B: Single discount = 64.00%.

=> Scheme C: Net Discount = 3 + 37 − (3 × 37 ÷ 100) = 40 − 1.11 = 38.89%.

=> Arranging in Ascending Order: 38.89% < 64% < 83.33%.

Therefore The correct answer is C, B, A.

Additional Information

Buy X Get Y Free

In such offers, the discount percentage is calculated as [Y ÷ (X + Y)] × 100, where Y is the free quantity and X+Y is the total quantity.

Successive Discounts

Two successive discounts of x% and y% are always less than a single discount of (x+y)% because the second discount is applied to a reduced price.

Q34. Answer: (a) 77.94 m

Shortcut Trick

For an angle of depression of 30°, the ratio of the height of the building to the distance of the car is 1 : √3.

Given height = 45 m, which corresponds to 1 unit.

Therefore, distance = 45 × √3 = 45 × 1.732 = 77.94 m.

Therefore The correct answer is 77.94 m.

Alternate Method

Given: Height of building (AB) = 45 m, Angle of depression = 30°.

Formula Used: tan θ = Perpendicular ÷ Base

=> In right-angled triangle ABC, let BC be the distance of the car.

=> tan 30° = AB ÷ BC

=> 1/√3 = 45 ÷ BC

=> BC = 45 × √3

=> BC = 45 × 1.732

=> BC = 77.94 m

Therefore The correct answer is 77.94 m.

Additional Information

Angle of Depression

It is the angle between the horizontal line and the line of sight when looking down at an object. It is numerically equal to the angle of elevation due to alternate interior angles.

Standard Trigonometric Ratios

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

Value of √3

The approximate value of √3 is 1.732, and √2 is 1.414. These are frequently used in heights and distances problems.

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Q35. Answer: (a) 50 cm

Shortcut Trick

In a rhombus, the relationship between side (a) and diagonals (d1, d2) is: $4a^2 = d1^2 + d2^2$.

Given diagonals are 24 cm and 7 cm.

Side (a) = $\sqrt{(d1^2 + d2^2)} \div 2 = \sqrt{(24^2 + 7^2)} \div 2 = \sqrt{(576 + 49)} \div 2 = \sqrt{625} \div 2 = 25 \div 2 = 12.5$ cm.

Perimeter = 4 × side = 4 × 12.5 = 50 cm.

Therefore The correct answer is 50 cm.

Alternate Method

Given: Diagonal d1 = 24 cm and Diagonal d2 = 7 cm.

Formula Used: In a rhombus, diagonals bisect each other at 90°. Using Pythagoras Theorem in the small right-angled triangle formed by the halves of the diagonals: $Side^2 = (d1/2)^2 + (d2/2)^2$.

Let the diagonals intersect at point O. In right-angled triangle AOB:

=> AO = d1 ÷ 2 = 24 ÷ 2 = 12 cm

=> BO = d2 ÷ 2 = 7 ÷ 2 = 3.5 cm

=> $AB^2 = AO^2 + BO^2$

=> $AB^2 = 12^2 + 3.5^2 = 144 + 12.25 = 156.25$

=> AB = $\sqrt{156.25}$ = 12.5 cm

=> Perimeter = 4 × Side = 4 × 12.5 = 50 cm

Therefore The correct answer is 50 cm.

Additional Information

Area of Rhombus

The area is calculated as half the product of its diagonals: Area = 1/2 × d1 × d2.

Properties of Rhombus

All four sides are equal, opposite angles are equal, and diagonals bisect each other at 90°.

Diagonal and Side Relation

For a rhombus with side 'a' and diagonals 'p' and 'q', the identity is $p^2 + q^2 = 4a^2$.

Q36. Answer: (b) Rs. 6615

Shortcut Trick

Effective Rate of Interest for 2 years at 5% = x + y + (xy/100)

=> 5 + 5 + (5 × 5)/100 = 10.25%

Total Amount = 100% + 10.25% = 110.25% of Principal

=> Amount = 6000 × 110.25 / 100 = 60 × 110.25 = Rs. 6615

Therefore The correct answer is Rs. 6615.

Alternate Method

Given:

Principal (P) = Rs. 6000

Rate (R) = 5% per annum

Time (n) = 2 years

Formula Used:

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

Calculations:

=> $A = 6000 \times (1 + 5/100)^2$

=> $A = 6000 \times (1 + 1/20)^2$

=> $A = 6000 \times (21/20) \times (21/20)$

=> $A = 6000 \times (441 / 400)$

=> A = 15 × 441

=> A = Rs. 6615

Therefore The correct answer is Rs. 6615.

Additional Information

Compound Interest Formula

The interest earned is given by CI = Amount − Principal = $P[(1 + R/100)^n - 1]$.

Difference between CI and SI for 2 years

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

Half-Yearly Compounding

When interest is compounded half-yearly, the rate becomes R/2 and the time period becomes 2n.

Q37. Answer: (b) 8 seconds

Shortcut Trick

Total distance = 165 + 195 = 360 m

Relative speed (opposite direction) = 83 + 79 = 162 kmph

Relative speed in m/s = 162 × 5/18 = 45 m/s

Time = 360 ÷ 45 = 8 seconds

Therefore The correct answer is 8 sec.

Alternate Method

Given: Length of first train (L1) = 165 m, Length of second train (L2) = 195 m. Speed of first train (S1) = 83 km/hr, Speed of second train (S2) = 79 km/hr.

Formula Used: Time = (L1 + L2) ÷ (S1 + S2)

=> Total Length = 165 + 195 = 360 m

=> Relative Speed = (83 + 79) × 5/18 m/s

=> Relative Speed = 162 × 5/18 = 9 × 5 = 45 m/s

=> Time taken = 360 / 45

=> Time taken = 8 seconds

Therefore The correct answer is 8 sec.

Additional Information

Relative Speed in Opposite Direction

When two objects move in opposite directions, their relative speed is the sum of their individual speeds: $V_{rel} = S1 + S2$.

Relative Speed in Same Direction

When two objects move in the same direction, their relative speed is the difference between their individual speeds: $V_{rel} = |S1 − S2|$.

Conversion of Speed Units

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

Q38. Answer: (d) 250

Shortcut Trick

Let the cost price to B be CP.

Successive Profit Multiplier: B sells at 112% and C sells at 112%.

CP × 1.12 × 1.12 = 313.60

CP × 1.2544 = 313.60

CP = 313.60 ÷ 1.2544 = 250

Therefore The correct answer is Rs. 250.

Alternate Method

Given → Profit % for B = 12%, Profit % for C = 12%, Final SP (to D) = Rs. 313.60.

Formulas: SP = CP × (100 + P%) ÷ 100

=> Let CP of B = x

=> CP of C (which is SP of B) = x × (112 ÷ 100) = 1.12x

=> SP of C (which is CP of D) = 1.12x × (112 ÷ 100) = 1.2544x

=> 1.2544x = 313.60

=> x = 313.60 ÷ 1.2544 = 250

Therefore The correct answer is Rs. 250.

Additional Information

Successive Percentage Change

When a value changes by a% and then by b%, the net percentage change is given by [a + b + (ab ÷ 100)]%.

Cost Price and Selling Price Relationship

The Selling Price (SP) of the seller is always equal to the Cost Price (CP) of the buyer in a transaction chain.

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Q39. Answer: (c) 80/3

Shortcut Trick

Let D's age be D and B's age be B.

Given D = B + 10 → B = D − 10.

B = 5 × |C − D|. Since we need minimum D and D = B + 10, D must be greater than B.

For minimum D, we check the case where D < C: D − 10 = 5(30 − D).

D − 10 = 150 − 5D => 6D = 160 => D = 80/3.

Therefore The correct answer is 80/3 years.

Alternate Method

Given: C = 30 years, B = 5|C − D|, D = B + 10.

From the problem, we have two possible cases for the absolute difference |C − D|:

Case 1: D ≥ C

=> B = 5(D − 30)

Substitute B = D − 10:

=> D − 10 = 5D − 150

=> 4D = 140 => D = 35 years

Case 2: D < C

=> B = 5(30 − D)

Substitute B = D − 10:

=> D − 10 = 150 − 5D

=> 6D = 160 => D = 160/6 = 80/3 years

Comparing 35 and 80/3 (26.66), the minimum age is 80/3.

Therefore The correct answer is 80/3 years.

Additional Information

Absolute Difference in Ages

The expression |x − y| ensures a positive value regardless of which person is older, leading to two linear equations.

Ages involving Ratios

If the ratio of ages is a:b, we assume ages as ax and bx to solve for the constant x.

Q40. Answer: (b) decrease by Rs. 10,285

Shortcut Trick

Initial Savings = 5.5% of 34,000 = Rs. 1,870. Initial Expenditure = 94.5% of 34,000 = Rs. 32,130.

New Income = 34,000 × 1.17 = Rs. 39,780.

New Expenditure = 32,130 × 1.50 = Rs. 48,195.

New Savings = 39,780 − 48,195 = −Rs. 8,415 (Deficit).

Change in Savings = −8,415 − 1,870 = −Rs. 10,285.

Therefore The correct answer is decrease by Rs. 10,285.

Alternate Method

Given: Initial Income = Rs. 34,000, Savings % = 5.5%, Income increase = 17%, Expenditure increase = 50%.

Formula: Income = Expenditure + Savings

=> Initial Savings = (5.5 ÷ 100) × 34,000 = Rs. 1,870

=> Initial Expenditure = 34,000 − 1,870 = Rs. 32,130

=> New Income = 34,000 + (17 ÷ 100 × 34,000) = 34,000 + 5,780 = Rs. 39,780

=> New Expenditure = 32,130 + (50 ÷ 100 × 32,130) = 32,130 + 16,065 = Rs. 48,195

=> New Savings = 39,780 − 48,195 = −Rs. 8,415

=> Change in Savings = New Savings − Initial Savings = −8,415 − 1,870 = −Rs. 10,285

Therefore The correct answer is decrease by Rs. 10,285.

Additional Information

Income-Expenditure Relation

The fundamental equation is Income = Expenditure + Savings. Any change in two variables directly affects the third.

Percentage Change

New Value = Original Value × (1 ± Change%/100). A negative result in savings indicates a deficit or debt.

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Base Value Importance

Always ensure the percentage increase is applied to the correct base component (e.g., expenditure increase is on initial expenditure, not income).

Q41. Answer: (a) $25y^2$

Shortcut Trick

For two numbers a and b, the third proportional is given by $b^2 \div a$.

Here, $a = 16x^2$ and $b = 20xy$.

Third Proportional = $(20xy)^2 \div 16x^2$

=> $(400x^2y^2) \div 16x^2 = 25y^2$.

Therefore The correct answer is $25y^2$.

Alternate Method

Given: First term (a) = $16x^2$, Second term (b) = $20xy$.

Formula Used: If a, b, c are in continued proportion, then $a/b = b/c \Rightarrow c = b^2/a$.

=> Let the third proportional be c.

=> $16x^2 \div 20xy = 20xy \div c$

=> $c = (20xy \times 20xy) \div 16x^2$

=> $c = 400x^2y^2 \div 16x^2$

=> $c = 25y^2$

Therefore The correct answer is $25y^2$.

