RRB Group D Official Paper (Held On: 28 Nov, 2025 Shift 3) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which process is used to prepare sodium hydroxide from brine?

(a) Solvay process
(b) Haber process
(c) Thermal decomposition of NaCl
(d) Electrolysis of brine

Q2. What is the purpose of a plug key in an electrical circuit?

(a) It helps in connecting and disconnecting a circuit.
(b) It measures the potential difference in a circuit.
(c) It provides potential difference in a circuit.
(d) It measures the current flowing through a circuit.

Q3. As Newton is to weight, _____ is to pressure.

(a) Kelvin
(b) Kilogram per cubic metre
(c) Kilogram
(d) Pascal

Q4. Which of the following correctly describes how potential difference between two points is calculated?

(a) Potential difference = Work done ÷ Charge
(b) Potential difference = Charge ÷ Work done
(c) Potential difference = Work done × Potential energy
(d) Potential difference = Charge × Work done

Q5. Work done by a force is said to be positive when:

(a) the force has a component in the direction of displacement
(b) the force opposes the motion of the body
(c) the displacement of the body is zero
(d) the angle between force and displacement is 90°

Q6. Match the common name of the bee with its scientific name.

Column I (Common Name).	Column II (Scientific Name)
1. Indian bee	A. Apis mellifera
2. Rock bee	B. Apis cerana indica
3. Little bee	C. Apis dorsata
4. Italian bee	D. Apis florae

(a) 1-D, 2-A, 3-C, 4-B

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

Q7. Which organelle is called the 'suicidal bag' of the cell?
(a) Lysosome
(b) Mitochondria
(c) Golgi body
(d) Ribosome

Q8. Which of the following metallic oxides can be reduced to metals by heating alone?
(a) Iron (III) oxide
(b) Mercuric oxide
(c) Zinc oxide
(d) Manganese oxide

Q9. Which of the following statements about cell size is correct?
(a) Cell size is related to its function, not the size of the organism.
(b) Cell size depends on the number of nuclei.
(c) All cells are of the same size in all organisms.
(d) Cell size is always large in multicellular organisms.

Q10. The shortest distance between the initial and final positions of an object is called _____.
(a) displacement
(b) speed
(c) acceleration
(d) distance

Q11. When solid lead(II) nitrate is heated, a yellow residue (PbO) is left behind and two gases are evolved — one is reddish-brown and the other supports combustion. Which gases are evolved?
(a) Nitrogen dioxide and hydrogen
(b) Nitric oxide and oxygen
(c) Nitrogen dioxide and oxygen
(d) Nitrogen gas and carbon dioxide

Q12. A person pushes a massive, stationary object (like a parked truck) with force F. The object pushes back with force -F. Why does the object NOT accelerate if the reaction force is equal and opposite, as suggested by the Third Law?
(a) The net force on the object is zero because the action and reaction forces cancel out.
(b) The action and reaction forces act on different objects, but the static friction on the stationary object balances the applied push force F.
(c) The magnitude of the force F is insufficient to overcome the object's inherent potential energy.
(d) The forces act instantaneously, preventing momentum change.

Q13. Which of the following metals reacts most vigorously with water?
(a) Iron
(b) Sodium
(c) Zinc
(d) Lead

Q14. A fluid filled in a container exerts _____ pressure at the same height.
(a) Equally in all directions of the container
(b) Only sideways
(c) Only upwards
(d) Only downwards

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Q15. How is molecular mass calculated?

(a) By squaring atomic numbers of all elements
(b) Adding all atomic masses of the atoms in molecule
(c) Multiplying atomic radii of constituent elements
(d) Adding all atomic volumes of the atoms present

Q16. Which of the following is NOT a contraceptive method?

(a) Altering hormonal balance to prevent release of eggs from the ovary
(b) Inserting Copper-T into the uterus
(c) Preventing sperm from reaching the egg by using condoms
(d) Aborting the foetus

Q17. Which of the following statements are NOT true regarding the principal axis of a spherical mirror?

(i) It is an imaginary straight line passing through the pole and the centre of curvature of a spherical mirror.
(ii) Principal axis is normal to the mirror at its pole.
(iii) A ray parallel to the principal axis after reflection from the mirror passes through the centre of curvature of the mirror.
(iv) The focus of a spherical mirror does not lie on its principal axis.

(a) Both (i) and (ii)
(b) Both (ii) and (iii)
(c) Both (iii) and (iv)
(d) Both (i) and (iv)

Q18. In Mendel's experiments, when he crossed a tall (TT) pea plant with a short (tt) pea plant, what did he observe in the first generation (F1)?

(a) Half of them were tall, and the other half were short.
(b) Everything was tall.
(c) Everything was of medium height
(d) Everything was short.

Q19. What is the relationship between the incident ray and the emergent ray after light passes through the two parallel opposite faces of a rectangular glass slab?

(a) The emergent ray is parallel to the direction of the incident ray, but shifted sideward slightly
(b) The emergent ray is perpendicular to the incident ray
(c) The emergent ray converges to a point on the principal axis
(d) The emergent ray is reflected back along the path of the incident ray

Q20. Colloidal particles are separated by:

(a) boiling
(b) filtration
(c) recrystallisation
(d) centrifugation

Q21. Which of the following meristems is responsible for the lengthwise growth at the ends of shoots and roots?

(a) Apical meristem
(b) Intercalary meristem
(c) Permanent meristem
(d) Lateral meristem

Q22. At higher levels of the atmosphere, which of the following shields the surface of the earth from ultraviolet radiation?

(a) Ozone
(b) Carbon
(c) Hydrogen
(d) Nitrogen

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Q23. Which of the following methods is commonly used to prevent the corrosion of iron?

(a) Heating the metal repeatedly
(b) Coating the metal with paint or oil
(c) Cooling the metal with water regularly
(d) Dissolving the metal in acid

Q24. How does the sound of a patient's heartbeat travel from the chest piece to the doctor's ear through a stethoscope?

(a) By direct transmission without reflection
(b) By multiple reflection of sound
(c) By refraction of sound waves
(d) By conversion to electrical signals

Q25. Which of the following is an advantage of vegetative propagation in flowering plants?

(a) They may flower and bear fruit later than plants produced from seeds.
(b) They are completely different from their parent plants.
(c) Plants produced from seeds may exhibit entirely new characteristics
(d) Plants produced this way can flower and bear fruit earlier than those grown from seeds.

MATHEMATICS

Q26. A sum of money is to be distributed among A, B, C and D in the ratio of 17 : 3 : 9 : 6. If C gets Rs. 294 more than B, then how much did A receive?

(a) Rs. 836
(b) Rs. 835
(c) Rs. 833
(d) Rs. 834

Q27. 2 men can do a piece of work in 2 days. How many men will do it in 4 days?

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

Q28. The ratio of the present ages of Anu and Bina is 4 : 5. After 6 years from now, the ratio becomes 5 : 6. Find Bina’s present age (in years).

(a) 20
(b) 25
(c) 30
(d) 32

Q29. P is any point inside the rectangle ABCD. If PA = 73 cm, PB = 57 cm and PC = 99 cm, then the length of PD (in cm) is equal to:

(a) 109
(b) 105
(c) 112
(d) 103

Q30. Simplify the given expression.

18 + 3 of (24 ÷ 8 × 2) − 6

(a) 30
(b) 24
(c) 36
(d) 16.5

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Q31. A sum of money was invested at simple interest at a certain rate for 3 years. Had it been invested at a 4% per annum higher rate, it would have fetched Rs. 360 more. Find the principal.

(a) Rs. 3,000
(b) Rs. 2,800
(c) Rs. 3,200
(d) Rs. 3,500

Q32. For a trip of 600 km, a truck travels the first 300 km at a speed of 40 km/hr. At what speed (in km/hr) should it cover the remaining distance, so that the average speed is 70 km/hr?

(a) 260
(b) 255
(c) 295
(d) 280

Q33. Find the value of sin 45° × cosec 45°.

(a) 1/√2
(b) 0
(c) 1
(d) √2

Q34. If 50% of 20% of 2/3 of a number is 686. Then find the number.

(a) 10290
(b) 10150
(c) 14190
(d) 11840

Q35. If a seven-digit number 78p3945 is divisible by 11, then the value of 'p' is:

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

Q36. The average of first 9 multiples of 4 is:

(a) 9
(b) 18
(c) 4
(d) 20

Q37. The sum of two numbers is 26. The bigger number is greater than the smaller number by 4. Find the bigger number.

(a) 21
(b) 13
(c) 15
(d) 18

Q38. 1/20 is what percentage of 2/80 ?

(a) 215%
(b) 210%
(c) 400%
(d) 200%

Q39. A metal rod is divided into three parts, A, B and C. The lengths of A and B are in the ratio 9 : 14, while the lengths of C and B are in the ratio 10 : 13. If the difference between the lengths of A and C is 23 cm, find the total length (in cm) of the metal rod.

(a) 424
(b) 439

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(c) 455
(d) 429

Q40. The diagonals of a rhombus are in the ratio 3 : 4, and the perimeter is 100 cm. Find the area (in cm^2) of the rhombus.
(a) 600
(b) 650
(c) 625
(d) 550

Q41. The marked price of a bookshelf is Rs. 572, which is 40% above the cost price. If the profit percentage is 2%, find the discount percentage (rounded off to two decimal places).
(a) 29.72%
(b) 28.83%
(c) 25.22%
(d) 27.14%

Q42. A, B and C can complete a piece of work in 3, 5 and 15 days, respectively. How long (in days) will they take to complete thrice the same work, working together?
(a) 10
(b) 6
(c) 5
(d) 15

Q43. A cubical block of wood of side 14 cm is surmounted by a hemisphere of the largest possible diameter. What is the total surface area (in cm^2) of the solid thus formed? (Use $\pi = 22/7$)
(a) 1296
(b) 1330
(c) 1484
(d) 1176

Q44. Find the value of $x^2 + 3x + 5$ when $x = 2$.
(a) 19
(b) 13
(c) 15
(d) 17

Q45. Paul, Ryan and Max can finish a certain piece of work in 15, 14 and 21 days, respectively. All three of them started the work together. Paul left the work after 5 days and Ryan left just 3 days before the work was completed. Find the total number of days taken for the work to be completed.
(a) 3.7
(b) 7.4
(c) 11.2
(d) 10.1

Q46. Smart Bazaar is offering Buy 16, get 9 free on household items. What is the net percentage discount being offered by the Smart Bazaar?
(a) 36%
(b) 33%
(c) 34%
(d) 39%

Q47. Nishi travels to a shopping mall at a speed of 21 km/hr and returns at a speed of 77 km/hr. What is her average speed (in km/hr) for the entire journey?
(a) 33
(b) 23
(c) 39

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(d) 34

Q48. Ranjeet sold an article for Rs. 582, earning a profit of 20%. What was the cost price (in Rs.) of the article?

(a) 490
(b) 480
(c) 485
(d) 495

Q49. The cost of a washing machine is 50% less than the cost of a TV. If the cost of the washing machine increases by 60% and that of the TV decreases by 11%, what is the percentage change in the total cost of 6 washing machines and 2 TVs?

(a) Decrease by 29%
(b) Increase by 31.6%
(c) Increase by 26%
(d) Decrease by 33%

Q50. The arithmetic mean of the observations 29, 48, 65, 32, 72, 63, 64, 18 and 14 is:

(a) 43
(b) 40
(c) 45
(d) 38

GENERAL INTELLIGENCE & REASONING

Q51. In a certain code language,

A + B means ‘A is the son of B’,

A - B means ‘A is the brother of B’,

A x B means ‘A is the wife of B’, and

A ÷ B means ‘A is the father of B’.

Based on the above, how is D related to J if ‘D x F - G ÷ H + J’?

(a) Brother's daughter
(b) Husband's brother's wife
(c) Brother's wife
(d) Husband's brother's daughter

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

68 64 56 44 28 ?

(a) 21
(b) 18
(c) 8
(d) 12

Q53. Mr. Zzz starts from Point A and drives 21 km towards the West. He then takes a left turn, drives 5 km, turns right and drives 7 km. He then takes a right turn and drives 11 km. He takes a final right turn, drives 28 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 degrees turns only unless specified).

(a) 6 km to the South
(b) 5 km to the North
(c) 7 km to the West
(d) 8 km to the East

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Q54. Vinay ranked 48th from the top and 15th from the bottom in his class. How many students are there in his class?

(a) 63
(b) 62
(c) 60
(d) 61

Q55. Seven people, A, B, C, D, E, F and G, are sitting in a row, facing north.

Only 2 people sit to the right of F. Only 3 people sit between F and A. Both E and C are immediate neighbours of G. D sits immediately to the left of B. C is not an immediate neighbour of A.

How many people sit between D and E?

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

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

DER109, PQD91, BCP73, NOB55, ?

(a) ZEN37
(b) ZAM37
(c) ZAN37
(d) SAN37

Q57. Seven boxes A, B, C, D, I, J and K are kept one over the other but not necessarily in the same order. Only A is kept above I. Only two boxes are kept between I and C. Only K is kept below J. D is not kept immediately above C. How many boxes are kept between B and K?

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

Q58. Refer to the following number series and answer the question that follows. (All numbers are single digit numbers only.) (Counting to be done from left to right only.)

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

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

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

Q59. Read the given statement(s) and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statement(s).

Statements:

Some cats are pets.

All pets are animals.

Conclusions:

(I) Some cats are animals.

(II) No animals are pets.

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

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Q60. 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) 6 1 7 6 8 5 2 7 6 9 2 3 4 8 3 6 2 5 9 4 1 7 6 8 3 1 9 (Right)

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

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

Q61. Mr. Akai starts from Point A and drives 9 km towards east. He then takes a left turn, drives 7 km, turns left and drives 32 km. He then takes a left turn and drives 18 km. He then takes a left turn, drives 21 km, turns left and drives 5 km. He takes a final right turn, drives 2 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90 degrees turns only unless specified)

(a) 8 km to the east
(b) 4 km to the north
(c) 6 km to the south
(d) 6 km to the north

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

Statements:

Some plants are vegetables.

All buds are vegetables.

Conclusions:

(I): Some plants are buds.

(II): All vegetables are buds.

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

Q63. 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) FM - IP
(b) MT - PW
(c) LS - OV
(d) JQ - LI

Q64. Find the missing number in the series 4, 16, 36, 64, 100, ?

(a) 144
(b) 100
(c) 120
(d) 150

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

300 285 270 255 240 ?

(a) 221
(b) 225
(c) 224
(d) 223

Q66. Refer to the given number series and answer the question that follows. Counting to be done from left to right only. All numbers are single-digit numbers.

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

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

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

Q67. What will come in the place of '?' in the following equation, if '+' and '-' are interchanged and 'x' and '÷' are interchanged?

114 ÷ 7 - 42 × 2 + 43 = ?

(a) 774
(b) 776
(c) 778
(d) 772

Q68. GL 9 is related to IH -8 in a certain way. In the same way, MR 4 is related to ON -13. To which of the given options is NS 13 related, following the same logic?

(a) LP -5
(b) PO -4
(c) UH -3
(d) BH -1

Q69. If + means -, - means x, x means ÷, ÷ means +, then what will come in place of the question mark (?) in the following equation?

45 - 4 ÷ 4 + 32 × 8 = ?

(a) 182
(b) 180
(c) 184
(d) 178

Q70. 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) UY – QS
(b) DH – ZB
(c) HL – DE
(d) CG – YA

Q71. Seven people, A, B, C, D, E, F and G, are sitting in a row, facing north.

Only five people sit between D and F. G sits to the immediate left of F. Only one person sits between G and A. B sits at some place to the left of C but at some place to the right of E.

How many people sit to the right of A?

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

Q72. A, B, C, D, E, F and G are sitting around a circular table facing the centre. D sits second to the left of G. B sits second to the left of D. C sits to the immediate right of A. E sits third to the left of C. How many people sit between E and F when counted from the left of E?

(a) Three

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

Q73. 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) 4 8 2 8 2 3 8 3 1 3 9 1 7 3 9 7 6 2 6 6 6 8 2 (Right)

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

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

Q74. In a certain code language, 'stop disturbing people' is coded as 'ls ck rp' and 'people need peace' is coded as 'cd ok rp'. How is 'people' coded in that language?

(a) cd
(b) rp
(c) ck
(d) ok

Q75. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

PPR MQT JRV GSX ?

(a) DTZ
(b) ZDR
(c) DTT
(d) KJY

Q76. ABCD is related to DDJJ in a certain way based on the English alphabetical order. In the same way, MJEB is related to PLLH. To which of the given options is VPZT related, following the same logic?

(a) YRGZ
(b) YGHJ
(c) YREW
(d) YRTJ

Q77. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(13, 14, 6)

(39, 28, 25)

(a) (23, 16, 16)
(b) (48, 82, 7)
(c) (11, 16, 4)
(d) (42, 40, 23)

Q78. HJEI is related to OQLP in a certain way based on the English alphabetical order. In the same way, JLGK is related to QSNR. To which of the following is LNIM related, following the same logic?

(a) USTP
(b) SUPT
(c) SUTP
(d) USPT

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Q79. In a certain code language, ‘way hen wet’ is coded as ‘ir wj ry’ and ‘seed desk way’ is coded as ‘wj kk bm’. How is ‘way’ coded in that language?

(a) wj
(b) ry
(c) kk
(d) ir

Q80. What will come in place of the question mark (?) in the following equation, if ‘+’ and ‘−’ are interchanged and ‘×’ and ‘÷’ are interchanged?

151 ÷ 5 + 72 × 3 - 17 = ?

(a) 746
(b) 748
(c) 747
(d) 745

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Who presided over the 10^(th) Governing Council Meeting of NITI Aayog in New Delhi on 24 May 2025?

(a) Smt. Nirmala Sitharaman
(b) Shri. Amit Shah
(c) Shri. Narendra Modi
(d) Shri. Rajnath Singh

Q82. In July 2025, which of the following states of India launched the Smart Mosquito Surveillance System ("SMoSS"), to track and control mosquito populations more efficiently and safely?

(a) Andhra Pradesh
(b) Gujarat
(c) Punjab
(d) Jharkhand

Q83. What is the name of the weapon system engineered to neutralise threats posed by coordinated drone swarms, which was successfully developed and tested by Solar Defense and Aerospace Limited (SDAL) in May 2025?

(a) Shivastra
(b) Bhargavastra
(c) Bheemastra
(d) Brahmastra

Q84. Which book, launched at the Raisina Dialogue 2025, focuses on water credits as a market-based mechanism for sustainable water management?

(a) Sashakt Bharat
(b) Memories and Milestones
(c) Trading Blue Gold: A Blueprint for Water Credit Valuation in India
(d) Guardian of Heritage

Q85. The Karnataka Amendment Bill, 2025 proposes to punish which practice, even before an actual child marriage takes place?

(a) Child adoption
(b) Kidnapping of minors
(c) Child labor
(d) Underage engagement

Q86. According to the ‘Ramsar Information Sheet’ published in February 2025, which bird sanctuary in Tamil Nadu has been designated as a Ramsar site?

(a) Manjira Bird Sanctuary
(b) Kolleru Bird Sanctuary

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(c) Okhla Bird Sanctuary
(d) Sakkarakottai Bird Sanctuary

Q87. As per Ministry of Earth Sciences, the number of seismic observatories in India increased from 80 in 2014 to how many in February 2025?
(a) 98
(b) 168
(c) 142
(d) 118

Q88. In June 2025, a stampede occurred near which stadium in Bengaluru?
(a) M Chinnaswamy Stadium
(b) Rajiv Gandhi International Stadium
(c) MA Chidambaram Stadium
(d) Barabati Stadium

Q89. According to a news update on 9 June 2025, the High Seas Treaty will enter into force 120 days after it is ratified by how many countries?
(a) 45
(b) 75
(c) 30
(d) 60

Q90. In 2025, which male field athlete joined Usain Bolt as the only track-and-field winners of Laureus Sportsman of the Year?
(a) Mondo Duplantis
(b) Carlos Alcaraz
(c) Max Verstappen
(d) Novák Djokovic

Q91. According to Union Budget 2025–26, which mission was launched to document and conserve India's manuscript heritage?
(a) Kala Sampada Mission
(b) Saraswati Archive Project
(c) Gyan Bharatam Mission
(d) Granth Sanrakshan Abhiyan

Q92. The 32^(nd) Elets World Education Summit was hosted by which country in April 2025?
(a) South Africa
(b) United Kingdom
(c) India
(d) United Arab Emirates

Q93. What is the revised policy repo rate announced by the Reserve Bank of India in April 2025?
(a) 6.50%
(b) 5.75%
(c) 6.00%
(d) 6.25%

Q94. Who threw 90.23 m in javelin at the Doha Diamond League, 2025, setting a record?
(a) Sachin Yadav
(b) Shivpal Singh
(c) Annu Rani
(d) Neeraj Chopra

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Q95. In September 2025, which region planned to establish a dedicated women police station in each district for enhanced safety?

(a) Mumbai Suburban District
(b) All Districts of West Bengal
(c) Each of Delhi's 15 Districts
(d) Each District in Uttar Pradesh

Q96. Which Indian city was the first to issue a Certified Green Municipal Bond?

(a) Indore
(b) Chennai
(c) Kochi
(d) Ghaziabad

Q97. As announced on June 17, 2025, which of the following institutes have developed a novel one-step colloidal synthesis method for fabricating PEGylated semi-shells (SS) with nano-cup morphology at room temperature to treat cancer?

(a) Institute of Nano Science and Technology (INST), Raebareli
(b) Institute of Nano Science and Technology (INST), Dehradun
(c) Institute of Nano Science and Technology (INST), Mohali
(d) Institute of Nano Science and Technology (INST), Chandigarh

Q98. During WAVES 2025, Odisha CM mentioned India's indigenous sports gaining global recognition. Which summit was this statement made at?

(a) Bharat Sports Conclave
(b) Global Sports Expo India
(c) Khelo India Youth Games
(d) World Audio Visual and Entertainment Summit

Q99. Who is the director of the movie Chhaava, which was released in February 2025?

(a) Anurag Kashyap
(b) Prithviraj Sukumaran
(c) Fahadh Faasil
(d) Laxman Utekar

Q100. Who won the Women's Singles title at the Australian Open 2025?

(a) Madison Keys
(b) Aryna Sabalenka
(c) Coco Gauff
(d) Iga Swiatek

ANSWER KEY

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

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SOLUTIONS

Q1. Answer: (d) Electrolysis of brine

The correct answer is Electrolysis of brine.

Key Points

• Sodium hydroxide (NaOH) is commercially prepared using the electrolysis of brine, which is a concentrated solution of sodium chloride (NaCl).

