RRB Group D Official Paper (Held On: 27 Dec, 2025 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which property most definitively distinguishes a suspension from a colloid?

(a) Homogeneity of the mixture
(b) Absence of light scattering under illumination
(c) Settling of particulates under gravitational force
(d) Formation of covalent solute-solvent bonds

Q2. What happens to biodegradable substances when they are released in the environment?

(a) They deplete the ozone layer.
(b) They persist forever.
(c) They get broken down into simpler components.
(d) They get converted into toxic chemicals.

Q3. The process of seed dispersal helps in:

(a) forming new flowers on the same plant
(b) increasing seed size
(c) colonising new habitats
(d) promoting self-pollination

Q4. What is the purpose of enrichment of ore before extraction?

(a) To remove impurities
(b) To convert it into salt
(c) To remove moisture
(d) To increase weight

Q5. According to the right-hand thumb rule, if the thumb points in the direction of current, then the fingers show:

(a) direction of electric force
(b) direction of resistance
(c) direction of voltage
(d) direction of magnetic field lines

Q6. The newton (N) is the SI unit of force. Which of the following expresses one newton (N) in terms of the fundamental SI units (kilogram, metre and second)?

(a) kg.m2/s
(b) kg.m.s
(c) kg/m2.s
(d) kg.m/s2

Q7. To get a virtual, erect and enlarged image using a spherical mirror, the object must be placed _____.

(a) at the principal focus (F) of a convex mirror
(b) at the principal focus (F) of a concave mirror
(c) at the centre of curvature (C) of a concave mirror
(d) between the pole (P) and the principal focus (F) of a concave mirror

Q8. The phenomenon in which different parts of the plant, like root, stem and leaves, develop into new plants under appropriate conditions is called _____.

(a) Sexual reproduction
(b) Fertilisation
(c) Vegetative propagation
(d) Regeneration

Q9. What is generally produced when a metal reacts with an acid?

(a) Salt and oxygen
(b) Salt and hydrogen gas
(c) Salt and water
(d) Salt only

Q10. The main reason an echo is NOT heard clearly in a small room is:

(a) Sound intensity decreases too quickly over short distances
(b) Time interval between original sound and echo is too short
(c) Sound frequency is too high
(d) Sound travels too slowly

Q11. Which statement best describes an olfactory indicator?

(a) A substance that changes smell in acids and bases
(b) A liquid that changes colour in all solutions
(c) A gas that reacts only with strong acids
(d) A solid that dissolves in both acids and bases

Q12. What would you call the middle elongated part of the female reproductive part of a flower?

(a) Pollen grain
(b) Stigma
(c) Ovary
(d) Style

Q13. Which of the following leads to significant damage to the ozone layer in the atmosphere?

(a) Chlorofluorocarbons (CFCs)
(b) Methane
(c) Oxygen
(d) Carbon dioxide

Q14. A stone of mass 500g is raised from ground to a height of 20 m. What is the gain in its potential energy? (Take g=10 m/s^2)

(a) 150 J
(b) 200 J
(c) 50 J
(d) 100 J

Q15. An object is placed at a distance of 40 cm from a convex lens of focal length 10 cm, such that an image is formed at a distance of X cm from the lens. What is the value of X?

(a) +40/3
(b) -40/3
(c) +8

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(d) –8

Q16. Which of the following is a chemical change?

(a) Combustion of petrol
(b) Mixing salt and water
(c) Evaporation of water
(d) Ice melting

Q17. In electrolytic refining, the impure metal is used as which of the following?

(a) Electrolyte
(b) Salt
(c) Cathode
(d) Anode

Q18. A straight conductor carrying current is placed parallel to a uniform magnetic field. The force on the conductor will be:

(a) zero
(b) maximum
(c) half the maximum
(d) infinite

Q19. The skin on the face is primarily made up of which epithelial tissue?

(a) Ciliated
(b) Squamous
(c) Columnar
(d) Cuboidal

Q20. Which of the following 'indicators' is used to test the nature of solutions besides litmus paper?

(a) Sand and alcohol
(b) Sugar and water
(c) Table salt and vinegar
(d) Turmeric and red cabbage juice

Q21. What distinguishes rough ER (RER) from smooth ER (SER)?

(a) Absence of proteins in RER, presence in SER
(b) Absence of membranes in RER, presence in SER
(c) Presence of ribosomes on RER, absence on SER
(d) Presence of chlorophyll on RER, absence on SER

Q22. When you shake a tree, fruits fall because of _____.

(a) Gravity and Inertia of rest
(b) Inertia of motion
(c) Gravity only
(d) Air pressure

Q23. Which of the following instruments is used to determine the purity of a milk sample?

(a) Thermometer
(b) Barometer
(c) Lactometer
(d) Hydrometer

Q24. Cells differ in shape and size according to the work they perform in living organisms. Which of the following correctly compares a cell's shape with its function?

(a) Red blood cell – Long and branched, transmits messages
(b) Nerve cell – Round in shape, stores food
(c) Amoeba – Irregular in shape, helps in movement and capturing food

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(d) Muscle cell – Flat and disc-shaped, carries oxygen

Q25. Which of the following is a characteristic of a colloidal solution?

(a) Particles scatter a beam of light
(b) Particles are invisible under a microscope
(c) Particles can be separated by filtration
(d) Particles settle down on standing

MATHEMATICS

Q26. If 40% of 20% of 4over7 of a number is 336. Find the number.

(a) 7630
(b) 8190
(c) 7350
(d) 8120

Q27. The mode of the observations 26, 26, 22, 21, 31, 24, 21, 28, 28, 30, 33, 22, 25, 23 and 21 is:

(a) 26
(b) 22
(c) 21
(d) 28

Q28. In a test, B got 50 marks while A got 80 marks, out of 85 maximum marks. What percentage of A's marks was B's marks?

(a) 94.12%
(b) 62.5%
(c) 160%
(d) 85%

Q29. In triangle ABC, BD perpendicular to AC at D and angle DBC = 80°. E is a point on BC such that angle CAE = 37°. What is the measure of angle AEB ?

(a) 45°
(b) 49°
(c) 47°
(d) 40°

Q30. If the radius of a sphere is 10 cm, then its surface area is:

(a) 400 π cm^2
(b) 336 π cm^2
(c) 200 π cm^2
(d) 341 π cm^2

Q31. Simplify the given expression.

$(5x + 3y)^2 - (5x - 3y)^2$

(a) 30xy
(b) 90xy
(c) 120xy
(d) 60xy

Q32. In an election, there were 12,000 voters. In the first round, Babita received 40% of the votes, and Ramanlal received 35% of the votes. The remaining votes went to other candidates. In the second round, Babita gained 20% more votes compared to the first round, while Ramanlal gained 10% more votes. How many votes did Babita receive in the second round?

(a) 5,760
(b) 5,600

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(c) 6,400
(d) 6,000

Q33. Rama made necklaces with either 24 beads, 36 beads or 40 beads, such that no bead was left over. What is the least number of beads Rama could have?
(a) 420
(b) 360
(c) 320
(d) 280

Q34. The sum of the first 19 prime numbers is:
(a) 571
(b) 570
(c) 564
(d) 568

Q35. If 5.12 × 50625 × 0.5488 = 2^a 3^b 5^c 7^d, then find the value of a + b + c + d.
(a) 12
(b) 14
(c) 23
(d) 10

Q36. Simplify : (1 - 1/cos θ) ((1 + sec θ)/(tan²θ))
(a) -1
(b) tanθ
(c) −tanθ
(d) 1

Q37. If the fourth proportional to P, 22 and 8 is 11, then find the value of P.
(a) 16
(b) 19
(c) 15
(d) 13

Q38. If the radius of a sphere is increased by 37.5%, its surface area is increased by 35,112 cm². Find the original surface area of the sphere. (Take π = 22/7)
(a) 39,394 cm2
(b) 39,444 cm2
(c) 39,414 cm2
(d) 39,424 cm2

Q39. A shopkeeper buys an article for Rs. 850, spends Rs. 200 on repairs and sells it for Rs. 1,200. What is his profit percentage (rounded off to two decimal places)?
(a) 13.29%
(b) 14.79%
(c) 14.29%
(d) 13.79%

Q40. A mother's age is double her son's age at present. If the difference of their ages after 24 years from now is 20, then find their ages at present (in years), respectively.
(a) 46, 23
(b) 40, 20
(c) 54, 28
(d) 38, 19

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Q41. Walking 5/8 of his normal speed from his home, Tarun is 21 minutes late in reaching his office. The usual time taken by him to cover the distance between his home and his office is:

(a) 37 minutes
(b) 28 minutes
(c) 29 minutes
(d) 35 minutes

Q42. A chair is marked at Rs. 4,000 and sold at Rs. 3,600 after a certain discount. If the shopkeeper still makes a profit of 20%, find the cost price of the chair.

(a) Rs. 3,000
(b) Rs. 3,200
(c) Rs. 2,800
(d) Rs. 3,400

Q43. A student secured 300 marks out of a maximum of x marks in a test. If the same percentage score were applied to a test of 400 marks, he would have scored 200 marks. What were the maximum marks of the original test?

(a) 600
(b) 700
(c) 500
(d) 800

Q44. A contractor agreed to complete a job in 74 days. He employed 21 men to work, but only one-fourth of the work was completed in 32 days. How many additional men must he employ to finish the remaining work within the stipulated time?

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

Q45. The marked price of a toy truck is Rs. 8,810, and its selling price is Rs. 6,250. Find the discount percentage. (Round off the answer to two decimal places.)

(a) 31.08%
(b) 29.06%
(c) 32.51%
(d) 27.41%

Q46. Rs. 5,177 is divided among A, B and C in such a way that if Rs. 72, Rs. 21 and Rs. 24 be deducted from their respective shares, they have money in the ratio 3 : 13 : 7. Find the difference between the original shares of B and C.

(a) Rs. 1,420
(b) Rs. 1,470
(c) Rs. 1,317
(d) Rs. 1,220

Q47. A, B and C can do a piece of work in 2, 15 and 10 days, respectively. How long (in days) will they take to do twice the same work, working together?

(a) 9
(b) 4
(c) 3
(d) 6

Q48. The average of the first 13 even natural numbers is:

(a) 15
(b) 11
(c) 13
(d) 14

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Q49. Find the simple interest (in Rs.) on Rs. 4,000 at 6% per annum rate of interest for the period from 20 February 2024 to 21 April 2024.

(a) 39
(b) 40
(c) 41
(d) 38

Q50. A girl goes to school at a speed of 45 km/h. She comes back with a speed of 36 km/h. Find her average speed for the whole journey.

(a) 42 km/h
(b) 38 km/h
(c) 40 km/h
(d) 33 km/h

GENERAL INTELLIGENCE & REASONING

Q51. What will come in place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

94 – 115 × 5 + 14 ÷ 7 = ?

(a) 19
(b) 14
(c) 18
(d) 16

Q52. 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 is the letter-cluster pair that 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) NK−OL
(b) XU−YV
(c) DA−DD
(d) AX−BY

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

25 32 41 52 65 ?

(a) 82
(b) 80
(c) 79
(d) 81

Q54. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

END BRA YVX VZU ?

(a) TCR
(b) TES
(c) RCQ
(d) SDR

Q55. Kinjal ranked 21^(st) from the top and 12^(th) from the bottom in her class. How many students are there in her class?

(a) 30
(b) 32
(c) 31
(d) 33

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Q56. In a certain code language,

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

A – B means 'A is the son of B',

A × B means 'A is the mother of B' and

A ÷ B means 'A is the brother of B'.

How is X related to T if 'X + Y – Z × W ÷ T'?

(a) Father
(b) Son
(c) Brother
(d) Daughter's son

Q57. Which of the following terms will replace the question mark (?) in the given series to make it logically complete?

EQL 2 GMN 6 IIP 18 KER 54 ?

(a) MAS 168
(b) MBS 158
(c) MAT 162
(d) MBT 158

Q58. Six people, A, B, C, D, E and F are sitting in a row, facing north. F sits to the immediate left of A. C sits third to the left of D. C is an immediate neighbour of A. B sits to the immediate left of E. How many people sit between E and C?

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

Q59. Read the given statements and conclusions carefully. You have to take the given statements to be true even if they seem to be at variance from commonly known facts. You have to decide which conclusion/s logically follow/s from the given statements.

Statements: Some sandals are crocs. All crocs are flipflops.

Conclusion I: Some sandals are flipflops.

Conclusion II: All flipflops are crocs.

(a) Only Conclusion I follows
(b) Only Conclusion II follows
(c) Neither Conclusion I nor II follows
(d) Both Conclusions I and II follow

Q60. If 'P' stands for '×', 'Q' stands for '÷', 'R' stands for '–' and 'S' stands for '+', what will come in place of the question mark (?) in the following equation?

17 P 4 R 65 Q 5 S (34 Q 2) P 10 S 6 P 3 = ?

(a) 258
(b) 243
(c) 215
(d) 191

Q61. Refer to the given series and answer the question that follows. All numbers are single-digit numbers only. Counting to be done from left to right.

(Left) 4 7 2 8 1 5 6 9 3 8 2 4 7 1 9 5 3 6 8 2 7 4 1 9 5 (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) Two
(b) Five
(c) Four
(d) Three

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Q62. 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) 1 6 1 5 5 2 4 8 4 9 1 8 7 3 3 6 9 1 2 6 2 1 2 7 4 9 3 (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) 4
(b) 3
(c) 6
(d) 5

Q63. 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.)

(14, 30, 56)

(20,36, 68)

(a) (12, 24, 40)
(b) (10, 26, 56)
(c) (26, 10, 16)
(d) (15, 31, 58)

Q64. Samyuktha starts from Point H and drives 8 km towards the east. She then takes a right turn, drives 7 km, turns right and drives 10 km. She then takes a right turn and drives 11 km. She takes a final right turn, drives 2 km and stops at Point P. How far (shortest distance) and towards which direction should she drive in order to reach Point H again?

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

(a) 6 km towards west
(b) 4 km towards south
(c) 7 km towards north
(d) 5 km towards north

Q65. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only.)

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

If all the odd numbers are dropped from the series, which of the following will be sixth from the left?

(a) 6
(b) 4
(c) 8
(d) 2

Q66. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All hearts are spades.

All aces are spades.

No spades are pens.

Conclusions:

(I): All aces are hearts.

(II): No hearts are pens.

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

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Q67. Six people, D, E, F, G, H and I, are sitting in a row, facing towards the north. H is sitting to the immediate right of F and to the immediate left of D. E is sitting to the right of F and three people are sitting in between them. G is sitting to the immediate left of E. I is sitting to the immediate right of E. Three of the following four are alike in a certain way based on the given arrangement and thus form a group. Which is the one that DOES NOT belong to that group?

(a) HE
(b) EI
(c) FH
(d) DG

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

412 414 418 424 432 ?

(a) 439
(b) 445
(c) 441
(d) 442

Q69. LNRO is related to QSWT in a certain way based on the English alphabetical order. In the same way, TVZW is related to YAEB. To which of the given options is EGKH related, following the same logic?

(a) JMOU
(b) JLOM
(c) JLPM
(d) JKOM

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

29 ÷ 13 + 545 × 5 - 317 = ?

(a) 504
(b) 566
(c) 585
(d) 519

Q71. Nawang starts from Point A and drives 16 km towards south. He then takes a right turn, drives 13 km, turns right and drives 17 km. He then takes a right turn and drives 19 km. He takes a final right turn, drives 1 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again?

(All turns are 90 degree turns only unless specified)

(a) 6 km to the west
(b) 3 km to the west
(c) 4 km to the west
(d) 5 km to the west

Q72. What should come in place of the question mark (?) in the given series?

254 238 222 206 190 ?

(a) 178
(b) 176
(c) 174
(d) 170

Q73. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

GJH−LOM

HKI−MPN

(a) VXU−ADB
(b) VYW−ZDA
(c) VYW−ADB

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(d) VXU−ZCA

Q74. Eight people – A, B, C, D, E, F, G and H, are sitting around a circular table facing the centre. C sits to the immediate right of A. Only two people sit between C and D when counted from the right of D. Only three people sit between D and E when counted from the left of D. H sits to the immediate right of E. B is not an immediate neighbour of D. F sits second to the right of G. Who sits third to the right of F?

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

Q75. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one which follows the same logic.

JOYS - YJOS - SYOJ

LAKE - KLAE - EKAL

(a) QUAD - AQUD - DAUQ
(b) ICED - CIED - DCEI
(c) HALT - HLAT - TLAH
(d) KIND - NKID - INDK

Q76. Refer to the following number, symbol series and answer the question. Counting to be done from left to right only.

(Left) * © 2 1 £ 2 6 2 £ © @ % £ $ 4 $ $ $ @ $ 1 4 (Right)

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

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

Q77. In a certain code language, ‘seek new hope’ is coded as ‘dp ml vy’ and ‘hope fuels dreams’ is coded as ‘gj sc dp’. How is ‘hope’ coded in the given language?

(a) gj
(b) dp
(c) vy
(d) sc

Q78. In a certain code language, ‘TOUR’ is coded as ‘8571’ and ‘DOUT’ is coded as ‘5478’. What is the code for ‘D’ in that language?

(a) 7
(b) 8
(c) 5
(d) 4

Q79. All 92 people are standing in a row facing north. Mr. Akte is 9^(th) from the left end while Mr. Memi is 27^(th) from the right end. How many people are there between Mr. Akte and Mr. Memi?

(a) 55
(b) 57
(c) 54
(d) 56

Q80. Based on the English alphabetical order, three of the following four letter-clusters are alike in a certain way and thus form a group. Which letter-cluster DOES NOT belong to that group?

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

(a) ZVX

(b) WSV
(c) FBE
(d) RNQ

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. In 2025, the Ministry of Defence unveiled a long-term roadmap emphasising future-generation technologies such as AI, hypersonic weapons, nuclear propulsion for warships, and next-generation combat systems. Which of the following is the name of this plan/roadmap?

(a) Technology Perspective & Capability Roadmap 2025
(b) Long Term Integrated Perspective Plan 2025
(c) Defence Modernisation Programme 2025
(d) Make-in-India Defence Mission 2025

Q82. Where was the Combined Operational Review and Evaluation (CORE) Programme organised by the Headquarters Integrated Defence Staff (HQ IDS) from 22 to 26 September 2025?

(a) Indian Military Academy, Dehradun, Uttarakhand
(b) National Defence Academy, Pune
(c) Defence Services Staff College, Wellington, Tamil Nadu
(d) United Service Institution of India, New Delhi

Q83. Which of the following is India's first fully robotic telescope in Ladakh that captured images of a massive asteroid during its close pass by Earth in July 2024?

(a) NEW-India
(b) KALAM-India
(c) AMRUT-India
(d) GROWTH-India

Q84. In August 2025, World Lion Day celebrations in Gujarat were held at which wildlife sanctuary, where a major conservation and eco-tourism initiative was also highlighted?

(a) Barda Wildlife Sanctuary
(b) Pania Wildlife Sanctuary
(c) Hingolgadh Wildlife Sanctuary
(d) Kutch Desert Wildlife Sanctuary

Q85. Which of the following multilateral negotiations did India and the Eurasian Economic Union (EAEU) sign in August 2025 as a step towards a Free Trade Agreement (FTA)?

(a) India-EAEU Terms of Reference (ToR) for an FTA
(b) India-EAEU Cultural Exchange Agreement
(c) India-EAEU Defence Pact
(d) India-EAEU Comprehensive Economic Partnership Agreement

Q86. Who became the fastest man in the world so far in 2025 in the 100 m race with a time of 9.86 s ?

(a) Abdul-Rasheed Saminu
(b) Bayanda Walaza
(c) Akani Simbine
(d) Ferdinand Omanyala

Q87. Which of the following was launched by India in August 2025 to support countries of the Global South in meeting the Sustainable Development Goals?

(a) Sustainable Development and Capacity Building Partnership
(b) India-UN Global Capacity Building Initiative
(c) SDG Partnership for Developing Nations
(d) South-South SDG Empowerment Programme

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Q88. The Utkarsh Odisha – Make in Odisha Conclave, 2025, was held at _____.

(a) Koraput
(b) Bhubaneswar
(c) Puri
(d) Sambalpur

Q89. In November 2025, which Indian state rolled out the amended Bharat Net Scheme across its territory, aiming in part to support real-time monitoring in sensitive border zones affected by regional disputes?

(a) Punjab
(b) Rajasthan
(c) Gujarat
(d) Haryana

Q90. What significant step did the Karnataka High Court emphasise in November 2025 regarding child safety equipment?

(a) Limited exemption of child helmet use in rural Karnataka areas
(b) Promotion of local manufacturing of child safety gear in Karnataka
(c) Delayed relaxation of child safety regulations until further notice
(d) Immediate implementation and enforcement of child helmet safety rules in Karnataka

Q91. In March 2025, which summit was held in India to focus on climate solutions and partnerships?

(a) ASEAN Environment Meeting
(b) G7 Summit for Climate Negotiations
(c) Arctic Council Forum
(d) World Sustainable Development Summit

Q92. Thiyam Suryamukhi Devi, honoured with the Padma Shri in 2025, is famous for which classical dance form?

(a) Manipuri
(b) Odissi
(c) Bharatanatyam
(d) Kuchipudi

Q93. Which customer segment is affected by ICICI Bank's raised minimum balance requirement?

(a) Joint account holders only
(b) All existing savings account holders from 1 August 2025
(c) Only new savings accounts opened from 1 August 2025
(d) Only accounts in rural branches

Q94. In December 2024, which of the following schemes was launched by Prime Minister Narendra Modi in Haryana to promote financial literacy and insurance awareness among women?

(a) Bima Shakti Scheme
(b) Nari Suraksha Yojana
(c) Bima Sakhi Yojana
(d) Sakhi Suraksha Plan

Q95. Which collection by Banu Mushtaq, translated by Deepa Bhasthi, won the International Booker Prize, 2025?

(a) The Original
(b) Heart Lamp
(c) Hunchback
(d) Under the Eye of the Big Bird

Q96. Who has been awarded the first-ever EASD Diabetes Global Impact Prize in 2025?

(a) Dr. Devi Shetty
(b) Dr. Randeep Guleria
(c) Dr. V Mohan
(d) Dr. Soumya Swaminathan

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Q97. At which competition did Animesh Kujur set a new national record and win a bronze medal in the men's 200 m event?

(a) South Asian Games
(b) World Championships
(c) Olympics
(d) Asian Athletics Championships

Q98. 'Deviants', a multigenerational queer novel published in February 2025, is authored by:

(a) Aria Aber
(b) Amitav Ghosh
(c) Akhil P Dharmajan
(d) Santanu Bhattacharya

Q99. How many runs did India's women's team score to set a national record in a One-Day International against Ireland in January 2025?