Additional Information

Mean Proportional

The mean proportional between two numbers a and b is $\sqrt{(ab)}$.

Fourth Proportional

If four quantities a, b, c, d are in proportion (a:b = c:d), then the fourth proportional $d = (b \times c) \div a$.

Continued Proportion

Three numbers a, b, c are in continued proportion if the ratio of the first to the second is equal to the ratio of the second to the third (a:b = b:c).

Q42. Answer: (a) 100

Shortcut Trick

Observe the relation between numerator and denominator terms:

$0.0079 = 0.079 \div 10$

Every term in the denominator is 1/10th of the corresponding term in the numerator.

Since the terms are squared, the denominator becomes 1/100th of the numerator.

Expression = Numerator ÷ (Numerator ÷ 100) = 100

Therefore The correct answer is 100.

Alternate Method

Given:

Expression = $(0.079^2 + 0.25^2 + 3.37^2) \div (0.0079^2 + 0.025^2 + 0.337^2)$

Calculations:

=> Let a = 0.079, b = 0.25, and c = 3.37

=> The denominator terms can be written as:

=> $0.0079 = a / 10$

=> $0.025 = b / 10$

=> $0.337 = c / 10$

=> Substituting these variables into the given expression:

=> Expression = $(a^2 + b^2 + c^2) \div [(a / 10)^2 + (b / 10)^2 + (c / 10)^2]$

=> Expression = $(a^2 + b^2 + c^2) \div [(a^2 / 100) + (b^2 / 100) + (c^2 / 100)]$

=> Expression = $(a^2 + b^2 + c^2) \div [(a^2 + b^2 + c^2) / 100]$

=> Expression = $100 \times [(a^2 + b^2 + c^2) \div (a^2 + b^2 + c^2)]$

=> Expression = $100 \times 1 = 100$

Therefore The correct answer is 100.

Additional Information

Decimal Fractions

When shifting the decimal point one place to the left, the value is divided by 10. Squaring this shifted value effectively divides the original square by 100.

Algebraic Substitution

Replacing complex decimal numbers with variables (like a, b, c) simplifies the expression visually and makes it easier to cancel out common terms.

BODMAS Rule

Always resolve powers (orders) and division before addition to avoid calculation errors in simplification questions.

Q43. Answer: (b) 59

Shortcut Trick

Teacher's Age = New Average + (Initial Count × Increase in Average)

Increase in average = 19 − 18 = 1 year

Teacher's Age = 19 + (40 × 1)

Teacher's Age = 19 + 40 = 59 years

Therefore The correct answer is 59 years.

Alternate Method

Given:

Number of students = 40

Initial average age = 18 years

New average age (including teacher) = 19 years

Formula Used:

Total Age = Average Age × Number of Persons

Calculations:

=> Total age of 40 students = 40 × 18 = 720 years

=> Total number of people including teacher = 40 + 1 = 41

=> Total age of 41 people = 41 × 19 = 779 years

=> Age of the teacher = Total age of 41 people − Total age of 40 students

=> Teacher's age = 779 − 720 = 59 years

Therefore The correct answer is 59 years.

Additional Information

General Average Formula

Average = (Sum of all observations) ÷ (Total number of observations).

Effect of New Entry

If the average increases by 'x' when one person is added, the new person's value = Old Average + (New Total Strength × x).

Weighted Average

When two groups with averages A1 and A2 and sizes n1 and n2 are combined, Average = (n1A1 + n2A2) ÷ (n1 + n2).

Q44. Answer: (c) 15 days

Shortcut Trick

Total Work in terms of Men = 5 × 16 = 80 Man-days.

Total Work in terms of Women = 9 × 8 = 72 Woman-days.

Equating Work: 80M = 72W => 10M = 9W => 1M = 0.9W.

Required Group: 3W + 2M = 3W + 2(0.9W) = 3W + 1.8W = 4.8W.

Days = (Total Woman-days) ÷ (Efficiency of Group) = 72 ÷ 4.8 = 15 days.

Therefore The correct answer is 15 days.

Alternate Method

Given: 5 Men in 16 days, 9 Women in 8 days.

Formula Used: Total Work = Number of People × Efficiency × Time

Person	Days	Total Work	Efficiency
5 Men	16	720	45 (9 per Man)

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9 Women	8	90 (10 per Woman)	

=> Efficiency of 1 Man = 45 ÷ 5 = 9 units/day
=> Efficiency of 1 Woman = 90 ÷ 9 = 10 units/day
=> Efficiency of (3 Women + 2 Men) = (3 × 10) + (2 × 9) = 30 + 18 = 48 units/day
=> Total Work = 5 × 9 × 16 = 720 units
=> Days Required = 720 ÷ 48 = 15 days
Therefore The correct answer is 15 days.
Additional Information
Work Equivalence Formula
M1D1H1 = M2D2H2 is used when the amount of work remains constant across two different groups.
Efficiency and Time Relationship
Efficiency is inversely proportional to the time taken to complete the work (E prop. to 1/T).
Man-Day Concept
The total work is often expressed in Man-days or Woman-days to simplify ratio calculations between different genders or groups.

Q45. Answer: (b) 250%

Shortcut Trick
Convert fractions to decimals for easier comparison.
1/20 = 0.05 and 2/100 = 0.02
Percentage = (0.05 ÷ 0.02) × 100 = 5/2 × 100 = 250%
Therefore The correct answer is 250%.
Alternate Method
Given:
First number (A) = 1/20
Second number (B) = 2/100
Formula Used:
Percentage = (Value / Base Value) × 100
Calculations:
=> Required Percentage = [(1/20) ÷ (2/100)] × 100
=> Required Percentage = [1/20 × 100/2] × 100
=> Required Percentage = [100/40] × 100
=> Required Percentage = 2.5 × 100
=> Required Percentage = 250%
Therefore The correct answer is 250%.
Additional Information
Percentage to Fraction
To convert a percentage to a fraction, divide the number by 100 and remove the % sign (e.g., 25% = 25/100 = 1/4).
Fraction to Percentage
To convert a fraction to a percentage, multiply the fraction by 100 and add the % sign (e.g., 1/5 × 100 = 20%).
Base Value Identification
In questions like "A is what % of B", B is always the denominator (base), and A is the numerator.

Q46. Answer: (c) 36

Shortcut Trick
Evaluate power first: $3^2 = 9$
Expression becomes: 4 × 17 × 9 ÷ 12 + 26 − 41
Cancel: 4/12 = 1/3 => 17 × 9 ÷ 3 = 17 × 3 = 51
Now: 51 + 26 − 41
Therefore Answer = 36
Alternate Method
Given:

$4 \times (17 \times (3^2)) \div 12 + 26 - 41$

Concept Used:

BODMAS rule

Calculation:

=> $4 \times (17 \times 9) \div 12 + 26 - 41$

=> $4 \times 153 \div 12 + 26 - 41$

=> $612 \div 12 + 26 - 41$

=> $51 + 26 - 41$

=> $77 - 41$

=> 36

Therefore The correct answer is 36.

Additional Information

BODMAS Rule

Brackets, Orders (powers), Division and Multiplication, Addition and Subtraction

Order of Operations

Solve powers first, then × and ÷ from left to right, then + and −

Simplification Trick

Cancel common factors early to reduce calculation

Q47. Answer: (b) 1,422 m²

Shortcut Trick

Ratio of dimensions = 8 : 5 : 3. Let common factor be x.

Diagonal square ratio: $8^2 + 5^2 + 3^2 = 64 + 25 + 9 = 98$ units.

Actual diagonal squared = $(21\sqrt{2})^2 = 441 \times 2 = 882$.

Calculating $x^2 = 882 \div 98 = 9$ => $x = 3$.

Total Surface Area (TSA) = $2 \times x^2 \times (8 \times 5 + 5 \times 3 + 3 \times 8) = 2 \times 9 \times 79 = 1,422$ m².

Therefore The correct answer is 1,422 m².

Alternate Method

Given: Ratio of Length (L), Breadth (B), and Height (H) = 8 : 5 : 3 and Diagonal (D) = $21\sqrt{2}$ m.

Formula Used: Diagonal = $\sqrt{(L^2 + B^2 + H^2)}$ | TSA = 2(LB + BH + HL)

=> Let L = 8x, B = 5x, H = 3x.

=> $(8x)^2 + (5x)^2 + (3x)^2 = (21\sqrt{2})^2$

=> $64x^2 + 25x^2 + 9x^2 = 441 \times 2$

=> $98x^2 = 882$

=> $x^2 = 9$ => $x = 3$ m.

=> L = 8 × 3 = 24 m, B = 5 × 3 = 15 m, H = 3 × 3 = 9 m.

=> TSA = 2 × (24 × 15 + 15 × 9 + 24 × 9)

=> TSA = 2 × (360 + 135 + 216)

=> TSA = 2 × 711

=> TSA = 1,422 m².

Therefore The correct answer is 1,422 m².

Additional Information

Total Surface Area of Cuboid

It is the sum of the areas of all 6 faces: TSA = 2(lb + bh + hl).

Diagonal of a Cuboid

The longest rod that can be placed inside a cuboid is its diagonal, given by $d = \sqrt{(l^2 + b^2 + h^2)}$.

Volume of Cuboid

The space occupied by the cuboid is calculated as Volume = l × b × h.

Lateral Surface Area (LSA)

The area of the four side walls (excluding top and bottom) is LSA = 2h(l + b).

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Q48. Answer: (d) 5

Shortcut Trick

Combined efficiency of A, B, and C = 1/2 + 1/20 + 1/20 = (10 + 1 + 1)/20 = 12/20 = 3/5 unit/day.

Days taken for same work = 1 / (3/5) = 5/3 days.

Days taken for thrice the work = 3 × (5/3) = 5 days.

Therefore The correct answer is 5 days.

Alternate Method

Given: Time taken by A = 2 days, B = 20 days, C = 20 days.

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

Calculations:

=> Total Work (LCM of 2, 20, 20) = 20 units

=> Total Efficiency of (A + B + C) = 10 + 1 + 1 = 12 units/day

=> New Work = 3 × Total Work = 3 × 20 = 60 units

=> Time required = New Work ÷ Total Efficiency

=> Time = 60 ÷ 12 = 5 days

Therefore The correct answer is 5 days.

Additional Information

Efficiency and Time Relation

Time taken is inversely proportional to efficiency. Work = Time × Efficiency.

Work and Days Direct Proportion

If the amount of work increases by a factor of n, the time taken to complete it (at constant efficiency) also increases by factor n.

Q49. Answer: (b) 13.48%

Shortcut Trick

The relation between Cost Price (CP) and Marked Price (MP) is given by the ratio:

CP : MP = (100 − Discount%) : (100 + Profit%)

Let Discount% be d. Given MP is 41% above CP, so MP/CP = 141/100.

100 / 141 = (100 − d) / (100 + 22)

100 / 141 = (100 − d) / 122 => 12200 = 14100 − 141d

141d = 1900 => d = 1900 ÷ 141 ≈ 13.48%.

Therefore The correct answer is 13.48%.