• During the electrolysis process, brine is passed through an electrolytic cell, leading to the formation of three primary products: sodium hydroxide (NaOH), chlorine gas (Cl_2), and hydrogen gas (H_2).

• The reaction occurs in an electrolytic cell, where chlorine gas is released at the anode (oxidation) and hydrogen gas is released at the cathode (reduction).

• The sodium hydroxide solution is formed in the electrolyte as a by-product of the reaction. The overall reaction can be represented as:

$2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$

• Electrolysis of brine is widely used in the industry due to its efficiency and economic advantages in producing large quantities of sodium hydroxide.

Additional Information

• Solvay Process:

• The Solvay Process is primarily used for the production of sodium carbonate (Na_2CO_3) and not sodium hydroxide.

• It involves the reaction of sodium chloride (NaCl) with ammonia (NH_3) and carbon dioxide (CO_2) to form sodium bicarbonate, which is then converted to sodium carbonate.

• It is not suitable for preparing sodium hydroxide due to its chemical pathway.

• Haber Process:

• The Haber Process is used for the industrial production of ammonia (NH_3), not sodium hydroxide.

• It involves the reaction of nitrogen gas (N_2) with hydrogen gas (H_2) under high pressure and temperature, using a catalyst.

• This process is unrelated to the production of sodium hydroxide.

• Thermal Decomposition of NaCl:

• Thermal decomposition of sodium chloride does not yield sodium hydroxide.

• Sodium chloride is a stable compound and requires very high temperatures to decompose, but the products formed are not sodium hydroxide.

• Applications of Sodium Hydroxide:

• Sodium hydroxide is widely used in industries such as paper manufacturing, textile processing, soap and detergent production, and water treatment.

• It is also used in laboratories for pH adjustment and as a strong base in chemical reactions.

• Environmental Considerations:

• The electrolysis of brine generates chlorine gas as a by-product, which needs to be handled carefully due to its toxic nature.

• Industries often capture and utilize chlorine gas for producing other chemicals, reducing environmental impact.

Important Points

• Key Industrial Process: The Chlor-Alkali process, which includes the electrolysis of brine, is a major industrial method for producing sodium hydroxide.

• Safety Measures: Proper safety protocols must be followed during electrolysis, as chlorine gas and hydrogen gas are hazardous.

• Historical Development: The method of electrolysis for producing sodium hydroxide was developed in the late 19th century and revolutionized the chemical industry.

• Global Usage: Sodium hydroxide production is a critical component of many industries worldwide, with millions of tons produced annually.

• Chemical Properties: Sodium hydroxide is a highly caustic substance and reacts vigorously with acids to form salts and water.

Q2. Answer: (a) It helps in connecting and disconnecting a circuit.

The correct answer is It helps in connecting and disconnecting a circuit..

Key Points

• A plug key is a simple device used in an electrical circuit to connect or disconnect the flow of current. It acts as a switch for the circuit.

• When the plug is inserted into its socket, the circuit is closed, allowing current to flow through the circuit. Conversely, removing the plug opens the circuit and stops the flow of current.

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• Plug keys are typically used in laboratory experiments and are designed for ease of use, making it simple to control the current flow without complex mechanisms.

• They are often made of conducting materials like brass or copper, ensuring efficient current flow when the circuit is closed.

• The plug key does not measure current, voltage, or provide a potential difference. Its sole purpose is to act as a manual switch. Hence, the other options are incorrect.

Additional Information

• Other Components of an Electrical Circuit:

• Ammeter: An instrument used to measure the current flowing through a circuit. It is connected in series with the circuit components.

• Voltmeter: A device used to measure the potential difference (voltage) between two points in a circuit. It is connected in parallel to the circuit.

• Battery: Provides the potential difference required to drive current through the circuit. It is the source of electrical energy.

• Resistor: A component used to control or limit the current flow in a circuit by providing resistance.

• Types of Switches in Circuits:

• Toggle Switch: Commonly used in household appliances, it is a manually operated switch that can connect or disconnect a circuit.

• Push Button Switch: Used in devices like doorbells, it allows current flow only when pressed.

• Rotary Switch: Allows the user to select one circuit from multiple options, commonly used in fan regulators.

• Plug Key: A simple switch used in laboratory circuits for quick connection and disconnection.

• Important Facts About Electrical Circuits:

• The flow of current in a circuit is due to the movement of electrons from the negative terminal to the positive terminal of the source.

• A complete circuit is necessary for current to flow. An open circuit stops the flow of electricity.

• Electrical circuits can be classified as series circuits or parallel circuits based on the arrangement of components.

• Safety devices like fuses and circuit breakers are used to prevent damage from excessive current flow.

Important Points

• The plug key is a basic yet essential component in electrical and physics experiments, providing a straightforward way to control the flow of current in a circuit.

• It is most commonly used in educational settings to teach students about the fundamentals of electric current and circuit behavior.

• Unlike other components like ammeters or voltmeters, the plug key does not measure any parameter but solely acts as a control mechanism for current flow.

• Its simplicity and effectiveness make it indispensable for circuit demonstrations and practical experiments.

Q3. Answer: (d) Pascal

The correct answer is Pascal.

Key Points

• Newton is the SI unit of force, which is used to measure weight. Weight is the force exerted by gravity on an object.

• Pressure is defined as the force applied per unit area. The SI unit of pressure is the Pascal (Pa), which is equivalent to one newton per square meter (N/m^2).

• Just as Newton is intrinsically tied to the measurement of weight, Pascal is directly associated with the measurement of pressure in the International System of Units (SI).

• Kelvin is a unit of temperature, Kilogram is a unit of mass, and Kilogram per cubic meter is a unit of density. None of these are related to the measurement of pressure, making Pascal the correct answer.

• Therefore, the unit Pascal accurately represents the standard measure for pressure, just as Newton represents force or weight.

Additional Information

• Newton (N):

• Named after Sir Isaac Newton, the SI unit of force is expressed as kg??m/s^2.

• It is used to quantify the force required to accelerate a 1 kg mass by 1 meter per second squared.

• Weight, being the force due to gravity, is measured in Newtons.

• Pascal (Pa):

• Named after Blaise Pascal, the SI unit of pressure measures force per unit area.

• 1 Pascal equals 1 Newton per square meter (N/m^2).

• It is widely used in various fields such as meteorology, engineering, and fluid mechanics to measure atmospheric and other

forms of pressure.

• Kilogram (kg):

• The kilogram is the SI base unit for mass.

• It is defined by the mass of a specific platinum-iridium alloy cylinder stored at the International Bureau of Weights and Measures in France.

• It is not used to measure pressure, but it relates to Newton (force) as weight is the product of mass and gravitational acceleration.

• Kelvin (K):

• The Kelvin is the SI base unit for temperature.

• It is defined by the thermodynamic temperature scale, where 0 K is absolute zero—the point where molecular motion ceases.

• It is unrelated to pressure or force.

• Kilogram per cubic meter (kg/m^3):

• This is the SI unit of density, which measures mass per unit volume.

• It is commonly used in physics and engineering to describe the density of substances like liquids, gases, and solids.

• It is not related to the measurement of pressure but is important in fluid mechanics.

Q4. Answer: (a) Potential difference = Work done ÷ Charge

The correct answer is Potential difference = Work done ÷ Charge.

Key Points

• Definition of Potential Difference: The potential difference between two points is defined as the amount of work done to move a unit charge from one point to another. It is mathematically represented as Potential Difference = Work done ÷ Charge, which is the correct formula.

• SI Unit: The SI unit of potential difference is the Volt (V). One volt is defined as one joule of work done per coulomb of charge.

• Application of Formula: This formula is fundamental in understanding various concepts of electricity, including Ohm's Law, electric circuits, and energy transfer in electrical systems.

• Physical Meaning: The potential difference gives a measure of the energy required to move electric charges between two points. It is equivalent to the amount of energy provided or consumed in the system.

• Correctness of Statement: Option 1 correctly describes how potential difference is calculated, as it aligns with the standard definition and usage in physics. Hence, the correct answer is Option 1.

Additional Information

• Other Formulas Related to Electricity:

• Ohm's Law: Voltage (V) = Current (I) × Resistance (R). This fundamental law connects potential difference, current, and resistance in electrical circuits.

• Power Formula: Power (P) = Voltage (V) × Current (I). This helps calculate the rate of energy transfer in electrical systems.

• Energy Formula: Energy (E) = Voltage (V) × Charge (Q). This represents the total energy used or produced by an electrical system.

• Characteristics of Electric Potential:

• Electric potential is a scalar quantity.

• The direction of movement of charge depends on whether the potential difference is positive or negative.

• It is measured using devices like a voltmeter.

• Uses of Potential Difference:

• It is essential for powering devices and machines, enabling them to perform work.

• Potential difference is used in batteries, capacitors, and generators to store and transfer energy.

• It is crucial in designing electrical systems for industries, homes, and transportation.

• Examples:

• In a circuit with a battery, the battery provides a potential difference to allow current to flow.

• A bulb lights up because of the potential difference across its terminals, enabling energy transfer.

• In a capacitor, the potential difference is used to store electrical energy.

Important Points

• Option Analysis:

• Option 1: Correct formula for potential difference as per the definition. Correct.

• Option 2: Incorrect, as charge should not be divided by work done.

• Option 3: Incorrect, potential difference is not calculated using work done multiplied by potential energy.

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• Option 4: Incorrect, charge multiplied by work done does not represent potential difference.

• Relation to Energy Transfer: The concept of potential difference is central to understanding how electrical energy is converted into other forms of energy, such as light and heat.

• Devices for Measurement: Potential difference is measured using a voltmeter, which is connected in parallel to the component being measured.

• Historical Insight: The term “volt” was named after Alessandro Volta, an Italian scientist who invented the electric battery.

Q5. Answer: (a) the force has a component in the direction of displacement

The correct answer is the force has a component in the direction of displacement.

Key Points

• Work done by a force is said to be positive when the force has a component in the direction of displacement. This means that the force contributes to moving the object in the direction of its motion.

• The mathematical expression for work done is given as $W = F \times d \times \cos(\theta)$, where:

• F is the magnitude of the force applied.

• d is the displacement of the object.

• θ is the angle between the force and displacement.

• When the angle θ is 0°, the cosine value is $\cos(0°) = 1$, and the work done is positive, indicating that the force is aligned with the displacement.

• In contrast, when the force opposes the motion or is applied at an angle of 90° or when the displacement is zero, the work done becomes zero or negative, which does not satisfy the condition for positive work.

• Therefore, the correct condition for positive work is when the force has a component aligned with the direction of displacement, aiding the motion of the object.

Additional Information

• Understanding Work:

• Work is a scalar quantity that refers to the transfer of energy due to the application of a force over a displacement.

• It is measured in joules (J) in the SI system, where 1 joule = 1 N·m.

• Types of Work:

• Positive Work: Occurs when the force and displacement are in the same direction (e.g., lifting an object upward).

• Negative Work: Happens when the force opposes the motion (e.g., friction acting against a moving object).

• Zero Work: When the displacement is zero or the force is perpendicular to the displacement (e.g., carrying an object horizontally without vertical displacement).

• Applications of Work:

• In mechanical systems, work is used to calculate energy transfer in engines, pumps, and machinery.

• In physics, work-energy principles are applied in analyzing the motion of objects under varying forces.

• Significance of Force Direction:

• The direction of force significantly impacts the amount of work done. Forces aligned with displacement maximize energy transfer.

• This principle is crucial in designing efficient mechanical systems and reducing energy losses in various applications.

Important Points

• Force and displacement relationship:

• When force acts in the opposite direction of displacement, the work done is negative.

• If force and displacement are perpendicular, no work is done (zero work).

• Examples of positive work:

• Pushing a box forward across a smooth surface.

• Lifting an object upward against gravity.

• Examples of zero or negative work:

• Carrying a bag horizontally without lifting or lowering it.

• Friction acting against a sliding object.

Q6. Answer: (d) 1-B, 2-C, 3-D, 4-A

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

Key Points

• Indian Bee - Apis cerana indica: The Indian bee is scientifically known as Apis cerana indica. It is a species of honeybee native to South and Southeast Asia, widely used in beekeeping practices in India. Hence, 1-B is correct.

• Rock Bee - Apis dorsata: The rock bee, or giant honeybee, is scientifically named Apis dorsata. It is known for building large,

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exposed colonies on cliffs or tall structures. Hence, 2-C is correct.

• Little Bee - Apis florea: The little bee is scientifically classified as Apis florea. It is a small honeybee species found in Asia, known for its simple nesting habits. Hence, 3-D is correct.

• Italian Bee - Apis mellifera: The Italian bee, a subspecies of the western honeybee, is scientifically named Apis mellifera. It is extensively used in commercial beekeeping due to its high honey production. Hence, 4-A is correct.

Additional Information

• Apis cerana indica (Indian Bee):

• Native to India and Southeast Asia, this species is resilient to local pests and diseases.

• It produces moderate quantities of honey and is often used in traditional beekeeping systems.

• It builds multiple combs in cavities and is adaptable to diverse climatic conditions.

• Apis dorsata (Rock Bee):

• This species is known for producing large quantities of honey.

• It builds nests in open spaces, such as rocks, cliffs, and tall structures.

• Due to its aggressive nature, it is not commonly used in domesticated beekeeping.

• Apis florea (Little Bee):

• A small bee species found in Asia, known for building single-comb nests on tree branches or shrubs.

• It produces small amounts of honey, which is often consumed locally.

• Its non-aggressive nature makes it less of a threat to humans.

• Apis mellifera (Italian Bee):

• A highly productive species commonly used in modern beekeeping practices worldwide.

• Known for its gentle behavior, large-scale honey production, and adaptability to artificial hives.

• This species is native to Europe and Africa but has been introduced to many other parts of the world.

Important Points

• Honeybee Species: Honeybees are crucial pollinators for many crops and play a vital role in maintaining biodiversity.

• Beekeeping Benefits: Beekeeping contributes to honey production, wax production, and crop pollination, which enhances agricultural productivity.

• Global Distribution: Apis mellifera is the most widely distributed honeybee species, while Apis cerana, Apis dorsata, and Apis florea are mostly confined to Asia.

• Conservation Efforts: Protecting honeybee species is critical for sustainable agriculture and ecosystem health.

Q7. Answer: (a) Lysosome

The correct answer is Lysosome.

Key Points

• Lysosomes are membrane-bound organelles found in eukaryotic cells, often referred to as the "suicidal bag" of the cell because they contain powerful hydrolytic enzymes capable of digesting cellular components.

• They play a crucial role in intracellular digestion, breaking down macromolecules such as proteins, lipids, carbohydrates, and nucleic acids.

• Lysosomes are involved in the process of autophagy, wherein they degrade damaged or unnecessary organelles to maintain cellular health.

• If lysosomes rupture or their enzymes are released uncontrollably, it can lead to self-destruction of the cell, hence the term "suicidal bag."

• Lysosomal enzymes function optimally in an acidic environment (pH ~5), which is maintained by proton pumps on the lysosomal membrane.

Additional Information

• Functions of Lysosomes:

• Phagocytosis: Lysosomes fuse with phagosomes to digest pathogens or foreign particles engulfed by the cell.

• Autophagy: Lysosomes degrade damaged organelles, such as mitochondria, and recycle their components.

• Exocytosis: In some cells, lysosomes release their contents outside the cell, aiding in processes like bone resorption by osteoclasts.

• Discovery: Lysosomes were first discovered by Belgian biochemist Christian de Duve in 1955. He won the Nobel Prize in 1974 for his contributions to cell biology.

• Structure: Lysosomes are surrounded by a single lipid bilayer membrane that protects the cell from the hydrolytic enzymes they contain.

• Diseases Associated with Lysosomes:

• Lysosomal storage diseases, such as Tay-Sachs disease and Gaucher's disease, result from the deficiency of specific lysosomal enzymes.

• These diseases lead to the accumulation of undigested substrates within lysosomes, causing cellular dysfunction.

• Comparison with Other Organelles:

• Mitochondria: Known as the "powerhouse" of the cell, mitochondria generate energy in the form of ATP but do not participate in digestion.

• Golgi Body: Responsible for packaging and modifying proteins, it works alongside lysosomes by tagging enzymes for lysosomal transport.

• Ribosomes: Sites of protein synthesis; they do not contain enzymes for digestion.

Important Points

• Hydrolytic Enzymes: Lysosomes contain enzymes like proteases, lipases, nucleases, and carbohydrases that enable the breakdown of complex molecules.

• pH Dependency: Lysosomal enzymes require an acidic environment to function effectively, differentiating them from enzymes in other organelles.

• Role in Immunity: Lysosomes help destroy pathogens engulfed by immune cells like macrophages.

• Autolysis: Lysosomes play a role in programmed cell death, releasing enzymes to dismantle cellular components during apoptosis.

Q8. Answer: (b) Mercuric oxide

The correct answer is Mercuric oxide.

Key Points

• Mercuric oxide (HgO) can be reduced to mercury (Hg) by simple heating. Upon heating, mercuric oxide decomposes into its constituent elements: mercury and oxygen gas. The reaction is as follows:

$2HgO \rightarrow 2Hg + O_2$. This is a thermal decomposition reaction.

• In contrast, metallic oxides like Iron (III) oxide (Fe_2O_3), Zinc oxide (ZnO), and Manganese oxide (MnO) require a reducing agent (like carbon or hydrogen) to be reduced to their respective metals. They cannot be reduced by heating alone.

• Mercuric oxide is unique among these options because it is thermally unstable. This instability allows it to decompose easily with heat, without the need for a reducing agent.

• The ease of reduction of metallic oxides depends on their position in the reactivity series. Mercury is a less reactive metal compared to iron, zinc, and manganese, which makes its oxide easier to reduce by heating.

• The fact that mercuric oxide decomposes into mercury and oxygen gas was famously demonstrated by Joseph Priestley in the 18th century, contributing to the discovery of oxygen.

Additional Information

• Iron (III) oxide (Fe_2O_3):

• This oxide is stable at high temperatures and cannot be reduced to iron by heating alone. It requires a reducing agent like carbon (in the form of coke) in a blast furnace. This is a crucial step in the extraction of iron from its ores.

• It is commonly found in nature as hematite, a key ore of iron.

• Zinc oxide (ZnO):

• Zinc oxide is another stable metallic oxide. It requires a reducing agent like carbon monoxide or coke to convert it into zinc metal in a furnace.

• Zinc oxide is widely used in various industries, including rubber, ceramics, and cosmetics, due to its unique chemical properties.

• Manganese oxide (MnO):

• MnO is a stable oxide and cannot be reduced to manganese by heating alone. It requires a reducing agent like aluminum powder in a thermite reaction or carbon in a furnace.

• Manganese and its compounds have extensive industrial applications, including in steel production and batteries.

• Thermal Decomposition of Oxides:

• Metal oxides of highly reactive metals like sodium, potassium, and calcium are highly stable and cannot be reduced by heating. However, oxides of less reactive metals like mercury and silver decompose easily upon heating.

• This principle is often used in metallurgy for the extraction of less reactive metals.

• Reactivity Series:

• The reactivity series of metals determines how easily a metal can be extracted from its oxide. Metals higher in the reactivity series form more stable oxides and require stronger reducing agents or electrolysis for reduction.

• Mercury's position low in the reactivity series makes its oxide less stable and easier to reduce by heat alone.

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Q9. Answer: (a) Cell size is related to its function, not the size of the organism.

The correct answer is Cell size is related to its function, not the size of the organism.

Key Points

• Cell size depends on function: The size of a cell is primarily determined by its specific function rather than the size of the organism. For example, nerve cells are long to transmit signals over large distances, while red blood cells are small and flexible to fit through capillaries. Hence, this statement is correct.

• Cell size and nuclei: Cell size does not necessarily depend on the number of nuclei. For example, some cells like skeletal muscle cells are multinucleated but this is an exception rather than a rule. Hence, this statement is incorrect.

• Uniformity in cell size: All cells are not of the same size in all organisms. Different organisms and even different tissues within the same organism can have cells of varying sizes and shapes. Hence, this statement is incorrect.

• Cell size in multicellular organisms: Cell size is not always large in multicellular organisms. In fact, many unicellular organisms like the amoeba can have larger cell sizes compared to cells in multicellular organisms. Hence, this statement is incorrect.

Additional Information

• Factors influencing cell size:

• Surface area-to-volume ratio: Smaller cells have a higher surface area-to-volume ratio, which facilitates efficient exchange of materials like nutrients and waste.

• Function: Specialized cells such as neurons (long and thin) and red blood cells (small and biconcave) are adapted to their functions.

• Type of organism: Single-celled organisms like bacteria are smaller compared to some specialized cells in multicellular organisms.

• Examples of cell size variations:

• Bacteria: Average size is 0.5–5 µm.

• Human red blood cells: Approximately 6–8 µm in diameter.

• Human egg cell: One of the largest human cells, approximately 100 µm in diameter.

• Giant algae (e.g., Acetabularia): Can grow up to several centimeters in length.

• Exceptions to general cell size rules:

• Multinucleated cells: Certain cells like skeletal muscle fibers are multinucleated and can be very large in size.

• Giant cells: Some unicellular organisms like Amoeba proteus can be larger than cells in multicellular organisms.

• Importance of cell specialization:

• Cell specialization allows organisms to have cells of different sizes and shapes suited to perform specific functions efficiently.

Important Points

• Cell theory: Proposed by Schleiden and Schwann, it states that all living organisms are composed of cells and that cells are the basic unit of life.

• Prokaryotic vs Eukaryotic cells: Prokaryotic cells (e.g., bacteria) are generally smaller (1-10 µm) than eukaryotic cells (10-100 µm).

• Microscopy: The study of cells primarily relies on microscopes. The development of electron microscopy has allowed detailed visualization of cellular structures.

• Cell adaptations: The structure and size of cells are adapted to their roles, ensuring efficiency in biological processes like oxygen transport, signal transmission, and nutrient absorption.

Q10. Answer: (a) displacement

The correct answer is displacement.

Key Points

• Displacement is defined as the shortest distance between the initial and final positions of an object, measured along a straight line. It is a vector quantity, meaning it has both magnitude and direction.

• The magnitude of displacement represents the shortest path covered, while its direction indicates the direction of motion from the initial to the final position.

• Displacement can be positive, negative, or zero. For example:

• If an object moves from point A to point B in a straight line, its displacement is positive in the direction of motion.

• If it moves back to its starting point, the displacement becomes zero.

• Displacement can also be negative if the direction of motion is opposite to the defined positive direction.

• Displacement is independent of the path taken. Even if the object moves along a curved or zigzag path, the displacement only considers the straight-line distance between the starting and ending points.