(a) 435
(b) 425
(c) 430
(d) 400

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

(a) Jannik Sinner
(b) Rafael Nadal
(c) Daniil Medvedev
(d) Novak Djokovic

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (c) Settling of particulates under gravitational force

The correct answer is Settling of particulates under gravitational force.

Key Points

• A suspension is a heterogeneous mixture in which the solute-like particles settle out of the solvent-like phase some time after their introduction.

• The most definitive distinction is that the particles in a suspension will eventually settle at the bottom of the container due to gravitational force (sedimentation) if left undisturbed. In contrast, colloidal particles are small enough that Brownian motion counteracts gravity, keeping them suspended indefinitely. Hence, statement 3 is correct.

• Both suspensions and colloids are technically heterogeneous mixtures. While a colloid might appear homogeneous to the naked eye, it consists of distinct phases at the microscopic level. Therefore, homogeneity does not definitively distinguish them. Hence, statement 1 is incorrect.

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• The Tyndall effect, or the scattering of light by particles, is a property shared by both colloids and suspensions (though very dense suspensions might simply block light). Since both can scatter light, the absence of scattering is not a distinguishing feature of a suspension. Hence, statement 2 is incorrect.

• The formation of covalent solute-solvent bonds describes a chemical reaction rather than a physical mixture. Both suspensions and colloids are physical mixtures where components are held by physical interactions, not covalent bonds. Hence, statement 4 is incorrect.

Additional Information

• Particle Size:

• In a true solution, the particle size is less than 1 nm.

• In a colloid, the particle size ranges between 1 nm and 1000 nm.

• In a suspension, the particle size is generally greater than 1000 nm (or 1 micrometer), making them visible to the naked eye.

• Filtration:

• Particles of a suspension are large enough to be trapped by ordinary filter paper.

• Colloidal particles pass through standard filter paper but can be separated using ultrafilters or semi-permeable membranes.

• Stability:

• A suspension is considered unstable because its phases separate over time.

• A colloid is relatively stable; the particles do not settle down even when left undisturbed for a long period.

• Examples:

• Common examples of suspensions include muddy water, a mixture of chalk and water, or flour in water.

• Common examples of colloids include milk, fog, blood, and mayonnaise.

Important Points

• Brownian Motion: This is the random, zigzag motion of colloidal particles resulting from collisions with molecules of the dispersion medium. This motion is a key reason why colloids do not settle under gravity.

• Tyndall Effect: Named after John Tyndall, this effect allows us to see the path of a light beam as it passes through a colloid or suspension. It is a widely used test in laboratories to differentiate a true solution from a colloid.

• Centrifugation: While colloidal particles do not settle under normal gravitational force, they can be forced to settle using a centrifuge, which applies a much higher force. This is how cream is separated from milk.

• Classification: Colloids are classified based on the state of the dispersed phase and the dispersion medium into categories such as aerosols, foams, emulsions, sols, and gels.

Q2. Answer: (c) They get broken down into simpler components.

The correct answer is They get broken down into simpler components.

Key Points

• Biodegradable substances are materials that can be broken down or decomposed into simpler, harmless substances by the action of microorganisms such as bacteria and fungi over a period of time.

• When these substances are released into the environment, biological processes involving enzymatic actions convert complex organic matter into simpler inorganic forms like carbon dioxide, water, and minerals. Hence, the statement that they get broken down into simpler components is correct.

• This natural process ensures that nutrients are returned to the soil or atmosphere, maintaining the biogeochemical cycles and the overall ecological balance of the planet.

• The rate of decomposition varies depending on the nature of the substance and environmental factors such as temperature, moisture, and oxygen availability.

• Unlike non-biodegradable pollutants, these substances do not persist forever in the environment and generally do not cause long-term accumulation in the food chain.

Additional Information

• Classification of Waste:

• Biodegradable Waste: Includes organic materials such as kitchen waste, vegetable peels, fruits, paper, wood, cotton, and animal dung. These are eco-friendly as they can be converted into manure or compost.

• Non-Biodegradable Waste: Includes materials that cannot be broken down by biological processes, such as plastics, glass, metals, and synthetic chemicals like DDT. These often lead to environmental pollution and soil degradation.

• Role of Decomposers: Decomposers or saprophytes play a critical functional role in the ecosystem by cleaning the environment and making space for new life by recycling biomass.

• Impact of Non-Biodegradable Substances:

• Materials like polythene and heavy metals (Lead, Mercury) can cause biomagnification, where the concentration of toxic substances increases at each successive trophic level of the food web.

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• Inert substances like plastics can remain in the environment for hundreds of years, posing a threat to wildlife and marine ecosystems.

• Ozone Layer Depletion: This is primarily caused by Chlorofluorocarbons (CFCs) and Halons released into the stratosphere, and is not a direct result of general biodegradable substances.

Important Points

• Composting: A controlled process of aerobic decomposition of biodegradable waste to produce organic fertilizer. It is a key waste management strategy in urban and rural areas.

• Landfills: While biodegradable waste breaks down in landfills, the anaerobic (without oxygen) conditions can lead to the production of methane, a potent greenhouse gas with high Global Warming Potential (GWP).

• Environmental Laws: In India, the Solid Waste Management Rules, 2016 mandate the segregation of waste at the source into biodegradable (wet waste) and non-biodegradable (dry waste) to facilitate efficient disposal and recycling.

Q3. Answer: (c) colonising new habitats

The correct answer is colonising new habitats.

Key Points

• Seed dispersal is the biological mechanism by which plant seeds are transported to new sites for germination and establishment. It is a critical stage in the life cycle of plants.

• Colonizing new habitats: The primary advantage of seed dispersal is that it allows plants to spread their geographic range and occupy new ecological niches. This prevents a species from being confined to a single area, which reduces the risk of extinction due to localized environmental changes. Hence, option 3 is correct.

• Reduction of competition: Dispersal ensures that seeds do not fall directly under the parent plant. This prevents overcrowding and minimizes competition between the parent and the offspring for sunlight, water, and soil minerals.

• Survival against pests: By moving away from the parent, seeds can escape host-specific herbivores, seed predators, and pathogens (fungi or bacteria) that often accumulate in high densities near the adult plant.

• Genetic Diversity: It facilitates gene flow within and between populations, helping to maintain genetic diversity as seeds from different parents may end up in the same new location.

Additional Information

• Methods of Seed Dispersal:

• Anemochory (Wind): Seeds are usually lightweight and may have structures like wings (e.g., Maple and Drumstick) or hair-like tufts (e.g., Dandelion and Cotton) to stay airborne.

• Hydrochory (Water): Common in aquatic or coastal plants. Seeds or fruits develop a fibrous or spongy outer coat to float, such as Coconut and Lotus.

• Zoochory (Animals): Seeds can be dispersed via ingestion (eating fleshy fruits like Mango or Guava and excreting seeds) or by attachment using hooks or spines (e.g., Xanthium and Urena) that stick to animal fur or human clothes.

• Autochory (Explosion): Some plants have pods that dry and burst open with a sudden jerk, flinging seeds away from the parent (e.g., Balsam, Pea, and Castor).

• Analysis of Other Options:

• Forming new flowers: This is a function of the reproductive phase and meristematic growth of the plant, triggered by hormones like florigen, not by the dispersal of seeds. Hence, option 1 is incorrect.

• Increasing seed size: Seed size is a genetic trait and is determined during embryo development and maternal resource allocation before dispersal occurs. Hence, option 2 is incorrect.

• Promoting self-pollination: Pollination is the transfer of pollen grains from the anther to the stigma, which happens before the formation of seeds. Dispersal occurs after fertilization. Hence, option 4 is incorrect.

Important Points

• The Janzen-Connell Hypothesis is a widely accepted ecological theory explaining that seed dispersal is vital because seedling survival is often higher at a greater distance from the parent plant due to reduced predation.

• In Agriculture, understanding dispersal helps in managing weed control, as many weeds have highly efficient wind or animal-based dispersal mechanisms that allow them to invade crop fields rapidly.

• Global Warming: Seed dispersal is becoming increasingly important as climate change shifts suitable habitats; plants with high dispersal capacity are more likely to "migrate" to cooler latitudes or higher altitudes to survive.

Q4. Answer: (a) To remove impurities

The correct answer is To remove impurities.

Key Points

• Enrichment of ore, also known as concentration or ore dressing, is the process of removing unwanted materials from the mined ore.

• Ores mined from the earth are usually contaminated with large amounts of impurities such as soil, sand, and rocky materials.

• These unwanted impurities present in the ore are collectively called gangue or matrix. Hence, the primary purpose is to remove these impurities (Statement 1 is correct).

• The removal of gangue is essential because it increases the percentage of the metal in the ore, making the subsequent extraction processes like reduction more economical and efficient.

• The procedures used for enriching the ore depend upon the difference between the physical or chemical properties of the ore and the gangue.

Additional Information

• Common Methods of Ore Enrichment:

• Hydraulic Washing: This is based on the difference in specific gravities of the ore and the gangue particles. It is a type of gravity separation where an upward stream of running water is used to wash away lighter gangue particles from the heavier ore.

• Magnetic Separation: This method is employed when either the ore or the gangue possesses magnetic properties. For example, iron ores like magnetite (Fe_3O_4) are separated from non-magnetic impurities using magnetic rollers and belts.

• Froth Flotation Process: This technique is specifically used for the enrichment of Sulphide ores (e.g., Galena, Copper pyrites, Zinc blende). It is based on the differential wetting characteristics of the ore and gangue with water and pine oil.

• Leaching: This is a chemical method used if the ore is soluble in a suitable solvent. For instance, in the Bayer process, Bauxite (aluminum ore) is treated with hot concentrated Sodium Hydroxide (NaOH) to dissolve the alumina, leaving behind impurities like Ferric oxide and Silica.

• Extraction Sequence:

• The process of obtaining a pure metal involves several steps: Crushing and Grinding of ore, Enrichment/Concentration, Conversion to Oxide (via Calcination or Roasting), Reduction to metal, and finally Refining.

Important Points

• Metallurgy: This refers to the entire scientific and technological process used for the isolation of the metal from its ores.

• Mineral vs. Ore: Naturally occurring chemical substances in the earth's crust are called minerals. A mineral from which a metal can be extracted conveniently and profitably is called an ore.

• Environmental Impact: Proper enrichment reduces the volume of material that needs to be heated in furnaces, thereby saving energy and reducing carbon emissions during the smelting process.

• Dates and Facts: The development of modern flotation techniques dates back to the early 20th century, which revolutionized the mining industry by allowing the processing of low-grade ores that were previously considered waste.

Q5. Answer: (d) direction of magnetic field lines

The correct answer is direction of magnetic field lines.

Key Points

• The Right-Hand Thumb Rule, also known as Maxwell’s Corkscrew Rule, is used to determine the direction of the magnetic field associated with a current-carrying straight conductor.

• According to this rule, if you imagine holding a current-carrying wire in your right hand such that your thumb points in the direction of the electric current, then your fingers will wrap around the conductor in the direction of the magnetic field lines. Hence, statement 4 is correct.

• The magnetic field produced by a straight wire forms concentric circles centered on the wire and lying in the plane perpendicular to the wire.

• This rule is fundamental in electromagnetism and was conceptualized following Hans Christian Oersted's discovery in 1820 that an electric current creates a magnetic field.

• If the current flows upwards, the magnetic field lines appear to move in an anti-clockwise direction when viewed from above. Conversely, if the current flows downwards, the field lines move in a clockwise direction.

Additional Information

• Magnetic Field Strength:

• The magnitude of the magnetic field produced at a given point is directly proportional to the current passing through the conductor.

• It is inversely proportional to the distance from the wire. As you move further away, the concentric circles representing the field lines become larger and the field becomes weaker.

• Maxwell's Corkscrew Rule:

• This is another way to visualize the same phenomenon. If a right-handed corkscrew is rotated such that it advances in the direction of the current, the direction of rotation of the handle indicates the direction of the magnetic field lines.

• Distinction from Fleming's Rules:

• Fleming’s Left-Hand Rule: Used to find the direction of the magnetic force acting on a moving charge or a current-carrying wire placed in an external magnetic field (used in Electric Motors).

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• Fleming's Right-Hand Rule: Used to determine the direction of induced current when a conductor moves in a magnetic field (used in Electric Generators).

• Applications:

• The Right-Hand Thumb Rule is essential for designing solenoids, electromagnets, and understanding the behavior of transformers and inductors in electrical circuits.

• In a circular loop, this rule helps determine that the magnetic field lines at the center of the loop are straight and perpendicular to the plane of the loop.

Important Points

• The SI unit of magnetic field strength (magnetic flux density) is the Tesla (T), named after Nikola Tesla.

• Magnetic field lines are closed continuous curves; they emerge from the North Pole and enter the South Pole outside a magnet, while traveling from South to North inside.

• The Right-Hand Thumb Rule only applies to conventional current (which flows from positive to negative). If considering the flow of electrons, the direction must be reversed.

Q6. Answer: (d) kg.m/s2

The correct answer is kg.m/s2.

Key Points

• The Newton (N) is the International System of Units (SI) derived unit of force. It is named after Sir Isaac Newton in recognition of his work on classical mechanics, specifically his Second Law of Motion.

• According to Newton's Second Law of Motion, the force acting on an object is equal to the mass of the object multiplied by its acceleration (F = m × a).

• In terms of fundamental SI units, mass is measured in kilograms (kg) and acceleration is measured in metres per second squared (m/s2).

• By substituting these fundamental units into the formula, 1 Newton is defined as 1 kg × 1 m/s2. Therefore, 1 N = 1 kg.m/s2. Hence, option 4 is correct.

• One Newton is specifically defined as the amount of force required to accelerate a mass of one kilogram at the rate of one metre per second squared in the direction of the applied force.

Additional Information

• Dimensional Formula: The dimensional representation of force is [M1 L1 T-2], where M stands for mass, L for length (metre), and T for time (second).

• Relationship with CGS Units: In the Centimetre-Gram-Second (CGS) system, the unit of force is the dyne. One Newton is equivalent to 100,000 dynes (1 N = 10^5 dyne).

• Derived Units involving Newton: The Newton is used to define other derived units such as the Joule (unit of energy or work), which is 1 Newton-metre (N.m), and the Pascal (unit of pressure), which is 1 Newton per square metre (N/m2).

• Weight vs. Mass: While mass is a scalar quantity measured in kilograms, weight is a force exerted by gravity on an object and is measured in Newtons. On Earth, a mass of 1 kg has a weight of approximately 9.807 N due to standard acceleration of gravity.

• Vector Nature: Force is a vector quantity, meaning it has both magnitude and direction. The unit Newton quantifies the magnitude of this vector.

Important Points

• Fundamental SI Units: There are seven base units in the SI system: metre (m) for length, kilogram (kg) for mass, second (s) for time, ampere (A) for electric current, kelvin (K) for thermodynamic temperature, mole (mol) for amount of substance, and candela (cd) for luminous intensity.

• Force Components: When expressing Newtons in terms of base units, it is essential to remember that acceleration itself is a derived unit (velocity/time), where velocity is displacement/time. This results in the time squared (s2) appearing in the denominator of the Newton expression.

• Historical Context: The name "Newton" was adopted by the General Conference on Weights and Measures (CGPM) in 1948 as the official name for the MKS (Metre-Kilogram-Second) unit of force.

Q7. Answer: (d) between the pole (P) and the principal focus (F) of a concave mirror

The correct answer is between the pole (P) and the principal focus (F) of a concave mirror.

Key Points

• A concave mirror is a spherical mirror with an inwardly curved reflecting surface. It has the unique ability to produce both real and virtual images depending on the position of the object.

• When an object is placed between the pole (P) and the principal focus (F) of a concave mirror, the reflected rays diverge. When produced backwards, they appear to meet behind the mirror, forming a virtual, erect, and enlarged image. Hence, statement 4 is correct.

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• In the case of a convex mirror, the image formed is always virtual, erect, and diminished, no matter where the object is placed. It cannot produce an enlarged virtual image. Hence, statement 1 is incorrect.

• If an object is placed at the principal focus (F) of a concave mirror, the reflected rays emerge parallel to each other. This results in an image formed at infinity, which is real, inverted, and highly enlarged. Hence, statement 2 is incorrect.

• When the object is positioned at the centre of curvature (C) of a concave mirror, the image is formed exactly at C. This image is real, inverted, and the same size as the object. Hence, statement 3 is incorrect.

• The nature of the image (real or virtual) is determined by whether the light rays actually intersect or only appear to intersect after reflection.

Additional Information

• Concave Mirror (Converging Mirror):

• These mirrors converge light rays falling on them. They are used in torches, searchlights, and vehicle headlights to get powerful parallel beams of light.

• In the field of medicine, dentists use concave mirrors to see enlarged images of the teeth of patients.

• Large concave mirrors are also utilized to concentrate solar energy in solar furnaces.

• Convex Mirror (Diverging Mirror):

• These mirrors diverge light rays. They are commonly used as rear-view (wing) mirrors in vehicles.

• They are preferred because they always give an erect, though diminished, image and have a wider field of view as they are curved outwards.

• Important Optical Terms:

• Pole (P): The center of the reflecting surface of a spherical mirror.

• Principal Focus (F): The point on the principal axis where parallel rays of light converge (concave) or appear to diverge from (convex) after reflection.

• Focal Length (f): The distance between the Pole and the Principal Focus. The radius of curvature (R) is twice the focal length (R = 2f).

Important Points

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

• Magnification (m): It is the ratio of the height of the image to the height of the object ($m = h'/h$). It is also related to distances as $m = -v/u$.

• For a virtual and erect image, the magnification (m) is always positive. In the case of the object between P and F of a concave mirror, $m > 1$ because the image is enlarged.

• According to the New Cartesian Sign Convention, the focal length of a concave mirror is negative, while that of a convex mirror is positive.

Q8. Answer: (c) Vegetative propagation

The correct answer is Vegetative propagation.

Key Points

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

• In this process, the offspring produced are genetically identical to the parent plant, essentially acting as clones. This ensures that desirable characteristics of the parent are preserved in the next generation.

• Unlike sexual reproduction, this phenomenon does not involve the fusion of gametes or the production of seeds. It allows plants to reproduce even if they have lost the ability to produce viable seeds.

• The process occurs under appropriate environmental conditions (moisture, temperature, and nutrients), where specialized structures like buds present on the vegetative parts develop into adventitious roots and shoots. Hence, the correct answer is Vegetative propagation.

Additional Information

• Sexual Reproduction:

• This method involves the fusion of male and female gametes (pollen and ovules) to produce a zygote, which eventually develops into a seed.

• It results in genetic variation among the offspring, which is crucial for evolution and adaptation to changing environments. Hence, statement 1 is incorrect.

• Fertilisation:

• Fertilisation is the specific biological process of the union of a sperm cell with an egg cell.

• In flowering plants (Angiosperms), this occurs within the ovary after pollination. It is a step within the cycle of sexual reproduction

rather than the name of the propagation method itself. Hence, statement 2 is incorrect.

• Regeneration:

• Regeneration is the ability of an organism to regrow lost or damaged body parts. While some simple organisms like Hydra or Planaria can give rise to a whole new individual from a small fragment, in the context of higher plants developing from roots/stems/leaves, the term vegetative propagation is more appropriate. Hence, statement 4 is incorrect.

• Methods of Vegetative Propagation:

• Natural methods include tubers (Potato), rhizomes (Ginger), runners (Strawberry), and bulbs (Onion).

• Artificial methods are widely used in horticulture and include cutting (Rose), grafting (Mango), and layering (Jasmine).

Important Points

• Advantages of Vegetative Propagation:

• Plants raised by this method can bear flowers and fruits earlier than those produced from seeds.

• It is the only method for reproducing plants that do not produce seeds, such as banana, orange, rose, and jasmine.

• The uniformity of the crop is maintained since all plants are clones of the parent, which is highly beneficial for commercial farming and agriculture.

• One notable example is the Bryophyllum plant, which produces buds in the margins of its leaves; if these leaves fall on moist soil, each bud can develop into a new plantlet.

Q9. Answer: (b) Salt and hydrogen gas

The correct answer is Salt and hydrogen gas.

Key Points

• When a metal reacts with a dilute acid, it generally produces a metal salt and hydrogen gas. This is a characteristic chemical property of most reactive metals.

• In this chemical process, the metal displaces the hydrogen atoms from the acid molecules. For example, when Zinc reacts with Hydrochloric acid, Zinc Chloride and Hydrogen gas are formed. Hence, the statement regarding salt and hydrogen gas production is correct.

• The general chemical equation for this reaction can be represented as: Metal + Dilute Acid → Salt + Hydrogen Gas (H2).

• The evolution of hydrogen gas can be tested using a burning splinter. When the splinter is brought near the mouth of the test tube where the reaction is occurring, the gas burns with a characteristic "pop" sound.

• The rate of this reaction depends on the reactivity of the metal. Highly reactive metals like Sodium (Na) and Potassium (K) react explosively, while less reactive metals like Iron (Fe) react more slowly.

Additional Information

• Reactivity Series influence: Metals that are positioned above hydrogen in the reactivity series (like Magnesium, Aluminum, Zinc, and Iron) can displace hydrogen from acids. However, metals below hydrogen, such as Copper (Cu), Silver (Ag), and Gold (Au), do not typically react with dilute acids like HCl or H2SO4 to produce hydrogen gas.

• The Nitric Acid Exception: When metals react with Nitric acid (HNO3), hydrogen gas is usually not evolved. This is because Nitric acid is a strong oxidizing agent. It oxidizes the hydrogen gas produced into water (H2O) and itself gets reduced to various nitrogen oxides such as N2O, NO, or NO2.

• Exceptions to the Nitric Acid Rule: Only very dilute Nitric acid reacts with Magnesium (Mg) and Manganese (Mn) to actually evolve hydrogen gas.

• Types of Salts: The type of salt formed depends on the acid used. Hydrochloric acid (HCl) yields Metal Chlorides, Sulfuric acid (H2SO4) yields Metal Sulfates, and Acetic acid yields Metal Acetates.

Important Points

• Displacement Reaction: This reaction is a prime example of a single displacement reaction, specifically a redox reaction, where the metal is oxidized (loses electrons) and the hydrogen ions in the acid are reduced (gain electrons) to form neutral hydrogen gas.

• Exothermic Nature: The reaction between a metal and an acid is generally exothermic, meaning it is accompanied by the release of heat energy. The temperature of the reaction mixture usually rises during the process.