Alternate Method

Given: MP = Rs. 331, MP is 41% above CP, Profit = 22%.

Formulas: CP = MP × 100 ÷ (100 + Markup%); SP = CP × (100 + Profit%) ÷ 100; Discount% = (MP − SP) ÷ MP × 100.

=> CP = 331 × 100 ÷ 141 = Rs. 234.7517...

=> Selling Price (SP) = 234.7517 × 122 ÷ 100 = Rs. 286.397...

=> Discount = MP − SP = 331 − 286.397 = Rs. 44.603...

=> Discount% = (44.603 ÷ 331) × 100 = 13.475% ≈ 13.48%.

Therefore The correct answer is 13.48%.

Additional Information

Marked Price and Markup

Markup is the extra price added to the Cost Price to arrive at the Marked Price. Markup% = (Markup ÷ CP) × 100.

Effective Percentage Change

Successive application of markup and discount results in profit: %Profit = %Markup − %Discount − (%Markup × %Discount) ÷ 100.

Q50. Answer: (b) 1

Shortcut Trick

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For 7n4 to be divisible by 6, it must be divisible by both 2 and 3.
Since the last digit is 4, it is divisible by 2.
For divisibility by 3, the sum of digits (7 + n + 4 = 11 + n) must be a multiple of 3.
The smallest single-digit whole number n making 11 + n divisible by 3 is 1 (since 11 + 1 = 12).
Therefore The correct answer is 1.
Alternate Method
Given: Three-digit number is 7n4 which is divisible by 6.
Formula Used: A number is divisible by 6 if it is divisible by both 2 and 3.
=> Divisibility by 2: The unit digit is 4, which is even. Thus, 7n4 is divisible by 2 for any integer n.
=> Divisibility by 3: Sum of the digits must be divisible by 3.
=> Sum of digits = 7 + n + 4 = 11 + n
=> For 11 + n to be divisible by 3, the possible values of (11 + n) are 12, 15, 18, etc.
=> If 11 + n = 12 => n = 1
=> If 11 + n = 15 => n = 4
=> If 11 + n = 18 => n = 7
=> The least possible value for n is 1.
Therefore The correct answer is 1.
Additional Information
Divisibility Rule of 3
A number is completely divisible by 3 if the sum of all its individual digits is a multiple of 3.
Divisibility Rule of 6
A number is divisible by 6 if it is simultaneously divisible by its co-prime factors, 2 and 3.
Divisibility Rule of 9
A number is divisible by 9 if the sum of its digits is divisible by 9.

Q51. Answer: (a) GOI33

The position and positional values or English Alphabets are:
Given: PCR45, MGO41, JKL37, ?
The logic followed here is:
Thus, GOI33 will replace the question mark (?) in the following series to make it logically complete.
Hence, the correct answer is "Option 1".

Q52. Answer: (d) Wife's father's brother

Family Chart:
Decoding the Symbols:

A is				
Symbol	•	@	•	#
Meaning	sister	brother	wife	father
to B				

Given: O @ P # T + G - V
It means: O is the brother of P, P is the father of T, T is the sister of G, G is the wife of V.
Thus, O is V's Wife's father's brother.
Hence, the correct answer is "Option 4".

Q53. Answer: (d) NR59

The position and positional values or English Alphabets are:
Given: RV23, QU32, PT41, OS50, ?
The logic followed here is:
Thus, NR59 will replace the question mark (?) in the given series to make it logically complete.
Hence, the correct answer is "Option 4".

Q54. Answer: (a) 9

Given: If 2 is added to each odd digit and 2 is subtracted from each even digit in the number 3267451.

Highest digit = 9

Lowest digit = 0

Difference = 9 − 0 = 9

Thus, 9 will be the difference between the highest and lowest digits in the new number thus formed.

Hence, the correct answer is "Option 1".

Q55. Answer: (a) 5

Given: 604, 895, 469, 742, 307

Highest number = 895

Lowest number = 307

Third digit of highest number 895 is 5.

Second digit of lowest number 307 is 0

Now add them:

5 + 0 = 5

Thus, 5 will be the resultant, if the third digit of the highest number is added to the second digit of the lowest number.

Hence, the correct answer is "Option 1".

Q56. Answer: (b) MOPS - OSPM - SPOM

The logic followed here is:

KEPT - ETPK - TPEK

SAIL - ALIS - LIAS

Let's check each option:

1. TURN - UTRN - NURT

This triad does not follow the same logic.

2. MOPS - OSPM - SPOM

This triad follows the same logic.

3. HOPE - HPOE - EPOH

This triad does not follow the same logic.

4. PACK - APCK - KACP

This triad does not follow the same logic.

Thus, MOPS - OSPM - SPOM from the given options, the one which follows the same logic.

Hence, the correct answer is "Option 2".

Q57. Answer: (c) OVXV

The position and positional values or English Alphabets are:

Given: UPNF is related to YLPD in a certain way based on the English alphabetical order.

The logic followed here is:

Similarly,

Thus, KZVX is related to OVXV, following the same logic.

Hence, the correct answer is "Option 3".

Q58. Answer: (a) Neither follows

Statements:

No father is a mother.

No mother is a son.

The least possible Venn diagram for the given statement is:

Conclusions:

(I) All mothers are fathers. - Does not follow (Because, no father is a mother, so no mothers are fathers.)

(II) No father is a son. - Does not follow (There is no definite relation between fathers and sons, it can be possible but it is not definite.)

Thus, neither follows.

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Hence, the correct answer is "Option 1".

Q59. Answer: (d) IFH

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster follows the pattern -4, +3.

Let's check each option:

1. WSV

This letter-cluster follows the pattern -4, +3.

2. UQT

This letter-cluster follows the pattern -4, +3.

3. PLO

This letter-cluster follows the pattern -4, +3.

4. IFH

This letter-cluster does not follow the pattern -4, +3.

Thus, IFH is the odd one out.

Hence, the correct answer is "Option 4".

Q60. Answer: (c) 15

Given: Pavan ranked 13th from the top and 3rd from the bottom in his class.

Pavan's rank from the top = 13th

Pavan's rank from the bottom = 3rd

Total students in the class

= Rank from top + Rank from bottom − 1

= 13 + 3 − 1

= 16 - 1

= 15

Thus, 15 students are there in the class.

Hence, the correct answer is "Option 3".

Q61. Answer: (b) 791

Shortcut Trick

Interchange signs: (+ → −), (− → +), (× → ÷), (÷ → ×)

New Expression → 172 × 4 − 183 ÷ 3 + 164

Step 1 (Div/Mult): 688 − 61 + 164

Step 2 (Final): 627 + 164 = 791

Therefore The correct answer is 791.

Alternate Method

Given Equation: 172 ÷ 4 + 183 × 3 − 164 = ?

According to the question, we interchange the signs as follows:

• is interchanged with −

× is interchanged with ÷

=> 172 × 4 − 183 ÷ 3 + 164 = ?

Applying BODMAS rule:

=> 172 × 4 − 61 + 164 = ?

=> 688 − 61 + 164 = ?

=> 852 − 61 = ?

=> 791

Therefore The correct answer is 791.

Additional Information

BODMAS Rule

It specifies the order of operations: Brackets, Orders, Division × Multiplication (left to right), and Addition × Subtraction (left to right).

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Sign Interchange Strategy

When signs are interchanged, always rewrite the entire expression clearly before starting calculations to avoid mixing old and new operators.

Arithmetic Accuracy

In interchanged equations, a single error in sign replacement leads to a completely different result; double-check the mapping (+ ↔ −, × ↔ ÷).

Q62. Answer: (a) 2

Given: (Left) @ 4 6 8 * $ $ $ £ % 4 6 7 1 5 * 4 * 4 4 2 $ (Right)

Now,

Symbols, each of which is immediately preceded by a number and also immediately followed by a number.

So, the needed pattern is: Number — Symbol — Number

Thus, there are 2 such symbols, each of which is immediately preceded by a number and also immediately followed by a number.

Hence, the correct answer is "Option 1".

Q63. Answer: (d) Three

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

Now,

Prime numbers which are immediately followed by an odd number.

Prime numbers among single digits are: 2, 3, 5, 7

So, the needed pattern is: Prime Number — Odd Number

Thus, there are three prime numbers, which are immediately followed by an odd number.

Hence, the correct answer is "Option 4".

Q64. Answer: (c) 10 km to the north

Given: Mr. Akai starts from Point A and drives 10 km towards east. He then takes a left turn, drives 11 km, turns left and drives 19 km. He then takes a left turn and drives 21 km. He takes a final left turn, drives 9 km and stops at Point P.

Thus, he should drive 10 km to the north in order to reach Point A again.

Hence, the correct answer is "Option 3".

Q65. Answer: (b) 684

Logic followed here is.

Logic: Each term in the series is calculated by taking the factorial of its position (n!) and subtracting the square of its position (n^2).

For

n = 4, the term is 8 →

n	n!	n^2
4	24	16

Value = 24 - 16 = 8

n = 5, the term is 95 →

n	n!	n^2
5	120	25

Value = 120 - 25 = 95

The pattern observed is: (n! - n^2).

Similarly, let's find the missing term for n = 6:

n	n!	n^2
6	720	36

Value = 720 - 36 = 684

Therefore, the value that should come in place of the question mark is 684.

Q66. Answer: (c) ly

Given: In a certain code language, ‘the birds sings’ is coded as ‘ly gn ws’ and ‘birds have beak’ is coded as ‘ie ly nt’.

Thus, ‘birds’ is coded as 'ly' in that language.

Hence, the correct answer is "Option 3".

Q67. Answer: (a) Y

Given: M, N, O, P, W, X and Y are sitting around a circular table facing the centre of the table.

1. Only two people sit between X and W when counted from the right of X.
2. Only two people sit between W and M when counted from the right of W.
3. Only three people sit between X and N when counted from the right of X.
4. P sits to the immediate left of Y.

O, the only person left will occupy the vacant position.

Thus, Y sits third to the left of O.

Hence, the correct answer is "Option 1".

Q68. Answer: (c) IL-PJ

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster pair follows the pattern +7, -1.

Let’s check each option:

1. QT-XS

This letter-cluster pair follows the pattern +7, -1.

2. EH-LG

This letter-cluster pair follows the pattern +7, -1.

3. IL-PJ

This letter-cluster pair does not follow the pattern +7, -1.

4. MP-TO

This letter-cluster pair follows the pattern +7, -1.

Thus, IL-PJ is the odd one out.

Hence, the correct answer is "Option 3".

Q69. Answer: (b) Five

Given: Seven boxes D, E, F, U, V, W and X are kept one over the other but not necessarily in the same order.

1. Only five boxes are kept below X.
2. Only three boxes are kept between F and X.
3. V is kept at one of the positions below F.
4. Only E is kept between X and W.
5. D is kept at one of the positions above X.

D
X
E
W
F
V

U, the only box left will occupy the vacant position.

D
X
E

W
U
F
V

Thus, five boxes are kept between V and D.

Hence, the correct answer is "Option 2".1064

Q70. Answer: (b) 156

Given: 131, 132, 135, 140, 147, ?

