RRB Group D Official Paper (Held On: 04 Dec, 2025 Shift 1) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. What is the need for sexual reproduction in plants?

(a) To produce identical clones
(b) To increase genetic variation for better adaptation
(c) To avoid growing flowers
(d) To eliminate the need for pollination

Q2. Sound waves in air are longitudinal because:

(a) Particles move perpendicular to direction of propagation
(b) Air molecules do not vibrate
(c) Particles move along the direction of propagation
(d) Particles move randomly

Q3. If a body falls freely from a height, its potential energy is converted into _____.

(a) Sound energy
(b) Thermal energy
(c) Chemical energy
(d) Kinetic energy

Q4. Which of the following environmental cues determined the sex of fertilised egg in few reptiles?

(a) Temperature
(b) Wind velocity
(c) Touch
(d) Water

Q5. If the thrust acting on a surface is constant but the area of contact decreases, the pressure:

(a) remains the same
(b) becomes zero
(c) decreases
(d) increases

Q6. Which of the following is a popular marine fish variety found in India?

(a) Pomfret
(b) Catla
(c) Mrigal
(d) Rohu

Q7. Which of the following cell organelles releases Adenosine Tri Phosphate (ATP) molecules needed for life activities?

(a) Mitochondria
(b) Golgi apparatus
(c) Lysosomes

(d) Vacuoles

Q8. The Law of conservation of mass states that:

(a) volume can neither be created nor destroyed in a chemical reaction
(b) temperature can neither be created nor destroyed in a chemical reaction
(c) pressure can neither be created nor destroyed in a chemical reaction
(d) mass can neither be created nor destroyed in a chemical reaction

Q9. A concave lens produces an image one-third the size of the object. If the focal length is 12 cm, the object distance is:

(a) 12 cm
(b) 18 cm
(c) 24 cm
(d) 36 cm

Q10. Which of the following methods is NOT effective to prevent the corrosion of metals?

(a) Painting
(b) Exposure to moisture
(c) Applying sacrificial anodes
(d) Galvanisation

Q11. A car travels 100 km at an average speed of 50 km h^(-1) and immediately returns along the same route covering the distance in 1 hour. What is the average speed of the car for the entire journey in m s^(-1) ?

(a) 20.0 m s^(-1)
(b) 16.67 m s^(-1)
(c) 13.9 m s^(-1)
(d) 18.52 m s^(-1)

Q12. Which of the following compounds is unsaturated?

(a) Butane
(b) Propane
(c) Propene
(d) Methane

Q13. What is the name of the place where bees are kept for commercial honey production?

(a) Aquarium
(b) Apiary
(c) Aviary
(d) Sanctuary

Q14. In the sign convention for lenses, all distances are measured from:

(a) The pole of the lens
(b) The focus of the lens
(c) The optical centre of the lens
(d) The principal axis only

Q15. Which of the following organisms reproduce by the method of binary fission?

(a) Butterfly
(b) Leishmania
(c) Rose plant
(d) Neem plant

Q16. What is the atomic mass of Carbon-13 Isotope?

(a) 13 amu
(b) 12 amu
(c) 11 amu

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(d) 14 amu

Q17. In the connective tissue, what is the relative position of the cells with respect to each other?

(a) Far away from each other
(b) Loosely packed
(c) One above the other
(d) Tightly packed

Q18. The atomic number is defined as the total number of _____ present in the nucleus of an atom.

(a) neutrons and half of the protons
(b) protons and neutrons
(c) only protons
(d) only neutrons

Q19. The reactivity series, also known as the activity series, is a list of metals arranged in order of their:

(a) decreasing reactivity
(b) increasing reactivity
(c) first increasing, then decreasing reactivity
(d) first decreasing, then increasing reactivity

Q20. Which of the following gases is evolved when dilute hydrochloric acid reacts with sodium hydrogencarbonate?

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

Q21. Read the statements given below and select the correct option.

Statement I: Zinc displaces copper from copper sulphate solution, but copper cannot displace zinc from zinc sulphate solution.

Statement II: Zinc is more reactive than copper in the reactivity series.

(a) Only statement II is correct.
(b) Only statement I is correct.
(c) Both statements are correct, and Statement II correctly explains Statement I.
(d) Both statements are correct, but Statement II does not explain Statement I.

Q22. Which of the following represents an end product of anaerobic respiration in animals?

(a) Carbon monoxide
(b) Lactic acid
(c) Glucose
(d) Oxygen

Q23. A gun recoils backward when fired. The backward motion of the gun is due to:

(a) Air resistance
(b) Gravity acting on the gun
(c) Friction between gun and person
(d) Reaction force of the bullet on the gun

Q24. A charge of 1.5 C is moved through a potential difference. If the work done is 30 J, what is the potential difference between the two points?

(a) 45 V
(b) 25 V
(c) 30 V
(d) 20 V

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Q25. The magnetic field at the centre of a current carrying circular loop is directly proportional to _____.

(a) the square of the radius of the circular loop
(b) the current flowing through the loop
(c) inverse of current flowing through the loop
(d) the square of the current flowing through the loop

MATHEMATICS

Q26. The income of Raman is Rs. 25,000. He saves 25.5% of his income. If his income increases by 20% and expenditure increases by 40%, then his savings will:

(a) increase by Rs. 2,453
(b) decrease by Rs. 2,450
(c) decrease by Rs. 2,452
(d) increase by Rs. 2,446

Q27. From a point on the ground, the angle of elevation to the top of a tower is θ such that tan θ = 3/4. Find the sine of angle θ.

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

Q28. The vertices of a quadrilateral are A(2,3), B(5,7), C(10,6), and D(7,2). Find the area of the quadrilateral ABCD.

(a) 25 sq. units
(b) 20 sq. units
(c) 28 sq. units
(d) 23 sq. units

Q29. The unit prices of lemon chocolate and strawberry chocolate are in the ratio 28 : 26, and a family consumes them in the ratio 15 : 14 by quantity. Find the ratio of expenditure on strawberry chocolate to that on lemon chocolate.

(a) 13 : 15
(b) 12 : 21
(c) 15 : 17
(d) 10 : 21

Q30. What is the simple interest on a sum of Rs. 3,500, if the rate of interest for the first 6 years is 8% per annum and for the last 3 years is 3% per annum?

(a) Rs. 1,995
(b) Rs. 2,025
(c) Rs. 2,015
(d) Rs. 1,955

Q31. The length of each of the two equal sides of an isosceles triangle is 78 cm, and the length of its base is 60 cm. Find the area (in cm^2) of the triangle.

(a) 2158
(b) 2165
(c) 2175
(d) 2160

Q32. The number of prime numbers lying between 440 and 452 is:

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

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Q33. 1/20 is what percentage of 2/50?

(a) 125%
(b) 250%
(c) 1355
(d) 140%

Q34. Seema bought a microwave oven for Rs. 7,500 and sold it for Rs. 8,750. Find Seema's profit percentage. (Round off your answer to two decimal places.)

(a) 16.33%
(b) 18.67%
(c) 14.23%
(d) 16.67%

Q35. R pays Rs. 20 with Rs. 2 and Rs. 5 coins. If at least one coin of each denomination is used in paying the amount, then the number of Rs. 2 coins used is _____.

(a) 10
(b) 8
(c) 5
(d) 4

Q36. If X - Y = 20 and XY = 12, then find the value of $X^2 + Y^2$.

(a) 420
(b) 426
(c) 424
(d) 422

Q37. If an item marked at Rs. 758 is sold for Rs. 256, then what is the discount percentage? (Round off the answer to two decimal places)

(a) 68.01%
(b) 68.94%
(c) 68.31%
(d) 66.23%

Q38. Calculate the mode of the following data. (Round off to two decimal places)

Marks	4-8	8-12	12-16	16-20	20-24	24-28	28-32	32-36
No. of Students	9	12	18	34	26	20	12	7

(a) 22.67
(b) 24.67
(c) 18.67
(d) 20.67

Q39. One pipe can fill a tank in 6 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-fourth of the tank?

(a) 12
(b) 9
(c) 3
(d) 6

Q40. The sides of a triangle are 102 cm, 154 cm, and 80 cm. What is the length (in cm) of its altitude corresponding to the side with a length of 154 cm?

(a) 94
(b) 15
(c) 3

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(d) 48

Q41. If 30% of 40% of 5/9 of a number is 704, find the number.

(a) 10,560
(b) 10,540
(c) 13,420
(d) 10,960

Q42. The marked price of an item is set at 51% above its cost price. If the merchant sells the item at 8% below the marked price, his profit percentage (rounded off to 1 decimal place) is:

(a) 36.8%
(b) 42.9%
(c) 38.9%
(d) 42.4%

Q43. Simplify the following.

$(2x^3y^5z) \times (5xy^6z^2) \div (15x^2yz^2)$

(a) $(x^2 y^5 z^2)/2$
(b) $(2x^2 y^{10} z)/3$
(c) $(2x^2 y^{10} z)/5$
(d) $(x^2 y^{10} z)/3$

Q44. A train overtakes two persons walking along a railway track. The first one walks at 5.4 km/hr. The other one walks at 18 km/hr. The train needs 30 and 44 seconds, respectively, to overtake them. What is the speed of the train, if both the persons are walking in the same direction as the train?

(a) 38 km/hr
(b) 45 km/hr
(c) 37 km/hr
(d) 49 km/hr

Q45. The sum of three numbers is 4512. If the ratio between the first and second numbers is 16 : 9 and that of between the second and third is 15 : 21, then find the difference between the first and the third number.

(a) 480
(b) 398
(c) 389
(d) 408

Q46. 2 men or 9 women can do a job in 9 days. 2 men work for 5 days and leave. The number of women required to complete the remaining work in 9 days is:3889

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

Q47. A garrison of 1,200 men has provisions for 12 days. How long (in days) will the provisions last if the garrison is increased to 1,800 men?2691

(a) 7
(b) 10
(c) 9
(d) 8

Q48. A train, 1195 m-long, is running at a speed of 23m/s. If it takes 72 seconds to cross a tunnel, then find the length of the tunnel.3717

(a) 461 m
(b) 454 m
(c) 452 m

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(d) 462 m

Q49. The ratio of the ages of John and James will be 8 : 7 after 8 years. If the difference between their ages is 5 years, find the present age of James.

(a) 27 years
(b) 28 years
(c) 32 years
(d) 35 years

Q50. A class of 43 students took a Physics test. 10 students had an average score of 99. The other students had an average score of 55. What is the average score (rounded off to one decimal place) of the whole class?

(a) 65.2
(b) 66.8
(c) 67.5
(d) 74.8

GENERAL INTELLIGENCE & REASONING

Q51. F, G, H, I, M, N and O are sitting around a circular table, facing the centre of the table. Only two people sit between F and G, when counted from the right of F. Only two people sit between G and M, when counted from right of G. Only three people sit between F and N, when counted from the right of F. H sits to the immediate left of I. Who sits third to the left of O?

(a) I
(b) G
(c) F
(d) H

Q52. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(13, 39, 3)

(15, 75, 5)

(a) (12, 36, 3)
(b) (5, 25, 15)
(c) (64, 8, 4)
(d) (10, 35, 3)

Q53. Refer to the following series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.

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

How many such digits are there each of which is immediately preceded by a perfect square and also immediately followed by a perfect square?

(Note: 1 is also a perfect square)

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

Q54. John ranked 21^(st) from the bottom and 33^(rd) from the top in his class. How many students are there in his class?

(a) 52
(b) 51
(c) 50
(d) 53

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Q55. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which is the letter-cluster pair that DOES NOT belong to that group?

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

(a) UX-SW
(b) RU-PT
(c) OR-MQ
(d) LO-JM

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

OZJ81, QWN78, STR75, ?

(a) VRV73
(b) VQW73
(c) UQV72
(d) URW72

Q57. What will come in the place of the question mark (?) in the following equation, if '+' and '–' are interchanged and '×' and '÷' are interchanged?

48 + 36 ÷ 36 × 24 - 50 = ?

(a) 42
(b) 44
(c) 46
(d) 45

Q58. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusion(s) logically follow(s) from the statements.

Statements:

Some balls are hens.

All vans are hens.

Conclusion (I) : Some balls are vans.

Conclusion (II) : All hens are vans.

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

Q59. Refer to the following number, symbol series and answer the question. Counting to be done from left to right only. All numbers are single-digit numbers.

(Left) 1 # 2 3 Ω 9 % 4 7 8 & * £ 5 + @ 6 $ (Right)

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

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

Q60. What should come in place of the question mark (?) in the given series?

24 35 47 60 ? 89

(a) 72
(b) 70
(c) 74
(d) 66

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Q61. In a certain code language, ‘she play guiter’ is coded as ‘so tn yw’ and ‘play chess daily’ is coded as ‘nj bg so’. How is ‘play’ coded in the given language?

(a) tn
(b) nj
(c) so
(d) bg

Q62. A, B, C, R, S, T and U are sitting around a circular table facing the centre of the table. Only one person sits between B and T when counted from the right of B. Only one person sits between T and R when counted from the left of R. Only one person sits between B and U when counted from the right of U. Only two people sit between C and R when counted from the left of R. Only one person sits between A and U when counted from the right of A. Who sits third to the right of S ?

(a) C
(b) R
(c) A
(d) T

Q63. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which letter-cluster pair DOES NOT belong to that group?

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

(a) RO−JJ
(b) YV−RO
(c) HE−AX
(d) EB−XU

Q64. Himesh starts from Point A and drives 4 km towards the south. He then takes a left turn, drives 7 km, turns right and drives 6 km. He then takes a right turn and drives 7 km. He takes a final right turn, drives 3 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90 degrees turns only, unless specified.)

(a) 4 km towards north
(b) 7 km towards west
(c) 7 km towards north
(d) 11 km towards east

Q65. What will come in the place of the question mark (?) in the following equation, if ‘+’ and ‘−’ are interchanged and ‘×’ and ‘÷’ are interchanged?

21 ÷ 5 - 25 + 180 × 3 = ?

(a) 70
(b) 72
(c) 75
(d) 74

Q66. What should come in place of the question mark (?) in the given series?

153 135 117 99 81 ?

(a) 68
(b) 61
(c) 69
(d) 63

Q67. Mr. Z starts from Point A and drives 14 km towards the North. He then takes a left turn, drives 19 km, then turns left and drives 30 km. He then takes a left turn and drives 21 km. He takes a final left turn, drives 16 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) 1 km to the south
(b) 2 km to the west

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(c) 5 km to the north
(d) 3 km to the east

Q68. Refer to the following series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.

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

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

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

Q69. In a certain code language, 'OVAL' is coded as '2635' and 'LAVE' is coded as '5762'. What is the code for 'E' in the given code language?

(a) 2
(b) 6
(c) 5
(d) 7

Q70. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

HCK 29, KHH 42, NME 55, QRB 68, ?

(a) TWY 81
(b) SWX 83
(c) UVY 81
(d) TXZ 81

Q71. 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 necks are faces.

Some necks are arms.

Conclusions:

(I): All arms are necks.

(II): Some faces are arms.

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

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

TIPS - PTIS - SPIT

LOST - SLOT - TSOL

(a) BOND - OBND - DONB
(b) SPIN - ISPN - NIPS
(c) OATH - OTAH - HTAO
(d) FROM - OFRM - ROMF

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Q73. In a certain code language,

'A ? B' means 'A is the daughter of B',

'A = B' means 'A is the wife of B',

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

'A √ B' means 'A is the father of B'.

How is C related to L if 'C @ D ? E √ F = L'?

(a) Mother
(b) Wife's mother
(c) Wife
(d) Wife's sister

Q74. Seven people, A, B, C, D, E, F, and G, are sitting in a row, facing the north. Only five people sit between D and F. G sits to the immediate left of F. Only one person sits between G and A. B sits at some place to the left of C but at some place to the right of E.

How many people sit to the right of A?

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

Q75. What should come in place of the question mark (?) in the given series?

20 27 13 34 ? 413814

(a) 6
(b) 4
(c) 8
(d) 10

Q76. QN 3 is related to RJ −12 in a certain way. In the same way, HE 7 is related to IA −8. To which of the given options is LI 11 related, following the same logic?

(a) ME −4
(b) LE −8
(c) MD −8
(d) LD −4

Q77. If each of the digits in the number 47315628 is arranged in ascending order from left to right, then the position(s) of how many digits will remain unchanged as compared to that in the original number?

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

Q78. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one that follows the same logic.

CAFE - CEAF - ECFA

ABLY - AYBL - YALB

(a) NEAR - NREA - ENAR
(b) MAZE - AMZE - EAZM
(c) ECHO - EOCH - OEHC
(d) KALE - KLAE - ELAK

Q79. Seven boxes M, N, O, P, Q, R, and S are kept one over the other but not necessarily in the same order. Only three boxes are kept above S. Only one box is kept between R and S. Only three boxes are kept between R and Q. Q is kept at some place above S. N is kept immediately below Q. M is kept at one of the places above O. P is not kept immediately above or below R. Which box is kept at the lowermost position?

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(a) O
(b) S
(c) N
(d) M

Q80. Refer to the number and symbol series given below and answer the question that follows. Counting to be done from left to right only.

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

(Left) £ $ 9 3 4 9 7 £ % & # 7 3 1 8 7 5 * @ 4 £ $ (Right)

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

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

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. In May 2025, iPhone maker Foxconn announced to invest how much amount in India?

(a) US$ 4.2 billion
(b) US$ 5.2 billion
(c) US$ 3.5 billion
(d) US$ 1.5 billion

Q82. As notified in April 2025, how many new species of Sericinae scarab beetles from the biodiversity-rich regions of India were discovered by Zoological Survey of India in collaboration with Germany's Museum A. Koenig?

(a) 6
(b) 5
(c) 4
(d) 7

Q83. According to the January 2025 draft rules of the Digital Personal Data Protection Rules (DPDP) Act, children under what age require parental consent to join social media platforms?

(a) 20 years
(b) 16 years
(c) 15 years
(d) 18 years

Q84. Which of the following teams set the 4x100m relay record at the National Relay Carnival 2025?

(a) Archana, Dhanalakshmi, Hima, Dutee
(b) Gurindervir Singh, Animesh Kujur, Manikanta Hoblidar and Amlan Borgohain
(c) Archana, Dhanalakshmi, Manikanta Hoblidar and Amlan Borgohain
(d) Anas, Jacob, Ajmal, Ramesh

Q85. In June 2025, up to what loan amount did the Reserve Bank of India raise the Loan-to-Value (LTV) ratio on gold loans from 75% to 85%?

(a) Rs. 5.5 lakhs
(b) Rs. 3.5 lakhs
(c) Rs. 4.5 lakhs
(d) Rs. 2.5 lakhs

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Q86. As per the India Justice Report, 2025, (which presents a comprehensive assessment of the capacity and performance of Indian states in delivering justice) which of the following states ranked top among small states?

(a) Nagaland
(b) Manipur
(c) Goa
(d) Sikkim

Q87. As of June 2025, who announced the decision to host Khelo India Northeast Games every year?

(a) Narendra Modi
(b) Mansukh Mandaviya
(c) Dharmendra Pradhan
(d) Gajendra Singh Shekhawat

Q88. Which of the following bodies implemented the 'UPI for International Transactions' pilot in 2025?

(a) Securities and Exchange Board of India (SEBI)
(b) National Payments Corporation of India (NPCI)
(c) Reserve Bank of India (RBI)
(d) Central Board of Direct Taxes (CBDT)

Q89. Which year was declared as the ‘Year of Reforms’ by the Ministry of Defence of the Government of India?

(a) 2026
(b) 2025
(c) 2024
(d) 2023

Q90. In May 2025, which organization released the Global Report on Food Crises, highlighting rising hunger due to conflict and climate extremes?

(a) UN Environment Programme
(b) Food and Agriculture Organization
(c) World Bank
(d) Global Network Against Food Crises

Q91. The Constitution (Scheduled Tribes) Order (Third Amendment) Bill, 2022, seeks to amend the Constitution (Scheduled Tribes) Order, 1950, with respect to its application to _____.

(a) Tamil Nadu
(b) Andhra Pradesh
(c) Punjab
(d) Himachal Pradesh

Q92. The September 2025 guidelines on Anganwadi–School co-location emphasise which key component of child development?

(a) Early Childhood Care and Education
(b) Vocational Training for Adolescents
(c) Digital Literacy and Coding Skills
(d) Universal Primary Health Coverage

Q93. The C40 World Mayors Summit of 3-5 November 2025 is scheduled for which city?

(a) New York, USA
(b) London, UK
(c) Rio de Janeiro, Brazil
(d) Seoul, South Korea

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Q94. As per the survey conducted by the Yale Program on Climate Change Communication and CVoter from 5 December 2024 to 18 February 2025, what percentage of Indians reported experiencing severe heatwaves in the past 12 months?

(a) 85%
(b) 60%
(c) 52%
(d) 71%

Q95. As per the announcement made in May 2025, India is set to conduct its first-ever biological experiments aboard the International Space Station (ISS) to study the sustainability of Human life in Space, as an important initiative under the _____..

(a) BioE3 Biotechnology policy
(b) BioE7 Biotechnology policy
(c) BioE5 Biotechnology policy
(d) BioE9 Biotechnology policy

Q96. The National Conference on 'Environment – 2025', inaugurated by President Droupadi Murmu, was held in which city?

(a) New Delhi
(b) Hyderabad
(c) Bengaluru
(d) Mumbai

Q97. Who did Praggnanandhaa defeat to reach the No.1 spot among Indian chess players?

(a) Fabiano Caruana
(b) Nodirbek Abdusattorov
(c) Hikaru Nakamura
(d) D Gukesh

Q98. Which film featuring caste and police brutality themes was submitted as India's Oscar entry but banned domestically by the Central Board of Film Certification?

(a) Bhool Chuk Maaf
(b) Chhaava
(c) Santosh
(d) Dacoit

Q99. Which of the following countries hosted the 2025 ISSF World Cup in Rifle/Pistol shooting?

(a) Germany
(b) Peru
(c) India
(d) Egypt

Q100. What was the purpose of Operation Brahma launched by India in March 2025?

(a) War extradition
(b) Military exercise
(c) Earthquake relief
(d) Tsunami relief

ANSWER KEY

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

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

SOLUTIONS

Q1. Answer: (b) To increase genetic variation for better adaptation

The correct answer is To increase genetic variation for better adaptation.

Key Points

• Sexual reproduction in plants involves the fusion of male and female gametes to form a zygote, which later develops into a new organism. This process results in genetic variation.

• Genetic variation produced during sexual reproduction allows plants to adapt better to changing environmental conditions such as climate, diseases, or pests. This is critical for their survival and evolution.

• Unlike asexual reproduction, which produces identical clones, sexual reproduction ensures that offspring are genetically diverse. This diversity increases the chances of survival for the species in adverse conditions. Hence, option 1 is incorrect.

• Sexual reproduction is essential for plants to produce seeds, which are often dispersed far and wide, ensuring the propagation of the species over large areas.