• It is different from distance, which measures the total path covered by the object without considering direction.

Additional Information

• Difference between Displacement and Distance:

• Displacement: It is the shortest straight-line distance between two points. It is a vector quantity with both magnitude and direction.

• Distance: It is the total length of the path traveled by the object, irrespective of direction. It is a scalar quantity.

• For example: If a car travels 5 km north and then 5 km south, its distance is 10 km, but its displacement is 0 because it returns to the starting point.

• Types of Motion and Displacement:

• In linear motion, displacement and distance may be equal if the object moves in a straight line without changing direction.

• In circular motion, displacement depends on the initial and final positions, while distance considers the total circumference covered.

• Mathematical Representation of Displacement:

• Displacement is often calculated using the formula: $\Delta x = x_f - x_i$, where:

• x_f = Final position

• x_i = Initial position

• For 2D or 3D motion, displacement can be calculated using vector components and the Pythagorean theorem.

• Examples of Displacement:

• A person walking in a straight line from point A to point B has a displacement equal to the straight-line distance between A and B.

• If a ball is thrown vertically upward and returns to its starting point, the displacement is zero, even though the distance covered is twice the height it reached.

• Vector Representation: Displacement can be represented as an arrow pointing from the initial position to the final position, with the arrow's length proportional to the magnitude of displacement.

Important Points

• Option 2: Speed: Speed is a scalar quantity that measures the rate at which an object covers distance. It does not consider direction and is not the shortest path.

• Option 3: Acceleration: Acceleration is the rate of change of velocity of an object with respect to time. It is not related to the shortest distance between two points.

• Option 4: Distance: Distance is a scalar quantity that measures the total path covered by an object. It does not consider direction and is usually greater than or equal to displacement.

Q11. Answer: (c) Nitrogen dioxide and oxygen

The correct answer is Nitrogen dioxide and oxygen.

Key Points

• When solid lead(II) nitrate ($Pb(NO_3)_2$) is heated, it undergoes thermal decomposition, breaking down into lead(II) oxide (PbO), nitrogen dioxide (NO_2), and oxygen (O_2).

• The yellow residue left behind after heating is lead(II) oxide (PbO). This confirms the decomposition of lead(II) nitrate.

• The reddish-brown gas evolved is nitrogen dioxide (NO_2), which is a characteristic product of the decomposition of nitrates containing heavy metals.

• The gas that supports combustion is oxygen (O_2), which is also released during the decomposition process.

• The reaction can be represented as: $Pb(NO_3)_2\ (s) \rightarrow PbO\ (s) + 2NO_2\ (g) + \frac{1}{2}\ O_2\ (g)$

• Hence, the two gases evolved during the decomposition of lead(II) nitrate are nitrogen dioxide (NO_2) and oxygen (O_2).

Additional Information

• Thermal Decomposition of Nitrates:

• Thermal decomposition is a process where a chemical compound breaks down into simpler substances when heated.

• Metal nitrates decompose to release oxygen, nitrogen oxides, and sometimes metal oxides depending on the metal involved.

• For example:

• Sodium nitrate ($NaNO_3$) decomposes to form sodium nitrite ($NaNO_2$) and oxygen.

• Lead(II) nitrate ($Pb(NO_3)_2$) decomposes to form lead oxide, nitrogen dioxide, and oxygen.

• Nitrogen Dioxide (NO_2):

• It is a reddish-brown gas with a pungent odor.

• It is a significant air pollutant and contributes to the formation of acid rain and smog.

• In the laboratory, NO_2 is often observed during the thermal decomposition of nitrates.

• Oxygen (O_2):

• It is a colorless and odorless gas that is essential for combustion and respiration.
• In this reaction, oxygen is released as a by-product of the decomposition of lead(II) nitrate.
• The presence of oxygen can be confirmed using a glowing splint test, where the splint relights in the presence of oxygen.
• Lead(II) Oxide (PbO):
• PbO is a yellow solid formed as a residue after the decomposition of Pb(NO3)2.
• It is used in glass manufacturing, ceramics, and as an intermediate in other chemical reactions.
• Applications of Thermal Decomposition:
• This principle is used in various industries for the production of oxygen or other gases.
• It is also used in the analysis of compounds and in the extraction of metals from their ores.

Important Points

• Decomposition Reactions:
• A decomposition reaction involves the breakdown of a compound into two or more simpler substances.
• It often requires heat, light, or electricity to occur.
• Example: 2HgO → 2Hg + O2
• Test for Gases:
• Oxygen: Relights a glowing splint.
• Nitrogen Dioxide: Has a reddish-brown appearance and a pungent smell.
• Environmental Impacts:
• Nitrogen oxides, including NO2, contribute to acid rain and air pollution.
• Proper precautions should be taken to minimize the release of such gases into the environment.

Q12. Answer: (b) The action and reaction forces act on different objects, but the static friction on the stationary object b...

The correct answer is The action and reaction forces act on different objects, but the static friction on the stationary object balances the applied push force F..

Key Points

• Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction. However, the action and reaction forces act on different objects, so they do not cancel each other out. This is the core reason why the object does not accelerate despite the reaction force being equal and opposite.
• The person applies a force F on the stationary object (e.g., a truck). This applied force is counteracted by the static friction between the object and the ground. If the force F is less than the maximum static frictional force, the object does not move.
• The reaction force (-F) acts on the person pushing the object, not the object itself. Thus, it has no role in causing or preventing the motion of the object.
• The net force on the stationary object is zero because the applied force is balanced by the force of static friction. Therefore, there is no acceleration, as per Newton's Second Law of Motion (F = ma).
• The object's inertia also plays a role. A massive object like a truck has a significant resistance to changes in motion due to its large mass. This inertia must be overcome for the object to accelerate, which requires a force greater than the maximum static frictional force.

Additional Information

• Static Friction:
• Static friction is the force that resists the initiation of motion between two surfaces in contact. It adjusts itself to counterbalance the applied force up to a maximum limit, known as the maximum static friction.
• When the applied force exceeds the maximum static friction, the object begins to move, and kinetic friction takes over.
• The formula for the maximum static frictional force is f_s = μ_s * N, where μ_s is the coefficient of static friction and N is the normal force.
• Newton's Laws of Motion:
• First Law: An object remains at rest or in uniform motion unless acted upon by an external force.
• Second Law: The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass (F = ma).
• Third Law: For every action, there is an equal and opposite reaction. The forces act on different objects and therefore do not cancel each other out.
• Inertia:
• Inertia is the property of an object to resist changes in its state of motion or rest. The greater the mass of an object, the greater its inertia.

• A massive object like a truck requires a significant force to overcome its inertia and initiate motion.

• Common Misconception:

• Many people incorrectly believe that action and reaction forces cancel each other out, but this is not true because they act on different objects.

• In the case of a stationary truck, the reaction force (-F) acts on the person pushing it, not on the truck itself.

Important Points

• Static vs Kinetic Friction:

• Static friction acts when there is no relative motion between the surfaces, while kinetic friction acts when the surfaces are sliding over each other.

• Static friction is generally greater than kinetic friction.

• Real-Life Applications:

• Static friction allows cars to stay stationary on a slope and prevents slipping while walking.

• Understanding the role of static friction and Newton's Third Law is crucial in engineering applications, such as designing brakes and tires.

• Practical Implication of Newton's Third Law:

• This law explains phenomena like rocket propulsion, where the exhaust gases exert a backward force, and the rocket moves forward due to the reaction force.

• It also clarifies why pushing against a wall does not cause the wall to move, as the wall exerts an equal and opposite force on the person pushing it.

Q13. Answer: (b) Sodium

The correct answer is Sodium.

Key Points

• Sodium reacts most vigorously with water compared to other metals listed in the options. Sodium belongs to the group of alkali metals in the periodic table, which are known for their high reactivity with water.

• When sodium comes in contact with water, it reacts rapidly to form sodium hydroxide (NaOH) and releases hydrogen gas (H2). This reaction is highly exothermic, often producing flames due to the ignition of hydrogen gas.

• The reaction can be represented as: 2Na + 2H2O → 2NaOH + H2 + heat.

• The vigorous reaction of sodium with water is due to its low ionization energy and its ability to easily lose an electron to form a positively charged ion (Na^+).

• Other metals in the options, such as iron, zinc, and lead, react with water either very slowly or not at all under normal conditions, as they are less reactive than sodium.

Additional Information

• Reactivity of Metals with Water:

• Group 1 Alkali Metals: Metals like sodium, potassium, and lithium react vigorously with water. Potassium reacts even more violently than sodium, often causing explosions.

• Iron: Iron reacts with water only at high temperatures, forming iron oxides and hydrogen gas. Its reaction is much slower compared to sodium.

• Zinc: Zinc reacts with steam to form zinc oxide and hydrogen gas but does not react with cold water.

• Lead: Lead is a very unreactive metal and does not react with water under normal conditions.

• Sodium's Properties:

• Soft Metal: Sodium is a soft, silvery-white metal that can be easily cut with a knife.

• Stored in Oil: Due to its high reactivity with water and air, sodium is stored in oil to prevent accidental reactions.

• Applications: Sodium is used in industries for the production of sodium hydroxide (NaOH), sodium vapor lamps, and as a coolant in nuclear reactors.

• Safety Precautions:

• Handling sodium requires extreme caution due to its vigorous reaction with water and air. It should always be stored under oil or inert gas.

• Direct contact with water or moisture can lead to explosions, so sodium must be handled in a dry environment.

• Hydrogen Gas: The hydrogen gas released during the reaction is highly flammable, which can cause explosions if ignited. This is another reason why sodium's reaction with water is dangerous.

Important Points

• Reactivity Series: Sodium is placed higher in the reactivity series of metals, indicating its high reactivity with water. The reactivity series is a list of metals arranged in order of their reactivity, with the most reactive at the top.

• Alkali Metals: All alkali metals (Group 1 elements) react with water, but the intensity increases as you go down the group. For

example, potassium reacts more violently than sodium.

• Industrial Use of Sodium: The high reactivity of sodium makes it a valuable element in chemical synthesis, such as in the production of esters and other organic compounds.

• Hydrogen Safety: The hydrogen gas released in the reaction is highly flammable and poses significant safety risks. Proper ventilation and handling procedures are essential when dealing with reactive metals like sodium.

Q14. Answer: (a) Equally in all directions of the container

The correct answer is Equally in all directions of the container.

Key Points

• A fluid at rest exerts equal pressure in all directions at a given height. This is a fundamental property of fluids in static equilibrium.

• The pressure at a specific depth is determined by the equation P = ρgh, where ρ is the fluid density, g is gravitational acceleration, and h is the height (or depth).

• This pressure is independent of the container's shape or size and acts equally in all directions: upward, downward, and sideways.

• The phenomenon is explained by Pascal's Law, which states that the pressure applied to a confined fluid is transmitted equally in all directions throughout the fluid.

• This principle underlies the working of various hydraulic systems and explains why objects submerged in a fluid experience uniform pressure at a given depth.

Additional Information

• Pascal's Law:

• Discovered by Blaise Pascal, this law states that when pressure is applied to a confined fluid, it is transmitted equally in all directions.

• This is the basis for hydraulic systems, such as hydraulic presses, car brakes, and lifts.

• Fluid Pressure Characteristics:

• Fluid pressure depends on density (ρ), gravitational acceleration (g), and depth (h).

• It is independent of the fluid's surface area or the container's shape.

• Applications of Equal Pressure:

• Used in designing submarines, dam walls, and underwater vehicles.

• Helps in understanding phenomena like buoyancy and fluid dynamics.

• Real-Life Examples:

• A balloon expands uniformly when air is blown into it, demonstrating equal pressure in all directions.

• Pressure felt while swimming underwater increases uniformly with depth.

Important Points

• Incorrect Options Explained:

• Option 2 (Only sideways): Incorrect because fluid pressure acts in all directions, not just sideways.

• Option 3 (Only upwards): Incorrect as pressure is not limited to one direction.

• Option 4 (Only downwards): Incorrect since pressure acts equally upward, downward, and sideways at a given height.

• Hydrostatic Pressure:

• The pressure exerted by a fluid at rest due to its weight is termed hydrostatic pressure.

• It increases with depth and is responsible for the equal pressure observed in all directions at a given height.

Q15. Answer: (b) Adding all atomic masses of the atoms in molecule

The correct answer is Adding all atomic masses of the atoms in molecule.

Key Points

• The molecular mass of a compound is calculated by summing up the atomic masses of all the atoms present in its molecular formula. This involves identifying the number and type of atoms in the molecule and then adding their respective atomic masses.

• The atomic mass of an element is the weighted average mass of its isotopes, measured in atomic mass units (amu), and is available in the periodic table.

• For example, for water (H2O):

• The atomic mass of hydrogen (H) is approximately 1 amu, and there are 2 hydrogen atoms in water.

• The atomic mass of oxygen (O) is approximately 16 amu, and there is 1 oxygen atom in water.

• The molecular mass = (2 × 1) + (1 × 16) = 18 amu.

• The molecular mass is crucial in chemistry for stoichiometric calculations, determining molar masses, and balancing chemical

equations.

• This method is applicable to all compounds, including organic and inorganic molecules, provided their molecular formula is known.

Additional Information

• Atomic Mass:

• The atomic mass of an element is typically measured in atomic mass units (amu) or unified mass units (u).

• 1 amu is defined as 1/12th the mass of a carbon-12 atom.

• For example, the atomic mass of carbon is approximately 12.01 amu, reflecting the weighted average of its isotopes.

• Molecular Formula:

• The molecular formula represents the actual number of each type of atom in a molecule.

• For instance, the molecular formula of glucose is C6H12O6, indicating it contains 6 carbon, 12 hydrogen, and 6 oxygen atoms.

• Applications of Molecular Mass:

• Used to determine the molar mass of substances for stoichiometric calculations in chemical reactions.

• Helps in identifying compounds and calculating concentrations in solutions (e.g., molarity).

• Essential in determining the empirical and molecular formulas of unknown substances.

• Common Misconceptions:

• Atomic numbers are not used for molecular mass calculation, as they represent the number of protons in an atom, not its mass.

• Similarly, atomic radii or volumes have no role in determining molecular mass.

Important Points

• Periodic Table:

• The atomic masses of all elements are listed in the periodic table. These values are essential for calculating molecular masses.

• Molar Mass:

• Molar mass is numerically equal to the molecular mass but is expressed in grams per mole (g/mol).

• For instance, the molar mass of water is 18 g/mol.

• Isotopes:

• The atomic mass of an element accounts for its isotopic abundance. For example, chlorine's atomic mass (35.45 amu) reflects the presence of two isotopes, Cl-35 and Cl-37.

• Precision:

• For highly accurate scientific calculations, molecular masses are calculated using atomic masses with several decimal places.

Q16. Answer: (d) Aborting the foetus

The correct answer is Aborting the foetus.

Key Points

• Contraceptive methods are techniques or devices used to prevent pregnancy. They typically work by interfering with the fertilization of the egg, the implantation of the fertilized egg, or the release of eggs from the ovaries.

• Altering hormonal balance to prevent the release of eggs from the ovary is a widely used contraceptive method. This is achieved through hormonal contraceptives such as oral pills, patches, or injectables. Hence, this statement is correct.

• Inserting Copper-T (an intrauterine device, IUD) into the uterus is another effective contraceptive method. It prevents sperm from fertilizing the egg or inhibits implantation. Hence, this statement is correct.

• Using condoms is a barrier method that prevents sperm from reaching the egg, thus acting as a contraceptive. Condoms are also effective in protecting against sexually transmitted infections (STIs). Hence, this statement is correct.

• Aborting the foetus is not a contraceptive method. It refers to the termination of an already established pregnancy and is considered a medical procedure rather than a preventive measure. Hence, this statement is incorrect.

• Contraceptive methods are focused on preventing conception, whereas abortion deals with ending a pregnancy after conception has occurred. This fundamental difference makes abortion ineligible to be classified as a contraceptive method.

Additional Information

• Types of Contraceptive Methods:

• Barrier methods: These include condoms, diaphragms, and cervical caps that prevent sperm from entering the uterus. They are effective and also protect against STIs.

• Hormonal methods: These include oral contraceptive pills, patches, injections, and implants that regulate or suppress ovulation and alter the uterine lining to prevent implantation.

• Intrauterine devices (IUDs): Copper-T and hormonal IUDs are placed in the uterus to prevent fertilization or implantation.

• Natural methods: These include fertility awareness-based methods, withdrawal, and lactational amenorrhea method (LAM) that rely on understanding the menstrual cycle to avoid conception.

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• Surgical methods: Permanent solutions like tubal ligation for women and vasectomy for men prevent the transport of eggs and sperm respectively.

• Abortion:

• Abortion refers to the deliberate termination of a pregnancy. It is not considered a contraceptive method as it does not prevent conception but rather ends an existing pregnancy.

• There are two main types of abortion: medical abortion (using medications) and surgical abortion (procedures like dilation and curettage).

• Abortion laws and regulations vary across countries. For instance, in India, the Medical Termination of Pregnancy (MTP) Act, 1971, regulates abortion practices.

• Importance of Contraception:

• Contraception helps in family planning, controlling population growth, and improving maternal and child health.

• It empowers individuals to make informed decisions about reproduction and reduces the incidence of unintended pregnancies.

• By preventing pregnancies, contraceptives also lower the risk of unsafe abortions, which can lead to significant health complications.

• Global Perspective:

• The World Health Organization (WHO) advocates for universal access to contraceptive methods as part of reproductive health services.

• As per the United Nations Population Fund (UNFPA), access to contraception is a fundamental human right and plays a crucial role in achieving Sustainable Development Goals (SDGs).

Important Points

• Abortion vs. Contraception:

• While contraception prevents pregnancy, abortion terminates a pregnancy after it has occurred.

• Contraceptive failure is one of the reasons individuals may seek an abortion.

• Abortion Laws in India:

• The MTP Act, 1971, allows abortion up to 24 weeks of pregnancy under specific conditions, such as risk to the mother's life or fetal abnormalities.

• The act was amended in 2021 to increase the gestational limit for special categories, including survivors of rape or incest.

• Contraceptive Use in India:

• As per the National Family Health Survey (NFHS-5), contraceptive prevalence in India has increased significantly, with a focus on modern methods like IUDs and hormonal pills.

• Government programs like Mission Parivar Vikas aim to increase awareness and availability of contraceptive methods.

Q17. Answer: (c) Both (iii) and (iv)

The correct answer is Option 3.

Key Points

• Statement (i): The principal axis of a spherical mirror is an imaginary straight line passing through the pole and the centre of curvature of the mirror. This definition is accurate and forms the basis for understanding the geometry of spherical mirrors. Hence, statement (i) is correct.

• Statement (ii): The principal axis is normal (perpendicular) to the mirror at its pole. This is also true as it defines the alignment of the principal axis relative to the spherical mirror's surface. Hence, statement (ii) is correct.

• Statement (iii): A ray parallel to the principal axis after reflection from the mirror passes through the focus, not the centre of curvature. This is incorrect as the reflected rays converge at the focus, which lies between the pole and the centre of curvature. Hence, statement (iii) is incorrect.

• Statement (iv): The focus of a spherical mirror lies on its principal axis. This is a fundamental property of spherical mirrors where the focus is located along the principal axis. The statement incorrectly denies this fact. Hence, statement (iv) is incorrect.

• Thus, statements (iii) and (iv) are NOT true. The correct answer is Option 3.

Additional Information

• Spherical Mirrors:

• Spherical mirrors are of two types: concave and convex. Concave mirrors converge light rays, while convex mirrors diverge them.

• The principal axis is a critical element in understanding how light rays behave upon reflection.

• Concave mirrors have a real focus, while convex mirrors have a virtual focus.

• Key Terms:

• Pole: The midpoint of the spherical mirror's surface.

• Centre of Curvature: The center of the sphere of which the mirror is a part.

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• Focus: The point where reflected rays meet or appear to meet.
• Principal Axis: The line joining the pole and the center of curvature.
• Laws of Reflection:
• Light rays obey the laws of reflection when interacting with spherical mirrors.
• Incident ray, reflected ray, and normal all lie in the same plane.
• Applications:
• Concave mirrors: Used in telescopes, headlights, and shaving mirrors for magnification.
• Convex mirrors: Used in rearview mirrors and surveillance systems for a wider field of view.

Important Points

• Principal Axis: This axis serves as the reference line for spherical mirrors and is essential for defining properties like focus and curvature.
• Focus Position: In concave mirrors, the focus lies between the pole and the center of curvature, while in convex mirrors, it lies behind the mirror.
• Ray Behavior: Rays parallel to the principal axis converge or diverge depending on the type of mirror.
• Reflection Rules: The angle of incidence equals the angle of reflection, which governs the behavior of light rays in spherical mirrors.

Q18. Answer: (b) Everything was tall.

The correct answer is Everything was tall..

Key Points

• Gregor Mendel, the "Father of Genetics," conducted experiments on pea plants to study the inheritance of traits.
• In this specific experiment, Mendel crossed a pure tall plant (TT) with a pure short plant (tt).
• The resulting first-generation (F1) offspring were all tall plants. This phenomenon occurs because the tall trait is dominant, while the short trait is recessive.
• The genetic makeup (genotype) of the F1 generation was Tt, but the physical appearance (phenotype) was tall.
• This observation confirmed Mendel's principle of dominance, which states that in a heterozygous condition, the dominant allele masks the expression of the recessive allele.

Additional Information

• Mendel's Laws of Inheritance:
• Law of Segregation: During gamete formation, the two alleles for each trait separate, so each gamete carries only one allele for each trait.
• Law of Dominance: In a heterozygous condition, one allele (dominant) masks the expression of the other allele (recessive).
• Law of Independent Assortment: Alleles for different traits segregate independently of each other during gamete formation.
• Terminology:
• Genotype: The genetic constitution of an organism (e.g., TT, Tt, tt).
• Phenotype: The physical appearance of an organism (e.g., tall or short).
• Dominant trait: A trait that is expressed when at least one dominant allele is present (e.g., tallness in pea plants).
• Recessive trait: A trait that is expressed only when two recessive alleles are present (e.g., shortness in pea plants).
• Experimental Setup:
• Mendel used pea plants (Pisum sativum) because they have distinct traits, short generation time, and can self-pollinate or be cross-pollinated.
• He studied seven contrasting traits, including plant height (tall vs. short), seed shape (round vs. wrinkled), and seed color (yellow vs. green).
• Importance of Mendel's Work:
• Mendel's experiments laid the foundation for modern genetics.
• His findings were rediscovered in the early 20th century, leading to the development of the field of genetics.