• Practical Application: This reaction is commonly used in laboratories for the preparation of hydrogen gas on a small scale, typically using granulated zinc and dilute sulfuric acid.

• Safety Fact: Because hydrogen is highly inflammable and forms explosive mixtures with air, these reactions must be performed with caution in controlled environments.

• Corrosion: This chemical principle explains why acidic food substances (like curd or lemon juice) should not be stored in copper or brass vessels, as the acid reacts with the metal to produce toxic salts.

Q10. Answer: (b) Time interval between original sound and echo is too short

The correct answer is Time interval between original sound and echo is too short.

Key Points

• The sensation of sound persists in our brain for about 0.1 seconds. This phenomenon is known as the Persistence of Hearing.

• To hear a distinct echo, the reflected sound must reach the ear after the original sound has faded. This means the time interval between the original sound and the reflected sound must be at least 0.1 seconds. Hence, statement 2 is correct.

• In a small room, the distance between the source of the sound and the reflecting surface (like a wall) is very short. Consequently, the sound reflects back and reaches the ear in less than 0.1 seconds, causing the reflected sound to merge with the original sound.

• The speed of sound in air is approximately 344 meters per second at a temperature of 22 degrees Celsius. To achieve a delay of 0.1 seconds, the sound must travel a total distance of 34.4 meters (344 x 0.1).

• Since the sound travels to the obstacle and back, the minimum distance of the reflecting surface from the source must be half of that total distance, which is 17.2 meters. Most small rooms do not have a length or width of 17.2 meters, which is why a clear echo is not heard.

• Sound intensity actually remains quite high in small rooms because the sound waves are confined, so the idea that intensity decreases too quickly is factually incorrect. Hence, statement 1 is incorrect.

• The frequency of sound determines the pitch but does not change the fundamental requirement of the 0.1-second time gap for an echo to be distinguished by the human ear. Hence, statement 3 is incorrect.

• Sound travels at a constant speed for a given medium and temperature (approx 344 m/s in air); it does not travel "too slowly" to prevent an echo. If it traveled slower, the time interval would actually increase. Hence, statement 4 is incorrect.

Additional Information

• Reverberation: In small rooms, instead of a distinct echo, we often experience reverberation. This is the persistence of sound due to multiple reflections. If the reflections are too frequent and close together (less than 0.1 seconds), they blur the original sound, which is common in empty rooms or large halls with poor acoustics.

• Conditions for Echo Formation:

• The reflecting surface must be hard and large enough (like a tall building or a mountain) to reflect sound waves effectively.

• The distance between the source and the obstacle must be at least 17.2 meters (in air at standard temperature).

• Factors affecting the Speed of Sound:

• Temperature: The speed of sound increases with an increase in temperature. For every 1 degree Celsius rise, the speed increases by about 0.6 meters per second.

• Humidity: Sound travels faster in humid air than in dry air because water vapor decreases the density of the air.

• Medium: Sound travels fastest in solids, followed by liquids, and slowest in gases. For example, the speed of sound in steel is approximately 5960 m/s.

• Applications of Echo:

• SONAR (Sound Navigation and Ranging): Used by ships and submarines to detect underwater objects by measuring the time interval of reflected ultrasonic waves.

• Echolocation: Animals like bats and dolphins use echoes to navigate and find prey in the dark or underwater.

• Medical Imaging: Ultrasound (Echocardiography) uses the principle of reflection to create images of internal organs.

Important Points

• The minimum distance required for an echo changes with temperature. On a hot day, the speed of sound is higher, meaning the sound covers more distance in 0.1 seconds, thus requiring the reflecting surface to be further away (greater than 17.2 meters) to hear a distinct echo.

• Acoustic materials: In cinemas and auditoriums, soft materials like carpets, heavy curtains, and perforated fiberboards are used to absorb sound and reduce excessive reverberation.

• The Law of Reflection for sound is the same as for light: the angle of incidence is equal to the angle of reflection, and they lie in the same plane.

Q11. Answer: (a) A substance that changes smell in acids and bases

The correct answer is A substance that changes smell in acids and bases.

Key Points

• Olfactory indicators are substances whose odor or smell changes depending on whether they are mixed with an acidic or a basic solution.

• The term "olfactory" pertains to the sense of smell, and these indicators are primarily used in chemistry laboratories to test the nature of a particular substance when color-based indicators cannot be used.

• In an acidic medium, the characteristic smell of these indicators typically remains the same or does not disappear.

• In a basic medium, the characteristic smell of these indicators is usually destroyed or cannot be detected. Hence, statement 1 is correct.

• A liquid that changes color in solutions refers to visual indicators like Litmus, Phenolphthalein, or Methyl Orange, but not specifically to olfactory ones. Hence, statement 2 is incorrect.

• A gas that reacts only with strong acids or a solid that dissolves in both media does not define the functional property of an indicator meant for pH detection through smell. Hence, statements 3 and 4 are incorrect.

Additional Information

• Common Examples of Olfactory Indicators:

• Onion: When a cloth strip treated with onion juice is kept in a base like Sodium Hydroxide (NaOH), the pungent smell of the onion disappears. However, in an acid like Hydrochloric Acid (HCl), the smell persists.

• Vanilla Essence: The pleasant smell of vanilla vanishes when it is added to a basic solution. It retains its smell in acidic solutions.

• Clove Oil: The characteristic smell of clove oil also disappears in the presence of a base and remains detectable in the presence of an acid.

• Synthetic Indicators: Unlike olfactory indicators, synthetic indicators like Phenolphthalein are colorless in acidic solutions and turn pink in basic solutions. Methyl Orange turns red in acids and yellow in bases.

• Natural Indicators: Other natural indicators include Turmeric (which stays yellow in acid and turns reddish-brown in base) and Red Cabbage juice.

Important Points

• Utility for Visually Impaired: Olfactory indicators are highly significant for visually impaired students in science education. Since they cannot observe color changes in traditional indicators like litmus paper, they rely on the change in odor to identify the chemical nature of substances.

• Chemical Reaction: The change in smell occurs because the acid or base reacts with the organic compounds responsible for the scent in the indicator, effectively neutralizing or altering the molecules that the olfactory receptors detect.

• pH Scale Context: Indicators are used to determine if a substance has a pH less than 7 (Acidic) or a pH greater than 7 (Basic). Olfactory indicators provide a qualitative rather than quantitative measure of this property.

Q12. Answer: (d) Style

The correct answer is Style.

Key Points

• The female reproductive organ of a flower is known as the carpel or pistil, which consists of three distinct parts: the stigma, the style, and the ovary.

• The Style is the middle elongated part of the carpel that connects the stigma to the ovary. Hence, the correct answer is Style.

• One of its primary functions is to act as a physical barrier or a selective track for the growth of the pollen tube, ensuring that only compatible pollen reaches the ovules.

• The Style serves as a support structure that elevates the stigma to a height where it is more likely to capture pollen grains from pollinators like insects, birds, or the wind.

• During the process of fertilization, after a pollen grain germinates on the stigma, the pollen tube must travel through the internal tissues of the style to reach the female gametes located in the ovary.

Additional Information

• Stigma:

• The Stigma is the terminal or topmost part of the carpel.

• Its main feature is a sticky or feathery surface designed to receive and trap pollen grains during pollination.

• It plays a crucial role in pollen recognition, where the plant determines if the pollen is from the same species and is suitable for germination.

• Ovary:

• The Ovary is the basal swollen part of the pistil situated at the bottom of the style.

• It contains ovules, which house the egg cells; after fertilization, the ovules develop into seeds and the ovary matures into a fruit.

• In Angiosperms, the location of the ovary can be superior, inferior, or half-inferior depending on its position relative to other floral parts.

• Pollen Grain:

• A Pollen grain is not part of the female reproductive system; rather, it is the male gametophyte of seed plants.

• It is produced within the anther of the stamen (the male reproductive part).

• It contains generative cells that eventually produce male gametes required for sexual reproduction in plants.

• Pistil vs. Carpel:

• A carpel is the basic unit of the gynoecium. A pistil may consist of a single carpel (simple pistil) or several fused carpels

(compound pistil).

• The Gynoecium is the collective term for all the female parts of a flower.

Q13. Answer: (a) Chlorofluorocarbons (CFCs)

The correct answer is Chlorofluorocarbons (CFCs).

Key Points

• Chlorofluorocarbons (CFCs) are the primary chemicals responsible for the depletion of the ozone layer. These are non-toxic, non-flammable chemicals containing atoms of carbon, chlorine, and fluorine.

• When CFCs are released into the lower atmosphere, they are extremely stable and do not dissolve in rain. Over several years, they drift upward into the stratosphere.

• In the stratosphere, intense ultraviolet (UV) radiation from the sun breaks the chemical bonds in CFCs, releasing free chlorine atoms.

• A single chlorine atom can destroy over 100,000 ozone molecules before it is removed from the upper atmosphere. This catalytic cycle causes a significant thinning of the ozone layer. Hence, option 1 is the correct answer.

• The global recognition of this damage led to the Montreal Protocol in 1987, an international treaty designed to protect the ozone layer by phasing out the production of substances like CFCs and halons.

Additional Information

• The Ozone Layer:

• The ozone layer is a region of high ozone (O3) concentration in the stratosphere, located approximately 15 to 30 kilometers above the Earth's surface.

• It acts as a shield, absorbing about 97% to 99% of the Sun's medium-frequency ultraviolet light (UV-B), which otherwise would potentially damage exposed life forms on Earth.

• Other Ozone Depleting Substances (ODS):

• Apart from CFCs, other chemicals like halons (used in fire extinguishers), carbon tetrachloride, methyl chloroform, and hydrochlorofluorocarbons (HCFCs) also contribute to ozone depletion.

• The thickness of the ozone layer is measured in Dobson Units (DU). A typical ozone layer thickness is about 300 Dobson Units.

• Greenhouse Gases vs. ODS:

• Carbon dioxide (CO2) and Methane (CH4) are major greenhouse gases responsible for global warming and climate change. While they affect the atmospheric temperature profile, they are not the direct cause of the chemical destruction of the ozone layer like CFCs.

• Oxygen (O2) is essential for life and is the precursor for ozone formation in the stratosphere through the Chapman cycle, where UV rays split O2 into single atoms that then react with other O2 molecules to form O3.

• Consequences of Depletion:

• Thinning of the ozone layer leads to increased levels of UV-B radiation reaching the Earth's surface, which can cause skin cancer, cataracts, and weakened immune systems in humans.

• It also disrupts terrestrial and aquatic ecosystems, affecting phytoplankton productivity and damaging the early developmental stages of fish, shrimp, and crabs.

Important Points

• The Antarctic Ozone Hole was first discovered in the mid-1980s. It refers to the severe depletion of ozone that occurs over Antarctica during the Southern Hemisphere's spring (September to November).

• Polar Stratospheric Clouds (PSCs) play a critical role in ozone depletion over the poles by providing a surface for chemical reactions that convert benign chlorine compounds into reactive forms.

• World Ozone Day is celebrated every year on September 16 to commemorate the date of the signing of the Montreal Protocol.

Q14. Answer: (d) 100 J

The correct answer is 100 J.

Key Points

• Potential Energy is the energy possessed by an object due to its position relative to others, stresses within itself, electric charge, or other factors. Specifically, Gravitational Potential Energy is the energy an object possesses because of its position in a gravitational field.

• The formula for calculating the Gravitational Potential Energy (GPE) of an object is given by the product of its mass (m), the acceleration due to gravity (g), and the height (h) above a reference point. The mathematical expression is PE = m * g * h.

• In the given problem, the mass of the stone is provided as 500 g. To use the standard SI unit (Joules), we must first convert the mass into kilograms (kg). Since 1000 g = 1 kg, the mass m = 500 / 1000 = 0.5 kg.

• The height (h) to which the stone is raised is 20 m, and the acceleration due to gravity (g) is specified as 10 m/s2.

• By substituting these values into the formula: PE = 0.5 kg * 10 m/s2 * 20 m. The calculation results in 0.5 * 200 = 100. Therefore,

the gain in potential energy is 100 J. Hence, the correct answer is 100 J.

Additional Information

• Conservation of Mechanical Energy: In a closed system where only conservative forces (like gravity) are acting, the total mechanical energy (the sum of kinetic energy and potential energy) remains constant. When the stone is raised, work is done on it, which is stored as potential energy.

• Kinetic Energy (KE): This is the energy of an object due to its motion. It is defined by the formula KE = 1/2 * m * v2, where v is the velocity. If the stone were dropped from 20 m, its potential energy would convert back into kinetic energy as it falls.

• Work-Energy Theorem: This theorem states that the work done by the sum of all forces acting on a particle equals the change in the kinetic energy of the particle. In this context, the work done against gravity to lift the stone is exactly equal to the gain in potential energy.

• SI Unit of Energy: The standard unit for energy and work in the International System of Units is the Joule (J). One Joule is defined as the amount of work done when a force of one Newton displaces an object through a distance of one meter.

• Acceleration due to gravity: While the standard value of g on Earth's surface is approximately 9.81 m/s2, competitive exams often use 10 m/s2 to simplify calculations. g varies slightly depending on the latitude and altitude of the location.

Important Points

• Unit Consistency: Always ensure that mass is in kg and height is in meters before calculating energy in Joules. Forgetting to convert grams to kilograms is a common mistake that would lead to an incorrect answer of 100,000 J.

• Reference Level: Potential energy is relative. In this problem, the ground is considered the zero-energy reference level. The "gain" refers to the difference between the potential energy at 20 m and the potential energy at 0 m.

• Scalar Quantity: Energy is a scalar quantity, meaning it has magnitude but no direction, unlike force or velocity which are vectors.

• Factors Affecting GPE: The potential energy is directly proportional to mass, height, and gravity. If you double the mass or the height, the potential energy will also double.

Q15. Answer: (a) +40/3

The correct answer is +40/3.

Key Points

• To find the image distance in a lens system, we use the Lens Formula, which is given by: 1/f = 1/v - 1/u.

• In this problem, the object is placed at a distance of 40 cm from the lens. According to the Cartesian sign convention, the object distance (u) is always taken as negative. Therefore, u = -40 cm.

• The lens provided is a convex lens with a focal length (f) of 10 cm. For a convex lens, the focal length is always considered positive. Thus, f = +10 cm.

• Substituting these values into the lens formula:

• 1/10 = 1/v - 1/(-40)

• 1/10 = 1/v + 1/40

• Rearranging the equation to solve for 1/v:

• 1/v = 1/10 - 1/40

• Taking the LCM of 10 and 40, which is 40:

• 1/v = (4 - 1) / 40

• 1/v = 3 / 40

• Therefore, v = 40/3 cm. Since the value is positive, the image is formed on the opposite side of the lens. Hence, the correct answer is +40/3.

Additional Information

• Convex Lens: Also known as a converging lens, it is thicker at the center than at the edges. It converges parallel rays of light to a point called the principal focus. It is used in microscopes, telescopes, and for correcting hypermetropia (long-sightedness).

• Sign Convention for Lenses:

• The optical center is treated as the origin.

• Distances measured in the direction of incident light are positive, while those measured against it are negative.

• The object is always placed on the left side of the lens, making u negative.

• For a convex lens, f is positive; for a concave lens, f is negative.

• Nature of Image: In this specific case, since v is positive, the image is real and inverted. Because the absolute value of v (approx 13.33 cm) is less than the absolute value of u (40 cm), the image is diminished.

Important Points

• Magnification (m): It is the ratio of the height of the image to the height of the object, also expressed as m = v/u for lenses.

• In this problem, m = (40/3) / (-40) = -1/3.

• The negative sign indicates that the image is inverted, and the value 1/3 indicates that the image is one-third the size of the object.

• Power of Lens: The reciprocal of the focal length in meters is called Power (P). P = 1/f (in meters). The SI unit is Dioptre (D). For this lens, f = 0.1 m, so P = +10 D.

• Focal Length Comparison: If the object is placed beyond 2f (which is 20 cm in this case), the image always forms between f and 2f on the other side. Here, u = 40 cm (which is > 20 cm), and v = 13.33 cm (which is between 10 cm and 20 cm), confirming the laws of refraction.

Q16. Answer: (a) Combustion of petrol

The correct answer is Combustion of petrol.

Key Points

• A chemical change is a process where one or more substances are altered into one or more new and different substances. This involves a change in the chemical composition and the formation of new chemical bonds.

• Combustion of petrol: When petrol (a hydrocarbon) burns, it reacts with oxygen in the air to produce carbon dioxide and water vapor. Since entirely new substances are formed and the process is irreversible under normal conditions, it is a chemical change. Hence, option 1 is correct.

• Mixing salt and water: When salt is dissolved in water, it forms a solution. No new chemical substance is created, and the salt can be recovered through evaporation. This is a physical change. Hence, option 2 is incorrect.

• Evaporation of water: This is a phase transition where water changes from a liquid state to a gaseous state. The chemical formula (H_2O) remains the same throughout the process. Hence, option 3 is incorrect.

• Ice melting: This involves a change of state from solid to liquid. It is a reversible process, and the molecular structure of the water molecules does not change. Hence, option 4 is incorrect.

Additional Information

• Characteristics of Chemical Changes:

• They are usually irreversible, meaning the original substance cannot be easily recovered.

• New products are formed with different chemical properties.

• Significant energy changes occur, often involving the absorption or release of heat or light.

• Examples include rusting of iron, cooking an egg, ripening of fruits, and digestion of food.

• Characteristics of Physical Changes:

• These changes affect the physical properties such as shape, size, or state of matter (solid, liquid, gas).

• They are generally reversible in nature.

• No new substance is produced during the process.

• Examples include breaking glass, chopping wood, freezing water, and sublimation of camphor.

• Combustion Reactions:

• Combustion is an exothermic reaction, meaning it releases thermal energy.

• The Flash point is the lowest temperature at which a liquid (like petrol) produces enough vapor to ignite in the air.

• In an internal combustion engine, the chemical energy of petrol is converted into mechanical energy.

Important Points

• Conservation of Mass: In any chemical change, the total mass of the reactants is equal to the total mass of the products, as per the Law of Conservation of Mass.

• Indicators of Chemical Change: Look for signs such as evolution of gas, formation of a precipitate, change in color, or a significant change in temperature.

• Chemical Equations: Scientists represent chemical changes using chemical equations to show how atoms are rearranged. For example, the combustion of methane is represented as $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.

Q17. Answer: (d) Anode

The correct answer is Anode.

Key Points

• Electrolytic refining is a technique used by industries to purify impure metals obtained from their ores through chemical reduction processes.

• In this setup, a thick rod or block of the impure metal is made the Anode, which is the positive electrode. During electrolysis, the metal atoms from the impure anode lose electrons and enter the electrolyte as ions. Hence, the statement that impure metal is used as the Anode is correct.

• A thin strip or sheet of pure metal is made the Cathode, which is the negative electrode. The metal ions from the solution gain electrons at this electrode and get deposited as pure metal. Hence, the statement regarding the Cathode is incorrect in the context of the impure metal's placement.

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• The Electrolyte is a water-soluble salt of the same metal that is being refined (for example, Copper Sulphate for refining copper). It acts as the medium for ion transport. Hence, the statement regarding the Electrolyte is incorrect.

• A Salt is a chemical compound used to prepare the electrolyte solution but does not serve as the physical electrode where the impure metal is placed. Hence, the statement regarding Salt is incorrect.

• As the electric current passes through the electrolyte, the equivalent amount of pure metal from the electrolyte is deposited on the cathode, while the same amount of metal dissolves from the impure anode into the electrolyte.

Additional Information

• Metals Refined: This process is widely used for the purification of metals such as Copper (Cu), Zinc (Zn), Tin (Sn), Lead (Pb), Nickel (Ni), Silver (Ag), and Gold (Au).

• Anode Mud: The insoluble impurities present in the impure metal settle down at the bottom of the electrolytic tank, specifically below the anode. These are known as Anode Mud or Anode Sludge. These often contain precious metals like Antimony, Selenium, Tellurium, Silver, Gold, and Platinum, which can be recovered to offset the cost of the refining process.

• Soluble Impurities: Impurities that are more electropositive than the metal being refined go into the electrolyte solution and remain there, not depositing on the cathode.

• Purity Level: Electrolytic refining is highly efficient and can produce metals with a purity level of up to 99.99%, which is essential for electrical applications (like copper wiring) where high conductivity is required.

Important Points

• Chemical Reactions:

• At the Anode (Oxidation): The metal (M) loses 'n' electrons to become a cation: M → M^(n+) + ne^-.

• At the Cathode (Reduction): The metal cation (M^(n+)) from the solution gains 'n' electrons to become pure metal: M^(n+) + ne^- → M.

• Specific Example (Copper Refining): In the refining of Copper, the Anode is impure copper, the Cathode is a thin plate of pure copper, and the Electrolyte is an acidified solution of Copper(II) Sulphate (CuSO4).

• Energy Requirement: The process requires a continuous supply of Direct Current (DC). The voltage applied is usually low to ensure that only the desired metal ions are discharged at the cathode.

• Environmental Impact: While effective, the process requires significant electrical energy and generates chemical waste (spent electrolyte) that must be managed according to environmental regulations.

Q18. Answer: (a) zero

The correct answer is zero.

Key Points

• When a straight conductor carrying an electric current (I) is placed in a uniform magnetic field (B), it experiences a mechanical force. This force is mathematically expressed by the formula F = BIL sin(θ).

• In this formula, F represents the magnetic force in Newtons (N), B is the magnetic flux density in Tesla (T), I is the current in Amperes (A), L is the length of the conductor in meters (m), and θ is the angle between the direction of the current and the direction of the magnetic field lines.

• The question states that the conductor is placed parallel to the uniform magnetic field. In geometry and physics, parallel orientation implies that the angle (θ) between the two vectors is 0 degrees.

• According to trigonometric principles, the value of sin(0°) is exactly 0. Substituting this into the force equation gives F = BIL × 0, which results in a total force of zero. Hence, the statement that the force is zero is correct.

• Similarly, if the conductor were placed antiparallel (in the opposite direction) to the field, the angle would be 180 degrees. Since sin(180°) is also 0, the force would remain zero.

Additional Information

• Maximum Force Condition:

• The magnetic force on a current-carrying wire reaches its maximum value when the conductor is placed perpendicular (at an angle of 90 degrees) to the magnetic field.

• This is because sin(90°) = 1, making the force formula F = BIL. This configuration is widely used in the design of electric motors to maximize torque.

• Fleming's Left-Hand Rule:

• The direction of the magnetic force can be determined using Fleming's Left-Hand Rule. When the forefinger points in the direction of the Magnetic Field and the middle finger points in the direction of the Current, the thumb represents the direction of the Force (Motion).

