RRB Group D Official Paper (Held On: 04 Feb, 2026 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of the following features enables simple squamous epithelium to efficiently carry out diffusion?

(a) Thick cytoplasm with large nuclei
(b) Cells with cilia for movement
(c) Flat, thin, and closely packed cells
(d) Presence of multiple layers of cells

Q2. What was the primary goal of the Chipko Movement of the Garhwal region?

(a) Protection of the forest
(b) Cutting of forest
(c) Grazing of forest
(d) Aforestation

Q3. Which of the following statements is correct about Ohm's law?

(a) Current is inversely proportional to voltage at constant temperature.
(b) Resistance remains constant only for non-ohmic conductors.
(c) Ohm's law is applicable to all materials at all temperatures.
(d) Current is directly proportional to voltage at constant temperature.

Q4. In wastewater treatment plant, the biogas is obtained from which of the following substance?

(a) Coconut husk
(b) Dried leaves
(c) Sludge
(d) Banana peels

Q5. What do the ovary and ovule form after fertilisation in plants?

(a) Ovary forms the plumule and ovule forms the radicle.
(b) Ovary forms the fruit and ovule forms the seed.
(c) Ovary forms the seed and ovule forms the embryo.
(d) Ovary forms the fruit and ovule forms the cotyledons.

Q6. Which proteins are essential for muscle contraction and relaxation?

(a) Elastin and fibrin
(b) Contractile proteins
(c) Keratin and collagen
(d) Myoglobin and haemoglobin

Q7. Which of the following statements is/are correct?

a. Zinc granules when placed in dilute sulphuric acid, hydrogen gas is evolved.
b. Zinc granules when placed in sodium hydroxide solution forms zinc hydroxide.

c. Zinc granules when placed in sodium hydroxide forms sodium zincate.

(a) a and c
(b) a and b
(c) Only b
(d) Only a

Q8. The Tyndall effect is observed when:

(a) light is absorbed by particles in a solution
(b) light reflects from a mirror surface
(c) light is scattered by very fine particles suspended in a medium
(d) light passes through a vacuum

Q9. Which of the following statements is true about work done by a constant force?

(a) It is independent of displacement
(b) It depends only on the initial and final positions
(c) It depends on the path of motion
(d) It is always positive

Q10. In a hypotonic solution, which of the following statements is correct for animal tissues compared with plant tissues?

(a) Animal cells have thicker cellulose walls than plants.
(b) Animal cells resist swelling due to a rigid wall.
(c) Animal cells are more likely to lyse without an external wall.
(d) Animal cells shrink more than plant cells in dilute media.

Q11. Which of the following animals produces infrasound?

(a) Horses and cows
(b) Birds and snakes
(c) Dogs and cats
(d) Whales and elephants

Q12. In which of the following reactions does colour change, gas evolution, and solid residue formation, all occur simultaneously during decomposition?

(a) $CaCO3 \rightarrow CaO + CO2$
(b) $Pb(NO3)2 \rightarrow PbO + NO2 + O2$
(c) $2KClO3 \rightarrow 2KCl + 3O2$
(d) $2AgCl \rightarrow 2Ag + Cl2$

Q13. When an iron nail is dipped in copper sulphate solution, which of the following observations confirms that a displacement reaction has occurred?

(a) The solution remains blue, and the iron nail remains shiny.
(b) The solution turns colourless, and hydrogen gas is released.
(c) A white precipitate is formed.
(d) The blue colour of the copper sulphate solution fades, and a reddish-brown deposit appears on the iron nail.

Q14. In a laboratory, a student mixes starch in water and observes that the mixture is neither a true solution nor a suspension. What property of this mixture confirms it is a colloidal solution?

(a) The particles scatter a beam of light but do not settle on standing.
(b) The particles are visible to the naked eye.
(c) The particles settle down after some time.
(d) The mixture is completely transparent and does not scatter light.

Q15. A mixture differs from a compound in that:

(a) it has fixed proportions of elements
(b) its components retain their properties
(c) it shows combined properties only

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(d) its components cannot be separated

Q16. If two daughter cells produced by cell division show minor differences in their structure, which process during DNA copying most likely caused these variations?

(a) Errors in protein synthesis after DNA copying
(b) The separation of DNA copies into new cells is incomplete
(c) Minor variations occur during DNA copying due to the inherent unreliability of biochemical reactions
(d) The absence of DNA blueprints in the nucleus

Q17. What is the correct definition of one unit of force (1 newton)?

(a) The force required to keep an object at rest
(b) The force that causes a 1 kg object to accelerate at 1 m/s^2
(c) The force needed to move a 1 kg object to a distance of 1 metre
(d) The force that causes a 1 g object to accelerate at 1 metre

Q18. Why is graphite a good conductor of electricity?

(a) It melts at low temperatures.
(b) It absorbs water easily.
(c) It forms strong ionic bonds.
(d) It has free-moving electrons.

Q19. An electric geyser has a power of 2200 W when it is operated at 220 V. How much will be the current flowing through the heater?

(a) 1100 A
(b) 1 A
(c) 10 A
(d) 100 A

Q20. Starting from rest, a car attains a velocity of 10 m/s in 20 s. Braking reduces the velocity to 5 m/s in the next 5 s. What is the respective acceleration in the two scenarios?

(a) 1 m/s^2 ; 0.5 m/s^2
(b) 0.5 m/s^2 ; 1 m/s^2
(c) 0.5 m/s^2 ; -1 m/s^2
(d) -1 m/s^2 ; 0.5 m/s^2

Q21. If the value of the Universal Gravitational Constant (G), the mass of the Earth (M), and the radius of the Earth (R) are known, which equation is used to calculate the acceleration due to gravity (g) near the Earth's surface?

(a) $g = GR/M^2$
(b) $R^2/(GM)$
(c) $g = GM/R$
(d) $g = GM/R^2$

Q22. The process of transfer of pollen grains from one flower to the stigma of another flower is called _____.

(a) gestation
(b) pollination
(c) guttation
(d) germination

Q23. The principal focus of a spherical mirror is defined as:

(a) The point on the principal axis where parallel rays converge (or appear to diverge) after reflection
(b) The center of the mirror's reflecting surface
(c) The midpoint of the radius of curvature
(d) The distance between object and image

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Q24. An atom contains 17 electrons and 18 neutrons. Find the number of protons.

(a) 36
(b) 17
(c) 35.5
(d) 18

Q25. In a 250 mL solution, 5 g of solute is dissolved. What is the concentration (mass by volume %) of the solution?

(a) 5%
(b) 2%
(c) 0.2%
(d) 20%

MATHEMATICS

Q26. The square of the expression $(x^3)/(y^2) \times 1/(x^{(-1)}) \div y^{(-2)} \times (1/(x^2))^2$ is _____.

(a) x
(b) x^2
(c) 1
(d) $(x^2)/(y^2)$

Q27. For 7 innings, a cricketer had an average of 59 runs. In the 8^(th) inning, he scored 217 runs. His average score increased by _____. (Round off the answer to the nearest whole number.)

(a) 20
(b) 11
(c) 29
(d) 19

Q28. The sum of the first 13 prime numbers is:

(a) 241
(b) 238
(c) 243
(d) 235

Q29. If the fourth proportion to 5, X and 3 is 63, then find the value of X.4886

(a) 107
(b) 108
(c) 105
(d) 106

Q30. Walking at 5/7 th of his normal speed from his home, Shahid is 12 minutes late in reaching his office. The usual time taken by him to cover the distance between his home and his office is:

(a) 34 minutes
(b) 28 minutes
(c) 23 minutes
(d) 30 minutes

Q31. If regular polygons of sides 6 and 5 are inscribed in a circle of radius R, then what is the ratio of their areas?

(a) $3\sqrt{3} : 5\sqrt{(10 - 2\sqrt{5})}$
(b) $12\sqrt{3} : 5\sqrt{(10 + 2\sqrt{5})}$
(c) $4\sqrt{3} : 5\sqrt{(10 - 2\sqrt{5})}$
(d) $4\sqrt{3} : 5\sqrt{(10 + 2\sqrt{5})}$

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Q32. The volume of the cube is 1728 cm^3. Find its total surface area.

(a) 864 cm^2
(b) 464 cm2
(c) 144 cm2
(d) 664 cm2

Q33. If cos t = x and t is an acute angle, find the value of sin t.

(a) $x\sqrt{(1 - x^2)}$
(b) $\sqrt{(1 - x^2)}$
(c) $x/(\sqrt{(1 - x^2)})$
(d) $1/(\sqrt{(1 - x^2)})$

Q34. The amount on a sum of Rs. 5,000 at 18% per annum compound interest, compounded annually, in 2 years will be:

(a) Rs. 7,068
(b) Rs. 6,962
(c) Rs. 7,015
(d) Rs. 6,984

Q35. Bibha bought a number of bananas at 2 for a rupee and an equal number at 3 for a rupee. To make a profit of 40%, she should sell a dozen for Rs. .

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

Q36. The cost of a washing machine is 25% less than the cost of a TV. If the cost of the washing machine increases by 75% and that of the TV decreases by 49%, then what is the percentage change in the total cost of 6 washing machines and 3 TVs?

(a) Decrease by 19.5%
(b) Decrease by 26.4%
(c) Increase by 25.4%
(d) Increase by 24.5%

Q37. Simplify: 2/5 + 1.4

(a) 5.4
(b) 2.8
(c) 1.8
(d) 3.9

Q38. A is three times as old as B. If six years are subtracted from B's age and four years are added to A's age, then A's age will be five times B's age. How old was A two years ago?

(a) 36 years
(b) 40 years
(c) 49 years
(d) 54 years

Q39. Rs. 5,403 is divided among A, B, and C in such a way that if Rs. 79, Rs. 25, and Rs. 19 be deducted from their respective shares, they have money in the ratio 14:5:11. Find the difference between the B's and C's original shares.

(a) Rs. 1,156
(b) Rs. 1,206
(c) Rs. 956
(d) Rs. 1,050

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Q40. A person's monthly income is Rs. 60,000. He spends 25% of his income on rent, 15% on groceries, 10% on transportation and saves the rest. How much money does he save every month?

(a) Rs. 30,000
(b) Rs. 40,000
(c) Rs. 45,000
(d) Rs. 25,000

Q41. If 90% of 80% of 2/7 of a number is 576, find the number.

(a) 2800
(b) 6740
(c) 5180
(d) 3710

Q42. Two trains of lengths 316 m and 349 m are running at speeds of 58 km/h and 68 km/h, respectively, on parallel tracks in opposite directions. In how many seconds will they cross each other?

(a) 27 seconds
(b) 22 seconds
(c) 19 seconds
(d) 30 seconds

Q43. The mode of given list of numbers 115, 190, 110, 185, 85, 110, 115, 102, 90, 95, 85, 68, 85 is:6536

(a) 92
(b) 68
(c) 110
(d) 85

Q44. Find the effective price percentage of the marked price after three consecutive discounts of 10%, 27% and 8% (rounded off to two decimal places).

(a) 59.64%
(b) 58.28%
(c) 62.64%
(d) 60.44%

Q45. In a basketball game, a player scored 36 points using only 2-point shots and 3-point shots. She made 14 successful shots in total. How many 2-point and how many 3-point shots did she make?

(a) Number of 2-point shots = 6; Number of 3-point shots = 8
(b) Number of 2-point shots = 10; Number of 3-point shots = 4
(c) Number of 2-point shots = 8; Number of 3-point shots = 6
(d) Number of 2-point shots = 7; Number of 3-point shots = 7

Q46. One pipe can fill a tank in 6 minutes, while another pipe can empty the completely filled tank in 7 minutes. If both the pipes are opened together when the tank is empty, how many minutes will it take to fill one-half of the tank?

