RRB Group D Official Paper (Held On: 06 Feb, 2026 Shift 1) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of the following statements about Newton's third law of motion is incorrect?

(a) The action and reaction forces act on the same object.
(b) The forces act simultaneously on two different objects.
(c) When one object exerts a force on another, the second object exerts an equal and opposite force back.
(d) The forces are equal in magnitude but opposite in direction.

Q2. A wire of resistivity ρ, has a length L and area of cross-section A. If the resistance of the wire is R, then which of the following is the correct relation for R ?

(a) R = Aρ/L
(b) R = ρLA
(c) R = ρL/A
(d) R = L/ρA

Q3. Which method is commonly used to prevent rusting of Iron?

(a) Magnetising
(b) Melting
(c) Galvanisation
(d) Heating

Q4. The resistance of a metal wire of length 2 m is 10 Ω at 25°C. If the diameter of the wire is 0.4 mm, what will be the resistivity of the metal at that temperature?

[Given, π = 3.14]

(a) 6.3 x 10^(-5) Ωm
(b) 6.3 x 10^(-7) Ωm
(c) 3.6 x 10^(-6) Ωm
(d) 1.55 x 10^(-6) Ωm

Q5. Which of the following feature enables muscular tissue to produce movement in animals?

(a) Storage of fat droplets
(b) Presence of contractile proteins
(c) Ability to transmit nerve impulses
(d) Secretion of digestive enzymes

Q6. What will the distance-time graph look like for an object moving with uniform speed?

(a) The graph looks like a sine wave.
(b) The graph cannot be drawn.
(c) The graph is a zig zag line.
(d) The graph is a straight line.

Q7. Which of the following statement(s) is/are true regarding a concave lens?

(i) A concave lens is also called a diverging lens.

(ii) A concave lens always forms a real and inverted image of the object placed anywhere in front of it.

(iii) A concave lens always forms a virtual and erect image of the object placed anywhere in front of it.

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

Q8. A student wants to separate a heterogeneous mixture of mud and water collected from a pond. Based on your understanding of mixtures, which method would be most effective and why?

(a) Chromatography, because it separates based on movement in a medium
(b) Distillation, because it separates based on boiling points
(c) Evaporation, because it removes the solvent
(d) Filtration, because the solid particles in mud are not dissolved in water

Q9. A ball is thrown up with a velocity of x m/s. The ball attains a maximum height of 50 m. What is the value of x? (Take the value of g as 10 m/s^2)

(a) 10 m/s
(b) 100 m/s
(c) 1000 m/s
(d) $10\sqrt{10}$ m/s

Q10. Which of the following is a straight-chain saturated hydrocarbon?

(a) Butane
(b) Cyclohexane
(c) Propene
(d) Benzene

Q11. Which part of the brain is primarily responsible for higher-level thought processes and complex interpretation of sensory information?

(a) The spinal cord
(b) The forebrain
(c) The cerebellum
(d) The brainstem

Q12. A molecule of methane contains one carbon atom bonded to four hydrogen atoms. What is the chemical formula for methane?

(a) C4H
(b) CH4
(c) CH3
(d) C2H4

Q13. The way of obtaining fish from natural resources is called _____.

(a) Culture fishing
(b) Capture fishing
(c) Farming fishing
(d) Composite fishing

Q14. Lenses are used in spectacles to correct vision because they work on the principle of _____.

(a) Polarization
(b) Diffraction
(c) Reflection
(d) Refraction

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Q15. When a force is applied at 90° to the direction of displacement of an object, the work done:

(a) is maximum
(b) is zero
(c) is minimum but not zero
(d) cannot be determined

Q16. A substance is said to be reduced when:

(a) it loses oxygen or gains hydrogen
(b) it gains hydrogen only
(c) it loses oxygen only
(d) it loses hydrogen or gains oxygen

Q17. Which gas is released when hydrochloric acid reacts with calcium carbonate?

(a) Nitrogen
(b) Carbon dioxide
(c) Hydrogen
(d) Oxygen

Q18. Consider the following statements and select the correct option.

Statement A: Small quantities of ethanol cause drunkenness.

Statement B: Intake of pure ethanol is safe for health.

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

Q19. Which component of blood serves as the fluid matrix in which cells are suspended?

(a) Platelets
(b) Red blood cells
(c) Plasma
(d) White blood cells

Q20. The cellular organelles are suspended in a jelly called _____.

(a) Stroma
(b) Lumen
(c) Cytoplasm
(d) Nucleoplasm

Q21. In plants, after fertilisation, the ovule develops into which of the following?

(a) Seed
(b) Embryo
(c) Endosperm
(d) Fruit

Q22. Which property best explains why solids have a definite shape and volume?

(a) The particles are closely packed in a fixed arrangement.
(b) The particles are randomly arranged.
(c) The particles have large spaces between them.
(d) The particles can move freely past each other.

Q23. What is ultrasonography used for during pregnancy?

(a) To find the blood group of the baby
(b) To measure the mother's weight
(c) To check the mother’s heartbeat
(d) To detect birth defects and monitor the baby’s growth

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Q24. In plants that reproduce by budding, which process directly initiates the formation of a new individual?

(a) Development of seeds from flowers
(b) Fusion of gametes from different individuals
(c) Random cell death in tissues
(d) Localized repeated cell division at a specific site

Q25. In a large population of sweet pea plants growing in stable conditions, which of the following best explains why genetic variation through sexual reproduction is still crucial for their long-term survival?

(a) Variation helps sweet pea plants avoid cross-pollination, maintaining purity of the parental line.
(b) Genetic variation ensures uniform flower color and height across future generations.
(c) Hidden (recessive) alleles in sweet peas may offer resistance against future environmental stress.
(d) Sweet pea plants reproduce faster sexually than asexually, ensuring more biomass production.

MATHEMATICS

Q26. The amount on a sum of Rs. 8,400 at 15% per annum compound interest, compounded annually, in 2 years will be:

(a) Rs. 11,668
(b) Rs. 11,339
(c) Rs. 11,109
(d) Rs. 10,837

Q27. The price of a faucet and a wash basin are Rs. 860 and Rs. 2900, respectively. If the price of the faucet and that of the wash basin is increased by 5% and 10%, respectively, then find the price of 6 faucets and 6 wash basins. 6720

(a) Rs. 24,558
(b) Rs. 22,560
(c) Rs. 36,500
(d) Rs. 20,550

Q28. If Rs. 2,443 is divided among 363 children such that each girl and each boy get Rs. 6 and Rs. 7, respectively, then how many boys are there?

(a) 325
(b) 265
(c) 225
(d) 285

Q29. The marked price of a jeans was Rs. 7,750 but the shopkeeper offered successive discounts of 20% and 30%. Ultimately for how much did he sell the item? 593

(a) Rs. 4,397
(b) Rs. 4,356
(c) Rs. 4,340
(d) Rs. 4,224

Q30. A garrison of 1200 men has provisions for 13 days. How long (in days) will the provisions last if the garrison is increased by 360 men? 2670

(a) 30
(b) 20
(c) 10
(d) 5

Q31. Find the perimeter of the minor sector of a circle of radius 21 m subtending an angle of 45° at the centre. (Use $\pi = 22/7$)

(a) 56.5 m
(b) 50.5 m
(c) 58.5 m
(d) 52.5 m

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Q32. Rs. 12,986 is divided among A, B and C in such a way that if Rs. 33, Rs. 70 and Rs. 19 are deducted from their respective shares, they have money in the ratio 14:8:2. Find the difference between B's and C's original shares.

(a) Rs. 3,166
(b) Rs. 3,267
(c) Rs. 3,366
(d) Rs. 3,116

Q33. If $(4^2)^a \times (16^2)^{(2a)} \times (3^4)^b \times (9^2)^{(2b)} = 2^{(20)} \times (9^2)^6$, find the values of a and b, respectively.

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

Q34. The LCM of two numbers 216 and 120 is 1080. Find the HCF of these numbers.

(a) 48
(b) 24
(c) 32
(d) 36

Q35. A person earns Rs. 40,000 per month. He allocates 25% of his income to rent, 15% to food, and 10% to transportation, and saves the remainder. How much does he save every month?

(a) Rs. 20,000
(b) Rs. 24,000
(c) Rs. 10,000
(d) Rs. 12,000

Q36. The volume of a solid cylinder is 6776 cm^3 and its height is 44 cm. What is the total surface area of the solid cylinder?

(Use $\pi = 22/7$)

(a) 2244 cm2
(b) 2227 cm2
(c) 2273 cm2
(d) 2221 cm2

Q37. Nilu covers a distance by walking for 6 h. While returning, her speed decreases by 2 km/h and she takes 9 h to cover the same distance. What was her speed while returning?

(a) 2 km/h
(b) 4 km/h
(c) 5 km/h
(d) 7 km/h

Q38. In an equilateral triangle ABC, point D lies on side BC such that, 3BD = BC. Which of the following relations is correct?

(a) $4AD^2=3AB^2$
(b) $9AD^2=7AB^2$
(c) $3AD^2=4AB^2$
(d) $7AD^2=9AB^2$

Q39. One pipe can fill a tank in 9 minutes, while another pipe can empty the completely filled tank in 12 minutes. If both the pipes are opened together when the tank is empty, how many minutes will it take to fill one-half of the tank?

(a) 19
(b) 18
(c) 36
(d) 37

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Q40. The arithmetic mean of the observations 67, 76, 97, 34, 38, 63, 95, 95 and 74 is:

(a) 68
(b) 71
(c) 63
(d) 62

Q41. The income of Amit in 2019 was Rs. 22,200. He gets an increment of 10% every year. What was his income (in Rs.) in 2021?

(a) 26,640
(b) 26,862
(c) 24,420
(d) 22,200

Q42. The average of the first 10 odd natural numbers is:

(a) 10.5
(b) 10
(c) 11
(d) 9.5

Q43. A person covers a certain distance with a speed of 17 km/h in 8 min. If he wants to cover the same distance in 5 min, what should be his speed?

(a) 27.2 km/h
(b) 26.2 km/h
(c) 29.2 km/h
(d) 28.2 km/h

Q44. A cistern has a leak at the bottom. A pipe can fill the cistern in 6 hours, but due to the leak, it takes 8 hours to fill the cistern. How long would the leak take to empty the full cistern?

(a) 30 hours
(b) 24 hours
(c) 18 hours
(d) 36 hours

Q45. The selling price of an item including GST is Rs. 1,680. The rate of GST is 20%. If the shopkeeper made a profit of 12%, then what is the cost price of the article (in Rs.)?

(a) 1,520
(b) 1,250
(c) 1,205
(d) 1,280

Q46. A shopkeeper offers the following four schemes.

A) Two successive discounts of 19% and 19%
B) Buy 2, get 10
C) Discount of 11%
D) Two successive discounts of 25% and 17%

Which scheme is best for customers?

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

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Q47. A basket contains 96 fruits consisting of mangoes and oranges. If there are 42 more mangoes than oranges, then how many mangoes are there?

(a) 69
(b) 49
(c) 59
(d) 79

Q48. The simplified value of (x - 1/x) (x + 1/x) (x² + 1/(x²)) (x^4 + 1/(x^4)) is:

(a) (x^8 - 1/(x^8))
(b) (x^8 + 1/(x^8))
(c) (x^7 - 1/(x^7))
(d) (x^7 + 1/(x^7))

Q49. If sin θ = 3/5, then find the value of cos θ.

(a) 3/5
(b) 5/4
(c) √3/2
(d) 4/5

Q50. Four times the present age of Anil is equal to five times the present age of Bhavya.
After 6 years, the age of Bhavya will be 6 years less than twice the present age of Anil.
What is the difference (in years) between their present ages?

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

GENERAL INTELLIGENCE & REASONING

Q51. 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 one that does not belong to that group?
(Note: The odd man out is not based on the number of consonants/vowels or their position in the letter cluster)

(a) TG - XK
(b) DW - HA
(c) BN - GS
(d) VR - ZV

Q52. In a certain code language, ‘TEAR’ is coded as ‘5731’ and ‘POST’ is coded as ‘2148’. What is the code for ‘T’ in the given code language?

(a) 2
(b) 1
(c) 5
(d) 8

Q53. Refer to the following series and answer the question (all numbers are single digit numbers only).
(Left) 8 6 5 6 7 2 5 9 8 6 3 2 3 3 4 4 4 6 1 4 4 1 4 5 2 6 6 (Right)
How many such even numbers are there (from left to right) each of which is immediately preceded by an odd number and also immediately followed by an odd number?

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

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Q54. All 36 students in a class are standing in a row, facing north. Priya is 9^(th)from the left end while Neeraj is 27^(th) from the right end. How many people stand between Priya and Neeraj?

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

Q55. LMUG is related to RHYD in a certain way. In the same way, JNSF is related to PIWC. To which of the following is HIVT related, following the same logic?

(a) MEZR
(b) MDYQ
(c) NEYR
(d) NDZQ

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

FVO 18, DTM 29, BRK 40, ZPI 51, ?

(a) XNG 62
(b) WNH 61
(c) YNF 65
(d) XNF 62

Q57. ANTY is related to CKOZ in a certain way based on English alphabetical order. In the same way, UIQL is related to WFLM. To which of the following is DSNB related to, following the same logic?

(a) EPLD
(b) GPKC
(c) HPKD
(d) FPIC

Q58. What should come in place of ? in the given series?

30 36 47 63 84 ?

(a) 111
(b) 110
(c) 112
(d) 109

Q59. What will come in the place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

42 × 7 ÷ 8 - 16 + 9 = ?

(a) 52
(b) 60
(c) 50
(d) 55

Q60. What should come in place of ? in the given series in order to make it logically complete?

AZ81 BC64 DG49 GL36 ?

(a) JT25
(b) KR25
(c) KR16
(d) JS25

Q61. Based on the alphabetical order, three of the following four are alike in a certain way and thus form a group. Which is the one 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) EIM

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(b) WBF
(c) MRV
(d) TYC

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

Statements:

Some bats are nets.

All cubs are nets.

Conclusions:

(I) Some bats are cubs.

(II) All nets are cubs.

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

Q63. JITD is related to EEQB in a certain way based on the English alphabetical order. In the same way, QHSB is related to LDPZ. To which of the following is TNYT related to following the same logic?

(a) PJUS
(b) PKVS
(c) OJVR
(d) OKUR

Q64. This question is based on the five, three-digit numbers given below.

(Left) 629 125 534 756 438 (Right)

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

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

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

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

Q65. Anand starts from Point A and drives 43 km towards the south. He then takes a left turn, drives 40 km, turns left and drives 45 km. He then takes a left turn and drives 51 km. He takes a final left turn, drives 2 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90-degree turns only unless specified.)

(a) 10 km to the east
(b) 11 km to the east
(c) 12 km to the west
(d) 13 km to the west

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 pencils are erasers.

All pencils are rulers.

All rulers are boxes.

Conclusions:

(I) All pencils are boxes.

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(II) Some rulers are erasers.

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

Q67. Raman ranked 10th from the top and 5th from the bottom in his class. How many students are there in his class?

(a) 10
(b) 14
(c) 12
(d) 11

Q68. In a certain code language,

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

A – B means 'A is the father of B',

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

A ÷ B means 'A is the mother of B'.

How is N related to S if 'N ÷ O × P – Q + S'?

(a) Father's mother
(b) Mother's sister
(c) Father's sister
(d) Sister

Q69. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(5, 14, 35)

(4,13, 33)

(a) (7, 16, 40)
(b) (8, 17, 27)
(c) (16, 7, 21)
(d) (10, 19, 45)

Q70. Refer to the following series and answer the question (all numbers are single-digit numbers only) (Counting to be done from left to right only)

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

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

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

Q71. Seven people, S, Q, U, A, R, E and D are sitting in a row, facing north.

Only two people sit to the left of U. Only three people sit between U and R. Only one person sits between R and S. E sits to the immediate left of A. D is not an immediate neighbor of R.

How many people sit to the right of Q?

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

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Q72. Ravi drove 20 km from his office towards the north. He then took a right turn and drove 5 km. He took another right turn and drove 10 km, and then turned right, drove 5 km, and stopped at point A. How far is Ravi from his initial position?

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

(a) 15 km
(b) 20 km
(c) 5 km
(d) 10 km

Q73. In a certain code language, 'YARN' is coded as '5731' and 'ROSE' is coded as '2148'. What is the code for 'R' in the given code language?

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

Q74. A, B, C, D, E, F and G are sitting around a circular table facing the centre. B sits second to the right of A. E sits to the immediate left of A. C is the immediate neighbour of F and G. D sits second to the left of F.

How many people sit between E and G when counted from the left of E?

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

Q75. If 1 is added to each odd digit and 2 is subtracted from each even digit in the number 5431786, what will be difference between the highest and lowest digits in the number thus formed?

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

Q76. Six people G, H, I, Q, R and S are sitting in a straight line facing the north. Only three people are seated to the left of H. Only Q is seated to the right of S. Only three people are seated between Q and I. G is seated at some place to the right of R. How many people are seated between R and S?

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

Q77. What should come in place of the question mark (?) in the given series?

158 169 191 224 268 ?

(a) 312
(b) 323
(c) 321
(d) 332

Q78. What should come in place of '?' in the given series?

153 164 177 192 209 ?

(a) 226
(b) 227
(c) 230
(d) 228

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Q79. Refer to the given series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.

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

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

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

Q80. If 'I' stands for '+', 'J' stands for '×', 'K' stands for '÷' and 'L' stands for '−', then what will come in place of question mark (?) in the following equation?

59 J 4 K 2 I 150 J 2 L 102 K 2 L 15 K 5 L 10 = ?

(a) 312
(b) 354
(c) 298
(d) 376

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. According to a US business intelligence report, who was the most popular democratic leader in July 2025?

(a) Narendra Modi
(b) Nirmala Sitharaman
(c) Rahul Gandhi
(d) Amit Shah

Q82. Under which Article of the Constitution of India was Justice Meenakshi Madan Rai appointed by the President to perform the duties of the Chief Justice of the Sikkim High Court in December 2025?

(a) Article 223
(b) Article 217
(c) Article 226
(d) Article 124

Q83. Which city hosted the 2024 National Boxing Championships from 6 to 13 January?

(a) Patna
(b) Jaipur
(c) Guwahati
(d) Bareilly

Q84. In April 2025, the Securities and Exchange Board of India (SEBI) came out with the operational framework for PaRRVA. What is the purpose of PaRRVA?

(a) Tax auditing of listed firms
(b) Verifying investment performance claims
(c) Settling trading disputes
(d) Approving mutual fund licences

Q85. The 11^(th) edition of the Joint Military Exercise 'MITRA SHAKTI-2025' between India and Sri Lanka was held in which of the following cities?

(a) Belagavi
(b) Chennai
(c) Kochi
(d) Jodhpur

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Q86. In 2025, which ministry launched the Trade Intelligence and Analytics Portal to offer transparent and real-time trade data?

(a) Ministry of Finance
(b) Ministry of Commerce and Industry
(c) Ministry of External Affairs
(d) Ministry of Statistics and Programme Implementation

Q87. Who scored 759 runs to win the IPL 2025 Orange Cap for Gujarat Titans?

(a) Virat Kohli
(b) Suryakumar Yadav
(c) Sai Sudharsan
(d) Rajat Patidar

Q88. Which group of people is expected to benefit the most from the removal of minimum balance penalties by Indian Bank and Punjab National Bank in July 2025?

(a) Rural citizens and low-income account holders
(b) Urban business executives and corporate professionals
(c) High-income investors and wealthy individuals
(d) College students and monthly salaried employees

Q89. Which international joint naval exercise in a disputed maritime region raised eyebrows in 2025?

(a) India–Philippines naval drill in the South China Sea
(b) Exercise Ajeya Warrior in the Bay of Bengal
(c) Iron Fist Drill with Russia in the Indian Ocean
(d) Exercise Malabar with India and Australia near the Malacca Strait

Q90. In September 2025, TDK Corporation inaugurated its Advanced Technologies Lithium-ion Battery Manufacturing Plant in which Indian state?

(a) Rajasthan
(b) Kerala
(c) Uttarakhand
(d) Haryana

Q91. Which is the first fully indigenous microprocessor developed by C-DAC under the Microprocessor Development Programme in 2025?

(a) SHAKTI101
(b) DHRUV64
(c) PRATYUSH55
(d) PARAM32

Q92. Which of the following countries is set to host the first ever Olympic Esports Games, as announced by the International Olympic Committee (IOC) in 2027?

(a) France
(b) China
(c) Saudi Arabia
(d) Qatar

Q93. As per the new Know Your Customer (KYC) relaxations of the Reserve Bank of India (RBI) notified in May 2025, low-risk customers are allowed to continue transactions without KYC until _____.

(a) 31 March 2026
(b) 31 December 2025
(c) 30 June 2025
(d) 30 June 2026

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Q94. Which of the following countries was among the 37 countries that presented its Voluntary National Review (VNR) at the High-Level Political Forum (HLPF) held in July 2025?

(a) China
(b) Nepal
(c) Sri Lanka
(d) India

Q95. Who became the sixth male golfer in history to complete a career Grand Slam by winning the 2025 Masters Tournament?

(a) Jordan Spieth
(b) Phil Mickelson
(c) Rory McIlroy
(d) Tiger Woods

Q96. In July 2025, which panel has suggested revising the 'Guidelines for declaration of ESZ, 2011' issued by the Ministry of Environment, Forest and Climate Change (MoEFCC)?

(a) The Standing Committee of National Tiger Conservation Authority
(b) The Standing Committee of the National Board for Wildlife
(c) The Standing Committee of Central Pollution Control Board
(d) The Standing Committee of Ministry of Rural Development

Q97. Which of the following was the first integrated multi-state mock drill in Delhi-NCR, simulating a large-scale earthquake across 55 locations, conducted from 1 August 2025?

(a) Exercise Tristate Shakti
(b) Exercise Suraksha Chakra
(c) Exercise Sahayata Setu
(d) Exercise Surya Kiran

Q98. What was the theme of India's 76th Republic Day celebrated on 26 January 2025?

(a) Swarnim Bharat: Virasat aur Vikas
(b) Atmanirbhar Bharat: Udaan Nayi Soch Ki
(c) Ek Bharat Shreshtha Bharat
(d) Digital India: Power to Empower

Q99. Who is the 2025 World Junior champion of the open section of Atomic Chess Championship held at Petrovac, Montenegro?

(a) GM Amar Elham
(b) Matic Lavrencic
(c) Pentala Harikrishan
(d) Pranav Venkatesh

Q100. Which of the following volcanoes, located in Ethiopia, was in the news in November 2025 for erupting for the first time in recorded history?