Important Points

• Dominant and Recessive Alleles:
• Dominant allele (T): Responsible for the tall phenotype in pea plants.
• Recessive allele (t): Responsible for the short phenotype, expressed only in homozygous condition (tt).
• F2 Generation:
• When F1 plants (Tt) are self-pollinated, the F2 generation shows a phenotypic ratio of 3:1 (tall:short).
• The genotypic ratio in the F2 generation is 1:2:1 (TT:Tt:tt).

• Modern Relevance:

• Mendel's work is crucial for understanding heredity, genetic disorders, and breeding techniques.

• His principles are applied in fields like agriculture, medicine, and biotechnology.

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Q19. Answer: (a) The emergent ray is parallel to the direction of the incident ray, but shifted sideward slightly

The correct answer is The emergent ray is parallel to the direction of the incident ray, but shifted sideward slightly.

Key Points

• When light passes through a rectangular glass slab, it undergoes refraction at both interfaces (air-glass and glass-air).

• The incident ray enters the glass slab and bends towards the normal due to the higher refractive index of glass compared to air.

• As the light exits the slab, it bends away from the normal since it is transitioning back to a medium of lower refractive index (air).

• The emergent ray is parallel to the incident ray because the two opposite faces of the rectangular slab are parallel, causing the angular deviation to cancel out. However, the ray is slightly shifted laterally, a phenomenon known as lateral displacement.

• This lateral displacement depends on factors such as the thickness of the slab, the angle of incidence, and the refractive index of the material.

Additional Information

• Refraction:

• It is the bending of light as it passes from one medium to another with a different refractive index.

• The amount of bending is governed by Snell's Law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$, where n represents the refractive index and θ the angle of incidence/refraction.

• Lateral Displacement:

• It is the perpendicular distance between the original path of the incident ray and the emergent ray after refraction.

• The formula to calculate lateral displacement is given by: *d = t * sin(i - r) / cos(r)*, where t is the thickness of the slab, i is the angle of incidence, and r is the angle of refraction.

• Factors Affecting Refraction:

• The refractive index of the material: Higher refractive indices cause greater bending of light.

• The wavelength of light: Shorter wavelengths (e.g., blue light) refract more than longer wavelengths (e.g., red light).

• The angle of incidence: Larger angles of incidence result in more significant refraction.

• Applications:

• Rectangular glass slabs are used in optical instruments to align or shift light paths without deviating their angle.

• This principle is also applied in devices like prisms and beam splitters.

Important Points

• Option 2: The emergent ray is perpendicular to the incident ray – This is incorrect because the refracted ray does not bend by 90° in a rectangular glass slab. The emergent ray remains parallel to the incident ray.

• Option 3: The emergent ray converges to a point on the principal axis – This is incorrect because convergence occurs in lenses, not in a glass slab.

• Option 4: The emergent ray is reflected back along the path of the incident ray – This is incorrect because reflection only occurs if light hits a surface at a specific angle and is not refracted.

Q20. Answer: (d) centrifugation

The correct answer is centrifugation.

Key Points

• Centrifugation is a technique used to separate colloidal particles from a solution by applying centrifugal force. It is widely used in laboratories for isolating components of a mixture based on their densities.

• Colloidal particles are typically small in size (1-1000 nanometers) and do not settle under normal gravitational forces. Centrifugation overcomes this limitation by applying a rotational force, causing the heavier particles to settle at the bottom.

• The process involves spinning the mixture in a centrifuge, which generates high-speed rotational force. The denser colloidal particles move outward and form a sediment, separating them from the liquid medium.

• Centrifugation is highly effective in separating colloidal particles from liquids, making it the preferred method for isolating substances such as proteins, DNA, and nanoparticles.

• This technique is commonly used in industries like pharmaceuticals, food processing, and water treatment plants for purifying substances and separating impurities.

Additional Information

• Filtration:

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• Filtration is a technique used to separate solid particles from a liquid or gas using a porous medium such as filter paper or membranes. However, it is ineffective for separating colloidal particles due to their small size.

• This method is ideal for larger particles or impurities in mixtures like sand in water or air pollutants.

• Boiling:

• Boiling involves heating a liquid until it turns into vapor, leaving behind non-volatile impurities. This method is not suitable for separating colloidal particles as they remain dispersed in the liquid even after boiling.

• It is commonly used for sterilization purposes or concentrating solutions by evaporating the solvent.

• Recrystallisation:

• Recrystallisation is a purification technique used for solids, where impurities are removed by dissolving the substance in a solvent at high temperatures and then cooling it to form pure crystals.

• This process is effective for purifying chemicals but does not work for colloidal systems.

• Centrifugation Applications:

• In biotechnology, centrifugation is used to isolate DNA, RNA, and proteins.

• In medical diagnostics, it separates blood components like plasma and red blood cells.

• In environmental science, it aids in water and wastewater treatment by removing suspended particles.

• In nanotechnology, it helps in separating nanoparticles based on size and density.

Important Points

• Colloids: Colloids are mixtures where one substance is dispersed in another. Examples include milk, fog, and paint.

• Characteristics of Colloidal Particles: They are small enough to remain suspended and do not settle under normal conditions due to Brownian motion.

• Industrial Use: Centrifugation is extensively used for purifying liquids in industries such as oil refining, dairy processing, and drug manufacturing.

• Scientific Importance: Centrifugation is crucial for isolating biomolecules and conducting research in molecular biology and genetics.

Q21. Answer: (a) Apical meristem

The correct answer is Apical meristem.

Key Points

• Apical meristem is the type of meristem located at the tips of stems and roots.

• It is responsible for the lengthwise growth of plants, enabling elongation at the ends of shoots and roots.

• Apical meristems consist of actively dividing cells that contribute to primary growth in plants.

• The activity of the apical meristem results in the formation of primary tissues such as the epidermis, cortex, vascular tissues, and pith.

• This meristem is crucial in the development of the plant's overall structure and helps plants grow taller and deeper into the soil.

Additional Information

• Types of Meristems:

• Apical Meristem: Found at the tips of roots and shoots. Responsible for primary growth (lengthwise growth).

• Lateral Meristem: Present along the sides of stems and roots, involved in secondary growth (increase in girth or thickness).

• Intercalary Meristem: Located at nodes and internodes, contributing to growth in specific regions like grasses.

• Permanent Meristem: These are differentiated cells that no longer divide actively.

• Functions of Apical Meristem:

• Promotes elongation of shoots and roots, aiding plants in reaching sunlight and water sources.

• Contributes to the formation of primary tissues such as the xylem, phloem, and epidermis.

• Influences the formation of leaves and floral structures in plants.

• Importance in Plant Growth:

• Provides a continuous supply of new cells for growth.

• Helps plants adapt to their environment by growing toward resources like light and nutrients.

• Examples:

• Growth at the tip of a tree branch is due to the activity of apical meristem.

• Root tips elongating into deeper layers of soil demonstrate apical meristem functionality.

Important Points

• Growth Direction: Apical meristems ensure growth in a polarized manner, meaning shoot tips grow upward while root tips grow downward.

• Hormonal Regulation: Growth in apical meristems is regulated by plant hormones like auxins, which promote elongation.

• Primary Growth: Helps plants grow taller and deeper, allowing them to access resources like sunlight and water more effectively.

• Application in Agriculture: Understanding apical meristem activity is critical for practices like pruning, which encourages bushier plant growth.

Q22. Answer: (a) Ozone

The correct answer is Ozone.

Key Points

• Ozone (O3) is a molecule composed of three oxygen atoms and is found in the Earth's stratosphere, forming the ozone layer.

• The ozone layer is located in the stratosphere, approximately 10 to 30 kilometers above the Earth's surface, and acts as a protective shield by absorbing the majority of the Sun's ultraviolet (UV) radiation.

• UV radiation is divided into three types: UV-A, UV-B, and UV-C. While the ozone layer absorbs almost all UV-C and most UV-B radiation, some UV-A still reaches the Earth's surface.

• The depletion of the ozone layer, caused by chemicals like chlorofluorocarbons (CFCs) and halons, leads to increased UV radiation reaching the surface, which can cause severe health issues like skin cancer, cataracts, and damage to plant life and ecosystems.

• The importance of the ozone layer was recognized globally, leading to the adoption of the Montreal Protocol in 1987, which aims to phase out the production and use of ozone-depleting substances.

Additional Information

• Carbon:

• Carbon is a fundamental element found in all organic compounds and is essential for life on Earth.

• In the atmosphere, carbon exists primarily in the form of carbon dioxide (CO2), which plays a significant role in the greenhouse effect and global warming.

• Unlike ozone, carbon does not directly protect the Earth from UV radiation.

• Hydrogen:

• Hydrogen is the most abundant element in the universe and is primarily found in compounds like water (H2O) on Earth.

• Hydrogen plays no role in shielding the Earth from ultraviolet radiation.

• Nitrogen:

• Nitrogen makes up approximately 78% of the Earth's atmosphere and is a critical component of amino acids, proteins, and DNA.

• While nitrogen is essential for life, it does not absorb or block UV radiation.

• Importance of UV Protection:

• UV radiation can cause skin cancer, sunburn, and premature aging in humans.

• It can also damage the photosynthetic processes in plants and affect aquatic ecosystems.

• Protecting the ozone layer is essential for maintaining the Earth's ecological balance and human health.

Important Points

• Montreal Protocol:

• The Montreal Protocol on Substances that Deplete the Ozone Layer was signed in 1987 and is considered one of the most successful environmental agreements.

• It aims to phase out the production and consumption of ozone-depleting substances like CFCs, halons, and hydrochlorofluorocarbons (HCFCs).

• Ozone Hole:

• The term "ozone hole" refers to the significant thinning of the ozone layer over Antarctica, which is most pronounced during the spring months (September to November).

• This phenomenon is caused by the reaction of CFCs with ozone molecules in the presence of sunlight.

• Ozone Formation:

• Ozone is formed in the stratosphere when ultraviolet light splits oxygen molecules (O2) into individual oxygen atoms, which then combine with other oxygen molecules to form ozone (O3).

Q23. Answer: (b) Coating the metal with paint or oil

The correct answer is Coating the metal with paint or oil.

Key Points

• Corrosion is a chemical process where metals react with environmental elements such as oxygen and moisture, leading to the formation of rust (iron oxide in the case of iron).

• Coating iron with paint or oil prevents the direct contact of iron with air and moisture, thus inhibiting the corrosion process. This method is cost-effective and widely used.

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• Paint acts as a physical barrier, blocking moisture and oxygen from reaching the metal surface. Oil creates a thin film that repels water and reduces exposure to oxygen.

• Other methods, like galvanization (coating iron with zinc), are also effective but involve a more complex process compared to simple painting or oil coating.

• Option 1: Heating the metal repeatedly does not prevent corrosion; instead, it could accelerate oxidation under high temperatures. (Incorrect)

• Option 3: Cooling the metal with water regularly does not protect it; rather, it increases moisture exposure, leading to faster corrosion. (Incorrect)

• Option 4: Dissolving the metal in acid is not a preventive measure; it will damage and degrade the metal completely. (Incorrect)

Additional Information

• Galvanization:

• It is a process of coating iron or steel with zinc to prevent corrosion.

• Zinc acts as a sacrificial layer, corroding itself to protect the underlying metal.

• Galvanization is commonly used in industries and construction for long-term protection.

• Electroplating:

• Involves coating metals with another metal layer using electrochemical processes.

• For example, iron can be electroplated with nickel or chromium for corrosion resistance.

• Other Protective Methods:

• Use of stainless steel: Stainless steel contains chromium, which forms a protective oxide layer.

• Cathodic protection: A sacrificial anode is used to divert corrosion from the main metal.

• Environmental Factors:

• Corrosion is accelerated in humid, coastal, or industrial areas due to higher exposure to moisture and pollutants.

• Protective measures are more crucial in such locations.

Important Points

• Rust Formation:

• Rust (iron oxide) occurs due to the reaction of iron, oxygen, and water.

• The chemical equation for rust formation is: $4Fe + 3O2 + 6H2O \rightarrow 4Fe(OH)3$.

• Over time, $Fe(OH)3$ dehydrates to form $Fe2O3 \cdot nH2O$, which is rust.

• Economic Impact:

• Corrosion causes significant economic losses due to metal degradation.

• Industries spend billions annually on corrosion prevention and maintenance.

• Global Practices:

• Countries with high humidity or coastal regions, like India and Japan, prioritize anti-corrosion measures.

• Advanced techniques like nanotechnology-based coatings are emerging globally to combat corrosion.

Q24. Answer: (b) By multiple reflection of sound

The correct answer is By multiple reflection of sound.

Key Points

• The sound of a patient's heartbeat travels through the stethoscope's tubing by multiple reflections of sound waves. This ensures that the sound is transmitted efficiently from the chest piece to the doctor's ears.

• The stethoscope tube is designed to act as a channel that enables sound waves to bounce back and forth multiple times, maintaining the quality and clarity of the sound.

• The chest piece of the stethoscope captures the sound of the heartbeat, which travels as pressure waves through the air inside the tube.

• The rubber tubing used in stethoscopes minimizes external noise interference and prevents sound dissipation, ensuring that the multiple reflections inside the tube convey the sound clearly to the earpieces.

• The principle of multiple reflections is essential for amplifying and transmitting low-intensity sounds, such as heartbeats or lung sounds, to the doctor’s ears for accurate diagnosis.

Additional Information

• Components of a Stethoscope:

• The chest piece consists of a diaphragm and a bell. The diaphragm is used for high-frequency sounds, while the bell is for low-frequency sounds.

• The tubing is usually made of thick rubber or PVC to ensure sound insulation and proper transmission of sound waves.

• The earpieces are ergonomically designed to fit into the doctor’s ears and ensure that external noise does not interfere with the

transmitted sound.

• Sound Transmission in a Stethoscope:

• When the chest piece is placed on the patient's body, vibrations caused by the heartbeat or breathing generate sound waves.

• These sound waves travel through the tubing by the process of multiple reflections, maintaining their intensity and clarity.

• The earpieces deliver these amplified sound waves to the doctor's ears, enabling accurate analysis of the patient's condition.

• Importance of Multiple Reflection of Sound:

• Multiple reflections help in amplifying weak sounds, such as heart murmurs or abnormal lung sounds, making them audible to the doctor.

• This principle is not only used in stethoscopes but also in other devices like hearing aids and acoustic instruments.

• Comparison of Other Options:

• Direct Transmission without Reflection: This is incorrect, as direct transmission would lead to significant loss of sound energy.

• Refraction of Sound Waves: Refraction occurs when sound waves change their medium, which is not applicable in a stethoscope.

• Conversion to Electrical Signals: This principle applies to electronic stethoscopes, not traditional acoustic ones.

Important Points

• Historical Background: The stethoscope was invented by René Laennec in 1816. Initially, it was a simple wooden tube.

• Modern Developments: Advanced stethoscopes now include electronic versions that amplify sound and reduce ambient noise.

• Applications: Stethoscopes are widely used in medical diagnosis for monitoring heart sounds, lung sounds, and intestinal sounds.

• Other Uses: Specialized stethoscopes, such as fetal stethoscopes, are used to monitor the heartbeat of a fetus during pregnancy.

Q25. Answer: (d) Plants produced this way can flower and bear fruit earlier than those grown from seeds.

The correct answer is Plants produced this way can flower and bear fruit earlier than those grown from seeds..

Key Points

• Vegetative propagation is a method of asexual reproduction in plants where new plants grow from vegetative parts such as stems, roots, and leaves rather than seeds.

• This method ensures that plants retain the genetic characteristics of the parent plant, making it ideal for cultivating desirable traits like taste, color, or resistance to diseases.

• One major advantage is that plants produced through vegetative propagation can flower and bear fruit much earlier compared to plants grown from seeds. This is because the vegetative parts are already mature and do not need to undergo the seed germination process.

• Unlike plants grown from seeds that may show genetic variations, vegetative propagation produces genetically identical clones, ensuring consistency in crop quality.

• This method is particularly beneficial for species that have poor seed viability or germination rates, allowing propagation of plants that might otherwise struggle to reproduce.

Additional Information

• Methods of vegetative propagation:

• Natural methods: Includes propagation through structures like runners (e.g., strawberry), tubers (e.g., potato), bulbs (e.g., onion), and rhizomes (e.g., ginger).

• Artificial methods: Includes techniques like cutting, grafting, layering, and tissue culture, which are widely used in agriculture and horticulture.

• Advantages of vegetative propagation:

• Time efficiency: Plants grow faster and mature earlier as the parts used for propagation are already developed.

• Consistency: Produces genetically identical plants, ensuring uniformity in traits such as taste, size, and disease resistance.

• Economic benefits: Reduces the time required for cultivation and increases yield, making it cost-effective for farmers.

• Preservation of traits: Ideal for propagating plants with desired traits like ornamental flowers or high-yield crops.

• Examples of plants propagated vegetatively:

• Common examples include banana, sugarcane, rose, jasmine, potato, onion, and garlic.

• Commercial crops such as grapevine and apple are often propagated using grafting techniques.

• Comparison with seed propagation:

• Seed propagation: Involves genetic recombination, which can lead to variations in traits. Plants take longer to grow and mature.

• Vegetative propagation: Produces clones with consistent traits, ensuring quicker flowering and fruiting.

Important Points

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• Applications of vegetative propagation:
• Used in horticulture for cultivating ornamental plants like roses, orchids, and lilies.
• Widely applied in agriculture for propagating crops like sugarcane, potato, and banana.
• Essential for conserving endangered plant species by cloning them in controlled environments.
• Role in plant breeding:
• Helps in mass multiplication of hybrids and genetically modified plants.
• Ensures preservation of high-yield or disease-resistant varieties.
• Challenges:
• Limited genetic diversity can make plants more susceptible to diseases and pests.
• Requires expertise in artificial propagation techniques for large-scale application.

Q26. Answer: (c) Rs. 833

Shortcut Trick
Ratio of A : B : C : D = 17 : 3 : 9 : 6
Difference between C and B in units = 9 − 3 = 6 units
Given, 6 units = Rs. 294 => 1 unit = Rs. 49
A's share = 17 units = 17 × Rs. 49 = Rs. 833
Therefore The correct answer is Rs. 833.
Alternate Method
Given: Ratio A:B:C:D = 17:3:9:6 and (C − B) = Rs. 294
Let the shares be 17x, 3x, 9x, and 6x respectively.
=> 9x − 3x = 294
=> 6x = 294
=> x = 294 ÷ 6
=> x = 49
=> A's share = 17x = 17 × 49
=> A's share = Rs. 833
Therefore The correct answer is Rs. 833.
Additional Information
Ratio and Proportion
A ratio compares values by division. If a total amount is divided in ratio a:b:c, the shares are ax, bx, and cx where x is the common multiplier.
Unitary Method
Identify the value of 1 unit by dividing the given difference by the difference in ratio parts, then multiply by the required ratio part.
Calculation Tip
To calculate 17 × 49 quickly, use 17 × (50 − 1) = 850 − 17 = 833.

Q27. Answer: (b) 1

Shortcut Trick
Apply the Chain Rule formula: M1 × D1 = M2 × D2
Here, 2 men × 2 days = M2 × 4 days
4 = M2 × 4
M2 = 1 man
Therefore The correct answer is 1 man.
Alternate Method
Given:
Initial men (M1) = 2
Initial days (D1) = 2
Final days (D2) = 4

Person	Days	Total Work	Efficiency
2 Men	2	4 units	2

Required Men	4	1	

Calculations:

=> Total Work = Men × Days = 2 × 2 = 4 units

=> Required Men = Total Work ÷ New Days

=> Required Men = 4 ÷ 4

=> Required Men = 1

Therefore The correct answer is 1 man.

Additional Information

General Chain Rule

For varying work and hours: (M1×D1×H1)/W1 = (M2×D2×H2)/W2 where M is men, D is days, H is hours, and W is work.

Inverse Proportion

Number of men is inversely proportional to the time taken to complete the same work (M prop. to 1/D).

Work and Wages

Wages are distributed in the ratio of the work done or the efficiency of the individuals involved.

Q28. Answer: (c) 30

Shortcut Trick

Initial age ratio of Anu and Bina = 4 : 5

Ratio after 6 years = 5 : 6

Difference in ratio parts for both = 1 unit (5 − 4 = 1 and 6 − 5 = 1)

Since 1 unit → 6 years, then Bina's present age (5 units) = 5 × 6 = 30 years.

Therefore The correct answer is 30 years.

Alternate Method

Given:

Present ratio of Anu and Bina = 4 : 5

Ratio after 6 years = 5 : 6

Let the present ages of Anu and Bina be 4x and 5x respectively.

=> (4x + 6) / (5x + 6) = 5 / 6

=> 6 × (4x + 6) = 5 × (5x + 6)

=> 24x + 36 = 25x + 30

=> 25x − 24x = 36 − 30

=> x = 6

=> Bina's present age = 5x = 5 × 6 = 30 years.

Therefore The correct answer is 30 years.

Additional Information

Concept of Age Difference

The numerical difference between the ages of two persons remains constant at any point in time.

Ratio Balancing Method

If the difference between ratio parts is not equal, multiply the ratios by the difference of the other ratio to balance the gap.

Average Age

Average age = (Sum of ages of all persons) ÷ (Total number of persons).

Q29. Answer: (a) 109

Shortcut Trick

For any point P inside a rectangle ABCD, the British Flag Theorem states that the sum of the squares of distances to opposite vertices is equal.

Formula: $PA^2 + PC^2 = PB^2 + PD^2$

=> $73^2 + 99^2 = 57^2 + PD^2$

=> 5329 + 9801 = 3249 + PD^2

=> 15130 − 3249 = PD^2

=> PD = √11881 = 109 cm

Therefore The correct answer is 109 cm.

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Alternate Method

Given: PA = 73 cm, PB = 57 cm, PC = 99 cm.

Formula Used: In rectangle ABCD, for any point P: $PA^2 + PC^2 = PB^2 + PD^2$

Calculations:

=> $PA^2 + PC^2 = PB^2 + PD^2$

=> $(73)^2 + (99)^2 = (57)^2 + PD^2$

=> $5329 + 9801 = 3249 + PD^2$

=> $15130 = 3249 + PD^2$

=> $PD^2 = 15130 - 3249$

=> $PD^2 = 11881$

=> $PD = \sqrt{11881}$

=> PD = 109 cm

Therefore The correct answer is 109 cm.

Additional Information

British Flag Theorem

It applies to any point P (inside or outside) relative to a rectangle ABCD, ensuring $PA^2 + PC^2 = PB^2 + PD^2$ based on the Pythagorean theorem.

Diagonal Property

In a rectangle, diagonals are equal and bisect each other; $AC = BD = \sqrt{(l^2 + b^2)}$.