• This rule only applies when the current and field are not parallel, as no force exists in the parallel state.

• Lorentz Force:

• The force on the conductor is a macroscopic manifestation of the Lorentz Force acting on individual moving charges (electrons) within the wire.

• The microscopic formula is F = q(v × B), where q is the charge and v is the drift velocity. If the velocity of the charges is parallel to the magnetic field, the cross product is zero.

• Magnetic Field (B):

• A uniform magnetic field is one where the magnetic field strength and direction are the same at all points in the region. It is often represented by equidistant parallel lines.

• The SI unit of magnetic field is the Tesla (T), named after Nikola Tesla in 1960. Another common unit is the Gauss (G), where 1 Tesla = 10,000 Gauss.

Important Points

• The force is vectorial in nature, meaning it has both magnitude and direction.

• If the current in the conductor is zero, the force will be zero regardless of the strength of the magnetic field.

• The length (L) refers to the portion of the conductor that is actually immersed within the magnetic field boundaries.

• In 1820, Hans Christian Orsted discovered that electric currents create magnetic fields, which eventually led to the understanding of how external fields exert forces on these currents.

Q19. Answer: (b) Squamous

The correct answer is Squamous.

Key Points

• The skin on the face, as with the rest of the body's exterior, is primarily composed of Stratified Squamous Epithelium. This tissue consists of multiple layers of flat, scale-like cells known as squamous cells. Hence, option 2 is correct.

• This specific type of epithelium is keratinized, meaning the outer layers are filled with a tough, protective protein called keratin. This makes the facial skin waterproof and resistant to friction and bacterial invasion.

• Ciliated epithelium contains hair-like projections called cilia that help in the movement of particles or fluids. This tissue is typically found in the respiratory tract (to move mucus) and fallopian tubes (to move the ovum). Hence, option 1 is incorrect.

• Columnar epithelium consists of tall, pillar-like cells. It is primarily involved in absorption and secretion and is found in the lining of the stomach and intestines. Hence, option 3 is incorrect.

• Cuboidal epithelium is made of cube-shaped cells and is commonly found in the ducts of glands and kidney tubules, where it performs functions related to secretion and absorption. Hence, option 4 is incorrect.

Additional Information

• Epithelial Tissue: This is one of the four basic types of animal tissues. It covers the external surfaces of the body, lines internal organs and cavities, and forms glands. Its primary functions include protection, secretion, absorption, and filtration.

• Simple vs. Stratified: Epithelium is classified based on the number of cell layers. Simple epithelium consists of a single layer of cells (ideal for diffusion and filtration), while stratified epithelium consists of two or more layers (ideal for protection against mechanical or chemical stress).

• Squamous Cells: These cells are extremely thin and flat with a centralized nucleus. In the skin, they are packed tightly to form a barrier. In the lungs (alveoli), they facilitate the exchange of gases due to their thinness.

• The Epidermis: The facial skin's outer layer is the epidermis, which lacks blood vessels (avascular) and relies on the underlying dermis for nutrients. It is constantly regenerating, with new cells forming at the basal layer and moving upward.

Important Points

• Skin Layers: The epidermis is divided into five distinct sub-layers: Stratum corneum, Stratum lucidum (only in thick skin), Stratum granulosum, Stratum spinosum, and Stratum basale.

• Keratinization: This is the process where cells in the skin accumulate keratin as they move toward the surface, eventually dying and forming a tough, protective dead layer.

• Melanocytes: Found in the stratified squamous epithelium of the skin, these cells produce melanin, the pigment responsible for skin color and UV protection.

• Cell Junctions: Epithelial cells are held together by specialized structures like desmosomes and tight junctions, which provide structural integrity and prevent leakages between cells.

Q20. Answer: (d) Turmeric and red cabbage juice

The correct answer is Turmeric and red cabbage juice.

Key Points

• An indicator is a special substance that changes its color when exposed to an acidic or basic medium, thereby helping to determine the chemical nature of a solution.

• Turmeric is a very common natural indicator. It contains a yellow pigment called curcumin. In acidic and neutral solutions, turmeric remains yellow, but it turns reddish-brown when it comes into contact with a base (such as soap solution). Hence, the option containing turmeric is correct.

• Red cabbage juice is another effective natural indicator derived from the leaves of red cabbage. It contains anthocyanin

molecules that change color depending on pH. It turns red or pink in acidic solutions, purple in neutral solutions, and green or yellow in basic solutions. Hence, the option containing red cabbage juice is correct.

• Substances like sand, alcohol, sugar, water, and table salt are not indicators because they do not change color in a predictable way to signify the presence of hydrogen ions (acids) or hydroxide ions (bases).

• Other natural indicators include China Rose (Gudhal), which turns dark pink (magenta) in acidic solutions and green in basic solutions.

Additional Information

• Natural Indicators:

• Litmus: Extracted from Lichens, it is the most commonly used indicator. It is purple in distilled water, turns red in acidic solutions, and blue in basic solutions.

• Onion and Vanilla: These are known as Olfactory Indicators. Their characteristic smell changes or disappears when mixed with acids or bases, which is particularly useful for visually impaired students.

• Synthetic Indicators:

• Phenolphthalein: This is a man-made indicator that remains colorless in acidic solutions but turns deep pink in basic solutions.

• Methyl Orange: Another synthetic indicator that shows a red color in acidic media and a yellow color in basic media.

• The pH Scale:

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

• The scale ranges from 0 to 14. A pH of 7 is considered neutral (e.g., pure water). A pH less than 7 indicates an acid, while a pH greater than 7 indicates a base.

• Universal Indicator: This is a mixture of several indicators that shows different colors at different concentrations of hydrogen ions in a solution, providing a more precise pH value than simple litmus paper.

Important Points

• Reaction of Acids and Bases: When an acid and a base react, they undergo a neutralization reaction to form salt and water. Indicators are often used in titrations to find the equivalence point of this reaction.

• Everyday Examples: The reddish-brown stain of turmeric on a white shirt turns yellow again when washed with plenty of water or treated with an acid like lemon juice, illustrating the reversible nature of the indicator's color change.

• Anthocyanins: These are the pigments found in Red Cabbage, Blueberries, and Raspberries that provide their vibrant colors and serve as pH-sensitive chemical sensors.

Q21. Answer: (c) Presence of ribosomes on RER, absence on SER

The correct answer is Presence of ribosomes on RER, absence on SER.

Key Points

• The Endoplasmic Reticulum (ER) is a large, dynamic structure that serves many roles in the cell including calcium storage, protein synthesis, and lipid metabolism. It consists of a network of membranous tubules and flattened sacs called cisternae.

• Rough Endoplasmic Reticulum (RER) is named for its rough, granular appearance under an electron microscope, which is due to the presence of ribosomes attached to its outer (cytoplasmic) surface. Hence, statement 3 is correct.

• Smooth Endoplasmic Reticulum (SER) lacks these attached ribosomes, which gives it a smooth, tubular appearance. It is primarily involved in the synthesis of lipids, such as phospholipids and cholesterol.

• The RER is the site where protein synthesis occurs for proteins that are either secreted from the cell, incorporated into the cell's plasma membrane, or sent to an organelle like the lysosome.

• While RER is dominated by cisternae (flattened sacs), SER is largely composed of a network of tubules that are interconnected.

Additional Information

• Functions of Rough ER:

• It plays a central role in protein folding and quality control. Proteins that are misfolded are retained in the RER and eventually degraded.

• It is involved in glycosylation, the process of adding carbohydrate chains to proteins to form glycoproteins.

• The RER is continuous with the nuclear envelope, facilitating the transport of molecules between the nucleus and the cytoplasm.

• Functions of Smooth ER:

• In liver cells, the SER contains enzymes that catalyze reactions to detoxify drugs, metabolic wastes, and harmful chemicals.

• It is responsible for the synthesis of steroid hormones, such as estrogen and testosterone, in the reproductive organs.

• In muscle cells, a specialized form of SER called the sarcoplasmic reticulum regulates calcium ion concentration, which is vital for muscle contraction.

Important Points

• Membrane Presence: Both RER and SER are part of the endomembrane system and are composed of phospholipid bilayers. Therefore, saying membranes are absent in RER is factually wrong. Hence, statement 2 is incorrect.

• Protein Presence: Both types of ER contain a variety of enzymatic proteins required for their specific metabolic activities. SER contains proteins for lipid synthesis, while RER contains proteins like translocons for ribosome docking. Hence, statement 1 is incorrect.

• Chlorophyll Location: Chlorophyll is a pigment found exclusively within the thylakoid membranes of chloroplasts in plant cells and algae; it is never found in the Endoplasmic Reticulum. Hence, statement 4 is incorrect.

• Lumen: The internal space of the ER is known as the ER lumen or cisternal space. It is distinct from the surrounding cytosol and provides a unique environment for chemical modifications.

Q22. Answer: (a) Gravity and Inertia of rest

The correct answer is Gravity and Inertia of rest.

Key Points

• When a tree is shaken, the branches are set into a state of motion by the external force applied by the person shaking it. However, the fruits attached to these branches tend to maintain their state of rest due to a property called Inertia of rest.

• As the branch moves rapidly back and forth, the fruit, resisting this change in motion, lags behind. This creates a significant mechanical strain or tension at the point of attachment (the stalk or pedicel). When this force exceeds the strength of the stalk, the fruit gets detached from the tree. Hence, the initial separation is due to Inertia of rest.

• Once the fruit is detached and becomes a free body, it is no longer supported by the tree's structure. At this moment, the Force of Gravity exerted by the Earth acts upon the fruit.

• This gravitational pull causes the fruit to accelerate toward the ground at a constant acceleration due to gravity, which is approximately 9.8 m/s^2 near the Earth's surface. Hence, the downward movement is due to Gravity.

• Therefore, the falling of fruits is a physical phenomenon that involves a combination of both Inertia (to break the connection) and Gravity (to bring it to the ground). Hence, the correct answer is Gravity and Inertia of rest.

Additional Information

• Newton’s First Law of Motion:

• Commonly known as the Law of Inertia, it was formulated by Sir Isaac Newton in his work Philosophiæ Naturalis Principia Mathematica published in 1687.

• The law states that an object will remain in its state of rest or uniform motion in a straight line unless compelled to change that state by an unbalanced external force.

• In this context, the shaking action is the external force that changes the state of the branch, but the fruit's inertia resists that change.

• Inertia and Mass:

• Inertia is an inherent property of all matter. The amount of inertia an object possesses is directly proportional to its Mass.

• A heavier fruit (like a Mango or Apple) has more inertia than a leaf, making it more likely to detach when the tree is shaken because it offers greater resistance to the sudden change in motion.

• Universal Law of Gravitation:

• Gravity is a non-contact force that attracts any two objects with mass. The force is governed by the Universal Law of Gravitation.

• For objects near the surface of the Earth, this force is what we perceive as Weight. It acts vertically downwards toward the center of the planet.

Important Points

• Types of Inertia:

• Inertia of Rest: The tendency of an object to stay at rest. Example: Dust particles falling off a Carpet when it is beaten with a Stick.

• Inertia of Motion: The tendency of an object to stay in motion. Example: An Athlete running some distance even after crossing the Finish Line.

• Inertia of Direction: The tendency of an object to maintain its direction. Example: Passengers in a Car leaning sideways when the vehicle takes a sharp Turn.

• Applications in Daily Life:

• The principle of Inertia of rest is also observed when a Tablecloth is pulled quickly from under dishes without disturbing them.

• The concept of Gravity is essential for understanding Planetary Orbits, Tides caused by the Moon, and the Atmospheric Pressure held around the Earth.

Q23. Answer: (c) Lactometer

The correct answer is Lactometer.

Key Points

• A Lactometer is a specialized instrument used to check the purity of milk by measuring its density or specific gravity relative to water.

• It operates on Archimedes' principle, which states that a solid suspended in a fluid is buoyed up by a force equal to the weight of the fluid displaced by the submerged part of the suspended solid.

• The instrument consists of a cylindrical bulb and a graduated stem. When placed in milk, it sinks to a certain level; the depth to which it sinks indicates the purity or the extent of water adulteration.

• Pure milk has a specific gravity range, typically between 1.026 and 1.032. If water is added to the milk, its density decreases, causing the lactometer to sink deeper, resulting in a lower reading on the scale.

• It is widely used in dairy industries and by quality control agencies to ensure that milk has not been diluted or tampered with before reaching the consumer.

Additional Information

• Thermometer:

• This instrument is used to measure temperature or temperature gradients.

• It was significantly developed by Daniel Gabriel Fahrenheit (who invented the mercury thermometer in 1714) and Anders Celsius.

• It finds extensive use in medical diagnostics, scientific research, and industrial processes to monitor heat levels.

• Barometer:

• A Barometer is a scientific instrument used to measure atmospheric pressure.

• It was invented by Evangelista Torricelli in the year 1643.

• The primary application of a barometer is in meteorology for weather forecasting and determining altitude in altimeters.

• Hydrometer:

• A Hydrometer is a general instrument used to measure the relative density (specific gravity) of various liquids.

• It is usually made of glass and consists of a cylindrical stem and a bulb weighted with mercury or lead shot to make it float upright.

• Applications include measuring the alcohol content in spirits, sugar content in beverages (saccharometer), and acid levels in lead-acid batteries.

Important Points

• Milk Density: The density of cow milk usually ranges from 1.028 to 1.030 g/ml, while buffalo milk is denser, ranging from 1.030 to 1.032 g/ml.

• Adulteration Detection: Apart from water, other substances like urea, detergents, and starch are sometimes added to milk, but a lactometer primarily detects volumetric dilution with water.

• Scientific Context: The Specific Gravity measured by these instruments is a dimensionless quantity, representing the ratio of the density of the substance to the density of a reference material (usually water at 4 degrees Celsius).

Q24. Answer: (c) Amoeba – Irregular in shape, helps in movement and capturing food

The correct answer is Amoeba – Irregular in shape, helps in movement and capturing food.

Key Points

• Amoeba is a single-celled organism that lacks a fixed shape, making it irregular. It utilizes temporary finger-like projections called pseudopodia (false feet) for locomotion and to capture food through a process called phagocytosis. Hence, statement 3 is correct.

• Red blood cells (RBCs) are generally round, spherical, or biconcave in shape. This specific biconcave structure increases the surface area for the diffusion of oxygen and allows them to flow easily through narrow capillaries. They do not transmit messages. Hence, statement 1 is incorrect.

• Nerve cells, also known as neurons, are long and branched. This structure is specialized for receiving and transferring messages (electrical impulses), thereby helping to control and coordinate the working of different parts of the body. They do not store food. Hence, statement 2 is incorrect.

• Muscle cells are typically spindle-shaped, meaning they are long and pointed at both ends. This shape is optimized for contraction and relaxation, which facilitates physical movement in living organisms. They are not flat disc-shaped oxygen carriers. Hence, statement 4 is incorrect.

• The shape of a cell is intricately linked to the specific function it performs. For instance, the elongated nature of some cells allows them to cover distances, while the flat or disc shape of others may help in protection or transport.

Additional Information

• Diversity in Cell Shape:

• Cells exhibit a wide variety of shapes, including polygonal, columnar, cuboid, thread-like, and even irregular.

• In humans, White Blood Cells (WBCs) like Leucocytes also have the ability to change their shape, which helps them move through blood vessel walls to reach sites of infection.

• In plants, guard cells of the stomata are kidney-shaped (or bean-shaped) to regulate the opening and closing of pores for gas exchange.

• Components Affecting Shape:

• Components of the cell are enclosed in a membrane. This membrane provides shape to the cells of plants and animals.

• In plant cells, an additional covering called the cell wall is present outside the cell membrane, which provides rigidity and a fixed shape to the cells.

• Specialized Functions:

• Sperm cells have a long tail (flagellum) that enables motility to reach the egg for fertilization.

• Skin cells are often flat and packed closely together to form a protective barrier for the body.

Important Points

• Cell Size Facts:

• The smallest cell is 0.1 to 0.5 micrometre in size, found in Bacteria (specifically Mycoplasma).

• The largest cell is the egg of an ostrich, measuring about 170 mm × 130 mm.

• The size of the cells has no relation to the size of the body of the animal or plant. For example, nerve cells in both an elephant and a rat are long and branched and perform the same function of transferring messages.

• Discovery of Cell:

• Cells were first discovered and named by Robert Hooke in 1665 while observing a thin slice of cork under a primitive microscope.

• He observed box-like compartments that reminded him of small rooms (cells) in a monastery.

Q25. Answer: (a) Particles scatter a beam of light

The correct answer is Particles scatter a beam of light.

Key Points

• A colloid is a heterogeneous mixture in which the size of particles is intermediate between those in a true solution and a suspension.

• The particles of a colloid are large enough to scatter a beam of light passing through it, which makes the path of the light visible. This phenomenon is known as the Tyndall Effect. Hence, statement 1 is correct.

• Colloidal particles are very small, typically ranging between 1 nanometer (nm) to 1000 nanometers. While they cannot be seen with the naked eye, they can be observed using a high-powered ultramicroscope. Hence, statement 2 is incorrect.

• Because of their small size, colloidal particles cannot be separated from the mixture by the process of filtration as they easily pass through filter paper. Hence, statement 3 is incorrect.

• Colloids are stable mixtures. The particles do not settle down when left undisturbed, unlike a suspension where gravity causes particles to precipitate. Hence, statement 4 is incorrect.

• Hence, the correct answer is Particles scatter a beam of light.

Additional Information

• Components of a Colloid:

• Dispersed Phase: The solute-like component or the particles dispersed in a colloid.

• Dispersion Medium: The solvent-like component in which the dispersed phase is suspended.

• Types of Colloids:

• Aerosol: Formed when a liquid or solid is dispersed in a gas. Examples include fog, clouds, and smoke.

• Emulsion: Formed when a liquid is dispersed in another liquid. Examples include milk and face cream.

• Sol: A solid dispersed in a liquid. Examples include mud and magnesium milk.

• Gel: A liquid dispersed in a solid. Examples include jelly, cheese, and butter.

• The Tyndall Effect:

• Named after the physicist John Tyndall, who studied it in the 19th century.

• It can be observed when sunlight passes through the canopy of a dense forest; here, mist contains tiny droplets of water, which act as particles of colloid dispersed in air.

Important Points

• Brownian Motion: Colloidal particles move in a continuous zig-zag motion. This movement was first observed by Robert Brown in 1827 and is responsible for the stability of colloidal sols by preventing particles from settling.

• Centrifugation: Since filtration does not work, a special technique called centrifugation is used to separate colloidal particles. This is widely used in diagnostic laboratories for blood and urine tests, and in dairies to separate butter from cream.

• Colligative Properties: Colloidal particles have a high average molar mass, meaning the number of particles in a colloidal solution is comparatively small. Consequently, their colligative properties (like osmotic pressure or boiling point elevation) are of a smaller order compared to true solutions.

• Electrophoresis: The existence of charge on colloidal particles is confirmed by this process. When an electric potential is applied,

the particles move toward the oppositely charged electrode.

Q26. Answer: (c) 7350

Shortcut Trick

Convert percentages and fractions into a single product: 0.4 × 0.2 × (4/7) × Number = 336.

Number = (336 × 100 × 100 × 7) ÷ (40 × 20 × 4)

Number = (336 × 7) ÷ (0.4 × 0.2 × 4) = 336 ÷ 0.0457... → 7350.

Therefore The correct answer is 7350.

Alternate Method

Given: 40% of 20% of 4/7 of a number = 336.

Formula Used: Percentage value = (Value/100) × Total.

Let the number be x.

=> (40/100) × (20/100) × (4/7) × x = 336

=> (2/5) × (1/5) × (4/7) × x = 336

=> (8/175) × x = 336

=> x = (336 × 175) ÷ 8

=> x = 42 × 175

=> x = 7350

Therefore The correct answer is 7350.

Additional Information

Percentage to Fraction Conversion

To simplify calculations, convert percentages to fractions: 40% = 2/5, 20% = 1/5, 25% = 1/4, etc.

Successive Percentages

When percentages are applied successively ('of' operator), they are always multiplied together.

Base Change

If a number is increased by x%, the new value is (100+x)/100 times the original value.

Q27. Answer: (c) 21

Shortcut Trick

Mode is defined as the observation that occurs the maximum number of times in a data set.

In the given series, the number 21 appears 3 times.

All other numbers appear fewer than 3 times (26, 22, 28 appear twice; others appear once).

Therefore The correct answer is 21.

Alternate Method

Given: Observations = 26, 26, 22, 21, 31, 24, 21, 28, 28, 30, 33, 22, 25, 23, 21

Step 1: Count the frequency (repetition) of each unique number.

=> Frequency of 21 = 3

=> Frequency of 22 = 2

=> Frequency of 26 = 2

=> Frequency of 28 = 2

=> Frequency of 23, 24, 25, 30, 31, 33 = 1 each

=> Maximum frequency = 3 (for the number 21)

Therefore The correct answer is 21.

Additional Information

Measure of Central Tendency: Mode

The value which appears most often in a set of data. A data set can be unimodal (one mode), bimodal (two modes), or multimodal.

Empirical Relationship

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

Median

The middle value of a data set when it is arranged in ascending or descending order. If n is odd, Median = ((n+1)/2)^(th) term.

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Q28. Answer: (b) 62.5%

Shortcut Trick

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

Required percentage = (50 / 80) × 100

Required percentage = 5 / 8 × 100 = 62.5%

Therefore The correct answer is 62.5%.

Alternate Method

Given:

Marks obtained by B = 50

Marks obtained by A = 80

Formula Used:

Percentage = (Value / Base Value) × 100

Calculations:

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

=> Required Percentage = (50 / 80) × 100

=> Required Percentage = 5/8 × 100

=> Required Percentage = 0.625 × 100

=> Required Percentage = 62.5%

Therefore The correct answer is 62.5%.

Additional Information

Percentage Change

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

Fraction to Percentage Conversion

Common fractions: 1/8 = 12.5%, 3/8 = 37.5%, 5/8 = 62.5%, and 7/8 = 87.5%.

Base Value Selection

In phrases like 'B is what % of A', the value following 'of' (which is A) always acts as the denominator.

Q29. Answer: (c) 47°

Shortcut Trick

In right-angled triangle BDC, the angle at C is the complement of angle DBC.

angle C = 90° − 80° = 10°

In triangle AEC, angle AEB is the exterior angle at vertex E.

Using the Exterior Angle Theorem: angle AEB = angle CAE + angle ACE

angle AEB = 37° + 10° = 47°

Therefore The correct answer is 47°.

Alternate Method

Given:

In triangle ABC, BD perpendicular to AC at D, angle DBC = 80°, and angle CAE = 37° where E is on BC.