(a) Mount Semeru
(b) Kilauea
(c) Hayli Gubbi
(d) Krasheninnikov

ANSWER KEY

1	a	2	c	3	c	4	b	5	b	6	d	7	c	8	d	9	d	10	a
11	b	12	b	13	b	14	d	15	b	16	a	17	b	18	a	19	c	20	c
21	a	22	a	23	d	24	d	25	c	26	c	27	a	28	b	29	c	30	c
31	c	32	b	33	d	34	b	35	a	36	a	37	b	38	b	39	b	40	b

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41	b	42	b	43	a	44	b	45	b	46	b	47	a	48	a	49	d	50	c
51	c	52	b	53	a	54	b	55	d	56	a	57	d	58	b	59	d	60	b
61	a	62	c	63	c	64	b	65	b	66	a	67	b	68	a	69	d	70	a
71	b	72	d	73	c	74	c	75	d	76	d	77	b	78	d	79	a	80	b
81	a	82	a	83	d	84	b	85	a	86	b	87	c	88	a	89	a	90	d
91	b	92	c	93	d	94	d	95	c	96	b	97	b	98	a	99	d	100	c

SOLUTIONS

Q1. Answer: (a) The action and reaction forces act on the same object.

The correct answer is The action and reaction forces act on the same object..

Key Points

• Newton's Third Law of Motion states that for every action, there is always an equal and opposite reaction. This means that forces always exist in pairs.

• A fundamental requirement of this law is that the action and reaction forces act on two different objects. If they acted on the same object, the net force would always be zero, making it impossible for any individual object to accelerate or change its state of motion. Hence, statement 1 is incorrect.

• The forces involved in the interaction act simultaneously. There is no time delay or "cause and effect" lag between the action and the reaction; they happen at the exact same moment. Hence, statement 2 is correct.

• When one object (Object A) exerts a force on another (Object B), the second object (Object B) instantaneously exerts a force back on the first (Object A). Hence, statement 3 is correct.

• These two forces are equal in magnitude but opposite in direction. This is why the law is often expressed mathematically using vectors as Fab = -Fba. Hence, statement 4 is correct.

• Hence, the correct answer is that the statement "The action and reaction forces act on the same object" is the incorrect one.

Additional Information

• Sir Isaac Newton: He formulated the three laws of motion and published them in his monumental work, "Philosophiae Naturalis Principia Mathematica", in the year 1687. These laws form the basis of Classical Mechanics.

• Newton's First Law (Law of Inertia): It states that an object will remain at rest or continue to move at a constant velocity unless acted upon by an external unbalanced force.

• Newton's Second Law: It establishes that the force (F) acting on an object is equal to the mass (m) of the object multiplied by its acceleration (a), commonly expressed as F = ma. It also defines force as the rate of change of momentum.

• Practical Examples of the Third Law:

• Recoil of a Gun: When a bullet is fired (action), the gun pushes back on the shoulder of the shooter (reaction).

• Walking: To walk forward, a person pushes the ground backward with their foot (action), and the ground pushes the person forward (reaction).

• Propulsion of a Rocket: The rocket engine expels hot exhaust gases downward (action), and the gases exert an upward thrust on the rocket (reaction), allowing it to lift off.

• Swimming: A swimmer pushes the water backward (action), and the water pushes the swimmer forward (reaction).

• Force Measurement: The SI unit of force is the Newton (N). One Newton is defined as the force required to accelerate a mass of 1 kilogram at a rate of 1 meter per second squared (1 kg·m/s²).

Important Points

• Cancellation of Forces: A common misconception is that because the forces are equal and opposite, they should cancel each other out. However, cancellation only occurs when multiple forces act on the same single body. Since action-reaction pairs act on different bodies, they do not cancel each other.

• Mass and Acceleration: While the forces are equal in magnitude, the resulting accelerations of the two objects may be very different depending on their masses (as per the Second Law). For example, the Earth pulls on a falling apple with the same force the apple pulls on the Earth, but the Earth's massive inertia means its acceleration is negligible.

Q2. Answer: (c) R = ρL/A

The correct answer is R = ρL/A.

Key Points

• The electrical resistance (R) of a conductor is defined as the opposition offered by the conductor to the flow of electric current through it.

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• It has been experimentally observed that the resistance of a uniform metallic conductor is directly proportional to its length (L). This means that as the length of the wire increases, the resistance increases proportionally. Hence, the numerator must contain L.

• The resistance is also inversely proportional to the area of cross-section (A) of the conductor. A larger cross-sectional area allows more electrons to flow, thereby reducing the resistance. Hence, the denominator must contain A.

• The resistivity (ρ), also known as specific resistance, is a constant of proportionality that depends on the nature of the material and the temperature. It is a fundamental property of a material that quantifies how strongly it resists or conducts electric current.

• By combining these dependencies, we arrive at the mathematical relation: R = ρ (L / A). This formula is used to calculate the resistance of any linear conductor when its physical dimensions and material properties are known. Hence, the correct relation is R = ρL/A.

Additional Information

• SI Units:

• The SI unit of resistance (R) is the Ohm, represented by the Greek symbol Ω.

• The SI unit of resistivity (ρ) is the Ohm-meter (Ω·m).

• Length (L) is measured in meters (m), and Area (A) is measured in square meters (m^2).

• Nature of Materials:

• Conductors, such as Silver, Copper, and Aluminium, have very low resistivity, typically in the range of 10^-8 Ω·m to 10^-6 Ω·m.

• Insulators like Rubber, Glass, and Ebonite have very high resistivity, often ranging from 10^12 Ω·m to 10^17 Ω·m.

• Alloys like Constantan and Manganin have higher resistivity than their constituent metals and are often used to make standard resistors because their resistance does not change significantly with temperature.

• Conductance and Conductivity:

• The reciprocal of resistance is called Conductance (G), measured in Siemens (S) or mho.

• The reciprocal of resistivity is called Electrical Conductivity (σ), which measures the ability of a material to conduct electricity.

Important Points

• Effect of Temperature: For most metallic conductors, the resistance and resistivity increase with an increase in temperature. However, for semiconductors (like Silicon and Germanium), the resistance decreases as the temperature rises.

• Stretching a Wire: If a wire of resistance R is stretched to n times its original length, its new resistance becomes n^2R. This is because while the length (L) increases, the area of cross-section (A) decreases simultaneously to keep the volume constant.

• Resistivity vs Resistance: It is important to note that while resistance depends on the shape and size (length and area) of the conductor, resistivity is independent of dimensions and depends only on the material and temperature.

• Ohm's Law: This relation is often used in conjunction with Ohm's Law (V = IR), where V is the potential difference and I is the current flowing through the conductor.

Q3. Answer: (c) Galvanisation

The correct answer is Galvanisation.

Key Points

• Galvanisation is a widely used method to protect Iron and Steel from corrosion or rusting by applying a thin protective layer of Zinc.

• The process typically involves Hot-Dip Galvanizing, where the metal component is submerged in a bath of molten Zinc at a temperature of approximately 450°C (842°F).

• The Zinc coating acts as a physical barrier, preventing Oxygen and moisture (water) from reaching the Iron surface, which are the two primary requirements for rust formation.

• Even if the coating is damaged or scratched, the Zinc provides cathodic protection by acting as a sacrificial anode; it corrodes in preference to the Iron because Zinc is more chemically active.

• Common applications of this method include G.I. pipes (Galvanised Iron), roofing sheets, nails, screws, fencing wire, and structural steel used in construction. Hence, the correct answer is Galvanisation.

Additional Information

• The Chemistry of Rusting:

• Rusting is an oxidation reaction where Iron reacts with Oxygen in the presence of water to form Hydrated Iron (III) Oxide ($Fe_2O_3 \cdot nH_2O$).

• Unlike the oxide layer on Aluminum, rust is porous and flaky; it does not protect the underlying metal but instead promotes further corrosion.

• Alloying:

• This involves mixing Iron with other elements like Chromium and Nickel to produce Stainless Steel.

• The Chromium (usually at least 10.5%) reacts with Oxygen to form a very thin, invisible, and self-healing layer of Chromium Oxide that prevents rust.

• Other Protective Methods:

• Painting: Provides a simple barrier; commonly used for bridges, ships, and cars.

• Greasing and Oiling: Used for moving machine parts and tools where paint cannot be applied; it displaces moisture.

• Electroplating: Using electricity to deposit a layer of metals like Tin, Chromium, or Nickel on the surface of Iron objects.

• Incorrect Options:

• Magnetising: This is the process of making a substance magnetic and has no effect on the chemical process of rusting.

• Melting: This is a physical change from solid to liquid and does not offer any long-term protection against oxidation.

• Heating: Exposure to high heat in the presence of air can actually accelerate the formation of metal oxides rather than preventing them.

Important Points

• The rate of rusting is significantly higher in coastal areas because the saltwater (saline water) contains ions that increase the electrical conductivity of the water film on the metal, speeding up the electrochemical reaction.

• Zinc has an atomic number of 30 and is placed higher than Iron (atomic number 26) in the Reactivity Series of metals.

• Anodizing is a similar electrochemical process but is specifically used to thicken the natural oxide layer on Aluminum surfaces to increase durability.

• The Iron Pillar of Delhi, built in the 4th century CE, is a world-famous example of corrosion resistance achieved through specific metallurgical compositions (high phosphorus content) rather than modern Galvanisation.

Q4. Answer: (b) 6.3 x 10^(-7) Ωm

The correct answer is 6.3 x 10^(-7) Ωm.

Key Points

• The relationship between the resistance (R) of a wire, its length (L), and its area of cross-section (A) is given by the formula R = ρ (L / A), where ρ (rho) represents the resistivity of the material.

• In this problem, the given values are: Resistance (R) = 10 Ω, Length (L) = 2 m, and Diameter (d) = 0.4 mm. The temperature is constant at 25°C, ensuring that the resistivity remains stable during the measurement.

• First, the diameter must be converted to meters (m) to maintain SI unit consistency. Since 1 mm = 10^(-3) m, the diameter (d) is 0.4 x 10^(-3) m or 4 x 10^(-4) m.

• The area of cross-section (A) of the wire is calculated using the formula for the area of a circle, A = (πd²) / 4. Substituting π = 3.14 and d = 4 x 10^(-4) m, we get A = (3.14 x (4 x 10^(-4))²) / 4, which simplifies to 12.56 x 10^(-8) m².

• To find the resistivity (ρ), we rearrange the formula to ρ = (R x A) / L. Substituting the values: ρ = (10 Ω x 12.56 x 10^(-8) m²) / 2 m. This calculation yields ρ = 6.28 x 10^(-7) Ωm, which is approximately 6.3 x 10^(-7) Ωm.

Additional Information

• Resistivity (ρ): It is an intrinsic property of a material that quantifies how strongly it resists the flow of electric current. Unlike resistance, it does not depend on the shape or size of the object but only on the nature of the material and its temperature.

• SI Unit: The standard unit of resistivity is the Ohm-meter (Ωm). Materials with low resistivity, such as Copper (1.68 x 10^(-8) Ωm) and Silver, are excellent conductors, while those with high resistivity, like Glass or Rubber, act as insulators.

• Temperature Dependence: For most metals, resistivity increases linearly with an increase in temperature. This is because increased thermal vibrations of atoms impede the flow of electrons. The specific temperature of 25°C mentioned in the question is a standard reference point for such physical constants.

• Resistance vs. Resistivity: While resistance (R) changes if you stretch or cut a wire (changing its length or area), the resistivity (ρ) remains the same as long as the material and temperature are unchanged. This makes resistivity a vital parameter in material science and electrical engineering for selecting appropriate wires for circuits.

Important Points

• Mathematical Steps Summary:

• Radius (r) = d / 2 = 0.2 mm = 2 x 10^(-4) m.

• Area (A) = πr² = 3.14 x (2 x 10^(-4))² = 3.14 x 4 x 10^(-8) = 1.256 x 10^(-7) m².

• Resistivity (ρ) = (10 x 1.256 x 10^(-7)) / 2 = 6.28 x 10^(-7) Ωm.

• Significance of Diameter: Small changes in diameter have a squared effect on the area, significantly impacting the total resistance of the wire. A thinner wire (smaller diameter) will have a much higher resistance for the same length and material.

• Applications: Knowing the resistivity helps in designing heating elements (like Nichrome) where high resistivity is desired to generate heat, or transmission lines (like Aluminum) where low resistivity is essential to minimize energy loss.

Q5. Answer: (b) Presence of contractile proteins

The correct answer is Presence of contractile proteins.

Key Points

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• Muscular tissue consists of elongated cells, also known as muscle fibers. This tissue is responsible for all types of movement within the body of an animal.

• Muscles contain special proteins called contractile proteins, which contract and relax to cause movement. The two primary types of these proteins are actin and myosin.

• When these proteins slide over one another, the muscle cell shortens, leading to contraction. When they return to their original position, it leads to relaxation. This coordinated cycle is the fundamental mechanism of locomotion and internal physical functions.

• Regarding the other options provided in the question:

• Storage of fat droplets: This is a primary function of adipose tissue, which acts as an energy reservoir and insulator. Hence, statement 1 is incorrect.

• Presence of contractile proteins: These are the mechanical engines of the muscle cell that facilitate physical displacement and force. Hence, statement 2 is correct.

• Ability to transmit nerve impulses: While muscles respond to electrical signals, the actual transmission of impulses over long distances is the specialized function of nervous tissue (neurons). Hence, statement 3 is incorrect.

• Secretion of digestive enzymes: This is a function performed by epithelial tissue, specifically glandular epithelium found in the stomach, pancreas, and intestines. Hence, statement 4 is incorrect.

Additional Information

• Types of Muscular Tissue:

• Striated Muscle (Skeletal Muscle): These are voluntary muscles mostly attached to bones. Under a microscope, they show alternate light and dark bands or striations. They are long, cylindrical, unbranched, and multinucleated.

• Smooth Muscle (Unstriated Muscle): These are involuntary muscles found in the walls of hollow internal organs such as the alimentary canal, blood vessels, and the iris of the eye. They are spindle-shaped (tapering at ends) and have a single nucleus.

• Cardiac Muscle: These are found exclusively in the heart. They are involuntary, cylindrical, branched, and uninucleated. They show rhythmic contraction and relaxation throughout the lifespan of the animal without getting fatigued.

• Mechanism of Movement:

• The Sliding Filament Theory is the most widely accepted explanation for muscle contraction. It states that the thick (myosin) and thin (actin) filaments slide past each other, decreasing the length of the sarcomere (the functional unit of contraction).

• Muscle contraction is often triggered by Calcium ions (Ca^{2+}) released from the sarcoplasmic reticulum following a stimulus from the nervous system.

Important Points

• Sarcomere: It is defined as the segment between two neighboring Z-lines and is considered the basic unit of a muscle's cross-striated myofibril.

• Excitability: This is the ability of muscle tissue to receive and respond to stimuli, which distinguishes it from other connective tissues.

• Energy Requirement: Muscle contraction is an active process that requires a significant amount of Adenosine Triphosphate (ATP), which is why muscle cells contain a high number of mitochondria.

• Locomotion vs. Movement: While movement refers to the change in position of any part of the body, locomotion specifically refers to the movement of the entire animal from one location to another.

Q6. Answer: (d) The graph is a straight line.

The correct answer is The graph is a straight line.

Key Points

• For an object moving with uniform speed, the distance traveled is directly proportional to the time taken. This linear relationship ensures that as time increases, the distance increases at a constant rate.

• In a distance-time graph, time is typically plotted on the X-axis (independent variable) and distance is plotted on the Y-axis (dependent variable).

• The slope of a distance-time graph represents the speed of the object. Since the speed is uniform (constant), the slope remains the same at every point on the graph, which mathematically results in a straight line.

• A straight line passing through the origin (0,0) indicates that the object was at the reference starting point at time zero and moved with a constant velocity thereafter. Hence, statement 4 is correct.

• A sine wave graph represents oscillatory or periodic motion, such as a pendulum, where the position varies harmonically over time. Hence, statement 1 is incorrect.

• A zig-zag line represents non-uniform motion where the speed and direction change abruptly and inconsistently. Hence, statement 3 is incorrect.

Additional Information

• Uniform Motion:

• An object is said to be in uniform motion if it covers equal distances in equal intervals of time, no matter how small these time

intervals may be.

• In this state, the acceleration of the object is zero because the velocity does not change in magnitude or direction.

• Non-Uniform Motion:

• If an object covers unequal distances in equal intervals of time, it is in non-uniform motion.

• The distance-time graph for non-uniform motion is a curved line, indicating that the speed is changing (accelerating or decelerating).

• Object at Rest:

• When an object is stationary, its distance from the reference point does not change as time passes.

• The distance-time graph for an object at rest is a horizontal straight line parallel to the time-axis (X-axis), where the slope is zero.

• Speed Calculation from Graph:

• To find the speed from a distance-time graph, one can pick any two points (x1, y1) and (x2, y2) on the line and calculate the gradient.

• The formula used is Speed = (Distance2 - Distance1) / (Time2 - Time1). For a straight line, this value will always be constant.

Important Points

• Steepness of the Graph: The steepness or gradient of the straight line indicates the magnitude of speed. A steeper line represents a higher speed, while a flatter line represents a lower speed.

• Physical Constraints: A distance-time graph can never be a vertical line parallel to the Y-axis. This would imply the object is covering distance in zero time, which means it has infinite speed—a physical impossibility in classical mechanics.

• Comparison: By plotting distance-time lines for two different objects on the same graph, one can easily compare their relative speeds by looking at which line is closer to the Y-axis (steeper).

• Units: Standard SI units used in these graphs are meters (m) for distance and seconds (s) for time, making the unit of the slope (speed) m/s.

Q7. Answer: (c) Both (i) and (iii)

The correct answer is Both (i) and (iii).

Key Points

• A concave lens is an optical device that is thinner at the center than at the edges. It is fundamentally known as a diverging lens because it causes parallel rays of light to spread out or diverge after passing through it. Hence, statement (i) is correct.

• The divergence of light rays means they never meet on the opposite side of the lens; instead, they appear to originate from a single point called the principal focus on the same side as the object.

• A concave lens always produces a virtual, erect, and diminished image, regardless of where the object is placed. It cannot form a real and inverted image because the refracted rays do not actually intersect. Hence, statement (ii) is incorrect.

• Because the image is always formed by the apparent intersection of light rays, it is categorized as virtual. Since the image is oriented in the same direction as the object, it is described as erect. Hence, statement (iii) is correct.

• Therefore, the correct answer is Both (i) and (iii).

Additional Information

• Optical Characteristics:

• The focal length of a concave lens is considered negative according to the Cartesian sign convention.

• The power of a concave lens is also negative, expressed in Dioptres (D). For example, a prescription of -2.0 D indicates a concave lens.

• Image Positions:

• If an object is placed at infinity, the image is formed at the focus (F1), being highly diminished and point-sized.

• If the object is between infinity and the optical center (O), the image is formed between the focus and the optical center on the same side as the object.

• Common Applications:

• Spectacles: These lenses are the primary tool used to correct Myopia (nearsightedness), helping the eye focus light correctly on the retina.

• Flashlights: They are used to diverge the light beam to cover a larger area.

• Peepholes: Installed in doors to provide a diminished but wide-angle view of the area outside.

• Telescopes: Often used in the eyepieces of Galilean telescopes to provide an upright image.

Important Points

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

• Magnification (m): It is the ratio of the height of the image to the height of the object, or m = v/u. For a concave lens, the magnification is always positive and less than 1, indicating the image is virtual and smaller than the object.

• Refractive Index: The degree of divergence depends on the refractive index of the material (like glass or plastic) and the curvature of the lens surfaces.

• Comparison: Unlike a convex lens (converging lens), which can form real, inverted, magnified, or virtual images based on the object's position, the concave lens is much more limited and consistent in its image properties.

Q8. Answer: (d) Filtration, because the solid particles in mud are not dissolved in water

The correct answer is Filtration, because the solid particles in mud are not dissolved in water.

Key Points

• Filtration is a physical separation method used to remove insoluble solid particles from a liquid or gas by passing the mixture through a porous medium (like filter paper).

• A mixture of mud and water is a heterogeneous mixture (specifically a suspension), meaning the components are not uniformly distributed and the solid mud particles do not dissolve in the water. Hence, the statement provided in option 4 is correct.

• During this process, the clear liquid that passes through the filter is called the filtrate, while the solid particles trapped on the filter medium are referred to as the residue.

• This method is highly effective for pond water because the particle size of mud is significantly larger than the pore size of standard filtration media, ensuring a clear separation without needing heat or chemical additives.

• Unlike methods that involve phase changes, filtration preserves both the solid and the liquid components in their original states, making it efficient for large volumes of muddy water.

Additional Information

• Evaporation:

• This method involves heating the mixture until the solvent (water) turns into vapor, leaving the solute (mud) behind.

• While it separates the mud, it is less "effective" for general separation because the water is lost to the atmosphere unless a condenser is used. It is typically used for homogeneous mixtures like salt and water.

• Distillation:

• Distillation is a process that separates components based on differences in their boiling points.

• It is primarily used to separate miscible liquids (like alcohol and water) or to obtain pure water from a salt solution. Using it for mud and water is unnecessarily complex and energy-intensive compared to filtration.

• Chromatography:

• This technique is used to separate components of a mixture based on their different rates of movement through a stationary phase under the influence of a mobile phase.

• It is used for separating dyes, pigments, or chemicals in a solution, rather than separating bulk solids like mud from water.

• Heterogeneous vs. Homogeneous Mixtures:

• Heterogeneous mixtures (e.g., mud in water, oil in water) have visible boundaries of separation.

• Homogeneous mixtures (e.g., sugar in water, air) have a uniform composition throughout and cannot be separated by simple filtration.

Important Points

• Sedimentation and Decantation: Before filtration, a mixture of mud and water can be left undisturbed to allow the heavier mud particles to settle at the bottom due to gravity; this is sedimentation. The clear water can then be poured out, which is decantation. Filtration is often the final step after these to ensure total clarity.

• Loading: Sometimes, very fine mud particles stay suspended. To speed up sedimentation, Alum (potash alum) is added. This process is called loading, where the alum particles attach to the fine dirt, making them heavy enough to sink.

• Applications: Filtration is a critical step in municipal water treatment plants, where large-scale sand filters are used to provide potable water to cities. In daily life, it is used in tea strainers and HEPA filters in vacuum cleaners to trap dust.

Q9. Answer: (d) 10√10 m/s

The correct answer is 10√10 m/s.

Key Points

• The problem describes a case of vertical motion under gravity, which is a form of uniformly accelerated motion where the acceleration is constant.

• When an object is thrown vertically upward, its velocity decreases until it reaches the highest point. At this maximum height, the final velocity (v) of the object becomes 0 m/s.

• To find the initial velocity (x), we use the third equation of motion: $v^2 = u^2 + 2as$. In this context, u is the initial velocity (x), v is the final velocity (0 m/s), a is the acceleration due to gravity (-g), and s is the maximum height (H).

• Given values are maximum height (H) = 50 m and acceleration due to gravity (g) = 10 m/s². Because the ball is moving upward against the pull of gravity, the acceleration is taken as -10 m/s².

• Substituting the values into the equation: $0^2 = x^2 + 2(-10)(50)$. This simplifies to $0 = x^2 - 1000$.