The logic followed here is:

Thus, 156 should come in place of the question mark (?) in the given series.

Hence, the correct answer is "Option 2".

Q71. Answer: (b) 23

BODMAS Rule:

Given equation: 36 × 6 − 2 ÷ 13 + 9 = ?

Now, if '+' and '−' are interchanged and '×' and '÷' are interchanged, then the equation becomes:

Now replacing the sign from left to right using BODMAS Rule, we get:

=> 36 ÷ 6 + 2 × 13 - 9 = ?

=> 6 + 2 × 13 - 9 = ?

=> 6 + 26 - 9 = ?

=> 32 - 9 = 23 = ?

=> 23 = ?

Hence, the correct answer is "Option 2".

Q72. Answer: (c) ERMP

The position and positional values or English Alphabets are:

Given: FGNE is related to KDSB in a certain way based on the English alphabetical order. In the same way, PAXY is related to UXCV.

The logic followed here is:

Similarly,

Thus, ZUHS is related to ERMP, following the same logic.

Hence, the correct answer is "Option 3".

Q73. Answer: (c) rs

Given: In a certain code language, 'music is life' is coded as 'cd jk rs' and 'life is precious' is coded as 'ap cd jk'.

Thus, 'music' is coded as 'rs' in that language.

Hence, the correct answer is "Option 3".

Q74. Answer: (b) 159

Shortcut Trick

Pattern: Subtract consecutive odd numbers in descending order.

264 − 25 = 239

239 − 23 = 216

216 − 21 = 195

195 − 19 = 176

176 − 17 = 159

Therefore The correct answer is 159.

Alternate Method

Given series: 264, 239, 216, 195, 176, ?

264

−25

→
239
−23
→
216
−21
→
195
−19
→
176
−17
→
159

The pattern is based on subtracting consecutive odd numbers starting from 25.

=> 264 − 239 = 25

=> 239 − 216 = 23

=> 216 − 195 = 21

=> 195 − 176 = 19

=> Following the logic, the next difference must be 17.

=> Missing term = 176 − 17 = 159

Therefore The correct answer is 159.

Additional Information

Difference Series

A series where the gap between consecutive terms follows a specific logical sequence, such as an Arithmetic Progression (AP) or Geometric Progression (GP).

Double Difference Pattern

When the first level of differences does not show a pattern, check the difference between those differences. In this series, the double difference is a constant −2.

Odd and Prime Series

Common patterns in exams often involve subtracting or adding consecutive odd numbers (1, 3, 5...) or prime numbers (2, 3, 5, 7, 11...).

Q75. Answer: (a) C

Given: Eight people – A, B, C, D, E, F, G and H are sitting around a circular table facing the centre.

1. Only one person sits between A and B when counted from the right of A.

2. E sits to the immediate left of A.

3. Only three people sit between E and C when counted from the left of E.

4. F sits third to the right of C.

5. D sits to the immediate right of H.

G, the only person left will occupy the vacant position.

Thus, C sits second to the right of G.

Hence, the correct answer is "Option 1".

Q76. Answer: (a) (16, 32, 2)

The logic followed here is:

Logic: (a, b, c) → a × c = b

15 × 6 = 90

13 × 5 = 65

Let's check each option:

1. (16, 32, 2) → 16 × 2 = 32

2. (11, 55, 6) → 11 × 6 = 66 ≠ 55

3. (17, 24, 2) → 17 × 2 = 34 ≠ 24

4. (14, 46, 4) → 14 × 4 = 56 ≠ 46

Thus, (16, 32, 2) is the set in which the numbers are related in the same way as the given sets.

Hence, the correct answer is "Option 1".

Q77. Answer: (d) Only conclusion (II) follows.

Statements:

All pouches are trunks.

All bags are trunks.

The least possible Venn diagram for the given statement is:

Conclusions:

(I) Some pouches are bags. - Does not follow (There is no definite relation between pouches and bags, it can be possible but it is not definite.)

(II) Some trunks are bags. - Follow (Because, all bags are trunks, which means some trunks are bags.)

Thus, only conclusion (II) follows.

Hence, the correct answer is "Option 4".

Q78. Answer: (c) 63 km towards east

Given: Tarun starts from Point Y and drives 36 km towards west. He then takes a left turn, drives 83 km, turns right and drives 68 km. He then takes a right turn and drives 55 km. He takes a right turn, drives 41 km. He then turns left, drives 28 km to stop at Point Z.

Thus, he should drive 63 km towards east in order to reach Point Y again.

Hence, the correct answer is "Option 3".

Q79. Answer: (a) Three

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

Now,

Even digits, each of which is immediately preceded by an odd digit and also immediately followed by an odd digit.

So, the needed pattern is: Odd — Even — Odd

Thus, there are three even digits, each of which is immediately preceded by an odd digit and also immediately followed by an odd digit.

Hence, the correct answer is "Option 1".

Q80. Answer: (d) Two

Given: A, B, C, D, W, X and Y are sitting around a circular table facing the centre of the table.

1. Only four people sit between B and A when counted from the right of B.

2. B sits third to the left of X.

3. W sits third to the left of Y.

4. C is an immediate neighbour of both A and X.

D, the only person left will occupy the vacant position.

Thus, two people sit between D and C when counted from the right of D.

Hence, the correct answer is "Option 4".

Q81. Answer: (b) Rs. 10 lakh

The correct answer is Rs. 10 lakh.

Key Points

• The Ministry of Home Affairs (MHA) has implemented a mechanism where financial fraud complaints reported on the National Cyber Crime Reporting Portal (NCCRP) involving an amount of Rs. 10 lakh or more are automatically converted into an e-Zero FIR.

• This initiative is designed to ensure that high-value financial frauds are met with immediate legal action and formal investigation without the delay of jurisdictional disputes.

• The National Cyber Crime Reporting Portal (www.cybercrime.gov.in) was launched in 2019 to allow victims to report all types of cybercrimes, especially those against women and children, and financial frauds.

• The Indian Cyber Crime Coordination Centre (I4C), which operates under the Ministry of Home Affairs, manages the portal and coordinates with States and Union Territories to handle these complaints.

• The auto-conversion into an e-Zero FIR helps in the rapid tracking of the money trail across multiple bank accounts and states,

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increasing the chances of recovering the defrauded amount. Hence, the correct answer is Rs. 10 lakh.

Additional Information

• Zero FIR:

• A Zero FIR is a First Information Report that can be filed in any police station, regardless of where the incident occurred.

• Unlike a regular FIR, it is given a serial number '0' (zero) and is later transferred to the police station that has the appropriate jurisdiction for investigation.

• This concept was introduced based on the recommendations of the Justice Verma Committee in 2013, following the Nirbhaya case, to ensure that the police cannot refuse to register a complaint citing a lack of jurisdiction.

• Cyber Fraud Helpline:

• The National Helpline Number 1930 (formerly 155260) is dedicated to reporting online financial frauds.

• It works in tandem with the Citizen Financial Cyber Fraud Reporting and Management System (CFCFRMS) to provide immediate assistance.

• I4C (Indian Cyber Crime Coordination Centre):

• Established in 2018, it serves as a nodal point in the fight against cybercrime in India.

• It has several components including the National Cyber Crime Threat Analytics Unit and the National Cyber Crime Forensic Laboratory.

Important Points

• CFCFRMS System: This system allows for the real-time freezing of funds. When a victim reports a fraud on 1930 or the portal, the CFCFRMS sends alerts to the respective Banks or Wallets to block the transaction before the fraudster can withdraw the money.

• Legal Framework: The Bharatiya Nagarik Suraksha Sanhita (BNSS), which replaced the CrPC, has formalized the provisions for Zero FIR and e-FIR, making it mandatory for police stations to register them.

• Data Fact: Since its inception, the National Cyber Crime Reporting Portal has helped in saving hundreds of crores of rupees of citizens' money by facilitating the prompt blocking of defrauded amounts.

• The threshold of Rs. 10 lakh was specifically chosen to prioritize major scams that involve significant economic loss and complex inter-state criminal networks.

Q82. Answer: (a) PM Dhan Dhaanya Krishi Yojana

The correct answer is PM Dhan Dhaanya Krishi Yojana.

Key Points

• The Indian Prime Minister announced the launch of a new flagship initiative for the farming sector in October 2025. This scheme is specifically designed to bolster agricultural infrastructure and output.

• The PM Dhan Dhaanya Krishi Yojana has been sanctioned with a significant financial outlay of Rs. 24,000 crore to support farmers across the country. Hence, option 1 is correct.

• This programme focuses on modernizing traditional farming practices and ensuring better market access for rabi and kharif crops, aiming to increase the income of small and marginal farmers.

• While PM Fasal Bima Yojana is an existing crop insurance scheme launched in 2016, it does not match the specific funding and launch timeline mentioned in the question. Hence, option 2 is incorrect.

• The PM Krishi Sinchai Yojana, which focuses on irrigation ("Har Khet Ko Pani"), was formulated in 2015 and is distinct from the new 2025 initiative. Hence, option 3 is incorrect.

• The PM Kisan Samman Yojana (PM-KISAN) provides direct income support of Rs. 6,000 per year in three installments and was launched in 2019. Hence, option 4 is incorrect.

Additional Information

• Budgetary Allocation for Agriculture:

• The allocation of Rs. 24,000 crore represents a substantial investment in the Primary Sector of the Indian economy.

• Large-scale funding of this nature is typically directed toward technological integration, such as drones for agriculture and precision farming tools.

• Pradhan Mantri Kisan Samman Nidhi (PM-KISAN):

• Launched on February 24, 2019, this central sector scheme provides 100% funding from the Government of India.

• It targets landholding farmer families to supplement their financial needs for procuring various inputs.

• Pradhan Mantri Fasal Bima Yojana (PMFBY):

• This scheme provides a comprehensive insurance solution against natural calamities, pests, and diseases.

• The premium rates are kept low for farmers: 2% for Kharif, 1.5% for Rabi, and 5% for commercial/horticultural crops.

• PM Krishi Sinchai Yojana (PMKSY):

• Launched with the motto of 'More Crop Per Drop', it aims at improving water-use efficiency in the farming sector.

• It integrates multiple components like Accelerated Irrigation Benefit Programme (AIBP) and Watershed Development.

Important Points

• The PM Dhan Dhaanya Krishi Yojana is expected to address the challenges of food security and crop diversification in the upcoming financial years.

• The fund of Rs. 24,000 crore is one of the highest dedicated outlays for a single agricultural scheme introduced in the mid-2020s.

• Implementation of such programs usually involves the Ministry of Agriculture and Farmers Welfare and state-level agricultural departments to ensure last-mile delivery.

• This initiative aligns with the national goal of Atmanirbhar Bharat (Self-reliant India) by reducing dependency on imported agricultural technologies and enhancing domestic production capacities.

Q83. Answer: (d) 120 km and 300 km

The correct answer is 120 km and 300 km.

Key Points

• As per the notification on 20 June 2025, the Defence Research and Development Organisation (DRDO) is set to significantly enhance India's artillery reach by developing new variants of the Pinaka Multi-Barrel Rocket Launcher (MBRL) system.