• Flowers are a crucial part of sexual reproduction in plants as they facilitate pollination, leading to fertilization. Therefore, sexual reproduction does not avoid growing flowers; rather, it necessitates them. Hence, option 3 is incorrect.

• Pollination is a fundamental step in sexual reproduction for transferring pollen from male to female parts of the plant. Sexual reproduction, therefore, does not eliminate the need for pollination. Hence, option 4 is incorrect.

Additional Information

• Methods of Pollination:

• Self-pollination: Occurs when pollen from the same flower or another flower on the same plant fertilizes the ovule.

• Cross-pollination: Pollen is transferred from the flower of one plant to another plant, often facilitated by wind, water, or animals like bees, butterflies, and birds.

• Advantages of Sexual Reproduction:

• Promotes genetic diversity, which enhances adaptability and survival in changing environments.

• Helps in the elimination of harmful mutations over generations.

• Plays a significant role in evolution by introducing new traits into a population.

• Examples of Plants with Sexual Reproduction:

• Plants like sunflowers, roses, mangoes, and apple trees reproduce sexually through flowers.

• Some plants, like corn and grasses, rely on wind for pollination, while others, like orchids, depend on animals.

• Key Features of Genetic Variation:

• Genetic variation arises due to processes like meiosis, recombination, and fertilization.

• It improves a species' ability to resist diseases and adapt to environmental changes.

• Examples include the development of disease-resistant crop varieties through selective breeding.

Important Points

• Reproduction in Plants:

• Asexual reproduction occurs without the fusion of gametes, producing genetically identical offspring, such as in potatoes and onions.

• Sexual reproduction requires gamete fusion, leading to genetic diversity, as seen in flowering plants.

• Pollinators:

• Bees, butterflies, birds, and bats are common pollinators crucial for the process of sexual reproduction in plants.

• The decline in pollinator populations due to environmental changes can negatively impact plant reproduction and biodiversity.

• Role of Seeds:

• Seeds formed through sexual reproduction ensure the continuity of plant species.

• They allow plants to spread to new areas, promoting growth in diverse habitats.

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Q2. Answer: (c) Particles move along the direction of propagation

The correct answer is Sound waves in air are longitudinal because particles move along the direction of propagation..

Key Points

• Longitudinal Waves: Sound waves in air are classified as longitudinal waves because the particles of the medium vibrate parallel to the direction of wave propagation. This means that the compressions and rarefactions in the wave occur along the same direction as the wave travels.

• Particle Motion: The air particles oscillate back and forth in the direction of propagation, creating regions of high pressure (compressions) and low pressure (rarefactions). Hence, the statement "particles move along the direction of propagation" is correct.

• Incorrect Options: The statement "particles move perpendicular to the direction of propagation" describes transverse waves, which are not applicable to sound waves in air. Similarly, "air molecules do not vibrate" and "particles move randomly" are incorrect because molecular vibration and organized particle motion are essential for sound propagation.

• Propagation Mechanism: Sound waves require a medium (like air, water, or solids) to travel. The longitudinal nature of sound waves is due to the way the medium's particles transfer energy, through successive compressions and rarefactions.

• Physical Characteristics: The speed, frequency, and wavelength of sound waves are influenced by the medium's properties, such as its density and elasticity. Air is the most common medium for sound waves, and its molecules vibrate parallel to the wave's propagation direction.

Additional Information

• Longitudinal vs. Transverse Waves:

• Longitudinal waves involve particle motion parallel to the direction of wave propagation. Examples include sound waves in air and seismic P-waves.

• Transverse waves involve particle motion perpendicular to the direction of wave propagation. Examples include light waves and water waves.

• Compressions and Rarefactions:

• Compressions are regions where particles are closer together, resulting in higher pressure.

• Rarefactions are regions where particles are farther apart, resulting in lower pressure.

• This alternating pattern of compressions and rarefactions allows sound waves to travel through a medium.

• Applications of Sound Waves:

• Sound waves are widely used in communication systems (e.g., telephones, radios).

• Medical applications include ultrasound imaging, which utilizes high-frequency sound waves.

• Industrial applications include material testing and acoustic sensors.

• Speed of Sound:

• The speed of sound in air is approximately 343 m/s at room temperature (20°C).

• The speed varies with the medium; it is faster in solids and liquids compared to gases due to higher density and elasticity.

Important Points

• Energy Transfer: Sound waves transfer energy from one particle to another without transporting matter over long distances. This is a key characteristic of mechanical waves.

• Human Hearing Range: Humans can hear sound frequencies between 20 Hz and 20,000 Hz, known as the audible range.

• Sound Intensity: Measured in decibels (dB), sound intensity depends on the amplitude of the wave. Higher amplitude results in louder sounds.

• Reflection and Refraction: Sound waves can reflect off surfaces (echo) and refract when passing through mediums with varying densities.

Q3. Answer: (d) Kinetic energy

The correct answer is Kinetic energy.

Key Points

• When a body falls freely from a height under the influence of gravity, its potential energy is gradually converted into kinetic energy. This is due to the principle of energy conservation in a closed system.

• Potential energy (PE) is the energy possessed by a body due to its position or configuration. It is given by the formula $PE = m \times g \times h$, where m is mass, g is acceleration due to gravity, and h is height.

• As the body falls, the height (h) decreases, causing the potential energy to decrease proportionally. Simultaneously, the velocity of the body increases due to gravitational acceleration, causing its kinetic energy (KE) to increase.

• Kinetic energy (KE) is the energy possessed by a body due to its motion. It is given by the formula $KE = 1/2 \times m \times v^2$, where m is mass and v is velocity.

• At the highest point, the body has maximum potential energy and zero kinetic energy. As it falls, potential energy decreases and

is entirely converted into kinetic energy just before impact, assuming no energy losses due to air resistance.

• This process demonstrates the law of conservation of energy, which states that energy in a closed system remains constant and only transforms from one form to another.

Additional Information

• Sound energy:

• Sound energy is produced when a vibrating object creates waves that propagate through a medium such as air, water, or solids.

• In the case of a falling object, sound energy may be generated upon impact with the ground, but it is not a direct conversion of potential energy during free fall.

• Thermal energy:

• Thermal energy refers to the energy possessed by a substance due to the kinetic energy of its molecules or atoms.

• In real-world scenarios, a small amount of potential energy could be converted into thermal energy due to air resistance, but this is negligible in an ideal free-fall scenario.

• Chemical energy:

• Chemical energy is stored in the bonds of chemical compounds and is released during chemical reactions.

• Free-fall motion does not involve any chemical reactions, so potential energy is not converted into chemical energy.

• Law of Conservation of Energy:

• This fundamental law states that energy cannot be created or destroyed; it can only be transformed from one form to another.

• In the case of free fall, the total mechanical energy (sum of potential and kinetic energy) remains constant, neglecting air resistance.

• Practical Applications:

• The conversion of potential energy to kinetic energy is utilized in systems like hydroelectric power plants, where water stored at height (potential energy) is used to generate electricity through turbines (kinetic energy).

• It is also observed in roller coasters, where the initial height determines the energy available for motion.

Important Points

• Gravitational force: The force of gravity acts as the driving force for the conversion of potential energy to kinetic energy during free fall.

• Air resistance: In real-world conditions, air resistance reduces the efficiency of energy conversion, leading to a small loss of energy as heat.

• Velocity at impact: The final velocity of a falling object can be calculated using the formula $v = \sqrt{(2 \times g \times h)}$, where g is the acceleration due to gravity and h is the height.

• Understanding energy transformations is crucial in engineering, physics, and various practical applications like designing efficient machines and energy systems.

Q4. Answer: (a) Temperature

The correct answer is Temperature.

Key Points

• Temperature-dependent sex determination (TSD) is a phenomenon observed in certain reptiles, including turtles, crocodiles, and some lizards, where the sex of the offspring is determined by the temperature during the incubation period of the eggs.

• In species with TSD, higher incubation temperatures typically produce one sex, while lower temperatures yield the other sex. For example, in many turtles, warmer temperatures produce females, while cooler temperatures produce males.

• This mechanism is distinct from genetic sex determination found in mammals and birds, where sex chromosomes dictate the sex of an individual. (Hence, this statement is correct.)

• The pivotal temperature is the temperature at which an equal ratio of males and females are produced. Variations around this temperature lead to skewed sex ratios. (This is an essential concept related to TSD.)

• TSD is believed to have evolved as an adaptive mechanism to maximize reproductive success under varying environmental conditions. For example, producing more females during favorable conditions can ensure population growth. (This highlights the evolutionary advantage of TSD.)

Additional Information

• Temperature and Reptile Reproduction:

• Reptiles, such as turtles, crocodiles, and some lizards, exhibit TSD rather than chromosomal sex determination.

• Species like the Red-eared slider turtle and American alligator are classic examples of organisms with temperature-dependent sex determination.

• In crocodiles, intermediate temperatures produce males, while extreme temperatures (both high and low) tend to produce females.

• Key Characteristics of Other Options:

• Wind velocity: Wind does not influence the sex determination of reptile eggs. While it plays a role in environmental factors like plant pollination and seed dispersal, it is irrelevant to sex determination. (This statement is incorrect.)

• Touch: Touch or physical interaction does not affect the sex determination of reptiles. It is more relevant to behavioral aspects in other species. (This statement is incorrect.)

• Water: Water availability may impact the survival and development of embryos but does not influence sex determination. (This statement is incorrect.)

• Importance of TSD in Ecology:

• TSD allows reptiles to adapt to environmental changes, ensuring population stability by balancing sex ratios.

• Climate change poses a threat to species with TSD, as rising temperatures may lead to skewed sex ratios, potentially endangering populations.

• Examples of TSD:

• Leatherback turtles: Warmer temperatures produce females, while cooler temperatures produce males.

• American alligators: Intermediate temperatures produce males, while extreme temperatures lead to females.

Important Points

• Impact of Climate Change: Rising global temperatures could severely disrupt TSD mechanisms, leading to imbalanced sex ratios and threatening species survival.

• Pivotal Temperature: This is a critical concept in TSD and varies among species. Research on pivotal temperatures helps in understanding and conserving reptiles.

• Conservation Efforts: Efforts to protect habitats and regulate temperatures during incubation are vital for species with TSD. Conservationists often monitor and manage nesting sites to ensure balanced sex ratios.

Q5. Answer: (d) increases

The correct answer is increases.

Key Points

• Pressure is defined as the force exerted per unit area. Mathematically, it is expressed as:

Pressure = Force/Area.

• When the thrust (force acting perpendicular to a surface) is kept constant, the pressure is inversely proportional to the area of contact.

• If the area of contact decreases while the thrust remains constant, the pressure increases because the same amount of force is concentrated over a smaller area.

• This principle is commonly observed in daily life. For example, sharp knives cut better because they apply the same force over a smaller surface area, increasing pressure.

• Hence, in this scenario, when the area of contact decreases while maintaining constant thrust, the pressure increases.

Additional Information

• Pressure:

• It is a scalar quantity and is measured in Pascals (Pa) in the SI system. 1 Pascal is equal to 1 Newton per square meter (N/m^2).

• Pressure is crucial in many applications such as hydraulics, pneumatics, and fluid mechanics.

• Thrust:

• Thrust is a force that acts perpendicular to a surface.

• In physics, thrust is an essential factor in understanding pressure and is applied in various fields like aerodynamics and engineering.

• Examples of Pressure Variation:

• High Heels: They exert more pressure on the ground because the contact area is smaller compared to flat shoes.

• Snowshoes: These increase the surface area, reducing pressure and preventing a person from sinking into the snow.

• Applications of Pressure:

• Hydraulics: Pressure is used to lift heavy objects using hydraulic machines.

• Aerodynamics: Understanding pressure helps in designing aircraft wings for efficient flight.

Important Points

• Factors Affecting Pressure:

• Force: Greater force leads to higher pressure if the area remains constant.

• Area: Smaller area leads to higher pressure when force is constant.

• Practical Applications:

• Syringes: Applying pressure to the plunger forces liquid out through a narrow nozzle.

• Nails and Screws: Their pointed ends reduce the area of contact, making it easier to penetrate materials.

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• Real-Life Demonstrations:

• Walking on sand with bare feet sinks deeper due to greater pressure compared to wearing flat wooden planks.

• Using a hydraulic press, where a small force applied over a small area can lift heavy loads over a larger area.

Q6. Answer: (a) Pomfret

The correct answer is Pomfret.

Key Points

• Pomfret is one of the most popular and widely consumed marine fish varieties in India. It is commonly found in the coastal regions of the country.

• Pomfret belongs to the family Stromateidae and is known for its delicate flavor, soft texture, and high demand in Indian cuisine.

• This fish is predominantly found in the Arabian Sea, Bay of Bengal, and Indian Ocean, making it a vital resource for the fishing industry in India.

• Pomfret is rich in protein, omega-3 fatty acids, and essential nutrients, making it a healthy choice for seafood lovers.

• The fish is often used in various traditional Indian recipes such as Pomfret fry, curry, and grilled dishes, making it a staple in coastal culinary traditions.

Additional Information

• Catla:

• Catla is a freshwater fish native to the rivers and lakes of India. It belongs to the carp family.

• It is an important species in aquaculture and is farmed in various parts of the country.

• Catla is known for its large size and is widely consumed in states like West Bengal and Assam.

• Mrigal:

• Mrigal is another freshwater fish commonly found in Indian rivers and reservoirs.

• It is a popular species in Indian aquaculture, especially in composite fish farming systems.

• Mrigal is appreciated for its mild taste and nutritional value, including being a good source of protein.

• Rohu:

• Rohu is a widely cultivated freshwater fish in India, belonging to the carp family.

• It is highly prized for its flavor and texture and is a significant part of the cuisine in eastern and northern India.

• Rohu is rich in omega-3 fatty acids, vitamins, and minerals, making it a healthy dietary choice.

• Marine vs. Freshwater Fish:

• Marine fish like Pomfret are found in the ocean, while freshwater species such as Catla, Mrigal, and Rohu are native to rivers and lakes.

• Marine fish are often higher in iodine and omega-3 fatty acids, whereas freshwater fish are a good source of protein and minerals.

Important Points

• Significance of Marine Fish: Marine fish like Pomfret play a crucial role in India's coastal economy, supporting livelihoods through fishing and export activities.

• Marine ecosystems: Pomfret and other marine fish are integral to maintaining the balance of marine biodiversity.

• Health benefits: Marine fish are an excellent source of essential nutrients like omega-3 fatty acids, which are beneficial for heart and brain health.

• Fishing industry: Pomfret is a valuable catch for Indian fishermen, contributing significantly to the seafood market.

Q7. Answer: (a) Mitochondria

The correct answer is Mitochondria.

Key Points

• Mitochondria, often referred to as the “powerhouse of the cell,” are responsible for the production of Adenosine Tri Phosphate (ATP), the primary energy currency of cells.

• ATP is produced through a process called cellular respiration, which occurs in the mitochondria. This process involves the breakdown of glucose and oxygen to release energy.

• Mitochondria have a unique double-membrane structure. The inner membrane is folded into structures called cristae, which increase the surface area for ATP production.

• The mitochondria are semi-autonomous organelles, meaning they have their own DNA and ribosomes, enabling them to produce some of their own proteins and enzymes required for ATP synthesis.

• ATP molecules produced in the mitochondria are used in various cellular processes, such as muscle contraction, active transport, and biochemical reactions essential for life activities.

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Additional Information

• Golgi Apparatus:

• The Golgi apparatus is primarily involved in the modification, sorting, and packaging of proteins and lipids for secretion or use within the cell.

• It does not play a role in the production of ATP.

• It is also responsible for the formation of lysosomes and the transport of lipids.

• Lysosomes:

• Lysosomes are membrane-bound organelles that contain digestive enzymes to break down waste materials and cellular debris.

• They are often referred to as the “suicidal bags” of the cell due to their role in autophagy and apoptosis.

• Lysosomes do not produce ATP.

• Vacuoles:

• Vacuoles are storage organelles found in both plant and animal cells, though they are larger in plant cells.

• They store nutrients, waste products, and other substances but are not involved in ATP synthesis.

• In plants, they help maintain turgor pressure, which is essential for structural support.

• ATP (Adenosine Triphosphate):

• ATP is a nucleotide consisting of three components: adenine (a nitrogenous base), ribose (a sugar), and three phosphate groups.

• The energy stored in the high-energy phosphate bonds is released when ATP is hydrolyzed to ADP (Adenosine Diphosphate) and inorganic phosphate.

• This energy is used in various cellular processes, such as active transport, metabolism, and mechanical work.

• Important Points:

• The mitochondria are unique among organelles because they are inherited maternally (from the mother).

• Examples of ATP-utilizing processes include muscle contraction, nerve impulse transmission, and biosynthesis of macromolecules.

• The human body synthesizes and uses its own weight in ATP molecules daily.

• Damaged or dysfunctional mitochondria can lead to energy deficits and are implicated in several disorders, such as mitochondrial myopathies and neurodegenerative diseases.

Q8. Answer: (d) mass can neither be created nor destroyed in a chemical reaction

The correct answer is mass can neither be created nor destroyed in a chemical reaction.

Key Points

• The Law of Conservation of Mass states that mass can neither be created nor destroyed in a chemical reaction. This principle is fundamental in the study of chemistry and physics.

• It was proposed by Antoine Lavoisier in 1789, who is considered the "Father of Modern Chemistry."

• According to this law, the total mass of reactants in a chemical reaction is equal to the total mass of the products. For example, in a reaction where carbon reacts with oxygen to form carbon dioxide, the mass of carbon plus oxygen equals the mass of carbon dioxide.

• This law is valid for both closed systems (where no matter enters or leaves the system) and in isolated systems, ensuring mass balance in chemical equations.

• This principle forms the basis for the stoichiometric calculations used in chemical equations, ensuring that the quantities of reactants and products are balanced.

Additional Information

• Antoine Lavoisier's Contribution:

• Lavoisier demonstrated the law through experiments involving combustion and concluded that the total mass of substances involved in a chemical reaction remained constant.

• He debunked the phlogiston theory and laid the groundwork for modern chemical nomenclature and analytical techniques.

• Applications of the Law:

• It is crucial in industries such as pharmaceuticals, where precise quantities of reactants are needed to produce the desired products.

• Used in environmental science to balance chemical reactions in pollution control and waste treatment processes.

• Mathematical Representation:

• The law can be expressed mathematically as: $\Sigma m_{reactants} = \Sigma m_{products}$, where m represents mass.

• Important Limitations:

• While the law is valid in classical physics and chemistry, it does not account for mass-energy equivalence as explained by

Einstein's theory of relativity ($E = mc^2$), where mass can be converted into energy in nuclear reactions.

• It is not applicable in systems where nuclear transformations occur, such as in nuclear fission and fusion.

• Comparison with Other Conservation Laws:

• While the Law of Conservation of Mass focuses on mass, other laws like the Law of Conservation of Energy and Law of Conservation of Momentum address energy and momentum in physical systems.

Important Points

• Option 1: Volume conservation is not universal in chemical reactions. For example, gases may change volume depending on conditions like pressure and temperature. Incorrect.

• Option 2: Temperature is a variable, not a conserved quantity. It can increase or decrease during reactions due to energy exchange. Incorrect.

• Option 3: Pressure is also not conserved and depends on factors like the number of gas molecules and volume. Incorrect.

• Option 4: The mass of reactants equals the mass of products in a chemical reaction, making this the correct answer.

Q9. Answer: (c) 24 cm

The correct answer is 24 cm.

Key Points

• A concave lens always forms a virtual, erect, and diminished image.

• The magnification of a lens is given by: m = v/u

• Since the image is one-third the size of the object, m = +1/3.

• Therefore, v = u/3.

• Using the lens formula: 1/f = 1/v − 1/u

• For a concave lens:

• f = –12 cm

• v = u/3

• Substituting,

1/(-12) = 1/(u/3) − 1/u

−1/12 = 3/u − 1/u

−1/12 = 2/u

u = −24 cm.

• The negative sign indicates that the object is placed in front of the lens. Hence, the object distance is 24 cm.

• Hence, the correct answer is 24 cm.

Additional Information

• Lens Formula:

• 1/f = 1/v − 1/u

• Applicable to both convex and concave lenses using the Cartesian sign convention.

• Concave Lens:

• Has a negative focal length.

• Always produces a virtual, erect, and diminished image for a real object.

• Magnification:

• m = v/u = h_i/h_o

• For a concave lens, the magnification is positive but less than 1.

Q10. Answer: (b) Exposure to moisture

The correct answer is Exposure to moisture.

Key Points

• Corrosion is a natural process where metals deteriorate due to environmental factors such as moisture, oxygen, and pollutants. Preventing corrosion involves techniques that create a barrier or reduce the reactivity of the metal surface.

• Painting: Applying paint on metal surfaces forms a protective layer that prevents direct contact with moisture and oxygen, which are primary causes of corrosion. Hence, painting is an effective method to prevent corrosion.

• Galvanisation: This process involves coating the metal with a layer of zinc. Zinc acts as a protective barrier, and even if the coating gets scratched, zinc acts as a sacrificial metal, preventing corrosion of the underlying metal. Hence, galvanisation is an effective anti-corrosion method.

• Applying sacrificial anodes: In this method, a more reactive metal (e.g., zinc or magnesium) is attached to the metal that needs protection. The sacrificial anode corrodes instead of the protected metal. Hence, this is another effective corrosion prevention

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method.

• Exposure to moisture: Moisture accelerates the electrochemical reaction that causes corrosion. Allowing metals to come into direct contact with moisture will increase their rate of corrosion rather than prevent it. Hence, exposure to moisture is NOT an effective method to prevent corrosion.

Additional Information

• Corrosion Process:

• Corrosion is an electrochemical process where a metal reacts with its environment, leading to the formation of oxides, hydroxides, or other compounds.

• For example, iron reacts with oxygen and water to form iron oxide (rust), which weakens the metal over time.

• Common Corrosion Prevention Methods:

• Electroplating: Coating the surface of a metal with a layer of another metal using electrolysis (e.g., chrome or nickel plating).

• Anodising: A process used for aluminum where the surface is oxidized to create a protective oxide layer.

• Greasing or Oil Coating: Lubricants provide a physical barrier that protects metals from moisture and oxygen.

• Factors Influencing Corrosion:

• Environmental factors: Presence of moisture, oxygen, and pollutants like sulfur dioxide or salt.

• Metal properties: Reactivity, purity, and surface area of the metal significantly influence corrosion rate.

• Temperature: Higher temperatures generally accelerate the corrosion process.

• Examples of Corrosion:

• Rusting of Iron: Formation of reddish-brown iron oxide in the presence of moisture and oxygen.

• Green Patina on Copper: Copper reacts with carbon dioxide and moisture to form copper carbonate, giving it a green appearance.

Important Points

• Economic Impact of Corrosion: Corrosion leads to significant economic losses, including maintenance, repair, and replacement costs. According to studies, the global cost of corrosion is estimated to be 3-4% of the global GDP.