• Solving for x, we get $x^2 = 1000$, which means $x = \sqrt{1000}$. This can be simplified to $x = \sqrt{(100 \times 10)}$, resulting in $x = 10\sqrt{10}$ m/s. Hence, the calculated value of initial velocity is correct.

Additional Information

• Newton's Equations of Motion:

• These equations describe the relationship between velocity, acceleration, time, and displacement for an object moving with constant acceleration.

• The first equation is $v = u + at$, used to find velocity or time.

• The second equation is $s = ut + (1/2)at^2$, used to determine the displacement of an object over a period of time.

• The third equation is $v^2 = u^2 + 2as$, which is independent of time and relates velocity directly to displacement.

• Acceleration due to Gravity (g):

• This is the acceleration gained by an object due to the gravitational force of the Earth.

• Its standard value is approximately 9.8 m/s^2 at sea level, but for competitive exams and simplified calculations, it is often taken as 10 m/s^2.

• The value of g varies slightly depending on altitude and latitude, being higher at the poles and lower at the equator.

• Maximum Height (H):

• The maximum height attained by a projectile or a vertically thrown object occurs when its kinetic energy is fully converted into potential energy (neglecting air resistance).

• The formula derived from the equations of motion for maximum height is $H = u^2 / (2g)$.

• If the initial velocity is doubled, the maximum height will increase by four times, following the square relationship.

Important Points

• Sign Convention: In physics problems involving vertical motion, it is crucial to maintain a consistent sign convention. Usually, upward direction is taken as positive and downward direction as negative. Since gravity always acts downward, g is treated as negative when an object is thrown upward.

• Mass Independence: In a vacuum (where air resistance is zero), the maximum height reached by an object depends only on its initial velocity and gravity, not on its mass. A heavy ball and a light ball thrown with the same velocity will reach the same height.

• Time of Ascent and Descent: For an object thrown vertically upward, the time taken to reach the maximum height (time of ascent) is equal to the time taken to return to the original level (time of descent), provided air resistance is ignored. This is calculated as $t = u / g$.

• Kinetic and Potential Energy: At the point of projection, the object has maximum kinetic energy. At the maximum height of 50 m, its kinetic energy is zero, and its potential energy is at its maximum value.

Q10. Answer: (a) Butane

The correct answer is Butane.

Key Points

• Butane is a saturated hydrocarbon belonging to the alkane family with the molecular formula C_4H_{10}.

• A saturated hydrocarbon is one where all the carbon-carbon bonds are single covalent bonds, allowing the maximum number of hydrogen atoms to be bonded to the carbon skeleton.

• The term straight-chain refers to an acyclic structure where the carbon atoms are linked in a continuous, unbranched sequence. Butane (specifically n-butane) consists of 4 carbon atoms arranged in a line. Hence, statement 1 is correct.

• In Butane, each of the two inner carbon atoms is bonded to 2 hydrogen atoms, and the two terminal carbon atoms are bonded to 3 hydrogen atoms, following the general formula for alkanes, which is C_nH_{2n+2}.

• It is a colorless, highly flammable gas at room temperature and atmospheric pressure, commonly used as fuel in LPG (Liquefied Petroleum Gas) and lighters.

Additional Information

• Propene:

• It is an unsaturated hydrocarbon with the chemical formula C_3H_6.

• It belongs to the alkene group because it contains at least one double bond between carbon atoms.

• Since it contains a double bond, it does not meet the criteria of being "saturated." Hence, statement 3 is incorrect.

• Cyclohexane:

• It is a saturated hydrocarbon because it contains only single bonds, but it is cyclic rather than straight-chain.

• Its molecular formula is C_6H_{12}, and the carbon atoms form a hexagonal ring structure.

• While it is saturated, its ring structure excludes it from being a "straight-chain" hydrocarbon. Hence, statement 2 is incorrect.

• Benzene:

• It is an aromatic hydrocarbon with the chemical formula C_6H_6.

• It is cyclic and highly unsaturated, containing three alternating double bonds within a 6-carbon ring.

• Because it is both cyclic and unsaturated, it does not fit the category of straight-chain saturated hydrocarbons. Hence, statement 4 is incorrect.

Important Points

• Alkanes (Saturated): These hydrocarbons follow the general formula CnH2n+2. Examples include Methane (CH4), Ethane (C2H6), and Propane (C3H8). They are generally less reactive than unsaturated hydrocarbons.

• Alkenes and Alkynes (Unsaturated): These contain double (CnH2n) or triple bonds (CnH2n-2), respectively. They are called unsaturated because they can undergo addition reactions to bond with more hydrogen atoms.

• Isomerism: While n-butane is a straight chain, it has an isomer called isobutane (or 2-methylpropane), which is a branched-chain saturated hydrocarbon. Both share the same formula C4H10 but have different structural arrangements.

• Homologous Series: Alkanes form a homologous series where each successive member differs from the previous one by a CH2 group and has a mass difference of 14 units.

Q11. Answer: (b) The forebrain

The correct answer is The forebrain.

Key Points

• The forebrain, also known as the prosencephalon, is the most developed and largest part of the human brain, primarily responsible for higher-order cognitive functions.

• It consists of the cerebrum, thalamus, and hypothalamus. The cerebrum forms the bulk of the brain and is the seat of intelligence, memory, and consciousness.

• The cerebral cortex, the outer layer of the cerebrum, is highly folded into gyri and sulci to increase surface area, allowing for complex interpretation of sensory information such as vision, hearing, and touch. Hence, the statement regarding higher-level thought processes is correct.

• It is the site where voluntary motor actions are initiated and where abstract reasoning, problem-solving, and language processing occur.

• The thalamus within the forebrain acts as a major relay station, filtering and directing sensory impulses to the appropriate regions of the cerebral cortex for processing.

Additional Information

• Structure of the Cerebrum:

• The cerebrum is divided into two cerebral hemispheres connected by a thick band of nerve fibers called the corpus callosum.

• Each hemisphere is divided into four lobes: the Frontal lobe (decision making and motor control), Parietal lobe (sensory perception), Temporal lobe (auditory processing and memory), and Occipital lobe (visual processing).

• The Hypothalamus:

• Located at the base of the forebrain, it plays a critical role in maintaining homeostasis.

• It regulates body temperature, hunger, thirst, and circadian rhythms, and controls the pituitary gland, linking the nervous system to the endocrine system.

• The Cerebellum:

• Located in the hindbrain, it is known as the "little brain." Its primary function is the coordination of voluntary movements, maintenance of posture, and balance.

• It does not initiate movement but fine-tunes it for accuracy and timing.

• The Brainstem:

• Comprising the midbrain, pons, and medulla oblongata, it connects the brain to the spinal cord.

• It controls autonomic functions essential for survival, such as breathing, heart rate, and blood pressure.

Important Points

• The Spinal Cord: This is a long, thin bundle of nervous tissue that extends from the brainstem. It primarily functions as a conduction pathway for messages between the brain and the rest of the body and coordinates spinal reflexes.

• Limbic System: Often referred to as the "emotional brain," it is located within the forebrain and includes the amygdala (emotion) and hippocampus (long-term memory formation).

• Gray Matter vs. White Matter: The cerebral cortex is composed of gray matter (cell bodies), while the inner part of the forebrain contains white matter (myelinated axons) that facilitates communication between different brain regions.

• Evolutionary Context: The forebrain has undergone the most significant expansion in mammals, particularly in humans, which accounts for our advanced cognitive capabilities compared to other species.

Q12. Answer: (b) CH4

The correct answer is CH4.

Key Points

• Methane is a chemical compound with the chemical formula CH4. It is the simplest member of the alkane series, which consists of saturated hydrocarbons.

• A single molecule of methane consists of one carbon atom located at the center, which is bonded to four hydrogen atoms.

• The bonding in methane is characterized by four single covalent bonds. The carbon atom shares its four valence electrons with four individual hydrogen atoms, allowing all atoms to achieve a stable electronic configuration.

• The molecular geometry of methane is tetrahedral. This means the four hydrogen atoms are positioned at the corners of a tetrahedron with the carbon atom at the center, resulting in bond angles of approximately 109.5 degrees.

• Methane is the primary component of natural gas, often comprising 70% to 90% of the mixture depending on the source.

Additional Information

• Physical Properties:

• At standard temperature and pressure, methane is a colorless, odorless, and tasteless gas. Because it is odorless, gas companies often add a chemical called mercaptan (which smells like rotten eggs) to natural gas to make leaks detectable.

• It has a very low boiling point of approximately -161.5 degrees Celsius and a melting point of -182.5 degrees Celsius.

• Industrial and Domestic Uses:

• Methane is a vital fuel source used globally for heating, cooking, and generating electricity in power plants.

• In the chemical industry, it serves as a primary raw material for the production of hydrogen gas, methanol, acetic acid, and acetylene through processes like steam reforming.

• Environmental and Biological Significance:

• Methane is a potent greenhouse gas. Although it persists in the atmosphere for a shorter time than carbon dioxide, its Global Warming Potential (GWP) is estimated to be 25 to 28 times greater than that of CO2 over a 100-year period.

• Natural sources include wetlands, termites, and oceans. Human-related sources include landfills, rice agriculture, and livestock farming (through enteric fermentation in ruminants like cattle).

Important Points

• Chemical Reaction (Combustion): When methane burns in the presence of sufficient oxygen, it undergo complete combustion to produce carbon dioxide and water vapor, releasing 891 kJ/mol of energy. The balanced equation is: CH4 + 2O2 -> CO2 + 2H2O.

• Molar Mass: The molar mass of methane is approximately 16.04 grams per mole, calculated from the atomic mass of Carbon (12.01) and Hydrogen (1.008 x 4).

• Historical Context: Methane was first scientifically identified by Alessandro Volta between 1776 and 1778 while he was studying marsh gas from Lake Maggiore in Italy.

• Alternative Names: Methane is frequently referred to as marsh gas, swamp gas, or firedamp (specifically when found in coal mines).

Q13. Answer: (b) Capture fishing

The correct answer is Capture fishing.

Key Points

• Capture fishing is the process of obtaining fish directly from natural resources such as rivers, lakes, oceans, and seas.

• In this method, the fish population is not manually bred or reared; instead, it relies on the natural reproduction and growth of fish in their wild habitats. Hence, the statement aligns with the definition of capture fishing.

• Capture fishing can be classified into two main types: Marine fishery (conducted in salt water) and Inland fishery (conducted in fresh water).

• Common techniques used in Capture fishing include the use of fishing nets, traditional boats, and mechanized trawlers to harvest fish from the wild.

• Popular marine fish varieties caught through this method include Mackerel, Tuna, Sardines, and Pomphret, which are of high economic value.

Additional Information

• Culture Fishing (Aquaculture):

• This involves the controlled cultivation and rearing of aquatic organisms, including fish, mollusks, and crustaceans.

• Unlike capture fishing, Culture fishing requires human intervention in the breeding process to increase production.

• Mariculture:

• This is a specialized branch of aquaculture involving the cultivation of marine organisms for food in the open ocean or enclosed sections of the sea.

• Commonly cultured organisms include Prawns, Oysters, and Seaweeds.

• Composite Fish Culture:

• This is a highly productive system where five or six fish species are grown together in a single fishpond.

• Species are selected such that they have different feeding habits and do not compete for food. For example, Catla are surface

feeders, Rohu feed in the middle zone, and Mrigal and Common Carp are bottom feeders.

• This method ensures that the food available in all parts of the pond is utilized efficiently, leading to a high yield.

• Blue Revolution:

• The Blue Revolution refers to the time of intense growth in the worldwide aquaculture industry from the mid-1960s to the present day.

• In India, it was launched during the 7th Five-Year Plan (1985-1990) to double the income of fish farmers and increase fish production through modern technology.

Important Points

• Inland Fisheries: These include freshwater resources like canals, ponds, reservoirs, and rivers, as well as brackish water resources like estuaries and lagoons.

• Economic Significance: Fish is a cheap source of animal protein and fishing provides a livelihood to millions of people, especially in coastal states of India such as Kerala, West Bengal, and Andhra Pradesh.

• Sustainable Fishing: Due to over-exploitation, many natural fish stocks are depleting, making the balance between capture fishing and culture fishing essential for environmental sustainability.

Q14. Answer: (d) Refraction

The correct answer is Refraction.

Key Points

• Refraction is the fundamental optical principle where light rays bend when they pass from one transparent medium to another of different optical density, such as from air into a glass or plastic lens.

• Spectacle lenses are designed with specific curvatures to utilize refraction to redirect light. This ensures that the light rays entering the eye are properly focused directly onto the retina, rather than in front of or behind it.

• The degree of bending depends on the refractive index of the lens material and the angle of incidence. Corrective lenses use materials with a higher refractive index than air to achieve the desired vision correction.

• This principle is governed by Snell's Law, which describes the relationship between the angles of incidence and refraction. Hence, the correct answer is Refraction.

Additional Information

• Myopia (Nearsightedness):

• In this condition, the eyeball is too long or the cornea is too curved, causing light to focus in front of the retina.

• It is corrected using a Concave Lens (diverging lens), which spreads the light rays before they reach the eye, moving the focal point back onto the retina.

• Hypermetropia (Farsightedness):

• In this case, light focuses behind the retina because the eyeball is too short or the lens lacks sufficient converging power.

• A Convex Lens (converging lens) is used to bend the light rays inward earlier, allowing them to converge exactly on the retinal surface.

• Other Optical Principles (Incorrect Options):

• Reflection: This is the bouncing back of light when it hits a surface. While mirrors work on reflection, lenses do not rely on this to correct vision. Statement 3 is incorrect.

• Polarization: This process involves filtering light waves to vibrate in a single plane. It is used in sunglasses to reduce glare from reflective surfaces like water or roads, but it does not correct refractive errors. Statement 1 is incorrect.

• Diffraction: This is the slight bending of light as it passes around the edge of an object or through an opening. It is not the principle used for standard vision correction in spectacles. Statement 2 is incorrect.

• Astigmatism: This occurs when the cornea or lens has an irregular shape, leading to blurred vision at all distances. It is corrected using Cylindrical Lenses that refract light differently in horizontal and vertical planes.

Important Points

• Lens Power: The ability of a lens to refract light is measured in Dioptres (D). The power (P) is the reciprocal of the focal length (f) in metres (P = 1/f).

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

• Presbyopia: A condition associated with age (typically appearing after 40 years), where the eye's natural lens loses elasticity, making it difficult to focus on close objects. It is often corrected with Bifocal or Progressive lenses.

• Contact Lenses: These work on the same principle of refraction but are placed directly on the tear film of the cornea.

Q15. Answer: (b) is zero

The correct answer is is zero.

Key Points

• In physics, Work Done is defined as the product of the component of the Force in the direction of the Displacement and the magnitude of that displacement.

• The mathematical formula used to calculate work is W = F s cos θ, where W is the work done, F is the magnitude of the force applied, s is the displacement of the object, and θ (theta) is the angle between the force vector and the displacement vector.

• When a force is applied at an angle of 90 degrees to the direction of displacement, it is considered perpendicular. In trigonometry, the value of cos 90 degrees is exactly 0.

• Substituting this into the formula (W = F x s x 0), the resulting Work Done becomes zero. This indicates that the force does not contribute to the movement of the object in that specific direction. Hence, the statement that work done is zero is correct.

• A practical example is a person walking on a flat road while carrying a load on their head. The force of gravity acts vertically downwards, while the displacement is horizontal (at a 90-degree angle). Therefore, the work done by gravity on the load is zero.

Additional Information

• Positive Work: This occurs when the force and the displacement are in the same direction, meaning the angle θ is 0 degrees (or generally between 0 and 90). In this scenario, cos θ is positive, and the work done adds kinetic energy to the object.

• Negative Work: This happens when the force acts in the opposite direction to the displacement, such as when the angle θ is 180 degrees. A common example is the force of friction, which opposes motion, resulting in a negative value because cos 180 degrees is -1.

• SI Unit: The standard International System of Units (SI) unit for work is the Joule (J). One Joule is defined as the work done by a force of one Newton (N) causing a displacement of one meter (m).

• Scalar Nature: Although both force and displacement are vector quantities, work done is a scalar quantity. This means it only has magnitude and no specific direction in space.

Important Points

• Centripetal Force: In the case of uniform circular motion, the centripetal force is always directed towards the center of the circle, while the displacement is tangential. Because the angle between them is always 90 degrees, the work done by the centripetal force is always zero.

• Zero Displacement: Even if a massive amount of force is applied, the work done is zero if the object does not move. For example, pushing against a rigid stone wall that does not budge results in no work being performed in the scientific sense.

• Energy Transformation: Work is a method of energy transfer. When zero work is done at a 90-degree angle, it signifies that no energy is being transferred into or out of the system by that particular force component.

• Dimensions: The dimensional formula for work is [M1 L2 T-2], which is the same as the dimensional formula for energy and torque.

Q16. Answer: (a) it loses oxygen or gains hydrogen

The correct answer is it loses oxygen or gains hydrogen.

Key Points

• Reduction is a fundamental chemical process that can be defined in multiple ways. Classically, it refers to the removal of oxygen from a chemical species or the addition of hydrogen to it. Hence, statement 1 is correct.

• While gaining hydrogen is a form of reduction, the definition is broader than just hydrogen alone. Focusing only on hydrogen neglects the oxygen-loss aspect of the process. Hence, statement 2 is incorrect.

• Similarly, while losing oxygen is a hallmark of reduction, the definition also encompasses the gain of hydrogen. Relying only on oxygen loss makes the definition incomplete in classical chemistry. Hence, statement 3 is incorrect.

• The process of losing hydrogen or gaining oxygen is actually the definition of Oxidation, which is the chemical opposite of reduction. Hence, statement 4 is incorrect.

• In modern electronic theory, reduction is more accurately described as a process where an atom, ion, or molecule gains one or more electrons. This gain of electrons leads to a decrease in the oxidation state of the substance.

Additional Information

• Oxidation and Reduction (Redox): These two processes never occur in isolation. If one substance is reduced, another must be oxidized. These coupled reactions are known as Redox reactions. For example, in the reaction between Magnesium and Oxygen to form Magnesium Oxide, magnesium is oxidized while oxygen is reduced.

• Reducing Agents: A substance that provides electrons or hydrogen, or removes oxygen, is called a Reducing Agent. Paradoxically, the reducing agent itself undergoes oxidation during the reaction. Common reducing agents include Carbon (C), Carbon Monoxide (CO), and Hydrogen gas (H2).

• Industrial Applications: Reduction is vital in Metallurgy. Most metals exist in nature as oxides. To obtain pure metal, the ore must be reduced. For instance, in a Blast Furnace, Iron(III) Oxide is reduced by carbon monoxide to produce molten iron.

• Biological Significance: Reduction processes are essential for life. In Photosynthesis, Carbon Dioxide (CO_2) is reduced to form Glucose ($C_6H_{12}O_6$). In cellular respiration, electron carriers like NAD+ are reduced to NADH to transport energy within the cell.

• Mnemonics for Memory: Students often use the phrase "OIL RIG" to remember the electronic definitions: Oxidation Is Loss (of electrons), Reduction Is Gain (of electrons). Another popular one is "LEO says GER": Lose Electrons Oxidation, Gain Electrons

Reduction.

Important Points

• Oxidation Number: A clear indicator of reduction is a numerical decrease in the oxidation number. For example, if an ion goes from a +3 charge to a +2 charge, it has been reduced.

• Electropositive/Electronegative Elements: Beyond oxygen and hydrogen, reduction can be defined as the addition of an electropositive element or the removal of an electronegative element from a compound.

• Corrosion: While oxidation causes the corrosion of metals (like the rusting of iron), reduction is used in electroplating and cathodic protection to prevent such damage by supplying electrons to the metal surface.

Q17. Answer: (b) Carbon dioxide

The correct answer is Carbon dioxide.

Key Points

• When hydrochloric acid (HCl) is added to calcium carbonate ($CaCO_3$), a chemical reaction occurs that produces calcium chloride ($CaCl_2$), water (H_2O), and carbon dioxide (CO_2).

• The balanced chemical equation for this reaction is: $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$.

• The release of carbon dioxide gas is observed as brisk effervescence, which is the rapid formation of bubbles in the liquid.

• This reaction is a classic example of an acid-carbonate reaction, where an acid reacts with a metal carbonate to yield a salt, water, and carbon dioxide gas.

• The carbon dioxide released in this process is a colorless and odorless gas that is heavier than air.

Additional Information

• Calcium Carbonate ($CaCO_3$):

• It is a chemical compound found naturally in rocks as limestone, chalk, and marble.

• It is the primary component of eggshells, shells of marine organisms (like corals and mollusks), and pearls.

• In the pharmaceutical industry, it is used as an antacid to relieve heartburn and indigestion or as a calcium supplement.

• Hydrochloric Acid (HCl):

• It is a strong acid and a major component of gastric acid found in the human stomach, where it aids in digestion.

• In industrial applications, it is used for pickling of steel, production of organic compounds, and pH regulation.

• Testing for Carbon Dioxide:

• The standard laboratory test for CO_2 involves passing the gas through lime water (an aqueous solution of calcium hydroxide).

• The lime water turns milky or turbid due to the formation of insoluble calcium carbonate ($CaCO_3$).

• If the gas continues to be passed through the milky solution, the milkiness disappears because soluble calcium bicarbonate ($Ca(HCO_3)_2$) is formed.

Important Points

• Properties of CO_2: Carbon dioxide is essential for photosynthesis in plants. However, in high concentrations, it acts as a greenhouse gas, contributing to global warming.

• Reaction with other acids: Similar reactions occur with other acids. For example, sulfuric acid (H_2SO_4) reacting with calcium carbonate produces calcium sulfate, water, and carbon dioxide.

• Fire Extinguishers: The principle of producing CO_2 through the reaction of an acid and a carbonate (like sodium bicarbonate) was historically used in soda-acid fire extinguishers to smother fires by displacing oxygen.

• Daily Life Examples: The "fizz" felt when vinegar (acetic acid) is poured onto baking soda (sodium bicarbonate) is also due to the release of carbon dioxide gas.

Q18. Answer: (a) Statement A is correct, but B is incorrect.

The correct answer is Statement A is correct, but B is incorrect.

Key Points

• Ethanol, also known as ethyl alcohol, with the chemical formula C_2H_5OH, is the active ingredient in all alcoholic drinks. It is a colorless liquid at room temperature and is highly inflammable.

• Statement A: Consumption of even small quantities of dilute ethanol leads to drunkenness or intoxication. This occurs because ethanol acts as a depressant on the central nervous system, affecting motor skills and judgement. Hence, statement A is correct.

• Statement B: Intake of pure ethanol (also known as absolute alcohol) is not safe. Consuming even a very small amount of 100% pure ethanol can be lethal to the human body and cause severe damage to the internal organs. Hence, statement B is incorrect.

• While ethanol is used widely in industrial processes and medicines like tincture iodine, cough syrups, and many tonics due to its properties as a good solvent, its consumption as a beverage is strictly regulated due to its addictive nature and health risks.