Apollonius Theorem

Relates the length of a median of a triangle to the lengths of its sides: $AB^2 + AC^2 = 2(AD^2 + BD^2)$ where AD is the median.

Q30. Answer: (a) 30

Given:

Simplify the expression: 18 + 3 of (24 ÷ 8 × 2) − 6

Formula used:

Follow BODMAS: Brackets, Orders (powers and roots, etc.), Division and Multiplication (from left to right), Addition and Subtraction (from left to right).

Calculation:

Expression: 18 + 3 of (24 ÷ 8 × 2) − 6

=> 18 + 3 of (3 × 2) − 6

=> 18 + 3 of 6 − 6

=> 18 + (3 × 6) − 6

=> 18 + 18 − 6

=> 36 − 6

=> 30

Therefore The correct answer is option (1).

Q31. Answer: (a) Rs. 3,000

Shortcut Trick

Extra interest % = Rate increase × Time

Extra interest % = 4% × 3 = 12%

Given that 12% of Principal = Rs. 360

1% of Principal = 360 ÷ 12 = Rs. 30

100% (Principal) = 30 × 100 = Rs. 3,000

Therefore The correct answer is Rs. 3,000.

Alternate Method

Given:

Time (T) = 3 years

Rate increase (ΔR) = 4% per annum

Extra Interest fetched = Rs. 360

Formula Used:

Simple Interest (SI) = (P × R × T) ÷ 100

Calculations:

=> Increase in Interest (ΔSI) = (P × ΔR × T) ÷ 100

=> 360 = (P × 4 × 3) ÷ 100

=> 360 = 12P ÷ 100

=> 12P = 360 × 100

=> P = (360 × 100) ÷ 12

=> P = 30 × 100

=> P = 3000

Therefore The correct answer is Rs. 3,000.

Additional Information

Simple Interest (SI) Property

Simple Interest remains constant every year if the Principal and Rate are unchanged. It is always calculated on the original Principal.

Amount Formula

The total Amount (A) at the end of the period is the sum of Principal (P) and Interest (I). Formula: A = P + (P × R × T) ÷ 100.

Rate of Interest

The Rate (R) can be calculated if other variables are known using: R = (SI × 100) ÷ (P × T).

Q32. Answer: (d) 280

Shortcut Trick

Total Time = Total Distance ÷ Average Speed = 600 ÷ 70 = 60/7 hours.

Time taken for first half = 300 ÷ 40 = 7.5 hours or 15/2 hours.

Time for second half = 60/7 − 15/2 = (120 − 105) ÷ 14 = 15/14 hours.

Required Speed = Remaining Distance ÷ Remaining Time = 300 ÷ (15/14) = 20 × 14 = 280 kmph.

Therefore The correct answer is 280 km/hr.

Alternate Method

Given: Total Distance = 600 km, S1 = 40 km/hr for 300 km, Average Speed = 70 km/hr.

Formula Used: Average Speed = Total Distance ÷ Total Time

=> Total Time (T) = 600 ÷ 70 = 60/7 hours

=> Time for first part (t1) = 300 ÷ 40 = 7.5 hours

=> Time for second part (t2) = T − t1 = 60/7 − 15/2

=> t2 = (120 − 105) / 14 = 15/14 hours

=> Speed for second part (S2) = 300 ÷ (15/14)

=> S2 = (300 × 14) / 15 = 20 × 14 = 280 km/hr

Therefore The correct answer is 280 km/hr.

Additional Information

Average Speed (Equal Distances)

If a journey is divided into two equal distances with speeds x and y, the Harmonic Mean is used: Avg Speed = 2xy / (x + y).

Relative Speed

For objects moving in the same direction, relative speed is |s1 − s2|. For opposite directions, it is s1 + s2.

Unit Conversion

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

Q33. Answer: (c) 1

Shortcut Trick

Since cosec θ is the reciprocal of sin θ, we have cosec θ = 1 ÷ sin θ.

Therefore, sin 45° × cosec 45° = sin 45° × (1 ÷ sin 45°) = 1.

Therefore The correct answer is 1.

Alternate Method

Given:

Expression: sin 45° × cosec 45°

Formula Used:

sin 45° = 1 ÷ √2

cosec 45° = √2

Calculations:

=> Value = sin 45° × cosec 45°

=> Value = (1 ÷ √2) × √2

=> Value = 1

Therefore The correct answer is 1.

Additional Information

Reciprocal Identities

The primary trigonometric functions and their reciprocals always satisfy sin θ × cosec θ = 1, cos θ × sec θ = 1, and tan θ × cot θ = 1 for all valid angles θ.

Trigonometric Values of 45°

For θ = 45°, sin 45° = 1/√2, cos 45° = 1/√2, tan 45° = 1, cosec 45° = √2, sec 45° = √2, and cot 45° = 1.

Q34. Answer: (a) 10290

Shortcut Trick

Convert percentages and fractions into a single multiplier.

50% × 20% × 2/3 × Number = 686

1/2 × 1/5 × 2/3 × Number = 686

1/15 × Number = 686 => Number = 686 × 15 = 10290

Therefore The correct answer is 10290.

Alternate Method

Given: Result = 686, Percentages = 50% and 20%, Fraction = 2/3

Let the number be 'x'.

=> 50% of 20% of 2/3 × x = 686

=> (50/100) × (20/100) × (2/3) × x = 686

=> (1/2) × (1/5) × (2/3) × x = 686

=> (1 × 1 × 2) / (2 × 5 × 3) × x = 686

=> 2/30 × x = 686

=> 1/15 × x = 686

=> x = 686 × 15

=> x = 10290

Therefore The correct answer is 10290.

Additional Information

Percentage to Fraction Conversion

To convert percentage to fraction, divide by 100. Example: 25% = 25/100 = 1/4.

Successive Percentage Rule

When multiple percentages or fractions are applied to a base number 'of' indicates multiplication.

Base Change Principle

If a number is reduced by x%, the new value is (100−x)% of the original base.

Q35. Answer: (a) 5

Shortcut Trick

For a number to be divisible by 11, the difference between the sum of digits at odd positions and even positions must be 0 or a multiple of 11.

Sum of digits at odd positions (7, p, 9, 5) = 7 + p + 9 + 5 = 21 + p

Sum of digits at even positions (8, 3, 4) = 8 + 3 + 4 = 15

Difference = (21 + p) − 15 = 6 + p

For 6 + p to be divisible by 11, p must be 5 (since 6 + 5 = 11).

Therefore The correct answer is 5.

Alternate Method

Given number: 78p3945

Divisibility Rule of 11: |(Sum of digits at odd places) − (Sum of digits at even places)| = 0, 11, 22, ...

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=> Let positions be counted from left to right: 1st=7, 2nd=8, 3rd=p, 4th=3, 5th=9, 6th=4, 7th=5
=> Sum_(odd) = 7 + p + 9 + 5 = 21 + p
=> Sum_(even) = 8 + 3 + 4 = 15
=> Difference = (21 + p) − 15
=> Difference = 6 + p
=> Since p is a single digit (0-9), the only value for which 6 + p is a multiple of 11 is p = 5.
=> 6 + 5 = 11 (which is divisible by 11)
Therefore The correct answer is 5.
Additional Information
Divisibility by 3 and 9
A number is divisible by 3 or 9 if the sum of its digits is divisible by 3 or 9 respectively.
Divisibility by 8
A number is divisible by 8 if the last three digits of the number are divisible by 8.
Divisibility by 7
Double the last digit and subtract it from the remaining number; if the result is divisible by 7, the original number is too.

Q36. Answer: (d) 20

Shortcut Trick
The first 9 multiples of 4 form an Arithmetic Progression (AP) with common difference 4.
For an odd number of terms (n = 9) in an AP, the Average is always the Middle Term.
Middle term position = (9 + 1) ÷ 2 = 5^(th) term.
Average = 5^(th) multiple of 4 = 4 × 5 = 20.
Therefore The correct answer is 20.
Alternate Method
Given: First 9 multiples of 4 (4, 8, 12, 16, 20, 24, 28, 32, 36).
Formula Used: Average of an AP = (First term + Last term) ÷ 2
=> First term (a) = 4 × 1 = 4
=> Last term (l) = 4 × 9 = 36
=> Average = (4 + 36) ÷ 2
=> Average = 40 ÷ 2
=> Average = 20
Therefore The correct answer is 20.
Additional Information
Average of first 'n' natural numbers
The formula is Average = (n + 1) ÷ 2.
Average of first 'n' multiples of 'k'
The general formula is Average = k × (n + 1) ÷ 2.
Sum of 'n' terms in AP
Sum = (n ÷ 2) × [First term + Last term].

Q37. Answer: (c) 15

Shortcut Trick
To find the bigger number when the sum and difference are known:
Bigger number = (Sum + Difference) ÷ 2
=> (26 + 4) ÷ 2 = 30 ÷ 2 = 15
Therefore The correct answer is 15.
Alternate Method
Given:
Sum of two numbers = 26
Difference between numbers = 4
Let the bigger number be x and the smaller number be y.
=> x + y = 26 ----(i)

=> x − y = 4 ----(ii)

Adding equation (i) and (ii):

=> (x + y) + (x − y) = 26 + 4

=> 2x = 30

=> x = 30 ÷ 2

=> x = 15

Therefore The correct answer is 15.

Additional Information

Finding the Smaller Number

To find the smaller number, use the formula: (Sum − Difference) ÷ 2. In this case, (26 − 4) ÷ 2 = 11.

Ratio of Two Numbers

If the sum (S) and difference (D) are given, the ratio of the numbers is (S + D) : (S − D).

Product of Two Numbers

The product of two numbers can be found using [(Sum)² − (Difference)²] ÷ 4.

Q38. Answer: (d) 200%

Given:

1/20 is what percentage of 2/80 ?

Formula used:

Percentage = Part/Whole × 100

Calculation:

Part = 1/20, Whole = 2/80

=> Percentage = (1/20)/(2/80) × 100

=> Percentage = 1/20 × 80/2 × 100

=> Percentage = (1 × 80 × 100)/(20 × 2)

=> Percentage = 8000/40

=> Percentage = 200

=> The correct answer is 4%.

Therefore The correct answer is option (4).

Q39. Answer: (b) 439

Shortcut Trick

Combine ratios A : B = 9 : 14 and B : C = 13 : 10 by making B common (multiply by 13 and 14).

A : B : C = (9 × 13) : (14 × 13) : (10 × 14) = 117 : 182 : 140.

Difference |C − A| = 140 − 117 = 23 units → 23 cm (so 1 unit = 1 cm).

Total length = 117 + 182 + 140 = 439 units = 439 cm.

Therefore The correct answer is 439 cm.

Alternate Method

Given: Ratio A : B = 9 : 14 and Ratio C : B = 10 : 13 (or B : C = 13 : 10).

Formula Used: Compounding of ratios and unitary method.

=> To equalize B, multiply (A : B) by 13 and (B : C) by 14.

=> A = 9 × 13 = 117 units.

=> B = 14 × 13 = 182 units.

=> C = 10 × 14 = 140 units.

=> Difference (C − A) = 140 − 117 = 23 units.

=> Given 23 units = 23 cm Therefore 1 unit = 1 cm.

=> Total length = A + B + C = 117 + 182 + 140 = 439 cm.

Therefore The correct answer is 439 cm.

Additional Information

Ratio Balancing

To combine A:B and B:C, find the LCM of the common term B to create a continuous ratio A:B:C.

Compound Ratio

The compound ratio of (a : b) and (c : d) is (ac : bd), used when relating different segments of a whole.

Unitary Method in Ratios

The actual value is found by equating the unit difference to the given physical difference (Value = Units × Value of 1 unit).

Q40. Answer: (a) 600

Shortcut Trick

Side of rhombus (a) = Perimeter ÷ 4 = 100 ÷ 4 = 25 cm.

Diagonal ratio 3 : 4 => Half-diagonal ratio = 3 : 4.

Using Pythagorean triplet (3, 4, 5), the side corresponds to 5 units.

5 units = 25 cm => 1 unit = 5 cm.

Diagonals: d1 = 3 × 2 × 5 = 30 cm and d2 = 4 × 2 × 5 = 40 cm.

Area = (30 × 40) ÷ 2 = 600 cm².

Therefore The correct answer is 600 cm².

Alternate Method

Given: Perimeter = 100 cm, Ratio of diagonals (d1 : d2) = 3 : 4.

Formula Used: Side (a) = Perimeter ÷ 4; Area = (1 ÷ 2) × d1 × d2; $a^2 = (d1/2)^2 + (d2/2)^2$.

=> Side (a) = 100 ÷ 4 = 25 cm.

=> Let diagonals be d1 = 3x and d2 = 4x.

=> Half-diagonals are OA = 1.5x and OB = 2x.

=> In right-angled triangle AOB, $OA^2 + OB^2 = AB^2$.

=> $(1.5x)^2 + (2x)^2 = 25^2$

=> $2.25x^2 + 4x^2 = 625$

=> $6.25x^2 = 625$

=> $x^2 = 100$ => x = 10.

=> d1 = 3 × 10 = 30 cm and d2 = 4 × 10 = 40 cm.

=> Area of rhombus = (d1 × d2) ÷ 2 = (30 × 40) ÷ 2 = 600 cm².

Therefore The correct answer is 600 cm².

Additional Information

Area Formulas for Rhombus

The area of a rhombus can be calculated as Area = 1/2 × d1 × d2 using diagonals, or Area = base × height.

Relationship between Side and Diagonals

For a rhombus with side 'a', the relation is given by $4a^2 = d1^2 + d2^2$, which is derived from the Pythagorean theorem.

Properties of Rhombus

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

Q41. Answer: (d) 27.14%

Shortcut Trick

Relation between Marked Price (MP) and Cost Price (CP): MP/CP = (100 + Profit%)/(100 − Discount%)

Given Marked Price is 40% above Cost Price, so MP/CP = 140/100 = 7/5.

7/5 = (100 + 2)/(100 − D) => 7(100 − D) = 5 × 102

700 − 7D = 510 => 7D = 190 => D = 27.1428...

Therefore The correct answer is 27.14%.

Alternate Method

Given:

Marked Price (MP) = Rs. 572

MP is 40% above Cost Price (CP).

Profit% = 2%

=> Let Cost Price (CP) = x

=> Marked Price (MP) = 1.40x = 572 => x = 572 ÷ 1.4 = Rs. 408.57

=> Selling Price (SP) = CP × (100 + Profit%)/100

=> SP = (572 ÷ 1.4) × 1.02 = 583.44 ÷ 1.4 = Rs. 416.74

=> Discount = MP − SP = 572 − 416.74 = Rs. 155.26

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=> Discount% = (Discount ÷ MP) × 100

=> Discount% = (155.26 ÷ 572) × 100 ≈ 27.14%

Therefore The correct answer is 27.14%.

Additional Information

Markup and Discount Relation

Effective change formula for profit: Profit% = Markup% − Discount% − (Markup% × Discount%)/100.

Successive Discounts

If two discounts d1 and d2 are given, the single equivalent discount is (d1 + d2 − d1d2/100)%.

Dishonest Dealer

Profit% = [Error / (True Value − Error)] × 100 when weight manipulation is involved.

Q42. Answer: (c) 5

Shortcut Trick

Combined efficiency of A, B, and C = 5 + 3 + 1 = 9 units/day.

Total work (LCM of 3, 5, 15) = 15 units.

Thrice the work = 15 × 3 = 45 units.

Time taken = 45 ÷ 9 = 5 days.

Therefore The correct answer is 5 days.

Alternate Method

Given: Time taken by A = 3 days, B = 5 days, and C = 15 days.

Formula Used: Efficiency = Total Work ÷ Time; Time = Total Work ÷ Total Efficiency

Person	Days	Total Work	Efficiency
A	3	15 (LCM)	5
B	5	3	
C	15	1	

=> Combined efficiency of A + B + C = 5 + 3 + 1 = 9 units/day.

=> Original work = 15 units.

=> New work to be completed = 3 × 15 = 45 units.

=> Time required = 45 ÷ 9

=> Time required = 5 days.

Therefore The correct answer is 5 days.

Additional Information

Total Work using LCM

Taking the LCM of individual days provides a common multiple that represents the total work in units, making efficiency calculations simpler.

Combined Work Rate

When multiple people work together, their individual efficiencies are added. Total Time = Total Work ÷ Sum of Efficiencies.

Work Proportionality

If the amount of work increases by a factor of 'k', the time taken also increases by the same factor 'k', provided the efficiency remains constant.

Q43. Answer: (b) 1330

Shortcut Trick

Total Surface Area (TSA) of the solid = Area of 5 faces + (Area of 1 face − Base area of hemisphere) + CSA of hemisphere

=> TSA = $5a^2 + (a^2 - \pi r^2) + 2\pi r^2 = 6a^2 + \pi r^2$

Given a = 14 cm, the largest diameter is also 14 cm, so r = 7 cm.

=> TSA = $6 \times 14^2 + (22/7) \times 7^2 = 1176 + 154 = 1330$ cm².

Therefore The correct answer is 1330 cm².

Alternate Method

Given:

Side of the cubical block (a) = 14 cm

Radius of the hemisphere (r) = Side/2 = 14/2 = 7 cm

Formula Used:

Total Surface Area of solid = $6a^2 + \pi r^2$

Calculations:

=> Area of the six faces of the cube = $6 \times a^2 = 6 \times 14 \times 14 = 1176$ cm²

=> Curved Surface Area (CSA) of the hemisphere = $2\pi r^2 = 2 \times (22/7) \times 7 \times 7 = 308$ cm²

=> Area of the circular base of the hemisphere = $\pi r^2 = (22/7) \times 7 \times 7 = 154$ cm²

=> Total Surface Area = (Area of cube) − (Area of hemisphere base) + (CSA of hemisphere)

=> Total Surface Area = 1176 − 154 + 308

=> Total Surface Area = 1176 + 154 = 1330 cm²

Therefore The correct answer is 1330 cm².

Additional Information

Surface Area of Cube

Total Surface Area = $6a^2$, where 'a' is the side length. Lateral Surface Area = $4a^2$.

Hemisphere Formulas

Curved Surface Area = $2\pi r^2$. Total Surface Area (including base) = $3\pi r^2$.

Combined Solids

When one solid is placed on another, the overlapping area (the base of the top solid) must be subtracted once from the total outer surface area.

Q44. Answer: (c) 15

Shortcut Trick

Substitute the value of x = 2 directly into the algebraic expression.

$x^2 + 3x + 5 \rightarrow 2^2 + 3(2) + 5$

4 + 6 + 5 = 15

Therefore The correct answer is 15.

Alternate Method

Given:

The numerical value of the variable x = 2.

The given expression is $x^2 + 3x + 5$.

Formula Used:

Evaluation of a polynomial by substitution of a constant value.

Calculations:

=> Expression = $x^2 + 3x + 5$

=> Substituting x = 2: $(2)^2 + 3 \times 2 + 5$

=> 4 + 6 + 5

=> 15

Therefore The correct answer is 15.

Additional Information

Quadratic Expression

An expression of the form $ax^2 + bx + c$ is called a quadratic expression because its highest power (degree) is 2.

Nature of Roots

The discriminant (D) is calculated as $b^2 - 4ac$ to determine if the roots of the equation are real or imaginary.

Sum and Product of Roots

For a quadratic equation, the sum of roots is −b/a and the product of roots is c/a.

Q45. Answer: (b) 7.4

Shortcut Trick

Let the total work be LCM(15, 14, 21) = 210 units.

Efficiencies: Paul = 14, Ryan = 15, Max = 10.

Paul leaves after 5 days: 210 − (14 × 5) = 140 units.

Ryan leaves 3 days before end (add his work): 140 + (15 × 3) = 185 units.

Remaining work handled by Ryan and Max: 185 ÷ (15 + 10) = 7.4 days.
Therefore The correct answer is 7.4 days.
Alternate Method
Given: Paul = 15 days, Ryan = 14 days, Max = 21 days.

Person	Days	Total Work	Efficiency
Paul	15	210	14
Ryan	14	15	
Max	21	10	

Let the total time taken be 'x' days.
Paul worked for 5 days, Max worked for x days, and Ryan worked for (x − 3) days.
=> (14 × 5) + 15(x − 3) + 10x = 210
=> 70 + 15x − 45 + 10x = 210
=> 25x + 25 = 210
=> 25x = 185
=> x = 185 ÷ 25 = 7.4 days
Therefore The correct answer is 7.4 days.
Additional Information
Leaving Before Completion
If a person leaves 'n' days before completion, add their n-days work to the total work and divide by combined efficiency.
Leaving After Starting
If a person leaves 'n' days after starting, subtract their work from the total and exclude them from future calculations.
Work & Efficiency
Total Work = Efficiency × Time. Efficiency is inversely proportional to the time taken to complete the work.

Q46. Answer: (a) 36%

Shortcut Trick
Discount % = [Free Items ÷ Total Items (Paid + Free)] × 100
Discount % = [9 ÷ (16 + 9)] × 100
Discount % = (9 ÷ 25) × 100 = 9 × 4 = 36%
Therefore The correct answer is 36%.
Alternate Method
Let the Marked Price (MP) of each item be Rs. 1.
=> Total MP of 25 items = Rs. 25.
=> Selling Price (SP) = Price of 16 items = Rs. 16.
=> Discount = Total MP − SP = 25 − 16 = Rs. 9.
=> Discount % = (Discount ÷ Total MP) × 100
=> Discount % = (9 ÷ 25) × 100 = 36%.
Therefore The correct answer is 36%.
Additional Information
Successive Discounts
When two discounts a% and b% are given, net discount = [a + b − (ab/100)]%.
Marked Price and SP Relation
SP = MP × [(100 − Discount %) / 100]. Discount is always calculated on the Marked Price.
Buy X Get Y Free with Extra Discount
If an additional d% discount is given on "Buy X Get Y", net SP = MP of X items × (100 − d)%.

Q47. Answer: (a) 33

Shortcut Trick
For the entire journey involving two equal distances with speeds x and y:
Average Speed = (2 × x × y) ÷ (x + y)
Average Speed = (2 × 21 × 77) ÷ (21 + 77)

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Average Speed = 3234 ÷ 98 = 33 km/hr
Therefore The correct answer is 33 km/hr.
Alternate Method
Given:
Speed to mall (v1) = 21 km/hr
Speed returning (v2) = 77 km/hr
Formula Used:
Average Speed = Total Distance ÷ Total Time
Calculations:
=> Let the distance to the mall be D km.
=> Time taken to go (t1) = D ÷ 21
=> Time taken to return (t2) = D ÷ 77
=> Total Distance = D + D = 2D
=> Total Time = (D/21) + (D/77) = (11D + 3D) ÷ 231 = 14D ÷ 231
=> Average Speed = 2D ÷ (14D / 231)
=> Average Speed = (2 × 231) ÷ 14
=> Average Speed = 462 ÷ 14 = 33 km/hr
Therefore The correct answer is 33 km/hr.
Additional Information
Average Speed (Equal Distances)
When a person covers two equal distances at speeds v1 and v2, the average speed is the harmonic mean: 2v1v2 ÷ (v1 + v2).
Average Speed (General Case)
For unequal distances and times, always use the basic definition: Average Speed = (Total Distance) ÷ (Total Time).
Relative Speed
In same direction, relative speed = |v1 − v2|. In opposite direction, relative speed = v1 + v2.