• The new variants are specifically designed to target assets at distances of 120 km and 300 km, representing a major leap from the current operational ranges. Hence, the statement regarding the ranges of 120 km and 300 km is correct.

• This development is being spearheaded by the Armament Research & Development Establishment (ARDE) in Pune, which is the lead laboratory for the Pinaka project under the DRDO.

• The extension to 120 km and 300 km is aimed at providing the Indian Army with deep-strike capabilities to neutralize enemy logistics, troop concentrations, and communication centers far behind the front lines.

• The 300 km variant is expected to utilize advanced propulsion technologies and potentially guided mechanisms to maintain accuracy over such a vast distance.

Additional Information

• Overview of Pinaka MBRL:

• The Pinaka system is named after the divine bow of Lord Shiva and was developed to replace the aging Soviet-era Grad BM-21 systems.

• It is an indigenous all-weather, indirect fire, free-flight artillery rocket system that provides high-volume fire in a short duration.

• A standard Pinaka battery consists of six launcher vehicles, each capable of firing 12 rockets in just 44 seconds, effectively saturating an area of 700m x 500m.

• Evolution of Ranges:

• Pinaka Mk-I: The initial version had a range of approximately 38 km.

• Pinaka Mk-II (Extended Range): This version enhanced the range to about 60 km to 75 km.

• Guided Pinaka: Developed to improve precision, this variant uses an Integrated Navigation, Control, and Guidance System to hit targets at ranges up to 75-90 km.

• Manufacturing and Production:

• The system is produced through a successful partnership between the public and private sectors, including Tata Power SED, Larsen & Toubro (L&T), and Munitions India Limited (MIL).

• The propellant for these rockets is developed by the High Energy Materials Research Laboratory (HEMRL), another DRDO unit.

Important Points

• Export Success: The Pinaka system achieved a major milestone in 2022 when Armenia signed a deal worth approximately Rs 2,000 crore to procure the system, marking a significant win for India's defense exports.

• Strategic Significance: Developing a 300 km variant places the Pinaka in the category of Long-Range Guided Weapons, bridging the gap between traditional artillery and short-range ballistic missiles like the Pralay.

• Atmanirbhar Bharat: The continuous upgrades to the Pinaka system by DRDO align with the Government of India's vision of self-reliance in defense manufacturing, reducing dependence on foreign imports for high-end military hardware.

• Components: A complete Pinaka regiment includes launcher vehicles, loader-cum-replenishment vehicles, command posts, and DIGICORA MET radars.

Q84. Answer: (c) Luis Montenegro

The correct answer is Luis Montenegro.

Key Points

• Luis Montenegro is a prominent Portuguese politician who assumed the office of Prime Minister following the legislative elections held in March 2024 and continued his leadership into 2025.

• He serves as the president of the Social Democratic Party (PSD), which is the primary center-right political party in Portugal.

• His appointment was formalized by President Marcelo Rebelo de Sousa after the Democratic Alliance (AD), a center-right coalition led by Montenegro, secured the most seats in the national parliament.

• Luis Montenegro succeeded Antonio Costa, who had served as the Prime Minister for eight years before resigning in November 2023 due to a judicial probe.

• The Montenegro administration's primary focus involves economic liberalization, reducing income taxes, and managing the housing crisis that has significantly affected Portugal's urban centers.

Additional Information

• Democratic Alliance (AD):

• This political coalition was revived for the 2024 elections and consists of the PSD, the CDS – People's Party (CDS-PP), and the Monarchist People's Party (PPM).

• In the 230-seat Assembly of the Republic, the AD won 80 seats, requiring Luis Montenegro to lead a minority government.

• Antonio Costa:

• He was the Prime Minister of Portugal from 2015 to 2024 and a former leader of the Socialist Party (PS).

• His resignation followed Operation Influencer, an investigation into alleged corruption regarding lithium and green hydrogen projects.

• Pedro Nuno Santos:

• He is the current leader of the Socialist Party (PS), having taken over after Costa's departure.

• Under his leadership, the PS became the main opposition party after the 2024 electoral shift.

• Andre Ventura:

• He is the leader of the far-right party Chega, which saw a massive surge in popularity during the recent elections.

• Chega quadrupled its parliamentary representation to 50 seats, becoming the third-largest political force in Portugal.

Important Points

• Portugal's Political System: Portugal operates under a semi-presidential system where the President acts as the head of state and the Prime Minister as the head of government.

• Economic Landscape: Under Luis Montenegro, the government has aimed for a balanced budget while attempting to spur growth through private investment and structural reforms in the public health sector.

• Date of Appointment: Luis Montenegro was officially sworn in on April 2, 2024, and his cabinet survived a key confidence vote shortly thereafter, ensuring the stability of his premiership into 2025.

Q85. Answer: (d) Byrnihat

The correct answer is Byrnihat.

Key Points

• Byrnihat, a prominent industrial town located on the border of Meghalaya and Assam, has emerged as the most polluted city in India according to recent air quality data, including assessments aligned with the IQAir and CREA (Centre for Research on Energy and Clean Air) reports for 2024.

• The town has consistently recorded PM2.5 levels that are drastically higher than the World Health Organization (WHO) safety limit, often exceeding 100 micrograms per cubic meter on an annual average basis.

• The primary cause of severe air pollution in Byrnihat is the high concentration of industrial units, including ferro-alloy plants, cement factories, and iron and steel mills operating in the EPIP (Export Promotion Industrial Park) area.

• Geographically, Byrnihat is situated in a valley-like terrain, which leads to the phenomenon of atmospheric inversion during winter months, trapping toxic pollutants near the ground and preventing their dispersion.

• The IQAir World Air Quality Report and supplementary data for 2024-25 emphasize that while major metros like Delhi are frequently in the news, smaller industrial hubs like Byrnihat now face more critical air quality index (AQI) challenges.

Additional Information

• IQAir and Global Rankings:

• IQAir is a Swiss air quality technology company that prepares the annual World Air Quality Report based on data from over 30,000 air quality monitoring stations worldwide.

• In the 2023 report (released in 2024), Begusarai in Bihar was identified as the most polluted metropolitan area globally, but Byrnihat has topped specific national trackers for continuous pollution levels in 2024.

• PM2.5 and Health Impacts:

• PM2.5 refers to fine particulate matter with a diameter of less than 2.5 micrometers, which can penetrate deep into the lungs and enter the bloodstream, causing respiratory and cardiovascular diseases.

• The WHO guideline for annual mean PM2.5 concentration is 5 $\mu g/m^3$; however, most Indian cities exceed this by 10 to 20 times.

• National Clean Air Programme (NCAP):

• Launched by the Ministry of Environment, Forest and Climate Change (MoEFCC) in January 2019, NCAP is a long-term,

time-bound national strategy.

• It aims to achieve a 20% to 30% reduction in particulate matter concentrations by 2024, which was later updated to a goal of 40% reduction by 2026 for 131 non-attainment cities.

• Pollution in Delhi and NCR:

• Delhi and neighboring cities like Gurugram and Faridabad suffer from seasonal pollution peaks due to stubble burning in Punjab and Haryana, vehicular emissions, and construction dust.

• Despite being a major focus of policy interventions like the GRAP (Graded Response Action Plan), Delhi remains one of the world's most polluted capital cities.

Important Points

• Monitoring Agencies: Apart from IQAir, the Central Pollution Control Board (CPCB) in India monitors air quality through the National Air Quality Index (AQI), which uses eight pollutants (PM10, PM2.5, NO2, SO2, CO, O3, NH3, and Pb) to calculate the daily index.

• Economic Impact: Air pollution is estimated to cause a significant GDP loss to India due to health-related expenditures and lost labor productivity.

• Industrial Regulation: Cities like Byrnihat require stricter enforcement of Green Tribunal (NGT) norms to ensure that industrial emissions are scrubbed and filtered before release into the atmosphere.

Q86. Answer: (b) Wrestling

The correct answer is Wrestling.

Key Points

• Aman Sehrawat is a prominent Indian freestyle wrestler who specializes in the 57kg weight category.

• In January 2025, he was conferred with the prestigious Arjuna Award by the Government of India in recognition of his extraordinary achievements in the field of Wrestling.

• He gained international fame by winning a bronze medal at the 2024 Paris Olympics, making him India's youngest-ever individual Olympic medalist at the age of 21.

• He has been a consistent performer, securing a gold medal at the 2023 Asian Wrestling Championships held in Astana and a bronze medal at the 2022 Hangzhou Asian Games.

• Aman Sehrawat trains at the iconic Chhatrasal Stadium in North Delhi, which is famous for producing world-class wrestlers like Sushil Kumar, Yogeshwar Dutt, and Ravi Kumar Dahiya. Hence, the correct answer is Wrestling.

Additional Information

• Arjuna Award:

• Established in 1961, it is India's second-highest sporting honour, presented by the Ministry of Youth Affairs and Sports.

• The award consists of a statue of Arjuna, a scroll, and a cash prize of Rs. 15 lakh.

• It is awarded to athletes who show good performance at the international level consistently for four years and display qualities of leadership and sportsmanship.

• Other Distinguished Awards:

• Major Dhyan Chand Khel Ratna Award: The highest sporting honour in India, previously known as the Rajiv Gandhi Khel Ratna.

• Dronacharya Award: This is presented to coaches for their excellence in sports coaching.

• Rashtriya Khel Protsahan Puruskar: Awarded to organizations and individuals who have played a visible role in the area of sports promotion and development.

• Wrestling in India:

• Wrestling is one of the most successful individual sports for India at the Olympic Games, with medals won by K.D. Jadhav (1952), Sushil Kumar (2008, 2012), Sakshi Malik (2016), and Bajrang Punia (2020).

• The Wrestling Federation of India (WFI) is the governing body for the sport in the country.

• Comparison with other options:

• Weightlifting: Notable Indian athletes include Saikhom Mirabai Chanu (Silver at Tokyo 2020).

• Boxing: Notable athletes include Mary Kom and Lovlina Borgohain.

• Shooting: Notable athletes include Abhinav Bindra and Manu Bhaker (Double bronze at Paris 2024).

Important Points

• Aman Sehrawat's rise is significant because he achieved Olympic glory shortly after losing both his parents at a young age, showcasing immense mental resilience and discipline.

• The Arjuna Award 2024-25 cycle highlights the government's focus on rewarding young talent who have brought laurels at the Paris Olympics.

• The selection committee for these awards is headed by a retired judge and includes former Khel Ratna and Arjuna Awardees.

Q87. Answer: (d) Brison Fernandes

The correct answer is Brison Fernandes.

Key Points

• The All India Football Federation (AIFF) announced its annual awards for the 2023-24 season at a ceremony held in early 2025, recognizing excellence across various categories in Indian football.

• Brison Fernandes, a talented midfielder playing for FC Goa, was officially named the Promising Men's Player of the Year.

• This award is given to young players who have shown exceptional performance and growth in domestic leagues like the Indian Super League (ISL) and national team age-group tournaments.

• The AIFF Awards serve as the highest individual recognition in Indian football, with winners selected based on their contribution to their respective clubs and the Indian National Team.