(a) 22
(b) 21
(c) 42
(d) 43

Q47. Simplify: $(x + 5)(x - 5)$

(a) $x^2 - 25$
(b) $x^2 + 25$
(c) $x^2 + 10x + 25$
(d) $x^2 - 10x + 25$

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Q48. A dealer marks his goods at 25% above the cost price and allows a discount of 68% on the marked price. What is his gain or loss percentage?

(a) 63% gain
(b) 60% loss
(c) 58% loss
(d) 57% loss

Q49. A and B can complete a piece of work in 8 days and 12 days, respectively. A starts working on the task and after 3 days, B joins him. How many more days will it take to finish the work after B joins?

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

Q50. Water flows through a cylindrical pipe of internal diameter 14 cm at 5 metre per second. Calculate the time (in minutes) the pipe would take to fill an empty rectangular tank 8 m × 6 m × 4.62 m.

(Take π = 22/7)

(a) 50
(b) 46
(c) 44
(d) 48

GENERAL INTELLIGENCE & REASONING

Q51. 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 bottles are cups.

All bottles are glasses.

Some glasses are teapots.

Conclusions:

(I): Some teapots are bottles.

(II): Some glasses are cups.

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

Q52. Refer to the given series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.

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

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

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

Q53. P, Q, R, S, and T are sitting around a circular table, facing the centre. R is sitting second to the right of P. T is sitting second to the right of S. P is to the immediate left of S. Who is to the immediate right of T?

(a) S
(b) R

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(c) P
(d) Q

Q54. Which of the given letter-number clusters will replace the question mark (?) in the following series to make it logically complete?

PGE 18, TEI 26, XCM 34, BAQ 42, ?

(a) FYU 50
(b) GYV 50
(c) FCU 52
(d) FCV 52

Q55. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

19 - 2 - 21

14 - 6 - 20

(a) 15 - 4 - 21
(b) 9 - 13 - 24
(c) 19 - 10 - 29
(d) 30 - 11 - 43

Q56. A man is standing on the roof facing east. First, he turns 45 degrees clockwise, then 45 degrees anticlockwise. He then turns 180 degrees anticlockwise. Finally, he turns 90 degrees clockwise. In which direction is the man facing now?

(a) East
(b) South
(c) West
(d) North

Q57. Refer to the following number series and answer the question that follows. Counting to be done from left to right only. (All numbers are single digit numbers only.)

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

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

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

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

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

How many 6's are there, each of which is immediately preceded by an odd number and also immediately followed by an even number?

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

Q59. A, B, C, D, E and F are sitting around a circular table, facing the centre. B sits second to the left of E. D is an immediate neighbour of F. C sits to the immediate left of F. C sits second to the right of A. What is the position of E with respect to F?

(a) Immediate right
(b) Immediate left

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(c) Second to the left
(d) Second to the right

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

16, 22, 34, 52, 76, ?

(a) 104
(b) 106
(c) 105
(d) 107

Q61. In a row of 19 people facing north, Geetha is 6^(th) from the left end. If Divya sits 5^(th) to the right of Geetha, then what is Divya's position from the right end of the row?

(a) 11th
(b) 10th
(c) 9th
(d) 8th

Q62. In a row of 50 students facing north, Parash is 18th from the left end. If Aparna is 7th to the right of Parash, what is Aparna's position from the right end of the row?

(a) 26th
(b) 24th
(c) 23rd
(d) 25th

Q63. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

49 ÷ 5 + 153 × 3 − 314 = ?

(a) 512
(b) 508
(c) 505
(d) 521

Q64. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

KJN 72 RQU 63 YXB 54 FEI 45 ?

(a) MMO 36
(b) MLP 36
(c) MKO 35
(d) MUD 35

Q65. Seven friends, B, C, D, T, U, V and W, are sitting in a straight line facing north. All friends sits to the left of C. Only three people sit between C and T. Only two people sit between T and V. B sits third to the left of D. W sits to the immediate right of D. How many people sit between U and V?

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

Q66. In the following triad, 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.

DRAWING - ADRWGIN - RADWNGI

FORMULA - RFOMAUL - ORFMLAU

(a) FASHION - SFAHNOI - ASFIHNO
(b) FASHION - SAFHNIO - ASFHONI
(c) FASHION - SFAHNIO - ASFHONI

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(d) FASHION - SAFNHIO - FASONHI

Q67. 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 crows are sparrows.

No crow is a pigeon.

Conclusions:

(I): No sparrow is a pigeon.

(II): Some pigeons are crows.

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

Q68. In a certain code language,

A + B means ‘A is the sister of B’,

A # B means ‘A is the brother of B’,

A x B means ‘A is the wife of B’,

A @ B means ‘A is the father of B’.

Based on the above, how is L related to R if ‘L @ O x V # E + R’?

(a) Wife's father
(b) Brother's son
(c) Brother's wife's father
(d) Brother's wife's brother

Q69. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

WZX−ZCA

CFD−FIG

(a) DGE−FJG
(b) DGE−GJH
(c) DFC−FIG
(d) DFC−GJH

Q70. PNHT is related to VILQ in a certain way based on the English alphabetical order. In the same way, MSDT is related to SNHQ. To which of the given options is IRUI related, following the same logic?

(a) OMYF
(b) PMZF
(c) ONYE
(d) PNZE

Q71. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only). Counting to be done from left to right.

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

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

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

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Q72. Based on the English alphabetical order, three of the following four letter-clusters are alike in a certain way and thus form a group. Which letter-cluster DOES NOT belong to that group? (Note: The odd one out is not based on the number of consonants/vowels or their position in the letter-cluster.)

(a) TYR
(b) MRL
(c) QVP
(d) EJD

Q73. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

7 ÷ 5 + 12 × 3 - 19 = ? + 5

(a) 55
(b) 50
(c) 45
(d) 60

Q74. In a certain code language, 'PEARL' is coded as '18723' and 'PAYER' is coded as '82736'. What is the code for 'Y' in that language?

(a) 8
(b) 3
(c) 6
(d) 2

Q75. Wamiq starts from point A and drives 78 km towards the west. He then takes a right turn, drives 81 km, turns right and drives 80 km. He then takes a right turn and drives 90 km. He takes a final right turn, drives 2 km and stops at point P. How far (shortest distance) and towards which direction should he drive in order to reach point A again? (All turns are 90-degree turns only unless specified.)

(a) 10 km to the south
(b) 7 km to the north
(c) 9 km to the north
(d) 11 km to the south

Q76. In a certain code language, NSQE is coded as 165 and XIJA is coded as 132. What is the code for PEYO in that language?

(a) 170
(b) 179
(c) 183
(d) 188

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

17 28 ? 50 61 72

(a) 31
(b) 36
(c) 39
(d) 40

Q78. What will come in the place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

32 + 34 - 35 × 5 ÷ 22 = ?

(a) 150
(b) 152
(c) 153
(d) 154

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Q79. 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) MP - KN
(b) GJ - EH
(c) JM - HK
(d) KN - IM

Q80. What should come in place of the question mark (?) in the given series?

521 523 527 533 541 ?

(a) 555
(b) 553
(c) 551
(d) 549

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. The 15^(th) edition of the India-Vietnam Defence Policy Dialogue (DPD) was held in which of the following cities in November 2025?

(a) Hanoi
(b) New Delhi
(c) Pune
(d) Ho Chi Minh

Q82. What was India’s rank in the 2025 SDG Index released by the UN Sustainable Development Solutions Network?

(a) 121st
(b) 87th
(c) 99th
(d) 78th

Q83. In April 2025, at the National Federation Cup Athletics held at Maharaja's College Ground in Ernakulam, which Indian long jumper broke Anju Bobby George's 23-year-old national record with a jump of 6.64 m?

(a) Ancy Sojan
(b) Shaili Singh
(c) Priyanka Goswami
(d) D Sudha Singh

Q84. At which competition did Gurindervir Singh break the national 100 m record?

(a) Asian Games
(b) Olympic Trials
(c) South Asian Championships
(d) Indian Grand Prix 1

Q85. As of August 2025, who among the following was the Governor of the Reserve Bank of India?

(a) Dr. Poonam Gupta
(b) Shri Saugata Bhattacharya
(c) Dr. Nagesh Kumar
(d) Shri Sanjay Malhotra

Q86. What is the name of the comprehensive strategic partnership treaty signed in January 2025, between Russia and Iran, covering defense, energy, cybersecurity and regional cooperation?

(a) Iranian–Russian Treaty on Coordination and Security Partnership
(b) Iran–Russia Treaty on Business and Strategic Cooperation Treaty
(c) Iranian–Russian Treaty on Comprehensive Strategic Partnership

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(d) Iran–Russia Treaty on Comprehensive Defence and Trade Partnership

Q87. Which significant new financial institution was launched in June 2025 to support India's maritime economy?

(a) India Marine Credit Bank
(b) Coastal Infrastructure Fund
(c) Sagarmala Finance Corporation Ltd.
(d) Blue Economy Bank

Q88. Which tribal poet from Jharkhand received the Sahitya Akademi Yuva Puraskar in June 2025 for 'Phir Ugna'?

(a) Parvati Tirkey
(b) Kirtida Brahmbhatt
(c) Akhil P Dharmajan
(d) Mayur Khavdu

Q89. What is the name of India's first humanoid robot developed for space missions, announced in 2023?

(a) Vikram
(b) Vyommitra
(c) Suryamitra
(d) Aditya

Q90. Who set a new world indoor 5000 m race walk record at the Italian Indoor Championships in Ancona (Feb 2025)?

(a) Evan Dunfee
(b) Francesco Fortunato
(c) Matteo Giupponi
(d) Toshikazu Yamanishi

Q91. Which data collection method contributed to the accurate poverty estimates in India, as per the SBI report in June 2025?

(a) Modified Mixed Recall Period
(b) Uniform Recall Period
(c) Periodic Recall Method
(d) Mixed Recall Period

Q92. What approximate percentage of the Union Budget 2025-26 was allocated to gender-specific schemes to address women's empowerment?

(a) 12.21%
(b) 4.56%
(c) 8.86%
(d) 2.68%

Q93. In July 2025, the Union Environment Ministry notified the Environment Protection Rules, 2025, for which sites?

(a) Hilltop Sites
(b) Crowded Sites
(c) Chemically Contaminated Sites
(d) Tourist Sites

Q94. When did/will the new FASTag annual plan become effective in India?

(a) 26 November 2025
(b) 15 August 2025
(c) 1 September 2025
(d) 2 October 2025

Q95. At the Bharat Climate Forum 2026, Shri C. P. Radhakrishnan stated that effective climate action can help India in which of the following?

(a) Limiting population growth
(b) Reducing agricultural exports

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(c) Focusing solely on fossil fuels
(d) Strengthening energy security

Q96. Who co-chaired the AI Action Summit held in Paris in February 2025?
(a) Chancellor Olaf Scholz and President Emmanuel Macron
(b) Prime Minister Narendra Modi and President Emmanuel Macron
(c) Prime Minister Rishi Sunak and President Emmanuel Macron
(d) Prime Minister Narendra Modi and President Joe Biden

Q97. Which league launched in January 2025 featured international kabaddi teams and set up record-level participation?
(a) World Kabaddi League
(b) Indian Super Kabaddi
(c) Global Indian Pravasi Kabaddi League
(d) Kabaddi Premier Series

Q98. At the World Governments Summit 2025 in Dubai, which of the following awards recognised pioneering government initiatives worldwide for innovation and social impact?
(a) Global Government Excellence Award
(b) Government Innovation Excellence Award
(c) Global Public Leadership Award
(d) Smart Governance Achievement Award

Q99. In 2025, India raised concerns with China regarding the construction of a major upstream hydropower project, urging protection of downstream rights. This project is being developed on which river?
(a) Sutlej
(b) Kosi
(c) Brahmaputra
(d) Indus

Q100. On which date is Birsa Munda Martyr's Day observed, as commemorated every year?
(a) 15th August
(b) 9th June
(c) 5th November
(d) 26th January

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (c) Flat, thin, and closely packed cells

The correct answer is Flat, thin, and closely packed cells.