Q48. Answer: (c) 485

Shortcut Trick
Profit = 20% = 1/5 → CP : SP = 5 : 6
6 units = Rs. 582
1 unit = 582 ÷ 6 = Rs. 97
5 units = 5 × 97 = Rs. 485
Therefore The correct answer is Rs. 485.
Alternate Method
Given: Selling Price (SP) = Rs. 582, Profit Percentage = 20%
Formula Used: Cost Price (CP) = [SP × 100] ÷ [100 + Profit %]
=> CP = [582 × 100] ÷ [100 + 20]
=> CP = [582 × 100] ÷ 120
=> CP = 582 × (5 ÷ 6)
=> CP = 97 × 5
=> CP = 485
Therefore The correct answer is Rs. 485.
Additional Information
Profit and Loss Basics
Profit occurs when SP > CP. Profit = SP − CP. Profit % = (Profit ÷ CP) × 100.
Loss Calculation
Loss occurs when CP > SP. Loss = CP − SP. Loss % = (Loss ÷ CP) × 100.
Marked Price and Discount
Selling Price = Marked Price − Discount. Discount % = (Discount ÷ MP) × 100.

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Q49. Answer: (b) Increase by 31.6%

Shortcut Trick

Let the cost of TV = 100. Then Washing Machine (WM) = 50.

Initial total cost of 6 WM and 2 TV = (6 × 50) + (2 × 100) = 300 + 200 = 500.

Net change in cost = [6 × (50 × 60%)] + [2 × (100 × −11%)] = [6 × 30] − [2 × 11] = 180 − 22 = +158.

% change = (158 ÷ 500) × 100 = 31.6%.

Therefore The correct answer is Increase by 31.6%.

Alternate Method

Given: Cost of Washing Machine (WM) is 50% less than TV.

=> Let cost of 1 TV = Rs. 100 and cost of 1 WM = Rs. 50.

=> Total initial cost for 6 WM and 2 TVs = (6 × 50) + (2 × 100) = 300 + 200 = Rs. 500.

=> New cost of 1 WM = 50 + (60% of 50) = 50 + 30 = Rs. 80.

=> New cost of 1 TV = 100 − (11% of 100) = 100 − 11 = Rs. 89.

=> New total cost = (6 × 80) + (2 × 89) = 480 + 178 = Rs. 658.

=> Percentage change = [(658 − 500) ÷ 500] × 100

=> (158 ÷ 500) × 100 = 31.6%.

Therefore The correct answer is Increase by 31.6%.

Additional Information

Percentage Change Formula

Percentage change = [(Final Value − Initial Value) ÷ Initial Value] × 100.

Successive Percentage Change

If a value changes by a% and then b%, the net change is [a + b + (ab/100)]%.

Weighted Average Method

Overall % change = (n1c1 + n2c2) ÷ (n1v1 + n2v2) where c is change and v is value.

Q50. Answer: (c) 45

Shortcut Trick

Assume a Deviated Mean of 40.

Deviations: −11, +8, +25, −8, +32, +23, +24, −22, −26

Sum of deviations = 45. Net deviation = 45 ÷ 9 = +5.

Actual Mean = 40 + 5 = 45.

Therefore The correct answer is 45.

Alternate Method

Given: Observations = 29, 48, 65, 32, 72, 63, 64, 18, 14

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

=> Sum = 29 + 48 + 65 + 32 + 72 + 63 + 64 + 18 + 14

=> Sum = 405

=> Total number of observations (n) = 9

=> Arithmetic Mean = 405 ÷ 9

=> Arithmetic Mean = 45

Therefore The correct answer is 45.

Additional Information

Arithmetic Mean Properties

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

Weighted Average

When observations have different weights (w), the mean is calculated as (Σw_ix_i) ÷ Σw_i.

Combined Mean

For two groups with means x1, x2 and sizes n1, n2, the combined mean is (n1x1 + n2x2) ÷ (n1 + n2).

Q51. Answer: (b) Husband's brother's wife

Family Chart:

Decoding the symbols:

Symbol	Meaning
A + B	A is the son of B
A − B	A is the brother of B
A × B	A is the wife of B
A ÷ B	A is the father of B

Given expression:

D × F − G ÷ H + J

Relationship asked:

D is the wife of F, and F is the brother of G.

Therefore, relative to J's family line, D becomes the wife of G brother's.

Hence, The correct answer is Option (2).

Q52. Answer: (c) 8

The logic followed here is:

Therefore The correct answer is Option (3).

Q53. Answer: (a) 6 km to the South

Mr. Zzz starts from Point A and drives 21 km towards the West.

He then takes a left turn, drives 5 km, turns right and drives 7 km.

He then takes a right turn and drives 11 km.

He takes a final right turn, drives 28 km and stops at Point P.

Thus, he should drive 6km in south in order to reach Point A again.

Hence, the correct answer is "Option 1".

Q54. Answer: (b) 62

Formula used:

Total students = (Position from top + Position from bottom) − 1

As per the given information:

Position from top = 48

Position from bottom = 15

Calculation:

Total students = 48 + 15 − 1

= 63 − 1

= 62

Hence, the correct answer is "Option (2)".

Q55. Answer: (c) 3

Given:

Seven people: A, B, C, D, E, F, G sit in a row facing north.

Conditions:

1) Only 2 people sit to the right of F.

2) Only 3 people sit between F and A.

3) E and C are immediate neighbours of G.

4) D sits immediately to the left of B.

5) C is not an immediate neighbour of A.

Step 1: Place F

If only 2 people sit to the right of F, F must be in position 5.

Positions:

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1 2 3 4 5 6 7

_ _ _ _ F _ _

Step 2: 3 people between F and A

If F is at position 5, A must be at position 1.

A _ _ _ F _ _

Step 3: G has neighbours E and C

So arrangement becomes:

E G C

or

C G E

Step 4: D immediately left of B

Using all conditions, the valid arrangement becomes:

Final Sitting Arrangement:

A E G C F D B

Positions:

D → Position 6

E → Position 2

People between them:

G, C, F → 3 people

Hence, the correct answer is Option (3): 3.

Q56. Answer: (c) ZAN37

The logic followed here is:

→ The letters are shifted by +12 to get the next letter of the next word.

→ The numbers are decreasing by 18 to get the next one.

Similarly from the last cluster, N(+12)=Z, O(+12)= A, B(+12)= N & 55 - 18 = 37

By combining all of this: ZAN37

Therefore The correct answer is Option (3).

Q57. Answer: (a) Two

Given: Seven boxes A, B, C, D, I, J and K are kept one above the other.

Conditions:

1) Only A is kept above I.

2) Only two boxes are kept between I and C.

3) Only K is kept below J.

4) D is not kept immediately above C.

Step 1: Only A above I

This means A must be at the top and I just below it.

A
I

Step 2: Two boxes between I and C

I is position 2 → C must be position 5.

A
I

C

Step 3: Only K below J

So J must be just above K at the bottom.

A
I
C
J
K

Step 4: D not immediately above C

So D cannot be position 4.

Remaining boxes B and D fill positions 3 and 4.

Thus D goes to position 3 and B to position 4.

Final Arrangement (Top → Bottom):

A
I
D
B
C
J
K

Positions:

B → Position 4

K → Position 7

Boxes between them: C, J

Total boxes between B and K = 2

Hence, the correct answer is Option (1).

Q58. Answer: (b) 6

Given Sequence:

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

There are 6 such odd numbers (5 3 2) (9 7 2) (3 9 8) (3 3 2) (9 3 4) (5 7 6) which is immediately preceded by an odd number and also immediately followed by an even number.

Therefore The correct answer is Option (2).

Q59. Answer: (a) Only conclusion (I) follows

Statements:

Some cats are pets.

All pets are animals.

Least possible venn digram,

Conclusions:

I. Some cats are animals

Since some cats are pets and all pets are animals, those cats must be animals.

Conclusion I → True

II. No animals are pets

This contradicts the statement because all pets are animals.

Conclusion II → False

Therefore The correct answer is Option (1).

Q60. Answer: (b) More than three

Given Sequence:

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

There are 4 such instances 6 8 5, 4 8 3, 6 2 5, 6 8 3 where even digit are immediately preceded by an even digit and also immediately followed by an odd digit.

Therefore The correct answer is Option (2).

Q61. Answer: (d) 6 km to the north

The correct answer is option4. The detailed solution will be updated soon.

Q62. Answer: (d) Neither conclusion (I) nor (II) follows

Statements:

Some plants are vegetables.

All buds are vegetables.

Least possible venn diagram:

Conclusions:

I. Some plants are buds

This is not definite. Plants and buds may overlap but it is not guaranteed.

Conclusion I → False

II. All vegetables are buds

The statement says All buds are vegetables, not the reverse.

So vegetables may include things other than buds.

Conclusion II → False

Therefore The correct answer is Option (4).

Q63. Answer: (d) JQ - LI

The logic followed here is:

1) FM – IP → F→I (+3), M→P (+3)

2) MT – PW → M→P (+3), T→W (+3)

3) LS – OV → L→O (+3), S→V (+3)

=> In all three, both letters move forward by 3 places in the alphabet.

4) JQ – LI → J→L (+2), Q→I (this one actually goes backward by 8), so it breaks the rule.

Therefore The correct answer is Option (4).

Q64. Answer: (a) 144

The logic followed here is:

Therefore The correct answer is Option (1).

Q65. Answer: (b) 225

The logic followed here is:

Therefore The correct answer is Option (2).

Q66. Answer: (c) 3

Given Sequence:

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

There are 3 such odd numbers (3 5 4) (1 1 6) (3 3 4) which is immediately preceded by an odd number and also immediately

followed by an even number.

Therefore The correct answer is Option (3).

Q67. Answer: (b) 776

Given Equation: 114 ÷ 7 − 42 × 2 + 43 = ?

Condition:

• and − are interchanged

× and ÷ are interchanged

After interchanging the symbols:

114 × 7 + 42 ÷ 2 − 43

Calculation:

114 × 7 + 42 ÷ 2 − 43

= 798 + 21 − 43

= 819 − 43

= 776

Hence, the correct answer is 776.

Q68. Answer: (b) PO -4

The correct answer is option2. The detailed solution will be updated soon.

Q69. Answer: (b) 180

Given Equation: 45 − 4 ÷ 4 + 32 × 8

Symbol meanings:

• means −

− means ×

× means ÷

÷ means +

After replacing the symbols:

45 × 4 + 4 − 32 ÷ 8

Calculation:

45 × 4 + 4 − 32 ÷ 8

= 180 + 4 − 4

= 184 − 4

= 180

Hence, the correct answer is 180.

Q70. Answer: (c) HL – DE

Check alphabetical positions:

Option 1:

U(21) → Q(17) = −4

Y(25) → S(19) = −6

Option 2:

D(4) → Z(26) = −4 (circular)

H(8) → B(2) = −6

Option 4:

C(3) → Y(25) = −4 (circular)

G(7) → A(1) = −6

Option 3:

H(8) → D(4) = −4

L(12) → E(5) = −7

Difference pattern: −4, −7 (different pattern)

Therefore, HL – DE does not follow the pattern.

Hence, the correct answer is Option (3).

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Q71. Answer: (c) 3

Given:

Seven people: A, B, C, D, E, F, G sit in a row facing north.

1) Five people sit between D and F

2) G sits immediately left of F

3) Only one person sits between G and A

4) B sits to the left of C and to the right of E

Step 1: Place D and F

Five people between them means they occupy the two ends.

D _ _ _ _ _ F

Step 2: G is immediately left of F

D _ _ _ _ G F

Step 3: One person between G and A

D _ _ A _ G F

Step 4: B is left of C and right of E

D E B A C G F

The remaining arrangement satisfying this condition is:

Final Seating Arrangement (Left → Right): D E B A C G F

People to the right of A: C, G, F, and one position counted according to arrangement → 3 people

Hence, the correct answer is Option (3).

Q72. Answer: (d) One

Given Information:

A, B, C, D, E, F and G are sitting around a circular table facing the centre.

D sits second to the left of G.

B sits second to the left of D.

C sits to the immediate right of A. E sits third to the left of C.

Thus, only 1 person is sitting between E and F when counted from left of E.

Hence, the correct answer is "Option 4".

Q73. Answer: (c) One

Given sequence:

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

There is only one instance (8 2 3) where an even number is preceded by an even number and followed by an odd number.

Hence, the correct answer will be Option (3).

Q74. Answer: (b) rp

The logic followed here is:

From the above reference 'people' will bee coded as 'rp'.

Therefore The correct answer is Option (2).

Q75. Answer: (a) DTZ

The position and positional values or English Alphabets are:

Given: PPR MQT JRV GSX ?

The logic followed here is:

=> P(-3) → M(-3)→ J(-3) → G(-3) → D

=> P(+1) → Q(+1) → R(+1) → S(+1) → T

=> R(+2) → T(+2) → V(+2) → X(+2) → Z

So, the final word is DTZ.

Hence, the correct answer is Option (1).

Q76. Answer: (a) YRGZ

The position and positional values or English Alphabets are:

ABCD : DDJJ
=> A(+3) → D, B(+2) → D, C(+7) → D, D(+6) → J
MJEB : PLLH
=> M(+3) → P, J(+2) → L, E(+7) → L, B(+6) → H
Similarly, VPZT : ?
=> V(+3) → Y, P(+2) → R, Z(+7) → G, T(+6) → Z
Hence the correct answer is Option (1).

Q77. Answer: (b) (48, 82, 7)

Logic followed here is:
=> 2nd Number = (1st Number - 3rd Number) × 2
Now, (13,14,6)
=> 14 = (13 - 6) × 2 = 7 × 2 = 14
(39,28,25)
=> 28 = (39 - 25) × 2 = 14 × 2 = 28
Similarly, In Option (2) (48, 82, 7)
=> 82 = (48 - 7) × 2 = 41 × 2 = 82
Hence, the correct answer is "Option 2".

Q78. Answer: (b) SUPT

The logic followed here is:
Each letter is shifted by +7 from its positional value to get the next word
=> HJEI : OQLP => H(+7)=O, J(+7)=Q, E(+7)=L, I(+7)=P
=> JLGK : QSNR => J(+7)=Q, L(+7)=S, G(+7)=N, K(+7)=R
Similarly,
=> LNIM: SUPT => L(+7)=S, N(+7)=U, I(+7)=P, M(+7)=T
Therefore The correct answer is Option (2).

Q79. Answer: (a) wj

The logic followed here is:
From the above arrangement 'way' will be coded as 'wj'.
Therefore The correct answer is Option (1).

Q80. Answer: (b) 748

Given Equation:
151 ÷ 5 + 72 × 3 − 17
Condition:
• and − are interchanged
× and ÷ are interchanged
After interchanging the symbols:
151 × 5 − 72 ÷ 3 + 17
Calculation:
151 × 5 − 72 ÷ 3 + 17
= 755 − 24 + 17 = 731 + 17 = 748
Hence, the correct answer is 748.

Q81. Answer: (c) Shri. Narendra Modi

The correct answer is Shri. Narendra Modi.
Key Points
• The 10th Governing Council Meeting of NITI Aayog was presided over by Shri. Narendra Modi, the Prime Minister of India, on 24 May 2025 in New Delhi.
• The Governing Council is the apex decision-making body of NITI Aayog, chaired by the Prime Minister, and includes Chief Ministers of all states, Union Territories with legislatures, and Lt. Governors of other Union Territories.
• This meeting addressed critical national issues such as sustainable development, economic growth, and implementation of

policies and reforms for better governance.

• The 10th meeting emphasized cooperative federalism, involving states and Union Territories in decision-making processes to achieve inclusive development goals.

• Shri. Narendra Modi has consistently advocated for the active participation of states in shaping India's development agenda through NITI Aayog meetings.

Additional Information

• NITI Aayog:

• Established in 2015, it replaced the Planning Commission of India.

• Serves as the policy think tank of the Government of India, focusing on policy formulation, monitoring, and fostering cooperative federalism.

• It aims to provide strategic and technical advice to the central and state governments on key initiatives and programs.

• Works towards promoting innovation, digital transformation, and sustainable development.

• Shri. Narendra Modi:

• The 14th and current Prime Minister of India, serving since May 26, 2014.

• Known for introducing ambitious reforms such as Digital India, Make in India, and Atmanirbhar Bharat.

• Has emphasized the importance of inclusive development and active participation of states in the governance framework.

• Governing Council of NITI Aayog:

• The council provides a platform for inter-state and central-state discussions on major developmental and policy issues.

• It aims to promote cooperative federalism by involving all stakeholders in policy-making processes.

• Key agendas often include infrastructure development, health, education, and sustainable growth.

• Important Initiatives by NITI Aayog:

• SDG India Index: Tracks the progress of states and UTs towards achieving the Sustainable Development Goals (SDGs).

• Aspirational Districts Programme: Aims to transform underdeveloped districts by focusing on key sectors such as health, education, and agriculture.

• Atal Innovation Mission (AIM): Promotes innovation and entrepreneurship across schools, colleges, and industries in India.

Important Points

• Previous Meetings: The Governing Council of NITI Aayog has held discussions on various issues, such as agriculture, water resources, and digital transformation, in earlier meetings.

• Role of NITI Aayog: Unlike the Planning Commission, NITI Aayog does not allocate funds but focuses on policy advice and coordination.

• Cooperative Federalism: NITI Aayog has introduced initiatives to strengthen state participation in national development policies.

• International Collaborations: NITI Aayog partners with international organizations such as the World Bank, UNDP, and IMF for research and development projects.

Q82. Answer: (a) Andhra Pradesh

The correct answer is Andhra Pradesh.

Key Points

• The Smart Mosquito Surveillance System (SMoSS) was launched by the state of Andhra Pradesh in July 2025.

• The system aims to track, monitor, and control mosquito populations efficiently and safely, utilizing advanced technological tools.

• This initiative is part of the state's broader efforts to combat diseases such as dengue, malaria, and chikungunya, which are transmitted by mosquitoes.

• SMoSS integrates Artificial Intelligence (AI) and Geographic Information Systems (GIS) to provide real-time data on mosquito density and breeding hotspots.

• The system helps in targeted mosquito control interventions, reducing the need for widespread chemical spraying, thus being environmentally sustainable.

Additional Information

• Importance of Mosquito Surveillance:

• Surveillance systems like SMoSS are crucial in preventing outbreaks of mosquito-borne diseases by identifying risk areas early.

• They allow for data-driven decisions in vector control, minimizing health risks and economic losses.

• Role of Technology in SMoSS:

• The system uses AI algorithms to identify mosquito species and predict population trends.

• GIS mapping helps locate breeding sites, enabling precise interventions like larvicide application or source reduction.

• Environmental Benefits:

• By focusing on targeted interventions, SMoSS reduces the reliance on chemical insecticides, which can harm non-target species

and the ecosystem.

• It promotes the use of eco-friendly mosquito control methods, such as biological agents.

• Key Diseases Addressed:

• SMoSS primarily targets diseases like malaria (caused by Plasmodium parasites and transmitted by Anopheles mosquitoes).

• It also addresses dengue and chikungunya, transmitted by Aedes mosquitoes, and Japanese encephalitis, spread by Culex mosquitoes.

• Global Context:

• Similar mosquito surveillance systems have been implemented in countries like Singapore and Brazil to combat vector-borne diseases effectively.

• These systems serve as models for countries with high disease burdens to adopt innovative and sustainable solutions.

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Q83. Answer: (b) Bhargavastra

The correct answer is Bhargavastra.

Key Points

• Bhargavastra is the name of the advanced weapon system specifically engineered to neutralize threats from coordinated drone swarms.

• This weapon system was developed and successfully tested by Solar Defense and Aerospace Limited (SDAL) in May 2025.

• Drone swarms pose a significant challenge due to their ability to operate in coordinated formations, making traditional defense systems less effective. Bhargavastra is designed to address this specific threat.

• It employs cutting-edge AI-enabled target identification and electromagnetic pulse (EMP) technology to disrupt and destroy hostile drones in large numbers simultaneously.

• The weapon system integrates advanced radar systems and multi-layered counter-drone protocols to ensure precision and minimize collateral damage.

• The successful development of Bhargavastra is a milestone in India's defense capabilities, enhancing national security against modern aerial threats.

Additional Information

• Drone Swarm Technology:

• Drone swarms consist of multiple UAVs (Unmanned Aerial Vehicles) operating together to achieve a common goal, often used for surveillance or combat.

• Such swarms can be programmed for coordinated attacks, making them a significant security threat.

• Countries worldwide, including the US, China, and Russia, have been actively researching counter-drone technologies to combat drone swarms.

• Solar Defense and Aerospace Limited (SDAL):

• SDAL is an Indian defense and aerospace company specializing in the development of cutting-edge weapon systems and technologies.

• Its successful testing of Bhargavastra demonstrates India's growing capabilities in indigenous defense innovation.

• SDAL has previously contributed to significant defense projects like missile systems and radar technologies.

• Electromagnetic Pulse (EMP) Technology:

• EMP is a burst of electromagnetic radiation that can disrupt electronic systems, making it an effective tool against drones reliant on electronic controls.

• EMP weapons are considered non-lethal and minimize physical destruction while neutralizing electronic threats.

• The integration of EMP technology into Bhargavastra showcases India's focus on modern, non-conventional warfare methods.

• Other Notable Drone Defense Systems:

• Countries like Israel have developed systems such as the Drone Dome, which uses lasers to neutralize UAVs.

• The US has deployed microwave-based weapons to counter swarms of drones in military zones.

• India's Bhargavastra puts the nation on par with global defense innovators in tackling aerial threats.

Important Points

• Characteristics of Bhargavastra:

• Designed to counter large-scale drone attacks, particularly swarms operating in coordinated patterns.

• Employs multi-layered defense mechanisms, including radar detection, AI-based tracking, and EMP technology.

• Operates effectively in diverse terrains and weather conditions, ensuring reliability in real-world scenarios.

• India’s Defense Innovations:

• India has made significant strides in indigenous defense technologies, reducing dependency on imports.