• The recognition of Brison Fernandes highlights the success of the youth development programs in Goa and the ISL, marking him as a future star for the senior national squad.

Additional Information

• Other Major Winners at AIFF Awards 2025:

• Lallianzuala Chhangte: He was awarded the AIFF Men’s Player of the Year for the second year in a row for his outstanding clinical performance with Mumbai City FC and the national team.

• Indumathi Kathiresan: She secured the AIFF Women’s Player of the Year title, reflecting her leadership and skill in the Indian Women's League (IWL).

• Profiles of Other Options:

• Subhasish Bose: A veteran defender and captain of Mohun Bagan Super Giant, he was recognized as the Best Defender of the season for his consistent backline leadership.

• Vishal Kaith: The Mohun Bagan shot-stopper was awarded the Best Goalkeeper award, following his high number of clean sheets and vital saves in the ISL and Durand Cup.

• Khalid Jamil: Currently the head coach of Jamshedpur FC, he was honoured as the Men's Coach of the Year, becoming a prominent figure for Indian coaches in top-tier football.

• Significance of the AIFF:

• The All India Football Federation (AIFF) was founded in 1937 and is the governing body for association football in India.

• Headquartered in New Delhi, it manages the Indian National Team, the Indian Super League, and the I-League, while being a member of FIFA and the Asian Football Confederation (AFC).

Important Points

• The AIFF Awards are usually determined by a voting process involving head coaches of the Indian Super League (ISL) and the I-League clubs.

• The 2025 awards ceremony emphasized the Vision 2047 roadmap, which aims to make India a powerhouse in Asian football by the centenary of its independence.

• The Promising Women's Player of the Year for the same period was awarded to Neha, a rising talent from Haryana playing in the women's leagues.

Q88. Answer: (d) Antyodaya Shramik Suraksha Yojana

The correct answer is Antyodaya Shramik Suraksha Yojana.

Key Points

• The Antyodaya Shramik Suraksha Yojana is an affordable accident insurance scheme specifically launched to provide a safety net for unorganised sector workers.

• The scheme is implemented through the India Post Payments Bank (IPPB) and the Department of Posts, leveraging their extensive reach to provide financial security to the labour force.

• A pilot launch of this insurance initiative was initially carried out in July 2023 at Nadiad in the Kheda district of Gujarat, making it the first state in India to introduce such a scheme for shramiks (workers).

• Under this scheme, unorganised workers can receive insurance benefits of Rs. 10 lakh in the event of accidental death or permanent disability, helping their families manage financial crises.

• The Antyodaya Shramik Suraksha Yojana was formally extended on 1 May 2025 to further strengthen social security for workers who are often excluded from formal banking and insurance sectors.

Additional Information

• India Post Payments Bank (IPPB):

• Established in 2018 under the Department of Posts, Ministry of Communications, with 100% equity owned by the Government of India.

• Its primary objective is to drive financial inclusion by providing accessible banking services through over 1.55 lakh post offices

across the country.

• Unorganised Sector and Welfare:

• The unorganised sector in India comprises a vast majority of the workforce, including construction workers, agricultural labourers, and street vendors.

• The e-Shram portal, launched by the Ministry of Labour and Employment, serves as a comprehensive database to identify and assist these workers with government schemes.

• Social Security Provisions:

• Schemes like the Antyodaya Shramik Suraksha Yojana are part of the broader social security framework intended to meet Sustainable Development Goals (SDG) related to poverty reduction.

• Other related schemes include the Pradhan Mantri Shram Yogi Maandhan (PM-SYM), which offers a monthly pension of Rs. 3000 to workers after they reach the age of 60.

Important Points

• The insurance coverage provided by Antyodaya Shramik Suraksha Yojana is highly competitive, often featuring low annual premiums starting around Rs. 289 or Rs. 499 depending on the specific policy tier chosen by the beneficiary.

• In case of the death of the insured worker, the nominee or family receives the claim amount, while in cases of partial disability, a significant portion of the sum assured is provided for rehabilitation.

• The collaboration between the Post Office and insurance companies ensures that workers in rural areas do not have to travel to urban centers to avail themselves of insurance services.

Q89. Answer: (d) 3rd

The correct answer is 3rd.

Key Points

• India has secured the 3rd position globally in the Hurun Global Unicorn Index 2025, published by the Hurun Research Institute.

• This ranking signifies that India continues to maintain its status as one of the world's premier startup ecosystems, trailing only behind the United States and China.

• The index defines a unicorn as a startup founded in the 2000s that has a valuation of at least $1 billion and is not yet listed on a public exchange.

• According to the 2025 report, India possesses a total of 67 unicorns, showcasing a robust entrepreneurial environment despite global economic fluctuations.

• The United States leads the global tally with 703 unicorns, while China holds the second spot with 340 unicorns.

Additional Information

• Understanding Unicorns:

• The term "Unicorn" was first coined by venture capitalist Aileen Lee in 2013 to describe rare private startups valued at over $1 billion.

• In addition to unicorns, the Hurun Research Institute tracks "Decacorns" (startups valued over $10 billion) and "Hectocorns" (startups valued over $100 billion).

• Geographical Distribution in India:

• Bengaluru remains the "Unicorn Capital of India", hosting the highest density of billion-dollar startups in the country.

• Other significant hubs include Mumbai, Gurugram, and Noida, which contribute significantly to the National Startup Ecosystem.

• Prominent Sectors:

• The majority of Indian unicorns are concentrated in the Fintech, E-commerce, SaaS (Software as a Service), and Edtech sectors.

• Notable Indian unicorns include companies like Byju's, Swiggy, Dream11, and Razorpay, although valuations vary across reporting cycles.

• Global Growth Trends:

• The Hurun Global Unicorn Index 2025 highlights that the total number of unicorns globally has reached a record high of 1,453.

• The report also identifies "Gazelles" (startups likely to become unicorns within three years) and "Cheetahs" (likely within five years), showing a strong pipeline of growth.

Important Points

• Impact of Funding:

• The Hurun Global Unicorn Index serves as a barometer for the health of the Venture Capital market and investor confidence in high-growth technology firms.

• While India saw a slight decline in the total number of unicorns compared to previous peak years due to the "funding winter," it has shown resilience by maintaining the 3rd global rank.

• Government Initiatives:

• The Startup India initiative, launched in 2016, has played a pivotal role in providing tax benefits, easier compliance, and financial support to budding entrepreneurs.

• The Department for Promotion of Industry and Internal Trade (DPIIT) oversees the recognition of startups, fostering an environment conducive to achieving Unicorn status.

Q90. Answer: (b) Anita Asante

The correct answer is Anita Asante.

Key Points

• The legendary former England international Anita Asante was honored with the Game Changer award at the Women's Football Awards 2025.

• The Game Changer award is specifically designed to recognize individuals whose influence extends beyond their performance on the pitch, impacting the culture, visibility, and structural growth of women's football.

• The 2025 edition of the awards ceremony continued its tradition of celebrating the most influential figures in the sport, including players, coaches, and advocates who have championed equality and excellence.

• Anita Asante has been a pivotal figure in the transition of women's football from an amateur to a fully professional era, serving as a role model for future generations of athletes.

• Since her retirement from active play, she has made significant strides as a first-team coach and a prominent media broadcaster, providing expert analysis for major global tournaments.

Additional Information

• Career and Achievements of Anita Asante:

• She earned 71 caps for the England national team, known as the Lionesses, and represented Great Britain during the 2012 London Olympics.

• Her club career spanned several top-tier teams, including Arsenal, Chelsea, and Aston Villa. She was a key member of the Arsenal team that won a historic quadruple in 2007, including the UEFA Women's Cup.

• She also played internationally in the United States (WPS) and Sweden (Damallsvenskan), gaining a global perspective on the development of the game.

• Advocacy and Impact:

• Asante is widely respected for her advocacy work with organizations such as Show Racism the Red Card and her efforts to promote LGBTQ+ rights and diversity within football.

• Her appointment to coaching roles, such as with Bristol City, highlights the growing opportunities for female former players to lead at the professional level.

• About the Women's Football Awards:

• This award ceremony is a major annual event in the United Kingdom that brings together stakeholders from across the globe to recognize excellence in the female game.

• Categories often include Player of the Year, Young Player of the Year, and Lifetime Achievement, alongside the Game Changer accolade.

Important Points

• Other prominent figures mentioned in the options also hold significant roles in the sport:

• Bethany England is a prolific striker for Tottenham Hotspur and has been a vital part of the England squad, known for her clinical finishing in the WSL.

• Keira Walsh is a world-class midfielder playing for FC Barcelona, known for her tactical intelligence and role in England's Euro 2022 victory.

• Viviane Asseyi is a French international forward playing for West Ham United, contributing to the international diversity of the Women's Super League.

• The recognition of Anita Asante in 2025 reinforces the importance of diverse representation in football leadership and the media.

Q91. Answer: (b) Nitesh Kumar and Sukant Kadam

The correct answer is Nitesh Kumar and Sukant Kadam.

Key Points

• The Indian pair of Nitesh Kumar and Sukant Kadam secured the Gold Medal in the Men's Doubles SL3–SL4 category at the 2025 Asia Para Badminton Championship.

• This victory highlights India's continued dominance in the para-badminton circuit, particularly in the SL (Standing Lower) classifications.

• Nitesh Kumar, who is a celebrated Paralympic Gold Medalist, paired effectively with the seasoned shuttler Sukant Kadam to overcome their competitors in the final match of the tournament.

• The 2025 Asia Para Badminton Championship serves as a crucial ranking event for para-athletes, contributing points toward

international standings governed by the Badminton World Federation (BWF).

• The win reinforces the strength of the Indian para-badminton contingent, which has been consistently producing world-class athletes under the guidance of the Paralympic Committee of India (PCI) and the Badminton Association of India (BAI).

Additional Information

• Classification SL3: This category is designated for players with impairment in one or both lower limbs and poor walking or running balance. To reduce the physical demand, SL3 matches are played on a half-court.

• Classification SL4: Players in this category have a lower limb impairment but possess better balance and movement compared to those in SL3. They compete on a full court.

• Nitesh Kumar: He is one of India's most prominent para-athletes, having won the Gold Medal in the Men's Singles SL3 event at the 2024 Paris Paralympics. He hails from Haryana and is known for his tactical brilliance on the court.

• Sukant Kadam: Based in Maharashtra, Sukant Kadam is a world-class athlete in the SL4 category. He has multiple medals to his name from the BWF Para-Badminton World Championships and the Asian Para Games.

• Asia Para Badminton Championship: This is a premier continental tournament held to determine the best para-badminton players in Asia. It features various categories including WH1-WH2 (Wheelchair), SL3, SL4, SU5, and SH6 (Short Stature).

• Recent Achievements: India has emerged as a powerhouse in para-badminton, with athletes like Pramod Bhagat, Krishna Nagar, and Manasi Joshi bringing international laurels to the country in recent years.

Q92. Answer: (c) Holistic Development of India

The correct answer is Holistic Development of India.

Key Points

• Civil Services Day is celebrated every year on April 21 in India to recognize the contribution of officers engaged in various public service departments.