• Corrosion-resistant Materials:

• Stainless Steel: Contains chromium, which forms a protective oxide layer and resists rusting.

• Aluminum: Forms a natural oxide layer that protects against further corrosion.

• Alloys: Materials like brass and bronze are more resistant to corrosion compared to pure metals.

• Environmental Protection: Preventing corrosion not only saves costs but also minimizes environmental damage caused by the disposal of corroded materials and the extraction of new metals.

Q11. Answer: (d) 18.52 m s^(-1)

The correct answer is 18.52 ms−1ms−1

.

Key Points

• Total Distance: The car travels 100 km in one direction and returns another 100 km, making the total distance covered 200 km.

• Time Taken: For the onward journey, the car travels at an average speed of 50 km/h, which takes 2 hours. The return trip covers the same 100 km in 1 hour, making the total time for the journey 3 hours.

• Average Speed Formula: Average speed is calculated using the formula:

Average Speed=Total DistanceTotal Time

Average Speed=Total DistanceTotal Time

Plugging in the values:

Average Speed=200 km3 hours=66.67 km/h

Average Speed=200 km3 hours=66.67 km/h

.

• Conversion to ms−1ms−1

: To convert the speed from km/h to ms−1ms−1

, multiply the value by

:

66.67×10003600=18.52ms−1

66.67×10003600=18.52ms−1

.

• Correct Answer: Hence, the average speed of the car for the entire journey is 18.52 ms−1ms−1

.

Additional Information

• Average Speed Concept: Average speed is a measure of the total distance traveled divided by the total time taken, irrespective of variations in speed during the trip. It is calculated using the formula:

Average Speed=Total DistanceTotal Time

Average Speed=Total DistanceTotal Time

.

• Unit Conversion: Speed in km/h can be converted to ms−1ms−1

by multiplying it by

or approximately. This is because 1 km = 1000 meters and 1 hour = 3600 seconds.

• Practical Applications: Calculating average speed is essential in transportation, logistics, and physics to determine efficiency, travel times, and performance metrics.

• Difference Between Average and Instantaneous Speed: Average speed considers the entire journey, while instantaneous speed measures the rate at which an object is moving at a specific moment.

• Real-World Examples: Average speed calculations are used in traffic analysis, determining fuel efficiency, and optimizing travel routes.

Important Points

• Speed and Velocity: While speed is a scalar quantity (magnitude only), velocity is a vector quantity (magnitude and direction).

• Uniform vs Non-Uniform Motion: In uniform motion, an object covers equal distances in equal time intervals, whereas in non-uniform motion, distances covered vary.

• SI Unit: The SI unit for speed is ms−1ms−1

, which stands for meters per second.

• Applications in Physics: Understanding speed and its variations is fundamental in mechanics, kinematics, and dynamics.

Q12. Answer: (c) Propene

The correct answer is Propene.

Key Points

• Unsaturated compounds are defined as organic compounds containing one or more double bonds (C=C) or triple bonds (C≡C) between carbon atoms in their molecular structure.

• Propene (C3H6) is an alkene that contains a carbon-carbon double bond, making it an unsaturated compound. Hence, it satisfies the criteria for being unsaturated.

• Butane (C4H10) and Propane (C3H8) are alkanes with only single bonds between carbon atoms, classifying them as saturated hydrocarbons.

• Methane (CH4) is the simplest alkane and also a saturated hydrocarbon, as it contains no double or triple bonds.

• Since Propene contains a double bond, it is the only option among the given compounds that qualifies as an unsaturated hydrocarbon.

Additional Information

• Saturated hydrocarbons:

• These are hydrocarbons that contain only single bonds between carbon atoms.

• They are also called alkanes and follow the general formula C_nH_(2n+2).

• Examples include methane (CH4), ethane (C2H6), and propane (C3H8).

• Unsaturated hydrocarbons:

• These are hydrocarbons containing one or more double bonds (alkenes) or triple bonds (alkynes).

• They are more reactive than saturated hydrocarbons due to the presence of π-bonds.

• Examples include ethene (C2H4), propene (C3H6), and ethyne (C2H2).

• Characteristics of alkenes:

• Alkenes contain at least one C=C double bond.

• They follow the general formula C_nH_(2n).

• Alkenes undergo addition reactions, such as hydrogenation, halogenation, and hydration, due to the presence of the double bond.

• Applications of unsaturated hydrocarbons:

• They are used as raw materials in the petrochemical industry for the production of plastics, synthetic rubber, and fibers.

• Ethene is used in the manufacture of ethanol, polyethylene, and other chemicals.

• Alkynes like ethyne (acetylene) are used in welding and cutting metals due to their high flame temperature.

Important Points

• Hydrocarbons classification:

• Alkanes: Saturated hydrocarbons with single bonds (e.g., methane, propane).

• Alkenes: Unsaturated hydrocarbons with double bonds (e.g., ethene, propene).

• Alkynes: Unsaturated hydrocarbons with triple bonds (e.g., ethyne).

• Testing for unsaturation: Unsaturated hydrocarbons decolorize bromine water or Baeyer's reagent ($KMnO_4$), indicating the presence of double or triple bonds.

• Environmental impact: Unsaturated hydrocarbons, when incompletely combusted, can release pollutants like carbon monoxide and soot, contributing to air pollution.

Q13. Answer: (b) Apiary

The correct answer is Apiary.

Key Points

• An apiary is a location where bees are kept and raised for the purpose of commercial honey production and other bee-related products like beeswax and royal jelly.

• Beekeeping in an apiary is also called apiculture, which involves the maintenance of bee colonies, typically in man-made hives.

• The main species of bees used for honey production include Apis mellifera (European honey bee) and Apis cerana (Asian honey bee).

• Apiaries are carefully managed environments that provide bees with adequate shelter, food, and water to ensure their health and productivity.

• Commercial apiaries can vary in size from a few hives to hundreds of hives, depending on the scale of honey production and other bee-related activities.

Additional Information

• Aquarium:

• An aquarium is a container or facility for keeping aquatic animals and plants, such as fish, in a controlled environment.

• It is not related to bees or honey production, making it an incorrect option for this question.

• Aviary:

• An aviary is an enclosed space where birds are kept for conservation, breeding, or display purposes.

• Since it deals with birds and not bees, it is also an incorrect option.

• Sanctuary:

• A sanctuary is a protected area established for the conservation of wildlife, including animals and plants.

• It does not specifically relate to commercial honey production or bees, making it an incorrect choice.

• Importance of Apiaries:

• Apiaries play a critical role in pollination, as bees are essential pollinators for many crops and plants.

• Beekeeping also provides economic benefits by producing honey, beeswax, and other products used in food, cosmetics, and medicine.

• Apiaries contribute to the environment by supporting biodiversity and the reproduction of flowering plants.

• Notable Practices in Beekeeping:

• Modern beekeepers use Langstroth hives, which consist of removable frames for easier management of bee colonies.

• Beekeeping requires regular monitoring of hives to prevent diseases and pests like Varroa mites.

• Proper location selection for an apiary is essential to ensure access to nectar-rich flowers and clean water sources.

Q14. Answer: (c) The optical centre of the lens

The correct answer is The optical centre of the lens.

Key Points

• In the sign convention for lenses, all distances are measured from the optical centre of the lens. This ensures uniformity and clarity in calculations.

• The optical centre is the point on the axis of the lens where the principal axis passes through the lens without bending. It acts as a reference point for all measurements.

• Distances measured towards the object (on the left side of the lens) are taken as negative, while those measured towards the image (on the right side of the lens) are taken as positive.

• The sign convention follows the Cartesian coordinate system, where distances above the principal axis are positive, and distances below are negative.

• This convention is crucial for deriving lens formulas, such as the lens maker's formula and the magnification formula, and for

accurately predicting the nature and position of images formed by lenses.

Additional Information

• Principal Axis:

• The principal axis is the straight line passing through the optical centre and perpendicular to the lens's surface.

• It serves as a baseline for measuring the focal length, object distance, and image distance in lenses.

• Focal Point:

• The focal point is the point on the principal axis where parallel rays of light converge (convex lens) or appear to diverge (concave lens) after passing through the lens.

• The distance between the optical centre and the focal point is known as the focal length.

• Sign Conventions:

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

• Heights of objects and images are positive if measured upwards from the principal axis and negative if measured downwards.

• Lens Formula:

• The lens formula is given by (1/f = 1/v - 1/u), where:

• f = Focal length

• v = Image distance

• u = Object distance

• This formula is derived considering the optical centre as the origin for all measurements.

• Applications of Lenses:

• Convex Lenses: Used in magnifying glasses, cameras, projectors, and human eye correction for hypermetropia.

• Concave Lenses: Used in correcting myopia, peepholes in doors, and certain optical instruments.

Important Points

• Option 1: The pole of the lens is not used as a reference for measuring distances in the sign convention. Hence, this option is incorrect.

• Option 2: The focus of the lens is an important point but is not used as the origin for measuring distances. Hence, this option is incorrect.

• Option 3: The optical centre is the correct reference point for measuring distances in the Cartesian coordinate system for lenses. This is the correct answer.

• Option 4: The principal axis is a reference line, not a reference point for measuring distances. Hence, this option is incorrect.

Q15. Answer: (b) Leishmania

The correct answer is Leishmania.

Key Points

• Binary fission is a mode of asexual reproduction in which a single organism divides into two identical daughter organisms. This method is commonly observed in unicellular organisms.

• Leishmania, a protozoan parasite, reproduces through binary fission. It divides longitudinally, ensuring each daughter cell receives a copy of the nucleus and cytoplasmic components. Hence, Leishmania reproduces via binary fission.

• Other organisms mentioned in the options such as Butterfly, Rose plant, and Neem plant, do not reproduce by binary fission. They reproduce sexually or through other methods like vegetative propagation.

• Butterflies reproduce sexually through the process of egg fertilization, while Rose and Neem plants reproduce through seeds (sexual reproduction) or vegetative propagation (e.g., cuttings in roses). Hence, these options are incorrect.

• Binary fission is a characteristic feature of simpler organisms like bacteria, amoeba, and certain protozoans. It is not observed in complex multicellular organisms like plants and animals.

Additional Information

• Binary Fission Process:

• During binary fission, the DNA of the organism is replicated first.

• The cytoplasm then divides, and the organism splits into two equal-sized daughter cells.

• Each daughter cell is genetically identical to the parent cell.

• Leishmania Details:

• Leishmania is a protozoan parasite responsible for diseases like Leishmaniasis, which affects humans and animals.

• It is transmitted through the bite of infected female sandflies (Phlebotomus species).

• Leishmania exhibits a specific mode of binary fission, where the cell divides longitudinally, unlike bacteria, which divide by transverse binary fission.

• Other Examples of Binary Fission:

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• Bacteria: They reproduce by transverse binary fission, dividing into two identical cells.
• Amoeba: A unicellular organism that divides into two daughter cells after replicating its nucleus.
• Paramecium: A ciliate protozoan that undergoes binary fission along its longitudinal axis.
• Reproduction in Other Organisms:
• Butterfly: Reproduces sexually; eggs are laid, which hatch into larvae (caterpillars) and undergo metamorphosis to become adult butterflies.
• Rose Plant: Can reproduce sexually through seeds and asexually through vegetative propagation (e.g., stem cuttings).
• Neem Plant: Reproduces sexually through seeds formed after pollination.

Important Points

• Binary Fission vs. Mitosis:
• Binary fission is simpler and occurs in prokaryotic organisms like bacteria and protozoans.
• Mitosis occurs in eukaryotic cells, involving the division of the nucleus followed by cytokinesis.
• Types of Binary Fission:
• Simple Binary Fission: Observed in Amoeba; cell divides in any plane.
• Longitudinal Binary Fission: Seen in Leishmania; division occurs along the longitudinal axis.
• Transverse Binary Fission: Seen in Paramecium; division occurs along the transverse axis.
• Oblique Binary Fission: Observed in certain protozoans; division occurs at an oblique angle.
• Significance of Binary Fission:
• Allows rapid population growth under favorable conditions.
• Ensures genetic consistency in offspring as they are clones of the parent.
• Helps organisms survive and adapt in specific ecological niches.

Q16. Answer: (a) 13 amu

The correct answer is 13 amu.

Key Points

• Atomic mass is the total mass of protons, neutrons, and electrons in an atom. However, since the mass of electrons is negligible, the atomic mass is primarily the sum of protons and neutrons in the nucleus.
• Carbon-13 is an isotope of carbon that contains 6 protons and 7 neutrons. The sum of these nucleons gives its atomic mass: 6 (protons) + 7 (neutrons) = 13 atomic mass units (amu).
• Isotopes are atoms of the same element with the same number of protons but a different number of neutrons. Hence, while the atomic number of all carbon isotopes is 6, their atomic masses differ due to the variation in the number of neutrons.
• The most common isotope of carbon is Carbon-12, which has an atomic mass of 12 amu. However, Carbon-13 occurs naturally in smaller amounts, approximately 1.1% of all carbon atoms.
• In scientific terms, the atomic mass of Carbon-13 is specifically measured as 13.00335 amu, but for simplicity, it is rounded to 13 amu.

Additional Information

• Isotopes of Carbon:
• Carbon-12: The most abundant isotope, comprising approximately 98.9% of carbon atoms. It contains 6 protons and 6 neutrons, giving it an atomic mass of 12 amu.
• Carbon-13: A stable isotope of carbon, which makes up about 1.1% of carbon atoms. It is used in various scientific fields, including carbon dating and nuclear magnetic resonance (NMR) spectroscopy.
• Carbon-14: A radioactive isotope with 6 protons and 8 neutrons. It has an atomic mass of 14 amu and is widely used in radiocarbon dating to determine the age of fossils and archaeological samples.
• Applications of Carbon-13:
• Carbon-13 is extensively used in NMR spectroscopy to study the molecular structure of organic compounds. Its nuclear spin properties make it useful for analyzing chemical environments.
• It is utilized in metabolic studies to trace biochemical pathways by incorporating Carbon-13-labeled compounds into biological systems.
• Carbon-13 is also used in climatology to analyze carbon cycles and understand historical changes in atmospheric carbon levels.
• Atomic Mass Unit (amu):
• An atomic mass unit is defined as one-twelfth of the mass of a Carbon-12 atom. It is the standard unit for expressing atomic and molecular masses.
• The exact value of 1 amu is 1.660539066 × 10^-²^7 kilograms.
• Using amu simplifies calculations in chemistry and physics by providing a convenient scale for comparing the masses of atoms

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and molecules.

Important Points

• Mass Number: The mass number is the total number of protons and neutrons in the nucleus of an atom. It is always a whole number.

• Atomic Number: The atomic number represents the number of protons in an atom and determines the chemical identity of an element. For carbon, the atomic number is 6.

• Natural Abundance: Isotopes of an element have different natural abundances. Carbon-12 is the most abundant isotope of carbon, while Carbon-13 and Carbon-14 occur in much smaller amounts.

• Stable vs. Radioactive Isotopes: Carbon-12 and Carbon-13 are stable isotopes, whereas Carbon-14 is radioactive, decaying over time with a half-life of approximately 5730 years.

Q17. Answer: (b) Loosely packed

The correct answer is Loosely packed.

Key Points

• Connective tissue is characterized by the presence of an abundant intercellular (extracellular) matrix.

• According to NCERT, the cells of connective tissue are loosely packed and are embedded in the matrix.

• The matrix may be fluid, jelly-like, or solid depending on the type of connective tissue and provides support, binding, protection, and transport.

• Unlike epithelial tissue, connective tissue has more intercellular space, which keeps its cells loosely arranged.

• Hence, the correct answer is Option 2 – Loosely packed.

Additional Information

• Connective tissue connects, supports, binds, and protects different tissues and organs of the body.

• Common types of connective tissue include areolar tissue, adipose tissue, tendon, ligament, cartilage, bone, and blood.

• Epithelial tissue has tightly packed cells with very little intercellular space, whereas connective tissue has a relatively larger amount of extracellular matrix.

Important Points

• NCERT wording: "The cells of connective tissue are loosely packed and embedded in an intercellular matrix."

• Exam Tip: If the options include both "loosely packed" and "far away from each other", choose "loosely packed" as it follows the standard NCERT terminology.

• Features of Connective Tissue:

• Cells are loosely arranged.

• Abundant extracellular matrix is present.

• Provides support, binding, protection, storage, and transport.

Q18. Answer: (c) only protons

The correct answer is only protons.

Key Points

• The atomic number of an element is defined as the total number of protons present in the nucleus of its atom. This is a fundamental property of an element and remains constant for all atoms of that element.

• The atomic number is symbolized by the letter Z. For example, for Hydrogen, Z = 1, as it has one proton in its nucleus.

• Neutrons do not determine the atomic number. Although neutrons are present in the nucleus, their count can vary in isotopes of an element without affecting the atomic number.

• The atomic number is used to uniquely identify an element in the periodic table. For example, Carbon has an atomic number of 6, which means it has 6 protons in its nucleus.

• Electrons in a neutral atom are equal in number to the protons, but they are not considered in defining the atomic number.

Additional Information

• Protons:

• Protons are positively charged particles found in the nucleus of an atom.

• The number of protons determines the chemical identity of an element. For instance, Oxygen always has 8 protons.

• Each proton has a charge of +1e (positive elementary charge) and a mass of approximately 1 atomic mass unit (amu).

• Neutrons:

• Neutrons are neutral particles (no charge) also located in the nucleus of an atom.

• The number of neutrons can vary among atoms of the same element, leading to the formation of isotopes.

• For example, Carbon has three common isotopes: Carbon-12 (6 neutrons), Carbon-13 (7 neutrons), and Carbon-14 (8

neutrons).

• Electrons:

• Electrons are negatively charged particles that orbit the nucleus in different energy levels or shells.

• In a neutral atom, the number of electrons is equal to the number of protons.

• Electrons play a crucial role in chemical bonding and reactions but do not affect the atomic number.

• Isotopes:

• Isotopes are atoms of the same element with the same number of protons but different numbers of neutrons.

• For example, Hydrogen has three isotopes: Protium (1 proton, 0 neutrons), Deuterium (1 proton, 1 neutron), and Tritium (1 proton, 2 neutrons).

• Despite having different masses, isotopes of the same element have identical chemical properties.

• Periodic Table:

• The periodic table is arranged in order of increasing atomic number (number of protons).

• Elements in the same group have similar chemical properties because they have the same number of valence electrons.

• For instance, Group 1 elements like Sodium and Potassium have a single valence electron and exhibit similar reactivity.

Important Points

• Atomic Mass Number (A): It is the sum of the number of protons and neutrons in the nucleus of an atom. For example, for Carbon-12, A = 6 (protons) + 6 (neutrons) = 12.

• Neutral Atom: In a neutral atom, the number of protons equals the number of electrons, maintaining electrical neutrality.

• Ions: When an atom loses or gains electrons, it becomes an ion. For example, Sodium (Na) loses one electron to form Na^+, and Chlorine (Cl) gains one electron to form Cl^-.

• Discovery of Protons: Protons were discovered by Ernest Rutherford in 1917 during his gold foil experiment.

Q19. Answer: (a) decreasing reactivity

The correct answer is decreasing reactivity.

Key Points

• The reactivity series is a list of metals arranged in the order of their decreasing reactivity. This means the most reactive metal is placed at the top, and the least reactive metal is at the bottom.

• Metals higher in the series can displace metals lower in the series from their compounds during chemical reactions, such as displacement reactions.

• The reactivity is determined based on how easily a metal can lose electrons to form positive ions (cations). Metals that lose electrons easily are more reactive.

• The series is critical in predicting the outcomes of chemical reactions, such as the reaction of metals with water, acids, and other chemicals.

• For example, in the reactivity series, potassium and sodium are at the top because they are highly reactive, while gold and platinum are at the bottom because they are least reactive.

Additional Information

• Reactivity Series:

• The reactivity series is also called the activity series, and it includes metals such as potassium, sodium, calcium, magnesium, aluminum, zinc, iron, lead, copper, silver, and gold, arranged in decreasing order of reactivity.

• Metals at the top (e.g., potassium and sodium) react vigorously with water and air, while metals at the bottom (e.g., gold and platinum) do not react easily.

• This series is determined experimentally through reactions of metals with water, acids, and other salts.

• Examples of Reactivity:

• Potassium and sodium react violently with water, forming hydroxides and releasing hydrogen gas.

• Iron reacts slowly with dilute acids, producing hydrogen gas, but does not react with water at room temperature.

• Gold and platinum are chemically inert and do not react with most acids or water.

• Applications of the Reactivity Series:

• It is used to predict the feasibility of a displacement reaction. For example, zinc can displace copper from copper sulfate solution, but copper cannot displace zinc.

• The series helps in the extraction of metals. Highly reactive metals like sodium and potassium are extracted using electrolysis, while less reactive metals like iron can be extracted using reduction with carbon.

• It is applied in designing corrosion-resistant materials and galvanization processes.

• Displacement Reaction:

• In a displacement reaction, a more reactive metal displaces a less reactive metal from its compound. For example: Zn + CuSO4

→ ZnSO4 + Cu

• This reaction occurs because zinc is higher in the reactivity series than copper.

Important Points

• The reactivity series also includes hydrogen, which is a reference point. Metals above hydrogen can displace it from acids, while metals below cannot.

• Metals like aluminum and zinc are used in sacrificial protection to prevent rusting of iron structures.

• Metals at the bottom of the series, such as silver and gold, are used in jewelry due to their low reactivity, making them resistant to tarnishing.

• The position of a metal in the reactivity series is also critical in determining its method of extraction. For example, electrolysis is used for highly reactive metals, while reduction is used for moderately reactive metals.

Q20. Answer: (d) Carbon dioxide

The correct answer is Carbon dioxide.

Key Points

• When dilute hydrochloric acid (HCl) reacts with sodium hydrogencarbonate (NaHCO3), the reaction produces carbon dioxide gas (CO2), along with water (H2O) and sodium chloride (NaCl).

• The chemical reaction for this process is: NaHCO3 + HCl → NaCl + H2O + CO2. This is a classic acid-carbonate reaction where carbon dioxide gas is released.

• The evolution of carbon dioxide can be observed as effervescence or bubbling during the reaction.

• This reaction is commonly used in experiments to demonstrate the presence of carbon dioxide, as the gas can turn limewater (Ca(OH)2) milky when bubbled through it, due to the formation of calcium carbonate (CaCO3).

• None of the other options (Nitrogen, Oxygen, or Hydrogen) is evolved in this reaction. The reaction specifically releases carbon dioxide due to the decomposition of the bicarbonate ion (HCO3^-).

Additional Information

• Sodium Hydrogencarbonate (NaHCO3):

• Also known as baking soda, it is a weak base commonly used in cooking, cleaning, and as an antacid.

• When it reacts with an acid like HCl, it releases carbon dioxide gas, which is responsible for the characteristic fizzing or bubbling.

• It is also used in baking to help dough rise, as the released carbon dioxide creates air pockets in the mixture.