Key Points

• Simple squamous epithelium is a single layer of flat, thin, and closely packed cells that resemble floor tiles when viewed from above. Their extremely thin profile creates a minimal barrier, which is essential for the rapid diffusion of gases and filtration of liquids across the membrane. Hence, statement 3 is correct.

• Cells with thick cytoplasm and large nuclei (Statement 1) are typically characteristic of cuboidal or columnar epithelium. These cells are more involved in metabolic activities, secretion, and absorption rather than passive diffusion, as the increased thickness would slow down the movement of molecules. Hence, statement 1 is incorrect.

• The presence of cilia (Statement 2) is a specialized feature of ciliated epithelium. These hair-like structures are used to move mucus or particles across the surface of the tissue, such as in the respiratory tract or fallopian tubes, and do not directly assist in the process of diffusion. Hence, statement 2 is incorrect.

• The presence of multiple layers of cells (Statement 4) describes stratified epithelium. This structure is designed for protection against mechanical or chemical stress (like in the skin) and is too thick to allow for efficient diffusion. Hence, statement 4 is incorrect.

• Because the cells are closely packed with very little intercellular matrix, they form a continuous surface that acts as a selective permeable membrane, allowing specific small molecules like oxygen and carbon dioxide to pass through easily.

Additional Information

• Locations of Simple Squamous Epithelium:

• Alveoli of the Lungs: Where gas exchange occurs between the air and the blood.

• Endothelium: The lining of blood vessels and lymphatic vessels, facilitating the exchange of nutrients and waste.

• Mesothelium: The epithelial component of serous membranes lining the body cavities (pleura, pericardium, and peritoneum).

• Bowman's Capsule: Found in the kidneys, where it aids in the filtration of blood to form urine.

• Primary Functions:

• Diffusion: Allows for the movement of molecules from an area of high concentration to low concentration.

• Osmosis: The movement of water through the thin membrane.

• Filtration: Passing fluids through a biological "sieve" to remove larger particles or cells.

• Structural Characteristics:

• The cells are often described as pavement epithelium due to their appearance.

• Each cell has a centrally located, oval or flattened nucleus that bulges slightly.

• The tissue is avascular, meaning it does not contain its own blood vessels and relies on diffusion from underlying connective tissue for nutrients.

Important Points

• Epithelial Tissue Classification: Tissues are classified based on the number of layers (Simple vs. Stratified) and the shape of the cells (Squamous, Cuboidal, or Columnar).

• Simple Epithelium: Consists of a single layer of cells and is found where absorption, secretion, and filtration occur.

• Stratified Epithelium: Consists of two or more layers and is primarily found in areas subject to wear and tear, providing high-level protection.

• Basement Membrane: All epithelial tissues rest on a non-cellular basement membrane, which provides structural support and attaches the epithelium to the underlying tissue.

Q2. Answer: (a) Protection of the forest

The correct answer is Protection of the forest.

Key Points

• The Chipko Movement was a non-violent, social, and ecological movement by rural villagers, particularly women, in India during the 1970s.

• The primary objective of the movement was the protection of the forest from commercial logging and deforestation authorized by the government. Hence, option 1 is correct.

• It originated in the Garhwal Himalayas of Uttarakhand (then part of Uttar Pradesh) in 1973 and quickly spread throughout the Himalayan region.

• The name of the movement comes from the word 'chipko', which means 'to hug' or 'to stick' in Hindi, reflecting the protesters' method of hugging trees to prevent them from being cut down.

• The movement was a landmark in environmentalism as it highlighted that the livelihood of local communities depends on the health of the natural ecosystem.

Additional Information

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• Key Figures:

• Sunderlal Bahuguna: An environmentalist who gave the movement a proper direction and appealed to the Prime Minister Indira Gandhi, which resulted in a 15-year ban on cutting green trees in the Himalayan forests in 1980.

• Chandi Prasad Bhatt: One of the pioneers who organized the local cooperative organization Dasholi Gram Swarajya Sangh (DGSS) to help locals utilize forest resources sustainably.

• Gaura Devi: A prominent woman leader who organized the women of Reni village to stop the felling of trees when the men were away.

• Inspiration: The movement was inspired by the Bishnoi community of Rajasthan. In the 1730s, Amrita Devi and 363 others sacrificed their lives to protect Khejri trees from being cut down by the orders of the Maharaja of Jodhpur.

• Global Impact: The Chipko Movement is often regarded as one of the first eco-feminist movements in the world because of the massive participation of women. It won the Right Livelihood Award in 1987 for its dedication to the conservation and restoration of India's natural resources.

Important Points

• Ecological Slogan: Sunderlal Bahuguna coined the famous slogan: "Ecology is permanent economy", emphasizing that long-term economic stability relies on environmental health.

• Outcome: Apart from the 15-year ban on commercial felling in the Himalayas, the movement led to the creation of the Forest Conservation Act of 1980 in India and a significant shift in India's forest policy from revenue generation to conservation.

• Geographic Reach: While it started in the Chamoli district, its success inspired similar movements across the country, such as the Appiko Movement in Karnataka in 1983.

Q3. Answer: (d) Current is directly proportional to voltage at constant temperature.

The correct answer is Current is directly proportional to voltage at constant temperature.

Key Points

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

• The mathematical expression for this relationship is V = IR, where R is the Resistance of the conductor.

• Statement 1: It claims current is inversely proportional to voltage. According to the formula I = V/R, current increases as voltage increases. Hence, statement 1 is incorrect.

• Statement 2: It suggests resistance remains constant only for non-ohmic conductors. In reality, resistance is constant for Ohmic conductors, while for non-ohmic conductors (like semiconductors), resistance varies with voltage or current. Hence, statement 2 is incorrect.

• Statement 3: It says the law is applicable to all materials at all temperatures. However, Ohm's law is not universal; it does not apply to insulators, semiconductors, or vacuum tubes, and it fails if the temperature changes significantly. Hence, statement 3 is incorrect.

• Statement 4: It correctly identifies the core principle that Current (I) is directly proportional to Voltage (V) at a constant temperature. Hence, statement 4 is correct.

• Hence, the correct answer is Current is directly proportional to voltage at constant temperature.

Additional Information

• Historical Context: The law was named after the German physicist Georg Simon Ohm, who published his findings in 1827 in his book "The Galvanic Circuit Investigated Mathematically."

• Units of Measurement:

• Voltage (V) is measured in Volts.

• Current (I) is measured in Amperes (A).

• Resistance (R) is measured in Ohms (Ω).

• Ohmic vs. Non-Ohmic Conductors:

• Ohmic Conductors: These materials follow Ohm's Law strictly. Examples include copper, silver, and aluminum under normal operating conditions. The V-I graph for these materials is a straight line passing through the origin.

• Non-Ohmic Conductors: These materials do not show a linear relationship between V and I. Examples include diodes, transistors, LEDs, and electrolytes. Their resistance changes as the applied voltage changes.

• Resistance Factors: The resistance of a conductor depends on its length, area of cross-section, nature of the material, and temperature. Generally, the resistance of metals increases with an increase in temperature.

Important Points

• Experimental Verification: When a graph is plotted between Potential Difference (V) on the y-axis and Current (I) on the x-axis, the slope of the straight line represents the Resistance (R) of the conductor.

• Limitations of Ohm's Law:

• It is not applicable to unilateral networks (circuits where current flows in only one direction, like those with diodes).

• It is not applicable to non-linear elements where the current does not change linearly with voltage (like thyristors).

• The law only holds true if physical parameters such as temperature, strain, and pressure are kept constant.

• Applications: Ohm's law is fundamental for determining the voltage, current, or resistance in a linear electric circuit. It is used extensively in electrical engineering, designing domestic appliances, and calculating the power consumption of electrical devices.

Q4. Answer: (c) Sludge

The correct answer is Sludge.

Key Points

• In a Wastewater Treatment Plant (WWTP), Sludge is the organic solid material that settles at the bottom of Sedimentation Tanks during the treatment process.

• This Sludge is transferred to a separate tank where it is decomposed by Anaerobic Bacteria. This process is known as Anaerobic Digestion.

• The byproduct of this biological decomposition is Biogas, which is a mixture of gases produced by the breakdown of organic matter in the absence of Oxygen.

• Biogas primarily consists of Methane (CH_4), which typically ranges from 50% to 75%, and Carbon Dioxide (CO_2), ranging from 25% to 50%, along with small amounts of Hydrogen Sulfide and Moisture.

• The Biogas generated from Sludge can be utilized as a Fuel for heating or to produce Electricity to power the treatment plant itself, making the facility more energy-efficient.

Additional Information

• Primary and Secondary Sludge:

• Primary Sludge is obtained during the Physical Treatment (primary sedimentation) where heavy solids settle down.

• Secondary Sludge (also called Activated Sludge) is obtained after Biological Treatment, where microorganisms consume organic pollutants in Aeration Tanks.

• Wastewater Treatment Process:

• The process involves Screening (removal of large objects), Grit Removal (settling of sand and pebbles), Primary Clarification (settling of organic solids), and Secondary Treatment (aeration and biological breakdown).

• After the Sludge is digested and Biogas is extracted, the remaining solid matter is dried and used as Manure or Fertilizer because it is rich in organic matter and nutrients like Nitrogen and Phosphorus.

• Other Options Analysis:

• Coconut Husk, Dried Leaves, and Banana Peels are forms of Biomass or Municipal Solid Waste. While they can be used in specialized Biogas Plants (like Gobar Gas plants) through composting or digestion, they are not the specific substances from which biogas is extracted within a standard Wastewater Treatment Plant.

• Sludge is specifically the byproduct of Sewage and Industrial Wastewater processing.

• Environmental Impact:

• Capturing Biogas from Sludge prevents the release of Methane, a potent Greenhouse Gas, into the atmosphere, thereby helping in the mitigation of Climate Change.

• The Clean Water Act and various environmental guidelines in India, managed by the Central Pollution Control Board (CPCB), mandate the proper treatment of sewage to protect water bodies from Eutrophication.

Q5. Answer: (b) Ovary forms the fruit and ovule forms the seed.

The correct answer is Ovary forms the fruit and ovule forms the seed.

Key Points

• In Angiosperms (flowering plants), fertilization occurs when the male gamete (pollen) fuses with the female gamete (egg cell) inside the ovule.

• After fertilization, the zygote develops into an embryo, and the ovule undergoes structural changes to become the seed.

• The ovary, which encloses the ovules, grows rapidly and ripens to form the fruit. Hence, statement 2 is correct.

• The transformation of the ovary into a fruit and the ovule into a seed occurs simultaneously.

• Other parts of the flower, such as the sepals, petals, and stamens, usually wither and fall off during this developmental phase.

Additional Information

• Double Fertilization: This is a unique feature of flowering plants where one male gamete fuses with the egg to form a diploid zygote, and another male gamete fuses with two polar nuclei to form a triploid endosperm.

• Development of the Seed:

• The integuments (outer layers) of the ovule harden to form the seed coat, consisting of the testa (outer) and tegmen (inner).

• The seed contains the embryo and, in many cases, a food reserve called the endosperm.

• Development of the Fruit:

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• The wall of the ovary develops into the pericarp (fruit wall), which can be fleshy (as in mango or orange) or dry (as in mustard or groundnut).

• Fruits that develop only from the ovary are called true fruits, while those involving other floral parts (like the thalamus in apples) are called false fruits.

Important Points

• Embryonic Parts: The embryo within the seed consists of an embryonal axis and one or two cotyledons.

• The radicle is the part of the embryonal axis that develops into the root system.

• The plumule is the portion that develops into the shoot system.

• Seed Germination: Under favorable conditions (availability of water, oxygen, and temperature), the seed germinates to produce a new seedling.