• When a person consumes alcohol, it reaches the brain through the bloodstream and slows down metabolic processes, leading to a lack of coordination, mental confusion, and drowsiness.

Additional Information

• Absolute Alcohol: This refers to ethanol that contains no more than 1% water. It is primarily used in laboratories and for industrial applications. It is extremely toxic if ingested directly.

• Denatured Alcohol: To prevent the misuse of industrial ethanol for drinking, it is often made unfit for consumption by adding poisonous substances like methanol. Dyes like copper sulphate are also added to give it a blue color so that it can be identified easily.

• Methanol Toxicity: Unlike ethanol, methanol (CH3OH) is highly poisonous even in very tiny quantities. In the liver, methanol is oxidized to methanal (formaldehyde), which reacts rapidly with the components of cells, causing protoplasm coagulation. It can also affect the optic nerve, leading to permanent blindness.

• Physical Properties of Ethanol: It has a melting point of 156 K and a boiling point of 351 K. It is soluble in water in all proportions.

Important Points

• Health Hazards: Long-term consumption of alcohol (ethanol) leads to various health issues, including cirrhosis of the liver, cardiovascular diseases, and damage to the nervous system.

• Social Impact: Alcohol acts by lowering inhibitions, which can lead to social problems and accidents, particularly drunk driving.

• Uses in Industry: Ethanol is used as a fuel (often blended with petrol to create gasohol) and in the manufacture of paints, varnishes, and perfumes.

• Chemical Reactions: Ethanol reacts with sodium to form sodium ethoxide and hydrogen gas. This reaction is often used as a test for the presence of an alcohol group.

Q19. Answer: (c) Plasma

The correct answer is Plasma.

Key Points

• Blood is a specialized connective tissue consisting of a fluid matrix, plasma, and formed elements.

• Plasma is the straw-colored, viscous fluid that constitutes nearly 55 per cent of the total blood volume. It serves as the fluid matrix in which all the cellular components of blood are suspended. Hence, the correct option is Plasma.

• Chemically, plasma is composed of about 90-92 per cent water, while proteins contribute approximately 6-8 per cent of its composition.

• The major proteins found in the plasma matrix include Fibrinogens, Globulins, and Albumins. Fibrinogens are essential for the clotting or coagulation of blood; Globulins are primarily involved in the defense mechanisms of the body; and Albumins help in maintaining osmotic balance.

• In addition to proteins, plasma contains small amounts of minerals like Na+, Ca++, Mg++, HCO3-, and Cl-. Glucose, amino acids, and lipids are also present as they are always in transit in the body.

Additional Information

• Red Blood Cells (RBCs):

• Also known as Erythrocytes, these are the most abundant cells in the blood. A healthy adult man has an average of 5 million to 5.5 million RBCs per cubic millimeter of blood.

• They contain a red-colored, iron-carrying complex protein called hemoglobin, which plays a significant role in the transport of respiratory gases.

• RBCs have an average lifespan of 120 days, after which they are destroyed in the spleen (often called the graveyard of RBCs).

• White Blood Cells (WBCs):

• Also known as Leukocytes, they are part of the body's immune system and help fight infections. They are nucleated and are relatively lesser in number, averaging 6000-8000 per cubic millimeter of blood.

• They are divided into two main categories: Granulocytes (Neutrophils, Eosinophils, and Basophils) and Agranulocytes (Lymphocytes and Monocytes).

• Platelets:

• Also known as Thrombocytes, these are cell fragments produced from megakaryocytes (special cells in the bone marrow).

• Blood normally contains 1,50,000-3,50,000 platelets per cubic millimeter. Their primary function is to release substances that aid in the coagulation or clotting of blood to prevent excessive blood loss.

• Serum:

• When plasma is separated from the clotting factors (like fibrinogen), the remaining fluid is called Serum.

Important Points

• The pH of human blood is slightly basic, typically maintained at approximately 7.4.

• The process of formation of blood cells is known as Haemopoiesis, which primarily occurs in the red bone marrow in adults.

• The formed elements (RBCs, WBCs, and Platelets) together constitute about 45 per cent of the blood, while the plasma matrix accounts for the other 55 per cent.

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Q20. Answer: (c) Cytoplasm

The correct answer is Cytoplasm.

Key Points

• Cytoplasm is a thick, jelly-like substance that fills each cell and is enclosed by the cell membrane.

• It is mainly composed of water, salts, and proteins. In eukaryotic cells, the cytoplasm includes all of the material inside the cell and outside of the nucleus.

• All the cellular organelles, such as the mitochondria, ribosomes, endoplasmic reticulum, and Golgi apparatus, are suspended within it.

• It plays a crucial role in maintaining the shape of the cell and providing a medium for chemical reactions and metabolic activities like glycolysis.

• The fluid portion of the cytoplasm that does not contain organelles is specifically referred to as the cytosol.

Additional Information

• Stroma:

• The Stroma refers to the colorless fluid surrounding the grana within the chloroplast in plant cells.

• It contains the chloroplast DNA, ribosomes, and various enzymes required for the Calvin cycle (light-independent reactions of photosynthesis).

• Lumen:

• In biology, a Lumen is the inside space of a tubular structure, such as an artery or intestine.

• In cellular biology, it can refer to the internal space of organelles like the Endoplasmic Reticulum (ER) or the thylakoids in chloroplasts.

• Nucleoplasm:

• Nucleoplasm is a type of protoplasm that is found within the nucleus of a cell, surrounded by the nuclear envelope.

• It serves as a suspension medium for the nucleolus and chromatin (DNA and proteins), facilitating gene expression and DNA replication.

Important Points

• The term protoplasm is often used to describe the entire content of a live cell, including the cytoplasm and the nucleus.

• In prokaryotic cells (like bacteria), which lack a defined nucleus, the cytoplasm contains the primary genetic material (the nucleoid).

• The cytoskeleton, a network of protein fibers (microtubules and microfilaments), is located within the cytoplasm to provide structural support and aid in intracellular transport.

• The cytoplasm acts as a physical buffer, protecting the genetic material and organelles from damage caused by movement or collision with other cells.

Q21. Answer: (a) Seed

The correct answer is Seed.

Key Points

• In the life cycle of flowering plants (Angiosperms), the process of fertilisation triggers significant developmental changes in the floral organs.

• The ovule, which contains the female gametophyte, undergoes a series of transformations following the fusion of gametes and eventually develops into a seed. Hence, option 1 is correct.

• During this transition, the integuments (the protective outer layers of the ovule) harden and dry out to form the seed coat or testa, which protects the internal embryo.

• The zygote, formed by the fusion of one male gamete with the egg cell, divides and differentiates to become the embryo, which is the "baby plant" contained within the seed.

• While the ovules turn into seeds, the surrounding ovary grows in size and ripens to become the fruit, acting as a vessel for seed protection and dispersal.

Additional Information

• Double Fertilisation: This is a characteristic feature of Angiosperms. It involves two fusions: one male gamete fuses with the egg (Syngamy) to form a diploid zygote, and the other fuses with two polar nuclei (Triple Fusion) to form a triploid endosperm.

• Endosperm: This tissue serves as a highly nutritious food store for the developing embryo. In some seeds, like Castor, the endosperm persists, while in others, like Pea and Bean, it is consumed during development.

• Fruit vs. Seed:

• The fruit is the ripened ovary.

• The seed is the ripened ovule.

• Fruit Types:

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• True Fruits: Fruits that develop only from the ovary after fertilisation, such as Mango and Grapes.

• False Fruits: Fruits where other floral parts, like the thalamus, contribute to fruit formation, such as Apple, Cashew, and Strawberry.

• Parthenocarpic Fruits: Fruits that develop without fertilisation and are usually seedless, like Banana.

Important Points

• The micropyle, a small opening in the ovule, remains as a tiny pore in the seed coat. This is essential for the entry of water and oxygen during the process of germination.

• As the seed reaches maturity, its water content is significantly reduced, reaching about 10 to 15 percent moisture by mass.

• The embryo may enter a state of dormancy, which is a period of suspended growth that allows the seed to survive unfavorable environmental conditions until germination is possible.

• In Gymnosperms, seeds are produced but they are "naked" because they do not develop inside an ovary, and therefore, gymnosperms do not produce fruits.

Q22. Answer: (a) The particles are closely packed in a fixed arrangement.

The correct answer is The particles are closely packed in a fixed arrangement.

Key Points

• In a solid, the constituent particles (atoms, molecules, or ions) are held together by very strong intermolecular forces of attraction, which keeps them in a fixed arrangement.

• Because the particles are closely packed, there is negligible intermolecular space between them, making solids rigid and giving them a definite shape and volume. Hence, statement 1 is correct.

• The particles are randomly arranged in liquids and gases (and to some extent in amorphous solids), which prevents them from maintaining a permanent, rigid structure. Hence, statement 2 is incorrect.

• Solids do not have large spaces between particles; instead, they have the highest density compared to other states of matter because the particles are packed so tightly. Hence, statement 3 is incorrect.

• The particles in a solid cannot move freely past each other; they only vibrate about their fixed mean positions. The ability to flow or move freely is a property of fluids (liquids and gases). Hence, statement 4 is incorrect.

Additional Information

• Characteristics of Solids:

• They possess rigidity and are incompressible because the particles are already at minimum distance from each other.

• Solids can be classified into Crystalline (regular long-range order, e.g., Quartz, Sodium Chloride) and Amorphous (irregular short-range order, e.g., Glass, Rubber).

• The Kinetic Energy of particles in a solid is the lowest among the three primary states of matter.

• Comparison with Liquids:

• Liquids have a definite volume but no definite shape. They take the shape of the container because their particles have enough energy to slide over one another.

• The intermolecular forces in liquids are weaker than in solids but stronger than in gases.

• Comparison with Gases:

• Gases have neither a definite shape nor a definite volume. They expand to fill whatever container they are in.

• Gases have maximum intermolecular spaces and maximum kinetic energy, allowing particles to move at high speeds in all directions.

Important Points

• Thermal Energy vs. Intermolecular Forces: The state of matter is a result of the competition between Intermolecular Forces (which try to keep particles together) and Thermal Energy (which tries to keep them apart by increasing movement).

• In solids, at low temperatures, the thermal energy is low enough that intermolecular forces dominate, locking the particles into a fixed position.

• Diffusion: Solids show a very slow rate of diffusion compared to liquids and gases because the particle movement is restricted to vibration.

• Density: Most substances are densest in their solid state, with Ice being a notable exception (it is less dense than liquid water due to its open cage-like structure).

Q23. Answer: (d) To detect birth defects and monitor the baby’s growth

The correct answer is To detect birth defects and monitor the baby’s growth.

Key Points

• Ultrasonography (USG), often called an ultrasound, is a primary diagnostic tool used during pregnancy to visualize the fetus and the mother's reproductive organs.

• Its main function is to monitor the baby's growth and development, ensuring that the fetus is hitting appropriate gestational milestones based on the date of conception.

• A critical application of this technology is to detect birth defects or congenital anomalies. Structural issues related to the heart, spine, brain, and limbs can often be identified through detailed scans like the Anomaly Scan (usually performed between 18 to 22 weeks).

• It is used to check the position of the placenta, the amount of amniotic fluid, and the heartbeat of the fetus, providing a comprehensive assessment of the pregnancy's health.

• Regarding the other options: It cannot determine the blood group of the baby (which requires invasive procedures like amniocentesis or cordocentesis), it is not used to measure mother's weight (done via a weighing scale), and while it can see the mother's organs, its primary routine use in pregnancy is not to check the mother's heartbeat (which is monitored via pulse or ECG).

Additional Information

• Mechanism of Action: Ultrasonography works by emitting high-frequency sound waves (ultrasound) through a transducer. These waves bounce off internal structures and return as echoes, which a computer translates into real-time images.

• Types of Ultrasounds:

• 2D Ultrasound: The standard scan providing flat, cross-sectional images of the baby.

• 3D/4D Ultrasound: Used to see facial features and movements in more detail; often used to detect specific cleft lips or spinal defects.

• Doppler Ultrasound: Used to measure the blood flow through the baby's umbilical cord and heart.

• Safety: Unlike X-rays, ultrasonography does not use ionizing radiation, making it safe for both the mother and the developing fetus when used by trained professionals.

• Timelines:

• First Trimester (6-9 weeks): Used for dating the pregnancy and confirming the number of fetuses.

• Second Trimester (18-22 weeks): The Anomaly Scan (Level II) is performed to check for physical abnormalities.

• Third Trimester: Used to check fetal presentation (position like breech or cephalic) before delivery.

Important Points

• Legal Regulations in India: The use of ultrasound is strictly governed by the Pre-Conception and Pre-Natal Diagnostic Techniques (PCPNDT) Act, 1994.

• The PCPNDT Act prohibits the use of ultrasonography for sex determination to prevent female foeticide.

• It is mandatory for all ultrasound clinics and genetic laboratories to be registered under this Act, and disclosing the gender of the fetus is a criminal offense punishable by imprisonment and fines.

• Diagnostic Limitations: While highly effective, ultrasound cannot detect 100% of birth defects; some genetic disorders may require additional biochemical screening or DNA testing.

Q24. Answer: (d) Localized repeated cell division at a specific site

The correct answer is Localized repeated cell division at a specific site.

Key Points

• Budding is a form of asexual reproduction in which a new individual develops from a generative anatomical point of the parent organism.

• In organisms like Hydra, a bud develops as an outgrowth due to localized repeated cell division at one specific site. This ensures that the new individual is genetically identical to the parent.

• These buds grow into tiny individuals and, when fully mature, detach from the parent body to become new independent individuals.

• This process is characteristic of certain multicellular organisms (like Hydra) and unicellular organisms (like Yeast).

• Unlike sexual reproduction, this process does not involve the fusion of gametes or the production of seeds. Hence, statement 4 is correct.

Additional Information

• Asexual Reproduction:

• It is a mode of reproduction by which offspring arise from a single organism, and inherit the genes of that parent only.

• The offspring produced are clones, meaning they are morphologically and genetically identical to each other and to their parent.

• Common methods include binary fission (Amoeba), fragmentation (Spirogyra), spore formation (Rhizopus), and vegetative propagation (Rose, Potato).

• Reproduction in Yeast:

• Yeast is a unicellular fungus that reproduces asexually by budding.

• A small bulb-like projection, called a bud, comes out from the yeast cell. The nucleus of the parent cell divides into two, and one

of the nuclei moves into the bud.

• The bud grows and eventually gets detached from the parent cell to form a new yeast cell.

• Comparison with Other Options:

• Development of seeds from flowers: This is a result of sexual reproduction involving pollination and fertilization. Hence, statement 1 is incorrect.

• Fusion of gametes: This defines syngamy in sexual reproduction, leading to genetic variation. Hence, statement 2 is incorrect.

• Random cell death: Also known as apoptosis, it is a programmed process for tissue maintenance or development (like losing a tail in tadpoles) but does not initiate new individuals in budding. Hence, statement 3 is incorrect.

Important Points

• Regenerative Cells: Organisms like Hydra use regenerative cells for reproduction in the process of budding. These cells undergo mitotic division rapidly.

• Conditions for Budding: This process usually occurs when environmental conditions are favorable, and there is an abundant supply of nutrients.

• Vegetative Propagation: In higher plants, reproduction through parts like roots, stems, or leaves is termed vegetative propagation. For example, Bryophyllum produces buds along its leaf margins which can grow into new plants.

• Binary Fission vs. Budding: In binary fission, the parent body divides into two nearly equal halves (e.g., Amoeba), whereas in budding, the parent remains intact while a smaller outgrowth is formed.

Q25. Answer: (c) Hidden (recessive) alleles in sweet peas may offer resistance against future environmental stress.

The correct answer is Hidden (recessive) alleles in sweet peas may offer resistance against future environmental stress.

Key Points

• Sexual reproduction in sweet pea plants (Pisum sativum) is a fundamental process that facilitates genetic recombination. This process involves meiosis, where crossing over and independent assortment create unique combinations of alleles in offspring.

• In a large population, recessive alleles can remain "hidden" in heterozygous individuals (carriers). While these traits might not be beneficial in current stable conditions, they provide a genetic reservoir that may contain traits essential for survival if the environment changes, such as resistance to a new pathogen or drought. Hence, statement 3 is correct.

• Maintaining "purity" through self-pollination or avoiding cross-pollination (Option 1) actually reduces genetic diversity and can lead to inbreeding depression, which weakens the long-term survival of the species. Hence, statement 1 is incorrect.

• Genetic variation inherently promotes diversity and phenotypic differences, such as variations in flower color, seed shape, and plant height. It does not aim for uniformity (Option 2), which is more characteristic of asexual reproduction or cloning. Hence, statement 2 is incorrect.

• While sexual reproduction is vital for evolution, it is generally slower and more energy-intensive than asexual reproduction. Biomass production (Option 4) is usually maximized through rapid vegetative growth rather than the complex process of gamete formation and fertilization. Hence, statement 4 is incorrect.

Additional Information

• Mendelian Genetics: Gregor Mendel conducted his historic experiments on sweet peas in the 1850s and 1860s. He identified that traits are inherited as discrete units (now known as genes) and established the Law of Segregation and the Law of Independent Assortment.

• Gene Pool: The total collection of genes and alleles in a population is called the gene pool. A large, diverse gene pool is a buffer against extinction, as it increases the likelihood that some individuals will possess the traits necessary to survive environmental shifts.

• Heterozygote Advantage: This occurs when an individual with a heterozygous genotype has higher fitness than those with homozygous dominant or recessive genotypes. This mechanism helps maintain recessive alleles within a population over generations.

• Environmental Stressors: These include biotic factors like fungal infections (e.g., powdery mildew) and abiotic factors like soil salinity or temperature fluctuations. Genetic variation ensures that the sweet pea population is not wiped out by a single adverse event.

Important Points

• Role of Meiosis: During Prophase I of meiosis, homologous chromosomes exchange segments (crossing over), ensuring that no two gametes are identical. This is the primary engine of variation in sexually reproducing organisms.

• Long-term Survival vs. Short-term Efficiency: Sexual reproduction may seem "wasteful" because it requires finding a pollinator or mate, but the evolutionary benefit of adaptation far outweighs the metabolic costs in dynamic ecosystems.

• Population Size: In large populations, the impact of genetic drift (random changes in allele frequencies) is minimized, allowing natural selection to act more effectively on the variation produced by sexual reproduction.

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Q26. Answer: (c) Rs. 11,109

Shortcut Trick

For 2 years, the effective compound interest rate is calculated using the formula: x + y + (xy/100)%

Effective Rate = 15 + 15 + (15 × 15)/100 = 30 + 2.25 = 32.25%

Total Amount = 100% (Principal) + 32.25% (Interest) = 132.25%

Required Amount = 8400 × 132.25% = 84 × 132.25 = 11109

Therefore The correct answer is Rs. 11,109.

Alternate Method

Given: Principal (P) = Rs. 8,400, Rate (R) = 15% per annum, Time (n) = 2 years.

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

Calculations:

=> $A = 8400 \times (1 + 15/100)^2$

=> $A = 8400 \times (1 + 3/20)^2$

=> $A = 8400 \times (23/20) \times (23/20)$

=> $A = 8400 \times 529 / 400$

=> $A = 21 \times 529$

=> $A = 11109$

Therefore The correct answer is Rs. 11,109.

Additional Information

Compound Interest vs Simple Interest for 2 Years

The difference between CI and SI for 2 years is given by the formula: Difference = $P \times (R/100)^2$.

Effective Rate of Interest

For a rate of R% compounded annually for 2 years, the net effective rate is $2R + R^2/100$ %.

Compounding Frequency

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

Q27. Answer: (a) Rs. 24,558

Shortcut Trick

Total New Price = 6 × [(860 × 1.05) + (2900 × 1.10)]

New Price of 1 Faucet = 860 + 43 = Rs. 903

New Price of 1 Wash Basin = 2900 + 290 = Rs. 3190

Total for 6 sets = 6 × (903 + 3190) = 6 × 4093 = Rs. 24,558

Therefore The correct answer is Rs. 24,558.

Alternate Method

Given:

Price of faucet = Rs. 860

Price of wash basin = Rs. 2900

Increase in faucet price = 5%

Increase in wash basin price = 10%

Calculations:

=> New price of 1 faucet = 860 + (5/100 × 860) = 860 + 43 = Rs. 903

=> New price of 1 wash basin = 2900 + (10/100 × 2900) = 2900 + 290 = Rs. 3190

=> New price of 6 faucets = 6 × 903 = Rs. 5418

=> New price of 6 wash basins = 6 × 3190 = Rs. 19140

=> Total price = 5418 + 19140 = Rs. 24558

Therefore The correct answer is Rs. 24,558.

Additional Information

Percentage Increase

New Value = Original Value × (1 + Rate/100). For a 5% increase, multiply by 1.05.

Distributive Property

To find the cost of multiple sets, use n × (Price A + Price B) which is equal to (n × Price A) + (n × Price B).

Successive Changes

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If a price increases by x% and then y%, the effective increase is [x + y + (xy/100)]%.

Q28. Answer: (b) 265

Shortcut Trick

Assume all 363 children are girls, total amount = 363 × 6 = Rs. 2,178.

Difference from actual amount = 2,443 − 2,178 = Rs. 265.

Difference between a boy's share and a girl's share = 7 − 6 = Rs. 1.

Number of boys = Total Difference ÷ Share Difference = 265 ÷ 1 = 265.

Therefore The correct answer is 265 boys.

Alternate Method

Given: Total children = 363, Total amount = Rs. 2,443, Girl's share = Rs. 6, Boy's share = Rs. 7.

=> Let the number of boys be x and the number of girls be (363 − x).

=> Total Amount = (Number of girls × 6) + (Number of boys × 7)

=> 2,443 = 6(363 − x) + 7x

=> 2,443 = 2,178 − 6x + 7x

=> 2,443 − 2,178 = x

=> x = 265

Therefore The correct answer is 265 boys.

Additional Information

Alligation Method

This problem can also be solved using alligation by finding the average share per child (2,443 ÷ 363) and placing it in the center of the cross diagram.

Linear Equations in Two Variables

Standard algebraic approach: B + G = 363 and 7B + 6G = 2443. Multiply the first by 6 and subtract from the second to find B.

Unitary Method Logic

The surplus amount beyond the minimum guaranteed share (Rs. 6 per child) is entirely attributed to the extra Rs. 1 given to each boy.

Q29. Answer: (c) Rs. 4,340

Shortcut Trick

Net discount % = a + b − (a × b) ÷ 100

Net discount = 20 + 30 − (20 × 30) ÷ 100 = 50 − 6 = 44%

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

SP = 7750 × (100 − 44) ÷ 100 = 7750 × 0.56 = 4340

Therefore The correct answer is Rs. 4,340.

Alternate Method

Given → Marked Price (MP) = Rs. 7,750, Discount1 (d1) = 20%, Discount2 (d2) = 30%.