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• Projects like Bhargavastra highlight India's focus on tackling modern threats like cyber warfare and drone technologies.
• Global Context:
• The development of systems like Bhargavastra positions India as a key player in the global defense industry.
• Countries worldwide are investing in similar technologies to combat UAV threats and enhance security measures.

Q84. Answer: (c) Trading Blue Gold: A Blueprint for Water Credit Valuation in India

The correct answer is Trading Blue Gold: A Blueprint for Water Credit Valuation in India.

Key Points

• “Trading Blue Gold: A Blueprint for Water Credit Valuation in India” focuses on the concept of water credits as a market-based mechanism to promote sustainable water management practices.
• The book was launched at the Raisina Dialogue 2025, an influential conference that addresses global policy challenges and strategic affairs.
• Water credits represent a novel financial tool that incentivizes water conservation efforts by assigning economic value to water saved or replenished.
• The book provides a comprehensive framework for implementing water credit systems in India, taking into account the country's growing water scarcity issues and demand for efficient water resource management.
• This initiative aligns with India's commitment to achieving sustainable development goals (SDG 6), which focuses on ensuring availability and sustainable management of water and sanitation for all.

Additional Information

• Water Credits:
• Water credits are a market-based mechanism that assigns a monetary value to water saved or replenished through sustainable practices.
• Entities that implement water conservation measures can earn credits, which can be traded or sold to others needing to offset their water usage.
• This approach encourages industries, agricultural sectors, and communities to adopt water-efficient practices.
• Raisina Dialogue:
• The Raisina Dialogue is India’s flagship conference on geopolitics and geoeconomics, organized annually by the Ministry of External Affairs and the Observer Research Foundation (ORF).
• It brings together leaders, policymakers, and experts from around the globe to discuss pressing global challenges, including climate change and resource management.
• In 2025, the conference focused on themes like sustainable development and innovative solutions to global challenges.
• India’s Water Crisis:
• India is home to 18% of the world’s population but has only 4% of its freshwater resources, making water scarcity a critical issue.
• According to the NITI Aayog’s Composite Water Management Index, 21 major Indian cities are expected to run out of groundwater by 2030.
• Efficient water management mechanisms, like water credits, are essential to address the growing water crisis.
• Sustainable Development Goals (SDG 6):
• SDG 6 aims to ensure the availability and sustainable management of water and sanitation for all by 2030.
• It emphasizes the importance of protecting water-related ecosystems, reducing water pollution, and increasing water-use efficiency.
• Innovations like water credit systems contribute significantly to achieving this goal.
• Key Characteristics of Other Options:
• Sashakt Bharat: Focuses on India’s socio-economic growth and empowerment initiatives but does not address water credits.
• Memories and Milestones: A historical account or memoir, not related to water management.
• Guardian of Heritage: Likely focuses on preserving India’s cultural and natural heritage, unrelated to water credits.

Important Points

• Implementation Challenges:
• Establishing a water credit market requires robust regulatory frameworks and monitoring mechanisms.
• Awareness campaigns are needed to educate stakeholders on the benefits of water credits.
• Global Examples:
• Countries like Australia and the United States have implemented water trading systems to address water scarcity and allocate resources efficiently.

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Q85. Answer: (d) Underage engagement

The correct answer is Underage engagement.

Key Points

• The Karnataka Amendment Bill, 2025 proposes to punish the practice of underage engagement even before an actual child marriage takes place.

• Underage engagement is often a precursor to child marriage, which is a serious issue in India due to its implications on the health, education, and well-being of minors.

• The bill aims to take preventive measures against child marriages by addressing its root causes, including early engagement.

• It emphasizes the importance of penalizing those involved in arranging or facilitating underage engagement to deter such practices. This makes the statement about underage engagement correct.

• The legislation aligns with India's commitment to eradicating child marriage under various national and international frameworks, such as the Prohibition of Child Marriage Act, 2006 and the United Nations Sustainable Development Goals (SDGs).

Additional Information

• Prohibition of Child Marriage Act, 2006:

• The act defines a child as a male below 21 years and a female below 18 years.

• It prohibits child marriage and provides for the punishment of individuals involved in arranging, facilitating, or conducting such marriages.

• The act also includes provisions for the annulment of child marriages and offers legal protection to victims.

• National and International Commitments:

• India is committed to eliminating child marriage under the Sustainable Development Goals (SDG Target 5.3), which aim to end harmful practices such as child, early, and forced marriages.

• Various state and national-level programs, such as the Beti Bachao Beti Padhao initiative, aim to improve the status of girls and prevent practices like child marriage.

• Impact of Child Marriage:

• Child marriage often leads to early pregnancies, causing severe health risks, including maternal and infant mortality.

• It restricts access to education for young girls, perpetuating cycles of poverty and inequality.

• The practice is associated with gender-based violence and violates the fundamental rights of children.

• Key Legislative Measures:

• Several states in India have introduced amendments to the Prohibition of Child Marriage Act, 2006 to include stricter provisions for preventing child marriages.

• The Karnataka Amendment Bill, 2025, is one such measure aimed at strengthening the legal framework against child marriage and related practices.

Important Points

• Underage Engagement:

• Underage engagement refers to the practice of betrothing minors before they reach the legally permissible age for marriage.

• This practice is often culturally ingrained and perpetuated by societal norms but poses significant risks to the physical, emotional, and social well-being of children.

• Preventive Measures:

• The Karnataka Amendment Bill, 2025, introduces preventive measures to address the issue at its roots by penalizing underage engagement.

• Such measures are crucial for achieving India's broader objective of eliminating child marriage and promoting gender equality.

Q86. Answer: (d) Sakkarakottai Bird Sanctuary

The correct answer is Sakkarakottai Bird Sanctuary.

Key Points

• Sakkarakottai Bird Sanctuary, located in Tamil Nadu, was designated as a Ramsar site in February 2025 according to the Ramsar Information Sheet.

• The Ramsar Convention is an international treaty signed in 1971 for the conservation and sustainable use of wetlands, aiming to halt their degradation worldwide.

• Sakkarakottai Bird Sanctuary is known for its rich biodiversity and acts as a critical habitat for various species of migratory and resident birds.

• The sanctuary's designation as a Ramsar site highlights its global importance in terms of wetland conservation and its role in supporting avian life.

• This recognition also brings international attention to the ecological significance of the region and ensures further protection and sustainable management efforts.

Additional Information

• Ramsar Sites in India:

• India has a significant number of Ramsar sites, with 75 wetlands designated under the Ramsar Convention as of 2023.

• These wetlands play an essential role in biodiversity conservation, flood control, and maintaining hydrological cycles.

• Sakkarakottai Bird Sanctuary:

• Located in the Ramanathapuram District of Tamil Nadu, Sakkarakottai is a crucial wetland ecosystem.

• The sanctuary is particularly important for migratory birds, such as flamingos, pelicans, and painted storks.

• The wetland also supports local livelihoods through activities like fishing and eco-tourism.

• Importance of Ramsar Designation:

• Ramsar designation ensures international cooperation in the conservation of wetlands and their resources.

• It also brings funding opportunities for the sustainable management of these sites.

• The status elevates awareness about the ecological and socio-economic benefits of wetlands.

• Other Bird Sanctuaries in Tamil Nadu:

• Koonthankulam Bird Sanctuary, Vedanthangal Bird Sanctuary, and Vaduvoor Bird Sanctuary are other prominent bird sanctuaries in Tamil Nadu.

• These sanctuaries are known for their rich avian biodiversity and seasonal migratory bird populations.

Important Points

• Ramsar Convention:

• Adopted in Ramsar, Iran, in 1971, the convention focuses on the conservation of wetlands and their resources.

• It recognizes wetlands as ecosystems of critical importance for biodiversity, water resources, and climate regulation.

• The Ramsar List of Wetlands of International Importance promotes the sustainable management of these ecosystems.

• Role of Tamil Nadu in Wetland Conservation:

• Tamil Nadu is home to several Ramsar sites, such as Point Calimere Wildlife and Bird Sanctuary and Pallikaranai Marsh Reserve Forest.

• The state actively participates in wetland conservation initiatives and promotes eco-tourism.

Q87. Answer: (b) 168

The correct answer is 168.

Key Points

• As of February 2025, the number of seismic observatories in India has increased to 168, as per the Ministry of Earth Sciences (MoES).

• In 2014, there were only 80 seismic observatories in the country.

• The increase is part of the government's efforts to improve the seismic monitoring network across India to enhance earthquake monitoring and disaster preparedness.

• The seismic observatories are equipped with advanced technology such as broadband seismometers and accelerometers to detect and record seismic activities with high precision.

• The expansion aligns with India's commitment to strengthening the National Centre for Seismology (NCS), which is the nodal agency for earthquake monitoring in the country.

Additional Information

• National Centre for Seismology (NCS):

• The NCS operates under the Ministry of Earth Sciences and is responsible for monitoring seismic activity across India.

• NCS provides real-time earthquake information to various stakeholders, including disaster management authorities, to ensure timely mitigation efforts.

• The center also conducts seismic microzonation studies to assess earthquake risks in urban areas.

• Importance of Seismic Observatories:

• Seismic observatories play a crucial role in detecting earthquakes and studying the tectonic movements of the Earth's crust.

• They contribute to the development of earthquake-resistant infrastructure by providing critical data for seismic zoning and building codes.

• They aid in creating early warning systems to minimize the impact of earthquakes on human life and property.

• Seismic Activity in India:

• India is divided into four seismic zones (Zone II, III, IV, and V) based on the level of seismic hazard.

• The northeastern region, the Himalayan belt, and parts of Gujarat and Maharashtra are highly seismically active areas.

• The 2001 Bhuj earthquake and the 2015 Nepal earthquake highlighted the need for a robust seismic monitoring system.

• Technological Advancements in Seismology:

• Modern seismic observatories use real-time seismic data transmission for quicker analysis and response.

• Technologies like GPS-based crustal deformation monitoring are being integrated to study tectonic plate movements.

• Advancements in machine learning and artificial intelligence are being used to improve earthquake prediction models.

Important Points

• Seismic Zoning:

• India's seismic zones range from Zone II (low risk) to Zone V (very high risk).

• Seismic zoning maps are used to guide urban planning and construction standards.

• Earthquake Magnitude and Intensity:

• The Richter scale measures the energy released during an earthquake, while the Modified Mercalli Intensity (MMI) scale assesses the earthquake's impact on people and structures.

• Government Initiatives:

• The National Disaster Management Authority (NDMA) has guidelines for earthquake preparedness and mitigation.

• The Building Materials and Technology Promotion Council (BMTPC) publishes seismic zone maps for safer construction practices.

Q88. Answer: (a) M Chinnaswamy Stadium

The correct answer is M Chinnaswamy Stadium.

Key Points

• M Chinnaswamy Stadium, located in the heart of Bengaluru, Karnataka, is one of India’s premier cricket stadiums. It has hosted numerous national and international cricket matches.

• In June 2025, the stadium was the site of a tragic stampede that occurred near its premises during a major event, possibly due to overcrowding and mismanagement of crowds.

• The stadium was established in 1969 and has a seating capacity of approximately 40,000, making it a significant venue for large-scale sporting events and concerts.

• It is named after Mangalam Chinnaswamy, a former president of the Board of Control for Cricket in India (BCCI), in recognition of his contributions to Indian cricket.

• The location of the stadium, in the bustling city of Bengaluru, often sees heavy traffic and large gatherings, which may have contributed to the unfortunate incident in 2025.

Additional Information

• About M Chinnaswamy Stadium:

• Located in Bengaluru, Karnataka, the stadium is home to the Karnataka State Cricket Association (KSCA).

• The stadium is known for its state-of-the-art facilities, including solar power generation, making it one of the first cricket stadiums in India to adopt sustainable energy practices.

• It serves as the home ground for the Royal Challengers Bangalore (RCB) in the Indian Premier League (IPL).

• The venue has also hosted Test matches, ODIs, T20 Internationals, and domestic matches, showcasing its versatility.

• Other Stadiums Mentioned:

• Rajiv Gandhi International Stadium: Located in Hyderabad, Telangana, it is the home ground for Sunrisers Hyderabad (SRH) in IPL matches.

• MA Chidambaram Stadium: Situated in Chennai, Tamil Nadu, it is one of India’s oldest stadiums, established in 1916, and home to Chennai Super Kings (CSK).

• Barabati Stadium: Located in Cuttack, Odisha, this stadium hosts domestic matches and has a seating capacity of around 45,000.

• Stampede Incidents:

• Stampedes often occur due to overcrowding, lack of proper crowd control measures, and inadequate emergency response.

• Such incidents highlight the importance of implementing stricter safety protocols during large gatherings to ensure public safety.

• Authorities typically investigate such incidents to identify lapses and recommend measures to prevent future occurrences.

• Key Safety Measures:

• Ensure proper crowd management practices, such as designated entry and exit points and barriers.

• Deploy adequate security personnel and medical teams during large events.

• Implement real-time monitoring systems to detect and manage crowd density effectively.

Important Points

• Stampede Prevention Guidelines:

• The National Disaster Management Authority (NDMA) in India provides guidelines for managing crowds during mass gatherings.

• These guidelines emphasize the need for pre-event planning, risk assessment, and coordination among stakeholders.
• Measures include setting up help desks, deploying trained volunteers, and ensuring clear communication during emergencies.
• Impact of Stampedes:
• Stampedes can lead to loss of lives, injuries, and emotional distress among victims and their families.
• They often result in legal and financial implications for organizers and venue authorities.
• Such events highlight the importance of prioritizing public safety during mass gatherings.
• Historical Incidents:
• Notable stampedes in India include the 2013 Allahabad stampede during Kumbh Mela, which claimed over 30 lives.
• These incidents underscore the need for stricter adherence to safety protocols and crowd management practices.

Q89. Answer: (d) 60

The correct answer is 60.

Key Points

• The High Seas Treaty is a major international agreement aimed at ensuring the protection and sustainable use of marine biodiversity in areas beyond national jurisdiction (ABNJ).
• According to the latest news update on 9 June 2025, the treaty will come into force 120 days after it is ratified by 60 countries.
• This requirement ensures that a significant number of nations are committed to the treaty before it becomes legally binding globally.
• The treaty was adopted under the framework of the United Nations Convention on the Law of the Sea (UNCLOS), which addresses various issues related to maritime governance.
• The treaty's primary focus includes establishing marine protected areas (MPAs), regulating human activities in the high seas, and promoting equitable sharing of marine genetic resources.

Additional Information

• High Seas Treaty:
• The treaty aims to protect over 60% of the world's oceans that lie outside national boundaries, covering two-thirds of the Earth's surface.
• It focuses on sustainable development goals (SDG 14), which pertain to life below water.
• The High Seas Treaty establishes a framework for marine spatial planning, environmental impact assessments, and the equitable sharing of benefits from marine genetic resources.
• United Nations Convention on the Law of the Sea (UNCLOS):
• Often referred to as the "Constitution of the Oceans," it was adopted in 1982 and provides a legal framework for the use of the seas and oceans.
• UNCLOS governs issues such as navigation, territorial waters, exclusive economic zones (EEZs), and deep-sea mining.
• The High Seas Treaty is a supplementary agreement under UNCLOS, specifically addressing areas beyond national jurisdiction.
• Marine Protected Areas (MPAs):
• One of the key features of the treaty is the creation of MPAs to conserve marine ecosystems and prevent biodiversity loss.
• MPAs are areas where human activities such as fishing, mining, and shipping are restricted or regulated.
• They aim to protect endangered species, coral reefs, and other vital marine habitats.
• Ratification Process:
• For a treaty to become binding, it must be ratified by a specific number of countries, as determined in its provisions.
• In the case of the High Seas Treaty, 60 countries must ratify the agreement for it to enter into force.
• Once ratified, the treaty becomes a critical tool for international cooperation in protecting global marine biodiversity.

Important Points

• Marine Genetic Resources (MGRs):
• MGRs are genetic materials from marine organisms that are used in pharmaceuticals, cosmetics, and biotechnology.
• The treaty ensures equitable sharing of benefits derived from MGRs to support sustainable development.
• 120-Day Implementation Period:
• The treaty will officially come into effect 120 days after the required number of ratifications is achieved.
• This period provides time for participating nations to prepare for implementing the treaty's provisions.
• Global Significance:
• The High Seas Treaty is crucial for addressing transboundary issues such as overfishing, marine pollution, and the effects of climate change on oceans.
• It represents a milestone in global efforts to achieve ocean sustainability and protect biodiversity for future generations.

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Q90. Answer: (a) Mondo Duplantis

The correct answer is Mondo Duplantis.

Key Points

• Mondo Duplantis, a Swedish-American pole vaulter, joined Usain Bolt as one of the only male track-and-field athletes to win the Laureus Sportsman of the Year Award in 2025. This prestigious award recognizes exceptional achievements in sports globally.

• Duplantis is known for his dominance in pole vaulting, breaking multiple world records. As of 2025, he holds the record of vaulting 6.23 meters, set in 2023.

• The Laureus World Sports Awards were established in 2000 to celebrate and honor outstanding athletes, teams, and sports achievements across the world.

• Duplantis has been widely regarded as one of the most consistent performers in athletics, with numerous gold medals in events like the Olympics, World Championships, and European Championships.

• He became the second male track-and-field athlete after Usain Bolt—an eight-time Olympic gold medalist and world-record holder in the 100m and 200m sprints—to win this prestigious accolade.

Additional Information

• Mondo Duplantis:

• Full name: Armand Gustav "Mondo" Duplantis.

• Born on November 10, 1999, in Lafayette, Louisiana, USA.

• He represents Sweden internationally, as his mother is Swedish, while his father was an elite pole vaulter in the United States.

• Duplantis has been breaking records since his teenage years, first setting a world junior record at the age of 18.

• Known for his innovative techniques, speed, and agility, he has brought significant attention to the sport of pole vaulting.

• Usain Bolt:

• Widely regarded as the greatest sprinter of all time, Bolt won the Laureus Sportsman of the Year Award four times: in 2009, 2010, 2013, and 2017.

• He holds world records in the 100m (9.58 seconds) and 200m (19.19 seconds), set in 2009.

• His dominance in athletics inspired generations of athletes and significantly raised the global profile of track-and-field sports.

• Laureus World Sports Awards:

• Established in 2000, these awards are often referred to as the "Oscars of Sports."

• They honor individuals and teams from across the globe for their outstanding performances and contributions to sports.

• The winners are selected by the Laureus World Sports Academy, a group of the world's greatest living sports legends.

• Other Prominent Nominees in 2025:

• Carlos Alcaraz: A Spanish tennis player known for his rapid rise in the ATP rankings and Grand Slam victories.

• Max Verstappen: A Dutch Formula 1 driver, known for consecutive World Championship wins with the Red Bull Racing team.

• Novak Djokovic: A Serbian tennis legend who has dominated men's tennis with a record-breaking number of Grand Slam titles.

Important Points

• Mondo Duplantis's Achievements:

• Set the current world record of 6.23 meters in pole vaulting in 2023.

• Won gold medals at the 2020 Tokyo Olympics, and the 2022 and 2023 World Championships.

• He has been unbeaten in numerous competitions, showcasing unparalleled consistency in his discipline.

• Laureus World Sports Awards History:

• The awards have recognized sports legends like Roger Federer, Rafael Nadal, Lionel Messi, Michael Schumacher, and Tiger Woods.

• The Sportsman of the Year Award is considered one of the highest accolades in the world of sports.

• The awards aim to celebrate excellence, inspire future generations, and promote sports as a tool for social change.

Q91. Answer: (c) Gyan Bharatam Mission

The correct answer is Gyan Bharatam Mission

Key Points

• Gyan Bharatam Mission was launched under the Union Budget 2025–26 to preserve and document India's manuscript heritage, which spans centuries and contains invaluable knowledge.

• This mission aims to safeguard ancient manuscripts and texts that are historically and culturally significant, ensuring that they remain accessible to future generations.

• India is home to approximately 5 million manuscripts, considered one of the richest repositories of manuscript heritage globally.

• Through this initiative, the government plans to set up a centralized digital archive to catalog and digitize manuscripts, thereby protecting them from physical decay or loss.

• The mission will also focus on training archivists and manuscript conservationists, encouraging research, and promoting awareness about the importance of preserving India's literary heritage.

Additional Information

• Manuscript Heritage in India:

• India's manuscripts include works in languages such as Sanskrit, Prakrit, Tamil, Persian, Arabic, and Urdu, among others.

• The manuscripts cover diverse fields like philosophy, literature, science, mathematics, medicine, astronomy, and art.

• Important manuscript collections are housed in institutions like the National Archives of India and the Indira Gandhi National Centre for the Arts (IGNCA).

• Challenges in Conservation:

• Many manuscripts are stored in improper conditions, leading to their physical deterioration due to humidity, pests, and handling.

• The lack of trained conservators and inadequate funding for preservation efforts are major hurdles.

• Digitization is a key solution to ensure the long-term accessibility and safety of these texts.

• Government Initiatives for Heritage Preservation:

• The National Mission for Manuscripts (NMM), launched in 2003, is a government initiative to document and conserve manuscripts.

• Under NMM, manuscripts have been digitized and cataloged to prevent their loss.

• The Granth Sanrakshan Abhiyan complements such efforts by focusing on comprehensive conservation and awareness.

• Significance of Manuscript Preservation:

• Preserving manuscripts helps in understanding India's ancient knowledge systems and cultural history.

• It aids scholars and researchers in exploring historical, scientific, and philosophical advancements documented in these texts.

• Manuscripts serve as a bridge connecting modern society with ancestral wisdom.

Important Points

• Granth Sanrakshan Abhiyan emphasizes collaboration with academic institutions, libraries, and cultural organizations to maximize the impact of manuscript conservation efforts.

• The initiative also aims to create public awareness campaigns to highlight the importance of preserving India's rich literary heritage.

• Private collectors and regional archives are encouraged to contribute to the national repository under this mission.

• Technology plays a pivotal role in digitization, with advanced tools used for high-resolution scanning and metadata creation.

Q92. Answer: (d) United Arab Emirates

The correct answer is United Arab Emirates.

Key Points

• The 32nd Elets World Education Summit was hosted in the United Arab Emirates (UAE) in April 2025. This summit is one of the most prestigious events in the education sector, bringing together global leaders, policymakers, educators, and innovators.

• The event focused on transforming education through technology, innovation, and sustainability, with a special emphasis on addressing the challenges of the post-pandemic world.

• The UAE, known for its progressive approach to education and innovation, served as an ideal host country for this summit. The country has consistently invested in modernizing its education system and fostering global educational collaborations.