• Parthenocarpy: In some cases, a fruit may develop without fertilization; such fruits are called parthenocarpic fruits (e.g., banana) and are typically seedless.

• Dispersal: The primary function of the fruit is to protect the seeds and aid in their dispersal to different locations via wind, water, or animals.

Q6. Answer: (b) Contractile proteins

The correct answer is Contractile proteins.

Key Points

• Contractile proteins are specialized molecular structures within muscle fibers that transform chemical energy (ATP) into mechanical work, enabling movement.

• The two primary contractile proteins are Actin and Myosin. Actin forms the thin filaments, while Myosin forms the thick filaments of the sarcomere, which is the functional unit of a muscle.

• During contraction, the myosin heads attach to binding sites on the actin filaments to form cross-bridges, pulling the actin toward the center of the sarcomere in a process known as the Sliding Filament Theory.

• Relaxation occurs when Calcium ions (Ca^(2+)) are actively transported back into the sarcoplasmic reticulum, causing the myosin heads to detach and the filaments to slide back to their original positions.

• Regulatory proteins such as Troponin and Tropomyosin are also essential as they control the interaction between actin and myosin by masking or unmasking active sites in response to nerve impulses.

Additional Information

• Elastin and Fibrin:

• Elastin is a highly elastic protein found in connective tissues like skin and blood vessels, allowing them to resume shape after stretching.

• Fibrin is a fibrous, non-globular protein involved in blood clotting, formed from fibrinogen during the coagulation cascade.

• Keratin and Collagen:

• Keratin is a tough, protective structural protein found in hair, nails, and the outer layer of skin.

• Collagen is the most abundant structural protein in the human body, providing tensile strength to tendons, ligaments, and cartilage.

• Myoglobin and Haemoglobin:

• Haemoglobin is a metalloprotein in red blood cells that carries oxygen from the lungs to the body tissues.

• Myoglobin is an iron- and oxygen-binding protein found in skeletal and cardiac muscle tissue that serves as a local oxygen storage unit for high-demand activity.

Q7. Answer: (a) a and c

The correct answer is a and c.

Key Points

• Statement a: When Zinc granules are added to dilute sulphuric acid (H2SO4), a chemical reaction occurs where Zinc displaces Hydrogen from the acid. This displacement reaction produces Zinc Sulphate (ZnSO4) and evolves Hydrogen gas (H2). Hence, statement a is correct.

• Statement b: The reaction between Zinc and Sodium Hydroxide does not primarily produce zinc hydroxide as the final stable product in a direct metal-base reaction. Instead, it proceeds to form a complex salt. Hence, statement b is incorrect.

• Statement c: Zinc is an amphoteric metal, meaning it can react with both acids and strong bases. When Zinc granules are heated with a concentrated Sodium Hydroxide (NaOH) solution, it forms Sodium Zincate (Na2ZnO2) and releases Hydrogen gas. Hence, statement c is correct.

• Hence, the correct answer is a and c.

Additional Information

• Amphoteric Nature of Zinc:

• Zinc is characterized by its amphoteric nature, allowing it to exhibit both acidic and basic characteristics depending on the reactant. Other common amphoteric metals include Aluminium and Lead.

• In the reaction with NaOH, the chemical equation is: $Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$. This reaction is a classic example of a metal reacting with a base to form a salt and Hydrogen.

• Reaction with Acids:

• Zinc is placed above Hydrogen in the Reactivity Series. Therefore, it readily displaces Hydrogen from dilute hydrochloric acid or dilute sulphuric acid.

• The physical observation of this reaction includes the formation of bubbles on the surface of the Zinc granules, which indicates the evolution of gas.

• Properties of Hydrogen Gas:

• The Hydrogen gas evolved during these reactions is colourless and odourless.

• A standard laboratory test for Hydrogen involves bringing a burning splinter near the gas, which results in a characteristic "pop" sound.

Important Points

• Sodium Zincate (Na_2ZnO_2): This is an inorganic compound. In aqueous solution, the Zincate ion is often represented as $[Zn(OH)_4]^{2-}$.

• Zinc Granules: The use of granules instead of a large piece of Zinc increases the surface area, which significantly increases the rate of reaction with the acid or base.

• Chemical Safety: Reactions involving the production of Hydrogen gas must be performed with caution as Hydrogen is highly inflammable and can form explosive mixtures with air.

• Oxidation States: In both reactions (with H_2SO_4 and NaOH), Zinc undergoes oxidation, changing its oxidation state from 0 to +2.

Q8. Answer: (c) light is scattered by very fine particles suspended in a medium

The correct answer is light is scattered by very fine particles suspended in a medium.

Key Points

• The Tyndall effect is a physical phenomenon where light beams are scattered by particles in a colloid or a very fine suspension.

• It is observed when the size of the individual particles is comparable to the wavelength of the light, typically ranging between 1 nanometer and 1000 nanometers.

• The effect was first described in detail by the Irish physicist John Tyndall in the year 1869. It helps in distinguishing between a true solution and a colloidal solution.

• When a beam of light passes through a colloid, the suspended particles scatter the light, making the path of the beam visible to the observer. Hence, the correct answer is option 3.

• Common examples of this effect include sunlight passing through the canopy of a dense forest where mist/droplets scatter light, or the visible beam of headlights in fog or dusty air.

Additional Information

• True Solutions: These are homogeneous mixtures where the solute particles are extremely small (less than 1 nm). Because the particles are so small, they do not scatter light, and the Tyndall effect is not observed in substances like salt water or sugar solution.

• Colloids: These are mixtures where the particle size is intermediate between a solution and a suspension. Examples include milk, butter, gelatin, and whipped cream. Colloids always exhibit the Tyndall effect.

• Suspensions: These are heterogeneous mixtures with large particles (greater than 1000 nm) that eventually settle down. A suspension may show the Tyndall effect while the particles are still suspended in the medium, such as chalk powder in water.

• Blue Sky vs. Tyndall Effect: While both involve scattering, the blue color of the sky is primarily due to Rayleigh scattering by much smaller gas molecules (nitrogen and oxygen), whereas the Tyndall effect involves larger colloidal particles.

• Applications: The Tyndall effect is used in nephelometers to determine the concentration and size of particles in a liquid or gas, and in laboratories to verify the purity of solutions.

Important Points

• Intensity of Scattering: The intensity of the scattered light depends on the frequency of the light and the density of the particles. Like Rayleigh scattering, blue light is scattered more strongly than red light by the Tyndall effect.

• Visible Path: For the path of light to become visible, the particles must not absorb all the light (unlike option 1) but rather deflect it in various directions.

• Vacuum: Light passing through a vacuum (option 4) undergoes no scattering because there is no matter or particles to interact with the photons.

• Reflection: Regular reflection from a mirror surface (option 2) involves light bouncing off in a single predictable direction governed by the Laws of Reflection, which is distinct from the multi-directional scattering seen in the Tyndall effect.

Q9. Answer: (b) It depends only on the initial and final positions

The correct answer is It depends only on the initial and final positions.

Key Points

• Work done by a constant force is mathematically defined as the scalar product (dot product) of the force vector and the displacement vector. The formula is expressed as W = F ? d ? cos(θ), where F is the magnitude of the force, d is the magnitude of displacement, and θ is the angle between them.

• Displacement is a vector quantity that represents the shortest distance between the initial position and the final position of an object. Because the work formula uses displacement rather than distance, the total work done by a constant force is determined solely by where the object started and where it ended. Hence, statement 2 is correct.

• The assertion that work is independent of displacement is false. Work is directly proportional to the magnitude of the displacement. If there is no displacement (e.g., pushing against a wall), the work done is zero. Hence, statement 1 is incorrect.

• For a constant force, the work done is independent of the path taken between two points. Such forces (like gravity or a constant electric field) are known as conservative forces. Whether the object moves in a straight line or a zigzag, the work remains the same as long as the start and end points are identical. Hence, statement 3 is incorrect.

• Work is not always positive. Its sign depends on the angle (θ). If the angle is between 0° and 90°, work is positive; if the angle is exactly 90°, work is zero; and if the angle is between 90° and 180°, work is negative. Hence, statement 4 is incorrect.

Additional Information

• Conservative Forces: A force is considered conservative if the total work done in moving an object between two points is independent of the path taken. Examples include gravitational force, electrostatic force, and spring force. A constant force is a special case of a conservative force.

• Non-Conservative Forces: These are forces where the work done depends on the path. The most common example is friction. If you move an object over a longer path, friction does more (negative) work because it acts along the entire distance traveled, not just the net displacement.

• SI Unit of Work: The standard unit for work and energy in the International System of Units is the Joule (J). One Joule is defined as the work done by a force of one Newton (1 N) acting over a displacement of one meter (1 m).

• Dimensional Formula: The dimensional representation of work is $[M^1L^2T^2]$, which is derived from Force (Mass × Acceleration) × Displacement.

• Work-Energy Theorem: This fundamental principle of physics states that the net work done on an object by all forces is equal to the change in the object's kinetic energy (W = ΔK).

Important Points

• Zero Work Scenarios: Work is zero when the force is perpendicular to the displacement (e.g., a person carrying a bucket horizontally, where gravity acts downward and motion is forward) or when the displacement is zero.

• Nature of Work: Work is a scalar quantity, meaning it has only magnitude and no direction, even though it is calculated from the product of two vector quantities.

• Constant Force vs. Variable Force: While the work for a constant force is F ? d ? cos(θ), the work done by a variable force must be calculated using integration of the force over the path of motion.

Q10. Answer: (c) Animal cells are more likely to lyse without an external wall.

The correct answer is Animal cells are more likely to lyse without an external wall.

Key Points

• A hypotonic solution is one where the solute concentration outside the cell is lower than the concentration inside the cytoplasm. This creates a gradient where water moves into the cell via osmosis.

• Animal cells, such as red blood cells (erythrocytes), are enclosed only by a thin, flexible plasma membrane. When placed in a hypotonic solution, the rapid influx of water causes the cell to swell and eventually burst, a process known as osmotic lysis or cytolysis. Hence, statement 3 is correct.

• Plant cells possess a rigid cell wall composed of cellulose. While the cell swells in a hypotonic medium, the cell wall exerts an opposing mechanical pressure (wall pressure) that prevents the cell from bursting, making it turgid instead.

• Statement 1 is incorrect because animal cells do not have cellulose walls at all; this feature is unique to plants, algae, and some bacteria. Hence, statement 1 is incorrect.

• Statement 2 is incorrect because animal cells lack a rigid wall and therefore cannot resist the internal osmotic pressure during swelling, unlike plant cells which use their walls for structural integrity. Hence, statement 2 is incorrect.

• Statement 4 is incorrect because cells shrink (crenation or plasmolysis) in hypertonic (concentrated) media, not in dilute media (hypotonic), where they actually expand. Hence, statement 4 is incorrect.

Additional Information

• Hypertonic Solution:

• In this environment, the solute concentration outside is higher than inside. Water flows out of the cell, leading to crenation (shriveling) in animal cells and plasmolysis in plant cells.

• Isotonic Solution:

• The osmotic pressure is balanced between the cell and the surrounding medium. There is no net movement of water. This is the ideal state for animal tissues to maintain homeostasis.

• Osmoregulation:

• This is the process by which organisms regulate the water and electrolyte balance in their bodies. Contractile vacuoles in organisms like Amoeba are specialized organelles used to pump out excess water in hypotonic freshwater environments.

• Turgor Pressure:

• In plants, the pressure of the cell contents against the cell wall is called turgor pressure. It is essential for maintaining the upright posture of non-woody plants and the opening of stomata.

Important Points

• Cell Wall Structure: The plant cell wall is a complex matrix containing cellulose microfibrils, hemicellulose, and pectin. It provides protection against pathogens and mechanical stress.

• Semi-permeable Membrane: The plasma membrane is selectively permeable, allowing solvent molecules (water) to pass through via aquaporins while restricting most solutes.