Formulas: SP = MP × (100 − d1)% × (100 − d2)%

=> Price after 1st discount = 7750 × (80 ÷ 100) = 6200

=> Final Selling Price = 6200 × (70 ÷ 100)

=> SP = 62 × 70 = 4340

Therefore The correct answer is Rs. 4,340.

Additional Information

Marked Price & Discount

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

Successive Discount

When a series of discounts are applied, the second discount is calculated on the value remaining after the first discount. Formula: SP = MP × (1 − d1/100) × (1 − d2/100).

Q30. Answer: (c) 10

Shortcut Trick

Total Provision = Men × Days = 1200 × 13

New Men = 1200 + 360 = 1560

New Days = (1200 × 13) ÷ 1560
New Days = 15600 ÷ 1560 = 10
Therefore The correct answer is 10 days.
Alternate Method
Given:
Initial Men (M1) = 1200
Initial Days (D1) = 13
Increase in Men = 360
Final Men (M2) = 1200 + 360 = 1560
Formula Used:
M1D1 = M2D2
Calculations:
=> 1200 × 13 = 1560 × D2
=> D2 = (1200 × 13) ÷ 1560
=> D2 = 15600 ÷ 1560
=> D2 = 10
Therefore The correct answer is 10 days.
Additional Information
Inverse Proportion
When the number of men increases, the number of days provisions last decreases proportionally: M1 × D1 = M2 × D2.
Chain Rule
The general formula is (M1 × D1 × H1) / W1 = (M2 × D2 × H2) / W2, where M is men, D is days, H is hours, and W is work/provisions.
Ratio Method
Ratio of Men = 1200 : 1560 = 10 : 13. Therefore, ratio of Days = 13 : 10. Since 13 units = 13 days, 10 units = 10 days.

Q31. Answer: (c) 58.5 m

Shortcut Trick
A 45° sector represents exactly 1/8 of the circle's total circumference.
Circumference = 2 × (22/7) × 21 = 132 m.
Arc Length = 132 ÷ 8 = 16.5 m.
Total Perimeter = Arc Length + (2 × Radius) = 16.5 + 42 = 58.5 m.
Therefore The correct answer is 58.5 m.
Alternate Method
Given:
Radius (r) = 21 m
Central Angle (θ) = 45°
π = 22/7
Formula Used:
Perimeter of Sector = Arc Length (l) + 2 × Radius (r)
Arc Length (l) = (θ ÷ 360) × 2 × π × r
Calculations:
=> Arc length (l) = (45 ÷ 360) × 2 × (22 ÷ 7) × 21
=> l = (1 ÷ 8) × 2 × 22 × 3
=> l = (1 ÷ 8) × 132 = 16.5 m
=> Perimeter = 16.5 + (2 × 21)
=> Perimeter = 16.5 + 42
=> Perimeter = 58.5 m
Therefore The correct answer is 58.5 m.
Additional Information
Area of a Sector
The region bounded by two radii and an arc, calculated as Area = (θ/360) × πr2 or (1/2) × l × r.

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Length of an Arc

The distance along the curved edge of a sector, given by the formula l = (θ/360) × 2πr.

Major and Minor Sectors

A minor sector has an angle θ < 180°, while a major sector has an angle of (360 − θ).

Q32. Answer: (b) Rs. 3,267

Shortcut Trick

Total amount to be deducted = 33 + 70 + 19 = Rs. 122

Remaining amount = 12,986 − 122 = Rs. 12,864

Ratio of remaining shares A : B : C = 14 : 8 : 2 (Total parts = 24)

Difference between B and C parts = 8 − 2 = 6 parts

Difference in shares = (12,864 ÷ 24) × 6 + (70 − 19) = 3216 + 51 = Rs. 3,267

Therefore The correct answer is Rs. 3,267.

Alternate Method

Given: Total sum = Rs. 12,986. Deductions from A, B, and C are Rs. 33, Rs. 70, and Rs. 19 respectively. Ratio after deduction = 14 : 8 : 2.

=> Sum of remaining shares = 12,986 − (33 + 70 + 19)

=> Sum of remaining shares = 12,986 − 122 = Rs. 12,864

=> Total ratio parts = 14 + 8 + 2 = 24 units

=> 24 units = 12,864

=> 1 unit = 12,864 ÷ 24 = Rs. 536

=> B's original share = (8 × 536) + 70 = 4288 + 70 = Rs. 4,358

=> C's original share = (2 × 536) + 19 = 1072 + 19 = Rs. 1,091

=> Difference = 4,358 − 1,091 = Rs. 3,267

Therefore The correct answer is Rs. 3,267.

Additional Information

Ratio and Proportion

Ratio is the comparison of two quantities of the same kind. If a : b = c : d, then ad = bc (Product of extremes = Product of means).

Deduction Rule

When values are deducted from a total sum to maintain a ratio, subtract the total deduction from the principal amount before applying the ratio division.

Q33. Answer: (d) 1, 2

Shortcut Trick

Convert all to same base

4 = 2^2, 16 = 2^4, 3^4 and 9 = 3^2

Compare powers of 2 and 3 separately

=> a = 1, b = 2

Therefore Answer = (1, 2)

Alternate Method

Given:

$(4^2)^a \times (16^2)^{(2a)} \times (3^4)^b \times (9^2)^{(2b)} = 2^{2^0} \times (9^2)^6$

Concept Used:

Laws of exponents

Calculation:

=> $(4^2)^a = (2^4)^a = 2^{(4a)}$

=> $(16^2)^{(2a)} = (2^8)^{(2a)} = 2^{(16a)}$

=> Total power of 2 = 2^(20a)

=> RHS = 2^{2^0} => 20a = 20 => a = 1

=> $(3^4)^b = 3^{(4b)}$

=> $(9^2)^{(2b)} = (3^4)^{(2b)} = 3^{(8b)}$

=> Total power of 3 = 3^(12b)

=> RHS = $(9^2)^6 = (3^4)^6 = 3^{2^4}$

=> 12b = 24 => b = 2

Therefore The correct answer is (1, 2).

Additional Information

Exponent Rule

$(a^m)^n = a^{(mn)}$

Same Base Rule

$a^x = a^y \Rightarrow x = y$

Conversion Trick

Convert numbers into prime base form

Separation Method

Compare powers of different bases separately

Q34. Answer: (b) 24

Shortcut Trick

Product of two numbers = HCF × LCM

216 × 120 = HCF × 1080

HCF = (216 × 120) ÷ 1080 = 216 ÷ 9 = 24

Therefore The correct answer is 24.

Alternate Method

Given:

First Number (A) = 216

Second Number (B) = 120

LCM = 1080

Formula Used:

A × B = HCF(A, B) × LCM(A, B)

Calculations:

=> 216 × 120 = HCF × 1080

=> 25920 = HCF × 1080

=> HCF = 25920 ÷ 1080

=> HCF = 24

Therefore The correct answer is 24.

Additional Information

HCF and LCM Relation

For any two positive integers a and b, HCF(a, b) × LCM(a, b) = a × b. This property only holds true for two numbers.

Co-prime Numbers

If two numbers are co-prime, their HCF is always 1 and their LCM is the product of the two numbers.

Fractional LCM/HCF

LCM of fractions = (LCM of Numerators) ÷ (HCF of Denominators). HCF of fractions = (HCF of Numerators) ÷ (LCM of Denominators).

Q35. Answer: (a) Rs. 20,000

Shortcut Trick

Total Expenditure % = 25% + 15% + 10% = 50%

Savings % = 100% − 50% = 50%

Monthly Savings = 50% of Rs. 40,000 = Rs. 20,000

Therefore The correct answer is Rs. 20,000.

Alternate Method

Given:

Total Income = Rs. 40,000

Rent = 25% | Food = 15% | Transportation = 10%

Calculations:

=> Total spending = 25% + 15% + 10% = 50%

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=> Remaining savings percentage = 100% − 50% = 50%
=> Savings amount = (50 ÷ 100) × 40,000
=> Savings amount = 0.5 × 40,000 = 20,000
Therefore The correct answer is Rs. 20,000.
Additional Information
Percentage Change
To find the percentage of a value, use (Percentage/100) × Base Value.
Successive Percentage
If expenses are calculated on the remaining balance, use the formula: Final = Initial × (1 − r1/100) × (1 − r2/100).
Income-Expenditure Relation
Income = Expenditure + Savings. This base formula is used to solve most budget-related problems.

Q36. Answer: (a) 2244 cm2

Shortcut Trick
Total Surface Area of a cylinder = 2πr(r + h), where π = 22/7.
The final result must be a multiple of 11 as it contains the factor 22.
Check divisibility by 11 (Difference of sum of digits at odd and even places):
Option (1) 2244: (2+4) − (2+4) = 0 (Divisible by 11).
Other options are not divisible by 11, so 2244 is the answer.
Therefore The correct answer is 2244 cm².
Alternate Method
Given: Volume (V) = 6776 cm³, Height (h) = 44 cm
Formula Used: Volume = πr²h, Total Surface Area (TSA) = 2πr(r + h)
=> Volume = πr²h
=> 6776 = (22/7) × r² × 44
=> r² = (6776 × 7) / (22 × 44)
=> r² = 154 × 7 / 22 = 7 × 7
=> r = 7 cm
=> TSA = 2πr(r + h)
=> TSA = 2 × (22/7) × 7 × (7 + 44)
=> TSA = 44 × 51
=> TSA = 2244 cm²
Therefore The correct answer is 2244 cm².
Additional Information
Curved Surface Area of a Cylinder
It is the area of the curved surface only, excluding the top and bottom circles. Formula: CSA = 2πrh.
Volume of a Cylinder
It is the total space occupied by the cylinder. Formula: Volume = πr²h.
Total Surface Area of a Cylinder
It is the sum of the curved surface area and the areas of the two circular bases. Formula: TSA = 2πr(r + h).
Radius and Diameter Relation
The diameter (d) of the circular base is always twice the radius (r). Formula: d = 2r.

Q37. Answer: (b) 4 km/h

Shortcut Trick
Distance is constant Therefore Speed ratio is the inverse of Time ratio.
Time ratio (Forward : Return) = 6 : 9 = 2 : 3
Speed ratio (Forward : Return) = 3 : 2
Speed difference = 3 − 2 = 1 unit → 2 km/h
Return speed = 2 units = 2 × 2 = 4 km/h
Therefore The correct answer is 4 km/h.
Alternate Method

Given:
Time taken while walking forward (T1) = 6 h
Time taken while returning (T2) = 9 h
Decrease in speed = 2 km/h
Formula Used:
Distance = Speed × Time
=> Let the initial speed while walking forward be S km/h.
=> Distance covered = Speed × Time = S × 6 = 6S
=> Returning speed = (S − 2) km/h
=> Distance covered while returning = (S − 2) × 9 = 9(S − 2)
=> Since the distance is the same for both journeys:
=> 6S = 9(S − 2)
=> 6S = 9S − 18
=> 18 = 9S − 6S
=> 18 = 3S
=> S = 18 ÷ 3 = 6 km/h
=> Returning speed = S − 2 = 6 − 2 = 4 km/h
Therefore The correct answer is 4 km/h.
Additional Information
Speed-Time Relationship
When distance is constant, speed is inversely proportional to time (S1 × T1 = S2 × T2).
Average Speed for Equal Distances
If an object covers equal distances at speeds x and y, the average speed is 2xy ÷ (x + y).
Unit Conversion
To convert speed from km/h to m/s, multiply the value by 5 ÷ 18.

Q38. Answer: (b) $9AD^2=7AB^2$

Shortcut Trick
In an equilateral triangle ABC of side 'a', if a point D divides side BC such that BD = a/n,
The relation is given by the formula: $n^2AD^2 = (n^2 − n + 1)AB^2$.
Here, 3BD = BC => BD = BC/3, so n = 3.
Substituting n = 3: $3^2AD^2 = (3^2 − 3 + 1)AB^2$
$9AD^2 = (9 − 3 + 1)AB^2$ => $9AD^2 = 7AB^2$.
Therefore The correct answer is $9AD^2=7AB^2$.
Alternate Method
Given: ΔABC is equilateral, so AB = BC = CA. Point D is on BC such that BD = BC/3.
Formula Used: Pythagoras Theorem: $Hypotenuse^2 = Base^2 + Perpendicular^2$.
Let the side of the equilateral triangle AB = BC = CA = a.
Draw altitude AM perpendicular to BC. In an equilateral triangle, altitude bisects the base.
=> BM = MC = BC/2 = a/2.
=> $AM = \sqrt{(AB^2 − BM^2)} = \sqrt{(a^2 − (a/2)^2)} = \sqrt{(3a^2/4)} = (\sqrt{3}/2)a$.
Given BD = BC/3 = a/3.
=> DM = BM − BD = a/2 − a/3 = (3a − 2a)/6 = a/6.
In right-angled ΔADM, apply Pythagoras theorem:
=> $AD^2 = AM^2 + DM^2$
=> $AD^2 = [(\sqrt{3}/2)a]^2 + (a/6)^2$
=> $AD^2 = 3a^2/4 + a^2/36$
=> $AD^2 = (27a^2 + a^2) / 36$
=> $AD^2 = 28a^2 / 36 = 7a^2 / 9$
=> $9AD^2 = 7a^2$
Since a = AB:
=> $9AD^2 = 7AB^2$.

Therefore The correct answer is $9AD^2=7AB^2$.

Additional Information

Height of Equilateral Triangle

The altitude or height (h) of an equilateral triangle with side 'a' is always $(\sqrt{3}/2)\times a$.

Area of Equilateral Triangle

The area is given by $(\sqrt{3}/4)\times a^2$, where 'a' is the length of the side.

Inradius and Circumradius

For side 'a', the Inradius (r) is $a/(2\sqrt{3})$ and the Circumradius (R) is $a/\sqrt{3}$. Note that R = 2r.

Apollonius Theorem

For any triangle with side AB, AC and median AD on BC: $AB^2 + AC^2 = 2(AD^2 + BD^2)$.

Q39. Answer: (b) 18

Shortcut Trick

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

Efficiency of Filling pipe = 36 ÷ 9 = +4 units/min.

Efficiency of Emptying pipe = 36 ÷ 12 = −3 units/min.

Combined Efficiency = 4 − 3 = 1 unit/min.

Time to fill one-half (36 ÷ 2 = 18 units) = 18 ÷ 1 = 18 minutes.

Therefore The correct answer is 18.

Alternate Method

Given:

Time taken by filling pipe = 9 minutes

Time taken by emptying pipe = 12 minutes

Formula used: Efficiency = Total Work ÷ Time

Pipes	Time (min)	Capacity	Efficiency
Pipe 1 (+)	9	36 (LCM)	+4
Pipe 2 (−)	12	−3	

Calculations:

=> Total Capacity of tank = LCM(9, 12) = 36 units

=> Net efficiency of both pipes = 4 − 3 = 1 unit/min

=> Required capacity to fill = 1/2 × Total Capacity

=> Required capacity = 36 ÷ 2 = 18 units

=> Time required = Required capacity ÷ Net efficiency

=> Time = 18 ÷ 1 = 18 minutes

Therefore The correct answer is 18.

Additional Information

Inflow and Outflow Concept

Efficiency of an inlet pipe is always taken as positive, while the efficiency of an outlet or emptying pipe is taken as negative.

Net Rate of Filling

If pipe A fills in x hours and pipe B empties in y hours (where y > x), the net part filled in 1 hour is (1/x − 1/y).

Time and Work Relation

Total Capacity = Time × Efficiency. For fractional work, Time = (Fraction × Total Capacity) ÷ Efficiency.

Q40. Answer: (b) 71

Shortcut Trick

Let assumed mean be 70.

Deviations from 70: −3, +6, +27, −36, −32, −7, +25, +25, +4

Sum of deviations = −3 + 6 + 27 − 36 − 32 − 7 + 25 + 25 + 4 = +9

Adjustment = Sum ÷ Count = 9 ÷ 9 = +1

Correct Mean = 70 + 1 = 71.

Therefore The correct answer is 71.

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Alternate Method

Given: Observations = 67, 76, 97, 34, 38, 63, 95, 95, 74

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

=> Total number of observations (n) = 9

=> Sum of observations = 67 + 76 + 97 + 34 + 38 + 63 + 95 + 95 + 74

=> Sum = 639

=> Arithmetic Mean = 639 ÷ 9

=> Arithmetic Mean = 71

Therefore The correct answer is 71.

Additional Information

Properties of Arithmetic Mean

The sum of the deviations of a set of items from their arithmetic mean is always zero: $\Sigma(x_i - \text{mean}) = 0$.

Median and Mode

Median is the middle value of sorted data. Mode is the value that appears most frequently (here, 95).

Weighted Arithmetic Mean

Used when observations have different levels of importance: Mean = $\Sigma(w_i \times x_i) \div \Sigma w_i$.

Q41. Answer: (b) 26,862

Shortcut Trick

Net percentage increase for two successive years at 10% each = 10 + 10 + (10 × 10)/100 = 21%.

Total multiplying factor = 121% or 1.21.

Income in 2021 = 22,200 × 1.21 = 26,862.

Therefore The correct answer is 26,862.

Alternate Method

Given:

Income in 2019 (P) = Rs. 22,200

Rate of increment (R) = 10% per annum

Time (n) = 2021 − 2019 = 2 years

Formula used: Final Income = $P \times (1 + R/100)^n$

=> Income in 2021 = $22200 \times (1 + 10/100)^2$

=> Income in 2021 = $22200 \times (110/100) \times (110/100)$

=> Income in 2021 = $22200 \times 1.1 \times 1.1$

=> Income in 2021 = 22200×1.21

=> Income in 2021 = 26862

Therefore The correct answer is 26,862.

Additional Information

Successive Percentage Change

When a value changes by a% and then by b%, the effective change is [a + b + (ab/100)]%.

Compound Growth Formula

The formula for population or income growth is $A = P(1 + r/100)^n$, where P is the initial value and n is the number of years.

Multiplying Factor Method

For a 10% increase, the multiplying factor is (1 + 0.1) = 1.1. For n years, it becomes $(1.1)^n$.

Q42. Answer: (b) 10

Shortcut Trick

The average of the first n odd natural numbers is always equal to n.

Here, the number of terms n = 10.

Therefore Average = 10.

Therefore The correct answer is 10.

Alternate Method

Given:

First 10 odd natural numbers are: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19.

Formula Used:

Average = (Sum of all terms) ÷ (Total number of terms)

Sum of an Arithmetic Progression (AP) = (n/2) × [First term + Last term]

Calculations:

=> Total terms (n) = 10

=> Sum = (10/2) × [1 + 19]

=> Sum = 5 × 20 = 100

=> Average = 100 ÷ 10

=> Average = 10

Therefore The correct answer is 10.

Additional Information

Sum of first n odd numbers

The sum of the first n odd natural numbers is given by the formula n^2.

Average of first n even numbers

The average of the first n even natural numbers is always (n + 1).

Average of first n natural numbers

The average of the first n natural numbers is calculated as (n + 1) ÷ 2.

Q43. Answer: (a) 27.2 km/h

Shortcut Trick

When distance is constant, Speed is inversely proportional to Time (S prop. to 1/T).

Ratio of Time (T1 : T2) = 8 : 5

Ratio of Speed (S1 : S2) = 5 : 8

Given: 5 units = 17 km/h => 1 unit = 3.4 km/h

Required Speed (8 units) = 8 × 3.4 = 27.2 km/h

Therefore The correct answer is 27.2 km/h.

Alternate Method

Given:

Initial Speed (S1) = 17 km/h

Initial Time (T1) = 8 min = 8/60 hours

New Time (T2) = 5 min = 5/60 hours

Formula Used:

Distance = Speed × Time

=> Distance = S1 × T1

=> Distance = 17 × (8/60) km

=> New Speed (S2) = Distance ÷ New Time (T2)

=> S2 = [17 × (8/60)] ÷ (5/60)

=> S2 = 17 × 8 ÷ 5

=> S2 = 136 ÷ 5

=> S2 = 27.2 km/h

Therefore The correct answer is 27.2 km/h.

Additional Information

Constant Distance Relation

When the same distance is covered at different speeds, S1 × T1 = S2 × T2. This allows for direct substitution without calculating distance.

Average Speed

If a person covers two equal distances at speeds x and y, then the average speed is (2xy) ÷ (x + y).

Unit Conversion

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

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Q44. Answer: (b) 24 hours

Shortcut Trick

Use the formula: Emptying time = (a × b) ÷ (b − a)

where a = filling time without leak and b = filling time with leak.

=> Emptying time = (6 × 8) ÷ (8 − 6)

=> Emptying time = 48 ÷ 2 = 24 hours.

Therefore The correct answer is 24 hours.

Alternate Method

Given: Filling pipe (A) time = 6 hours | Filling pipe with leak (A + L) time = 8 hours.

Total capacity of cistern = LCM of (6, 8) = 24 units.

Entity	Time	Capacity	Efficiency
Pipe A	6	24	4
A + Leak	8	3	

=> Efficiency of Leak (L) = Efficiency of (A + L) − Efficiency of A

=> Efficiency of L = 3 − 4 = −1 units/hour (Negative sign indicates emptying)

=> Time taken by leak to empty cistern = Total Capacity ÷ |Efficiency of L|

=> Time taken = 24 ÷ 1 = 24 hours.

Therefore The correct answer is 24 hours.

Additional Information

Leakage Principle

A leak acts as an emptying pipe. Net efficiency = (Efficiency of filling pipe) − (Efficiency of leak).

Combined Rate Formula

If two pipes fill at rates x and y, combined rate = (x × y) ÷ (x + y). If one is a leak, the rate becomes (x × y) ÷ (y − x).

Pipes and Cisterns Basics

This topic follows the same logic as Time and Work, where work done is equivalent to cistern capacity.

Q45. Answer: (b) 1,250

Shortcut Trick

SP (excluding GST) = 1680 ÷ 1.2 = 1400

CP = 1400 ÷ 1.12 = 1250

Therefore The correct answer is 1,250.

Alternate Method

Given:

Selling Price (including GST) = Rs. 1,680

GST Rate = 20%

Profit = 12%

Formula Used:

SP (excluding tax) = Total SP ÷ (1 + Tax%/100)

CP = SP (excluding tax) ÷ (1 + Profit%/100)

Calculations:

=> SP (without GST) = 1680 ÷ (1 + 20/100)

=> SP (without GST) = 1680 ÷ 1.2 = 1400

=> CP × (1 + 12/100) = 1400

=> CP × 1.12 = 1400

=> CP = 1400 ÷ 1.12

=> CP = 1250

Therefore The correct answer is 1,250.

Additional Information

Profit and Loss Relationship

Profit % is always calculated on the Cost Price (CP) unless stated otherwise. SP = CP × (100 + Profit%)/100.

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GST and Sales Tax

Taxes are applied to the net selling price. Total SP = Base SP × (100 + Tax%)/100.

Successive Percentage Change

If a value changes by a% then b%, the net multiplier is (1 + a/100) × (1 + b/100).