Formula Used:

1. Sum of angles in a triangle = 180°

2. Exterior angle of a triangle = Sum of two opposite interior angles.

Calculations:

=> In triangle BDC, angle BDC = 90° (since BD perpendicular to AC).

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

=> angle BCD + 80° + 90° = 180°

=> angle BCD = 180° − 170° = 10°

=> Now, consider triangle AEC. Point B lies on the extension of segment CE.

=> angle AEB is the exterior angle of triangle AEC at vertex E.

=> angle AEB = angle CAE + angle ACE

=> angle AEB = 37° + 10°

=> angle AEB = 47°

Therefore The correct answer is 47°.

Additional Information

Exterior Angle Theorem

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

Angle Sum Property

The sum of the interior angles of any triangle is always 180°.

Linear Pair

Angles on a straight line add up to 180°. If E lies on BC, then angle AEB + angle AEC = 180°.

Q30. Answer: (a) 400 π cm²

Shortcut Trick

Direct formula for Surface Area of a sphere = $4 \times \pi \times r^2$

Here, r = 10 cm.

Surface Area = $4 \times \pi \times (10)^2 = 4 \times \pi \times 100 = 400\pi$

Therefore The correct answer is 400π cm².

Alternate Method

Given:

The radius (r) of the sphere = 10 cm.

Formula Used:

Surface Area (A) = $4\pi r^2$

Calculations:

=> Surface Area = $4 \times \pi \times (10)^2$

=> Surface Area = $4 \times \pi \times (10 \times 10)$

=> Surface Area = $4 \times \pi \times 100$

=> Surface Area = 400π cm²

Therefore The correct answer is 400π cm².

Additional Information

Volume of a Sphere

The total space occupied by a sphere is given by the formula: $V = (4/3)\pi r^3$.

Hemisphere Properties

For a hemisphere of radius r, the Curved Surface Area (CSA) is $2\pi r^2$ and the Total Surface Area (TSA) is $3\pi r^2$.

Ratio of Surface Area to Volume

The ratio of the surface area to the volume of a sphere is simplified as $(4\pi r^2) \div ((4/3)\pi r^3) = 3/r$.

Q31. Answer: (d) 60xy

Shortcut Trick

Apply the standard algebraic identity: $(a + b)^2 - (a - b)^2 = 4ab$.

Here, let a = 5x and b = 3y.

=> Result = $4 \times (5x) \times (3y)$

=> Result = 60xy

Therefore The correct answer is 60xy.

Alternate Method

Given Expression: $(5x + 3y)^2 - (5x - 3y)^2$

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

Treating (5x + 3y) as 'a' and (5x − 3y) as 'b':

=> $[(5x + 3y) + (5x - 3y)] \times [(5x + 3y) - (5x - 3y)]$

=> $(5x + 5x + 3y - 3y) \times (5x - 5x + 3y + 3y)$

=> $(10x) \times (6y)$

=> 60xy

Therefore The correct answer is 60xy.

Additional Information

Sum of Squared Binomials

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

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Square of a Binomial Expansion

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

Difference of Two Squares

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

Q32. Answer: (a) 5,760

Shortcut Trick

Babita's first round votes = 40% of 12,000 = 4,800.

Growth in second round = 20%.

Second round votes = 4,800 × 1.2 = 5,760.

Therefore The correct answer is 5,760.

Alternate Method

Given:

Total voters = 12,000

Babita's Round 1 percentage = 40%

Increase in Round 2 = 20% of Round 1 votes

Calculations:

=> Votes in Round 1 = (40 ÷ 100) × 12,000

=> Votes in Round 1 = 4,800

=> Increase in Round 2 = 20% of 4,800

=> Increase = (20 ÷ 100) × 4,800 = 960

=> Total votes in Round 2 = 4,800 + 960

=> Total votes in Round 2 = 5,760

Therefore The correct answer is 5,760.

Additional Information

Percentage Increase Formula

New Value = Original Value × (1 + Rate/100). For 20% increase, Multiply by 1.2.

Successive Percentage Change

If a value changes by x% then y%, effective change = [x + y + (xy/100)]%.

Base Change Property

Always identify the correct base for percentage calculation; here the 20% gain is based on the 40% initial share, not the total population.

Q33. Answer: (b) 360

Shortcut Trick

To find the least number of beads such that no bead is left over, we calculate the LCM (Least Common Multiple) of the given numbers.

Given numbers: 24, 36, and 40.

LCM(24, 36, 40) = 360.

Therefore The correct answer is 360 beads.

Alternate Method

Given: beads per necklace are 24, 36, or 40.

Formula Used: LCM by Prime Factorization Method.

=> Prime factors of 24 = 2 × 2 × 2 × 3 = $2^3 \times 3^1$

=> Prime factors of 36 = 2 × 2 × 3 × 3 = $2^2 \times 3^2$

=> Prime factors of 40 = 2 × 2 × 2 × 5 = $2^3 \times 5^1$

=> LCM = Highest power of each prime factor = $2^3 \times 3^2 \times 5^1$

=> LCM = 8 × 9 × 5 = 360

Therefore The correct answer is 360 beads.

Additional Information

Least Common Multiple (LCM)

The smallest positive integer that is divisible by each of the given numbers. Used for common timing or minimum quantity problems.

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Highest Common Factor (HCF)

The largest positive integer that divides each of the numbers without a remainder. Used for maximum size or distribution problems.

Product Rule

For two numbers a and b: LCM(a, b) × HCF(a, b) = a × b.

Q34. Answer: (d) 568

Shortcut Trick

List the first 19 prime numbers: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67.

Check the unit digit of the sum: (2+3+5+7+1+3+7+9+3+9+1+7+1+3+7+3+9+1+7) → Sum of unit digits = 78.

The unit digit of the sum must be 8.

From the options, only 568 ends with 8.

Therefore The correct answer is 568.

Alternate Method

Given: The first 19 prime numbers.

Formula Used: Sum of terms = S_n = a1 + a2 + ... + a_n

Calculation:

=> First 10 primes: 2 + 3 + 5 + 7 + 11 + 13 + 17 + 19 + 23 + 29 = 129

=> Next 9 primes: 31 + 37 + 41 + 43 + 47 + 53 + 59 + 61 + 67 = 439

=> Total Sum = 129 + 439

=> Total Sum = 568

Therefore The correct answer is 568.

Additional Information

Definition of Prime Numbers

A prime number is a natural number greater than 1 that has no positive divisors other than 1 and itself.

Even Prime Number

2 is the only even prime number; all other prime numbers are odd.

Smallest Prime Numbers

The smallest prime number is 2, and the smallest odd prime number is 3. 1 is neither prime nor composite.

Q35. Answer: (a) 12

Shortcut Trick

Convert decimals: 5.12 = 512/100, 0.5488 = 5488/10000

Write in primes: 512 = 2^9, 5488 = 2^4×7³, 50625 = 3^4×5^4

Denominator: 100 × 10000 = 2^6×5^6

Combine powers => 2^7 3^4 5^(-2) 7³

Therefore Answer = a + b + c + d = 12

Alternate Method

Given:

5.12 × 50625 × 0.5488 = 2^a 3^b 5^c 7^d

Formula used:

Convert decimals to fractions and use prime factorization with exponent rules

Calculation:

=> 5.12 = 512/100 = 2^9 / (2²×5²) = 2^7×5^(-2)

=> 50625 = 81 × 625 = 3^4×5^4

=> 0.5488 = 5488/10000 = (2^4×7³) / (2^4×5^4) = 7³×5^(-4)

=> Multiply all: 2^7 × 3^4 × 5^(-2) × 5^4 × 7³ × 5^(-4)

=> = 2^7 × 3^4 × 5^(-2+4-4) × 7³

=> = 2^7 × 3^4 × 5^(-2) × 7³

=> So a = 7, b = 4, c = -2, d = 3

=> a + b + c + d = 7 + 4 − 2 + 3 = 12

Therefore The correct answer is 12.

Additional Information

Decimal Conversion

Convert decimals into fractions to simplify multiplication and factorization.

Prime Factorization

Express numbers as products of primes like 2, 3, 5, 7 for exponent comparison.

Laws of Exponents

$a^m \times a^n = a^{(m+n)}$, and $a^{(-n)} = 1/a^n$

Handling Negative Powers

Negative exponent indicates the factor is in denominator.

Q36. Answer: (a) -1

Shortcut Trick

Put $\theta = 60°$ to verify the expression quickly.

$\sec 60° = 2$, $\cos 60° = 1/2$, $\tan 60° = \sqrt{3}$

Expression = $(1 - 1/(1/2)) \times (1 + 2)/(\sqrt{3})^2$

=> $(1 - 2) \times (3 / 3) = -1 \times 1 = -1$

Therefore The correct answer is -1.

Alternate Method

Given: $(1 - 1/\cos\theta) \times (1 + \sec\theta) / \tan^2\theta$

Formula Used: $\sec\theta = 1/\cos\theta$ and $\tan^2\theta = \sec^2\theta - 1$

=> $(1 - \sec\theta) \times (1 + \sec\theta) / \tan^2\theta$

=> $(1 - \sec^2\theta) / \tan^2\theta$

=> Since $\sec^2\theta - \tan^2\theta = 1$, then $1 - \sec^2\theta = -\tan^2\theta$

=> $-\tan^2\theta / \tan^2\theta$

=> -1

Therefore The correct answer is -1.

Additional Information

Trigonometric Identities

Fundamental identity: $\sin^2\theta + \cos^2\theta = 1$. Also, $1 + \tan^2\theta = \sec^2\theta$ and $1 + \cot^2\theta = \operatorname{cosec}^2\theta$.

Reciprocal Relations

$\sec\theta = 1/\cos\theta$, $\operatorname{cosec}\theta = 1/\sin\theta$, and $\cot\theta = 1/\tan\theta$.

Algebraic Identity Application

The difference of squares $(a - b)(a + b) = a^2 - b^2$ is frequently used to simplify trigonometric products.

Q37. Answer: (a) 16

Shortcut Trick

For four numbers a, b, c, d in proportion, the product of means equals the product of extremes: $a \times d = b \times c$.

Here, $P \times 11 = 22 \times 8$.

Divide by 11: $P = 2 \times 8 = 16$.

Therefore The correct answer is 16.

Alternate Method

Given: First proportional = P, Second = 22, Third = 8, Fourth = 11.

Formula Used: If a, b, c, d are in proportion, then $a/b = c/d$.

=> $P / 22 = 8 / 11$

=> $P = (8 \times 22) / 11$

=> $P = 8 \times 2$

=> $P = 16$

Therefore The correct answer is 16.

Additional Information

Fourth Proportional

For three numbers a, b, and c, the fourth proportional d is calculated as $d = (b \times c) \div a$.

Third Proportional

For two numbers a and b, the third proportional c is given by the relation a:b :: b:c, hence c = b² ÷ a.

Mean Proportional

The mean proportional between two numbers a and b is √(a × b).

Q38. Answer: (d) 39,424 cm2

Shortcut Trick

Radius increase = 37.5% = 3/8

Radius Ratio = 8 : 11 => Surface Area Ratio = 8² : 11² = 64 : 121

Increase in Area = 121 − 64 = 57 units

57 units = 35112 cm² => 1 unit = 35112 ÷ 57 = 616 cm²

Original Surface Area = 64 units × 616 = 39424 cm²

Therefore The correct answer is 39,424 cm².

Alternate Method

Given: Increase in radius = 37.5%, Increase in surface area = 35,112 cm².

Formula Used: Surface Area of Sphere (A) = 4πr²

Calculations:

=> Let original radius (r) = 8x

=> New radius (R) = 8x + 37.5% of 8x = 8x + 3x = 11x

=> Original Area (A1) = 4π(8x)² = 4π × 64x²

=> New Area (A2) = 4π(11x)² = 4π × 121x²

=> Increase in Area = A2 − A1 = 4πx² × (121 − 64) = 4πx² × 57

=> 35112 = 57 × [4πx²]

=> 35112 = 57 × A1 ÷ 64

=> A1 = (35112 × 64) ÷ 57

=> A1 = 616 × 64

=> A1 = 39424 cm²

Therefore The correct answer is 39,424 cm².

Additional Information

Volume of a Sphere

The amount of space inside a sphere is calculated as V = (4/3)πr³.

Successive Percentage for Area

If the radius increases by x%, the area increases by [2x + x²/100]%. Here, 2(37.5) + (37.5)²/100 = 75 + 14.0625 = 89.0625%.

Hemisphere Properties

Curved Surface Area (CSA) = 2πr² and Total Surface Area (TSA) = 3πr².

Q39. Answer: (c) 14.29%

Shortcut Trick

Effective Cost Price (CP) = Purchase Price + Repair Costs.

CP = 850 + 200 = 1050.

Selling Price (SP) = 1200.

Profit % = (SP − CP) ÷ CP × 100.

Profit % = (150 ÷ 1050) × 100 = 1 ÷ 7 × 100 ≈ 14.29%.

Therefore The correct answer is 14.29%.

Alternate Method

Given: Purchase Price = Rs. 850, Repair Cost = Rs. 200, SP = Rs. 1,200.

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

=> Total Cost Price (CP) = 850 + 200 = Rs. 1,050.

=> Selling Price (SP) = Rs. 1,200.

=> Profit = SP − CP = 1200 − 1050 = Rs. 150.

=> Profit Percentage = (150 ÷ 1050) × 100.

=> Profit Percentage = (1 ÷ 7) × 100 = 14.2857...% ≈ 14.29%.

Therefore The correct answer is 14.29%.

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Additional Information

Overhead Expenses

Any extra money spent on repairs, transport, or labor after buying an article is always added to the purchase price to calculate the Effective Cost Price.

Percentage Conversion

The fraction 1/7 is approximately equal to 14.28%. In competitive exams, remembering these reciprocal values helps in faster calculation.

Q40. Answer: (b) 40, 20

Shortcut Trick

The age difference between two people always remains constant throughout their lives.

Given: Difference after 24 years = 20 years → Present difference = 20 years.

Let Son's age = 1 unit, then Mother's age = 2 units.

Difference (2 − 1) = 1 unit → 1 unit = 20 years.

Present ages: Mother = 2 × 20 = 40 years, Son = 1 × 20 = 20 years.

Therefore The correct answer is 40, 20 years.

Alternate Method

Given:

Present Age Ratio (Mother : Son) = 2 : 1

Age difference after 24 years = 20 years

=> Let the present age of the Son be x years.

=> Then, the present age of the Mother = 2x years.

=> After 24 years, Mother's age = 2x + 24 and Son's age = x + 24.

=> According to the question: (2x + 24) − (x + 24) = 20

=> 2x + 24 − x − 24 = 20

=> x = 20

=> Mother's present age = 2 × 20 = 40 years.

=> Son's present age = 20 years.

Therefore The correct answer is 40, 20 years.

Additional Information

Constant Age Difference

The numerical difference between the ages of two persons never changes over time, regardless of how many years pass.

Ratio Balancing

If the age ratio changes over time, ensure the difference between ratio parts remains consistent with the actual age difference.

Q41. Answer: (d) 35 minutes

Shortcut Trick

Speed ratio (New : Usual) = 5 : 8

Since distance is constant, Time ratio (New : Usual) = 8 : 5

Difference in time ratio parts = 8 − 5 = 3 units

Given, 3 units = 21 minutes => 1 unit = 7 minutes

Usual time = 5 units = 5 × 7 = 35 minutes

Therefore The correct answer is 35 min.

Alternate Method

Given: New speed = 5/8 of Usual speed, Time delay = 21 minutes.

Formula Used: Distance = Speed × Time; If distance is constant, Speed prop. to 1/Time.

=> Let usual speed be S and usual time be T.

=> New speed = 5S/8

=> New time = 8T/5

=> Time difference = New time − Usual time = 21 min

=> 8T/5 − T = 21

=> 3T/5 = 21

=> T = (21 × 5) ÷ 3

=> T = 7 × 5 = 35 minutes

Therefore The correct answer is 35 min.

Additional Information

Inverse Proportion Rule

When distance is constant, the ratio of speeds is inversely proportional to the ratio of time: S1/S2 = T2/T1.

Usual Time Formula

If a person walks at a/b of usual speed and is 't' minutes late/early, Usual Time = [a / (b − a)] × t.

Average Speed

For constant distance with two speeds x and y, Average Speed = 2xy ÷ (x + y).

Q42. Answer: (a) Rs. 3,000

Shortcut Trick

Given Selling Price (SP) = Rs. 3,600 and Profit% = 20%.

Using the multiplier method: SP = CP × (100 + P%) ÷ 100.

3,600 = CP × 120 ÷ 100 => 3,600 = CP × 1.2.

CP = 3,600 ÷ 1.2 = 3,000.

Therefore The correct answer is Rs. 3,000.

Alternate Method

Given: Marked Price (MP) = Rs. 4,000, Selling Price (SP) = Rs. 3,600, Profit% = 20%.

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

=> In this problem, the Marked Price and Discount are extra information because SP is already given.

=> Let Cost Price (CP) be x.

=> SP = CP + Profit => 3,600 = x + (20 ÷ 100) × x.

=> 3,600 = x + 0.2x => 3,600 = 1.2x.

=> x = 3,600 ÷ 1.2 = 3,000.

Therefore The correct answer is Rs. 3,000.

Additional Information

Marked Price and Discount

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

Relation between CP and MP

The ratio of CP to MP can be expressed as: CP ÷ MP = (100 − D%) ÷ (100 + P%).

Q43. Answer: (a) 600

Shortcut Trick

Since the percentage score remains the same, the ratio of marks obtained to maximum marks is constant.

300 ÷ x = 200 ÷ 400

300 ÷ x = 1 ÷ 2

=> x = 300 × 2 = 600

Therefore The correct answer is 600 marks.

Alternate Method

Given:

Marks secured in first test = 300

Maximum marks of first test = x

Marks secured in second test = 200

Maximum marks of second test = 400

Formula Used: Percentage = (Marks Obtained ÷ Maximum Marks) × 100

Calculations:

=> Percentage in second test = (200 ÷ 400) × 100

=> Percentage = 50%

=> According to the question, percentage in first test is also 50%.

=> 50% of x = 300

=> (50 ÷ 100) × x = 300

=> 0.5x = 300
=> x = 300 ÷ 0.5
=> x = 600
Therefore The correct answer is 600 marks.
Additional Information
Percentage Comparison
When percentages are equal, the ratios of the parts to the whole are equal: a/b = c/d.
Percentage Change
Percentage change = [(New Value − Old Value) ÷ Old Value] × 100.
Conversion
To convert a fraction to a percentage, multiply by 100. To convert a percentage to a fraction, divide by 100.

Q44. Answer: (b) 27

Shortcut Trick
Apply the Chain Rule formula: (M1 × D1) ÷ W1 = (M2 × D2) ÷ W2
Given: M1 = 21, D1 = 32, W1 = 1/4. Remaining work W2 = 3/4. Remaining time D2 = 74 − 32 = 42 days.
(21 × 32) ÷ (1/4) = (M2 × 42) ÷ (3/4) => 21 × 32 = (M2 × 42) ÷ 3
M2 = (21 × 32 × 3) ÷ 42 = 48 men.
Additional men = 48 − 21 = 27 men.
Therefore The correct answer is 27 men.
Alternate Method
Given: Total days = 74 days, Initial men (M1) = 21, Days worked (D1) = 32 days, Work done (W1) = 1/4.
Formula Used: (M1 × D1) ÷ W1 = (M2 × D2) ÷ W2

Person	Days	Work Done	Total Men (M)
Initial Group	32	1/4	21
New Group	42	3/4	21 + x

Calculations:
=> Remaining Work (W2) = 1 − 1/4 = 3/4
=> Remaining Days (D2) = 74 − 32 = 42 days
=> (21 × 32) ÷ (1/4) = ((21 + x) × 42) ÷ (3/4)
=> 21 × 32 × 4 = (21 + x) × 42 × (4/3)
=> 21 × 32 = (21 + x) × 14
=> (21 × 32) ÷ 14 = 21 + x
=> 3 × 16 = 21 + x
=> 48 = 21 + x
=> x = 48 − 21 = 27
Therefore The correct answer is 27 men.
Additional Information
Work Equivalence Formula
The general formula for Man-Days is (M1×D1×H1)/W1 = (M2×D2×H2)/W2, where M is men, D is days, H is hours, and W is work.
Efficiency and Time
Efficiency is inversely proportional to the time taken to complete a constant amount of work. (E1 × T1 = E2 × T2).

Q45. Answer: (b) 29.06%

Shortcut Trick
Identify the Marked Price (MP) as 8,810 and Selling Price (SP) as 6,250.
The Discount Amount is the difference: 8,810 − 6,250 = 2,560.
Apply the multiplier logic: Discount% = (Discount ÷ MP) × 100.
Calculation: (2,560 ÷ 8,810) × 100 ≈ 29.0578%.
Rounding to two decimal places, we get 29.06%.
Therefore The correct answer is 29.06%.

Alternate Method

Given: Marked Price (MP) = 8,810, Selling Price (SP) = 6,250.

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

=> Discount = 8,810 − 6,250 = 2,560.

=> Discount Percentage = (2,560 ÷ 8,810) × 100.

=> Discount Percentage = 256,000 ÷ 8,810 ≈ 29.06%.

Therefore The correct answer is 29.06%.

Additional Information

Marked Price & Discount

Marked Price is the price printed on the label. Discount is always calculated on the Marked Price unless stated otherwise.

Selling Price Calculation

Selling Price = Marked Price × (100 − Discount%) ÷ 100. This is the final amount paid by the customer.

Q46. Answer: (c) Rs. 1,317

Shortcut Trick

Total deduction = Rs. (72 + 21 + 24) = Rs. 117.

Remaining amount to be divided = Rs. 5,177 − Rs. 117 = Rs. 5,060.

Ratio after deduction = 3 : 13 : 7 (Sum of parts = 23).

Value of 1 unit = 5,060 ÷ 23 = Rs. 220.

Difference between B and C after deduction = (13 − 7) units = 6 units.

Original difference = (Difference after deduction) + (Difference of deductions) = (6 × 220) + (21 − 24) = 1,320 − 3 = Rs. 1,317.

Therefore The correct answer is Rs. 1,317.

Alternate Method

Given: Total sum = Rs. 5,177. Deductions for A, B, C are Rs. 72, Rs. 21, Rs. 24.

=> Sum of remaining shares = 5,177 − (72 + 21 + 24)

=> Sum of remaining shares = 5,177 − 117 = Rs. 5,060

=> Let the remaining shares be 3x, 13x, and 7x.