• Hydrochloric Acid (HCl):

• HCl is a strong acid commonly used in laboratories and industries for various purposes, including cleaning, pH regulation, and in reactions with bases or carbonates.

• In the human body, HCl is a component of gastric acid, aiding in digestion by breaking down food and killing harmful microorganisms.

• Carbon Dioxide (CO2):

• CO2 is a colorless, odorless gas that is naturally present in Earth's atmosphere.

• It is a byproduct of respiration in animals and combustion of organic matter, and it plays a crucial role in the carbon cycle and photosynthesis in plants.

• In practical applications, it is used in the production of carbonated beverages, fire extinguishers, and as a refrigerant.

• Characteristics of Other Gases:

• Nitrogen (N2): A colorless, odorless, and inert gas, it makes up about 78% of Earth's atmosphere. It does not react with HCl or NaHCO3.

• Oxygen (O2): Essential for respiration, it is a highly reactive gas but is not produced in this reaction.

• Hydrogen (H2): A flammable gas, it is evolved in reactions between acids and metals, not in the reaction between HCl and NaHCO3.

Important Points

• Acid-Carbonate Reactions: These reactions are commonly used in laboratories to generate carbon dioxide gas for experiments.

• Testing for CO2: Carbon dioxide can be confirmed by passing it through limewater. If the solution turns milky, it indicates the presence of CO2.

• Applications of the Reaction: This reaction is utilized in household cleaning, baking, and in fire extinguishers where the rapid release of CO2 helps to smother flames.

• Environmental Role of CO2: While it is essential for photosynthesis, excessive CO2 in the atmosphere contributes to global warming and climate change.

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Q21. Answer: (c) Both statements are correct, and Statement II correctly explains Statement I.

The correct answer is Both statements are correct, and Statement II correctly explains Statement I..

Key Points

• Statement I: Zinc displaces copper from copper sulphate solution, but copper cannot displace zinc from zinc sulphate solution.

• This statement is correct.

• When zinc is added to copper sulphate solution, it reacts to form zinc sulphate and copper metal. This occurs because zinc is more reactive than copper.

• However, when copper is added to zinc sulphate solution, no reaction occurs as copper cannot displace zinc due to its lower reactivity.

• Statement II: Zinc is more reactive than copper in the reactivity series.

• This statement is also correct.

• The reactivity series is a list of metals arranged in order of their reactivity. Zinc is positioned above copper, indicating that it is more reactive.

• The higher reactivity of zinc allows it to displace copper from its compounds in aqueous solutions.

• Explanation:

• Statement II correctly explains Statement I because the ability of zinc to displace copper is directly due to its higher position in the reactivity series, which reflects its greater reactivity.

• Thus, both statements are correct, and Statement II provides the reason for the observation in Statement I.

Additional Information

• Reactivity Series:

• The reactivity series is a chart that ranks metals based on their reactivity with water, acids, and other substances.

• Zinc is placed above copper in the reactivity series, meaning it has a stronger tendency to lose electrons and form positive ions.

• Some highly reactive metals in the series include potassium, sodium, and calcium, while less reactive ones like gold and silver are found at the bottom.

• Displacement Reactions:

• A displacement reaction occurs when a more reactive metal displaces a less reactive metal from its compound in an aqueous solution.

• For example, zinc displaces copper from copper sulphate solution: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$.

• However, the reverse ($Cu + ZnSO_4$) does not occur because copper is less reactive than zinc.

• Applications of Reactivity Series:

• The reactivity series is used in industrial processes like metal extraction and refining.

• It helps predict the feasibility of chemical reactions, such as displacement and redox reactions.

• It is also used to prevent corrosion by selecting metals for galvanization or sacrificial protection (e.g., using zinc to protect iron from rusting).

• Examples of Displacement Reactions:

• Iron displacing copper: $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$.

• Magnesium displacing zinc: $Mg + ZnSO_4 \rightarrow MgSO_4 + Zn$.

Important Points

• Key Factors in Reactivity:

• The reactivity of a metal depends on its ability to lose electrons and form positive ions.

• Metals higher in the reactivity series are more electropositive and readily participate in chemical reactions.

• Galvanization:

• Galvanization is the process of coating iron or steel with a layer of zinc to prevent rusting.

• This process works because zinc, being more reactive, corrodes in place of the iron, acting as a sacrificial metal.

• Extraction of Metals:

• Less reactive metals like gold are found in nature in their elemental form, while more reactive ones like zinc are extracted from their ores through reduction or electrolysis.

Q22. Answer: (b) Lactic acid

The correct answer is Lactic Acid.

Key Points

• Anaerobic respiration occurs in the absence of oxygen and is a process by which cells generate energy. In animals, the end product of anaerobic respiration is lactic acid. This occurs primarily during intense physical activities when oxygen availability is limited.

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• Lactic acid formation: During anaerobic respiration, glucose is broken down into pyruvate through glycolysis. In the absence of oxygen, pyruvate is converted into lactic acid by the enzyme lactate dehydrogenase.

• Lactic acid accumulation: The buildup of lactic acid in muscle tissues leads to muscle fatigue and soreness. This is commonly experienced during strenuous exercises such as sprinting or heavy lifting.

• Energy yield: Anaerobic respiration yields only 2 ATP molecules per glucose molecule, which is significantly lower compared to aerobic respiration (which yields 36-38 ATP molecules).

• This process is temporary and reversible; once oxygen becomes available, lactic acid is transported to the liver where it is converted back into glucose through the Cori cycle.

Additional Information

• Anaerobic respiration in animals:

• This process is vital during high-energy demands when oxygen supply is insufficient, such as during short bursts of physical exertion.

• It allows cells to continue producing energy temporarily despite the lack of oxygen.

• It is common in muscle cells, especially during activities like sprinting, weightlifting, or intense sports.

• Comparison of aerobic and anaerobic respiration:

• Aerobic respiration: Requires oxygen, produces carbon dioxide and water as end products, and yields high energy (36-38 ATP molecules).

• Anaerobic respiration: Does not require oxygen, produces lactic acid in animals (or ethanol and carbon dioxide in yeast), and yields lower energy (2 ATP molecules).

• Lactic acid and exercise:

• During intense exercise, lactic acid buildup causes a burning sensation in muscles and fatigue.

• Post-exercise, oxygen-rich blood removes lactic acid, aiding recovery and reducing soreness.

• Proper hydration and stretching can help reduce the effects of lactic acid accumulation.

• Other end products of anaerobic respiration:

• In plants and yeast: The end products of anaerobic respiration are ethanol and carbon dioxide. This process is known as fermentation.

• In bacteria: Different bacteria produce various end products such as methane, hydrogen, or acetic acid, depending on their metabolism.

Important Points

• Lactic acid in clinical context: Elevated levels of lactic acid in the blood, termed lactic acidosis, can indicate conditions like hypoxia, sepsis, or metabolic disorders.

• Cori cycle: This metabolic pathway involves the conversion of lactic acid back into glucose in the liver, demonstrating the body's ability to recycle metabolic byproducts.

• Role of enzymes: The enzyme lactate dehydrogenase plays a crucial role in the conversion of pyruvate to lactic acid during anaerobic respiration.

• Adaptation in animals: Some animals, such as diving mammals, have adapted mechanisms to tolerate higher levels of lactic acid during prolonged periods of oxygen deprivation.

Q23. Answer: (d) Reaction force of the bullet on the gun

The correct answer is Reaction force of the bullet on the gun.

Key Points

• When a gun is fired, the bullet is propelled forward with a high velocity due to the explosive force generated by the combustion of gunpowder within the barrel. This action creates an equal and opposite reaction force on the gun, causing it to recoil backward. This phenomenon is explained by Newton's Third Law of Motion, which states: "For every action, there is an equal and opposite reaction."

• The backward motion of the gun, known as recoil, is directly proportional to the forward momentum of the bullet. This relationship is governed by the principle of conservation of momentum, which states that the total momentum of an isolated system remains constant if no external forces act on it.

• The mass of the gun is significantly larger than the bullet, so the gun's recoil velocity is much smaller in magnitude than the bullet's forward velocity. This inverse relationship ensures that the total momentum before and after firing remains balanced.

• Neither air resistance, gravity, nor friction between the gun and the person holding it plays a role in the gun's recoil. These factors may affect the gun's trajectory or stability but are not responsible for the recoil motion.

• This concept is critical in firearm design, as the recoil force must be managed to ensure the shooter’s safety and maintain accuracy during subsequent shots.

Additional Information

• Newton's Third Law of Motion:

• Newton's Third Law explains the interaction between two objects. If object A exerts a force on object B, object B simultaneously exerts an equal and opposite force on object A.

• This law governs not only firearm recoil but also other phenomena such as rocket propulsion, swimming, and walking.

• Conservation of Momentum:

• The total momentum of an isolated system remains constant if no external forces act on it.

• In the context of firearms, the momentum of the bullet moving forward is equal in magnitude but opposite in direction to the momentum of the recoiling gun.

• Firearm Recoil Management:

• Recoil can be reduced by using techniques such as adding weight to the firearm, using recoil pads, or employing gas-operated mechanisms in semi-automatic weapons.

• Suppressors or muzzle brakes are also commonly used to mitigate recoil by redirecting gases expelled during firing.

• Applications of Newton's Laws:

• Newton’s Third Law is instrumental in the design and operation of rockets, jet engines, and even vehicles, where propulsion relies on the expulsion of gases or forces in one direction to generate movement in the opposite direction.

• Misconceptions about Recoil:

• Some people mistakenly believe that air resistance or friction is responsible for the recoil of a gun. In reality, these factors are negligible compared to the reaction force caused by the bullet's forward motion.

Important Points

• Firearm Safety:

• Recoil management is crucial for accurate shooting and preventing injuries. Proper stance, grip, and understanding of the firearm’s behavior are essential for safe handling.

• Physics in Everyday Life:

• The principles of Newton's laws and momentum conservation are not limited to firearms but are integral to understanding a wide range of mechanical systems and daily activities.

• Historical Context:

• The study of firearm recoil and ballistics has been a significant area of research since the development of gunpowder-based weapons. Modern advancements in materials and design have enhanced both safety and performance.

Q24. Answer: (d) 20 V

The correct answer is 20 V.

Key Points

• The relationship between work done (W), charge (Q), and potential difference (V) is given by the formula: V = W/Q.

• Here, the work done (W) is given as 30 J, and the charge (Q) is 1.5 C.

• Using the formula: V = W/Q = 30 J / 1.5 C = 20 V.

• Therefore, the potential difference between the two points is 20 V. The calculation is correct based on the given values.

• Option 4: 20 V is the correct answer.

Additional Information

• Electric Potential Difference:

• The potential difference is the work done in moving a unit charge from one point to another in an electric field.

• It is measured in volts (V), where 1 volt = 1 joule/coulomb.

• Potential difference is a scalar quantity and is represented mathematically as V = W/Q.

• Work Done in Electric Fields:

• Work done refers to the energy required to move a charge against an electric field.

• It is given by W = Q × V, where Q is the charge and V is the potential difference.

• The SI unit of work is the joule (J).

• Charge:

• Charge is a fundamental property of matter that causes it to experience a force in an electric field.

• It is measured in coulombs (C), where 1 coulomb is the charge transported by a current of 1 ampere in 1 second.

• Applications of Potential Difference:

• Electrical Circuits: Potential difference drives current through circuits, powering devices like lights, motors, and appliances.

• Electrochemical Processes: It is crucial in batteries and electroplating, where chemical reactions are driven by electric potential differences.

• Measurement: Devices like voltmeters measure the potential difference across components in electrical circuits.

Important Points

• Formula Recap: Always remember the formula V = W/Q for calculating potential difference, where W is in joules and Q is in coulombs.

• Units:

• The unit of potential difference is volt (V), work is joules (J), and charge is coulombs (C).

• 1 volt = 1 joule/coulomb.

• Practical Example: The potential difference of a standard AA battery is approximately 1.5 V, while a car battery typically has a potential difference of 12 V.

• When solving problems, ensure consistent units (e.g., joules, coulombs) to avoid calculation errors.

Q25. Answer: (b) the current flowing through the loop

The correct answer is the current flowing through the loop.

Key Points

• The magnetic field at the center of a current-carrying circular loop is determined using Ampere's Law or Biot-Savart Law. It is given by the formula: B = (μ0 * I) / (2 * R), where:

• B: Magnetic field at the center (measured in Tesla).

• μ0: Permeability of free space (4π × 10^-^7 T·m/A).

• I: Current flowing through the loop.

• R: Radius of the loop.

• From the formula, it is evident that the magnetic field B is directly proportional to the current (I). Hence, an increase in current will lead to a proportional increase in the magnetic field.

• The radius of the loop affects the magnetic field inversely. However, the question specifically asks about direct proportionality, which is only true for the current flowing through the loop.

• The other options, such as the square of the radius or the square of the current, are not correct because the magnetic field does not depend on these quantities in that manner.

• Hence, the correct answer is the current flowing through the loop.

Additional Information

• Biot-Savart Law:

• The Biot-Savart law describes the magnetic field produced by a current element. It states that the magnetic field (dB) due to a small segment of current (IdL) at a point is directly proportional to the current and inversely proportional to the square of the distance between the segment and the point.

• Mathematically: dB = (μ0/4π) * (I * dL × r) / r².

• Ampere's Law:

• Ampere's Law relates the integrated magnetic field around a closed loop to the total electric current passing through the loop.

• It is expressed as: ∫B·dl = μ0I, where I is the current enclosed by the loop.

• Impact of Radius:

• The magnetic field at the center is inversely proportional to the radius of the loop. If the radius increases, the field decreases and vice versa.

• This relationship is evident from the formula: B = (μ0 * I) / (2 * R).

• Applications of Magnetic Fields in Circular Loops:

• Used in electromagnets for generating strong magnetic fields.

• Widely applied in electric motors, MRI machines, and particle accelerators.

• Units and Constants:

• Magnetic field (B) is measured in Tesla (T).

• Permeability of free space (μ0) has a value of 4π × 10^-^7 T·m/A.

Important Points

• Option 1: The square of the radius of the circular loop is not involved in the formula for the magnetic field. Thus, this option is incorrect.

• Option 3: The inverse of the current is incorrect because the magnetic field is directly proportional to the current.

• Option 4: The square of the current does not influence the magnetic field; hence, this is also incorrect.

Q26. Answer: (b) decrease by Rs. 2,450

Shortcut Trick

Initial Income = 100%, Savings = 25.5%, Expenditure = 74.5%.

New Income = 100 × 1.2 = 120%.
New Expenditure = 74.5 × 1.4 = 104.3%.
New Savings = 120% − 104.3% = 15.7%.
Change in Savings = 15.7% − 25.5% = −9.8% (Decrease).
Value decrease = 9.8% of Rs. 25,000 = Rs. 2,450.
Therefore The correct answer is decrease by Rs. 2,450.
Alternate Method
Given:
Initial Income = Rs. 25,000
Initial Savings % = 25.5%
Formula Used:
Income = Expenditure + Savings
Calculations:
=> Initial Savings = 25.5% of 25,000 = Rs. 6,375
=> Initial Expenditure = 25,000 − 6,375 = Rs. 18,625
=> New Income = 25,000 × (120/100) = Rs. 30,000
=> New Expenditure = 18,625 × (140/100) = Rs. 26,075
=> New Savings = 30,000 − 26,075 = Rs. 3,925
=> Change in Savings = 3,925 − 6,375 = −Rs. 2,450
Therefore The correct answer is decrease by Rs. 2,450.
Additional Information
Percentage Change in Savings
If income increases by x% and expenditure increases by y%, the new savings is calculated by subtracting the new expenditure from the new income.
Base Value Stability
When calculating absolute changes, always refer back to the original values unless successive changes are mentioned.
Expenditure Component
Expenditure = Income × (100 − Savings%). Any percentage increase in expenditure applies to this calculated component.

Q27. Answer: (a) 3/5

Shortcut Trick
Given tan θ = 3/4, which represents Perpendicular/Base.
Using Pythagorean Triplets (3, 4, 5), the Hypotenuse is 5.
sin θ = Perpendicular/Hypotenuse = 3/5.
Therefore The correct answer is 3/5.
Alternate Method
Given:
tan θ = 3/4
Formula Used:
tan θ = Perpendicular (P) / Base (B)
sin θ = Perpendicular (P) / Hypotenuse (H)
$H^2 = P^2 + B^2$
Calculations:
=> P = 3, B = 4
=> $H^2 = 3^2 + 4^2$
=> $H^2 = 9 + 16 = 25$
=> $H = \sqrt{25} = 5$
=> sin θ = P/H = 3/5
Therefore The correct answer is 3/5.
Additional Information
Pythagorean Identity
For any angle θ, $\sin^2\theta + \cos^2\theta = 1$. This can be used to find sine if cosine is known.

Trigonometric Ratios

cos θ = Base/Hypotenuse and cot θ = 1/tan θ. In this case, cos θ = 4/5.

Angle of Elevation

The angle formed by the line of sight with the horizontal when looking up at an object.

Q28. Answer: (d) 23 sq. units

Shortcut Trick

The area of a quadrilateral with vertices (x1, y1), (x2, y2), (x3, y3), and (x4, y4) is calculated using the Shoelace Formula:

Area = 1/2 |(x1y2 + x2y3 + x3y4 + x4y1) − (y1x2 + y2x3 + y3x4 + y4x1)|

Area = 1/2 |(2×7 + 5×6 + 10×2 + 7×3) − (3×5 + 7×10 + 6×7 + 2×2)|

Area = 1/2 |(14 + 30 + 20 + 21) − (15 + 70 + 42 + 4)|

Area = 1/2 |85 − 131| = 1/2 |−46| = 23 sq. units.

Therefore The correct answer is 23 sq. units.

Alternate Method

Given: Vertices of the quadrilateral are A(2,3), B(5,7), C(10,6), and D(7,2).

Formula Used: Area of Quadrilateral ABCD = Area of ΔABC + Area of ΔADC

=> Area of ΔABC = 1/2 |x1(y2−y3) + x2(y3−y1) + x3(y1−y2)|

=> Area of ΔABC = 1/2 |2(7−6) + 5(6−3) + 10(3−7)|

=> Area of ΔABC = 1/2 |2(1) + 5(3) + 10(−4)| = 1/2 |2 + 15 − 40| = 11.5 sq. units.

=> Area of ΔADC = 1/2 |x1(y4−y3) + x4(y3−y1) + x3(y1−y4)|

=> Area of ΔADC = 1/2 |2(2−6) + 7(6−3) + 10(3−2)|

=> Area of ΔADC = 1/2 |2(−4) + 7(3) + 10(1)| = 1/2 |−8 + 21 + 10| = 11.5 sq. units.

=> Total Area = 11.5 + 11.5 = 23 sq. units.

Therefore The correct answer is 23 sq. units.

Additional Information

Shoelace Formula

A general algorithm to find the area of any polygon by using the coordinates of its vertices in order.

Area of a Triangle

For vertices (x1, y1), (x2, y2), and (x3, y3), the area is 1/2 |x1(y2−y3) + x2(y3−y1) + x3(y1−y2)|.

Distance Formula

The distance between two points (x1, y1) and (x2, y2) is d = √((x2−x1)² + (y2−y1)²).

Q29. Answer: (a) 13 : 15

Shortcut Trick

Expenditure ratio is calculated by multiplying the Price ratio and Quantity ratio.

Expenditure (Lemon : Strawberry) = (28 × 15) : (26 × 14)

Simplify: (2 × 15) : (26 × 1) => 30 : 26 => 15 : 13

Required Ratio (Strawberry : Lemon) = 13 : 15

Therefore The correct answer is 13 : 15.

Alternate Method

Given:

Ratio of Unit Prices (Lemon : Strawberry) = 28 : 26

Ratio of Quantities (Lemon : Strawberry) = 15 : 14

Formula Used:

Expenditure = Price × Quantity

Calculations:

=> Expenditure on Lemon Chocolate = 28 × 15 = 420

=> Expenditure on Strawberry Chocolate = 26 × 14 = 364

=> Ratio (Strawberry : Lemon) = 364 : 420

=> Dividing both sides by 28:

=> 364 ÷ 28 = 13

=> 420 ÷ 28 = 15

=> Required Ratio = 13 : 15

Therefore The correct answer is 13 : 15.

Additional Information

Compound Ratio

When two or more ratios are multiplied term by term, the result is called a compound ratio. If a:b and c:d are two ratios, their compound ratio is (a×c) : (b×d).

Expenditure Relationship

Total Expenditure is directly proportional to both the price per unit and the total quantity consumed. E prop. to P and E prop. to Q.

Inverse Variation

If the total expenditure remains constant, the price is inversely proportional to the quantity (P prop. to 1/Q).

Q30. Answer: (a) Rs. 1,995

Shortcut Trick

Calculate the Total Effective Interest Rate by summing the products of individual rates and their respective time periods.

Effective Interest Rate = (6 years × 8%) + (3 years × 3%) = 48% + 9% = 57%

Total Simple Interest = 57% of Rs. 3,500

Total Simple Interest = 0.57 × 3500 = Rs. 1,995

Therefore The correct answer is Rs. 1,995.

Alternate Method

Given:

Principal (P) = Rs. 3,500

Case 1: Time (T1) = 6 years, Rate (R1) = 8% p.a.

Case 2: Time (T2) = 3 years, Rate (R2) = 3% p.a.

Formula Used:

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

Calculations:

=> SI1 (for first 6 years) = (3500 × 8 × 6) ÷ 100

=> SI1 = 35 × 48 = Rs. 1,680

=> SI2 (for last 3 years) = (3500 × 3 × 3) ÷ 100

=> SI2 = 35 × 9 = Rs. 315

=> Total SI = SI1 + SI2

=> Total SI = 1680 + 315 = Rs. 1,995

Therefore The correct answer is Rs. 1,995.

Additional Information

Total Amount Formula

The total Amount (A) to be paid at the end of the term is the sum of the Principal and the Total Simple Interest: A = P + SI.

Variable Interest Rates

When interest rates change over time, the total interest is calculated as SI = P × (R1T1 + R2T2 + ... + R_nT_n) ÷ 100.

Simple vs Compound Interest

In Simple Interest, the interest is calculated only on the initial principal, whereas in Compound Interest, interest is calculated on the principal plus any accumulated interest from previous periods.

Q31. Answer: (d) 2160

Shortcut Trick

Identify the Pythagorean Triplet in the right-angled triangle formed by the altitude.

Half of the base = 60 ÷ 2 = 30 cm; Equal side (hypotenuse) = 78 cm.

Simplify ratio: 30 : 78 → 5 : 13 (divided by 6). The triplet is (5, 12, 13).

Actual altitude = 12 × 6 = 72 cm.

Area = 1/2 × base × height = 1/2 × 60 × 72 = 2160 cm^2.

Therefore The correct answer is 2160 cm^2.

Alternate Method

Given: Equal sides (a) = 78 cm, Base (b) = 60 cm.