Q46. Answer: (b) B

Shortcut Trick

Scheme A: 19 + 19 − 3.61 = 34.39%

Scheme B: Buy 2 get 10 → Discount = (8/10) × 100 = 80%

Scheme C: 11%

Scheme D: 25 + 17 − 4.25 = 37.75%

Comparing discounts: 80% > 37.75% > 34.39% > 11%

Therefore The correct answer is B.

Alternate Method

Given:

Scheme A: Successive discounts 19% and 19%

Scheme B: Buy 2, get 10 items total

Scheme C: Single discount 11%

Scheme D: Successive discounts 25% and 17%

Formula Used:

Net Discount for successive a% and b% = [a + b − (ab/100)]%

Discount % for Buy X Get Y = [(Y − X) / Y] × 100

Calculations:

=> Net Discount A = 19 + 19 − (19 × 19)/100

=> Net Discount A = 38 − 3.61 = 34.39%

=> Net Discount B = [(10 − 2) / 10] × 100

=> Net Discount B = (8 / 10) × 100 = 80%

=> Net Discount C = 11%

=> Net Discount D = 25 + 17 − (25 × 17)/100

=> Net Discount D = 42 − 4.25 = 37.75%

=> Highest Discount = 80%

Therefore The correct answer is B.

Additional Information

Successive Discounts

When two discounts a% and b% are given, the total discount is always less than the sum (a+b) because the second discount is applied to the already reduced price.

Buy X Get Y Free

The effective discount percentage is calculated as [Free items ÷ Total items (Paid + Free)] × 100.

Marked Price and Selling Price

Selling Price = Marked Price × (100 − D%)/100. For multiple discounts, SP = MP × (100 − d1)/100 × (100 − d2)/100.

Q47. Answer: (a) 69

Shortcut Trick

To find the quantity of the larger value when the sum and difference are known:

Quantity of Mangoes = (Sum of fruits + Difference) ÷ 2

Quantity of Mangoes = (96 + 42) ÷ 2

Quantity of Mangoes = 138 ÷ 2 = 69

Therefore The correct answer is 69.

Alternate Method

Given:

Total fruits (Mangoes + Oranges) = 96

Difference (Mangoes − Oranges) = 42

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Method: Linear Equation in One Variable
Let the number of Oranges be x.
Then, the number of Mangoes = x + 42
According to the question:
=> x + (x + 42) = 96
=> 2x + 42 = 96
=> 2x = 96 − 42
=> 2x = 54
=> x = 54 ÷ 2
=> x = 27 (Number of Oranges)
=> Number of Mangoes = 27 + 42 = 69
Therefore The correct answer is 69.
Additional Information
Sum and Difference Formula
If the sum (S) and difference (D) of two numbers are known, the larger number is (S+D)÷2 and the smaller number is (S−D)÷2.
Linear Equations
Equations in the form ax + b = c are solved by isolating the variable x through inverse operations on both sides.
Ratio from Sum and Difference
The ratio of the two numbers can be calculated directly as (S+D) : (S−D). Here, Ratio = (96+42) : (96−42) = 138 : 54 = 23 : 9.

Q48. Answer: (a) (x^8 - 1/(x^8))

Shortcut Trick
Apply the identity $(a - b)(a + b) = a^2 - b^2$ successively to the terms.
$(x - 1/x)(x + 1/x) = x^2 - 1/x^2$
$(x^2 - 1/x^2)(x^2 + 1/x^2) = x^4 - 1/x^4$
$(x^4 - 1/x^4)(x^4 + 1/x^4) = x^8 - 1/x^8$
Therefore The correct answer is $(x^8 - 1/x^8)$.
Alternate Method
Given: $(x - 1/x)(x + 1/x)(x^2 + 1/x^2)(x^4 + 1/x^4)$
Formula Used: $(a - b)(a + b) = a^2 - b^2$
=> Simplifying the first two brackets:
=> $(x - 1/x) \times (x + 1/x) = x^2 - (1/x)^2 = x^2 - 1/x^2$
=> Multiplying the result with the third bracket:
=> $(x^2 - 1/x^2) \times (x^2 + 1/x^2) = (x^2)^2 - (1/x^2)^2 = x^4 - 1/x^4$
=> Multiplying the result with the fourth bracket:
=> $(x^4 - 1/x^4) \times (x^4 + 1/x^4) = (x^4)^2 - (1/x^4)^2 = x^8 - 1/x^8$
Therefore The correct answer is $(x^8 - 1/x^8)$.
Additional Information
Difference of Two Squares
The identity $(a - b)(a + b) = a^2 - b^2$ is used to simplify products of binomials containing the same terms with opposite signs.
Power of a Power Rule
When raising a term with an exponent to another power, multiply the exponents: $(x^m)^n = x^{(m \times n)}$.
Algebraic Identities
Other common identities include $(a + b)^2 = a^2 + 2ab + b^2$ and $(a - b)^2 = a^2 - 2ab + b^2$.

Q49. Answer: (d) 4/5

Shortcut Trick
The trigonometric ratio $\sin \theta = 3/5$ corresponds to Perpendicular / Hypotenuse.
Recognize the fundamental Pythagorean triplet: (3, 4, 5).
In this triplet, if Perpendicular = 3 and Hypotenuse = 5, then Base must be 4.
Using the ratio $\cos \theta$ = Base / Hypotenuse, we get $\cos \theta = 4/5$.
Therefore The correct answer is 4/5.

Alternate Method

Given: $\sin\theta = 3/5$

Formula: $\sin^2\theta + \cos^2\theta = 1$

$\Rightarrow \cos^2\theta = 1 - \sin^2\theta$

$\Rightarrow \cos\theta = \sqrt{(1 - (3/5)^2)}$

$\Rightarrow \cos\theta = \sqrt{(1 - 9/25)}$

$\Rightarrow \cos\theta = \sqrt{((25 - 9) / 25)}$

$\Rightarrow \cos\theta = \sqrt{(16/25)}$

$\Rightarrow \cos\theta = 4/5$

Therefore The correct answer is 4/5.

Additional Information

Trigonometric Identities

The primary identity is $\sin^2\theta + \cos^2\theta = 1$, from which we derive $\cos\theta = \sqrt{(1 - \sin^2\theta)}$.

Pythagorean Theorem

In a right-angled triangle, $\text{Base}^2 + \text{Perpendicular}^2 = \text{Hypotenuse}^2$.

Pythagorean Triplets

Common triplets used in exams include (3, 4, 5), (5, 12, 13), (8, 15, 17), and (7, 24, 25).

Ratio Definitions

$\sin\theta = P/H$, $\cos\theta = B/H$, $\tan\theta = P/B$, $\cot\theta = B/P$, $\sec\theta = H/B$, $\text{cosec}\,\theta = H/P$.

Q50. Answer: (c) 2

Shortcut Trick

Ratio of Anil (A) to Bhavya (B) present ages = 5 : 4

Let present ages be 5x and 4x.

According to question: $(4x + 6) = 2 \times (5x) - 6$

$\Rightarrow 4x + 6 = 10x - 6$

$\Rightarrow 6x = 12 \Rightarrow x = 2$

Difference between their ages = $5x - 4x = x = 2$ years.

Therefore The correct answer is 2.

Alternate Method

Given:

$4 \times \text{Anil} = 5 \times \text{Bhavya}$

After 6 years, Bhavya = 2 × Anil (Present) − 6

Let Anil's age = A and Bhavya's age = B

$\Rightarrow 4A = 5B \Rightarrow B = 4A/5$

$\Rightarrow (B + 6) = 2A - 6$

$\Rightarrow (4A/5) + 6 = 2A - 6$

$\Rightarrow 4A/5 + 12 = 2A$

$\Rightarrow 12 = 2A - 0.8A$

$\Rightarrow 1.2A = 12$

$\Rightarrow A = 10$ years

$\Rightarrow B = (4 \times 10)/5 = 8$ years

$\Rightarrow$ Difference = $10 - 8 = 2$ years

Therefore The correct answer is 2.

Additional Information

Constant Age Difference

The difference between the ages of two people remains the same regardless of how many years pass.

Ratio to Value Conversion

If two quantities are in the ratio x : y, they can be represented as kx and ky, where k is the common multiplier.

Future and Past Ages

If current age is X, age after n years is (X + n) and age n years ago was (X − n).

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Q51. Answer: (c) BN - GS

The logic followed here is:
Option 1) TG – XK
Option 2) DW – HA
Option 3) BN – GS
Option 4) VR – ZV
Here, BN – GS is odd from the given options.
Hence, the correct answer is "Option 3".

Q52. Answer: (b) 1

The logic followed here is:
Given:
TEAR → 5731
POST → 2148
So, the code for T = 1.
Hence, the correct answer is Option 2.

Q53. Answer: (a) 4

Given: (Left) 8 6 5 6 7 2 5 9 8 6 3 2 3 3 4 4 4 6 1 4 4 1 4 5 2 6 6 (Right)
Now,
Even numbers, which are immediately preceded by an odd number and also immediately followed by an odd number.
So, Needed pattern is: Odd Number - Even Number - Odd Number
(Left) 8 6 5 6 7 2 5 9 8 6 3 2 3 3 4 4 4 6 1 4 4 1 4 5 2 6 6 (Right)
So, total valid even numbers = 4
Hence, the correct answer is Option 1.

Q54. Answer: (b) 0

Given:
Priya is 9th from the left end and Neeraj is 27th from the right end in a row of 36 students.
Here,
Neeraj's position from the left end = (36 − 27) + 1 = 10th
Now, Number of people between Priya and Neeraj = (10 − 9) − 1
= 1 − 1
= 0
So, there are no people standing between Priya and Neeraj.
Hence, the correct answer is "Option 2".

Q55. Answer: (d) NDZQ

The logic followed here is:
For LMUG → RHYD
Now, for JNSF → PIWC
Now, applying the same logic for HIVT:
So, HIVT → NDZQ
Hence, the correct answer is "Option 4".

Q56. Answer: (a) XNG 62

The logic followed here is:
So, the missing term = XNG 62
Hence, the correct answer is Option 1.

Q57. Answer: (d) FPIC

The logic followed here is:
For ANTY → CKOZ
Now, for UIQL → WFLM

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Now, applying the same logic for DSNB:
So, DSNB → FPIC
Hence, the correct answer is "Option 4".

Q58. Answer: (b) 110

The logic followed here is:
thus, "110" will replace the question mark in the given series.
Hence, the correct option is "Option 2".

Q59. Answer: (d) 55

BODMAS Table:
Decoding the given information:

Alphabet	**•**	**−**	**×**	**÷**
Meaning	−	•	÷	×

Now, replacing the sign from left to right using BODMAS Rule, we get:
=> 42 ÷ 7 × 8 + 16 − 9 = ?
=> 6 × 8 + 16 − 9 = ?
=> 48 + 16 − 9 = ?
=> 64 − 9 = ?
=> 55
Hence, the correct option is "Option 4".

Q60. Answer: (b) KR25

The logic followed here is:
So, the missing term = KR25
Hence, the correct answer is Option 2.

Q61. Answer: (a) EIM

The logic followed here is:
Option 1) EIM
Option 2) WBF
Option 3) MRV
Option 4) TYC
Here, EIM is odd from the given options.
Hence, the correct answer is "Option 1".

Q62. Answer: (c) Neither conclusion (I) nor (II) follows.

Given Statements:
Some bats are nets.
All cubs are nets.
The least possible Venn diagram for the given statement is:
Conclusions:
I. Some bats are cubs – Does not follow (No direct relation is given between bats and cubs).
II. All nets are cubs – Does not follow (Only all cubs are nets is given, not the reverse).
So, neither conclusion I nor conclusion II follows.
Hence, the correct answer is "Option 3".

Q63. Answer: (c) OJVR

The logic followed here is:
For JITD → EEQB
Now, for QHSB → LDPZ
Now, applying the same logic for TNYT:
So, TNYT → OJVR

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Hence, the correct answer is "Option 3".

Q64. Answer: (b) One

Given: 629, 125, 534, 756, 438

Now, Arrange the numbers in ascending order and compare their positions with the original sequence.

Original sequence: 629 125 534 756 438

Ascending order: 125 438 534 629 756

Position	Original Number	New Number	Status
1st	629	125	Changed
2nd	125	438	Changed
3rd	534	534	Unchanged
4th	756	629	Changed
5th	438	756	Changed

Only one number, 534, remains in the same position.

So, total unchanged positions = 1

Hence, the correct answer is Option 2.

Q65. Answer: (b) 11 km to the east

The logic followed here is:

Given:

Anand starts from Point A and drives 43 km towards the south.

He then takes a left turn, drives 40 km, turns left and drives 45 km.

He then takes a left turn and drives 51 km.

He takes a final left turn, drives 2 km and stops at Point P.

So, To reach Point A, he must go 11 km towards the East

Hence, the correct answer is Option 2.

Q66. Answer: (a) Both conclusions (I) and (II) follow

Given Statements:

All pencils are erasers.

All pencils are rulers.

All rulers are boxes.

The least possible Venn diagram for the given statement is:

Conclusions:

I. All pencils are boxes – Follows (All pencils are rulers and all rulers are boxes, so all pencils are boxes).

II. Some rulers are erasers – Follows (Pencils are common to both rulers and erasers, so some rulers are erasers).

So, both conclusion I and conclusion II follow.

Hence, the correct answer is "Option 1".

Q67. Answer: (b) 14

Given:

Raman is 10th from the top and 5th from the bottom.

Here, Total students = 10 + 5 − 1 = 14

So, there are 14 students in the class.

Hence, the correct answer is "Option 2".

Q68. Answer: (a) Father's mother

Family Chart:

Decoding the Symbols:

Symbol	•	−	×	÷

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Meaning	Sister	Father	Brother	Mother

Given: N ÷ O × P − Q + S

It means: N is the mother of O, O is the brother of P, P is the father of Q, and Q is the sister of S.

Hence, N is the grandmother of S from the father's side, i.e., father's mother.

Hence, the correct answer is "Option 1".

Q69. Answer: (d) (10, 19, 45)

The logic followed here is:

Logic: Third Number = First Number + Second Number + 16.

For, (5, 14, 35) →

=> 5 + 14 = 19

=> 19 + 16 = 35

For, (4, 13, 33) →

=> 4 + 13 = 17

=> 17 + 16 = 33

Now, checking the options:

Option 1) (7, 16, 40)

=> 7 + 16 = 23

=> 23 + 16 = 39 ≠ 40

Option 2) (8, 17, 27)

=> 8 + 17 = 25

=> 25 + 16 = 41 ≠ 27

Option 3) (16, 7, 21)

=> 16 + 7 = 23

=> 23 + 16 = 39 ≠ 21

Option 4) (10, 19, 45)

=> 10 + 19 = 29

=> 29 + 16 = 45

Hence, the correct answer is Option 4.

Q70. Answer: (a) More than three

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

Now,

Odd digits, which are immediately preceded by an odd digit and also immediately followed by an odd digit.

So, Needed pattern is: Odd Digit - Odd Digit - Odd Digit

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

So, total valid odd digits = 9

Hence, the correct answer is Option 1.

Q71. Answer: (b) One

Given: S, Q, U, A, R, E and D are sitting in a row facing north.

Only two people sit to the left of U.

Only three people sit between U and R.

Only one person sits between R and S.

E sits to the immediate left of A.

D is not an immediate neighbor of R.

Now, People to the right of Q → 1

Hence, the correct answer is "Option 2".

Q72. Answer: (d) 10 km

The logic followed here is:

Given:

Ravi drove 20 km from his office towards the north.
He then took a right turn and drove 5 km.
He took another right turn and drove 10 km,
and then turned right, drove 5 km,
and stopped at point A.

Hence, the shortest distance from the starting point is 10 km
Hence, the correct answer is Option 4.

Q73. Answer: (c) 1

The logic followed here is:
Given:
YARN → 5731
ROSE → 2148
So, the code for R = 1.
Hence, the correct answer is Option 3.

Q74. Answer: (c) None

Given: Seven people A, B, C, D, E, F and G are sitting around a circular table facing the centre.
B sits second to the right of A.
E sits to the immediate left of A.
C is the immediate neighbour of F and G.
D sits second to the left of F.
So, No person sits between E and G.
Hence, the correct answer is "Option 3".

Q75. Answer: (d) 6

The logic followed here is:
Given number: 5431786
Logic:
Add 1 to each odd digit
Subtract 2 from each even digit
Original number: 5 4 3 1 7 8 6

Digit	Type	Operation	New Digit
5	Odd	5 + 1	6
4	Even	4 − 2	2
3	Odd	3 + 1	4
1	Odd	1 + 1	2
7	Odd	7 + 1	8
8	Even	8 − 2	6
6	Even	6 − 2	4

New number: 6 2 4 2 8 6 4
Now, Highest digit = 8
Lowest digit = 2
Difference = 8 − 2 = 6
Hence, the correct answer is Option 4.

Q76. Answer: (d) Three

Given: G, H, I, Q, R and S are sitting in a straight line facing north.
Only three people are seated to the left of H.

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Only Q is seated to the right of S.

Only three people are seated between Q and I.

G is seated at some place to the right of R.

Now, People between R and S → 3

Hence, the correct answer is "Option 4".

Q77. Answer: (b) 323

The logic followed here is:

thus, "323" will replace the question mark in the given series.

Hence, the correct option is "Option 2".

Q78. Answer: (d) 228

The logic followed here is:

thus, "228" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q79. Answer: (a) 1

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

Now,

Even numbers, which are immediately preceded by an odd number and also immediately followed by an even number.

So, Needed pattern is: Odd Number - Even Number - Even Number

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

So, total valid even numbers = 1

Hence, the correct answer is Option 1.

Q80. Answer: (b) 354

BODMAS Table:

Decoding the given information:

Alphabet	I	J	K	L
Meaning	•	×	÷	−

Now, replacing the sign from left to right using BODMAS Rule, we get:

=> 59 × 4 ÷ 2 + 150 × 2 − 102 ÷ 2 − 15 ÷ 5 − 10

=> 59 × 2 + 150 × 2 − 51 − 3 − 10

=> 118 + 300 − 51 − 3 − 10

=> 418 − 51 − 3 − 10

=> 367 − 3 − 10

=> 364 − 10

=> 354

Hence, the correct option is "Option 2".

Q81. Answer: (a) Narendra Modi

The correct answer is Narendra Modi.

Key Points

• According to the Global Leader Approval Rating Tracker released by the US-based business intelligence firm Morning Consult, Indian Prime Minister Narendra Modi was identified as the most popular democratic leader in July 2025.

• Prime Minister Narendra Modi consistently secured the top spot with an approval rating often exceeding 70%, significantly higher than his global counterparts from developed nations. Hence, option 1 is correct.

• The survey tracked the approval ratings of government leaders in various countries including the United States, United Kingdom, France, Australia, and Italy, among others.

• The report highlights India's Prime Minister's sustained popularity, which is attributed to various socio-economic reforms and diplomatic initiatives on the international stage.

• Narendra Modi has held the Prime Minister's office since May 2014, leading the Bharatiya Janata Party (BJP) to consecutive victories in the Lok Sabha elections.

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Additional Information

• About Morning Consult:

• Morning Consult is a proprietary data and business intelligence company founded in 2014 and headquartered in Washington, D.C.

• The firm provides real-time polling data on political elections, elected officials, and corporate brands, conducting thousands of interviews across the globe daily.

• Their Global Leader Approval Rating is based on a seven-day moving average of all adults in a given country, with sample sizes varying by nation.

• Other Leaders Mentioned in Options:

• Nirmala Sitharaman: She currently serves as the Minister of Finance and Minister of Corporate Affairs of India. While a highly influential leader, she is not typically ranked in the "Head of Government" approval surveys conducted by Morning Consult. Hence, option 2 is incorrect.

• Rahul Gandhi: He is a prominent leader of the Indian National Congress (INC) and served as the Leader of the Opposition in the 18th Lok Sabha. He is a key political figure but did not top the global approval rating for democratic heads of government in this report. Hence, option 3 is incorrect.

• Amit Shah: He serves as the Union Home Minister and the first Minister of Co-operation of India. Like the Finance Minister, he holds a critical cabinet position but the specific "World Leader" survey focuses on the Head of Government (Prime Minister/President). Hence, option 4 is incorrect.

• Global Context:

• The rankings usually feature other notable figures like Joe Biden (President of the USA), Justin Trudeau (Prime Minister of Canada), and Giorgia Meloni (Prime Minister of Italy).

• A high approval rating for a democratic leader often indicates strong public trust and satisfaction with the governance and policy implementation within the country.

Important Points

• Data Reliability: The Morning Consult data is considered a benchmark for geopolitical sentiment, as it uses a standardized methodology across all surveyed countries to ensure comparability.

• Socio-Economic Impact: Leaders with high approval ratings are often those who have successfully managed inflation, employment, and national security concerns.

• Democratic Significance: In the context of July 2025, these ratings reflect the political stability and the electoral mandate enjoyed by the leader in the world's largest democracy.

Q82. Answer: (a) Article 223

The correct answer is Article 223.

Key Points

• Article 223 of the Constitution of India deals with the appointment of an Acting Chief Justice for a High Court. It states that when the office of Chief Justice is vacant or when the Chief Justice is unable to perform their duties, the President may appoint one of the other Judges of the court to perform those duties.

• In December 2025, the President of India appointed Justice Meenakshi Madan Rai to perform the duties of the Chief Justice of the Sikkim High Court. Hence, the correct answer is Article 223.

• Justice Meenakshi Madan Rai is the Senior-most Judge of the Sikkim High Court and has the distinction of being the first woman from Sikkim to be appointed as a Judge of the High Court.

• The appointment was necessitated by the retirement or vacancy in the office of the permanent Chief Justice, ensuring that the judicial administration of the Sikkim High Court continues without interruption.

• The President issues the notification for such appointments through the Department of Justice, under the Ministry of Law and Justice.

Additional Information

• Article 217:

• This article relates to the appointment and conditions of the office of a Judge of a High Court.

• It specifies that every Judge shall be appointed by the President after consultation with the Chief Justice of India and the Governor of the State. Hence, statement 2 is incorrect in the context of "Acting" duties.

• Article 226:

• This article empowers the High Courts to issue certain writs, including Habeas Corpus, Mandamus, Prohibition, Quo Warranto, and Certiorari.

• These writs are issued for the enforcement of Fundamental Rights (Part III) and for any other legal purpose. Hence, statement 3 is incorrect.

• Article 124:

• This article provides for the establishment and constitution of the Supreme Court of India.

• It details the appointment of Supreme Court Judges and the Chief Justice of India, rather than High Court appointments. Hence, statement 4 is incorrect.

• High Court of Sikkim:

• It was established in 1975 when Sikkim became the 22nd State of the Indian Union.

• It is located in Gangtok and is one of the smallest High Courts in India in terms of judge strength.

Important Points

• Justice Meenakshi Madan Rai was first sworn in as a Judge of the Sikkim High Court on April 15, 2015.