=> 3x + 13x + 7x = 5,060

=> 23x = 5,060

=> x = 5,060 ÷ 23 = 220

=> Share of B after deduction = 13 × 220 = Rs. 2,860

=> Share of C after deduction = 7 × 220 = Rs. 1,540

=> Original share of B = 2,860 + 21 = Rs. 2,881

=> Original share of C = 1,540 + 24 = Rs. 1,564

=> Required Difference = 2,881 − 1,564 = Rs. 1,317

Therefore The correct answer is Rs. 1,317.

Additional Information

Ratio Division with Constraints

When fixed amounts are added or subtracted from shares, always perform the operation on the total sum first before applying the ratio division.

Compound Ratio

The compound ratio of (a : b) and (c : d) is calculated as (a × c) : (b × d).

Q47. Answer: (c) 3

Shortcut Trick

Total work (LCM of 2, 15, 10) = 30 units.

Combined efficiency of A + B + C = 15 + 2 + 3 = 20 units/day.

Twice the work = 30 × 2 = 60 units.

Time required = 60 ÷ 20 = 3 days.

Therefore The correct answer is 3 days.

Alternate Method

Given: Time taken by A = 2 days, B = 15 days, C = 10 days.

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Formula Used: Total Work = LCM of individual days; Efficiency = Total Work ÷ Time; Time = Work ÷ Efficiency.

Person	Days	Total Work	Efficiency
A	2	30 units	15
B	15	2	
C	10	3	

=> Total Efficiency of (A + B + C) = 15 + 2 + 3 = 20 units/day

=> New Work to be completed = 2 × 30 = 60 units

=> Time taken together = 60 ÷ 20 = 3 days

Therefore The correct answer is 3 days.

Additional Information

Combined Efficiency Rule

When multiple people work together, their individual efficiencies are added to find the total rate of work per day.

Work & Time Relationship

Time is inversely proportional to efficiency. If the work is doubled, the time required at the same efficiency also doubles.

Q48. Answer: (d) 14

Shortcut Trick

The average of the first n even natural numbers is always given by the direct formula: (n + 1).

Given n = 13 (the first 13 even numbers).

Average = 13 + 1 = 14.

Therefore The correct answer is 14.

Alternate Method

Given: Total even numbers (n) = 13.

Formula Used: Average of an Arithmetic Progression (AP) = (First term + Last term) ÷ 2.

=> First even natural number (a1) = 2

=> 13^(th) even natural number (a13) = 2 × 13 = 26

=> Average = (2 + 26) ÷ 2

=> Average = 28 ÷ 2 = 14

Therefore The correct answer is 14.

Additional Information

Sum of First n Even Numbers

The sum of the first n even natural numbers is calculated using the formula: S_n = n(n + 1).

Average of First n Odd Numbers

The average of the first n odd natural numbers is always equal to n.

Average of First n Natural Numbers

The average of the first n natural numbers (1, 2, 3, ..., n) is given by (n + 1) ÷ 2.

Q49. Answer: (b) 40

Shortcut Trick

Identify 2024 as a leap year, meaning it has 366 days.

Calculate total days: February (9) + March (31) + April (21) = 61 days.

Time period in years = 61 ÷ 366 = 1/6 year.

Simple Interest (SI) = 4000 × 6% × 1/6 = Rs. 40.

Therefore The correct answer is Rs. 40.

Alternate Method

Given:

Principal (P) = Rs. 4,000

Rate (R) = 6% per annum

Duration: 20 February 2024 to 21 April 2024

Formula Used:

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

Calculations:
=> Year 2024 is a leap year (divisible by 4), so February has 29 days.
=> Days in February = 29 − 20 = 9 days
=> Days in March = 31 days
=> Days in April = 21 days
=> Total Days (T) = 9 + 31 + 21 = 61 days
=> T (in years) = 61 ÷ 366 = 1/6 year
=> SI = (4000 × 6 × 1/6) ÷ 100
=> SI = (4000 × 1) ÷ 100 = 40
Therefore The correct answer is Rs. 40.
Additional Information
Simple Interest Formula
Simple interest is calculated only on the principal amount: SI = (P × R × T) ÷ 100.
Leap Year Calculation
A year is a leap year if it is divisible by 4 (e.g., 2024, 2028). For such years, T is divided by 366 instead of 365.
Day Counting Rule
Standard practice excludes the day of deposit and includes the day of withdrawal to calculate the interest period.

Q50. Answer: (c) 40 km/h

Shortcut Trick
When the distance is constant for two speeds x and y, Average Speed = (2 × x × y) ÷ (x + y).
Average Speed = (2 × 45 × 36) ÷ (45 + 36)
Average Speed = (2 × 45 × 36) ÷ 81 = 3240 ÷ 81 = 40 km/h.
Therefore The correct answer is 40 km/h.
Alternate Method
Given:
Speed to school (v1) = 45 km/h
Speed back (v2) = 36 km/h
Formula Used:
Average Speed = Total Distance ÷ Total Time
Calculations:
=> Let the distance between home and school be LCM(45, 36) = 180 km.
=> Time taken going to school (t1) = 180 ÷ 45 = 4 hours.
=> Time taken coming back (t2) = 180 ÷ 36 = 5 hours.
=> Total distance = 180 + 180 = 360 km.
=> Total time = 4 + 5 = 9 hours.
=> Average speed = 360 ÷ 9 = 40 km/h.
Therefore The correct answer is 40 km/h.
Additional Information
Average Speed Formula
For two equal distances with speeds a and b, the average speed is the harmonic mean: 2ab/(a+b).
Relative Speed
In the same direction, subtract speeds (v1 − v2); in opposite directions, add speeds (v1 + v2).
Speed Conversion
To convert km/h to m/s, multiply by 5/18. To convert m/s to km/h, multiply by 18/5.

Q51. Answer: (a) 19

Given Equation:
94 − 115 × 5 + 14 ÷ 7 = ?
Interchange the operators:

Original	New Operator

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•	–
–	•
×	÷
÷	×

Replace the operators:

= 94 + 115 ÷ 5 − 14 × 7

= 94 + 23 − 14 × 7

= 94 + 23 − 98

= 117 - 98

= 19

Therefore, the value of the expression is 19.

Hence, the correct answer is "Option 1".

Q52. Answer: (c) DA−DD

Logic followed here is:

The second letter-cluster is formed by increasing the positional value of each letter in the first letter-cluster by 1 (+1).

1) NK − OL

2) XU − YV

3) DA − DD

4) AX − BY

All pairs except 'DA − DD' follow the (+1, +1) increment pattern.

Therefore, the letter-cluster pair that does not belong to the group is DA − DD.

Hence, the correct answer is "Option 3".

Q53. Answer: (b) 80

Logic followed here is: The series follows an addition pattern where each term increases by consecutive odd numbers starting from 7.

Therefore, the value that should come in place of the question mark is 80.

Hence, the correct answer is "Option 2".

Q54. Answer: (d) SDR

Logic followed here is: The series progresses by applying a specific numerical change to the positional values of the letters in each term to find the next term.

Pattern for each position:

• Therefore, the term that comes in place of the question mark is SDR.

Hence, the correct answer is "Option 4".

Q55. Answer: (b) 32

Given:

Kinjal ranked 21^(st) from the top.

Kinjal ranked 12^(th) from the bottom.

Formula:

Total students = Rank from top + Rank from bottom − 1

Calculation:

= 21 + 12 − 1

= 33 − 1

= 32

Therefore, the total number of students in the class is 32.

Hence, the correct answer is "Option 2".

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Q56. Answer: (a) Father

Given Coding:

A is | Symbol | + | - | × | ÷ | | --- | --- | --- | --- | --- | | Meaning | father | son | mother | brother | to B	Symbol	•	•	×	÷	Meaning	father	son	mother	brother
Symbol	•	•	×	÷						
Meaning	father	son	mother	brother						

Given Expression:

X + Y − Z × W ÷ T: X is the father of Y. Y is the son of Z. Z is the mother of W. W is the brother of T.

Forming the Family Tree:

Therefore, X is related to T as Father.

Hence, the correct answer is "Option 1".

Q57. Answer: (c) MAT 162

Logic followed here is: The series consists of three letters and a number in each term. Each element follows a specific pattern as shown below:

Therefore, the term that will replace the question mark is MAT 162.

Hence, the correct answer is "Option 3".

Q58. Answer: (a) One

Given:

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

F sits to the immediate left of A.

C sits third to the left of D.

C is an immediate neighbour of A.

B sits to the immediate left of E.

Between E and C, only one person sits:

Therefore, 1 person sits between E and C.

Hence, the correct answer is "Option 1".

Q59. Answer: (a) Only Conclusion I follows

Statements:

Some sandals are crocs.

All crocs are flipflops.

Venn Diagram Logic:

Conclusions:

(I) Some sandals are flipflops: Follows (Because some sandals are crocs and all crocs are flipflops.Therefore, some sandals are definitely flipflops.)

(II) All flipflops are crocs: Does not follows (The statement says “All crocs are flipflops”, but it does not mean all flipflops are crocs.)

Therefore, only Conclusion I follows.

Hence, the correct answer is "Option 1".

Q60. Answer: (b) 243

Given Mapping:

Letter	Operation

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P	×
Q	÷
R	−
S	•

Given Equation:

17 P 4 R 65 Q 5 S (34 Q 2) P 10 S 6 P 3 = ?

Replace the letters with symbols:

= 17 × 4 − 65 ÷ 5 + (34 ÷ 2) × 10 + 6 × 3

= 68 − 13 + (17 × 10) + 18

= 68 − 13 + 170 + 18

= 256 - 13

= 243

Hence, the correct answer is "Option 2".

Q61. Answer: (d) Three

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

Logic followed here is: We need to find even numbers that are immediately preceded by an even number and immediately followed by an odd number.

Pattern: Even Number → Even Number → Odd Number

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

The required even numbers are:

• 8 in (2 8 1)

• 4 in (2 4 7)

• 2 in (8 2 7)

Therefore, there are 3 such even numbers.

Hence, the correct answer is "Option 4

Q62. Answer: (a) 4

Given:

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

Logic followed here is: We need to find odd numbers that are immediately preceded by an odd number and immediately followed by an even number.

Pattern: Odd Number → Odd Number → Even Number

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

The required odd numbers are:

• 5 in (5 5 2)

• 3 in (3 3 6)

• 1 in (9 1 2)

• 1 in (9 1 8)

Therefore, there are 4 such odd numbers.

Hence, the correct answer is "Option 1".

Q63. Answer: (d) (15, 31, 58)

Logic followed here is: (Sum of first and second numbers) + 12 = Third number.

For (14, 30, 56) →

Sum of first two numbers = 14 + 30 = 44

Third number = 44 + 12 = 56

For (20, 36, 68) →

Sum of first two numbers = 20 + 36 = 56

Third number = 56 + 12 = 68

Similarly, let's find the related set for option (4):

Sum of first two numbers = 15 + 31 = 46

Third number = 46 + 12 = 58

Therefore, the set (15, 31, 58) follows the same relationship.

Hence, the correct answer is "Option 4".

Q64. Answer: (b) 4 km towards south

Given:

Samyuktha starts from Point H and drives 8 km towards the east.

She then takes a right turn and drives 7 km.

Again, she takes a right turn and drives 10 km.

She then takes another right turn and drives 11 km.

Finally, she takes a right turn and drives 2 km and stops at Point P.

Final Position P = 4 km North of Point H

To reach Point H again, Samyuktha must move 4 km towards the south.

Hence, the correct answer is "Option 2".

Q65. Answer: (b) 4

Given Series:

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

Step 1:

Drop all odd numbers from the series.

Remaining even numbers:

4 2 4 8 6 4 6 4 8 6 2 4 2

Step 2:

Count from the left:

Position	Number
1	4
2	2
3	4
4	8
5	6
6	4

The 6^(th) number from the left is 4.

Hence, the correct answer is "Option 2".

Q66. Answer: (d) Only conclusion (II) follows

Statements:

All hearts are spades.

All aces are spades.

No spades are pens.

Venn Diagram Logic:

Conclusions:

(I) All aces are hearts: Does not follows (Both Aces and Hearts are inside Spades, but there is no direct relation given between Aces and Hearts.)

(II) No hearts are pens: Follows (All Hearts are Spades and no Spades are Pens.Therefore, no Hearts can be Pens.)

Therefore, only conclusion (II) follows.

Hence, the correct answer is "Only conclusion (II) follows".

Q67. Answer: (a) HE

Given Information:

1. H is sitting to the immediate right of F and to the immediate left of D.

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2. E is sitting to the right of F and three people are sitting between them.
3. G is sitting to the immediate left of E.
4. I is sitting to the immediate right of E.

Check the Options:

Option	Relation	Observation
HE	2 and 5	Not adjacent
EI	5 and 6	Adjacent
FH	1 and 2	Adjacent
DG	3 and 4	Adjacent

Three pairs are adjacent pairs, but HE is not adjacent.

Hence, the correct answer is "Option 1 – HE".

Q68. Answer: (d) 442

Logic followed here is: The series follows a pattern where each subsequent number is obtained by adding consecutive even numbers (2, 4, 6, 8, ...) to the preceding number.

Therefore, the number that should come in place of the question mark is 442.

Hence, the correct answer is "Option 4".

Q69. Answer: (c) JLPM

Logic followed here is:

Each letter of the first word is shifted forward by 5 positions in the English alphabetical order to obtain the corresponding letter of the second word.

For

LNRO is related to QSWT →

TVZW is related to YAEB →

The pattern observed is that each letter is increased by 5 positions (+5 shift).

Similarly, let's find the related word for EGKH:

Therefore, the related word for 'EGKH' is JLPM.

Hence, the correct answer is "Option 3".

Q70. Answer: (c) 585

Shortcut Trick

Transform the signs: ÷ → ×, + → −, × → ÷, − → +

Rewritten Equation: 29 × 13 − 545 ÷ 5 + 317

Solve using BODMAS: 377 − 109 + 317

Result: 268 + 317 = 585

Therefore The correct answer is 585.

Alternate Method

Given Equation: 29 ÷ 13 + 545 × 5 − 317 = ?

Method: Interchange '+' with '−' and '×' with '÷' and apply BODMAS rule.

=> New Equation: 29 × 13 − 545 ÷ 5 + 317

=> Perform Division: 545 ÷ 5 = 109

=> Perform Multiplication: 29 × 13 = 377

=> Updated Expression: 377 − 109 + 317

=> Perform Subtraction: 377 − 109 = 268

=> Perform Addition: 268 + 317 = 585

Therefore The correct answer is 585.

Additional Information

BODMAS Rule

It defines the sequence for solving multi-operator equations: Brackets, Orders (powers/roots), Division, Multiplication, Addition, and Subtraction.

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Mathematical Reasoning Sign Interchange

Always rewrite the entire expression with the new signs before starting calculations to avoid errors in the order of operations.

VBODMAS Rule

V stands for Vinculum (bar bracket), which must be solved even before standard brackets ().

Q71. Answer: (a) 6 km to the west

Given:

Nawang starts from Point A and drives 16 km towards south.

He then takes a right turn and drives 13 km.

Again, he takes a right turn and drives 17 km.

He then takes another right turn and drives 19 km.

Finally, he takes a right turn and drives 1 km and stops.

Step-by-Step Movement:

Final Observation:

Nawang stops 6 km to the east of Point A.

Therefore, to reach Point A again, he must travel 6 km towards the west.

Hence, the correct answer is "Option 1".

Q72. Answer: (c) 174

Logic followed here is.

Logic: The series follows a pattern where each subsequent number is determined by subtracting a constant value (16) from the preceding number.

Therefore, the value that should come in place of the question mark is 174.

Hence, the correct answer is "Option 3".

Q73. Answer: (c) VYW−ADB

Logic followed here is: (Position of letter in English alphabet) + 5.

For GJH is related to LOM →

For HKI is related to MPN →

Similarly, Option 3) VYW-ADB :

Therefore, the pair that follows the same pattern is 'VYW−ADB'.

Hence, the correct answer is "Option 3".

Q74. Answer: (b) E

Given Information:

1. C sits to the immediate right of A.
2. Only two people sit between C and D when counted from the right of D.
3. Only three people sit between D and E when counted from the left of D.
4. H sits to the immediate right of E.
5. B is not an immediate neighbour of D.
6. F sits second to the right of G.

Finding who sits third to the right of F:

Starting from F and moving right:

Count	Person
1st right	D
2nd right	G
3rd right	E

Therefore, E sits third to the right of F.

Hence, the correct answer is "Option 2".

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Q75. Answer: (a) QUAD - AQUD - DAUQ

Logic followed here is:Word 2 follows the letter order (3-1-2-4) and Word 3 follows the reverse order (4-3-2-1) of the first word.

For

JOYS - YJOS - SYOJ →

Word 2 (YJOS) rearrangement = Position (3), (1), (2), (4)

Word 3 (SYOJ) rearrangement = Position (4), (3), (2), (1)

LAKE - KLAE - EKAL →

Word 2 (KLAE) rearrangement = Position (3), (1), (2), (4)

Word 3 (EKAL) rearrangement = Position (4), (3), (2), (1)

Similarly, let's find the logic for QUAD - AQUD - DAUQ:

Word 2 (AQUD) rearrangement = Position (3), (1), (2), (4)

Word 3 (DAUQ) rearrangement = Position (4), (3), (2), (1)

Therefore, the triad that follows the same logic is QUAD - AQUD - DAUQ.

Hence, the correct answer is "Option 1".

Q76. Answer: (d) 2

Given Series:

(Left) * © 2 1 £ 2 6 2 £ © @ % £ $ 4 $ $ $ @ $ 1 4 (Right)

Logic Followed:

We need to find symbols that are:

Immediately preceded by a number and immediately followed by a symbol.

Required Pattern: Number → Symbol → Symbol

Checking the Series:

(Left) * © 2 1 £ 2 6 2 £ © @ % £ $ 4 $ $ $ @ $ 1 4 (Right)

Required Symbols:

• £ in (2 £ ©)

• $ in (4 $ $)

Therefore, there are 2 such symbols.

Hence, the correct answer is "Option 4".

Q77. Answer: (b) dp

Given:

‘seek new hope’ is coded as ‘dp ml vy’

‘hope fuels dreams’ is coded as ‘gj sc dp’

The common word is hope.

The common code in both code groups is dp.

Therefore, hope → dp.

Hence, the correct answer is "Option 2".

Q78. Answer: (d) 4

Given:

‘TOUR’ is coded as ‘8571’

‘DOUT’ is coded as ‘5478’

Therefore, the code for D = 4.

Hence, the correct answer is "Option 4".

Q79. Answer: (d) 56

Given:

Total people in the row = 92

Mr. Akte is 9^(th) from the left end.

Mr. Memi is 27^(th) from the right end.

Step 1:

Convert Mr. Memi’s position from the right into position from the left.

Position from left = Total people − Position from right + 1

= 92 − 27 + 1

= 66

So, Mr. Memi is 66^(th) from the left end.

Step 2:

Find the number of people between Mr. Akte and Mr. Memi.

= 66 − 9 − 1

= 56

Therefore, there are 56 people between Mr. Akte and Mr. Memi.

Hence, the correct answer is "Option 4".

Q80. Answer: (a) ZVX

Logic followed here is: (1st Letter positional value - 4 = 2nd Letter) and (2nd Letter positional value + 3 = 3rd Letter). 'ZVX' follows a +2 difference for the last letter instead of +3.

1) ZVX:

2) WSV:

3) FBE:

4) RNQ:

Therefore, the letter-cluster that does not belong to the group is ZVX.

Hence, the correct answer is "Option 1".

Q81. Answer: (a) Technology Perspective & Capability Roadmap 2025

The correct answer is Technology Perspective & Capability Roadmap 2025.

Key Points

• The Ministry of Defence (MoD) unveiled the Technology Perspective & Capability Roadmap (TPCR) 2025 to provide the domestic industry with a clear vision of the future requirements of the Indian Armed Forces.

• The roadmap serves as a guiding document for Defence Public Sector Undertakings (DPSUs), DRDO, and private sector players to align their Research and Development (R&D) efforts with the long-term needs of the military.

• It emphasizes the development of Future-generation technologies, specifically focusing on Artificial Intelligence (AI), Hypersonic Weapons, and Nuclear Propulsion for naval vessels.

• The TPCR 2025 is designed to reduce import dependency by fostering a robust indigenous ecosystem for next-generation combat systems and autonomous platforms.

• This document replaces or updates earlier versions like the TPCR 2018, reflecting the rapid changes in the global security landscape and the emergence of asymmetric warfare technologies.

Additional Information

• Hypersonic Technology:

• These weapons travel at speeds exceeding Mach 5 (five times the speed of sound).

• The TPCR 2025 prioritizes the indigenous development of Hypersonic Glide Vehicles (HGV) and Hypersonic Cruise Missiles to enhance India's strategic deterrence.

• Nuclear Propulsion for Warships:

• Unlike conventional diesel-electric engines, nuclear propulsion allows warships and submarines to operate at high speeds for extended periods without the need for frequent refueling.

• This technology is crucial for the Indian Navy to maintain a persistent presence in the Indian Ocean Region (IOR) and beyond.

• Artificial Intelligence (AI) in Defence:

• The roadmap highlights the integration of AI into command and control systems, predictive maintenance, and autonomous surveillance drones.

• The Defence AI Council (DAIC) and Defence AI Project Agency (DAIPA) are central to implementing these objectives.

• Atmanirbhar Bharat in Defence:

• The Government of India has set a target to achieve defence exports worth INR 35,000 crore (USD 5 billion) by 2025.

• The TPCR 2025 acts as a catalyst for the Make in India initiative by identifying complex platforms that can be built domestically.

Important Points

• Long Term Integrated Perspective Plan (LTIPP): The TPCR 2025 is derived from the broader 15-year LTIPP, which outlines the long-term capability building of the Army, Navy, and Air Force.

• iDEX (Innovations for Defence Excellence): Launched in April 2018, this initiative supports startups and MSMEs in developing

the high-end technologies listed in the roadmap.

• Quantum Computing: The roadmap also touches upon Quantum Key Distribution (QKD) and Quantum Communication to secure military networks against cyber threats.

• Directed Energy Weapons (DEWs): Future combat systems include lasers and high-power microwaves, which are mentioned as critical areas for technological sovereignty.

Q82. Answer: (d) United Service Institution of India, New Delhi

The correct answer is United Service Institution of India, New Delhi.

Key Points

• The Combined Operational Review and Evaluation (CORE) Programme is a high-level tri-service engagement aimed at enhancing the strategic and operational synergy among the Indian Armed Forces.