Formula Used: Area of isosceles triangle = 1/2 × base × height, where height (h) = $\sqrt{(a^2 - (b/2)^2)}$.

=> Semi-base = 60 ÷ 2 = 30 cm
=> Height (h) = √(78² − 30²)
=> h = √((78 − 30) × (78 + 30))
=> h = √(48 × 108) = √(16 × 3 × 36 × 3)
=> h = √(16 × 36 × 9) = 4 × 6 × 3 = 72 cm
=> Area = 1/2 × 60 × 72
=> Area = 30 × 72 = 2160 cm²
Therefore The correct answer is 2160 cm².
Additional Information
Heron's Formula
Area = √(s(s−a)(s−b)(s−c)), where s is the semi-perimeter (a + b + c) / 2. Useful for any triangle where all sides are known.
Properties of Isosceles Triangle
The altitude drawn to the base of an isosceles triangle also acts as the median and the angle bisector.
Direct Area Formula
Area = (b/4) × √(4a² − b²), where 'a' represents equal sides and 'b' represents the base.

Q32. Answer: (c) 2

Shortcut Trick
Check odd numbers between 440 and 452: 441, 443, 445, 447, 449, 451.
441 → 4+4+1=9 (divisible by 9); 445 → ends in 5; 447 → 4+4+7=15 (divisible by 3).
451 → 11 × 41. Remaining are 443 and 449.
Therefore The correct answer is 2.
Alternate Method
Given: Range of numbers is (440, 452).
Formula Used: A prime number is a natural number greater than 1 that has no positive divisors other than 1 and itself.
List of numbers between 440 and 452:
=> 441: 4+4+1 = 9, so divisible by 3 and 9. (Composite)
=> 442: Even number. (Composite)
=> 443: Not divisible by 2, 3, 5, 7, 11, 13, 17, 19. (Prime)
=> 444: Even number. (Composite)
=> 445: Divisible by 5. (Composite)
=> 446: Even number. (Composite)
=> 447: 4+4+7 = 15, so divisible by 3. (Composite)
=> 448: Even number. (Composite)
=> 449: Not divisible by any prime up to √449 ≈ 21. (Prime)
=> 450: Even number. (Composite)
=> 451: 11 × 41 = 451. (Composite)
=> Total prime numbers found = 2 (443 and 449).
Therefore The correct answer is 2.
Additional Information
Prime Number Property
To check if N is prime, test divisibility by primes up to √N.
Divisibility Rule of 11
Difference between sum of digits at odd places and even places is 0 or multiple of 11. (e.g., 451 → (4+1)−5 = 0).
Co-prime Numbers
Two numbers are co-prime if their HCF is 1, regardless of whether the numbers themselves are prime.

Q33. Answer: (a) 125%

Given:
Value 1 = 1 ÷ 20
Value 2 = 2 ÷ 50
Formula Used:

Percentage = (Value 1 ÷ Value 2) × 100
Calculation:
=> (1 ÷ 20) ÷ (2 ÷ 50)
=> = (1 ÷ 20) × (50 ÷ 2)
=> = 50 ÷ 40
=> = 5 ÷ 4
=> Percentage = (5 ÷ 4) × 100
=> = 125
Therefore The correct answer is 125%.

Q34. Answer: (d) 16.67%

Shortcut Trick
Cost Price (CP) : Selling Price (SP) ratio = 7500 : 8750
Divide by 1250 → 6 : 7
Profit = 7 − 6 = 1 unit on base of 6 units
Profit % = (1 ÷ 6) × 100 = 16.666...
Therefore The correct answer is 16.67%.
Alternate Method
Given:
Cost Price (CP) = Rs. 7,500
Selling Price (SP) = Rs. 8,750
Formula Used:
Profit = Selling Price − Cost Price
Profit % = (Profit ÷ Cost Price) × 100
Calculations:
=> Profit = 8750 − 7500
=> Profit = Rs. 1,250
=> Profit % = (1250 ÷ 7500) × 100
=> Profit % = (1 ÷ 6) × 100
=> Profit % = 16.666...% ≈ 16.67%
Therefore The correct answer is 16.67%.
Additional Information
Profit and Loss Basics
Profit occurs when SP > CP. Loss occurs when CP > SP. Both are always calculated on the Cost Price unless stated otherwise.
Marked Price and Discount
Discount is always calculated on the Marked Price (MP). SP = MP − Discount.
Relationship Formula
CP / MP = (100 − Discount %) / (100 + Profit %).

Q35. Answer: (c) 5

Shortcut Trick
Total amount = Rs. 20 using Rs. 2 and Rs. 5 coins.
Condition: At least one of each denomination must be used.
If Rs. 5 coins = 1 → Rs. 2 coins = (20 − 5)/2 = 7.5 (Not possible)
If Rs. 5 coins = 2 → Rs. 2 coins = (20 − 10)/2 = 5 coins.
If Rs. 5 coins = 3 → Rs. 2 coins = (20 − 15)/2 = 2.5 (Not possible)
Therefore The correct answer is 5 coins.
Alternate Method
Given: Total amount = Rs. 20, Denominations = Rs. 2 and Rs. 5.
Formula: 2x + 5y = 20 (where x and y are the number of coins, x, y ≥ 1).
=> 2x = 20 − 5y
=> x = (20 − 5y) / 2

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=> Since x must be an integer, (20 − 5y) must be even.

=> This implies 5y must be even, so y must be an even number.

=> Let y = 2: x = (20 − 5 × 2) / 2 = 10 / 2 = 5.

=> Let y = 4: x = (20 − 5 × 4) / 2 = 0 / 2 = 0 (Violates 'at least one' condition).

Therefore The correct answer is 5 coins.

Additional Information

Linear Diophantine Equations

Equations of the form ax + by = c where solutions must be integers. The number of positive integer solutions depends on the GCD(a, b).

Integer Constraints

In coin problems, the number of coins must always be a natural number (1, 2, 3...) if at least one is required.

Parity Rule

If the sum of two terms is even (20) and one term is even (2x), the other term (5y) must also be even.

Q36. Answer: (c) 424

Shortcut Trick

Apply the direct algebraic identity: $X^2 + Y^2 = (X - Y)^2 + 2XY$

Substitute the given values: $20^2 + 2(12)$

Calculate: 400 + 24 = 424

Therefore The correct answer is 424.

Alternate Method

Given:

Difference of two numbers (X − Y) = 20

Product of two numbers (XY) = 12

Formula Used:

We use the square of a binomial identity: $(X - Y)^2 = X^2 + Y^2 - 2XY$

Calculations:

=> $(X - Y)^2 = X^2 + Y^2 - 2XY$

=> $(20)^2 = X^2 + Y^2 - 2 \times 12$

=> $400 = X^2 + Y^2 - 24$

=> $X^2 + Y^2 = 400 + 24$

=> $X^2 + Y^2 = 424$

Therefore The correct answer is 424.

Additional Information

Sum Square Identity

The identity for the square of a sum is $(X + Y)^2 = X^2 + Y^2 + 2XY$.

Difference of Squares

The factors of the difference of two squares are given by $X^2 - Y^2 = (X - Y)(X + Y)$.

Relationship between Sum and Difference

The sum and difference of two numbers are related by $(X + Y)^2 = (X - Y)^2 + 4XY$.

Q37. Answer: (d) 66.23%

Shortcut Trick

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

Discount = 758 − 256 = 502

Discount % = (502 ÷ 758) × 100 ≈ 66.2269%

Rounding to two decimal places, we get 66.23%.

Therefore The correct answer is 66.23%.

Alternate Method

Given:

Marked Price (MP) = Rs. 758

Selling Price (SP) = Rs. 256

Formula Used:
Discount = Marked Price − Selling Price
Discount Percentage = (Discount ÷ Marked Price) × 100
Calculations:
=> Discount = 758 − 256 = Rs. 502
=> Discount % = (502 ÷ 758) × 100
=> Discount % = 50200 ÷ 758
=> Discount % = 66.22691...
=> Discount % ≈ 66.23%
Therefore The correct answer is 66.23%.
Additional Information
Successive Discounts
When two discounts d1 and d2 are given, the equivalent discount is [d1 + d2 − (d1 × d2)/100]%.
Marked Price and Cost Price Relation
The ratio of Marked Price to Cost Price is given by MP/CP = (100 + Profit%)/(100 − Discount%).
Selling Price Calculation
SP = Marked Price × (100 − Discount%)/100.

Q38. Answer: (c) 18.67

Shortcut Trick
Identify the Modal Class (highest frequency): 16 − 20 where f1 = 34.
Calculate frequency differences: d1 (f1 − f0) = 34 − 18 = 16 and d2 (f1 − f2) = 34 − 26 = 8.
Apply direct ratio: Mode = Lower Limit + [d1 / (d1 + d2)] × Class Width.
Mode = 16 + [16 / (16 + 8)] × 4 = 16 + (16 / 24) × 4 = 16 + 2.67 = 18.67.
Therefore The correct answer is 18.67.
Alternate Method
Given:
Modal Class (Class with max frequency 34) = 16 − 20
Lower limit (l) = 16 | Frequency of modal class (f1) = 34
Frequency of preceding class (f0) = 18 | Frequency of succeeding class (f2) = 26
Class interval height (h) = 4
Formula Used:
Mode = l + [(f1 − f0) / (2f1 − f0 − f2)] × h
Calculations:
=> Mode = 16 + [(34 − 18) / (2 × 34 − 18 − 26)] × 4
=> Mode = 16 + [16 / (68 − 44)] × 4
=> Mode = 16 + [16 / 24] × 4
=> Mode = 16 + [2 / 3] × 4
=> Mode = 16 + 2.666...
=> Mode ≈ 18.67
Therefore The correct answer is 18.67.
Additional Information
Empirical Relationship
For a moderately skewed distribution: Mode = 3 Median − 2 Mean.
Median for Grouped Data
Median = l + [(n/2 − cf) / f] × h, where cf is the cumulative frequency of the preceding class.
Mean for Grouped Data
Mean (χ) = $\Sigma f_i x_i / \Sigma f_i$, where x_i is the class mark (midpoint) of each interval.

Q39. Answer: (c) 3

Shortcut Trick
Net efficiency = (1/6) − (1/12) = 1/12 per minute.

Time to fill full tank = 12 minutes.
Time to fill 1/4th tank = 12 × (1/4) = 3 minutes.
Therefore The correct answer is 3 minutes.
Alternate Method
Given: Filling pipe (A) time = 6 min, Emptying pipe (B) time = 12 min.
Formula Used: Efficiency = Total Work ÷ Time; Required Time = Required Work ÷ Total Efficiency.

Person	Days	Total Work	Efficiency
Pipe A (Fill)	6	12	2
Pipe B (Empty)	12	−1	

=> Combined Efficiency of (A + B) = 2 − 1 = 1 unit/min
=> Total Work (Capacity) = 12 units
=> Target Work = 1/4 × 12 = 3 units
=> Required Time = 3 units ÷ 1 unit/min = 3 minutes
Therefore The correct answer is 3 minutes.
Additional Information
Pipes & Cisterns Sign Convention
Always take the efficiency of a filling pipe as positive (+) and the efficiency of an emptying pipe (outlet) as negative (−).
Net Time Formula
If pipe A fills in 'x' and pipe B empties in 'y', net time T = (x × y) ÷ (y − x). For a fraction 'k' of the tank, time = k × T.
Work & Wages
Wages are always distributed in the ratio of the work done or the ratio of efficiencies when time is constant.

Q40. Answer: (d) 48

Shortcut Trick
Calculate the semi-perimeter (s) of the triangle: s = (102 + 154 + 80) ÷ 2 = 168 cm.
Use Heron's Formula for Area: Area = √(168 × 66 × 14 × 88) = 3696 cm².
Altitude (h) to the base 154 cm: h = (2 × Area) ÷ Base = (2 × 3696) ÷ 154.
Simplifying the calculation: h = 3696 ÷ 77 = 48 cm.
Therefore The correct answer is 48 cm.
Alternate Method
Given: Sides of the triangle are a = 102 cm, b = 154 cm, and c = 80 cm.
Formula Used:
1. Semi-perimeter (s) = (a + b + c) ÷ 2
2. Area of triangle (A) = √[s(s − a)(s − b)(s − c)]
3. Area of triangle (A) = (1 ÷ 2) × base × altitude
=> Semi-perimeter (s) = (102 + 154 + 80) ÷ 2 = 336 ÷ 2 = 168 cm
=> Area = √[168 × (168 − 102) × (168 − 154) × (168 − 80)]
=> Area = √(168 × 66 × 14 × 88)
=> Area = √[(14 × 12) × (6 × 11) × 14 × (8 × 11)]
=> Area = √[14² × 11² × (12 × 6 × 8)]
=> Area = √(14² × 11² × 576) = 14 × 11 × 24 = 3696 cm²
=> 3696 = (1 ÷ 2) × 154 × Altitude
=> 3696 = 77 × Altitude
=> Altitude = 3696 ÷ 77 = 48 cm
Therefore The correct answer is 48 cm.
Additional Information
Heron's Formula
Used to find the area of a scalene triangle when all three sides are known: Area = √[s(s−a)(s−b)(s−c)].
Altitude Property
The altitude is the perpendicular distance from a vertex to the opposite side. The area is always (1 ÷ 2) × base × corresponding altitude.

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Right-Angled Triplets

In this triangle, the altitude divides the base 154 into segments of 90 cm and 64 cm, forming two right triangles with sides (48, 90, 102) and (48, 64, 80).

Q41. Answer: (a) 10,560

Given:

30% of 40% of 5/9 of number = 704

Formula Used:

x% = x/100

Calculation:

=> 30/100 × 40/100 × 5/9 × N = 704

=> 1200/10000 × 5/9 × N = 704

=> 6/50 × 5/9 × N = 704

=> 30/450 × N = 704

=> 1/15 × N = 704

=> N = 704 × 15 = 10560

Therefore The correct answer is 10560.

Q42. Answer: (c) 38.9%

Shortcut Trick

Apply the Successive Percentage Formula for Net Change: x + y + (x × y)/100

Here, Markup (x) = +51% and Discount (y) = −8%.

Net Profit % = 51 − 8 + (51 × (−8))/100

Net Profit % = 43 − 4.08 = 38.92%

Therefore The correct answer is 38.9%.

Alternate Method

Given: Marked Price (MP) is 51% above Cost Price (CP). Discount is 8% on MP.

Let Cost Price (CP) = 100

=> Marked Price (MP) = 100 + 51% of 100 = 151

=> Selling Price (SP) = MP − Discount

=> SP = 151 − (8% of 151)

=> SP = 151 − 12.08 = 138.92

=> Profit = SP − CP = 138.92 − 100 = 38.92

=> Profit Percentage = (38.92 / 100) × 100 = 38.92%

=> Rounded to 1 decimal place = 38.9%

Therefore The correct answer is 38.9%.

Additional Information

Marked Price and Cost Price Relation

The relationship between CP and MP can be expressed as: MP/CP = (100 + Profit%)/(100 − Discount%).

Effective Discount

Two successive discounts of a% and b% result in a single equivalent discount of (a + b − ab/100)%.

Markup Percentage

Markup % = [(MP − CP) / CP] × 100. It is always calculated on the Cost Price.

Q43. Answer: (b) (2x² y^(10) z)/3

Given:

(2x³y^5z) × (5xy^6z²) ÷ (15x²yz²)

Formula Used:

a^m × aⁿ = a^(m+n)

a^m ÷ aⁿ = a^(m-n)

Calculation:

(2x³y^5z × 5xy^6z²) ÷ (15x²yz²)

=> (10x^4y¹¹z³) ÷ (15x²yz²)

=> (10 ÷ 15) × x^(4-2) × y^(11-1) × z^(3-2)

=> (2 ÷ 3) × x² × y^(10) × z

Therefore The correct answer is (2x² y^(10) z)/3.

Q44. Answer: (b) 45 km/hr

Shortcut Trick

Since the train covers its own length in both cases, the distance is constant.

Ratio of times taken = 30 : 44 = 15 : 22

Therefore, the ratio of relative speeds = 22 : 15

Let the speed of the train be S km/hr. Since they walk in the same direction, relative speeds are (S − 5.4) and (S − 18).

=> (S − 5.4) ÷ (S − 18) = 22 ÷ 15 => 15S − 81 = 22S − 396 => 7S = 315 => S = 45 km/hr

Therefore The correct answer is 45 km/hr.

Alternate Method

Given:

Speed of first person (V1) = 5.4 km/hr = 5.4 × (5/18) = 1.5 m/s

Speed of second person (V2) = 18 km/hr = 18 × (5/18) = 5 m/s

Time taken to overtake first person (t1) = 30 seconds

Time taken to overtake second person (t2) = 44 seconds

Formula Used:

Distance = Relative Speed × Time

When moving in the same direction, Relative Speed = Speed of Train − Speed of Person

Calculations:

Let the speed of the train be S m/s and length of the train be L meters.

=> L = (S − 1.5) × 30

=> L = (S − 5) × 44

Equating the length of the train from both equations:

=> (S − 1.5) × 30 = (S − 5) × 44

=> 30S − 45 = 44S − 220

=> 14S = 175

=> S = 12.5 m/s

Converting speed of train into km/hr:

=> S = 12.5 × (18/5) = 45 km/hr

Therefore The correct answer is 45 km/hr.

Additional Information

Relative Speed

When two objects move in the same direction, their relative speed is the difference of their individual speeds (u − v). When they move in opposite directions, it is the sum of their speeds (u + v).

Unit Conversion

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

Q45. Answer: (d) 408

Shortcut Trick

Combine the ratios: First : Second = 16 : 9 and Second : Third = 15 : 21 (or 5 : 7).

Common ratio (1st : 2nd : 3rd) = (16×5) : (9×5) : (9×7) = 80 : 45 : 63.

Total units = 80 + 45 + 63 = 188 units → 4512.

Difference (1st − 3rd) = 80 − 63 = 17 units.

Value = (4512 ÷ 188) × 17 = 24 × 17 = 408.

Therefore The correct answer is 408.

Alternate Method

Given:

Sum of three numbers (A + B + C) = 4512

Ratio A : B = 16 : 9

Ratio B : C = 15 : 21 = 5 : 7

Calculations:

=> To equalize B, multiply (A : B) by 5 and (B : C) by 9.

=> A : B : C = (16×5) : (9×5) : (7×9) = 80 : 45 : 63

=> Let the numbers be 80x, 45x, and 63x.

=> 80x + 45x + 63x = 4512

=> 188x = 4512

=> x = 4512 ÷ 188 = 24

=> Difference between first and third number = 80x − 63x = 17x

=> Difference = 17 × 24 = 408

Therefore The correct answer is 408.

Additional Information

Compound Ratio

When two or more ratios are multiplied together, the result is the compound ratio. If A:B and B:C are given, the combined ratio A:B:C is found by equalizing the common term B.

Ratio Proportion Rule

If a : b = c : d, then product of extremes (a×d) = product of means (b×c).

Difference Calculation

To find the difference between two parts in a ratio total, multiply the total value by (difference in ratio units ÷ sum of all ratio units).

Q46. Answer: (c) 4

Shortcut Trick

Efficiency ratio of Man (M) to Woman (W): 2M = 9W → M/W = 9/2.

Total Work = 2 × 9 × 9 = 162 units.

Work done by 2 men in 5 days = 2 × 9 × 5 = 90 units.

Remaining Work = 162 − 90 = 72 units.

Required women (N) to complete 72 units in 9 days with efficiency 2: N × 2 × 9 = 72 => N = 4.

Therefore The correct answer is 4.

Alternate Method

Given: 2 men can complete the job in 9 days, or 9 women can complete the job in 9 days.

Formula Used: Total Work = Number of workers × Efficiency × Time

Person	Days	Total Work	Efficiency
2 Men	9 days	18 units	2 units/day
9 Women	9 days	2 units/day	

Let efficiency of 1 man = m and 1 woman = w.

=> 2m × 9 = 9w × 9

=> 2m = 9w

=> 1 man = 4.5 women

=> Since 2 men work for 5 days, their work is equivalent to 9 women working for 5 days.

=> Total work in terms of woman-days = 9 women × 9 days = 81 woman-days.

=> Work completed by 2 men in 5 days = Work completed by 9 women in 5 days = 45 woman-days.

=> Remaining work = 81 − 45 = 36 woman-days.

=> Number of women required to complete the remaining work in 9 days = 36 ÷ 9 = 4 women.

Therefore The correct answer is 4.

Additional Information

Work Equivalence Principle

When 'or' is used between different groups of workers, their total work capacities are equalized to find individual efficiency ratios (e.g., x Men = y Women).

Time and Work Basic Formula

M1 × D1 × H1 ÷ W1 = M2 × D2 × H2 ÷ W2, where M is number of workers, D is days, H is hours, and W is work.

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Q47. Answer: (d) 8

Shortcut Trick

Apply the Man-Days constant rule: M1 × D1 = M2 × D2

1200 × 12 = 1800 × D2

D2 = (1200 × 12) ÷ 1800 = 14400 ÷ 1800 = 8

Therefore The correct answer is 8 days.

Alternate Method

Given:

Initial number of men (M1) = 1,200

Initial provisions duration (D1) = 12 days

Final number of men (M2) = 1,800

Formula Used:

In problems of provisions, the total quantity remains constant. Since quantity is proportional to the number of men and number of days, we use the Inverse Proportion formula: M1D1 = M2D2.

Calculations:

=> Total provisions = 1200 × 12 = 14,400 man-units

=> New duration (D2) = Total provisions ÷ M2

=> D2 = 14400 ÷ 1800

=> D2 = 144 ÷ 18

=> D2 = 8 days

Therefore The correct answer is 8 days.

Additional Information

Chain Rule (Inverse Proportion)

When work is constant, men (M) and time (D) are inversely proportional. If men increase, days decrease: M1 × D1 = M2 × D2.

General Work Formula

For different work amounts and hours: (M1 × D1 × H1) ÷ W1 = (M2 × D2 × H2) ÷ W2.

Man-Days Concept

The product of total workers and time gives the total quantum of work or food stock available.

Q48. Answer: (a) 461 m

Shortcut Trick

Total Distance = Speed × Time

Total Distance = 23 × 72 = 1656 m

Tunnel Length = Total Distance − Train Length

Tunnel Length = 1656 − 1195 = 461 m

Therefore The correct answer is 461 m.

Alternate Method

Given:

Length of the train (L_t) = 1195 m

Speed of the train (S) = 23 m/s

Time taken to cross the tunnel (T) = 72 seconds

Formula Used:

Total Distance = Length of Train + Length of Tunnel

Distance = Speed × Time

Calculations:

=> Let the length of the tunnel be L_p.

=> Total Distance = L_t + L_p

=> 1195 + L_p = 23 × 72

=> 1195 + L_p = 1656

=> L_p = 1656 − 1195

=> L_p = 461 m

Therefore The correct answer is 461 m.

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Additional Information

Relative Speed

When two objects move in opposite directions, relative speed is S1 + S2. In the same direction, it is S1 − S2.