• Impact on Marine Life: Marine invertebrates are often osmoconformers, matching their body osmolarity to the ocean, whereas bony fish are osmoregulators that must actively manage salt and water levels to survive.

Q11. Answer: (d) Whales and elephants

The correct answer is Whales and elephants.

Key Points

• Infrasound is defined as sound waves with a frequency lower than 20 Hertz (Hz), which is the lower limit of human audibility.

• Whales and elephants are prominent examples of animals that produce infrasonic sounds to communicate over vast distances. Hence, option 4 is correct.

• In the ocean, Baleen whales like the Blue whale and Fin whale use infrasound to communicate across hundreds or even thousands of kilometers because low-frequency sounds dissipate less in water.

• Elephants use infrasound for social coordination, warning others of danger, and finding mates. These sounds can travel through the ground and be detected by other elephants through their feet.

• Other animals that utilize infrasound include Rhinoceroses, Hippopotamuses, Giraffes, and even certain species of birds like Pigeons (though pigeons primarily hear it rather than produce it for primary communication).

Additional Information

• Sound Frequency Spectrum:

• Infrasound: Frequencies below 20 Hz.

• Audible Sound: The frequency range perceptible to humans, typically between 20 Hz and 20,000 Hz.

• Ultrasound: Frequencies above 20,000 Hz (20 kHz).

• Ultrasound Producing Animals:

• Animals such as Bats, Dolphins, and Porpoises produce ultrasound.

• They use these high-frequency waves for echolocation to navigate and hunt prey in the dark or in murky waters.

• Dogs and Cats can hear ultrasonic frequencies, which is why they respond to "silent" dog whistles.

• Characteristics of Horses and Cows:

• Horses and Cows primarily communicate within the audible range for humans. While they have different hearing sensitivities, they are not categorized as primary producers of infrasound for long-distance communication.

• Characteristics of Birds and Snakes:

• Most birds communicate via audible songs and calls. Snakes do not have external ears and mostly "hear" by sensing vibrations from the ground through their jawbones.

Important Points

• Natural Infrasound Sources: Infrasound is not only biological; it is generated by natural phenomena such as earthquakes, volcanic eruptions, avalanches, thunder, and meteors.

• Sensing Disasters: It is often observed that elephants and other animals become restless before an earthquake or tsunami. This is because they can detect the infrasonic waves generated by the tectonic shifts long before the seismic waves are felt by humans.

• Human Impact: Although humans cannot hear infrasound, exposure to high-intensity infrasound can cause physiological effects like vertigo, nausea, or feelings of anxiety.

• Scientific Measurement: The study of these low-frequency waves is crucial in seismology and for monitoring nuclear explosions, as infrasound travels globally through the atmosphere.

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Q12. Answer: (b) $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$

The correct answer is $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$.

Key Points

• The decomposition of Lead(II) nitrate is a classic example of a thermal decomposition reaction where a single reactant breaks down into multiple products upon heating.

• When White crystalline Lead nitrate [$Pb(NO_3)_2$] is heated, it undergoes a chemical change to produce Lead(II) oxide (PbO), Nitrogen dioxide (NO_2), and Oxygen (O_2).

• Gas Evolution: During this reaction, Nitrogen dioxide is evolved as a characteristic reddish-brown gas. Oxygen, which is a colorless and odorless gas, is also released.

• Color Change: There is a distinct color change as the white lead nitrate decomposes into Lead oxide, which appears reddish-brown when hot and yellow when it cools down.

• Solid Residue Formation: After the gases (NO_2 and O_2) escape into the atmosphere, a solid residue of Lead oxide (also known as litharge) remains in the test tube.

• The balanced chemical equation for this process is: $2Pb(NO_3)_2(s) + heat \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$.

Additional Information

• Decomposition of Calcium Carbonate (Option 1):

• In the reaction $CaCO_3 \rightarrow CaO + CO_2$, Calcium carbonate (Limestone) is heated to form Calcium oxide (Quicklime) and Carbon dioxide gas.

• While gas evolution and solid residue formation occur, there is no significant color change as both the reactant and the residue are white or off-white. Hence, statement 1 is incorrect.

• Decomposition of Potassium Chlorate (Option 3):

• The reaction $2KClO_3 \rightarrow 2KCl + 3O_2$ involves the thermal decomposition of Potassium chlorate.

• This reaction produces Oxygen gas and a white solid residue of Potassium chloride. Since the color remains white throughout, it does not satisfy the color change criteria. Hence, statement 3 is incorrect.

• Decomposition of Silver Chloride (Option 4):

• The reaction $2AgCl \rightarrow 2Ag + Cl_2$ is a photochemical decomposition (photolysis) occurring in the presence of sunlight.

• Silver chloride (white) turns grey due to the formation of Silver metal, and Chlorine gas (yellowish-green) is evolved. While it shows color change and gas evolution, it is typically distinguished from thermal decomposition residue formation like the lead nitrate experiment. Hence, statement 4 is incorrect.

• Thermal Decomposition:

• This is a type of chemical reaction where a substance is decomposed by heat energy. These reactions are generally endothermic because heat is absorbed to break the chemical bonds.

• Common examples include the decomposition of metal carbonates, metal nitrates, and metal hydroxides.

Important Points

• Decrepitation: During the heating of Lead nitrate, a characteristic cracking sound is heard, which is known as decrepitation. This happens due to the expansion of air trapped in the crystals.

• Nature of NO_2: The Nitrogen dioxide gas produced is acidic in nature. It can be tested using moist blue litmus paper, which will turn red.

• Oxidation State: In this reaction, the nitrogen in the nitrate radical is reduced from an oxidation state of +5 to +4 in nitrogen dioxide.

• Lead(II) oxide: It is an important industrial compound used in the manufacturing of lead glass and ceramic glazes.

Q13. Answer: (d) The blue colour of the copper sulphate solution fades, and a reddish-brown deposit appears on the iron nail.

The correct answer is The blue colour of the copper sulphate solution fades, and a reddish-brown deposit appears on the iron nail.

Key Points

• A displacement reaction is a chemical reaction in which a more reactive element displaces a less reactive element from its compound. In this case, Iron (Fe) is more reactive than Copper (Cu).

• When an iron nail is dipped in a copper sulphate ($CuSO_4$) solution, the Iron atoms displace the Copper ions from the solution. This is a classic example of a single displacement reaction.

• The initial copper sulphate solution is blue in colour due to the presence of Cu^{2+} ions. As the reaction proceeds, the concentration of these ions decreases, causing the blue colour to fade and eventually turn light green. Hence, statement 4 is correct.

• The reddish-brown deposit observed on the iron nail is the metallic Copper (Cu) that has been displaced from the solution and settled on the surface of the nail.

• The chemical equation for the reaction is: Fe (s) + CuSO4 (aq) → FeSO4 (aq) + Cu (s). Here, FeSO4 is Iron(II) sulphate, which gives the solution its greenish tint.

• Statement 1 suggests the solution remains blue and the nail shiny, which implies no reaction took place. However, because Iron is higher in the reactivity series, a reaction must occur. Hence, statement 1 is incorrect.

• Statement 2 mentions hydrogen gas being released. Hydrogen gas is typically evolved when metals react with acids, not during the displacement of Copper from Copper Sulphate. Hence, statement 2 is incorrect.

• Statement 3 mentions a white precipitate. White precipitates are characteristic of specific double displacement reactions (e.g., Barium Chloride reacting with Sodium Sulphate), not this metal-salt displacement. Hence, statement 3 is incorrect.

Additional Information

• The Reactivity Series:

• The reactivity series is a list of metals arranged in the order of their decreasing chemical reactivity.

• Metals like Potassium (K), Sodium (Na), and Calcium (Ca) are at the top, meaning they are highly reactive.

• Iron (Fe) is placed above Copper (Cu), Silver (Ag), and Gold (Au). This positioning is the scientific reason why Iron can displace Copper, but Copper cannot displace Iron from its sulphate solution.

• Redox Nature of the Reaction:

• This displacement is also a Redox reaction (Reduction-Oxidation).

• Iron undergoes oxidation as it loses two electrons to become Fe2+ ions (Fe → Fe2+ + 2e-).

• Copper ions in the solution undergo reduction as they gain those two electrons to become solid Copper atoms (Cu2+ + 2e- → Cu).

• Copper Sulphate (CuSO4):

• Commonly known as Blue Vitriol, it is an inorganic compound that often exists as a pentahydrate (CuSO4·5H2O).

• It is widely used as a fungicide in agriculture, in electroplating, and as a mordant in dyeing.

Important Points

• Physical Observations: In a laboratory setting, the change is not instantaneous; it usually takes 15 to 30 minutes for the fading of the blue colour and the brown coating to become clearly visible.

• Iron(II) Sulphate (FeSO4): The resulting light green solution contains Ferrous sulphate. If left exposed to air for a long time, it may further oxidize to Iron(III) sulphate.

• Reaction Specificity: If a Copper wire were placed in an Iron Sulphate solution, no reaction would occur because Copper is less reactive than Iron and cannot displace it.

Q14. Answer: (a) The particles scatter a beam of light but do not settle on standing.

The correct answer is The particles scatter a beam of light but do not settle on standing.

Key Points

• A colloidal solution is a heterogeneous mixture where the size of particles is intermediate between those of a true solution and a suspension, typically ranging from 1 nanometer (nm) to 1000 nm.

• One of the most defining characteristics of a colloid is the Tyndall effect, which is the scattering of a beam of light by the dispersed particles, making the path of light visible. Hence, the statement regarding scattering light is correct.

• Unlike suspensions, colloidal particles are small enough that they do not settle down under the influence of gravity when left undisturbed, making the mixture relatively stable. Hence, the statement regarding particles not settling is correct.

• In the case of starch in water, the starch molecules are large enough to scatter light but are still kept in a state of constant motion by the surrounding water molecules, preventing sedimentation.

• Colloidal particles cannot be seen with the naked eye; however, they can be observed through an ultramicroscope. Hence, the option stating they are visible to the naked eye is incorrect.

Additional Information

• True Solution:

• A homogeneous mixture where the particle size is less than 1 nm.

• These mixtures are transparent and do not scatter light because the particles are too small. Hence, the option describing a transparent mixture that does not scatter light refers to a true solution, not a colloid.

• Examples include salt in water or sugar in water.

• Suspension:

• A heterogeneous mixture containing large particles (greater than 1000 nm).

• The particles are visible to the naked eye and will settle down after some time due to gravity. Hence, the options suggesting particles are visible to the naked eye or settle down refer to a suspension.

• Examples include chalk powder in water or muddy water.

• Components of a Colloid:

• Dispersed Phase: The substance that is distributed or scattered in the medium (like starch in this example).

• Dispersion Medium: The medium in which the particles are distributed (like water in this example).

Important Points

• Brownian Motion: Colloidal particles show a continuous zigzag motion known as Brownian motion. This kinetic activity helps counteract the force of gravity, contributing to the stability of the colloid.

• Filtration: Colloidal particles are small enough to pass through standard filter paper, but they can be separated using special ultra-filters or animal membranes.

• Common Examples: Colloids are very common in daily life. Examples include milk (liquid in liquid), fog (liquid in gas), smoke (solid in gas), and cheese (liquid in solid).

• Classification: Based on the state of the dispersed phase and medium, colloids are classified into sols, gels, emulsions, and aerosols. A starch mixture is specifically categorized as a sol.

Q15. Answer: (b) its components retain their properties

The correct answer is its components retain their properties.

Key Points

• A mixture is a substance made by combining two or more different materials in such a way that no chemical reaction occurs. In a mixture, each constituent substance retains its own chemical identity and properties. Hence, statement 2 is correct.

• Unlike a compound, which has a fixed ratio of atoms, the components of a mixture can be present in variable proportions. For example, a sugar solution can be dilute or concentrated depending on the amount of sugar added. Hence, statement 1 is incorrect.