• The programme was organised by the Headquarters Integrated Defence Staff (HQ IDS) from 22 to 26 September 2025.

• The venue for this prestigious event was the United Service Institution of India (USI), located in New Delhi. This institution serves as a premier center for research into national security and defense matters.

• The primary objective of the CORE Programme is to provide a platform for senior military leadership to evaluate current operational doctrines and evolve a unified approach toward future warfare scenarios.

• It focuses on fostering Jointness and Integration across the Indian Army, Indian Navy, and Indian Air Force to ensure a cohesive response to national security threats.

Additional Information

• United Service Institution of India (USI):

• Established in 1870 by Major General Sir Charles MacGregor, the USI is one of India's oldest national security and defense think tanks.

• Located in New Delhi, it provides a venue for lectures, discussions, and research on military history, strategy, and international relations.

• It plays a critical role in professional military education and the development of strategic culture in India.

• Headquarters Integrated Defence Staff (HQ IDS):

• HQ IDS was created on October 1, 2001, based on the recommendations of the Kargil Review Committee.

• It operates under the Ministry of Defence and is headed by the Chief of Integrated Defence Staff to the Chairman, Chiefs of Staff Committee (CISC).

• Its primary mission is to promote "Jointness" for "Victory" by coordinating between the different branches of the military in planning, procurement, and training.

• Strategic Significance of CORE:

• The programme addresses modern challenges such as Cyber Warfare, Space Defence, and Electronic Warfare (EW).

• It facilitates discussions on the transition toward Integrated Theatre Commands, which is a major reform intended to streamline command structures.

Important Points

• Jointness and Integration: The CORE programme is a step toward the goal of a fully integrated military force under the guidance of the Chief of Defence Staff (CDS).

• Future Warfare Training: The curriculum of such programmes often includes artificial intelligence (AI) in combat, drone technology, and asymmetric warfare tactics.

• Location Context: While institutions like the National Defence Academy (NDA) in Pune and the Indian Military Academy (IMA) in Dehradun focus on initial officer training, the USI in New Delhi focuses on high-level strategic review and policy-level evaluation.

• Role of CDS: The creation of the post of Chief of Defence Staff in December 2019 has significantly boosted the effectiveness of the HQ IDS in conducting such tri-service evaluations.

Q83. Answer: (d) GROWTH-India

The correct answer is GROWTH-India.

Key Points

• GROWTH-India is India’s first fully robotic optical research telescope, designed to automatically observe transient astronomical events.

• In July 2024, the telescope successfully tracked and captured images of a massive asteroid named 2011 MW1 during its close flyby of Earth.

• The telescope is located at the Indian Astronomical Observatory (IAO) in Hanle, Ladakh, situated at an altitude of approximately 4,500 meters above sea level.

• The GROWTH-India facility is a joint initiative between the Indian Institute of Astrophysics (IIA), Bengaluru, and the Indian Institute of Technology (IIT) Bombay.

• The primary objective of this telescope is to study time-domain astronomy, focusing on objects that change brightness or position rapidly, such as supernovae, gamma-ray bursts, and Near-Earth Objects (NEOs).

Additional Information

• Global Collaboration: The telescope is part of the Global Relay of Observatories Watching Transients Happen (GROWTH) project, an international network of telescopes spanning the globe to provide 24-hour monitoring of the night sky.

• Asteroid 2011 MW1: This specific asteroid is roughly 115 meters (380 feet) wide, comparable to the size of a skyscraper. In July 2024, it passed Earth at a safe distance of about 2.4 million miles (3.8 million kilometers).

• Technical Specifications: The telescope features a 0.7-meter primary mirror and is equipped with a sensitive camera that allows for a wide field of view, making it highly efficient for scanning the sky for fast-moving targets.

• Geographic Advantage: Hanle, Ladakh is chosen for such high-end research because of its high altitude, extremely low humidity, and minimal light pollution, offering some of the clearest skies in the world for astronomical observation.

• Funding and Support: The project was initially funded by the Science and Engineering Research Board (SERB) of the Department of Science and Technology (DST), Government of India, under the PIIRE (Partnerships for International Research and Education) program.

Important Points

• Fully Robotic Nature: Unlike traditional telescopes, GROWTH-India can operate without human intervention. It receives triggers from other telescopes or satellites and automatically slews to the target, captures data, and processes it in real-time.

• Significance of the 2024 Event: Capturing images of 2011 MW1 demonstrated India's growing capability in Planetary Defense, contributing vital data to global efforts in tracking potentially hazardous asteroids.

• Other Facilities at Hanle: The Indian Astronomical Observatory also houses the Himalayan Chandra Telescope (HCT), which is a 2-meter optical-infrared telescope, and the Major Atmospheric Cherenkov Experiment (MACE) telescope.

• Scientific Impact: Since its commissioning in 2018, the GROWTH-India telescope has contributed to numerous international discoveries, including the study of kilonovae resulting from neutron star mergers.

Q84. Answer: (a) Barda Wildlife Sanctuary

The correct answer is Barda Wildlife Sanctuary.

Key Points

• The World Lion Day celebrations in August 2025 were prominently held at the Barda Wildlife Sanctuary in Gujarat, marking a significant milestone in the expansion of the habitat for Asiatic Lions.

• During this event, the state government highlighted the progress of Project Lion, specifically focusing on the Barda-Lion Safari project, which aims to develop Barda as a secondary home for lions to reduce the concentration of the population in Gir.

• The initiative is designed to ensure the long-term genetic health and safety of the Asiatic Lion (Panthera leo leo) by creating a satellite population, which helps mitigate risks such as Canine Distemper Virus (CDV) or natural calamities.

• Barda Wildlife Sanctuary, established in 1979, is located in the Porbandar and Jamnagar districts of Gujarat and is characterized by its hilly terrain and deciduous forest, similar to the Gir National Park.

• The eco-tourism initiative launched during the celebrations aims to boost the local economy of the Saurashtra region by attracting wildlife enthusiasts to the new safari area.

Additional Information

• Asiatic Lions:

• The Asiatic Lion is slightly smaller than the African Lion and is distinguished by a longitudinal fold of skin running along its belly.

• Currently, their only wild population is found in the Saurashtra region of Gujarat, specifically in the Gir National Park and surrounding wildlife sanctuaries.

• In the IUCN Red List, they are categorized as Endangered, and they are protected under Schedule I of the Wildlife Protection Act, 1972 in India.

• Project Lion:

• Launched on the lines of Project Tiger, this program focuses on the conservation of the Asiatic Lion through habitat development, involvement of local communities, and modern technology in monitoring.

• The "Lion @ 47: Visions for Amrit Kaal" roadmap identifies Barda Wildlife Sanctuary as a crucial site for lion translocation and habitat restoration.

• Geographic and Administrative Details:

• Barda Wildlife Sanctuary covers an area of approximately 192 square kilometers.

• It is situated about 15 kilometers from the Porbandar coast, making it a unique coastal-hilly wildlife habitat.

• The forest type is predominantly Southern Tropical Forest, featuring species like Babul, Gorad, and Khair.

• Other Sanctuaries in Gujarat:

• Pania Wildlife Sanctuary: Located in Amreli, it acts as an extension of the Gir ecosystem.

• Hingolgadh Wildlife Sanctuary: Known as a premier Nature Education Sanctuary located in the Rajkot district.

• Kutch Desert Wildlife Sanctuary: One of the largest in India, famous for its Flamingo City and saline desert topography.

Important Points

• World Lion Day is celebrated globally on August 10th every year to raise awareness about the declining population of lions and the need for urgent conservation.

• The translocation of lions from Gir to Barda was recommended by the Supreme Court of India to prevent the extinction of the species from a single localized threat.

• The Barda Safari serves as a crucial link in the Greater Gir landscape, which now encompasses over 30,000 square kilometers across several districts in Gujarat.

Q85. Answer: (a) India-EAEU Terms of Reference (ToR) for an FTA

The correct answer is India-EAEU Terms of Reference (ToR) for an FTA.

Key Points

• In August 2025, India and the Eurasian Economic Union (EAEU) took a significant step toward deepening economic integration by signing the Terms of Reference (ToR) for a Free Trade Agreement (FTA).

• This document serves as the official framework and roadmap for negotiations, outlining the scope, sectors to be covered, and the timeline for the finalization of the trade deal. Hence, statement 1 is correct.

• The EAEU is an influential economic bloc comprising five member nations: Russia, Armenia, Belarus, Kazakhstan, and Kyrgyzstan.

• The signing follows a Joint Feasibility Study that highlighted the immense potential for trade growth between the two regions, particularly in manufacturing and services.

• The ToR is a prerequisite for formal institutional negotiations, marking a transition from preliminary discussions to structured legal and economic drafting of the FTA.

Additional Information

• Eurasian Economic Union (EAEU):

• The EAEU was established to create a single market for goods, services, capital, and labor among its member states. It officially came into existence on January 1, 2015.

• The bloc represents a market of over 180 million people with a combined GDP of several trillion dollars, making it a vital partner for India's "Extended Neighborhood" policy.

• Trade Dynamics:

• India’s trade with the EAEU has traditionally been dominated by Russia, but the FTA aims to diversify exports to other members like Kazakhstan and Armenia.

• Key sectors expected to benefit include pharmaceuticals, agriculture, textiles, engineering goods, and information technology.

• Connectivity and Logistics:

• A major component of this economic partnership is the International North-South Transport Corridor (INSTC), a 7,200-km long multi-mode network of ship, rail, and road routes.

• The INSTC is designed to reduce the freight travel time between India and Eurasia by nearly 40% and lower logistics costs by 30%.

Important Points

• Strategic Importance: The FTA is seen as a strategic move by India to balance its trade portfolio and secure energy resources, as EAEU nations are rich in oil, natural gas, and minerals.

• Regulatory Alignment: The Terms of Reference include provisions for discussing Sanitary and Phytosanitary (SPS) measures and Technical Barriers to Trade (TBT) to ensure smooth customs clearances.

• Timeline: Following the August 2025 signing, both parties have committed to fast-tracking the negotiations, with multiple rounds scheduled to address tariff lines and Rules of Origin.

• Historical Context: Formal interest in an India-EAEU FTA was first expressed in 2017, and the 2025 signing represents the culmination of nearly eight years of diplomatic groundwork.

Q86. Answer: (a) Abdul-Rasheed Saminu

The correct answer is Abdul-Rasheed Saminu.

Key Points

• Abdul-Rasheed Saminu, a prominent sprinter from Ghana, established himself as the fastest man in the world for the early 2025 season by clocking a remarkable time of 9.86 seconds in the 100 m dash.

• This performance occurred during a high-stakes competitive meet, showcasing his explosive start and top-end speed, which are essential for elite-level sprinting.

• A time of 9.86 seconds is considered world-class and often places an athlete among the top contenders for global titles at the

World Athletics Championships and the Olympic Games.

• Saminu has been a rising star in the NCAA (National Collegiate Athletic Association) circuit, representing the University of South Florida, where he has consistently lowered his personal bests.

• His achievement in 2025 highlights the growing depth of sprinting talent emerging from the African continent, specifically from West Africa.

Additional Information

• Ferdinand Omanyala:

• He is a Kenyan sprinter who currently holds the African record in the 100 m with a time of 9.77 seconds, set in 2021.

• Known as the fastest man in Africa, he has been a consistent sub-10 second runner and a major figure in global athletics.

• Akani Simbine:

• A South African sprinting icon who has reached multiple Olympic and World Championship finals.

• His personal best stands at 9.82 seconds, and he is celebrated for his consistency and sportsmanship on the international stage.

• Bayanda Walaza:

• A young prodigy from South Africa who gained international fame by winning double gold in the 100 m and 200 m at the World Athletics U20 Championships.

• He is regarded as one of the most promising future stars of South African track and field.

• 100 m Sprint Mechanics:

• The 100 m race is the shortest outdoor track distance and determines the "Fastest Man Alive."

• Key variables affecting performance include reaction time (measured in milliseconds from the starting gun), wind assistance (must be 2.0 m/s or less for a record to be official), and altitude.

Important Points

• Ghanaian Athletics Progress:

• The success of Abdul-Rasheed Saminu follows the legacy of other Ghanaian sprinters like Benjamin Azamati and Joseph Amoah, who have also broken the 10-second barrier.

• In 2024 and 2025, Ghana has seen a resurgence in its 4x100 m relay team, competing at the highest international levels.

• World Leading Times:

• A "World Lead" (WL) refers to the fastest time recorded globally in a specific calendar year.

• Saminu's 9.86 seconds serves as a benchmark for other elite sprinters like Noah Lyles and Kishane Thompson as they progress through the 2025 season.

Q87. Answer: (b) India-UN Global Capacity Building Initiative

The correct answer is India-UN Global Capacity Building Initiative.

Key Points

• The India-UN Global Capacity Building Initiative was launched in August 2025 as a strategic partnership between India and the United Nations to share India's development experiences and best practices with the countries of the Global South.

• This initiative is designed to support the achievement of the Sustainable Development Goals (SDGs) by providing a platform for technical expertise and knowledge exchange, specifically focusing on the 2030 Agenda.

• The initiative aims to operationalize the development priorities identified during India's G20 Presidency, emphasizing the needs of Developing Nations and Least Developed Countries (LDCs).

• It focuses heavily on the implementation of Digital Public Infrastructure (DPI), which includes systems like Aadhaar and Unified Payments Interface (UPI), to drive financial inclusion and social empowerment across the Global South.

• The program is implemented in collaboration with the United Nations Office for South-South Cooperation (UNOSSC) and United Nations India, ensuring a coordinated international effort to reach global targets.

Additional Information

• Sustainable Development Goals (SDGs):

• Adopted by all United Nations Member States in 2015, the SDGs are a collection of 17 interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all."

• The India-UN Global Capacity Building Initiative directly targets goals such as Goal 1 (No Poverty), Goal 8 (Decent Work and Economic Growth), and Goal 17 (Partnerships for the Goals).

• Digital Public Infrastructure (DPI):

• DPI refers to blocks or platforms such as digital identification, payment systems, and data exchange layers that help countries deliver vital services to their citizens.

• India has emerged as a global leader in DPI, using it to transfer subsidies directly to the bank accounts of millions, a model now being exported to other emerging economies.

• Global South:

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• The term Global South broadly refers to regions within Latin America, Asia, Africa, and Oceania that are often characterized as developing or underdeveloped.

• India has positioned itself as the "Voice of the Global South," advocating for debt restructuring, climate finance, and technology transfer for these nations.

Important Points

• Strategic Collaboration: The initiative represents a deepening of the relationship between India's Ministry of External Affairs (MEA) and the UN system to foster South-South Cooperation.

• Implementation Framework: It involves the creation of capacity-building workshops, training modules, and policy advisory services tailored to the specific geographical and economic contexts of the recipient countries.

• History of Partnership: This initiative follows the India-UN Development Partnership Fund, established in June 2017, which has supported numerous projects in SIDS (Small Island Developing States) and Landlocked Developing Countries (LLDCs).

• G20 Legacy: The New Delhi Leader's Declaration from the 2023 G20 Summit served as the conceptual foundation for this initiative, emphasizing that no one should be left behind in the digital age.

Q88. Answer: (b) Bhubaneswar

The correct answer is Bhubaneswar.

Key Points

• The Utkarsh Odisha – Make in Odisha Conclave 2025 is the state's flagship biennial business summit designed to showcase the diverse investment opportunities in Odisha.

• The 2025 edition of the conclave is scheduled to be held in the capital city, Bhubaneswar, specifically at the Janata Maidan.

• The event is set to take place on January 28 and 29, 2025, serving as a platform for global leaders, investors, and policymakers to discuss the state's industrial future.

• The Government of Odisha, led by Chief Minister Mohan Charan Majhi, has rebranded this edition as Utkarsh Odisha to reflect the state's aspirations for "prosperous" growth and a Viksit Odisha by 2047.

• The primary objective of the conclave is to position Odisha as a leading industrial hub in India by attracting investments in high-tech and emerging sectors.

Additional Information

• Historical Background:

• The Make in Odisha Conclave was first conceptualized and launched in 2016.

• Subsequent successful editions were held in 2018 and 2022, with the 2025 event being the fourth edition of the summit.

• Focus Sectors:

• The 2025 conclave focuses on several key areas including Semiconductors, Information Technology (IT), Green Energy, Petrochemicals, Food Processing, and Textiles.

• There is a significant emphasis on Electronics System Design and Manufacturing (ESDM) to align with the Digital India initiative.

• Global Outreach:

• To invite international participation, the state government conducted International Roadshows in countries like Singapore.

• Domestic roadshows were also organized in major economic centers like Mumbai, New Delhi, and Hyderabad to engage with top CEOs and Industry Leaders.

• Partnerships and Collaborations:

• The event is supported by national industry partners such as the Federation of Indian Chambers of Commerce & Industry (FICCI) and the Confederation of Indian Industry (CII).

• Several Partner Countries are expected to participate, strengthening bilateral trade and technological exchange.

Important Points

• Skill Development: A key highlight of the conclave is the Skilled-in-Odisha program, which aims to provide a ready workforce for the new industries coming to the state.

• Policy Framework: The Industrial Policy Resolution (IPR) 2022 provides the framework for incentives and ease of doing business that the 2025 Conclave seeks to leverage.

• Sustainability: The 2025 edition places a strong emphasis on Green Hydrogen and sustainable industrial practices to meet global environmental standards.

• Economic Impact: During the previous edition in 2022, the state received investment intents worth over Rs 10 lakh crore, and the 2025 event aims to surpass these figures to boost the Gross State Domestic Product (GSDP).

Q89. Answer: (a) Punjab

The correct answer is Punjab.

Key Points

• In November 2025, the state government of Punjab rolled out the amended Bharat Net Scheme to provide high-speed fiber-to-the-home (FTTH) connectivity across its rural landscape.

• The primary objective of this rollout in Punjab is to facilitate real-time monitoring in sensitive border zones. This is critical for detecting unmanned aerial vehicles (drones) and preventing cross-border smuggling along the international boundary.

• The amended Bharat Net model focuses on a Public-Private Partnership (PPP) approach, ensuring that the infrastructure is not only built but also maintained for high uptime and efficiency over the long term.

• The scheme aims to connect approximately 12,000 Gram Panchayats in Punjab, enabling digital equity and providing rural citizens with access to e-governance, tele-health, and online education.

• This initiative is part of the broader Phase III of the project, which emphasizes integrated network management and the utilization of Optical Fiber Cable (OFC) for reliable communication in dispute-prone regional areas.

Additional Information

• Bharat Net Project:

• Originally launched in October 2011 as the National Optical Fibre Network (NOFN), it was rebranded as Bharat Net in 2015. It is the world's largest rural broadband connectivity program.

• The project is funded by the Universal Service Obligation Fund (USOF) under the Ministry of Communications, Government of India.

• Strategic Border Security:

• Punjab shares a 553-kilometer-long international border with Pakistan. High-speed internet allows Border Security Force (BSF) and state police to utilize AI-based surveillance and night-vision cameras effectively.

• Districts such as Amritsar, Ferozepur, Gurdaspur, and Pathankot are high-priority areas for these broadband-enabled monitoring systems.

• Implementation Agencies:

• The Bharat Broadband Network Limited (BBNL) is the special purpose vehicle (SPV) responsible for the implementation, often collaborating with BSNL and state-run agencies to execute the last-mile connectivity.

• In the 2025 amended version, the government shifted towards a concessionaire model to involve private players in the operation and maintenance (O&M) of the network.

• Digital India Vision:

• Bharat Net serves as the backbone for Digital India, supporting Common Service Centres (CSCs) to provide G2C (Government to Citizen) services, including land records, pension disbursements, and digital literacy programs.

• By 2025, the focus has expanded to include 5G backhaul, ensuring that rural areas are ready for the next generation of mobile communication.

Q90. Answer: (d) Immediate implementation and enforcement of child helmet safety rules in Karnataka

The correct answer is Immediate implementation and enforcement of child helmet safety rules in Karnataka.

Key Points

• In a significant judicial move in November 2025, the Karnataka High Court took a stern stance on the safety of young commuters, emphasizing the immediate implementation and enforcement of child helmet safety rules across the state.

• The Court observed that despite the existence of central guidelines, there has been a lack of rigorous execution by the state authorities, leading to increased vulnerability of children on two-wheelers.

• The directive specifically mandates that the Transport Department and Traffic Police in Karnataka must ensure every child above a certain age wears a protective headgear (helmet) that fits them properly and meets safety standards.

• The ruling highlighted that road safety is a non-negotiable aspect of governance and that the delay in enforcing these rules contributes to avoidable fatalities and head injuries among minors. Hence, the correct option is Immediate implementation and enforcement of child helmet safety rules in Karnataka.

• The High Court also directed the state government to submit a compliance report regarding the steps taken to sensitize the public and the number of penalties issued for non-compliance.

Additional Information

• Legal Framework: The primary legislation governing this is the Motor Vehicles (Amendment) Act, 2019, specifically Section 129, which was updated to include provisions for children.

• Age Criteria: According to the Central Motor Vehicles (Second Amendment) Rules, 2022, children above the age of four years must wear a crash helmet while riding a motorcycle.

• Safety Harness: For children between the age of 9 months and 4 years, the rules mandate the use of a safety harness that attaches the child to the rider of the motorcycle. This harness must be adjustable, waterproof, and durable.

• Speed Restrictions: To further ensure the safety of toddlers, the Ministry of Road Transport and Highways (MoRTH) has prescribed that the speed of a motorcycle carrying a child below 4 years of age must not exceed 40 km/h.

• BIS Standards: All protective headgear for children must comply with the standards prescribed by the Bureau of Indian

Standards (BIS). Using non-certified or oversized adult helmets for children is considered a violation.

Important Points

• Penalties for Violation: Non-compliance with the child safety gear rules can lead to a fine of Rs. 1,000 and the suspension of the rider's driving license for a period of three months.

• Constitutional Context: The Karnataka High Court linked the enforcement of these safety measures to Article 21 of the Constitution of India, which guarantees the Right to Life and personal liberty, interpreting it to include the right to safe travel.

• Geographic Scope: While the order was passed by the Karnataka High Court, it aligns with national safety goals aimed at reducing India's high contribution to global road accident statistics. In Karnataka, cities like Bengaluru, Mysuru, and Hubballi are expected to see the most intensive enforcement drives.

• Public Awareness: The court urged the use of social media, radio, and newspapers to educate parents about the necessity of child helmets, rather than viewing them merely as a tool to avoid fines.

Q91. Answer: (d) World Sustainable Development Summit

The correct answer is World Sustainable Development Summit.

Key Points

• The World Sustainable Development Summit (WSDS) is the annual flagship event organized by The Energy and Resources Institute (TERI), which took place in March 2025 in New Delhi, India.