Unit Conversion

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

Crossing Stationary Objects

To cross a pole or person, distance = length of train. To cross a platform or bridge, distance = length of train + length of object.

Q49. Answer: (a) 27 years

Shortcut Trick

Age difference remains constant (5 years).

Ratio after 8 years → John : James = 8 : 7

Ratio difference = 8 − 7 = 1 unit → 5 years

James age after 8 years = 7 units × 5 = 35 years

Present age of James = 35 − 8 = 27 years

Therefore The correct answer is 27 years.

Alternate Method

Given: Age difference = 5 years; Future ratio (8 years later) = 8 : 7.

Formula Used: Ratio × constant = Age.

=> Let present age of James = x

=> Present age of John = x + 5

=> After 8 years, John age = x + 5 + 8 = x + 13

=> After 8 years, James age = x + 8

=> Ratio = (x + 13) / (x + 8) = 8 / 7

=> 7(x + 13) = 8(x + 8)

=> 7x + 91 = 8x + 64

=> x = 91 − 64 = 27

Therefore The correct answer is 27 years.

Additional Information

Constant Difference Property

The difference between the ages of two persons always remains the same throughout their lives, regardless of the number of years passed.

Ratio Scaling

If the difference in age is D and the ratio is a:b, then 1 unit of the ratio = D / |a-b|.

Present Age Calculation

Always subtract the years added for future ratios (or add for past ratios) from the calculated value to find the present age.

Q50. Answer: (a) 65.2

Shortcut Trick

Assume a base average score of 55 for all 43 students.

Surplus from 10 students = 10 × (99 − 55) = 440.

Distribute this surplus across the entire class: 440 ÷ 43 ≈ 10.23.

Required Average = 55 + 10.23 = 65.23 ≈ 65.2.

Therefore The correct answer is 65.2.

Alternate Method

Given:

Total students in the class = 43

Number of students with 99 average (n1) = 10

Number of other students (n2) = 43 − 10 = 33

Average of other students (a2) = 55

Formula Used:

Weighted Average = (n1 × a1 + n2 × a2) ÷ (n1 + n2)

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Calculations:

=> Total score of 10 students = 10 × 99 = 990

=> Total score of 33 students = 33 × 55 = 1815

=> Total score of the whole class = 990 + 1815 = 2805

=> Total students = 10 + 33 = 43

=> Average score of the class = 2805 ÷ 43

=> Average score ≈ 65.232

=> Rounded to one decimal place = 65.2

Therefore The correct answer is 65.2.

Additional Information

Weighted Average

It is the average of a data set in which each data point does not contribute equally to the final average. Formula: $A_w = \Sigma(w_i \times x_i) \div \Sigma w_i$.

Arithmetic Mean

The simple average of a set of numbers, calculated by dividing the sum of all elements by the total number of elements.

Deviation Method

A calculation shortcut where an assumed mean is used to find the net deviation, which is then divided by the total count and added back to the assumed mean.

Q51. Answer: (a) I

Given:

1. Since all persons face the centre, each person's right = counterclockwise direction. Fix F at top (pos 1). Two people between F and G from right of F (counterclockwise).

F ? ? ? G ? ?

2. Two people between G and M from right of G (counterclockwise).

F M ? ? G ? ?

3. Three people between F and N from right of F (counterclockwise).

F M ? N G ? ?

And O sits at the remaining place.

So, I sits third to the left of O.

Hence, the correct answer is "Option 1".

Q52. Answer: (a) (12, 36, 3)

The logic followed here is:

Logic: (1st number × 3rd number) = 2nd number.

Now,

For, (13, 39, 3)

=> (13 × 3) = 39.

For, (15, 75, 5)

=> (15 × 5) = 75.

Similarly, for Option 1: (12, 36, 3)

=> (12 × 3) = 36.

Hence, the correct answer is "Option 1".

Q53. Answer: (b) Four

Given series:

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

Condition to be checked:

Perfect Square → Digit → Perfect Square

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

Thus, there are four such digits (the 5 in 1 5 4, the 4 in 1 4 4, the 4 in 4 4 9, and the 5 in 9 5 9) that are following the above conditions.

Hence, the correct answer is "Option 2".

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Mistake Points
Immediately preceded by means immediately before or to come just before.
Immediately followed by means immediately after or to come just after.
As per the question, 1 is a perfect square. The single-digit perfect squares are 1, 4, and 9.

Q54. Answer: (d) 53

The logic followed here is:
Position of John from the bottom = 21st
Position of John from the top = 33rd
So,
Total number of students = (Position of John from the top + Position of John from the bottom) - 1
= (33 + 21) - 1
= 54 - 1 = 53.
Hence, the correct answer is "Option 4".

Q55. Answer: (d) LO-JM

The logic followed here is:
For Option 1) UX-SW:
For Option 2) RU-PT:
For Option 3) OR-MQ:
For Option 4) LO-JM:
In Options 1, 2, and 3, the vertical pattern is: the first letter shifts by -2 and the second letter shifts by -1. In Option 4, both the first and second letters shift by -2.
Thus, the letter-cluster that DOES NOT belong to that group is LO-JM.
Hence, the correct answer is "Option 4".

Q56. Answer: (c) UQV72

The logic followed here is:
Thus, the missing letter-number cluster in the series is UQV72.
Hence, the correct answer is "Option 3".

Q57. Answer: (b) 44

The given interchange rules are: '+' ↔ '−' and '×' ↔ '÷'.
The original equation: 48 + 36 ÷ 36 × 24 − 50 = ?
After applying the interchange rules, the new equation is:
48 − 36 × 36 ÷ 24 + 50 = ?
Now, we solve the equation following the BODMAS rule:
48 − 36 × 36 ÷ 24 + 50
=> 48 − 36 × 1.5 + 50
=> 48 − 54 + 50
=> 98 − 54 = 44
Hence, the correct answer is "Option 2".

Q58. Answer: (d) Neither conclusion (I) nor (II) follows.

The least possible Venn diagram for the given statement is:
Conclusion:
I. Some balls are vans - False (Because, No definite relation given between balls and vans, so it can be possible only).
II. All hens are vans - False (Because, All vans are hens is given, but the reverse is not necessarily true).
So, neither conclusion (I) nor (II) follows.
Hence, the correct answer is "Option 4".

Q59. Answer: (c) 2

Given series:
(Left) 1 # 2 3 Ω 9 % 4 7 8 & * £ 5 + @ 6 $ (Right)

Condition to be checked:
Symbol → Number → Number
Let's analyze the series for the pattern (Symbol - Number - Number):
1 # 2 3 Ω 9 % 4 7 8 & * £ 5 + @ 6 $
Thus, there are two such patterns (# 2 3 and % 4 7) where a number is preceded by a symbol and followed by a number.
Hence, the correct answer is "Option 4".

Q60. Answer: (c) 74

The logic followed here is:
Thus, the missing term in the series is 74.
Hence, the correct answer is "Option 3".

Q61. Answer: (c) so

The logic followed here is:
By comparing the two statements, we can see that the word 'play' is the only common word in both sentences.
Similarly, in the coded side, the code 'so' is the only common term in both sequences.
Clearly, 'so' is the code for the word 'play'.
Hence, the correct answer is "Option 3".

Q62. Answer: (d) T

Given:
1. One person between B and T from right of B (counterclockwise): B(1) → pos(7) → T(6).
B ? ? ? ? T ?
2. One person between T and R from left of R.
B ? ? R ? T ?
3. One person between B and U from right of U.
B ? U R ? T ?
4. Two people between C and R from left of R.
B ? U R ? T C
5. One person between A and U from right of A. And S sits at the remaining place.
B S U R A T C
Therefore, T sits third to the right of S.
Hence, the correct answer is "Option 4".

Q63. Answer: (a) RO−JJ

The logic followed here is:
For Option 1) RO−JJ:
For Option 2) YV−RO:
For Option 3) HE−AX:
For Option 4) EB−XU:
Thus, the letter-cluster that DOES NOT belong to that group is RO−JJ.
Hence, the correct answer is "Option 1".

Q64. Answer: (c) 7 km towards north

Given:
Himesh starts from Point A and drives 4 km towards the south.
He then takes a left turn, drives 7 km, turns right and drives 6 km.
He then takes a right turn and drives 7 km.
He takes a final right turn, drives 3 km and stops at Point P.
So, he should drive 7 km towards north to reach Point A again.
Hence, the correct answer is "Option 3".

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Q65. Answer: (a) 70

The given interchange rules are: '+' ↔ '−' and '×' ↔ '÷'.

The original equation: 21 ÷ 5 − 25 + 180 × 3 = ?

After applying the interchange rules, the new equation is:

21 × 5 + 25 − 180 ÷ 3 = ?

Now, we solve the equation following the BODMAS rule:

21 × 5 + 25 − 180 ÷ 3

=> 21 × 5 + 25 − 60

=> 105 + 25 − 60

=> 130 − 60 = 70

Hence, the correct answer is "Option 1".

Q66. Answer: (d) 63

The logic followed here is:

Thus, the missing term in the series is 63.

Hence, the correct answer is "Option 4".

Q67. Answer: (b) 2 km to the west

Given:

Mr. Z starts from Point A and drives 14 km towards the North.

He then takes a left turn, drives 19 km, then turns left and drives 30 km.

He then takes a left turn and drives 21 km.

He takes a final left turn, drives 16 km, and stops at Point P.

So, he should drive 2 km to the west in order to reach Point A again.

Hence, the correct answer is "Option 2".

Q68. Answer: (d) 2

Given series:

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

Condition to be checked:

Even number → Odd number → Even number

Let's scan the series for this specific pattern:

9 1 9 1 1 5 4 2 2 9 4 3 9 3 7 1 1 6 7 3 2 2 2 7 4 6 7

So, there are two such number which is immediately preceded by an even number and also immediately followed by an even number.

Hence, the correct answer is "Option 4".

Q69. Answer: (d) 7

The logic followed here is:

By process of elimination:

Common letters {V, A, L} correspond to common digits {2, 6, 5} in some order.

In the word 'LAVE', the remaining letter is E and the remaining digit is 7.

Clearly, 7 is the code for the letter E.

Hence, the correct answer is Option 4.

Q70. Answer: (a) TWY 81

The logic followed here is:

Thus, the missing letter-number cluster in the series is TWY 81.

Hence, the correct answer is "Option 1".

Q71. Answer: (b) Only II follows

The least possible Venn diagram for the given statement is:

Conclusions:

I. All arms are necks → False (Because, Some necks are arms is given, which implies some arms are necks, but not all arms are

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necessarily necks).

II. Some faces are arms - True (Because, All necks are faces and some necks are arms, so those part of arms which is necks will also be faces).

So, only conclusion II follows.

Hence, the correct answer is "Option 2".

Q72. Answer: (b) SPIN - ISPN - NIPS

The logic followed here is:

TIPS - PTIS - SPIT

T I P S P T I S S P I T

And,

LOST - SLOT - TSOL

L O S T S L O T T S O L

Similarly,

SPIN - ISPN - NIPS

S P I N I S P N N I P S

Hence, the correct answer is "Option 2".

Q73. Answer: (b) Wife's mother

Let us first decode the given symbols and then draw a family tree.

A is				
Symbol	?	=	@	√
Meaning	Daughter	Wife	Mother	Father
of B				

On checking: C @ D ? E √ F = L

1) C @ D – 'C @ D' means 'C is the mother of D'.

2) D ? E – 'D ? E' means 'D is the daughter of E'.

3) E √ F – 'E √ F' means 'E is the father of F'.

4) F = L – 'F = L' means 'F is the wife of L'.

Thus, the following family tree can be drawn:

Therefore, C (mother of F) is the Wife's Mother of L.

Hence, the correct answer is "Option 2".

Q74. Answer: (c) 3

Given:

1. There are 7 people facing North. "Only five people sit between D and F" means they must be at the extreme ends.

Possible cases:

2. "G sits to the immediate left of F". If F were at the left end, G could not sit to its left. Thus, F is at the right end and D is at the left end.

3. "Only one person sits between G and A".

4. "B sits at some place to the left of C but at some place to the right of E".

So, 3 people sit to the right of A.

Hence, the correct answer is "Option 3".

Q75. Answer: (a) 6

The logic followed here is:

Thus, the missing term in the series is 6.

Hence, the correct answer is "Option 1".

Q76. Answer: (a) ME −4

The logic followed here is.

For QN 3 : RJ -12

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For HE 7 : IA -8

Applying logic to LI 11:

Hence, the correct answer is "Option 1".

Q77. Answer: (c) Four

Given number:

4 7 3 1 5 6 2 8

Step-by-step Comparison:

Original Number	**4**	**7**	**3**	**1**	**5**	**6**	**2**	**8**
Ascending Order	1	2	3	4	5	6	7	8
	Changed	Changed	Unchanged	Changed	Unchanged	Unchanged	Changed	Unchanged

The digits that remain in the same position are 3, 5, 6, and 8.

Thus, there are four such digits whose positions remain unchanged.

Hence, the correct answer is "Option 3".

Q78. Answer: (c) ECHO - EOCH - OEHC

The logic followed here is:

CAFE - CEAF - ECFA

C A F E C E A F E C F A

And,

ABLY - AYBL - YALB

A B L Y A Y B L Y A L B

Similarly,

ECHO - EOCH - OEHC

E C H O E O C H O E H C

Hence, the correct answer is "Option 3".

Q79. Answer: (a) O

Given : Seven boxes M, N, O, P, Q, R, and S are kept one over the other in a stack of 7 positions.

1) Only three boxes are kept above S.

Position	**Box**
7 (Top)	
6	
5	
4	S
3	
2	
1 (Bottom)	

2) Only one box is kept between R and S.

This gives two possibilities: R is at 6 or R is at 2.

3) Only three boxes are kept between R and Q. Q is kept at some place above S.

4) N is kept immediately below Q.

Position	**Box**
7 (Top)	
6	Q

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5	N
4	S
3	
2	R
1 (Bottom)	

5) P is not kept immediately above or below R.

6) M is kept at one of the places above O.

Position	Box
7 (Top)	P
6	Q
5	N
4	S
3	M
2	R
1 (Bottom)	O

Box O is at the lowermost position (Position 1).

Hence, the correct answer is "Option 1".

Q80. Answer: (c) 1

Given series:

(Left) £ $ 9 3 4 9 7 £ % & # 7 3 1 8 7 5 * @ 4 £ $ (Right)

Condition to be checked:

Symbol → Number → Symbol

Let's analyze the series for the pattern (Symbol - Number - Symbol):

£ $ 9 3 4 9 7 £ % & # 7 3 1 8 7 5 * @ 4 £ $

So, there is only one such numbers are there each of which is immediately preceded by a symbol and also immediately followed by a symbol.

Hence, the correct answer is "Option 3".

Q81. Answer: (d) US$ 1.5 billion

The correct answer is US$ 1.5 billion.

Key Points

• Foxconn, the renowned Taiwanese electronics manufacturer and a key supplier for Apple's iPhones, announced a plan to invest US$ 1.5 billion in India in May 2025.

• This investment is aimed at expanding Foxconn's production facilities in India, which aligns with the Indian government's push to strengthen the domestic electronics manufacturing ecosystem.

• The move is expected to generate thousands of new job opportunities and bolster India's position in the global supply chain for consumer electronics.

• Foxconn's decision to invest in India is part of its strategy to diversify manufacturing locations outside China amid ongoing geopolitical tensions and to leverage India’s Production Linked Incentive (PLI) schemes.

• This large-scale investment reflects the growing importance of India as a manufacturing hub for global electronics companies and highlights the government's efforts to attract foreign direct investment (FDI).

Additional Information

• Foxconn Overview:

• Foxconn, officially known as Hon Hai Precision Industry Co., Ltd., is a Taiwanese multinational electronics contract manufacturer.

• It is one of the world's largest producers of electronics and semiconductors, manufacturing for major brands like Apple, Sony, Dell, and Microsoft.

• Foxconn has been operating in India for several years, with existing manufacturing facilities in states like Tamil Nadu.

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• India’s Electronics Manufacturing Push:

• The Indian government has introduced various Production Linked Incentive (PLI) schemes to promote domestic electronics manufacturing and attract foreign investors.

• India aims to become a global electronics manufacturing hub, focusing on sectors such as smartphones, semiconductors, and consumer electronics.

• Major global players like Samsung, Xiaomi, and Apple have already established manufacturing operations in India.

• Significance of Foxconn's Investment:

• Foxconn's investment of US$ 1.5 billion in India is expected to enhance the country's capabilities in high-tech manufacturing.

• The initiative aligns with the government’s “Make in India” campaign, which promotes domestic production and reduces dependency on imports.

• This investment is likely to strengthen India’s position as a preferred destination for electronics manufacturing in Asia.

• Global Geopolitical Context:

• Foxconn’s diversification strategy comes amid geopolitical tensions between the US and China, prompting companies to explore alternative manufacturing hubs.

• India, with its favorable policies and skilled labor force, is increasingly becoming a preferred choice for companies looking to reduce reliance on China.

Important Points

• Production Linked Incentive (PLI) Scheme:

• Introduced in 2020, the PLI scheme aims to boost domestic manufacturing by providing incentives to companies.

• It covers sectors like electronics, pharmaceuticals, automobiles, and textiles, encouraging global companies to establish manufacturing units in India.

• PLI schemes have attracted significant investments from global giants, including Apple suppliers like Foxconn, Wistron, and Pegatron.

• India’s Electronics Market:

• The electronics market in India is projected to reach US$ 400 billion by 2025, driven by increasing demand for smartphones, laptops, and other consumer electronics.

• India ranks among the top five smartphone markets globally and is a key destination for electronics manufacturing.

• Foxconn’s Expansion Plans:

• Foxconn is exploring other opportunities in India, including the possibility of manufacturing semiconductors and expanding its supply chain network.

• Its investment in India is expected to have a ripple effect, encouraging other global players to invest in the region.

Q82. Answer: (a) 6

The correct answer is 6.

Key Points

• The discovery of six new species of Sericinae scarab beetles was announced in April 2025.

• This discovery was made by the Zoological Survey of India (ZSI) in collaboration with Germany’s Museum A. Koenig.

• The newly discovered species were found in the biodiversity-rich regions of India, which include areas known for their high ecological diversity and unique habitats.

• These beetles belong to the subfamily Sericinae, which is part of the scarab beetle family (Scarabaeidae).

• The discovery highlights the importance of collaborative efforts in documenting biodiversity and conserving it for future generations.

Additional Information

• Sericinae Scarab Beetles:

• The subfamily Sericinae is part of the Scarabaeidae family, which contains a wide variety of beetles commonly known as scarabs.

• These beetles are known for their shiny, metallic appearance and are often found in soil, feeding on organic matter.

• Their ecological role includes helping in the decomposition of organic material and nutrient recycling.

• Zoological Survey of India (ZSI):

• The ZSI was established in 1916 to promote the survey, exploration, and research on the fauna of India.

• It is headquartered in Kolkata and functions under the Ministry of Environment, Forest, and Climate Change.

• The ZSI is instrumental in documenting India’s biodiversity and plays a key role in conservation strategies.

• Collaboration with Museum A. Koenig:

• Germany’s Museum A. Koenig is a renowned institution for zoological research and houses vast collections of animal

specimens.

• The collaboration signifies the importance of international partnerships in advancing scientific knowledge and biodiversity conservation.

• Biodiversity-rich regions of India:

• India is one of the megadiverse countries, hosting a significant portion of the world's flora and fauna.

• Regions such as the Western Ghats, Eastern Himalayas, and Northeast India are known for their rich biodiversity and endemic species.

• These areas are crucial for ecological research and conservation efforts.

Q83. Answer: (b) 16 years

The correct answer is 16 years.

Key Points

• According to the January 2025 draft rules of the Digital Personal Data Protection Rules (DPDP) Act, children under the age of 16 years require parental consent to access or join social media platforms.

• This measure aims to protect minors from harmful content and ensure their safety online.

• The Digital Personal Data Protection Act, 2023 is designed to regulate the usage of personal data and provides guidelines for data protection for individuals, especially vulnerable groups like children.

• Parental consent is mandatory for children below 16 years to ensure accountability and provide oversight for their activities on social media.

• The draft rules also emphasize the importance of age verification mechanisms to assist platforms in identifying users below the specified age.

Additional Information

• Digital Personal Data Protection Act, 2023:

• Enacted to protect the privacy and security of individuals' personal data, including special provisions for children.

• The act introduces measures to prevent misuse of data and ensures transparency in its processing.

• It applies to the processing of personal data within India and abroad if it involves offering goods or services to individuals in India.

• Age Verification Mechanisms:

• Social media platforms are required to implement mechanisms to verify the age of users to prevent children under the age of 16 years from joining without parental consent.

• These mechanisms ensure compliance with the law and reduce the exposure of minors to inappropriate content.

• Role of Parents:

• Parents play a critical role in overseeing their children's online activities and providing consent for social media usage.

• They are encouraged to educate their children about safe online practices and monitor their interactions on digital platforms.

• Global Context:

• Many countries have similar provisions regarding age restrictions for social media usage. For example, in the United States, the Children's Online Privacy Protection Act (COPPA) sets the age limit for online activities to 13 years.

• In the European Union, the General Data Protection Regulation (GDPR) establishes a default age limit of 16 years for consent in digital services.

Important Points

• Implementation Challenges: Social media platforms must develop robust age verification technologies to comply with the law while ensuring user experience remains seamless.

• Awareness Campaigns: Government and NGOs need to launch campaigns to educate parents and children about the importance of safe digital practices and adhering to age restrictions.

• Penalty for Non-Compliance: Platforms failing to adhere to the rules may face legal penalties under the DPDP Act, ensuring accountability in implementation.

Q84. Answer: (b) Gurindervir Singh, Animesh Kujur, Manikanta Hoblidar and Amlan Borgohain

The correct answer is Gurindervir Singh, Animesh Kujur, Manikanta Hoblidar, and Amlan Borgohain.

Key Points

• The National Relay Carnival 2025 witnessed a historic moment when the team of Gurindervir Singh, Animesh Kujur, Manikanta Hoblidar, and Amlan Borgohain set a new record in the 4x100m relay.

• This team demonstrated exceptional coordination, speed, and skill to achieve this milestone, showcasing their prowess in track and field events.

• Each member of the team has a strong athletic background:

• Gurindervir Singh is known for his explosive starts and is considered one of India's premier sprinters.

• Animesh Kujur has consistently performed in national-level competitions and is celebrated for his endurance and speed.
• Manikanta Hoblidar is recognized for his smooth transitions and reliability in relay events.
• Amlan Borgohain, already a record holder in individual sprints, added significant strength to the team.
• The team's performance not only broke the previous record but also set a benchmark for upcoming relay teams in India.
• This achievement highlights the importance of teamwork, precision, and rigorous training in relay events, contributing significantly to India's athletic legacy.