• The theme for the 17th Civil Services Day was Holistic Development of India, focusing on the integration of various government schemes to ensure comprehensive progress across the nation. Hence, statement 3 is correct.

• The date April 21 was chosen to commemorate the day in 1947 when Sardar Vallabhbhai Patel, the first Home Minister of independent India, addressed the probationers of Administrative Service Officers.

• In his historic speech at Metcalf House in Delhi, Sardar Patel referred to civil servants as the "Steel Frame of India", highlighting their pivotal role in maintaining the country's administration and integrity.

• The celebration serves as an occasion for civil servants to rededicate themselves to the cause of the citizens and renew their commitment to public service and excellence in work.

Additional Information

• Historical Evolution:

• The first-ever Civil Services Day was organized on April 21, 2006, at Vigyan Bhawan in New Delhi.

• Since then, it has become an annual event organized by the Department of Administrative Reforms and Public Grievances (DARPG), under the Ministry of Personnel, Public Grievances and Pensions.

• Prime Minister's Awards for Excellence:

• On this day, the Prime Minister's Awards for Excellence in Public Administration are conferred. These awards acknowledge the extraordinary and innovative work done by Districts and Organizations of the Central and State Governments.

• The awards are usually distributed across categories like Economic Development, Social Sector, and Innovation to encourage healthy competition among administrative units.

• Significance of the Theme:

• Recent themes have centered around the vision of Viksit Bharat @2047, aiming to transform India into a developed nation by the 100th year of independence.

• The focus remains on Empowering Citizens and Reaching the Last Mile, ensuring that the benefits of governance reach the most vulnerable sections of society.

• Institutional Framework:

• The civil services in India include the All India Services (IAS, IPS, IFoS), Central Services (Group A and B), and State Civil Services.

• They are responsible for the implementation of government policies and the delivery of essential services to the public at the grassroots level.

Q93. Answer: (a) Bangladesh

The correct answer is Bangladesh.

Key Points

• In June 2025, the Government of India, through the Directorate General of Foreign Trade (DGFT), implemented a major policy shift by restricting the import of jute and jute products from Bangladesh.

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• The notification specifies that these imports are now prohibited through all land and sea ports across the country, with the sole exception of the Nhava Sheva port (Jawaharlal Nehru Port) located in Maharashtra.

• This move is aimed at strictly monitoring the quality of imported jute and ensuring that anti-dumping regulations are effectively enforced to protect domestic manufacturers. Hence, the option Bangladesh is correct.

• Prior to this, a significant volume of jute entered India through land border crossings in West Bengal, such as Petrapole, but the new mandate redirects all traffic to a single maritime gateway for better oversight.

• The restriction is expected to impact the supply chain of the Indian jute industry, which relies on high-quality fiber from Bangladesh to supplement domestic production.

• Other neighboring countries like Pakistan, Nepal, and China do not have similar port-specific restrictions for jute in this specific June 2025 directive. Hence, these options are incorrect.

• Hence, the correct answer is Bangladesh.

Additional Information

• The Golden Fiber: Jute is known as the "Golden Fiber" due to its shiny golden color and high economic value. It is a biodegradable and eco-friendly natural fiber, primarily used for making gunny bags, twine, and carpets.

• Jute Production in India: India is the world's largest producer of raw jute. The state of West Bengal accounts for over 70% of the country's total production, followed by Bihar and Assam.

• Jute Packaging Materials Act, 1987: This Act makes the use of jute packaging mandatory for certain commodities. For example, 100% of food grains and 20% of sugar must be packed in diversified jute bags to support the livelihood of 4 million farmers and hundreds of thousands of mill workers.

• Jute Corporation of India (JCI): Established in 1971, the JCI is the nodal agency of the Government of India for the purchase of raw jute from farmers at the Minimum Support Price (MSP).

Important Points

• Nhava Sheva Port: Also known as Jawaharlal Nehru Port Trust (JNPT), it is the largest container port in India. Its selection as the exclusive entry point allows for centralized customs clearance and rigorous quality testing by specialized agencies.

• Trade Dynamics with Bangladesh: Bangladesh is the second-largest producer of jute globally. India often imports specific grades of jute fiber from Bangladesh that are used for blending or high-end exports.

• Anti-Dumping Duty: India has previously imposed anti-dumping duties on jute goods originating from Bangladesh and Nepal to prevent the domestic market from being flooded with cheap imports that could harm local jute mills.

• Climatic Requirements: Jute cultivation requires a warm and humid climate with temperatures between 24°C and 38°C and annual rainfall of more than 150 cm. It grows best in alluvial soil found in the Ganges-Brahmaputra delta.

Q94. Answer: (c) National Green Hydrogen Mission

The correct answer is National Green Hydrogen Mission.

Key Points

• The Green Hydrogen Certification Scheme, officially detailed in 2024-2025, is a critical regulatory framework under the National Green Hydrogen Mission to verify and certify the carbon intensity of hydrogen produced in India.

• The National Green Hydrogen Mission (NGHM) was approved by the Union Cabinet on 4 January 2023, with an initial financial outlay of Rs. 19,744 crore to transition the economy to a low-carbon path.

• This certification scheme ensures that hydrogen production meets the specific "Green" standards, which require that carbon emissions do not exceed 2 kg CO_2 equivalent per kg of hydrogen produced.

• It serves as a mechanism to facilitate international trade, allowing Indian producers to demonstrate compliance with global environmental standards, such as those required by the European Union and other Global North markets.

• The scheme is overseen by the Ministry of New and Renewable Energy (MNRE), which acts as the nodal ministry for implementing the mission's objectives and coordinating with the Bureau of Energy Efficiency (BEE).

Additional Information

• National Green Hydrogen Mission Targets:

• The mission aims to develop a green hydrogen production capacity of at least 5 Million Metric Tonnes (MMT) per annum by the year 2030.

• It seeks to add about 125 Gigawatts (GW) of renewable energy capacity to the country's grid specifically for hydrogen production.

• The mission is expected to reduce fossil fuel imports by over Rs. 1 lakh crore and abate nearly 50 MMT of annual greenhouse gas emissions by 2030.

• Green India Initiative:

• This is part of the National Action Plan on Climate Change (NAPCC), primarily focused on afforestation, protecting biodiversity, and increasing forest cover across India.

• National Solar Energy Mission:

• Launched in January 2010, it is a major initiative to promote solar power and establish India as a global leader in solar energy by creating policy conditions for its diffusion across the country.

• SIGHT Programme:

• The Strategic Interventions for Green Hydrogen Transition (SIGHT) is a financial incentive mechanism under the mission that provides subsidies for electrolyzer manufacturing and green hydrogen production.

Important Points

• Decarbonization of Hard-to-Abate Sectors: The certification scheme is vital for industries like Steel, Refineries, and Fertilizers, which are the primary consumers of hydrogen and need verified green sources to reach Net Zero targets.

• Well-to-Gate Scope: The certification follows a well-to-gate boundary, encompassing water treatment, electrolysis, gas purification, drying, and compression of hydrogen.

• Nodal Agencies: While MNRE is the lead, the Bureau of Energy Efficiency (BEE) is the designated agency for the accreditation of agencies that will carry out the actual monitoring, verification, and certification of projects.

• Environmental Commitment: This initiative aligns with India's commitment at COP26 to achieve Net Zero emissions by the year 2070.

Q95. Answer: (c) Harbin

The correct answer is Harbin.

Key Points

• The 9th Asian Winter Games are scheduled to be hosted by Harbin, the capital city of Heilongjiang Province in China.

• The multi-sport event is set to take place from 7 February to 14 February 2025, featuring athletes from across the Asian continent.

• This is the second time that Harbin has been selected as the host city; it previously hosted the 3rd Asian Winter Games in 1996.

• The Olympic Council of Asia (OCA) officially awarded the hosting rights to Harbin during its 42nd General Assembly held in Bangkok in 2023.

• The official slogan for the 2025 games is "Dream of Winter, Love among Asia," which aims to promote unity and the spirit of winter sports.

• The official mascots for the games are two Siberian tiger cubs named Binbin and Nini, while the emblem is named "Breakthrough," depicting a short-track speed skater and a lilac flower.

Additional Information

• Asian Winter Games (AWG):

• The Asian Winter Games is an international multi-sport event held every four years for members of the Olympic Council of Asia (OCA).

• The first-ever edition of the games was held in 1986 in Sapporo, Japan, following a proposal by the Japanese Olympic Committee in 1982.

• The games serve as a platform for Asian athletes to compete in winter disciplines such as alpine skiing, biathlon, curling, figure skating, ice hockey, and speed skating.

• Host Country History:

• China has a significant history with the Asian Winter Games, having hosted the event previously in 1996 (Harbin) and 2007 (Changchun).

• The hosting of the 2025 games follows China's successful organization of the 2022 Winter Olympics in Beijing, which boosted the popularity of winter sports in the country.

• Harbin - The Ice City:

• Known as the "Ice City," Harbin is world-renowned for its cold climate and the annual Harbin International Ice and Snow Sculpture Festival, which is one of the largest of its kind globally.

• Located in Northeast China, the city provides ideal natural conditions and existing high-quality infrastructure for hosting major winter sports competitions.

• Olympic Council of Asia (OCA):

• The OCA is the governing body of sports in Asia, currently consisting of 45 National Olympic Committees.

• It is responsible for organizing the Asian Games, Asian Winter Games, Asian Indoor and Martial Arts Games, and Asian Youth Games.

Q96. Answer: (a) Cold Desert Biosphere Reserve

The correct answer is Cold Desert Biosphere Reserve.

Key Points

• The Cold Desert Biosphere Reserve, located in the state of Himachal Pradesh, was inducted into the UNESCO World Network of Biosphere Reserves (WNBR) in September 2025.

• This reserve spans across the Spiti Valley and includes significant protected areas such as the Pin Valley National Park, Chandertal, and Sarchu.

• It is characterized by its high-altitude trans-Himalayan ecosystem, featuring extreme cold temperatures and arid conditions, which support a unique variety of flora and fauna.

• The reserve is a critical habitat for endangered species, most notably the Snow Leopard (Panthera uncia), and serves as a vital zone for conservation and scientific research under UNESCO's international standards.

• The inclusion of the Cold Desert in the WNBR aims to promote sustainable development while ensuring the protection of the delicate ecological balance of the Himalayan region.

Additional Information

• UNESCO World Network of Biosphere Reserves (WNBR):

• The WNBR is an international network created by UNESCO under the Man and the Biosphere (MAB) Programme launched in 1971.

• It seeks to establish a scientific basis for the improvement of relationships between people and their environments, promoting the conservation of biodiversity and sustainable use of resources.

• Pachmarhi Biosphere Reserve:

• Located in Madhya Pradesh, it was designated as a Biosphere Reserve by the Government of India in 1999 and added to the UNESCO WNBR in 2009.

• It includes Satpura National Park and serves as a transition zone between the Deccan Plateau and the Gangetic Plains.

• Achanakmar-Amarkantak Biosphere Reserve:

• This reserve covers parts of Chhattisgarh and Madhya Pradesh. It was included in the UNESCO list in 2012.

• It is known for being the source of the Narmada, Johilla, and Son Rivers and features diverse topography from hills to plains.