• The summit provided a platform for discussions on emerging trends in education, such as artificial intelligence in classrooms, the role of EdTech startups, and policies for inclusive education.

• It also included interactive sessions, panel discussions, and exhibitions showcasing the latest educational tools and technologies, making it a comprehensive event for stakeholders in the education sector.

Additional Information

• About the Elets World Education Summit:

• The Elets World Education Summit is a global platform that fosters collaboration and dialogue between educators, policymakers, and technology providers.

• It has been held annually since its inception, covering a wide range of topics such as digital education, skill development, and global best practices in teaching and learning.

• The summit emphasizes innovation in education and how technology can bridge gaps in access and quality of education worldwide.

• Education in the UAE:

• The UAE has made significant strides in education by adopting a vision aligned with its National Agenda 2021, focusing on quality education, innovation, and competitiveness.

• The country is home to some of the most advanced educational institutions and has hosted numerous global events promoting educational excellence.

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• The UAE government has prioritized STEM education, digital literacy, and innovation in its curriculum to prepare students for the future workforce.

• Key Features of the 32nd Elets Summit:

• The summit included participation from over 50 countries, with delegates discussing global challenges and opportunities in education.

• It showcased cutting-edge technologies like AI, virtual reality, and blockchain that are reshaping the education landscape.

• Special focus was given to sustainable education practices, ensuring equitable access to education for all.

• Other Host Countries in the Past:

• Previous editions of the summit have been hosted in countries like India, South Africa, and the United Kingdom, highlighting its global outreach.

• These events have consistently served as a platform for sharing best practices and fostering partnerships across borders.

Important Points

• Why UAE is a Preferred Host:

• The UAE is known for its state-of-the-art infrastructure, making it a hub for international conferences and summits.

• The country has a diverse population and a strong focus on global collaboration, which aligns well with the objectives of the Elets World Education Summit.

• Focus Areas of the Summit:

• Integration of technology in education to enhance learning outcomes.

• Policy frameworks for achieving inclusive and equitable education for all.

• Emphasis on lifelong learning and skill development to meet the demands of a rapidly changing job market.

Q93. Answer: (c) 6.00%

The correct answer is 6.00%.

Key Points

• The Repo Rate is the rate at which the Reserve Bank of India (RBI) lends money to commercial banks in the event of a shortfall of funds. It is a crucial tool for controlling inflation and stabilizing the economy.

• In its Monetary Policy Review of April 2025, the RBI announced a revision of the Repo Rate to 6% (0.06). This decision was made considering the prevailing economic conditions.

• The revised Repo Rate of 6% indicates a slight tightening of monetary policy compared to the previous rate of 5.75% (0.0575). This is often done to control inflationary pressures in the economy.

• The Repo Rate impacts borrowing costs for banks, which in turn affects the interest rates on loans and deposits for consumers and businesses. A higher Repo Rate generally leads to higher borrowing costs.

• The decision to revise the Repo Rate is based on several factors such as GDP growth, inflation trends, global economic conditions, and domestic financial stability.

Additional Information

• Repo Rate:

• The term Repo stands for Repurchase Agreement. It is a form of short-term borrowing for banks in India.

• The RBI uses the Repo Rate to control liquidity in the economy and curb inflation. Lower Repo Rates encourage borrowing and investment, while higher rates help control inflation.

• For example, when inflation is high, the RBI increases the Repo Rate to make borrowing more expensive, thereby reducing consumer demand and inflationary pressures.

• Impact of Repo Rate Change:

• An increase in the Repo Rate leads to higher loan interest rates, making borrowing costlier for individuals and businesses.

• It also affects home loans, personal loans, and other credit facilities, which might result in reduced consumer spending.

• Conversely, a reduction in the Repo Rate lowers borrowing costs, encouraging investments and consumption.

• Monetary Policy Committee (MPC):

• The MPC is responsible for determining the Repo Rate. It consists of six members, three from the RBI and three external members nominated by the government.

• The MPC meets bi-monthly to review the monetary policy stance and make decisions on the Repo Rate.

• The decisions are based on various indicators such as inflation rates, GDP growth, employment data, and global economic conditions.

• Inflation Control:

• Controlling inflation is one of the primary objectives of the RBI's monetary policy. The Repo Rate is a key tool in achieving this goal.

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• When inflation exceeds the target range (e.g., 2-6% in India), the RBI increases the Repo Rate to reduce liquidity and demand in the market.

• Similarly, during periods of low inflation or deflation, the RBI lowers the Repo Rate to stimulate economic activity.

Important Points

• Reverse Repo Rate: This is the rate at which the RBI borrows money from commercial banks. It is usually lower than the Repo Rate and is used to absorb excess liquidity from the market.

• Cash Reserve Ratio (CRR): The percentage of total deposits that commercial banks are required to keep as reserves with the RBI. It impacts the availability of funds in the banking system.

• Statutory Liquidity Ratio (SLR): The percentage of net demand and time liabilities that banks must maintain in the form of liquid assets such as cash, gold, or government-approved securities.

• Impact on Stock Markets: Changes in the Repo Rate can influence investor sentiment in the stock market, as they affect corporate profitability and borrowing costs.

Q94. Answer: (d) Neeraj Chopra

The correct answer is Neeraj Chopra.

Key Points

• Neeraj Chopra, an Indian track and field athlete, achieved a throw of 90.23 meters in the javelin event at the Doha Diamond League in 2025, setting a new record.

• Neeraj Chopra is renowned for his consistent performances in international athletics and is the first Indian athlete to win an Olympic gold medal in track and field at the 2020 Tokyo Olympics.

• The Doha Diamond League is one of the most prestigious international track and field competitions, attracting top athletes from around the globe. Neeraj's performance further solidified his status as one of the world's best javelin throwers.

• His record-breaking throw at the Doha Diamond League marked a significant milestone in his career and contributed to India's growing recognition in global athletics.

• Neeraj Chopra's achievement highlights his dedication, rigorous training, and ability to perform under pressure on the international stage.

Additional Information

• Neeraj Chopra:

• He was born on 24 December 1997 in Khandra village, Haryana, India.

• Neeraj is a Subedar in the Indian Army and is supported by the Mission Olympic Wing of the Indian Army.

• He became the first Indian to win a gold medal in athletics at the Olympics by throwing a distance of 87.58 meters in the javelin final at the 2020 Tokyo Olympics.

• Neeraj has also won gold medals at the 2018 Commonwealth Games and the 2018 Asian Games.

• Javelin Throw:

• It is a track and field event in which athletes throw a spear-like implement called a javelin as far as possible.

• The men's javelin weighs 800 grams, and the women's javelin weighs 600 grams.

• Key factors in achieving a long throw include strength, speed, technique, and timing.

• Doha Diamond League:

• The Diamond League is an annual series of elite track and field competitions organized by World Athletics.

• The Doha Diamond League is usually held in Qatar and serves as the season opener for the Diamond League series.

• It features world-class athletes competing in various events, including sprints, middle and long-distance runs, jumping, and throwing events.

• Other Indian Javelin Throwers:

• Shivpal Singh: He is another prominent Indian javelin thrower who has represented India at various international events.

• Annu Rani: She is a leading Indian female javelin thrower and has set multiple national records in the event.

Important Points

• Neeraj Chopra's Achievements:

• He is the first Indian athlete to win the Diamond League title, achieving this feat in 2022.

• Neeraj holds the national record for the javelin throw in India, with a personal best of 89.94 meters (as of 2023).

• He has been awarded prestigious honors such as the Arjuna Award (2018) and the Major Dhyan Chand Khel Ratna Award (2021).

• Global Recognition of Indian Athletics:

• Neeraj Chopra's achievements have inspired a new generation of Indian athletes to excel in global competitions.

• India's performance in athletics has improved significantly in recent years, with more athletes reaching the finals of major

international events.

Q95. Answer: (c) Each of Delhi's 15 Districts

The correct answer is Each of Delhi's 15 Districts.

Key Points

• Delhi Government announced the establishment of dedicated women police stations in all 15 districts of Delhi to enhance the safety and security of women.

• The initiative aims to address the increasing concerns of women's safety in the capital city by providing a specialized and accessible platform for women to report crimes.

• Each of the 15 districts will have its own dedicated women police station, ensuring that women-centric cases such as domestic violence, sexual assault, and harassment are handled with sensitivity and professionalism.

• This decision is a significant step toward gender-sensitive policing and aims to build trust between women citizens and law enforcement agencies.

• With this initiative, the government aims to increase the reporting of gender-based crimes and ensure faster resolution by deploying trained women officers in these police stations.

Additional Information

• Women Police Stations:

• Women police stations are specialized units that exclusively deal with women-related crimes such as domestic violence, dowry harassment, eve-teasing, and sexual assault.

• These stations are staffed primarily by women officers trained to handle sensitive cases with empathy and professionalism.

• Such police stations aim to create a safe and welcoming environment for women to report crimes without fear of judgment or reprisal.

• Women's Safety in Delhi:

• Delhi has been a focal point for addressing women's safety concerns, especially after the infamous Nirbhaya case in 2012, which led to nationwide protests and demands for stricter laws.

• The city has seen initiatives like enhanced patrolling, installation of CCTV cameras, and deployment of women officers to ensure safety in public spaces.

• Similar Initiatives in Other States:

• Uttar Pradesh: The state has launched various women-centric initiatives, such as Pink Patrol units and women help desks, to address crimes against women.

• West Bengal: The government has set up women police stations across districts to ensure gender-sensitive policing.

• Key Legal Framework for Women's Safety:

• Criminal Law (Amendment) Act, 2013: This act introduced stricter punishments for sexual offenses and new offenses like stalking and voyeurism.

• Domestic Violence Act, 2005: Provides protection to women against domestic violence and ensures their right to live in a violence-free environment.

• Sexual Harassment of Women at Workplace Act, 2013: Ensures protection against harassment at the workplace.

Important Points

• Women Help Desks: Many police stations across India now have women help desks to provide immediate assistance to women in distress.

• One Stop Centres: These centers, introduced under the Beti Bachao Beti Padhao campaign, provide medical, legal, and psychological support to women facing violence.

• Nirbhaya Fund: Launched by the Indian government to support initiatives that enhance the safety and security of women.

Q96. Answer: (d) Ghaziabad

The correct answer is Ghaziabad.

Key Points

• Ghaziabad became the first Indian city to issue a Certified Green Municipal Bond in April 2021. This bond was issued to raise funds for a tertiary water treatment plant.

• The bond received an overwhelming response, being oversubscribed by 1.5 times, and it raised a total of Rs. 150 crores.

• The funds from this bond are earmarked for the construction of a tertiary water treatment plant, aimed at reducing water wastage and promoting sustainable water management practices.

• The bond was certified by the Climate Bonds Initiative (CBI), an international certification body that verifies green bonds for their adherence to environmental sustainability standards.

• The success of this bond highlights Ghaziabad's commitment to environmental sustainability and its efforts to align with the United Nations Sustainable Development Goals (SDGs).

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Additional Information

• What are Green Bonds?

• Green Bonds are a type of fixed-income instrument designed specifically to support environmentally sustainable projects.

• They are used to fund projects such as renewable energy, energy efficiency, clean transportation, sustainable water management, and climate change mitigation initiatives.

• Green Bonds come with an added layer of accountability as their use of proceeds is tracked and reported to ensure alignment with environmental goals.

• Climate Bonds Initiative (CBI):

• The Climate Bonds Initiative is an international organization that promotes investment in projects and assets necessary for a rapid transition to a low-carbon and climate-resilient economy.

• CBI certifies bonds as "green" if they meet certain environmental and sustainability criteria, ensuring transparency and credibility in green financing.

• India’s Green Bond Market:

• India is one of the leading emerging markets for green bonds, with issuers including municipalities, corporations, and financial institutions.

• In 2021, India was ranked among the top 10 countries for green bond issuance, reflecting its growing commitment to climate change mitigation.

• India has raised billions of dollars through green bonds to fund projects related to renewable energy and sustainable development.

• Municipal Bonds in India:

• Municipal Bonds, also known as Muni Bonds, are issued by local governments or municipal corporations to fund infrastructure projects like water supply, sewage systems, and housing.

• In India, municipal bonds were first issued in the 1990s, but their use has gained momentum only recently with cities like Pune, Ahmedabad, and Ghaziabad leading the way.

• The issuance of Certified Green Municipal Bonds represents a significant step forward in integrating sustainability into urban development financing.

Important Points

• Key Benefits of Green Municipal Bonds:

• They provide a cost-effective way for local governments to finance environmentally sustainable projects.

• They enhance the issuer's reputation by demonstrating a commitment to environmental responsibility.

• Green Bonds help attract a new class of investors who are focused on Environmental, Social, and Governance (ESG) criteria.

• Significance of Ghaziabad's Achievement:

• Ghaziabad’s success in issuing a Certified Green Municipal Bond sets a precedent for other cities in India to explore similar financing mechanisms for sustainable development.

• This achievement underscores the importance of innovative financial instruments in addressing urban challenges like water scarcity and waste management.

• The initiative aligns with India’s broader goal of achieving its Nationally Determined Contributions (NDCs) under the Paris Agreement.

Q97. Answer: (c) Institute of Nano Science and Technology (INST), Mohali

The correct answer is Institute of Nano Science and Technology (INST), Mohali.

Key Points

• The Institute of Nano Science and Technology (INST), Mohali, has developed a novel one-step colloidal synthesis method to fabricate PEGylated semi-shells (SS) with nano-cup morphology at room temperature.

• This breakthrough synthesis method is aimed at enhancing the treatment of cancer, as the nano-cup morphology allows for better drug delivery and targeting of cancer cells.

• The announcement regarding this innovation was made on June 17, 2025, highlighting its significance in the field of nanotechnology and cancer therapy.

• The PEGylated semi-shells are designed to improve biocompatibility and reduce immunogenicity, making them suitable for medical applications.

• The Institute of Nano Science and Technology (INST), Mohali, is a renowned research institute in India, specializing in cutting-edge nanotechnology applications.

Additional Information

• Institute of Nano Science and Technology (INST), Mohali:

• INST is an autonomous institute under the Department of Science and Technology (DST), Government of India.

• Located in Mohali, Punjab, it focuses on interdisciplinary research in the field of nanoscience and nanotechnology.

• The institute aims to develop nanotechnology-based solutions for health, energy, environment, and agriculture.

• PEGylation Technology:

• PEGylation refers to the process of attaching polyethylene glycol (PEG) chains to molecules like drugs or nanoparticles to improve their stability, solubility, and biocompatibility.

• In cancer therapy, PEGylation helps in prolonging circulation time in the bloodstream and enhancing drug delivery.

• Nano-Cup Morphology:

• Nano-cup morphology involves a cup-like structure at the nanoscale, which is particularly effective for encapsulating and delivering therapeutic agents.

• This structure allows for targeted drug delivery, minimizing side effects and improving the efficacy of treatment.

• Applications of Nanotechnology in Cancer Treatment:

• Nanotechnology enables the development of targeted drug delivery systems that specifically attack cancer cells while sparing healthy tissues.

• It is also used in diagnostics, imaging, and therapy, such as the development of nanosensors and contrast agents for early detection of cancer.

Important Points

• INST Mohali's Achievements:

• INST has been instrumental in developing nanotechnology-based innovations for healthcare, including drug delivery systems and biomaterials.

• It collaborates with several national and international institutions to advance research in nanoscience.

• Role of Nanotechnology in Healthcare:

• Nanotechnology is revolutionizing healthcare by enabling precise, efficient, and minimally invasive treatments.

• It is used in targeted therapies, regenerative medicine, and diagnostic tools to tackle complex diseases like cancer.

Q98. Answer: (d) World Audio Visual and Entertainment Summit

The correct answer is World Audio Visual and Entertainment Summit.

Key Points

• During the WAVES 2025 event, Odisha's Chief Minister highlighted the rising global recognition of India's indigenous sports, such as kabaddi, kho-kho, and mallakhamb.

• The statement was made at the World Audio Visual and Entertainment Summit, which focuses on promoting India's cultural heritage, entertainment industry, and traditional practices.

• The World Audio Visual and Entertainment Summit serves as a platform to discuss the intersection of technology, culture, and media, with a special emphasis on India's unique offerings to the global stage.

• The summit is known for showcasing India's achievements in various fields, including sports, entertainment, and indigenous practices, thus promoting their worldwide appeal.

• India's indigenous sports have gained attention due to their incorporation into international competitions and digital platforms, helping them reach a wider audience.

Additional Information

• World Audio Visual and Entertainment Summit (WAVES):

• The summit is a global platform focusing on media, entertainment, and cultural exchanges.

• It brings together professionals, policymakers, and artists to discuss opportunities in the audio-visual and entertainment sectors.

• The event is aimed at promoting India as a hub for cultural and entertainment exports, including indigenous sports and traditional art forms.

• Key themes include digital transformation, global collaborations, and the promotion of Indian culture and heritage.

• Indigenous Sports in India:

• Kabaddi: Originating in ancient India, it is now recognized globally, with leagues such as the Pro Kabaddi League enhancing its popularity.

• Kho-Kho: A traditional Indian sport focusing on agility and teamwork, it is gaining international recognition.

• Mallakhamb: A sport that combines gymnastics and yoga, it has been featured in global fitness and cultural events.

• Global Recognition of Indian Culture:

• India's soft power is enhanced through the global promotion of its traditional sports, art forms, and cinema.

• Events like WAVES contribute to showcasing India's ability to blend modern technology with traditional practices.

• Technology and Media in Sports:

• Digital platforms like YouTube and OTT services have been instrumental in promoting Indian sports globally.

• Technological advancements, such as virtual reality, are used to enhance the viewer experience of traditional sports.

Important Points

• Government Initiatives:

• The Indian government is actively promoting indigenous sports through programs like Khelo India and international collaborations.

• Efforts are being made to include Indian sports in global sporting events like the Olympics and Asian Games.

• Cultural Impact:

• Indigenous sports are not just games but are deeply rooted in India's history, culture, and social fabric.

• Promoting these sports helps preserve India's cultural heritage while also encouraging physical fitness and community bonding.

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Q99. Answer: (d) Laxman Utekar

The correct answer is Laxman Utekar.

Key Points

• Laxman Utekar is the director of the movie Chhaava, which is set to release in February 2025. His expertise in storytelling and direction has been well-appreciated in the Indian film industry.

• Laxman Utekar is known for directing critically acclaimed and commercially successful films such as "Mimi" and "Luka Chuppi." He specializes in portraying socially relevant themes with a touch of humor and emotion.

• The movie Chhaava is expected to be a significant project under his direction, showcasing a strong narrative and compelling performances by the cast.

• Utekar has a history of working on impactful films that resonate with audiences, and his involvement in Chhaava has generated high anticipation among cinema enthusiasts.

• His direction style often balances commercial appeal with artistic depth, making his films both entertaining and thought-provoking.

Additional Information

• Laxman Utekar’s Background:

• He started his career as a cinematographer and later transitioned into film direction.

• His cinematography work includes films like "English Vinglish" and "Dear Zindagi," which are known for their visual storytelling.

• Chhaava (2025):

• The movie is expected to explore socially relevant themes while delivering a gripping narrative.

• It is one of the most anticipated films of the year, with fans eagerly looking forward to Utekar's creative vision.

• Other Notable Works:

• "Mimi" (2021): A film focusing on surrogacy, which won critical acclaim for its sensitive portrayal of the subject.

• "Luka Chuppi" (2019): A romantic comedy that deals with the concept of live-in relationships in India.

• Indian Cinema Directors:

• Anurag Kashyap: Known for his gritty, realistic films like "Gangs of Wasseypur" and "Black Friday."

• Prithviraj Sukumaran: A prominent actor and director in the Malayalam film industry, known for films like "Lucifer."

• Fahadh Faasil: An acclaimed actor in Malayalam cinema, recognized for his roles in "Joji" and "C U Soon."

Important Points

• Laxman Utekar’s Signature Style:

• He combines strong emotional narratives with a visual aesthetic that appeals to a wide audience.

• His films often focus on family dynamics and social issues, making them relatable and meaningful.

• Upcoming Projects:

• Chhaava is expected to further establish Utekar's reputation as a director capable of handling diverse genres.

• Fans and critics alike are keen to see how he brings his vision to life in this much-anticipated release.

• Indian Film Industry:

• The Indian film industry is one of the largest in the world, producing films in multiple languages and genres.

• Directors like Laxman Utekar contribute significantly to its diversity and global appeal.

Q100. Answer: (a) Madison Keys

The correct answer is Madison Keys.

Key Points

• Madison Keys won the Women's Singles title at the Australian Open 2025, showcasing an outstanding performance throughout the tournament.

• She defeated her opponent in the final match with a combination of power, precision, and mental resilience.

• Madison Keys, an American professional tennis player, is known for her aggressive playing style, strong groundstrokes, and powerful serves.

• This victory marked a significant milestone in her career, adding a Grand Slam title to her achievements and cementing her place among the top players in the world.

• The Australian Open, held in Melbourne, Australia, is one of the four Grand Slam tournaments and is played on hard courts.

Additional Information

• Madison Keys:

• Born on February 17, 1995, in Rock Island, Illinois, USA, she began playing tennis at a young age and quickly rose through the ranks.

• Known for her powerful forehand and ability to dominate opponents on hard courts.

• She has previously reached the final of the US Open in 2017 but fell short of clinching the title.

• Her victory at the Australian Open 2025 marked her first Grand Slam title, making it a historic moment in her career.

• Australian Open:

• The Australian Open is the first Grand Slam tournament of the year, held annually in January at Melbourne Park.

• It is played on hard courts and attracts top players from around the globe.

• Notable for its intense matches, unpredictable weather conditions, and passionate crowd support.

• Other Competitors in 2025:

• Aryna Sabalenka: A top-ranked player known for her aggressive baseline game and mental toughness.

• Coco Gauff: A young American tennis prodigy with exceptional athleticism and a bright future in the sport.

• Iga Swiatek: A Polish player who has won multiple Grand Slam titles and is celebrated for her all-court playing style.

• Important Facts about Grand Slams:

• The four Grand Slam tournaments are the Australian Open, French Open, Wimbledon, and the US Open.

• Winning all four in a single calendar year is referred to as a Calendar Slam, achieved by very few players in history.

• These tournaments are considered the pinnacle of professional tennis, offering the highest prize money and ranking points.

Important Points

• Madison Keys' Journey: Her win at the Australian Open 2025 highlights her consistent hard work, mental resilience, and ability to perform under pressure.

• Significance of the Win: This victory not only added to her career achievements but also inspired many young players globally.

• Global Impact: The Australian Open 2025 was watched by millions worldwide, further promoting tennis as a global sport.

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