Additional Information

• National Relay Carnival:
• The National Relay Carnival is an annual event that aims to promote relay races and bring together the best athletes from across the country.
• It serves as a platform for talent identification and preparation for international competitions such as the Asian Games and Olympics.
• The carnival includes a variety of relay events, including the 4x100m, 4x400m, and mixed relay categories.
• Importance of Relay Events:
• Relay races require excellent coordination among team members, precise baton exchanges, and strategic planning.
• They test not just individual speed but also teamwork and collective effort.
• Relay events are a prominent part of global athletic competitions like the Olympics and IAAF World Championships.
• Indian Athletics Development:
• India has made significant strides in athletics, with increasing investments in training facilities, coaching, and international exposure.
• Initiatives like the Target Olympic Podium Scheme (TOPS) have been instrumental in nurturing athletic talent.
• Indian sprinters, including those in relay teams, have started to make their presence felt in international events.
• Notable Achievements in Indian Relay History:
• India's relay teams have consistently performed well in regional competitions like the Asian Games.
• With the emergence of athletes like Amlan Borgohain and others, the country is poised to challenge world records in relay events.

Important Points

• Team Composition: The selection of relay team members is based on individual performances, compatibility, and reliability during baton exchanges.
• Training Regimen: Relay teams undergo specialized training focusing on baton exchange techniques, race strategies, and synchronization.
• Global Standards: India's relay teams are striving to meet international standards, with time benchmarks set by leading countries like the USA and Jamaica.
• Future Prospects: With continued investment and focus, Indian relay teams have the potential to excel in global competitions and bring laurels to the nation.

Q85. Answer: (d) Rs. 2.5 lakhs

The correct answer is Rs. 2.5 lakhs.

Key Points

• In June 2025, the Reserve Bank of India (RBI) raised the Loan-to-Value (LTV) ratio on gold loans from 75% to 85% for loans up to Rs. 2.5 lakhs.
• The decision was taken to provide greater liquidity to borrowers, particularly in rural and semi-urban areas where gold loans are prevalent.
• The LTV ratio indicates the maximum percentage of the gold's market value that can be provided as a loan. An increase from 75% to 85% means borrowers can avail a higher loan amount against the same quantity of gold.
• This measure aimed to support individuals and businesses in need of short-term credit during economic challenges or financial stress.
• Gold loans are a popular credit option in India due to their quick processing, minimal documentation, and lower interest rates compared to unsecured loans.

Additional Information

• Loan-to-Value (LTV) Ratio:
• The LTV ratio is the ratio of the loan amount to the market value of the collateral (in this case, gold). It represents the risk level for lenders.
• For example, if the LTV ratio is 85% and the gold pledged is worth Rs. 1 lakh, the borrower can avail a loan of up to Rs. 85,000.
• Gold Loan Market in India:

• India is one of the largest consumers of gold globally, and gold loans are a vital financial instrument for households and small businesses.

• Gold loans are commonly used for purposes like agricultural activities, education, medical emergencies, and small business expansion.

• RBI's Role in Gold Loans:

• The Reserve Bank of India regulates the LTV ratio for gold loans to ensure financial stability and safeguard the interests of both borrowers and lenders.

• Changes in the LTV ratio are often implemented to address economic conditions, such as liquidity needs or inflationary pressures.

• Important Features of Gold Loans:

• Gold loans have short processing times, with many banks and non-banking financial companies (NBFCs) disbursing loans within a few hours.

• They generally have lower interest rates than unsecured loans due to the collateralized nature of the loan.

• The repayment tenure for gold loans is typically short-term, ranging from a few months to a couple of years.

Important Points

• Economic Context of LTV Adjustment:

• Adjustments to the LTV ratio are often undertaken during economic downturns to boost liquidity in the market and support borrowers.

• Increased LTV ratios allow borrowers to access a higher amount of credit, aiding individuals and businesses during financial challenges.

• Eligibility for Gold Loans:

• Gold loans are available to individuals aged 18 years and above, including farmers, small business owners, and salaried employees.

• Borrowers need to provide basic identification documents such as Aadhaar or PAN card for loan approval.

• Impact of Higher LTV Ratios:

• A higher LTV ratio increases the amount of credit available to borrowers but also raises the risk for lenders in case of default.

• To mitigate this risk, lenders may impose stricter repayment conditions or charge slightly higher interest rates.

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Q86. Answer: (d) Sikkim

The correct answer is Sikkim.

Key Points

• The India Justice Report (2025) is an initiative to assess the capacity and performance of Indian states in delivering justice. It evaluates states on four pillars: police, judiciary, legal aid, and prisons.

• Among the small states category (states with a population less than 1 crore), Sikkim was ranked as the top-performing state.

• The report considers key parameters such as the state's budget utilization, diversity in police force, infrastructure, vacancies, and legal aid services to rank states.

• Sikkim's performance was particularly notable due to its high levels of investment in judicial and legal infrastructure, efficient legal aid mechanisms, and strong representation of women in the police and judiciary.

• The report highlights Sikkim’s commitment to justice delivery through its effective utilization of funds, low vacancy rates, and focus on inclusivity and access.

Additional Information

• India Justice Report:

• The India Justice Report is published by the Tata Trusts in collaboration with several organizations like the Centre for Social Justice, Common Cause, and the Commonwealth Human Rights Initiative.

• It ranks states based on data collected from government sources, including the National Crime Records Bureau (NCRB), Bureau of Police Research and Development (BPR&D), and court performance data.

• The report aims to promote transparency, accountability, and improvements in the justice delivery system across India.

• Performance of Small States:

• Small states are categorized separately due to their lower population and unique challenges in governance and resource allocation.

• In the 2025 report, Sikkim outperformed other small states like Goa, Nagaland, and Manipur due to its focus on judicial infrastructure and police modernization.

• Other states like Goa and Manipur also performed well but lagged in specific areas such as legal aid and filling vacancies.

• Justice Delivery Challenges in India:

• High Pendency of Cases: India has a significant backlog of cases in courts, which affects timely justice delivery.

• Vacancies in Judiciary: Many positions in the judiciary remain unfilled, leading to delays in case hearings and judgments.

• Lack of Legal Aid Awareness: Although free legal aid is available, many citizens are unaware of their rights and entitlements.

• Infrastructure Deficiencies: Several states face challenges in terms of infrastructure, particularly in lower courts and rural areas.

• Sikkim's Key Strengths:

• Efficient Budget Utilization: Sikkim effectively utilizes its allocated budget for police, judiciary, and prison reforms.

• Gender Representation: Sikkim has a higher percentage of women in its police force and judiciary compared to other small states.

• Access to Legal Aid: The state has implemented robust mechanisms to ensure that marginalized communities have access to free legal aid.

• Low Vacancy Rates: The state has one of the lowest vacancy rates in its judiciary and police force, ensuring smoother functioning of justice delivery systems.

Important Points

• Comparison with Other States: Goa was ranked second among small states, while Nagaland and Manipur followed. The rankings highlight the variations in justice delivery performance among states with similar population sizes.

• National Average: The India Justice Report also provides insights into the national average performance in areas like police modernization, prison reforms, and judiciary vacancies, enabling states to benchmark their performance.

• Impact of the Report: By identifying gaps and areas for improvement, the India Justice Report serves as a tool for policymakers to enhance justice delivery in their respective states.

• Significance of Justice Delivery: An efficient justice system ensures rule of law, social stability, and economic growth. States like Sikkim set an example for others to follow.

Q87. Answer: (b) Mansukh Mandaviya

The correct answer is Mansukh Mandaviya.

Key Points

• Mansukh Mandaviya, the Union Minister for Health and Family Welfare and Chemicals and Fertilizers, announced the decision to host the Khelo India Northeast Games every year from June 2025.

• The decision aims to promote sports culture and talent development in the Northeastern region of India.

• The announcement emphasizes the importance of integrating sports and youth engagement in the development of the Northeast, a region known for producing talented athletes.

• The Khelo India initiative was launched under the Ministry of Youth Affairs and Sports to revitalize the sports ecosystem in India by identifying and nurturing young talent.

• This annual event is expected to enhance sports infrastructure, encourage participation in sports, and provide a platform for athletes from eight Northeastern states to showcase their abilities.

Additional Information

• Khelo India Program:

• The Khelo India program was launched in 2018 by the Government of India to revive sports culture and identify sporting talent across the nation.

• It provides financial assistance to young athletes and facilitates the development of sports infrastructure.

• The program has introduced initiatives like Khelo India Youth Games and Khelo India University Games.

• Role of Northeast in Indian Sports:

• The Northeastern region is known for producing exceptional athletes in disciplines like football, boxing, weightlifting, and archery.

• Prominent athletes such as Mary Kom (boxing), Mirabai Chanu (weightlifting), and Bhaichung Bhutia (football) hail from this region.

• Mansukh Mandaviya:

• Mansukh Mandaviya is a senior member of the Bharatiya Janata Party (BJP) and currently serves as the Union Minister for Health and Family Welfare and Chemicals and Fertilizers.

• He has also been actively involved in promoting initiatives related to youth development and health awareness.

• Sports Infrastructure in Northeast India:

• The government has been investing in building sports academies, stadiums, and training facilities in the Northeast.

• Efforts are underway to ensure that athletes from rural and remote areas have access to world-class training facilities.

Important Points

• Khelo India Northeast Games:

• This event will focus on fostering regional sports talent and giving recognition to athletes from the Northeast.

• The initiative aligns with the government's mission to make India a global sports powerhouse.

• Government's Efforts for Sports Development:

• The government has launched several schemes, including Target Olympic Podium Scheme (TOPS) and Fit India Movement, to encourage sports participation and fitness.

• Special attention has been given to tribal and rural areas to ensure inclusivity in sports development initiatives.

Q88. Answer: (b) National Payments Corporation of India (NPCI)

The correct answer is National Payments Corporation of India (NPCI).

Key Points

• National Payments Corporation of India (NPCI) is the organization responsible for implementing the Unified Payments Interface (UPI) system in India and initiating its pilot for international transactions in 2025.

• The NPCI launched the pilot program to extend UPI's reach beyond India's borders, enabling seamless cross-border payments and fostering global financial inclusion.

• The objective of this initiative was to integrate UPI with international payment networks, allowing users to perform transactions abroad using UPI.

• Through this pilot, the NPCI aimed to enhance the acceptability and interoperability of UPI with global payment systems, paving the way for its widespread adoption internationally.

• The NPCI's efforts align with India's ambition to position its digital payment infrastructure as a global standard for financial innovation and inclusion.

Additional Information

• National Payments Corporation of India (NPCI):

• The NPCI was established in 2008 as an initiative by the Reserve Bank of India (RBI) and the Indian Banks' Association (IBA) to create a robust payment and settlement infrastructure in the country.

• It is a not-for-profit organization and serves as the umbrella entity for operating retail payments and settlement systems in India.

• NPCI is the driving force behind several innovative payment systems, including UPI, RuPay, Bharat Bill Payment System (BBPS), and Aadhaar Enabled Payment System (AePS).

• Unified Payments Interface (UPI):

• UPI is a real-time payment system that facilitates the transfer of money between bank accounts using a mobile platform.

• It was launched in 2016 by NPCI and has since become one of the most widely used digital payment platforms in India.

• The UPI system supports features such as P2P (peer-to-peer) transfers, bill payments, and merchant transactions.

• In recent years, UPI has achieved remarkable success, processing billions of transactions monthly and contributing significantly to India's digital economy.

• UPI for International Transactions:

• In 2025, the NPCI implemented a pilot project to extend UPI's functionality for international transactions.

• The aim was to enable Indian users to make payments in foreign countries and allow international users to access India's UPI framework.

• The system integrates with foreign payment networks and complies with global standards for cross-border financial transactions.

• Other Relevant Organizations:

• Reserve Bank of India (RBI): The RBI regulates and oversees financial systems in India but delegates operational tasks like UPI implementation to NPCI.

• Securities and Exchange Board of India (SEBI): SEBI is responsible for regulating securities markets and does not manage payment systems.

• Central Board of Direct Taxes (CBDT): The CBDT oversees direct taxation policies and administration in India and has no role in payment infrastructure development.

Important Points

• Collaboration for Cross-Border Payments:

• NPCI International Payments Limited (NIPL), a subsidiary of NPCI, spearheaded collaborations with international entities to expand UPI's reach globally.

• Countries like Singapore, UAE, and Bhutan have already adopted UPI-based systems or are in the process of integrating them.

• India's Digital Payment Ecosystem:

• India is one of the global leaders in digital payments, with systems like UPI, RuPay, and AePS contributing to its success.

• Efforts to globalize UPI highlight India's commitment to sharing its technological innovations on an international scale.

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Q89. Answer: (b) 2025

The correct answer is 2025.

Key Points

• The Ministry of Defence, Government of India, declared the year 2025 as the "Year of Reforms" to bring transformative changes in the defense sector.

• This declaration aims to align the defense sector with modern needs, focusing on self-reliance (Atmanirbhar Bharat) and enhancing operational efficiency.

• One of the primary goals is to implement reforms that boost indigenous production of defense equipment under the Make in India initiative.

• The Ministry is also working towards improving the ease of doing business in the defense sector by simplifying procurement processes and enhancing transparency.

• Several reforms under the "Year of Reforms" initiative include upgrading defense manufacturing capabilities, increasing private sector participation, and modernizing the armed forces.

Additional Information

• Atmanirbhar Bharat in Defense:

• The Atmanirbhar Bharat Abhiyan (Self-Reliant India campaign) was launched by the Government of India in 2020 to promote self-reliance in various sectors, including defense.

• It focuses on reducing reliance on imports and enhancing indigenous defense manufacturing capabilities.

• Key initiatives include the Defence Acquisition Procedure (DAP) 2020, which prioritizes indigenous procurement.

• Make in India in Defense:

• The Make in India initiative, launched in 2014, aims to develop India as a global manufacturing hub, including in the defense sector.

• The government has introduced several policy measures to encourage domestic production, such as the Strategic Partnership Model.

• Examples include the production of Tejas Light Combat Aircraft (LCA) and other indigenous defense equipment.

• Modernization of Armed Forces:

• The Ministry of Defence has been focusing on modernizing the armed forces to enhance operational readiness and combat capability.

• Modernization plans include procurement of advanced fighter jets, submarines, and artillery systems.

• Efforts are being made to ensure the armed forces are equipped with state-of-the-art technology and equipment.

• Defence Procurement Policy:

• The Defence Procurement Policy (DPP), now known as the Defence Acquisition Procedure (DAP), is a key framework for procurement in the defense sector.

• DAP 2020 emphasizes indigenization, encourages private sector participation, and aims to reduce procurement timelines.

• It also includes measures to boost research and development in defense technology.

Important Points

• Defense Exports:

• The Government of India has set an ambitious target to achieve defense exports worth $5 billion by 2025 as part of its self-reliance goals.

• India is promoting indigenous defense products such as the BrahMos missile system and Akash surface-to-air missiles in the global market.

• Defense Corridors:

• The government has established two dedicated defense corridors in Uttar Pradesh and Tamil Nadu to boost indigenous production and attract investment.

• These corridors aim to create a robust defense manufacturing ecosystem and generate employment opportunities.

• Innovation for Defence Excellence (iDEX):

• The iDEX initiative was launched to foster innovation and technology development in the defense sector.

• It encourages startups and MSMEs to develop solutions for defense and aerospace challenges.

• iDEX has significantly contributed to the development of cutting-edge technologies for the Indian armed forces.

Q90. Answer: (d) Global Network Against Food Crises

The correct answer is Global Network Against Food Crises.

Key Points

• The Global Network Against Food Crises is an international alliance founded in 2016 by the European Union (EU), Food and

Agriculture Organization (FAO), and World Food Programme (WFP).

• It aims to tackle food crises through coordinated humanitarian and development action, addressing the root causes of hunger and promoting food security worldwide.

• The Global Report on Food Crises is its flagship annual publication, which provides critical insights into the state of global food insecurity and its drivers, such as conflict, climate extremes, and economic shocks.

• The report for May 2025 highlights a significant rise in hunger globally, attributing the alarming trend primarily to factors like armed conflicts and worsening climate-related disasters.

• The organization collaborates with multiple stakeholders, including governments, international agencies, and NGOs, to implement solutions and strategies that address both immediate needs and long-term stability.

Additional Information

• Food and Agriculture Organization (FAO):

• The FAO is a specialized agency of the United Nations that leads international efforts to defeat hunger.

• Established in 1945, it focuses on improving agricultural productivity, ensuring food security, and promoting sustainable development in rural areas.

• Its work includes conducting research, publishing reports, and providing policy recommendations to governments and stakeholders.

• World Bank:

• The World Bank is an international financial institution established in 1944 to provide loans and grants to countries for development projects.

• Although it addresses poverty and economic development, its focus is broader than food crises, encompassing areas like education, infrastructure, and healthcare.

• It contributes to food security indirectly by funding projects aimed at agricultural innovation and rural development.

• UN Environment Programme (UNEP):

• The UNEP was founded in 1972 and focuses on the global environment, addressing issues such as climate change, biodiversity loss, and pollution.

• While it does not directly produce food-related reports, it highlights the environmental factors that impact agriculture and food security.

• UNEP emphasizes climate mitigation and adaptation to ensure sustainable ecosystems for food production.

• Global Network Against Food Crises:

• The network operates as a collaborative platform, bringing together humanitarian and development agencies to address food crises.

• It emphasizes data-driven decision-making, publishing the Global Report on Food Crises annually to guide policy interventions.

• Through partnerships, the network aims to reduce the number of people experiencing acute food insecurity and prevent future crises.

Important Points

• Drivers of Food Crises:

• Conflict: Armed conflicts disrupt agricultural production, trade, and livelihoods, leading to food shortages and inflation.

• Climate Extremes: Events like droughts, floods, and hurricanes severely impact food production and availability.

• Economic Shocks: Inflation, unemployment, and reduced income levels exacerbate food insecurity, particularly in vulnerable populations.

• Global Hunger Statistics:

• As of 2025, over 250 million people globally are experiencing acute food insecurity due to the mentioned drivers.

• The regions most affected include Sub-Saharan Africa, South Asia, and parts of the Middle East.

• Women and children are disproportionately impacted, with long-term effects on health and development.

• Collaborative Efforts:

• Organizations like FAO, WFP, and UNEP work together to provide short-term relief and promote sustainable solutions.

• Innovative approaches include climate-resilient agriculture, disaster risk reduction, and improved food distribution systems.

Q91. Answer: (d) Himachal Pradesh

The correct answer is Himachal Pradesh.

Key Points

• The Constitution (Scheduled Tribes) Order (Third Amendment) Bill, 2022, seeks to amend the Constitution (Scheduled Tribes) Order, 1950, specifically for Himachal Pradesh.

• This amendment aims to include new communities under the category of Scheduled Tribes in Himachal Pradesh.

• The Constitution (Scheduled Tribes) Order, 1950, originally identified communities that qualify as Scheduled Tribes in different states and union territories of India.

• The inclusion or exclusion of communities under Scheduled Tribes is critical for ensuring access to reserved benefits such as educational quotas, job opportunities, and welfare schemes.

• The amendment reflects the government's attempt to address the socio-economic and cultural needs of tribal communities in Himachal Pradesh by legally recognizing them.

Additional Information

• Scheduled Tribes in India:

• Scheduled Tribes are officially designated groups of people in India recognized as socially and economically disadvantaged.

• They are listed under Article 342 of the Indian Constitution, which gives the President the authority to specify Scheduled Tribes in consultation with the Governor of a state.

• India is home to over 705 Scheduled Tribes, as per the 2011 Census.

• Benefits provided to Scheduled Tribes include reservation in education, employment, and legislative bodies, as well as specific welfare schemes.

• Himachal Pradesh and Tribal Communities:

• Himachal Pradesh is known for its diverse tribal population, including groups such as Gaddis, Kinnauras, Gujjars, Pangwal, and Lahaulas.

• Tribal communities in Himachal Pradesh primarily reside in remote areas, including Lahaul-Spiti, Kinnaur, and Pangi.

• These communities depend on agriculture, animal husbandry, and handicrafts for their livelihood.

• Efforts to include new communities aim to address the socio-economic challenges faced by these groups.

• Constitutional Provisions for Scheduled Tribes:

• Article 342 allows the President to declare tribes or tribal communities as Scheduled Tribes.

• Article 15 and Article 16 provide reservation in education and employment for Scheduled Tribes.

• Article 330 and Article 332 ensure representation in the Lok Sabha and State Assemblies.

• Article 46 directs the State to promote the educational and economic interests of Scheduled Tribes.

• Amendment Process for Scheduled Tribes List:

• The inclusion or exclusion of communities in the Scheduled Tribes list requires legislative approval through a constitutional amendment.

• The process involves consultation with the concerned state government and validation by the Parliament.

• Such amendments are critical for ensuring that identified tribes benefit from government schemes and legal protections.

Important Points

• Historical Context:

• The Constitution (Scheduled Tribes) Order, 1950, was enacted to identify tribal communities across India.

• Several amendments have been introduced over the years to update the list of Scheduled Tribes based on evolving socio-political and cultural needs.

• These changes reflect the Indian government's commitment to recognizing and addressing the challenges faced by indigenous communities.

• Tribal Welfare Programs:

• Programs such as the Vanbandhu Kalyan Yojana and Tribal Sub-Plan aim to improve the living standards of tribal communities.

• Special focus is given to education, healthcare, and employment under these schemes.

• Institutions like the National Commission for Scheduled Tribes (NCST) oversee the implementation of these welfare initiatives.

Q92. Answer: (a) Early Childhood Care and Education

The correct answer is Early Childhood Care and Education.

Key Points

• Early Childhood Care and Education (ECCE) focuses on the holistic development of children during their formative years (0-6 years), including cognitive, emotional, social, and physical aspects.

• The September 2025 guidelines on Anganwadi–School co-location aim to integrate Anganwadi centers with schools to ensure a seamless transition and continuity in education for children.

• By co-locating Anganwadi centers and schools, the guidelines emphasize creating a strong foundation for school readiness, ensuring children are adequately prepared for formal schooling.

• The guidelines also focus on enhancing access to quality early childhood education for marginalized communities, addressing disparities in educational opportunities.

• This initiative aligns with the National Education Policy (NEP) 2020, which highlights ECCE as a critical factor in achieving

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universal foundational literacy and numeracy.

Additional Information

• Importance of Early Childhood Care and Education (ECCE):

• ECCE lays the foundation for lifelong learning, fostering critical thinking, creativity, and socio-emotional skills.

• Research highlights that the brain develops most rapidly during the first six years of life, making these years crucial for cognitive and emotional growth.

• Quality ECCE programs have been shown to improve academic performance and reduce dropout rates in later years.

• ECCE also plays a role in breaking the cycle of poverty, providing equitable opportunities to children from economically disadvantaged backgrounds.

• Anganwadi Centers:

• Established under the Integrated Child Development Services (ICDS) scheme, Anganwadi centers provide a range of services, including health, nutrition, and education, for children up to 6 years old.