• Kachchh Biosphere Reserve:

• Situated in Gujarat, it is the largest Biosphere Reserve in India by area.

• It is famous for the Great Rann of Kutch and provides a sanctuary for the Indian Wild Ass (Khur) and several migratory birds like Flamingos.

Important Points

• India currently has 18 designated Biosphere Reserves, with many of them now recognized under the UNESCO World Network.

• The first Biosphere Reserve to be established in India was the Nilgiri Biosphere Reserve in 1986, which was also the first to join the UNESCO list in 2000.

• Biosphere Reserves are divided into three zones: the Core Area (strictly protected), the Buffer Zone (used for research and education), and the Transition Area (where sustainable human activities occur).

• The designation of these sites helps in implementing the Convention on Biological Diversity and the Sustainable Development Goals (SDGs) set by the United Nations.

Q97. Answer: (c) E-Governance Award

The correct answer is E-Governance Award.

Key Points

• The President of India, Smt. Droupadi Murmu, presented the National Award for e-Governance 2024-25 to the Indian Bureau of Mines (IBM) in January 2025.

• The award was conferred in recognition of the Indian Bureau of Mines' exemplary implementation of digital solutions to enhance transparency, accountability, and efficiency in the mining sector.

• Specifically, the recognition was for the Mining Surveillance System (MSS) and the Integrated Mines and Minerals Management System, which utilize satellite imagery and remote sensing technology to monitor mining activities across the country.

• The e-Governance Award highlights the shift towards a "Digital India" where Information and Communication Technology (ICT) is used to curb illegal mining and ensure the sustainable development of mineral resources. Hence, option 3 is correct.

• The evaluation for this award is conducted by the Department of Administrative Reforms and Public Grievances (DARPG) under the Ministry of Personnel, Public Grievances and Pensions.

Additional Information

• Indian Bureau of Mines (IBM):

• Established on 1st March 1948, it is a multi-disciplinary government organization under the Ministry of Mines.

• The Headquarters of the Indian Bureau of Mines is located in Nagpur, Maharashtra.

• Its primary function is the conservation of minerals, protection of the environment in mines, and the scientific development of mineral resources (excluding coal, petroleum, and natural gas).

• Sahitya Akademi Award:

• It is a literary honor in India, established in 1954.

• The award is presented annually by the Sahitya Akademi to writers of the most outstanding books of literary merit published in any of the 24 major Indian languages (including English and Rajasthani). Hence, option 1 is incorrect.

• National Sports Awards:

• These are a collection of honors awarded by the Ministry of Youth Affairs and Sports to sportspersons for their achievements.

• Major categories include the Major Dhyan Chand Khel Ratna Award, the Arjuna Award, and the Dronacharya Award. Hence, option 2 is incorrect.

• Bharat Ratna:

• Instituted in 1954, it is the highest civilian award of the Republic of India.

• It is awarded in recognition of exceptional service or performance of the highest order in any field of human endeavor, without distinction of race, occupation, position, or sex. Hence, option 4 is incorrect.

Important Points

• Mining Surveillance System (MSS):

• This is a satellite-based monitoring system developed by the Ministry of Mines in collaboration with Bhaskaracharya Institute for Space Applications and Geo-informatics (BISAG-N).

• It aims to establish a regime of responsive mineral administration by using space technology to detect unauthorized mining activities within 500 meters of lease boundaries.

• The system triggers "triggers" or alerts when land-use changes are detected, which are then verified by field officials using a mobile app.

• National e-Governance Awards:

• These awards recognize and promote excellence in the implementation of e-Governance initiatives by various government departments and startups.

• The awards are usually divided into categories such as Gold and Silver, providing financial incentives and certificates to the winning teams.

Q98. Answer: (b) Microsoft

The correct answer is Microsoft.

Key Points

• In March 2025, Microsoft officially unveiled Dragon Copilot, a sophisticated AI voice assistant specifically engineered for the healthcare sector.

• This launch is a direct outcome of Microsoft's strategic acquisition of Nuance Communications, a leader in conversational AI and ambient clinical intelligence, for approximately $19.7 billion.

• The primary function of Dragon Copilot is to automate the creation of clinical documentation by capturing and summarizing conversations between physicians and patients in real-time.

• By utilizing ambient sensing and Generative AI, the tool helps reduce the administrative burden on doctors, often referred to as "pajama time," allowing them to focus more on direct patient care.

• The March 2025 announcement highlighted significant improvements in latency and medical terminology accuracy compared to previous iterations of health-tech assistants.

Additional Information

• Technological Foundation:

• Dragon Copilot is built upon the Microsoft Azure cloud infrastructure, ensuring that it can handle massive datasets with high-speed processing capabilities.

• It integrates OpenAI's GPT-4 (or later versions available in 2025) to understand complex medical nuances and provide high-quality summaries.

• EHR Integration:

• The assistant is designed to work seamlessly with major Electronic Health Record (EHR) providers such as Epic, Oracle Health (formerly Cerner), and Meditech.

• This ensures that the AI-generated notes are directly synced into the patient's official file, minimizing manual data entry.

• Regulatory Compliance:

• To operate within the healthcare industry, the tool adheres to HIPAA (Health Insurance Portability and Accountability Act) guidelines in the United States.

• It also follows the GDPR (General Data Protection Regulation) standards for deployments across the European Union.

• Healthcare Impact:

• Studies conducted during the pilot phases in early 2025 showed that clinicians using Dragon Copilot saved an average of 7 minutes per patient encounter on documentation alone.

Important Points

• Evolution of DAX: Dragon Copilot represents the next evolution of the DAX (Dragon Ambient eXperience) Copilot, which was previously released in 2023. The 2025 version introduces specialized voice commands for ordering prescriptions and labs via voice.

• Combating Burnout: One of the core missions stated by Microsoft executives during the March 2025 launch was to combat the global crisis of healthcare worker burnout, which has seen rising rates since the 2020 pandemic.

• Market Position: With this release, Microsoft solidifies its position against competitors like Google Health and Amazon Web Services (AWS) HealthScribe in the race for Clinical AI dominance.

• Availability: While the initial rollout in March 2025 focused on English-speaking markets, Microsoft committed to expanding support for 15 additional languages by the end of the year.

Q99. Answer: (a) 4.4% of GDP

The correct answer is 4.4% of GDP.

Key Points

• The Union Budget 2025–26 was presented in the Parliament of India by the Union Finance Minister Nirmala Sitharaman on February 1, 2025.

• For the financial year 2025-26, the Fiscal Deficit is estimated to be 4.4% of the Gross Domestic Product (GDP). This target is a significant milestone in the government's fiscal consolidation roadmap.

• This estimate follows the Revised Estimate (RE) of the previous financial year (2024-25), where the fiscal deficit was pegged at 4.9%. The reduction to 4.4% demonstrates a disciplined approach to managing the national debt.

• The government had previously set a target in the 2021-22 Budget to reach a fiscal deficit level below 4.5% of GDP by the year 2025-26. By setting the target at 4.4%, the government has successfully stayed ahead of its projected trajectory.

• The fiscal deficit represents the difference between the Total Expenditure of the government and its Total Receipts (excluding borrowings). A deficit of 4.4% indicates the extent to which the government must borrow to fund its operations and investments.

Additional Information

• Understanding Fiscal Deficit:

• It is a key indicator of the financial health of the economy. It shows the total borrowing requirements of the government from all sources, including Market Borrowings and the Reserve Bank of India (RBI).

• A lower fiscal deficit generally leads to lower inflation and lower interest rates, which encourages private investment.

• Capital Expenditure (Capex):

• Despite fiscal tightening, the Union Budget 2025-26 continues to prioritize Capital Expenditure to boost infrastructure development, such as Railways, Highways, and Renewable Energy projects.

• The multiplier effect of Capex is essential for sustaining long-term Economic Growth and job creation.

• Revenue Receipts:

• The fiscal target is supported by strong growth in Tax Revenue, including Goods and Services Tax (GST), Corporate Tax, and Personal Income Tax.

• Non-tax receipts, such as dividends from the RBI and Public Sector Undertakings (PSUs), also play a vital role in meeting the deficit targets.

Important Points

• FRBM Act: The Fiscal Responsibility and Budget Management (FRBM) Act, 2003, provides the legal framework for reducing the fiscal deficit and ensuring inter-generational equity in fiscal management.

• Financing the Deficit: In 2025-26, the gross and net market borrowings are managed to ensure there is enough liquidity available for the private sector, preventing the crowding out effect.

• Global Context: India's commitment to a 4.4% fiscal deficit is viewed positively by Global Rating Agencies, which helps maintain India's investment-grade sovereign rating.

• Nominal GDP Growth: The fiscal deficit percentage is calculated based on the estimated Nominal GDP growth for the year 2025-26, which accounts for both real growth and inflation.

Q100. Answer: (d) I-Pragati

The correct answer is I-Pragati.

Key Points

• The Government of Gujarat launched the I-Pragati scheme in May 2025 to revolutionize citizen-police interactions through technology.

• The I-Pragati system is designed to provide real-time SMS alerts to complainants regarding the status and progress of their police cases, ensuring they stay informed without manual follow-ups.

• Under this scheme, citizens receive automated notifications for various stages of the legal process, including the registration of an FIR, the appointment of an Investigating Officer (IO), and the submission of the charge sheet or final report in court. Hence, the

option I-Pragati is correct.

• The initiative aims to enhance transparency, accountability, and public trust by bridging the communication gap between the Gujarat Police and the general public.

• By utilizing the CCTNS (Crime and Criminal Tracking Network & Systems) database, the system automatically triggers messages to the registered mobile number of the victim or complainant as soon as an update is entered into the police records.

Additional Information

• e-FIR Service in Gujarat:

• Prior to I-Pragati, Gujarat had already established a robust digital framework, including an e-FIR portal for reporting mobile phone and vehicle thefts online.

• This service allows citizens to file complaints for specific non-heinous crimes through a web portal or mobile application, reducing the footfall at physical police stations.

• CCTNS Project:

• The Crime and Criminal Tracking Network & Systems (CCTNS) is a National e-Governance initiative aimed at creating a nationwide integrated system for sharing real-time crime data across different states.

• In Gujarat, the high level of CCTNS implementation has enabled the integration of various citizen-centric services like I-Pragati.

• VISWAS Project:

• The Video Integration and State Wide Advanced Security (VISWAS) is another major project by the Gujarat Government.

• It involves the installation of over 7,000 CCTV cameras across 33 districts for traffic management, crime prevention, and detection.

• Digital India and Gujarat:

• Gujarat consistently ranks high in e-governance indices in India, implementing various digital solutions like the Pocket Cop project, which provides smartphones to police officers for instant verification of criminal records and passport verifications.

Important Points

• Significance of Real-time Updates:

• The introduction of SMS alerts helps in curbing corruption and delays by making the police process more visible to the public.

• It specifically benefits individuals in rural areas who previously had to travel long distances to district headquarters or police stations just to inquire about their case status.

• The I-Pragati scheme reflects the "Minimum Government, Maximum Governance" philosophy by automating administrative communications.

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