• The summit serves as a major international platform that focuses on climate justice, sustainable development, and resource efficiency, particularly emphasizing the perspectives of the Global South.

• The 2025 edition aimed to foster global partnerships to accelerate the implementation of the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement objectives.

• It brought together a diverse range of stakeholders, including Heads of State, Nobel Laureates, ministers from various countries, corporate leaders, and civil society representatives to discuss green growth and climate resilience.

• A central theme of the March 2025 summit was the mobilization of climate finance and the adoption of clean energy technologies to mitigate the impacts of global warming.

Additional Information

• The Energy and Resources Institute (TERI):

• Established in 1974, TERI is a leading research institute in India specializing in the fields of energy, environment, and sustainable development.

• It was originally known as the Tata Energy Research Institute before being renamed in 2003.

• The institute provides technological solutions and policy advice to help the world transition toward carbon neutrality.

• Global Climate Initiatives:

• India has played a pivotal role in international climate diplomacy through initiatives like the International Solar Alliance (ISA), launched in 2015, and the Coalition for Disaster Resilient Infrastructure (CDRI).

• The Panchamrit targets announced by India at COP26 aim for a Net Zero carbon emission status by the year 2070.

• Summits like WSDS are critical for reviewing progress on Nationally Determined Contributions (NDCs) submitted by nations under the UNFCCC framework.

Important Points

• WSDS Evolution:

• Formerly known as the Delhi Sustainable Development Summit (DSDS), it was renamed in 2016 to reflect its expanding global scope and influence.

• The summit highlights the interconnectedness of poverty eradication and environmental conservation, advocating for equitable growth models.

• Climate Context 2025:

• The year 2025 is significant as it marks a decade since the adoption of the 2030 Agenda for Sustainable Development and the Paris Agreement.

• Discussions at the March 2025 summit focused on the "Global Stocktake" outcomes, urging developed countries to provide $100 billion and beyond annually in climate finance to developing nations.

Q92. Answer: (a) Manipuri

The correct answer is Manipuri.

Key Points

• Thiyam Suryamukhi Devi is a legendary figure in the realm of Indian classical dance, specifically renowned for her mastery of Manipuri dance.

• In 2025, she was honored with the Padma Shri, one of India's highest civilian awards, in recognition of her distinguished service and contribution to the field of Art.

• She hails from the state of Manipur and has played a pivotal role in preserving the traditional Raas Leela and other devotional dance forms associated with Vaishnavism.

• As a veteran artist and guru, she has been associated with the Jawaharlal Nehru Manipur Dance Academy (JNMDA) in Imphal, where she trained generations of dancers in the intricate movements and spiritual essence of Manipuri culture.

• Her performance style is characterized by the graceful, lyrical, and fluid movements that define the Jagoi style, moving away from the more vigorous movements found in other classical forms.

Additional Information

• Manipuri Dance:

• Originating from the northeastern state of Manipur, it is one of the eight primary classical dances of India.

• It is deeply rooted in religious rituals and depicts the Radha-Krishna love theme known as Raas Leela.

• A unique feature is the Potloi costume, a stiff cylindrical skirt worn by female dancers. It avoids sharp edges and jerky movements, emphasizing a soft, rounded silhouette.

• Odissi:

• This dance form originates from Odisha and is characterized by the Tribhanga posture (the three-fold bending of the body).

• It was traditionally performed by Maharis in temples like the Jagannath Temple in Puri.

• Bharatanatyam:

• Hailing from Tamil Nadu, it is considered the oldest classical dance form in India.

• It is known for its fixed upper torso, bent legs, and complex Mudras (hand gestures). It was historically associated with Devadasis.

• Kuchipudi:

• Originating from the Kuchelapuram village in Andhra Pradesh, it combines both dance and acting.

• It features the Tarangam, where a dancer balances on the rim of a brass plate while carrying a pot of water on their head.

Important Points

• Padma Awards 2025: These awards are conferred by the President of India at ceremonial functions held at Rashtrapati Bhawan. The Padma Shri is awarded for "distinguished service" in any field.

• Cultural Impact: Thiyam Suryamukhi Devi's work extends beyond performance to the documentation and academic preservation of Manipur's indigenous performing arts.

• Classical Status: The Sangeet Natak Akademi currently recognizes eight classical dances: Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, and Mohiniyattam.

• Sankirtana: Related to Manipuri dance, this ritual singing, drumming, and dancing of Manipur is inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity.

Q93. Answer: (c) Only new savings accounts opened from 1 August 2025

The correct answer is Only new savings accounts opened from 1 August 2025.

Key Points

• ICICI Bank, a leading private sector bank in India, has updated its policy regarding the Minimum Average Balance (MAB) requirements for its savings account holders.

• The revision is set to be implemented starting from 1 August 2025. This date acts as the primary threshold for determining which customers are affected by the new balance criteria.

• According to the bank's notification, the increased minimum balance requirement will apply only to new savings accounts opened on or after 1 August 2025. Hence, statement 3 is correct.

• Existing customers who established their accounts before the August 2025 deadline are not impacted by this specific increase and will continue to follow the Average Monthly Balance (AMB) rules applicable at the time of their account opening. Hence, statement 2 is incorrect.

• The policy applies based on the date of account creation rather than the type of account ownership. Therefore, joint account holders are treated based on when the account was opened, not their status as joint holders. Hence, statement 1 is incorrect.

Additional Information

• Average Monthly Balance (AMB): This is a financial metric calculated by adding the closing balance of an account for every day in a month and dividing the total by the number of days in that month. Banks use this to ensure customers maintain a minimum level of funds to cover operational costs.

• Branch Categorization: Minimum balance requirements in ICICI Bank often vary based on the location of the branch, categorized as Metro, Urban, Semi-Urban, and Rural. While the revision mentioned applies to new accounts, the specific amount required still depends on these geographical tiers. Hence, statement 4 is incorrect.

• ICICI Bank: Headquartered in Mumbai, it is one of the "Big Four" banks of India. It offers a wide range of banking products and financial services to corporate and retail customers through a variety of delivery channels.

• Non-Maintenance Charges: If a customer fails to meet the minimum balance criteria, the bank is entitled to levy penal charges. These charges are usually a percentage of the shortfall or a fixed fee as defined in the bank's Schedule of Charges.

• Regulatory Oversight: The Reserve Bank of India (RBI) mandates that all commercial banks must inform customers of any change in service charges or minimum balance requirements at least one month in advance to ensure transparency.

Important Points

• Exemptions: Certain account types, such as the Basic Savings Bank Deposit Account (BSBDA) or Zero Balance Accounts aimed at financial inclusion, typically do not fall under these revised minimum balance hikes.

• Effective Date: The specific date of 1 August 2025 is critical for new applicants. Anyone opening an account starting this year and month must be aware of the higher liquidity commitment required by ICICI Bank.

• Customer Communication: Banks generally use digital channels like SMS, Email, and mobile banking apps to notify their users about such policy updates to comply with fair practices.

Q94. Answer: (c) Bima Sakhi Yojana

The correct answer is Bima Sakhi Yojana.

Key Points

• The Bima Sakhi Yojana was launched by Prime Minister Narendra Modi in December 2024 during a high-profile event held in Panipat, Haryana.

• The primary objective of the scheme is to promote financial literacy and significantly increase insurance awareness among women, particularly those living in rural areas.

• The initiative aims to utilize the vast network of Self Help Groups (SHGs) across the country to drive the penetration of insurance products at the grassroots level.

• Under this scheme, selected women from these groups are trained to act as Bima Sakhis, who serve as insurance facilitators or point-of-sale persons to educate local communities and sell insurance policies. Hence, the option Bima Sakhi Yojana is the correct answer.

• This launch is a strategic part of the government’s larger vision to empower women economically and achieve the goal of creating 3 crore Lakhpati Didis (women members of SHGs earning an annual income of Rs 1 lakh or more).

Additional Information

• Economic Empowerment: By becoming Bima Sakhis, women can earn commissions and incentives, which provides them with a sustainable livelihood and enhances their financial independence.

• Insurance Penetration: India’s insurance density remains low in rural segments; this scheme addresses the "trust gap" by using local women as intermediaries who understand the local socio-cultural dynamics.

• Lakhpati Didi Initiative: Launched by the Ministry of Rural Development, this initiative focuses on diversifying the livelihood opportunities for women in Self Help Groups through various technical and financial interventions.

• Role of IRDAI: The Insurance Regulatory and Development Authority of India (IRDAI) plays a crucial role in simplified regulatory frameworks to allow Bima Sakhis to operate efficiently without excessive bureaucratic hurdles.

• Haryana's Role: The state of Haryana has been a frontrunner in implementing women-centric rural schemes, making it a strategic location for the national launch of such a pivotal financial inclusion project in 2024.

Important Points

• Training and Capacity Building: The Bima Sakhis undergo rigorous training modules covering the basics of life insurance, general insurance, and health insurance to ensure they can provide accurate information to villagers.

• Social Security Linkage: The scheme often facilitates enrollment in existing government insurance programs like the Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) and the Pradhan Mantri Suraksha Bima Yojana (PMSBY).

• Digital Integration: Most Bima Sakhis are equipped with digital tools or mobile applications to facilitate paperless transactions, aligning with the Digital India mission.

• Target Demographic: While the focus is on women, the ultimate goal is to provide risk coverage to the entire rural household, ensuring that families do not fall back into poverty due to unforeseen medical or accidental expenses.

Q95. Answer: (b) Heart Lamp

The correct answer is Heart Lamp.

Key Points

• Heart Lamp is a celebrated collection of short stories originally written in the Kannada language by the veteran author and activist Banu Mushtaq.

• The work was translated into English by the noted writer and journalist Deepa Bhasthi, bringing the local nuances of Karnataka to a global readership.

• In a historic achievement for Indian literature, the collection was awarded the International Booker Prize in 2025, recognizing the excellence of fiction translated into English.

• The stories in the collection predominantly revolve around the lived experiences of Muslim women in South India, particularly exploring themes of gender politics, social justice, and religious identity.

• The International Booker Prize win highlights the increasing global footprint of regional Indian languages and the vital role played by translators in cultural exchange.

Additional Information

• Banu Mushtaq:

• She is a prominent Kannada writer, advocate, and social activist based in Hassan, Karnataka.

• Her literary works are known for their feminist undertones and sharp critique of patriarchal structures within society.

• She has authored several influential books, including Hada (the original title of the winning collection) and Benki Male.

• International Booker Prize:

• This prestigious award is presented annually for a single book that is translated into English and published in the UK or Ireland.

• The prize aims to encourage more publishing and reading of quality fiction from all over the world and to promote the work of translators.

• The prize money of £50,000 is shared equally between the author and the translator, emphasizing their equal contribution to the work's success.

• Deepa Bhasthi:

• She is an independent writer and translator whose work focuses on the intersections of land, language, and identity.

• By translating Heart Lamp, she has successfully preserved the cultural idiom and linguistic flavor of the original Kannada text for an international audience.

Important Points

• Literary Context: Kannada literature has a rich history of over 1,500 years and has produced some of India’s finest writers, including multiple Jnanpith Award winners. The 2025 win for Heart Lamp further cements its status in world literature.

• Themes and Impact: The book addresses contemporary issues such as minority rights, educational empowerment, and the inner lives of women, making it a significant contribution to post-modern Indian fiction.

• The Original and Other Options: While titles like Hunchback or Under the Eye of the Big Bird refer to other significant works in Indian regional literature, they were not the recipients of the 2025 prize mentioned in this context.

Q96. Answer: (c) Dr. V Mohan

The correct answer is Dr. V Mohan.

Key Points

• Renowned Indian diabetologist Dr. V Mohan has been honored with the first-ever EASD Diabetes Global Impact Prize in 2025 (announced/presented during the 60th EASD Annual Meeting).

• The award was conferred by the European Association for the Study of Diabetes (EASD) to recognize his exceptional global contributions to the field of diabetes research and clinical practice.

• Dr. V Mohan is the Chairman and Chief Diabetologist of Dr. Mohan’s Diabetes Specialities Centre located in Chennai, Tamil Nadu.

• He has been instrumental in conducting large-scale epidemiological studies, such as the ICMR-INDIAB study, which mapped the prevalence of diabetes and hypertension across all states of India.

• His research work predominantly focuses on the genetics of diabetes, precision medicine, and the discovery of specific monogenic forms of diabetes in the Indian population.

Additional Information

• European Association for the Study of Diabetes (EASD):

• The EASD is a non-profit, medical scientific association founded in 1965 and headquartered in Düsseldorf, Germany.

• It aims to encourage and support research in the field of diabetes, the rapid diffusion of acquired knowledge, and to facilitate its application.

• About Dr. V Mohan:

• He was awarded the Padma Shri, India's fourth-highest civilian award, in 2012 for his contributions to the field of medicine.

• He has published over 1,600 scientific papers and is one of the most cited medical researchers in India.

• He established the Madras Diabetes Research Foundation (MDRF) in 1996, which is a dedicated center for advanced research in diabetes.

• Other Notable Options:

• Dr. Devi Shetty: A world-renowned cardiac surgeon and the founder of Narayana Health, known for his work in affordable healthcare.

• Dr. Randeep Guleria: An eminent pulmonologist and the former Director of the All India Institute of Medical Sciences (AIIMS), New Delhi.

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• Dr. Soumya Swaminathan: An Indian pediatrician and clinical scientist who served as the first Chief Scientist at the World Health Organization (WHO) from 2019 to 2022.

Important Points

• The Diabetes Global Impact Prize is a newly instituted prestigious award by EASD to honor individuals who have made a transformative impact on diabetes care globally.

• The selection of Dr. V Mohan highlights the growing recognition of Indian medical research in addressing non-communicable diseases (NCDs) on an international platform.

• Recent data from the ICMR indicates that India has over 101 million people living with diabetes, making the work of researchers like Dr. V Mohan critical for public health policy.

Q97. Answer: (d) Asian Athletics Championships

The correct answer is Asian Athletics Championships.

Key Points

• Animesh Kujur is a rising star in Indian athletics who specializes in the men's 200m and 100m sprint events.

• He achieved a significant milestone by winning a bronze medal at the Asian Athletics Championships, demonstrating his competitive edge at the continental level.

• During this prestigious competition, Kujur's performance was notable for setting a new national record in the 200m category, surpassing previous benchmarks set by Indian sprinters.

• The Asian Athletics Championships is a biennial event organized by the Asian Athletics Association, featuring the top athletes from across the Asian continent.

• Kujur's success at this level has positioned him as one of the fastest athletes in India, bringing attention to the country's growing prowess in short-distance track events.

Additional Information

• Athlete Profile:

• Animesh Kujur hails from the state of Chhattisgarh and has been trained under various high-performance programs in India.

• He has consistently clocked impressive times, such as 20.62 seconds in the 200m, which is among the fastest timings ever recorded by an Indian sprinter.

• Asian Athletics Association (AAA):

• The AAA is the governing body for the sport of athletics in Asia and is a member of World Athletics.

• The association was founded in 1973 and is responsible for organizing the Asian Athletics Championships and the Asian Indoor Athletics Championships.

• The 200m Event:

• The 200-meter sprint is a track and field race that begins on the curve of the track and ends on the home straight.

• It requires a combination of explosive power at the start and speed endurance to maintain velocity throughout the 200m distance.

• National Records in India:

• National records are officially recognized by the Athletics Federation of India (AFI), which is the apex body for athletics in the country.

• Other notable record holders in Indian sprinting include Amlan Borgohain, who has also held the national record for the 100m and 200m events in recent years.

• Support Systems:

• Indian athletes like Kujur benefit from government initiatives such as the Target Olympic Podium Scheme (TOPS) and the Khelo India project, which provide financial and infrastructure support.

• The Relay and Sprint High Performance Centre in Odisha has also played a crucial role in nurturing sprinting talent in the country.

Q98. Answer: (d) Santanu Bhattacharya

The correct answer is Santanu Bhattacharya.

Key Points

• Santanu Bhattacharya is the author of the highly anticipated second novel titled 'Deviants', which was published in February 2025.

• The book is described as a multigenerational queer novel that explores the complexities of identity, family, and desire within the context of changing Indian social norms.

• The narrative of 'Deviants' follows the protagonist, Shubhro, and spans several decades, moving from the 1970s to the present day, primarily set in the city of Kolkata.

• It delves into the lived experiences of individuals who exist on the margins of society, highlighting the struggle for

self-acceptance and the political shifts that have shaped modern India.

• The novel was published by Fig Tree, an imprint of Penguin Books, following the critical success of his debut work.

Additional Information

• Santanu Bhattacharya:

• He grew up in Kolkata and later moved to the United Kingdom. He is an alumnus of the University of Oxford and the University of East Anglia (UEA).

• Bhattacharya gained significant literary attention with his debut novel, 'One Small Voice', published in 2023, which was named a Book of the Year by several major publications including The Observer and The Daily Mail.

• He is the winner of the 2021 4th Estate B4ME Short Story Prize and was a recipient of the Desmond Elliott Residency.

• His writing style is noted for blending personal intimate histories with large-scale historical events like the 1992 riots or political Emergency periods in India.

• Other Authors Mentioned:

• Amitav Ghosh: A veteran Indian writer and Jnanpith Award winner, famous for the Ibis Trilogy and his recent non-fiction work 'Smoke and Ashes' (2023).

• Aria Aber: An Afghan-German poet and writer known for her award-winning poetry collection 'Hard Damage', which won the Whiting Award in 2020.

• Akhil P Dharmajan: A popular contemporary writer from Kerala, known for his bestselling novel 'Ram C/O Anandhi', which gained a massive following on social media platforms.

Important Points

• Literary Context: The novel 'Deviants' is considered a landmark in Contemporary Queer Indian Literature, providing a nuanced look at masculinity and queerness across generations.

• Themes: The book touches upon social alienation, the Naxalite movement of the 1970s, and the evolution of urban Indian spaces over the last fifty years.

• Geographical Setting: While much of the story resides in Kolkata, it also navigates the diasporic experience, reflecting the author's own journey between India and London.

• Recognition: Before the release of 'Deviants', Bhattacharya's contributions to literature were recognized by the National Centre for Writing in the UK as part of their 'Early Career Writers' program.

Q99. Answer: (a) 435

The correct answer is 435.

Key Points

• The India Women’s cricket team created history on January 17, 2025, by scoring a massive total of 435/4 in a One-Day International (ODI) against Ireland.

• This score of 435 runs set a new national record for the highest team total by the Indian Women's team in the history of ODI cricket.

• The match was the first ODI of the three-match series, held at the Niranjan Shah Stadium in Rajkot, Gujarat.

• The innings featured a historic double century by star opener Smriti Mandhana, who scored 209 runs off just 145 balls, becoming the first Indian woman to reach the 200-run mark in ODIs.

• Captain Harmanpreet Kaur also played a blistering knock, contributing 117 runs off 61 deliveries, which helped the team surpass the 400-run mark for the first time.

Additional Information

• Previous Record: Before this match, India’s highest total in Women's ODIs was 358/2, which was also achieved against Ireland in May 2017 during a quadrangular series in South Africa.

• Smriti Mandhana’s Achievement: With her 209-run innings, Smriti Mandhana registered the third-highest individual score in Women's ODI history, trailing only Amelia Kerr (232*) and Belinda Clark (229*).

• Partnership Record: During this innings, Mandhana and Kaur shared a record-breaking 239-run partnership for the third wicket, which is one of the highest in the history of the format.

• Global Context: While 435 is India's national record, the overall world record for the highest team total in Women's ODIs is held by New Zealand, who scored 491/4 against Ireland in 2018.

• Series Significance: This match was part of the ICC Women's Championship cycle, which is crucial for direct qualification for the 2025 Women's Cricket World Cup.

Important Points

• Venue: The Niranjan Shah Stadium (formerly known as the Saurashtra Cricket Association Stadium) in Rajkot provided a high-scoring pitch that facilitated several records during the January 2025 series.

• Match Result: India won the match by a massive margin of 328 runs after bowling out Ireland for 107, marking one of their largest victories in terms of runs.

• Statistical Milestone: This was only the fourth time in Women's ODI history that a team managed to cross the 400-run threshold, joining the ranks of New Zealand and Australia.

• Smriti Mandhana hit 26 boundaries and 6 sixes during her record-breaking knock, demonstrating a strike rate of over 144.

Q100. Answer: (a) Jannik Sinner

The correct answer is Jannik Sinner.

Key Points

• Jannik Sinner, the top-seeded Italian tennis professional, successfully clinched the 2025 Australian Open Men's Singles title.

• The final match took place on January 26, 2025, at the prestigious Rod Laver Arena located within Melbourne Park, Australia.

• Sinner defeated the German player Alexander Zverev in a highly competitive final to secure the championship.

• This victory represents Sinner's second consecutive Australian Open title, following his first-ever Grand Slam win at the same tournament in 2024.

• With this win, Jannik Sinner reinforced his position as the World No. 1 in the ATP (Association of Tennis Professionals) rankings, marking a dominant start to the 2025 tennis season.

Additional Information

• The Australian Open:

• It is the first of the four annual Grand Slam tennis tournaments, held annually over the last fortnight of January.

• The tournament was first established in 1905 and has been played at Melbourne Park since 1988.

• The event features Men's and Women's singles; Men's, Women's, and Mixed doubles; and junior's, wheelchair, legends, and exhibition events.

• Surface and Venue:

• Before 1988, the tournament was played on grass courts, but it transitioned to hard courts (GreenSet) upon moving to Melbourne Park.

• The Rod Laver Arena, named after the Australian tennis legend Rod Laver, is the primary venue and features a retractable roof.

• Prominent Records:

• Novak Djokovic holds the record for the most Australian Open Men's Singles titles, having won the tournament 10 times.

• The 2025 tournament marked a significant generational shift as younger players like Sinner and Carlos Alcaraz continue to lead the sport following the era of the Big Three (Federer, Nadal, and Djokovic).

• Runner-up Details:

• Alexander Zverev, the runner-up in 2025, is a prominent German player who won the Olympic Gold Medal in singles at the 2020 Tokyo Olympics.

• His run to the 2025 final included victories over several top-ten seeded players, solidifying his status as a major contender on hard courts.

Important Points

• Prize Money: The 2025 Australian Open featured a record-breaking prize pool, reflecting the growing commercial success and global viewership of the sport.

• National Milestone: Jannik Sinner is the first Italian male player in the Open Era to win multiple Grand Slam titles on hard courts.

• Tournament Format: The Men's Singles matches at the Australian Open are played in a best-of-five sets format, requiring immense physical endurance and mental fortitude.

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