• These centers focus on improving maternal and child health, ensuring adequate nutrition, and preparing children for school.

• There are approximately 1.37 million Anganwadi centers across India as of 2023.

• National Education Policy (NEP) 2020:

• The NEP 2020 emphasizes universal access to ECCE by 2030 through the establishment of Anganwadi centers and pre-primary schools.

• It recommends the integration of play-based and activity-based learning approaches to enhance foundational literacy and numeracy.

• The policy also highlights teacher training and capacity building to improve the quality of ECCE programs.

• Additional Government Initiatives for ECCE:

• Poshan Abhiyaan: Focuses on improving nutritional outcomes for children, pregnant women, and lactating mothers.

• Samagra Shiksha Abhiyan: Supports school readiness and ECCE through infrastructure development and capacity building.

• Saksham Anganwadi Scheme: Aims to upgrade Anganwadi centers into modern resource hubs for ECCE and maternal health services.

Important Points

• Role of Teachers and Caregivers:

• Teachers and Anganwadi workers are trained to deliver age-appropriate educational content and foster a nurturing environment.

• Continuous professional development programs ensure the adoption of best practices in ECCE.

• Global Perspective on ECCE:

• Countries like Finland and Sweden have successfully implemented robust ECCE systems, emphasizing play-based learning and holistic development.

• UNICEF advocates for universal access to ECCE as a strategy to achieve Sustainable Development Goal 4 (Quality Education).

• Challenges in ECCE Implementation:

• Lack of infrastructure and resources in remote areas limits access to quality ECCE programs.

• Ensuring equitable access for marginalized communities remains a key challenge.

Q93. Answer: (c) Rio de Janeiro, Brazil

The correct answer is Rio de Janeiro, Brazil.

Key Points

• The C40 World Mayors Summit is a global event where mayors from various cities come together to discuss climate change, urban sustainability, and environmental policies.

• The 2025 C40 World Mayors Summit is scheduled to be held in Rio de Janeiro, Brazil from 3-5 November 2025.

• Rio de Janeiro, a prominent city in Brazil, is renowned for its efforts in addressing urban challenges, including its initiatives related to climate resilience and sustainable urban development.

• The summit provides a platform for global leaders, climate experts, and city officials to collaborate and share innovative strategies to combat climate change.

• The selection of Rio de Janeiro reflects the city's commitment to tackling climate challenges in a region that faces diverse environmental issues, including deforestation and urban sprawl.

Additional Information

• About the C40 Cities Climate Leadership Group:

• C40 is a network of nearly 100 cities worldwide committed to addressing climate change and promoting sustainable urban living.

• It was established in 2005 and focuses on reducing greenhouse gas emissions and improving city-wide sustainability.

• C40 cities represent over 700 million citizens and one-quarter of the global economy.

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• Rio de Janeiro's Climate Initiatives:

• Rio de Janeiro has implemented policies like urban reforestation and the development of green infrastructure to mitigate the impacts of climate change.

• The city has been recognized for its efforts in creating resilient infrastructure to tackle challenges like flooding and rising sea levels.

• Rio is also a member of the C40 network, actively participating in global climate discussions and initiatives.

• Purpose of the C40 World Mayors Summit:

• The summit aims to accelerate efforts to meet the goals of the Paris Agreement and to limit global warming to 1.5°C.

• It provides a platform to announce bold climate action plans and share successful case studies from participating cities.

• Participants include mayors, policymakers, environmentalists, business leaders, and activists from across the globe.

• Other Cities in the Question:

• New York, USA: Known for its leadership in urban innovation, but it is not hosting the 2025 summit.

• London, UK: A significant player in climate action, having hosted previous climate-related events, but not chosen for the 2025 summit.

• Seoul, South Korea: Actively involved in sustainability efforts, including smart city initiatives, but not hosting the 2025 summit.

Important Points

• The C40 World Mayors Summit is held every three years, with the previous summit taking place in Buenos Aires, Argentina, in 2022.

• The summit underscores the importance of collaborative climate action at the city level, as urban areas are responsible for a significant share of global emissions.

• Rio de Janeiro's selection aligns with Brazil's efforts to balance development with environmental conservation, particularly in the Amazon region.

Q94. Answer: (d) 71%

The correct answer is 0.71.

Key Points

• The survey was conducted by the Yale Program on Climate Change Communication in collaboration with CVoter between 5 December 2024 and 18 February 2025.

• According to the survey, 71% of Indians reported experiencing severe heatwaves in the past 12 months.

• The survey aimed to assess the public perception and personal experiences related to climate change and extreme weather conditions in India.

• The findings highlight the increasing frequency and severity of heatwaves in India, which is a direct impact of global climate change.

• This data emphasizes the urgent need for climate adaptation and mitigation strategies to address these extreme weather events.

Additional Information

• Heatwaves:

• A heatwave is a period of excessively hot weather, often accompanied by high humidity, which poses serious risks to health and the environment.

• In India, heatwaves are defined as a situation when the maximum temperature exceeds 40°C in plains, 37°C in coastal areas, and 30°C in hilly regions.

• The frequency and intensity of heatwaves have increased in recent years due to global warming and urban heat island effects.

• Impact of Heatwaves:

• Heatwaves can lead to heat-related illnesses such as heatstroke, dehydration, and cardiovascular stress.

• They have significant impacts on agriculture, leading to crop failure and increased water demand.

• Prolonged heatwaves also strain energy systems due to higher demand for cooling and affect livelihoods, especially for outdoor workers.

• India's Vulnerability:

• India's geographical location and tropical climate make it highly susceptible to extreme weather events, including heatwaves.

• States like Rajasthan, Uttar Pradesh, Maharashtra, and Telangana frequently experience severe heat conditions.

• Urban areas, due to concrete structures and lack of vegetation, are more prone to higher temperatures.

• Mitigation Measures:

• The Indian government has implemented a Heat Action Plan (HAP) in several states to reduce the impact of heatwaves.

• Awareness campaigns, setting up cooling centers, and ensuring adequate water supply are part of HAP initiatives.

• Plantation drives, improving green cover, and using reflective building materials are long-term strategies to mitigate urban heat

island effects.

Important Points

• Survey Methodology: The survey conducted by Yale and CVoter utilized random sampling techniques to gather data from a representative sample of the Indian population.

• Climate Awareness: The survey also aimed to assess public awareness about climate policies and their support for measures like renewable energy adoption and carbon reduction initiatives.

• Global Context: Heatwaves are not unique to India; they are a global phenomenon, with regions like Europe, Australia, and North America also experiencing record-breaking temperatures in recent years.

• Policy Implications: The data from such surveys are crucial for informing climate policies and planning disaster-resilient infrastructure.

Q95. Answer: (a) BioE3 Biotechnology policy

The correct answer is BioE3 Biotechnology policy.

Key Points

• India's First Biological Experiments Aboard ISS: In May 2025, India announced its plan to conduct biological experiments aboard the International Space Station (ISS). This marks a significant milestone in India's space exploration journey.

• Objective: The experiments aim to study the sustainability of human life in space, focusing on biological processes, adaptability, and the potential for long-term space habitation.

• Policy Initiative: The initiative is part of the BioE3 Biotechnology policy, which emphasizes leveraging biotechnology for advancements in space exploration, health sciences, and sustainability.

• Collaborations: The project aligns with global partnerships and cooperation in space research, contributing to India's efforts in enhancing its technological capabilities in space and biotechnology.

• Strategic Importance: This experiment not only reinforces India's presence in the global space community but also highlights its commitment to scientific innovation and addressing challenges related to space sustainability.

Additional Information

• BioE3 Biotechnology Policy:

• Launched as part of India's vision for leveraging biotechnology in critical sectors, including space research.

• Focuses on fostering innovation, promoting interdisciplinary research, and encouraging collaboration between government agencies, research institutions, and private enterprises.

• Supports initiatives aimed at addressing global challenges, such as sustainable development and space exploration.

• International Space Station (ISS):

• The ISS is a collaborative space station involving NASA, Roscosmos, ESA, JAXA, and CSA.

• It serves as a hub for conducting scientific research in microgravity environments, including biological, physical, and astronomical studies.

• India's involvement in ISS-related experiments showcases its growing expertise and ambition in space exploration.

• Sustainability of Human Life in Space:

• Studying biological adaptability in space is crucial for understanding the effects of microgravity, radiation, and isolation on human health.

• These studies contribute to the development of technologies and strategies for long-term space missions and potential colonization efforts.

• India's Space Achievements:

• India has made remarkable progress in space technology, with missions like Chandrayaan, Mangalyaan, and the Gaganyaan program.

• This biological experiment reinforces India's position as a key player in the global space community.

Important Points

• Biotechnology in Space Research:

• Biotechnology plays a vital role in addressing challenges related to health, sustainability, and adaptability during space missions.

• Experiments aboard the ISS help develop solutions for space food production, regenerative medicine, and human survival in extreme environments.

• Global Impact:

• India's involvement in ISS experiments underscores its commitment to contributing to international scientific collaboration.

• Findings from these studies have implications not only for space exploration but also for earth-based applications in biotechnology and medicine.

Q96. Answer: (a) New Delhi

The correct answer is New Delhi.

Key Points

• The National Conference on ‘Environment – 2025’ was inaugurated by President Droupadi Murmu in New Delhi, the capital city of India.

• This conference aimed to address pressing environmental issues and devise strategies to achieve sustainable development by the year 2025.

• It brought together policy makers, environmentalists, scientists, and industry leaders to discuss the challenges posed by climate change, pollution, deforestation, and biodiversity loss.

• The conference focused on innovative solutions, the role of technology, and the importance of community participation in addressing environmental concerns.

• New Delhi, as the host city, is a hub for national and international events, symbolizing its status as the political and administrative center of India.

Additional Information

• Key Objectives of the Conference:

• To create awareness about environmental sustainability and its importance in achieving national growth goals.

• To identify and promote innovative practices for mitigating environmental degradation.

• To encourage collaborations between government, private sector, and civil society for environmental conservation.

• To deliberate on policy frameworks for achieving the United Nations Sustainable Development Goals (SDGs) related to the environment.

• Environmental Challenges in Focus:

• Air Pollution: India is home to some of the most polluted cities globally, requiring urgent action on emissions and clean air technologies.

• Water Scarcity: Addressing water management issues and promoting sustainable usage of water resources.

• Deforestation: Strategies to combat deforestation and promote afforestation projects.

• Biodiversity Conservation: Protecting endangered species and preserving natural ecosystems.

• Government Initiatives for the Environment:

• National Action Plan on Climate Change (NAPCC): Launched in 2008, it includes eight missions like the National Solar Mission and National Water Mission.

• Swachh Bharat Abhiyan: A nationwide cleanliness drive aimed at reducing pollution and promoting waste management.

• National Green Tribunal (NGT): Established in 2010 to handle environmental disputes and enforce legal action against polluters.

• Compensatory Afforestation Fund Act, 2016: Ensures funds for afforestation and ecological restoration projects.

• Role of New Delhi in Environmental Policy:

• As the capital city, New Delhi hosts the headquarters of the Ministry of Environment, Forest and Climate Change.

• It serves as the venue for major conferences and policy discussions on environmental governance.

• The city has implemented initiatives like the Odd-Even Rule to reduce vehicular pollution and promote public transport.

Important Points

• President Droupadi Murmu: She is the 15th President of India and the first tribal woman to hold the office. Her focus on environmental issues reflects her commitment to sustainable development.

• New Delhi’s Environmental Initiatives: The city is adopting measures to combat rising pollution levels, such as promoting electric vehicles and enhancing green cover.

• Global Commitments: India is a signatory to the Paris Agreement and has pledged to achieve Net Zero Carbon Emissions by 2070.

• Public Participation: The success of environmental conservation efforts depends on the active involvement of citizens, NGOs, and local communities.

Q97. Answer: (b) Nodirbek Abdusattorov

The correct answer is Nodirbek Abdusattorov.

Key Points

• Nodirbek Abdusattorov, a chess prodigy from Uzbekistan, is known for his exceptional performances in international chess tournaments.

• Praggnanandhaa, an Indian Grandmaster, defeated Nodirbek Abdusattorov in a crucial match to secure his position as the No.1 ranked Indian chess player.

• The victory was significant as it showcased Praggnanandhaa's ability to compete and win against some of the world's top chess

talents.

• The match against Nodirbek Abdusattorov demonstrated Praggnanandhaa's strategic brilliance, sharp tactical play, and deep understanding of the game.

• This achievement is a milestone in Indian chess history, highlighting the rising prominence of young Indian players in the global chess arena.

Additional Information

• Nodirbek Abdusattorov:

• He is a Grandmaster from Uzbekistan and was born in 2004.

• In 2021, he won the World Rapid Chess Championship, becoming the youngest player ever to win the prestigious title.

• Known for his aggressive and tactical playing style, Abdusattorov represents a new generation of chess players on the global stage.

• He has been instrumental in putting Uzbekistan on the map in international chess competitions.

• Praggnanandhaa:

• Rameshbabu Praggnanandhaa is an Indian chess player born in 2005 who earned the title of Grandmaster at the age of 12 years and 10 months.

• He is one of the youngest players to achieve the Grandmaster title in chess history.

• Praggnanandhaa has defeated several top-ranked players, including Magnus Carlsen, the reigning World Chess Champion.

• His rise in the chess rankings signifies India's growing influence in the world of chess.

• Indian Chess Achievements:

• India has produced some legendary chess players, including Viswanathan Anand, who is a five-time World Chess Champion.

• Young Indian talents like Praggnanandhaa, D. Gukesh, and Nihal Sarin are continuing the legacy and gaining recognition worldwide.

• The growth of chess academies and online platforms has contributed to the development of chess in India.

• India now has multiple players competing at the highest levels of international chess.

• Important Characteristics of Chess Players in Question:

• Fabiano Caruana: An American chess Grandmaster, known for his classical style of play and one of the top-ranked players globally.

• Hikaru Nakamura: A Japanese-American Grandmaster, famous for his rapid and blitz chess skills, as well as his online streaming of chess games.

• D. Gukesh: Another young Indian Grandmaster, born in 2006, who is rapidly rising in the global chess rankings.

• These players represent a diverse set of skills and playing styles, contributing to the competitive chess environment on an international level.

Important Points

• Chess Ratings: Rankings in chess are determined by the FIDE Elo rating system, which measures the skill level of players based on their performance in rated tournaments.

• Global Chess Competitions: Events like the World Chess Championship, Rapid & Blitz Championships, and Chess Olympiad provide platforms for players to showcase their talent and improve their rankings.

• India's Chess Growth: The country's chess infrastructure, including training centers, sponsorships, and government support, has been instrumental in nurturing young players.

• Future Prospects: With players like Praggnanandhaa and D. Gukesh leading the way, India's chess future looks promising, and the nation is expected to produce more world-class players.

Q98. Answer: (c) Santosh

The correct answer is Santosh.

Key Points

• Santosh is a critically acclaimed Indian film that explores themes of caste discrimination and police brutality.

• The film was selected as India’s official entry for the Academy Awards (Oscars), showcasing its international recognition.

• Despite its global acclaim, the film faced a domestic ban by the Central Board of Film Certification (CBFC) due to its sensitive portrayal of social issues.

• The film highlights the plight of marginalized communities and sheds light on systemic oppression, making it a powerful work of social commentary.

• The controversy surrounding the film’s ban drew widespread attention to the challenges faced by filmmakers in addressing politically and socially sensitive topics in India.

Additional Information

• Caste Discrimination in India:

• Caste-based discrimination is a historical and systemic issue in India, rooted in the caste system, which categorizes individuals based on their birth.

• Despite constitutional safeguards like Article 15 (prohibition of discrimination) and Article 17 (abolition of untouchability), caste-based inequalities persist in various forms.

• Films like Santosh bring attention to the lived experiences of marginalized communities, fostering awareness and dialogue.

• Police Brutality:

• Police brutality refers to the misuse of power by law enforcement officials, often targeting vulnerable groups.

• Instances of police violence in India have led to calls for reform, accountability, and adherence to human rights principles.

• Films addressing this issue aim to highlight the need for systemic changes in the criminal justice system.

• Role of the Central Board of Film Certification (CBFC):

• The CBFC is responsible for certifying films for public exhibition in India. It operates under the guidelines laid out in the Cinematograph Act, 1952.

• While its mandate is to ensure that films adhere to ethical and moral standards, its decisions often spark debates about freedom of expression.

• The ban on Santosh reflects the challenges faced by filmmakers in navigating censorship and creative freedom.

• India's Oscar Entries:

• India has submitted several films for the Academy Awards in the Best International Feature Film category since 1957.

• Films like Mother India, Lagaan, and Slumdog Millionaire have gained international acclaim, showcasing Indian cinema on a global stage.

• The selection process is overseen by the Film Federation of India, which aims to promote films that reflect the country's cultural and social realities.

Important Points

• Freedom of Expression vs. Censorship:

• While the Indian Constitution guarantees freedom of speech and expression under Article 19(1)(a), filmmakers often face challenges due to censorship.

• Films addressing sensitive topics like caste, religion, and politics are frequently subjected to scrutiny by the CBFC.

• The ban on Santosh raises questions about the balance between artistic freedom and regulatory oversight.

• Global Recognition of Indian Cinema:

• Indian films have gained international acclaim for their storytelling, cultural richness, and social relevance.

• Participation in global platforms like the Oscars provides an opportunity to showcase India's diverse cinematic talent.

• Films like Santosh underline the importance of addressing social issues through art and cinema.

Q99. Answer: (a) Germany

The correct answer is Germany.

Key Points

• The 2025 ISSF World Cup for Rifle/Pistol shooting will be hosted by Germany. The country is known for its consistent contribution to shooting sports and its world-class infrastructure for hosting international tournaments.

• The International Shooting Sport Federation (ISSF) organizes the World Cup events annually to promote competitive shooting sports globally.

• Germany has a rich history in shooting sports and frequently hosts international events due to its advanced facilities, skilled organizers, and passionate sports community.

• This decision underscores the country's capability to host large-scale global sporting events, aligning with its reputation for precision and excellence in sports administration.

• The ISSF World Cup is a significant event in the Olympic qualification process, attracting top shooters from across the globe to compete in various rifle and pistol disciplines.

Additional Information

• About ISSF:

• The International Shooting Sport Federation (ISSF) was established in 1907 to oversee and promote shooting sports worldwide.

• It governs various shooting disciplines, including rifle, pistol, and shotgun events, ensuring uniform rules and standards for global competitions.

• The ISSF is headquartered in Munich, Germany, further emphasizing Germany's central role in the shooting sports community.

• Germany's Contribution to Shooting Sports:

• Germany has produced many world-class shooters and Olympians over the years, contributing significantly to the growth of the sport.

• It hosts numerous domestic and international shooting events, offering cutting-edge facilities such as modern ranges and training centers.

• German shooters have consistently excelled in international competitions, including the Olympics, World Championships, and World Cups.

• ISSF World Cup Overview:

• The ISSF World Cup series is a prestigious annual event that brings together the best shooters from around the world.

• It serves as a platform for athletes to compete in rifle, pistol, and shotgun disciplines, with events held across multiple countries each year.

• The series also plays a vital role in the qualification process for the Olympic Games, making it a crucial competition for aspiring Olympians.

• Germany as a Sporting Hub:

• Germany is renowned for hosting various global sporting events, including the FIFA World Cup, UEFA European Championships, and numerous world championships in different sports.

• The country's sports culture is deeply rooted in excellence, discipline, and innovation, making it an ideal host for international competitions.

Important Points

• Olympic Qualification: The ISSF World Cup series is a key event for shooters aiming to secure their spots in the Olympics, as it offers ranking points and quota places for the Games.

• Disciplines: The competition includes events in 10m air rifle, 50m rifle, 10m air pistol, and 25m pistol, among others, catering to a wide range of shooting enthusiasts.

• Germany's Sports Infrastructure: The country's venues are equipped with the latest technology, ensuring a seamless experience for athletes, officials, and spectators alike.

• Previous Hosts: Other countries such as India, Egypt, and Peru have also hosted ISSF events, reflecting the global nature of the competition.

Q100. Answer: (c) Earthquake relief

The correct answer is Earthquake relief.

Key Points

• Operation Brahma was launched by India in March 2025 as a dedicated mission aimed at providing earthquake relief in regions that were severely affected by a devastating earthquake.

• The operation was initiated in response to a high-magnitude earthquake that caused widespread destruction, including loss of life, damage to infrastructure, and displacement of populations.

• The primary objective of the operation was to provide immediate humanitarian aid, including rescue operations, medical assistance, and the distribution of food and essential supplies.

• The operation involved the collaboration of multiple agencies, including the National Disaster Response Force (NDRF), Indian Armed Forces, and various non-governmental organizations (NGOs).

• Specialized teams were deployed to conduct search-and-rescue missions using advanced equipment and trained personnel to locate and save individuals trapped under rubble.

Additional Information

• Earthquakes in India:

• India is highly vulnerable to earthquakes, with over 59% of its landmass prone to seismic activity. The regions are classified into four seismic zones (Zone II, III, IV, and V).

• Zone V is the most seismically active region, covering areas like Northeast India, parts of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, and the Rann of Kutch in Gujarat.

• Major earthquakes in Indian history include the Bihar-Nepal earthquake (1934), Latur earthquake (1993), Bhuj earthquake (2001), and the Kashmir earthquake (2005).

• National Disaster Response Force (NDRF):

• The NDRF is a specialized force established under the Disaster Management Act, 2005, for disaster response and management in India.

• It operates under the Ministry of Home Affairs and is trained for rescue, relief, and rehabilitation operations during natural and man-made disasters.

• The force is equipped with state-of-the-art rescue equipment, including seismic sensors, life detectors, and cutting tools.

• Indian Armed Forces in Disaster Relief:

• The Indian Armed Forces play a critical role in disaster management, especially in large-scale emergencies like earthquakes, floods, and cyclones.

• They provide logistics, transportation, and airlift operations to deliver aid to inaccessible areas.

• For example, during the Bhuj earthquake (2001), the Indian Army and Air Force led massive relief and rescue operations in Gujarat.

• Disaster Preparedness in India:

• The National Disaster Management Authority (NDMA) is the apex body responsible for formulating policies and guidelines for disaster management in India.

• India has also implemented early warning systems and conducts regular mock drills to enhance disaster preparedness.

• Community-based disaster risk reduction programs aim to educate and empower local populations to respond effectively during emergencies.

Important Points

• Earthquake Magnitude: The magnitude of an earthquake is measured on the Richter scale, which quantifies the energy released by the seismic event.

• Seismic Building Codes: India has introduced seismic-resistant building codes to ensure that infrastructure is designed to withstand earthquakes, especially in high-risk areas.

• International Cooperation: India collaborates with global organizations like the United Nations Office for Disaster Risk Reduction (UNDRR) to enhance disaster resilience.

• Key Initiatives: Programs like the Sendai Framework for Disaster Risk Reduction (2015-2030) guide India's strategies for reducing disaster risks and enhancing preparedness.

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