• A mixture does not show "combined" or entirely new properties; rather, it exhibits the individual properties of its parts. If you mix iron filings and sulfur powder, the iron still remains magnetic and can be pulled away with a magnet. Hence, statement 3 is incorrect.

• The components of a mixture can be separated by physical methods such as filtration, distillation, crystallization, or magnetism because they are not chemically bonded. In contrast, compounds can only be separated into elements through chemical reactions. Hence, statement 4 is incorrect.

• The formation of a mixture is a physical change and usually involves no energy change (absorption or evolution of heat/light) during the mixing process, whereas compound formation is a chemical change often accompanied by energy transfer.

Additional Information

• Types of Mixtures:

• Homogeneous Mixtures: These have a uniform composition throughout. Examples include air (a mixture of gases like nitrogen, oxygen, and carbon dioxide) and alloys like brass (copper and zinc).

• Heterogeneous Mixtures: These have non-uniform compositions where the different components can often be seen with the naked eye or a microscope. Examples include oil and water, sand and salt, or blood.

• Characteristics of Compounds:

• A compound is a substance formed when two or more elements are chemically bonded together.

• The properties of a compound are entirely different from its constituent elements. For instance, water (H_2O) is a liquid used to extinguish fires, but it is made of hydrogen (highly flammable gas) and oxygen (supporter of combustion).

• Compounds follow the Law of Definite Proportions, meaning they always contain the same elements in the same mass ratio.

• Separation Techniques:

• Centrifugation: Used for separating denser particles from lighter particles in a liquid (e.g., separating cream from milk).

• Chromatography: A technique used to separate components of a mixture based on their solubility in a solvent (e.g., separating pigments from natural colors).

• Fractional Distillation: Used to separate miscible liquids with boiling point differences of less than 25 K, such as components of petroleum or liquid air.

• Key Examples:

• Gunpowder: A mixture of potassium nitrate (75%), charcoal (15%), and sulfur (10%).

• Common Salt (NaCl): A compound of sodium (a highly reactive metal) and chlorine (a poisonous gas).

Important Points

• Chemical vs Physical Identity: The most fundamental difference lies in the identity of the atoms. In a mixture, atoms exist side-by-side. In a compound, atoms are rearranged into molecules or ionic lattices with new chemical bonds.

• Melting and Boiling Points: Pure compounds have sharp and fixed melting and boiling points, whereas mixtures often melt or boil over a range of temperatures depending on their composition.

• Energy: Formation of a mixture is not accompanied by a net chemical energy change, whereas the formation of a compound involves breaking old bonds and forming new ones, releasing or absorbing enthalpy.

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Q16. Answer: (c) Minor variations occur during DNA copying due to the inherent unreliability of biochemical reactions

The correct answer is Minor variations occur during DNA copying due to the inherent unreliability of biochemical reactions.

Key Points

• DNA copying is a fundamental biological process that occurs during cell division to ensure that each daughter cell receives a complete set of genetic instructions.

• The process of replicating Deoxyribonucleic Acid (DNA) involves various biochemical reactions. In biological systems, no chemical reaction is 100% reliable or accurate every single time.

• Due to this inherent unreliability of biochemical reactions, small inaccuracies or mutations creep in during the creation of the DNA copies. Hence, statement 3 is correct.

• These minor variations in the DNA sequence lead to slight differences in the proteins produced, which ultimately manifest as minor differences in the structure or appearance of the daughter cells.

• If the DNA copying process were perfectly accurate, the daughter cells would be identical clones; however, these variations are the raw material for evolution.

• Errors in protein synthesis (Option 1) occur after the genetic code has been established and generally affect the immediate metabolism of the cell rather than being the root cause of inherited structural differences between siblings. Hence, statement 1 is incorrect.

• The separation of DNA copies (Option 2) is a physical process called mitosis or meiosis. If this were incomplete, it would lead to major chromosomal abnormalities or cell death, rather than "minor" differences. Hence, statement 2 is incorrect.

• The absence of DNA blueprints (Option 4) is impossible for a living, dividing cell, as the nucleus must contain the genetic material to direct the formation of a new cell. Hence, statement 4 is incorrect.

Additional Information

• The Importance of Variation: While consistency in DNA copying is necessary to maintain the body design of a species, variation is crucial for survival. It allows a population to adapt to changing environmental conditions, such as shifts in temperature, global warming, or the introduction of new pathogens.

• Biochemical Basis: The replication process is catalyzed by enzymes like DNA polymerase. Although these enzymes have proofreading capabilities, they are not infallible. The error rate is extremely low (roughly one in a billion nucleotides), but in a genome of billions of base pairs, some variations are inevitable.

• Cellular Apparatus: Creating a copy of DNA is not enough for reproduction. The parent cell must also produce an additional cellular apparatus (like mitochondria, ribosomes, and cytoplasm) so that each DNA copy can function in a viable daughter cell.

• Genetic Material: DNA is located in the chromosomes within the nucleus of the cell. It carries the blueprint for all hereditary traits passed from one generation to the next.

Important Points

• Evolutionary Impact: Variations during asexual reproduction are generally very subtle. In contrast, sexual reproduction creates significantly more diversity because it involves the recombination of genetic material from two different individuals.

• Survival Value: If a niche changes drastically and a population consists of identical individuals, the entire species might be wiped out. However, if some variants exist (e.g., bacteria resistant to heat), those few will survive and continue the lineage.

• Date and Discovery: The double-helix structure of DNA was famously identified by James Watson and Francis Crick in 1953, which helped scientists understand how replication and variations occur at a molecular level.

Q17. Answer: (b) The force that causes a 1 kg object to accelerate at 1 m/s²

The correct answer is The force that causes a 1 kg object to accelerate at 1 m/s².

Key Points

• The Newton (N) is the International System of Units (SI) derived unit of force. It is defined based on the relationship between mass and motion.

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

• One Newton is specifically defined as the amount of force required to give a mass of 1 kilogram (1 kg) an acceleration of 1 metre per second squared (1 m/s²) in the direction of the applied force. Hence, statement 2 is correct.

• Statement 1 refers to static equilibrium or inertia (Newton's First Law), where the net force is zero, but it does not define the magnitude of the unit itself. Hence, statement 1 is incorrect.

• Statement 3 describes a concept closer to Work or Energy (measured in Joules), which involves force applied over a distance (Work = Force x Displacement). Hence, statement 3 is incorrect.

• Statement 4 mentions a 1 g object and "acceleration at 1 metre," which uses incorrect CGS units for the mass part and lacks the correct unit for acceleration (which must be distance/time²). Hence, statement 4 is incorrect.

Additional Information

• Etymology and History: The unit is named after Sir Isaac Newton, the English mathematician and physicist who formulated the

Laws of Motion and the Law of Universal Gravitation in his work "Philosophiæ Naturalis Principia Mathematica" published in 1687.

• Dimensional Formula: In terms of base units, the dimensional formula for force is [M^1 L^1 T^(-2)], where M represents Mass, L represents Length, and T represents Time.

• CGS System: In the Centimetre-Gram-Second (CGS) system of units, the unit of force is the dyne. One Newton is equivalent to 100,000 dynes (10^5 dynes).

• Weight vs. Mass: Weight is the force exerted on an object by gravity. On Earth, where the acceleration due to gravity (g) is approximately 9.81 m/s^2, a mass of 1 kg has a weight of approximately 9.81 Newtons.

• Vector Nature: Force is a vector quantity, meaning it is characterized by both magnitude and direction. The application of 1 Newton must specify which way the force is being pushed or pulled.

Important Points

• Standard Measurement: Force is typically measured using a spring balance or a force gauge (dynamometer). These devices often use Hooke's Law to relate the extension of a spring to the amount of Newtons applied.

• Common Conversions:

• 1 Newton ≈ 0.2248 pounds-force (lbf).

• 1 kilogram-force (kgf) = 9.80665 Newtons.

• 1 kilonewton (kN) = 1,000 Newtons, often used in structural engineering to measure heavy loads.

• Applications: The Newton is used to quantify various types of interactions, including friction, tension, normal force, air resistance, and applied force in mechanical systems.

Q18. Answer: (d) It has free-moving electrons.

The correct answer is It has free-moving electrons.

Key Points

• Graphite is a naturally occurring allotrope of carbon that exhibits unique physical and chemical properties due to its internal structure.

• In the atomic structure of graphite, each carbon atom is covalently bonded to only three other carbon atoms in a hexagonal planar arrangement.

• Carbon has four valence electrons. Since only three are used for bonding in graphite, the fourth electron remains unbonded and is delocalized.

• These delocalized electrons are free to move throughout the hexagonal layers of the crystal lattice. Hence, the statement that it has free-moving electrons is correct.

• The presence of these mobile electrons allows graphite to conduct electricity efficiently, making it an exception among non-metals, which are generally poor conductors.

Additional Information

• Hybridization and Bonding:

• In graphite, the carbon atoms undergo sp2 hybridization.

• The covalent bonds within the hexagonal rings are extremely strong, contributing to graphite's high stability and a melting point of approximately 3600°C to 3900°C.

• Physical State and Lubrication:

• Graphite consists of multiple layers or sheets. These layers are held together by weak Van der Waals forces.

• Because these forces are weak, the layers can slide over one another, giving graphite its soft, slippery, and greasy feel.

• This property makes it an excellent dry lubricant for machines operating at high temperatures.

• Applications:

• Electrodes: Due to its high electrical conductivity and heat resistance, it is used to make electrodes for electric arc furnaces and batteries.

• Pencils: It is mixed with clay to create the "lead" in pencils.

• Nuclear Reactors: High-purity graphite is used as a neutron moderator to slow down fast-moving neutrons in nuclear power plants.

• Comparison with Diamond:

• Unlike graphite, Diamond involves sp3 hybridization where all four valence electrons are used to form strong covalent bonds in a tetrahedral structure.

• Because there are no free electrons in its structure, diamond is an insulator (a very poor conductor of electricity).

Important Points

• Anisotropy: The conductivity of graphite is anisotropic, meaning it conducts electricity much better parallel to its layers than perpendicular to them.

• Chemical Inertness: Graphite is chemically inert to most acids and alkalis under normal conditions, which increases its utility in

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industrial applications involving corrosive environments.

• Color and Lustre: It is a greyish-black, opaque substance with a metallic lustre.

• Density: The density of graphite is approximately 2.26 g/cm³, which is lower than that of diamond (3.51 g/cm³) because of the large spacing between its layers.

Q19. Answer: (c) 10 A

The correct answer is 10 A.

Key Points

• The electric power (P) of an appliance is defined as the rate at which electrical energy is consumed or converted into other forms of energy (such as heat or light). It is measured in the SI unit of Watt (W).

• The mathematical relationship between power (P), voltage (V), and electric current (I) is expressed by the formula P = V × I.

• In the given problem, the power of the electric geyser is 2200 W and the potential difference (voltage) at which it operates is 220 V.

• To find the current (I) flowing through the heating element, we rearrange the formula to I = P / V.

• Substituting the given numerical values: I = 2200 / 220. By performing the division, we get I = 10 A. This signifies that a current of 10 Amperes flows through the geyser when it is operational.

• Hence, the correct answer is 10 A.

Additional Information

• Electric Current (I):

• It is the rate of flow of electric charge through a cross-section of a conductor. The SI unit is the Ampere (A), which is equivalent to one Coulomb per second (1 C/s).

• The instrument used to measure the magnitude of current in a circuit is called an Ammeter, which is always connected in series.

• Voltage (V):

• Also known as electric potential difference, it is the work done in moving a unit positive charge from one point to another. Its SI unit is the Volt (V).

• A Voltmeter is used to measure the potential difference and is always connected in parallel across the points where the voltage is to be measured.