• She has previously served as the Acting Chief Justice of the Sikkim High Court multiple times, including instances in 2018, 2019, 2020, and 2021.

• The Acting Chief Justice holds the same powers and performs the same judicial and administrative functions as a permanent Chief Justice.

• The Judiciary in India follows a single integrated system, where the High Courts operate under the Supreme Court, but are independent of the State Executive.

Q83. Answer: (d) Bareilly

The correct answer is Bareilly.

Key Points

• The Junior National Boxing Championships (for both Boys and Girls) were organized in Bareilly, Uttar Pradesh, in the year 2024.

• The championship took place from 6 January to 13 January 2024, serving as a major platform for young pugilists in the country.

• The venue for this prestigious sporting event was Invertis University, located in Bareilly, which provided the necessary infrastructure for the multi-day tournament.

• Approximately 800 boxers from 35 states and Union Territories across India participated in various weight categories to compete for the national title.

• The event was organized under the aegis of the Boxing Federation of India (BFI), aiming to identify and nurture talent for future international events, including the 2028 Los Angeles Olympics.

Additional Information

• Boxing Federation of India (BFI):

• The BFI is the national governing body for Olympic boxing in India. It is responsible for organizing national championships and managing the national teams.

• It is recognized by the Ministry of Youth Affairs and Sports and is affiliated with the International Boxing Association (IBA).

• The current President of the BFI is Shri Ajay Singh, and the organization is headquartered in New Delhi.

• Bareilly City:

• Bareilly is a major city in the state of Uttar Pradesh, situated on the banks of the Ramganga River.

• It is famously known as Nath Nagri because of the presence of several ancient temples dedicated to Lord Shiva surrounding the city.

• The city is also a significant hub for trade and is well-known for its Zari-Zardosi embroidery and furniture industry.

• Other Recent National Boxing Events:

• The 7th Elite Women's National Boxing Championship was held in Greater Noida at Gautam Buddha University in December 2023.

• The Elite Men's National Boxing Championship 2023 was conducted in Shillong, Meghalaya, in November 2023.

• These tournaments are critical for the ranking of players and for their selection into the national coaching camps conducted by the Sports Authority of India (SAI).

• Importance of Junior Championships:

• Junior championships are the foundation of the Indian boxing ecosystem, where athletes aged 15 to 16 years showcase their skills.

• Top performers in these events are often drafted into the Khelo India scholarship scheme, which provides financial assistance and advanced training to budding sportspersons.

Q84. Answer: (b) Verifying investment performance claims

The correct answer is Verifying investment performance claims.

Key Points

• The Securities and Exchange Board of India (SEBI) introduced the operational framework for the Performance Reporting and Rating Verification Agency (PaRRVA) in April 2025 to bring transparency to the investment ecosystem.

• The primary objective of PaRRVA is the verification of investment performance claims made by regulated intermediaries, such

as Investment Advisers (IAs) and Research Analysts (RAs), ensuring they do not mislead investors with inflated return data. Hence, the correct answer is Verifying investment performance claims.

• Under this framework, any performance-related claims made in advertisements or marketing materials must be validated by PaRRVA before being circulated to the public.

• The agency is designed to act as an independent body (often supported by subsidiaries of Stock Exchanges) that checks the authenticity of historical data and the methodology used to calculate returns.

• By mandating this verification, SEBI aims to curb the practice of "cherry-picking" profitable periods or using "back-tested" data to lure unsuspecting retail investors into risky financial products.

Additional Information

• Securities and Exchange Board of India (SEBI):

• SEBI was established on April 12, 1988, and was given statutory powers on January 30, 1992, through the SEBI Act, 1992.

• It is the principal regulator for the securities market in India, headquartered in Mumbai, with regional offices in New Delhi, Kolkata, Chennai, and Ahmedabad.

• The main functions of SEBI include protecting the interests of investors, regulating the business in stock exchanges, and promoting the development of the securities market.

• Investment Advisers and Research Analysts:

• These entities are regulated under the SEBI (Investment Advisers) Regulations, 2013 and SEBI (Research Analysts) Regulations, 2014.

• They are prohibited from making guaranteed return claims or using superlative terms like "best" or "No. 1" without objective verification by bodies like PaRRVA.

• Investor Protection Measures:

• The introduction of PaRRVA is a step towards investor protection, preventing financial fraud and mis-selling in the growing digital investment advisory space.

• It complements other SEBI initiatives like the SCORES (SEBI Complaints Redress System) platform, which allows investors to lodge grievances against listed companies and intermediaries online.

• Digital Transformation in Regulation:

• The PaRRVA framework utilizes algorithmic verification and data feeds from Depositories and Exchanges to ensure that the reported performance matches actual transaction records.

• This move aligns with global best practices in financial regulation, where independent audits of performance track records are becoming standard for wealth management firms.

Q85. Answer: (a) Belagavi

The correct answer is Belagavi.

Key Points

• The 11th edition of the Joint Military Exercise MITRA SHAKTI was scheduled to be held in Belagavi, Karnataka, India.

• MITRA SHAKTI is a premier bilateral exercise conducted annually between the Indian Army and the Sri Lankan Army to bolster military cooperation.

• The primary objective of the 2025 edition is to enhance interoperability and synergy between the two nations while conducting counter-insurgency and counter-terrorism operations in a sub-conventional environment.

• The exercise involves the participation of infantry battalions from both sides, focusing on tactical drills and the exchange of best practices under a United Nations mandate.

• The training curriculum includes drone warfare, counter-IED (Improvised Explosive Device) techniques, and specialized operations in semi-urban terrains.

Additional Information

• History of Mitra Shakti:

• The joint exercise series was first initiated in 2012 to build strong bilateral relations and foster mutual understanding between the security forces of India and Sri Lanka.

• It has since evolved into a critical platform for sharing operational experiences gained during various peacekeeping missions and internal security duties.

• 10th Edition Recap:

• The 10th edition of Exercise Mitra Shakti was successfully conducted in August 2024 at the Army Training School in Maduru Oya, Sri Lanka.

• This edition saw a significant focus on Hadr (Humanitarian Assistance and Disaster Relief) operations and joint tactical planning.

• SLINEX (Sri Lanka-India Naval Exercise):

• Apart from the army exercise, the two countries participate in a bilateral maritime exercise called SLINEX.

• Launched in 2005, SLINEX aims to enhance maritime security and promote technical coordination between the Indian Navy and the Sri Lanka Navy.

Important Points

• Strategic Significance: These exercises are a cornerstone of India's "Neighbourhood First" policy and the SAGAR (Security and Growth for All in the Region) vision, aimed at maintaining peace in the Indian Ocean Region.

• Belagavi Training Hub: Belagavi (formerly Belgaum) is a significant military base in India, housing the Maratha Light Infantry Regimental Centre (MLIRC) and the Junior Leaders Wing of the Infantry School, making it an ideal location for international joint exercises.

• Scope of Operations: The drills often include sniping, combat conditioning, rappelling, and medical evacuation drills to ensure readiness for diverse combat scenarios.

Q86. Answer: (b) Ministry of Commerce and Industry

The correct answer is Ministry of Commerce and Industry.

Key Points

• The Ministry of Commerce and Industry officially launched the Trade Intelligence and Analytics Portal in January 2025 to empower Indian exporters with data-driven decision-making tools.

• The portal was inaugurated by the Union Minister of Commerce and Industry, Shri Piyush Goyal, as part of the government's digital transformation agenda for the trade sector.

• It serves as a comprehensive platform providing transparent and real-time trade data, which includes detailed information on export-import statistics, global market trends, and trade flows.

• The portal integrates Advanced Analytics and Artificial Intelligence (AI) to provide insights into Non-Tariff Barriers (NTBs), Rules of Origin, and tariff structures across more than 200 international markets.

• The primary objective of this initiative is to assist Micro, Small, and Medium Enterprises (MSMEs) and large exporters in identifying new opportunities to help India achieve its target of $2 trillion in exports by 2030.

Additional Information

• Directorate General of Foreign Trade (DGFT): Functioning under the Ministry of Commerce and Industry, the DGFT is responsible for formulating and implementing the Foreign Trade Policy (FTP) and promoting India's exports through various digital schemes.

• Foreign Trade Policy (FTP) 2023: This policy shifted India's approach from an incentive-based regime to a remission and entitlement-based regime, emphasizing Ease of Doing Business through automation and paperless processing.

• Export Targets: The Indian government has set a long-term goal to reach $1 trillion in merchandise exports and $1 trillion in services exports by the year 2030, supported by initiatives like the Trade Intelligence Portal.

• India's Trade Ecosystem: Key bodies such as Export Promotion Councils (EPCs) and Commodity Boards work under the aegis of this ministry to support specific sectors like pharmaceuticals, engineering goods, and textiles.

• Market Access Initiative (MAI) Scheme: This is an export promotion scheme that provides financial assistance to export promotion organizations and individual exporters for market studies, branding, and participation in international trade fairs.

Important Points

• The portal acts as a single-window solution for exporters to access HS Code-wise (Harmonized System) data and market intelligence, which was previously scattered across multiple platforms.

• By providing predictive analytics, the ministry helps businesses stay ahead of global supply chain disruptions and shifting geopolitical trade dynamics.

• The Department of Commerce, which manages this portal, is also the lead agency for negotiating Free Trade Agreements (FTAs) with countries like the UK, European Union, and members of the GCC to expand India's global footprint.

Q87. Answer: (c) Sai Sudharsan

The correct answer is Sai Sudharsan.

Key Points

• The Orange Cap for the IPL 2025 season was won by Sai Sudharsan, who represented the Gujarat Titans.

• He achieved this milestone by scoring a massive total of 759 runs throughout the tournament, displaying remarkable consistency at the top of the order.

• This feat makes him one of the primary contributors to the Gujarat Titans' batting strength, securing his position as a premier opening or top-order batter in the Indian Premier League.

• Winning the Orange Cap involves surpassing all other batters in the league in terms of total runs accumulated during a single edition of the tournament.

• His performance included several half-centuries and crucial match-winning knocks, helping the Ahmedabad-based franchise maintain a competitive edge in IPL 2025.

Additional Information

• The Orange Cap Award:

• It is an annual cricket award presented to the leading run-getter in the Indian Premier League (IPL) since its inception in 2008.

• The first-ever winner of the Orange Cap was Shaun Marsh, who scored 616 runs for Kings XI Punjab in the inaugural season.

• During the tournament, the player currently leading the run charts wears the physical Orange Cap while fielding.

• Gujarat Titans (GT):

• The franchise is based in Ahmedabad, Gujarat, and plays its home matches at the Narendra Modi Stadium.

• The team entered the IPL in 2022 and made history by winning the title in its debut season.

• The 759 runs scored by Sai Sudharsan represent one of the highest individual season totals for the franchise.

• Sai Sudharsan Profile:

• A stylish left-handed batter from Tamil Nadu, he was initially picked up by Gujarat Titans in the 2022 Mega Auction for his base price of 20 lakhs.

• He is known for his solid technique and ability to play both pace and spin with ease, making him a versatile player in the T20 format.

• Other Options in Context:

• Virat Kohli: He holds the all-time record for the most runs in a single IPL season, scoring 973 runs in 2016 for Royal Challengers Bengaluru (RCB).

• Suryakumar Yadav: A vital player for Mumbai Indians, renowned as one of the world's best T20 batters with his "360-degree" hitting ability.

• Rajat Patidar: An explosive middle-order batter for Royal Challengers Bengaluru, famous for his century in the 2022 playoffs.

Important Points

• The race for the Orange Cap is one of the most followed aspects of the IPL, reflecting the individual dominance of batters over the course of nearly two months of cricket.

• Sai Sudharsan reaching 759 runs highlights the rising importance of young Indian domestic talent in a league that features the best international cricketers.

• Statistical data from IPL 2025 shows that consistency in the powerplay and the ability to anchor the innings were key factors in achieving this high run tally.

Q88. Answer: (a) Rural citizens and low-income account holders

The correct answer is Rural citizens and low-income account holders.

Key Points

• The decision by Public Sector Banks (PSBs), specifically Indian Bank and Punjab National Bank (PNB), to remove minimum balance penalties in July 2025 is designed to alleviate the financial burden on the most vulnerable sections of society.

• Rural citizens and low-income account holders are the primary beneficiaries as they often possess limited disposable income and face fluctuations in cash flow, making it difficult to maintain a consistent Average Monthly Balance (AMB).

• Prior to this change, failure to maintain a minimum balance often resulted in automated penalty deductions, which could deplete the meager savings of wage laborers and small-scale farmers. Hence, statement 1 is correct.

• This policy shift is part of a broader effort to promote Financial Inclusion by ensuring that the cost of banking does not act as a barrier for the unorganized sector.

• By removing these penalties, banks encourage individuals from economically weaker sections (EWS) to utilize formal banking channels for remittances, savings, and government subsidies without the fear of hidden charges.

Additional Information

• Average Monthly Balance (AMB):

• AMB is the minimum average amount a customer is required to keep in their Savings Account over a month to avoid non-maintenance charges.

• In Public Sector Banks, the minimum balance requirement is typically lower in rural and semi-urban branches compared to metro branches, yet it remains a challenge for low-income groups.

• Financial Inclusion Initiatives:

• The Pradhan Mantri Jan Dhan Yojana (PMJDY), launched in 2014, was a pioneer in providing zero-balance accounts to the unbanked population.

• The Reserve Bank of India (RBI) has issued guidelines stating that banks should not levy penalties that result in a negative balance in a savings account.

• Impact on Banking Habits:

• Removal of penalties helps in building trust among first-time bankers in rural locations, preventing them from returning to informal and risky money-lending practices.

• It helps migrant workers and pensioners who may only receive funds at specific intervals and cannot always keep a buffer in their accounts.

• Banking Regulations:

• The Banking Codes and Standards Board of India (BCSBI) and RBI monitor the "reasonableness" of bank charges to ensure that social banking objectives are met.

• The removal of these charges by Indian Bank and PNB serves as a benchmark for other nationalized banks to prioritize social welfare over non-interest income.

Important Points

• Demographic Focus: While urban professionals and wealthy individuals (Options 2 and 3) generally maintain balances far above the minimum threshold, they do not feel the impact of penalty removals.

• Comparison: College students (Option 4) also benefit from no-frills accounts, but the scale of impact is highest on rural populations whose entire financial security depends on small-scale banking accessibility.

• Economic Data: According to various financial surveys, non-maintenance charges previously accounted for a significant portion of miscellaneous revenue for banks, often collected from those least able to afford it.

Q89. Answer: (a) India–Philippines naval drill in the South China Sea

The correct answer is India–Philippines naval drill in the South China Sea.

Key Points

• The India–Philippines naval drill conducted in the South China Sea in 2025 represents a significant escalation in bilateral defense ties and a shift in India's maritime strategy. This exercise was aimed at enhancing interoperability and demonstrating a commitment to freedom of navigation in international waters. Hence, statement 1 is correct.

• The drill took place within the Philippines' Exclusive Economic Zone (EEZ), a region where China asserts expansive territorial claims under its controversial Nine-Dash Line. By conducting maneuvers here, India signaled its support for the 2016 Permanent Court of Arbitration ruling.

• This joint exercise involved advanced naval assets, including guided-missile frigates and maritime patrol aircraft, focusing on anti-submarine warfare (ASW) and surface gunnery drills.

• Exercise Ajeya Warrior is a bilateral Army exercise between India and the United Kingdom, not a naval exercise in the Bay of Bengal. It focuses on counter-terrorism and tactical operations. Hence, statement 2 is incorrect.

• The Iron Fist Drill is historically a joint amphibious exercise between the United States and Japan; it does not traditionally involve Russia in the Indian Ocean as a joint "Iron Fist" branded partner for India. Hence, statement 3 is incorrect.

• Exercise Malabar is a multilateral naval exercise involving India, Australia, Japan, and the USA (the QUAD). While it occurs in the Indo-Pacific, the specific "eyebrow-raising" event in a disputed maritime region in 2025 specifically refers to the burgeoning India-Philippines security nexus in the South China Sea. Hence, statement 4 is incorrect.

Additional Information

• India–Philippines Defense Relations:

• The relationship has transformed from a primarily commercial one to a strategic partnership. A milestone in this journey was the 2024 delivery of the BrahMos supersonic cruise missiles to the Philippines, worth $375 million.

• In 2025, both nations expanded their Memorandum of Understanding (MOU) on Defense Cooperation to include joint patrols and intelligence sharing.

• Geopolitics of the South China Sea:

• The South China Sea is a critical maritime gateway through which approximately one-third of global shipping passes, valued at over $3 trillion annually.

• The United Nations Convention on the Law of the Sea (UNCLOS) serves as the legal framework for maritime rights, which India consistently advocates for to ensure a rules-based international order.

• India's Act East Policy:

• Launched in 2014 by Prime Minister Narendra Modi, this policy focuses on the extended neighborhood in the Asia-Pacific region. It has evolved from economic integration to include security and defense cooperation with ASEAN member states.

Important Points

• Exercise Malabar: This was originally a bilateral exercise between India and the USA in 1992. It became trilateral with the inclusion of Japan in 2015 and quadrilateral with Australia rejoining in 2020. It serves as a visual deterrent and a mechanism for QUAD nations to ensure a Free and Open Indo-Pacific.

• Freedom of Navigation Operations (FONOPs): While India does not officially join U.S.-led FONOPs, its presence in the South China Sea through joint drills with littoral states like the Philippines and Vietnam serves a similar purpose of asserting maritime sovereignty and international law.

• INS Kadmatt and INS Shivalik: These are examples of Indian Navy ships that have been frequently deployed for Long Range Operational Deployments in the South China Sea to engage with friendly foreign navies.

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Q90. Answer: (d) Haryana

The correct answer is Haryana.

Key Points

• In September 2025, the Japanese electronics giant TDK Corporation inaugurated its first state-of-the-art facility for manufacturing Lithium-ion (Li-ion) battery cells in India.

• The manufacturing plant is located in Manesar, which falls under the Gurugram district of the state of Haryana.

• This facility is specifically designed to produce high-end battery cells that will be supplied to major global technology companies, most notably for the assembly of Apple iPhones within India.

• The establishment of this plant in Haryana marks a significant shift in the global supply chain, as TDK Corporation previously imported these cells primarily from China.

• The project is a major boost to the "Make in India" initiative, aiming to increase domestic value addition in the electronics and mobile phone manufacturing sector.

Additional Information

• TDK Corporation: It is a leading Japanese multinational electronics company founded in 1935, with its global headquarters in Tokyo. The company is world-renowned for its expertise in magnetic materials and electronic components.

• Employment Generation: The inauguration of the Haryana plant is expected to create several thousand direct and indirect jobs, fostering local economic growth in the Manesar-Bawal industrial corridor.

• Investment Impact: This move by TDK Corporation signifies India’s growing status as a preferred destination for Foreign Direct Investment (FDI) in high-tech manufacturing, particularly for the components used in premium smartphones.

• Strategic Location: Haryana was chosen due to its robust industrial infrastructure, proximity to the national capital, New Delhi, and its existing ecosystem of automotive and electronics manufacturing.

Important Points

• Supply Chain Localization: By producing lithium-ion cells domestically, the dependency on imports for critical mobile components is reduced, helping India achieve greater self-reliance in the electronics sector.

• PLI Scheme: Such investments are often supported by the Government of India’s Production Linked Incentive (PLI) scheme, which incentivizes large-scale electronics manufacturing to compete on a global scale.

• Technology Transfer: The Manesar plant utilizes Advanced Technologies to ensure high energy density and safety standards for the batteries, bringing world-class Japanese engineering processes to the Indian soil.

• Environmental and Economic Goals: The production of Li-ion batteries is central to the global transition toward cleaner energy and portable power solutions, aligning with India's long-term goals for sustainable industrialization.

Q91. Answer: (b) DHRUV64

The correct answer is DHRUV64.

Key Points

• DHRUV64 is the first fully indigenous high-performance microprocessor developed by the Centre for Development of Advanced Computing (C-DAC) under the Microprocessor Development Programme (MDP), marking a significant milestone in 2025.

• It is built on the 64-bit RISC-V (Reduced Instruction Set Computer) open-source Instruction Set Architecture, designed to cater to complex computing needs within India.

• The development of DHRUV64 is a strategic step towards Atmanirbhar Bharat (Self-reliant India) in the semiconductor and hardware domain, reducing reliance on proprietary foreign architectures like Intel or ARM.

• This microprocessor is specifically optimized for applications in high-performance computing (HPC), secure servers, and critical infrastructure management, ensuring data sovereignty for the nation.

• The Microprocessor Development Programme (MDP) is an initiative funded and spearheaded by the Ministry of Electronics and Information Technology (MeitY) to design and fabricate a family of microprocessors within the country.

Additional Information

• Microprocessor Development Programme (MDP):

• The MDP aims to achieve complete indigenization of the electronic system design and manufacturing (ESDM) sector in India.

• Prior to DHRUV64, the program supported the development of the SHAKTI series by IIT Madras and the VEGA series by C-DAC.

• The goal is to provide domestic alternatives for various segments, including IoT devices, automotive electronics, and supercomputing.

• Significance of RISC-V Architecture:

• RISC-V is an open-standard architecture that allows Indian researchers and engineers to customize designs without paying heavy licensing fees or royalties to foreign corporations.

• By using RISC-V, DHRUV64 ensures a transparent and secure design process, which is vital for national security and strategic applications.

• C-DAC (Centre for Development of Advanced Computing):

• C-DAC is the premier R&D organization of the Ministry of Electronics and Information Technology (MeitY) for carrying out R&D in IT, Electronics, and associated areas.

• It is well-known for creating the PARAM series of supercomputers, and the development of DHRUV64 further cements its role in the hardware evolution of India.

Important Points

• Comparison with SHAKTI: While SHAKTI was India's first indigenous RISC-V processor (developed by IIT Madras), DHRUV64 represents the latest advancement in 2025 specifically targeting high-end 64-bit server-grade performance.

• Applications of DHRUV64:

• Data Centers: It provides a secure platform for domestic cloud services.

• Strategic Sectors: Ideal for use in Defense and Space missions where hardware security and reliability are paramount.

• Smart Cities: Can power large-scale IoT networks and urban management systems.

• Semiconductor Mission: The launch of DHRUV64 aligns with the India Semiconductor Mission (ISM), which seeks to build a vibrant semiconductor and display ecosystem to enable India’s emergence as a global hub for electronics manufacturing.

Q92. Answer: (c) Saudi Arabia

The correct answer is Saudi Arabia.

Key Points

• The International Olympic Committee (IOC) officially announced in July 2024 that the Kingdom of Saudi Arabia will host the inaugural Olympic Esports Games in 2025.

• This historic partnership between the IOC and the Saudi Arabian National Olympic Committee (NOC) is established for a duration of 12 years, ensuring that the Olympic Esports Games will be held regularly over this period.

• The proposal to create these games was unanimously approved by the IOC members during the 142nd IOC Session, which took place in Paris just before the start of the Olympic Games Paris 2024.

• The decision builds upon the momentum of the Olympic Esports Week, which was successfully pilot-tested in Singapore in June 2023, attracting over 500,000 unique participants.

• The IOC President, Thomas Bach, emphasized that this initiative combines the Olympic brand and values with the immense popularity of the esports community to engage a younger global audience.

Additional Information

• Saudi Arabia's Vision 2030: The hosting of the Olympic Esports Games aligns with Saudi Arabia's Vision 2030, a strategic framework aimed at diversifying the nation's economy and transforming it into a global hub for sports, tourism, and entertainment.

• Esports Infrastructure in Riyadh: The capital city, Riyadh, has already established itself as a premier destination for competitive gaming, having hosted the first-ever Esports World Cup in 2024, which featured a record-breaking prize pool of over $60 million.

• Operational Model: The IOC has clarified that the Olympic Esports Games will have a specialized organizational and financial model, distinct from the traditional Summer and Winter Olympic Games, to better address the unique requirements of the digital sports industry.

• Gender Equality and Inclusion: A key focus of the partnership is to promote gender equality in gaming; currently, Saudi Arabia has over 23.5 million gamers, with nearly half of them being women.

• Leadership: The initiative is championed by Prince Abdulaziz bin Turki Al Faisal, the Minister of Sport and President of the Saudi Arabian Olympic and Paralympic Committee, and Princess Reema bint Bandar Al Saud, a member of the IOC and the Saudi NOC.

Important Points

• IOC Esports Commission: The development of the games is overseen by the IOC Esports Commission, chaired by David Lappartient, which was established to explore the integration of virtual sports into the Olympic movement.

• Global Reach: As of 2024, there are estimated to be over 3 billion gamers worldwide, and the IOC's move into esports is a strategic effort to remain relevant in an increasingly digitalized sports landscape.

• Future Prospects: Following the 2025 debut in Saudi Arabia, the IOC intends to refine the selection of gaming titles, which may include physical virtual sports (like cycling on trainers) and traditional competitive video games that align with Olympic values.

Q93. Answer: (d) 30 June 2026

The correct answer is 30 June 2026.

Key Points

• The Reserve Bank of India (RBI), in a notification issued in May 2025, announced significant relaxations in the Know Your Customer (KYC) updation norms to enhance customer convenience and ensure the continuity of financial services.

• As per the new guidelines, low-risk customers are allowed to continue their banking transactions without a fresh KYC update until 30 June 2026, even if their periodic updation is currently due.

• This extension is specifically aimed at low-risk individuals who have not had any change in their identification or address details, allowing them to provide a self-declaration through digital channels instead of visiting a branch.

• The primary objective behind this move is to reduce the administrative burden on Regulated Entities (REs) and prevent the sudden freezing of bank accounts, which often causes distress to genuine customers.

• The RBI has encouraged banks and other financial institutions to utilize V-CIP (Video-based Customer Identification Process) and other non-face-to-face channels to complete the re-KYC process before the revised deadline.

Additional Information

• Understanding KYC (Know Your Customer):

• KYC is a mandatory process for financial institutions to verify the identity and address of their customers to prevent money laundering, terrorist financing, and other illegal activities.

• It involves the submission of Officially Valid Documents (OVDs) such as Aadhaar, Passport, Voter ID, or Driving License.

• Risk Categorization in Banking:

• Customers are categorized into High, Medium, and Low risk based on their profile, occupation, and nature of transactions.

• Traditionally, High-risk customers require a KYC update every 2 years, Medium-risk every 8 years, and Low-risk every 10 years.

• The May 2025 relaxation specifically targets the Low-risk category to simplify their compliance journey.

• The Role of PMLA:

• The KYC guidelines are framed under the Prevention of Money Laundering Act (PMLA), 2002, and the Prevention of Money Laundering (Maintenance of Records) Rules, 2005.

• Compliance with these rules is essential for the stability and integrity of the Indian financial system.

• Digital KYC and V-CIP:

• The V-CIP is a method of customer identification by an official of the Regulated Entity by undertaking a seamless, secure, real-time, online video call with the customer.

• It has become a popular alternative to physical visits, especially for re-KYC and opening new accounts.

Important Points

• Self-Declaration Policy: For low-risk customers, if there is no change in KYC information, a self-declaration submitted through registered email-id, registered mobile number, ATMs, or mobile apps is sufficient for re-KYC.

• Regulated Entities (REs): These include Commercial Banks, Regional Rural Banks, Cooperative Banks, NBFCs, and Payment System Operators regulated by the RBI.

• Account Freezing Rules: RBI has reiterated that accounts should not be frozen routinely without providing adequate notice and multiple reminders to the customer regarding KYC pendency.

• Master Direction: The overarching rules are governed by the RBI Master Direction - Know Your Customer (KYC) Direction, 2016, which is periodically updated to reflect changes in technology and regulatory policy.

Q94. Answer: (d) India

The correct answer is India.

Key Points

• India is among the 37 countries scheduled to present its Voluntary National Review (VNR) at the High-Level Political Forum (HLPF) on Sustainable Development in July 2025.

• The HLPF 2025 is convened under the auspices of the Economic and Social Council (ECOSOC) of the United Nations to review the global progress of the 2030 Agenda.

• This marks India's third submission of the VNR, following its previous presentations in the years 2017 and 2020.

• The VNR process in India is spearheaded by NITI Aayog, which acts as the nodal agency for coordinating the implementation of Sustainable Development Goals (SDGs) across the country.

• The report presented in 2025 highlights India's achievements and challenges in meeting the 17 SDGs, focusing on data-driven governance and inclusive growth.

• The July 2025 forum aims to reinforce international cooperation and share best practices among the 37 member states regarding social, economic, and environmental sustainability. Hence, the correct answer is India.

Additional Information

• High-Level Political Forum (HLPF):

• The HLPF was established in 2012 as a result of the Rio+20 Conference (United Nations Conference on Sustainable Development).

• It is the main United Nations platform for the follow-up and review of the Sustainable Development Goals (SDGs) at the global level.

• The forum meets annually in July for eight days under the Economic and Social Council (ECOSOC).

• Voluntary National Reviews (VNRs):

• VNRs are the mechanism through which countries assess and present their national progress in implementing the 2030 Agenda.

• These reviews are state-led and voluntary, providing a platform for sharing experiences, including successes, challenges, and lessons learned.

• The objective is to accelerate SDG implementation through peer learning and international support.

• NITI Aayog and SDGs in India:

• NITI Aayog (National Institution for Transforming India) was formed on January 1, 2015, replacing the Planning Commission.

• It has developed the SDG India Index, which ranks States and Union Territories on their performance across various parameters like poverty, health, education, and gender equality.

• The 2025 VNR preparation involved extensive consultations with State Governments, Civil Society Organizations, and the Private Sector.

• Sustainable Development Goals (SDGs):

• The SDGs consist of 17 goals and 169 targets adopted by all United Nations Member States in 2015.

• Key goals include Goal 1 (No Poverty), Goal 5 (Gender Equality), Goal 7 (Affordable and Clean Energy), and Goal 13 (Climate Action).

• The deadline for achieving these global targets is 2030.

Important Points

• Participation Count: While various countries participate in HLPF, the specific cohort presenting VNRs varies each year. In 2025, the total count of presenting nations is 37.

• Previous Submissions: India presented its first VNR in 2017 and its second in 2020 during the COVID-19 pandemic, emphasizing resilient recovery.

• Location: The HLPF sessions traditionally take place at the United Nations Headquarters in New York.

• Theme of 2025: The discussions in July 2025 specifically address the "acceleration" of the 2030 Agenda as the world enters the final five-year countdown to the deadline.

Q95. Answer: (c) Rory McIlroy

The correct answer is Rory McIlroy.

Key Points

• Rory McIlroy made history by winning the 2025 Masters Tournament, becoming only the sixth male golfer to complete the Career Grand Slam.

• By securing the victory at Augusta National Golf Club, he joined an elite group of legendary golfers who have won all four modern major championships: Gene Sarazen, Ben Hogan, Gary Player, Jack Nicklaus, and Tiger Woods.

• The Masters Tournament was the final piece of the puzzle for McIlroy, who had been seeking the elusive Green Jacket for over a decade to complete his collection of major trophies.

• This achievement solidifies his legacy as one of the greatest golfers of the 21st century, representing Northern Ireland on the global stage.

• The victory in 2025 ended a significant drought in major titles for McIlroy, whose previous major win occurred in 2014.

Additional Information

• Profile of Rory McIlroy:

• Born on May 4, 1989, in Holywood, Northern Ireland, he turned professional in 2007.

• Before his 2025 Masters win, his major championship record included the U.S. Open (2011), the PGA Championship (2012 and 2014), and The Open Championship (2014).

• He has spent over 100 weeks as the World Number One in the Official World Golf Ranking during his career.

• Other Golfers and the Grand Slam:

• Jordan Spieth: A three-time major winner who requires the PGA Championship to complete his Career Grand Slam.

• Phil Mickelson: A winner of five majors who has finished as runner-up in the U.S. Open six times, the only major he lacks.

• Tiger Woods: He completed his first Career Grand Slam at the age of 24 during the 2000 Open Championship, the youngest to ever do so.

• The Masters Tournament:

• Established in 1934, it is held annually at the Augusta National Golf Club in Georgia, USA.

• It is the only one of the four major championships that is played at the same location every year.

• The winner is traditionally presented with a Green Jacket, which must be returned to the clubhouse one year after the victory.

Important Points

• The Modern Grand Slam: In professional male golf, the Grand Slam consists of winning the Masters, the U.S. Open, The Open Championship (British Open), and the PGA Championship.

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• Historical Context: Before the modern era, the Grand Slam consisted of the U.S. Open, U.S. Amateur, British Open, and British Amateur. Bobby Jones is the only golfer to win all four of these in a single calendar year (1930).

• Significance of 2025: Rory McIlroy's win is considered a landmark event in sports history, as the gap between his third and fourth different major titles spanned 11 years, demonstrating immense resilience and longevity in the sport of golf.

Q96. Answer: (b) The Standing Committee of the National Board for Wildlife

The correct answer is The Standing Committee of the National Board for Wildlife.

Key Points

• The Standing Committee of the National Board for Wildlife (NBWL), in its meeting held in July 2025, recommended a comprehensive revision of the ‘Guidelines for declaration of Eco-Sensitive Zones (ESZ), 2011'.

• The original 2011 Guidelines were issued by the Ministry of Environment, Forest and Climate Change (MoEFCC) to provide a framework for designating buffer zones around National Parks and Wildlife Sanctuaries.

• The decision to revise the guidelines stems from the need to streamline the ESZ notification process and address the administrative and legal challenges faced over the last decade.

• The committee highlighted that the updated guidelines would aim to better balance the ecological integrity of protected areas with the socio-economic development and livelihood rights of local communities residing in these zones. Hence, statement 2 is the correct answer.

• The revision is expected to provide clearer definitions of prohibited, regulated, and permitted activities, ensuring that conservation goals are met without causing undue hardship to the public.

Additional Information

• National Board for Wildlife (NBWL):

• It is a statutory body constituted under Section 5A of the Wildlife (Protection) Act, 1972.

• The board is chaired by the Prime Minister of India, while the Standing Committee is chaired by the Minister of Environment, Forest and Climate Change.

• It serves as the apex body for all wildlife-related matters, including the approval of projects inside and around Protected Areas.

• Eco-Sensitive Zones (ESZ):

• ESZs are areas notified by the MoEFCC under the Environment (Protection) Act, 1986.

• The primary objective is to create "shock absorbers" for protected areas by regulating human activities in the immediate vicinity.

• Generally, an ESZ can extend up to 10 kilometers around a National Park or Wildlife Sanctuary, though this distance can be increased or decreased based on specific ecological requirements.

Important Points

• Regulatory Framework of ESZ:

• Prohibited Activities: These include commercial mining, setting up of sawmills, polluting industries, and major hydroelectric projects.

• Regulated Activities: These include the felling of trees, establishment of hotels and resorts, drastic change of agriculture systems, and the commercial use of natural water resources.

• Permitted Activities: These include ongoing agriculture and horticulture practices by local communities, rainwater harvesting, and the use of renewable energy sources.

• Judicial Interventions: In 2022, the Supreme Court of India mandated a minimum 1 km ESZ for all protected areas, though this was later modified in 2023 to allow for area-specific flexibility, emphasizing that rigid boundaries may not be practical for every geographical location.

Q97. Answer: (b) Exercise Suraksha Chakra

The correct answer is Exercise Suraksha Chakra.

Key Points

• Exercise Suraksha Chakra was the first major integrated multi-state mock drill conducted across the Delhi-NCR region, specifically designed to simulate a high-intensity earthquake scenario.

• The drill commenced on 1 August 2025 and was carried out simultaneously at 55 locations throughout the National Capital Region (NCR), including sensitive areas in Delhi, Uttar Pradesh, and Haryana.

• The primary objective of this exercise was to evaluate the disaster preparedness, inter-state coordination, and response time of various administrative and emergency services during a large-scale natural calamity.

• The exercise was organized under the aegis of the National Disaster Management Authority (NDMA) in collaboration with the Delhi Disaster Management Authority (DDMA) and state-level disaster response units.

• This integrated drill focused on testing the Standard Operating Procedures (SOPs) for emergency communication, debris clearance, medical triage, and the rescue of trapped individuals from high-rise buildings.

Additional Information

• Seismic Vulnerability of Delhi-NCR:

• The Delhi-NCR region falls under Seismic Zone IV, which is categorized as a High Damage Risk Zone. Proximity to active fault lines like the Sohna Fault and the Mahendragarh-Dehradun Fault necessitates frequent simulations like Exercise Suraksha Chakra.

• National Disaster Management Authority (NDMA):

• Headed by the Prime Minister of India, the NDMA is the apex body for disaster management, established under the Disaster Management Act, 2005. Its role is to lay down policies and guidelines for ensuring timely and effective responses to disasters.

• National Disaster Response Force (NDRF):

• The NDRF played a pivotal role in Exercise Suraksha Chakra. Established in 2006, it is a specialized force consisting of 12 battalions (as of recent data) trained for natural and man-made disasters including CBRN (Chemical, Biological, Radiological, and Nuclear) emergencies.

• Comparison with Other Exercises:

• While Exercise Suraksha Chakra is an internal disaster drill, Exercise Surya Kiran is a periodic bilateral military exercise conducted between the Indian Army and the Nepalese Army, primarily focusing on jungle warfare and counter-insurgency operations.

• Technological Integration:

• The drill utilized advanced tools such as Geographic Information Systems (GIS), drones for damage assessment, and satellite-based communication systems to ensure connectivity when traditional networks fail during an earthquake.

Important Points

• Multi-Agency Participation: The drill saw active involvement from the Indian Army, Central Armed Police Forces (CAPFs), local Police Departments, Fire Services, and major Hospitals in the NCR.

• Public Awareness: A critical component of Exercise Suraksha Chakra was the community participation segment, where residents were educated on "Drop, Cover, and Hold On" techniques and the identification of emergency assembly points.

• Reporting and Feedback: Post-exercise, an After-Action Report (AAR) was drafted to identify gaps in inter-departmental logistics and to refine the Disaster Management Plans of the involved states.

Q98. Answer: (a) Swarnim Bharat: Virasat aur Vikas

The correct answer is Swarnim Bharat: Virasat aur Vikas.

Key Points

• India celebrated its 76th Republic Day on January 26, 2025, with great fervor and national pride.

• The central theme for the 2025 celebrations was "Swarnim Bharat: Virasat aur Vikas", which translates to "Golden India: Heritage and Development".

• The theme was chosen to reflect India's dual commitment to preserving its rich cultural heritage (Virasat) while striving for rapid modern development (Vikas) towards the goal of Viksit Bharat by 2047.

• The Republic Day parade was held at the iconic Kartavya Path in New Delhi, showcasing the nation's military prowess, indigenous defense equipment, and diverse cultural tableaux.

• The celebration marked the 75th anniversary of the adoption of the Constitution of India, emphasizing the strength of Indian democracy.

Additional Information

• Historical Significance: Republic Day commemorates the date on which the Constitution of India came into effect on January 26, 1950. While the Constitution was adopted on November 26, 1949, the 26th of January was chosen because it was on this day in 1930 that the Purna Swaraj (Complete Independence) declaration was promulgated by the Indian National Congress.

• Viksit Bharat @2047: This is the government's vision to transform India into a developed nation by the centenary of its independence in 2047. The 2025 theme aligns with this long-term objective of economic growth and global leadership.

• Chief Guest Tradition: Every year, India invites a world leader as the Chief Guest for the Republic Day parade. For the 2025 celebrations, President Mohamed Muizzu of the Maldives was invited, highlighting India's "Neighborhood First" policy and maritime security cooperation.

• Previous Themes: In 2024, during the 75th Republic Day, the themes were "Viksit Bharat" and "Bharat - Loktantra ki Matruka" (India - Mother of Democracy), focusing on women-led development and democratic values.

• Beating Retreat Ceremony: The Republic Day festivities conclude with the Beating Retreat ceremony on the evening of January 29 at Vijay Chowk, featuring performances by the bands of the Indian Army, Navy, and Air Force.

Important Points

• Constitutional Head: The President of India, currently Droupadi Murmu, unfurls the National Flag and takes the salute during the parade, as the President is the Constitutional Head of the State.

• Padma Awards: On the eve of Republic Day, the Government of India announces the Padma Awards, which are among the highest civilian honors in the country, categorized into Padma Vibhushan, Padma Bhushan, and Padma Shri.

• Atmanirbhar Bharat: Recent parades have emphasized indigenization, featuring only Made-in-India weapon systems like the LCH Prachand, K-9 Vajra, and Nag anti-tank guided missiles to showcase self-reliance in defense.

Q99. Answer: (d) Pranav Venkatesh

The correct answer is Pranav Venkatesh.

Key Points

• Pranav Venkatesh, a highly acclaimed Grandmaster from India, emerged as the champion in the open section of the World Junior Atomic Chess Championship 2025.

• The prestigious tournament was hosted in the scenic coastal town of Petrovac, Montenegro, which is a frequent venue for international chess competitions.

• He secured the World Junior title by displaying exceptional tactical skills in the Atomic Chess variant, further solidifying his reputation as one of the most versatile young players in the global chess arena.

• Born in October 2006, the Chennai-based player has been a consistent performer in both classical and variant chess formats, representing the rising dominance of India in international chess.

• This victory in 2025 adds to his growing list of accolades, proving his proficiency in high-pressure junior-level championships.

Additional Information

• Atomic Chess Variant: Unlike standard chess, Atomic Chess is a variant where every capture results in an "explosion" that removes the capturing piece, the captured piece, and all non-pawn pieces in the eight surrounding squares. The game can end if a King is caught in an explosion.

• Pranav Venkatesh's Career: He became India's 75th Grandmaster in August 2022 at the age of 15. He achieved his final GM norm at the Limpedea Cup held in Baia Mare, Romania.

• Petrovac, Montenegro: This location is a prominent hub for chess in Europe, having hosted events like the European Individual Chess Championship and various FIDE-rated youth tournaments.

• Other Participants:

• Pentala Harikrishna: A veteran Indian Grandmaster and former World Junior Champion (2004) who paved the way for the younger generation.

• GM Amar Elham: A young prodigy from Norway known for his sharp attacking style in junior circuits.

• Matic Lavrencic: A competitive player from Slovenia who has represented his country in various European youth divisions.

Important Points

• Age Eligibility: The World Junior Championship is specifically designated for players who are under the age of 20 as of January 1st of the tournament year.

• India's Chess Growth: The success of players like Pranav Venkatesh highlights the effectiveness of the training ecosystems in Tamil Nadu, which has produced a significant percentage of India's Grandmasters.

• FIDE Recognition: While Atomic Chess is popular on online platforms like Lichess, specialized championships in Montenegro bring these variants to an over-the-board (OTB) professional setting, attracting top-tier talent.

• Historical Context: Pranav V crossed the 2500 ELO rating threshold early in his career, joining an elite group of Indian teenagers who have dominated the international chess rankings in the 2020s.

Q100. Answer: (c) Hayli Gubbi

The correct answer is Hayli Gubbi.

Key Points

• Hayli Gubbi is a shield volcano located at the southern end of the Erta Ale volcanic range in the Afar Region of Ethiopia.

• In November 2025, the volcano garnered significant attention from the global scientific community after it erupted for the first time in recorded history. Prior to this event, the volcano was primarily known for its fumarolic activity and was considered relatively quiet compared to its neighbors.

• The volcano reaches an elevation of approximately 521 meters (1,709 feet) and is situated within the Danakil Depression, a tectonic plate junction that is one of the lowest and hottest places on Earth.

• This eruption is geologically significant because it provides new evidence regarding the magmatic processes occurring within the Afar Triple Junction, where the Nubian, Somali, and Arabian tectonic plates are pulling away from each other.

• Volcanologists monitor this region closely as the Erta Ale range is one of the most active volcanic chains in Africa, though Hayli Gubbi specifically had no prior historical record of a major lava-producing eruption.

Additional Information

• Mount Semeru:

• Located in East Java, Indonesia, Mount Semeru is the highest mountain on the island of Java.

• It is an active stratovolcano known for its frequent eruptions, often producing pyroclastic flows and lahars that pose significant risks to local populations.

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• It is a prominent feature of the Bromo Tengger Semeru National Park and has been erupting almost continuously since 1967.

• Kilauea:

• Situated on the Big Island of Hawaii, USA, Kilauea is one of the most active shield volcanoes in the world.

• It is a hotspot volcano, meaning it is not located on a plate boundary but over a plume of magma rising through the Earth's crust.

• It is famous for its effusive eruptions and long-standing lava lakes, and it is a central part of the Hawaii Volcanoes National Park.

• Krasheninnikov:

• This is a complex volcanic system located on the Kamchatka Peninsula in Russia.

• It consists of two overlapping stratovolcanoes housed within a large caldera formed during the late Pleistocene epoch.

• The Kamchatka region is part of the Pacific Ring of Fire and contains one of the highest concentrations of active volcanoes in the world.

• Volcanism in Ethiopia:

• Ethiopia is home to more than 60 volcanoes, many of which are located along the Great Rift Valley.

• The Erta Ale volcano, also in the Afar region, is the most famous in the country, known for its persistent lava lake that has been active for decades.

• The tectonic activity in this region is slowly splitting the African continent apart, a process that will eventually lead to the formation of a new ocean basin.

Important Points

• Geological Context: The eruption of Hayli Gubbi in 2025 serves as a reminder of the unpredictable nature of dormant volcanoes in rift zones.

• Data Monitoring: Modern satellite technology and seismic sensors allow researchers to detect changes in ground deformation and gas emissions, which preceded the historical eruption of this Ethiopian volcano.

• Afar Triangle: This region is unique because it is the only place on Earth where a mid-ocean ridge can be studied on land, making the activity of volcanoes like Hayli Gubbi vital for geophysical research.

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