• Resistance (R) and Ohm's Law:

• Resistance is the property of a conductor to resist the flow of charges through it. Its SI unit is the Ohm (Ω).

• According to Ohm's Law, the current through a conductor is directly proportional to the voltage across it (V = I × R), provided physical conditions like temperature remain constant.

• For the geyser in the question, the resistance of the coil can be calculated as R = V / I = 220 / 10 = 22 Ω.

• Joule's Law of Heating:

• Electric geysers work on the principle of the heating effect of electric current. When current passes through a high-resistance wire, electrical energy is converted into heat energy.

• The heat produced (H) is given by H = I²Rt, where I is current, R is resistance, and t is the time for which the current flows.

Important Points

• Power Variations: Power can also be calculated using the formulas P = I²R or P = V² / R depending on the known variables in a circuit.

• Commercial Unit of Energy: While the Watt is the unit of power, the commercial unit of electrical energy is the kilowatt-hour (kWh), often referred to as a "unit." 1 kWh is equal to 3.6 × 10^6 Joules.

• Safety Devices: For high-power appliances like a 2200 W geyser, using a fuse or a Miniature Circuit Breaker (MCB) with an appropriate rating (e.g., 15 A or 16 A) is essential to prevent electrical fires due to overloading.

Q20. Answer: (c) 0.5 m/s² ; -1 m/s²

The correct answer is 0.5 m/s² ; -1 m/s².

Key Points

• In the first scenario, the car starts from rest, which means its initial velocity (u) is 0 m/s. It reaches a final velocity (v) of 10 m/s within a time (t) of 20 seconds.

• The formula for acceleration (a) is derived from the first equation of motion: a = (v - u) / t. By substituting the values, we get a = (10 - 0) / 20, which equals 0.5 m/s².

• In the second scenario, the car is already moving at 10 m/s, making this the new initial velocity (u). Braking reduces its final velocity (v) to 5 m/s over a period of 5 seconds.

• Applying the same formula for the second scenario, a = (5 - 10) / 5, which results in -5 / 5 = -1 m/s². This negative value indicates retardation.

• The respective accelerations for the two scenarios are 0.5 m/s² and -1 m/s².

Additional Information

• Definition of Acceleration: It is defined as the rate of change of velocity with respect to time. Because it has both magnitude and direction, it is classified as a vector quantity.

• SI Unit: The standard unit for measuring acceleration in the International System of Units (SI) is meters per second squared (m/s²).

• Retardation or Deceleration: When the acceleration of an object is in the opposite direction of its velocity, it is called negative acceleration or retardation. This occurs when an object slows down, such as when brakes are applied to a vehicle.

• Uniform vs. Non-Uniform Acceleration: If the velocity changes by equal amounts in equal intervals of time, the object is said to have uniform acceleration. If the change in velocity is not constant over time, it is non-uniform.

• Equations of Motion: These are mathematical formulas that describe the behavior of a physical system in terms of its motion. The primary equations include $v = u + at$, $s = ut + \frac{1}{2}at^2$, and $v^2 = u^2 + 2as$, where s represents displacement.

Important Points

• Initial Velocity (u): When a body starts from rest, its u is always taken as 0. Conversely, if a body comes to a stop, its final velocity (v) is 0.

• Direction of Acceleration: If the velocity and acceleration are in the same direction, the speed of the object increases. If they are in opposite directions, the speed decreases.

• Graphic Representation: On a Velocity-Time graph, the slope of the line represents the acceleration of the object. A positive slope indicates acceleration, while a negative slope indicates deceleration.

• Numerical Values: In the given problem, the calculation shows a clear transition from a positive acceleration of 0.5 m/s² during the speeding-up phase to a negative acceleration of -1 m/s² during the braking phase.

Q21. Answer: (d) $g = GM/R^2$

The correct answer is g = GM/R^2.

Key Points

• The relationship between acceleration due to gravity (g) and the Universal Gravitational Constant (G) is derived from Newton's Law of Universal Gravitation and Newton's Second Law of Motion.

• According to the Law of Universal Gravitation, the force of attraction (F) between the Earth (mass M) and an object (mass m) on its surface is given by F = G(Mm/R^2), where R is the radius of the Earth.

• According to Newton's Second Law, the force acting on the object is also its weight, expressed as F = mg, where g is the acceleration due to gravity.

• By equating the two formulas for force (mg = GMm/R^2), the mass of the object (m) cancels out from both sides, leaving the equation g = GM/R^2. Hence, option 4 is correct.

• This formula shows that the value of g depends only on the mass of the Earth (M) and the radius of the Earth (R), and is independent of the mass of the falling object.

• The options g = GR/M^2, R^2/(GM), and g = GM/R are mathematically and dimensionally inconsistent with the physical laws of gravitation. Hence, options 1, 2, and 3 are incorrect.

Additional Information

• Universal Gravitational Constant (G): It is a scalar quantity with a constant value of approximately 6.674 x 10^-11 N m^2/kg^2. It was first experimentally determined by Henry Cavendish in 1798.

• Mass of the Earth (M): The Earth's mass is approximately 5.972 x 10^24 kg. This value, combined with G and R, results in the standard gravity we experience.

• Radius of the Earth (R): The mean radius of the Earth is about 6,371 kilometers (or 6.4 x 10^6 meters). Because the Earth is an oblate spheroid, the radius is larger at the Equator and smaller at the Poles.

• Value of g: On the surface of the Earth, the standard value of g is taken as 9.8 m/s^2. However, since g is inversely proportional to R^2, the value of g is maximum at the Poles (smallest radius) and minimum at the Equator (largest radius).

• Variation with Altitude and Depth: The value of g decreases as we go higher above the Earth's surface (altitude increases R) and also decreases as we go down into the Earth (towards the center), becoming zero at the center of the Earth.

Important Points

• Difference between G and g: G is a universal constant that remains the same everywhere in the universe, while g is a vector quantity that changes depending on the location (planet, altitude, or latitude).

• Units and Dimensions: The SI unit of g is m/s^2 (same as acceleration), and its dimensional formula is [M^0 L^1 T^-2].

• Weight vs. Mass: While mass is the amount of matter in an object and remains constant, weight (W = mg) is a force that changes if the value of g changes (e.g., you would weigh less on the Moon where g is about 1.62 m/s^2).

• Applications: This equation is fundamental in astrophysics and space science to calculate the escape velocity of a planet and to determine the orbital velocity of satellites.

Q22. Answer: (b) pollination

p data-end="57" data-start="0">The correct answer is pollination.

Key Points

• Pollination is the biological process of transferring pollen grains from the male anther of a flower to the female stigma. This process is essential for the fertilization and production of seeds in angiosperms (flowering plants). Hence, the correct answer is pollination.

• There are two main types of pollination: Self-pollination, where pollen is transferred within the same flower or to another flower on the same plant, and Cross-pollination, where pollen is transferred to a flower on a different plant of the same species.

• The transfer of pollen requires various agents known as pollinators. These can be biotic (living) such as bees, butterflies, birds, and bats, or abiotic (non-living) such as wind and water.

• When pollen lands on a compatible stigma, it begins to grow a pollen tube down the style to reach the ovule, leading to the fusion of male and female gametes.

• Plants have evolved specific features to attract pollinators, including brightly colored petals, scent, and nectar, which serve as a food source for insects and animals.

Additional Information

• Germination:

• It is the process by which a seed develops into a new plant or seedling.

• This process begins when the seed absorbs water (imbibition), causing the seed coat to burst and the embryo to resume growth.

• Factors required for successful germination include oxygen, moisture, and an optimum temperature.

• Guttation:

• It is the loss of water in the form of liquid droplets from the margins or tips of leaves of some vascular plants.

• This occurs through specialized pores called hydathodes, usually during the night or early morning when the humidity is high and soil moisture is abundant.

• It is driven by root pressure rather than transpiration.

• Gestation:

• In biology, gestation refers to the period of development of an embryo or fetus inside the mother's uterus (womb).

• This term is specifically used for viviparous animals, primarily mammals.

• The gestation period varies by species; for example, it is approximately 280 days (9 months) in humans and about 600-660 days in elephants.

Important Points

• Pollination Syndromes: Different plants use different methods to attract pollinators. Anemophily refers to wind pollination, while Entomophily refers to pollination by insects.

• Fertilization: While pollination is the physical transfer of pollen, fertilization is the actual chemical union of the sperm (from pollen) and egg (inside the ovule).

• Ecological Importance: Pollination is a vital ecosystem service. Over 75% of the world's food crops depend, at least in part, on pollination by animals.

Q23. Answer: (a) The point on the principal axis where parallel rays converge (or appear to diverge) after reflection

The correct answer is The point on the principal axis where parallel rays converge (or appear to diverge) after reflection.

Key Points

• The Principal Focus (represented by F) of a spherical mirror is a specific point on the Principal Axis where light rays that are initially parallel to the axis actually meet or seem to meet after undergoing reflection.

• In the case of a Concave Mirror, the rays coming from infinity (parallel to the principal axis) actually converge at this point in front of the mirror. Hence, statement 1 is correct.

• In the case of a Convex Mirror, the parallel rays diverge after reflection, but they appear to originate from the principal focus located behind the mirror.

• The center of the mirror’s reflecting surface is known as the Pole (P), not the principal focus. Hence, statement 2 is incorrect.

• While the principal focus is mathematically the midpoint of the Radius of Curvature (distance between the Pole and the Center of Curvature), this describes its position rather than its fundamental definition. Hence, statement 3 is not the primary definition.

• The distance between the object and the image is a variable quantity depending on the object position and is not related to the definition of the focus. Hence, statement 4 is incorrect.

Additional Information

• Pole (P): The geometric center of the spherical reflecting surface of the mirror. It lies on the surface of the mirror and is the origin for all distance measurements in the Cartesian sign convention.

• Center of Curvature (C): The center of the hollow sphere of glass of which the spherical mirror is a part. For a concave mirror, it

is in front, whereas for a convex mirror, it is behind the reflecting surface.

• Principal Axis: An imaginary straight line passing through the Pole and the Center of Curvature of the mirror. It is normal to the mirror at its pole.

• Focal Length (f): The distance between the Pole and the Principal Focus. For spherical mirrors with small apertures, the focal length is exactly half of the Radius of Curvature (R), expressed as f = R/2.

• Aperture: The diameter of the reflecting surface of the spherical mirror, which determines the intensity of the image formed by the amount of light it can intercept.

Important Points

• Real Focus: A concave mirror has a real focus because light rays actually pass through it after reflection. It can be used to capture a sharp image of a distant object (like the Sun) on a screen.

• Virtual Focus: A convex mirror has a virtual focus because the light rays only appear to meet there. No real image can be formed at this point on a screen.

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

• Applications: Concave mirrors are used in solar furnaces to concentrate sunlight at the focus to produce heat. Convex mirrors are used as rear-view mirrors in vehicles because they provide a wider field of view and always form an erect image.

Q24. Answer: (b) 17

The correct answer is 17.

Key Points

• An atom is fundamentally neutral in its ground state. This means the total positive charge provided by the protons must be exactly balanced by the total negative charge provided by the electrons.

• The number of protons in an atom is known as its Atomic Number (represented by the symbol Z). It defines the identity of the chemical element.

• In the given question, the atom contains 17 electrons. For the atom to remain electrically neutral, the number of protons must be equal to the number of electrons. Therefore, the number of protons is 17. Hence, the correct answer is 17.

• The neutrons are subatomic particles found in the nucleus that carry no charge. While they contribute to the mass of the atom, they do not influence the count of protons required for electrical neutrality.

• The element with Atomic Number 17 is Chlorine (Cl). In this specific case, with 18 neutrons, the atom refers to the most common isotope of Chlorine, which is Chlorine-35.

Additional Information

• Subatomic Particles:

• Protons: These were discovered by Ernest Rutherford (though often associated with E. Goldstein). They have a relative charge of +1 and a mass of approximately 1.672 x 10^-27 kg.

• Electrons: Discovered by J.J. Thomson in 1897 through cathode ray experiments. They have a relative charge of -1 and a negligible mass compared to nucleons.

• Neutrons: Discovered by James Chadwick in 1932. They are neutral (zero charge) and have a mass slightly greater than that of a proton.

• Mass Number (A):

• The Mass Number is the sum of the total number of protons and neutrons present in the nucleus of an atom.

• For the given atom: Mass Number (A) = Protons (17) + Neutrons (18) = 35.

• The total number of protons and neutrons are collectively called nucleons.

• Atomic Notation:

• Elements are usually represented as ^AX_Z, where X is the chemical symbol, A is the mass number, and Z is the atomic number.

• The atom in the question would be represented as ^(35)Cl17.

Important Points

• Isotopes: These are atoms of the same element (same Atomic Number) that have different numbers of neutrons (different Mass Numbers). For example, Chlorine has isotopes like Chlorine-35 and Chlorine-37.

• Ions: If an atom gains or loses electrons, it becomes an ion. In an ion, the number of protons and electrons are not equal. However, the number of protons (atomic number) never changes during a chemical reaction.

• Valency: Chlorine has 17 electrons. Its electronic configuration is 2, 8, 7. Since it requires 1 electron to complete its octet, its valency is 1.

• Calculations:

• Number of Protons = Atomic Number (Z).

• Number of Neutrons = Mass Number (A) - Atomic Number (Z).

• In a neutral atom: Protons = Electrons.

Q25. Answer: (b) 2%

The correct answer is 2%.

Key Points

• The concentration of a solution is the amount of solute present in a given quantity of the solution or solvent. It can be expressed in various ways, including Mass by Volume Percentage.

• Mass by Volume Percentage (w/v %) is defined as the mass of the solute in grams dissolved in 100 mL of the solution.

• In this problem, the mass of the solute is given as 5 g.

• The total volume of the solution is given as 250 mL.

• The mathematical formula to calculate this concentration is: Concentration = (Mass of Solute / Volume of Solution) x 100.

• Substituting the given values: (5 / 250) x 100.

• Performing the calculation: 5 / 250 = 0.02. Then, 0.02 x 100 = 2. Therefore, the concentration is 2%.

Additional Information

• Solute: This is the component of the solution that is dissolved in the solvent and is usually present in a smaller amount. In this example, the 5 g of substance is the solute.

• Solvent: This is the component of the solution that dissolves the other component and is usually present in a larger amount (often water).

• Solution: A homogeneous mixture of two or more substances. The volume of the solution used in the denominator of the w/v % formula must represent the final volume of the mixture.

• Other Concentration Expressions:

• Mass by Mass Percentage (w/w %): Calculated as (Mass of Solute / Mass of Solution) x 100.

• Volume by Volume Percentage (v/v %): Calculated as (Volume of Solute / Volume of Solution) x 100, typically used for liquid-in-liquid solutions like alcohol in water.

• Molarity (M): Another vital unit of concentration defined as the number of moles of solute per liter of solution.

Important Points

• The units must be consistent when using the percentage formula. For mass by volume %, the standard practice is to use grams (g) for mass and milliliters (mL) for volume.

• A 2% (w/v) solution means that every 100 mL of that solution contains 2 g of the dissolved solute.

• In pharmacology and medicine, many intravenous fluids and liquid medications are labeled using this mass by volume percentage system (e.g., 0.9% Normal Saline).

• If the volume was given in Liters, it must be converted to milliliters (1 L = 1000 mL) before applying the percentage formula.

Q26. Answer: (c) 1

Shortcut Trick

Simplify the expression by summing the exponents of common bases x and y.

Power of x → 3 + 1 + (−4) = 0 => x^0 = 1.

Power of y → −2 − (−2) = 0 => y^0 = 1.

The total value of the expression is 1 × 1 = 1.

The square of the expression is $1^2 = 1$.

Therefore The correct answer is 1.

Alternate Method

Given:

Expression: $(x^3/y^2) \times (1/x^{(-1)}) \div y^{(-2)} \times (1/x^2)^2$

Formula Used:

1. $a^{(-n)} = 1/a^n$ | 2. $(a^m)^n = a^{(mn)}$ | 3. $a^m \times a^n = a^{(m+n)}$ | 4. $a^m \div a^n = a^{(m-n)}$

Calculations:

=> Term 1: $x^3/y^2 = x^3y^{(-2)}$

=> Term 2: $1/x^{(-1)} = x^1$

=> Term 3: $\div y^{(-2)} = \times (1/y^{(-2)}) = \times y^2$

=> Term 4: $(1/x^2)^2 = 1/x^4 = x^{(-4)}$

=> Combining all: $(x^3y^{(-2)}) \times x^1 \times y^2 \times x^{(-4)}$

=> Expression = x^((3 + 1 − 4)) × y^((−2 + 2))

=> Expression = x^0 × y^0 = 1 × 1 = 1

=> Square of Expression = $(1)^2$ = 1

Therefore The correct answer is 1.

Additional Information

Laws of Exponents

When multiplying terms with the same base, add the powers: a^m × a^n = a^(m+n). When dividing, subtract the powers: a^m ÷ a^n = a^(m−n).

Zero Exponent Rule

Any non-zero base raised to the power of zero is always equal to 1 (a^0 = 1).

Negative Exponents

A negative exponent denotes the reciprocal: a^(−n) = 1/a^n. Conversely, 1/a^(−n) = a^n.

Q27. Answer: (a) 20

Shortcut Trick

Find the deviation of the 8^(th) inning score from the old average: 217 − 59 = 158.

Distribute this excess score across the total number of innings (8).

Increase in average = 158 ÷ 8 = 19.75.

Rounding 19.75 to the nearest whole number gives 20.

Therefore The correct answer is 20.

Alternate Method

Given: Average of 7 innings = 59, Score in 8^(th) inning = 217.

Formula Used: Average = Total Runs ÷ Number of Innings; Increase = New Average − Old Average.

=> Total runs in 7 innings = 7 × 59 = 413

=> Total runs in 8 innings = 413 + 217 = 630

=> New average score = 630 ÷ 8 = 78.75

=> Increase in average = 78.75 − 59 = 19.75

=> Rounded to the nearest whole number = 20

Therefore The correct answer is 20.

Additional Information

Arithmetic Mean (Average)

The sum of all observations divided by the total number of observations. Formula: Avg = Σx ÷ n.

Deviation Method for Averages

When a new value is added, the change in average is (New Value − Old Average) ÷ New Total Count.

Rounding Off Rule

If the decimal part is 0.5 or greater, round up to the next integer; otherwise, round down. Here, 19.75 rounds to 20.

Q28. Answer: (b) 238

Shortcut Trick

List the first 13 prime numbers directly: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41.

Sum = 2 + 3 + 5 + 7 + 11 + 13 + 17 + 19 + 23 + 29 + 31 + 37 + 41 = 238.

Therefore The correct answer is 238.

Alternate Method

Given: First 13 prime numbers.

Formula Used: Sum of numbers = sum of individual terms.

=> Prime numbers are natural numbers greater than 1 that have no positive divisors other than 1 and themselves.

=> First 13 prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41.

=> Sum = 2 + 3 + 5 + 7 + 11 + 13 + 17 + 19 + 23 + 29 + 31 + 37 + 41

=> Sum = 10 + 7 + 11 + 13 + 17 + 19 + 23 + 29 + 31 + 37 + 41

=> Sum = 17 + 11 + 13 + 17 + 19 + 23 + 29 + 31 + 37 + 41

=> Sum = 28 + 13 + 17 + 19 + 23 + 29 + 31 + 37 + 41

=> Sum = 41 + 17 + 19 + 23 + 29 + 31 + 37 + 41

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=> Sum = 58 + 19 + 23 + 29 + 31 + 37 + 41

=> Sum = 77 + 23 + 29 + 31 + 37 + 41

=> Sum = 100 + 29 + 31 + 37 + 41

=> Sum = 129 + 31 + 37 + 41

=> Sum = 160 + 37 + 41

=> Sum = 197 + 41 = 238.

Therefore The correct answer is 238.

Additional Information

Prime Numbers

A prime number is a natural number greater than 1 that has exactly two distinct positive divisors: 1 and itself. The number 2 is the only even prime number.

Composite Numbers

Numbers greater than 1 that are not prime are called composite numbers. The number 1 is neither prime nor composite.

Co-prime Numbers

Two numbers are co-prime if their Highest Common Factor (HCF) is 1.

Q29. Answer: (c) 105

Shortcut Trick

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

Given a = 5, b = X, c = 3, and d = 63.

=> 5 × 63 = X × 3

=> X = (5 × 63) ÷ 3 = 5 × 21 = 105.

Therefore The correct answer is 105.

Alternate Method

Given: First term (a) = 5, Second term (b) = X, Third term (c) = 3, Fourth proportion (d) = 63.

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

=> 5/X = 3/63

=> 5/X = 1/21

=> X = 5 × 21

=> X = 105

Therefore The correct answer is 105.

Additional Information

Fourth Proportion

For three numbers a, b, and c, the fourth proportion d is defined such that a:b = c:d, which implies d = (b × c) ÷ a.

Third Proportion

For two numbers a and b, the third proportion c is defined such that a:b = b:c, which implies c = b^2 ÷ a.

Mean Proportion

The mean proportion between two numbers a and b is given by √(a × b).

Q30. Answer: (d) 30 minutes

Shortcut Trick

When distance is constant, Speed is inversely proportional to Time.

Speed Ratio (Usual : New) = 7 : 5

Time Ratio (Usual : New) = 5 : 7

Difference in time units = 7 − 5 = 2 units → 12 minutes

1 unit = 6 minutes

Usual Time = 5 units = 5 × 6 = 30 minutes

Therefore The correct answer is 30 min.

Alternate Method

Given: New speed = 5/7 of usual speed, Time delay = 12 minutes.

Formula Used: Distance = Speed × Time

=> Let usual speed be s and usual time be t.

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=> Distance D = s × t
=> New speed = 5s/7, New time = t + 12
=> D = (5s/7) × (t + 12)
=> s × t = (5s/7) × (t + 12)
=> 7t = 5t + 60
=> 2t = 60
=> t = 30 minutes
Therefore The correct answer is 30 min.
Additional Information
Speed-Time Inverse Relation
If speed becomes a/b of the original speed, the time taken becomes b/a of the original time.
Late/Early Concept
Usual Time = (Late Time × a) / (b − a) where speed factor is a/b and b > a.
Average Speed
For constant distance, Average Speed = (2 × s1 × s2) / (s1 + s2).

Q31. Answer: (b) 12√3 : 5√(10 + 2√5)

Shortcut Trick
Area of a regular n-gon inscribed in a circle of radius R is given by: Area = (n ÷ 2) × R^2 × sin(360° ÷ n).
Ratio of areas = [6 × sin(60°)] : [5 × sin(72°)]
Ratio = [6 × (√3 ÷ 2)] : [5 × (√(10 + 2√5) ÷ 4)]
Ratio = 3√3 : [5√(10 + 2√5) ÷ 4]
Ratio = 12√3 : 5√(10 + 2√5)
Therefore The correct answer is 12√3 : 5√(10 + 2√5).
Alternate Method
Given:
Radius of the circle = R
Number of sides of the first polygon (Hexagon), n1 = 6
Number of sides of the second polygon (Pentagon), n2 = 5
Formula Used:
Area of a regular polygon with n sides inscribed in a circle of radius R = (n ÷ 2) × R^2 × sin(2π ÷ n)
Calculations:
=> Area of Hexagon (A1) = (6 ÷ 2) × R^2 × sin(360° ÷ 6)
=> A1 = 3 × R^2 × sin(60°) = 3 × R^2 × (√3 ÷ 2) = (3√3 ÷ 2)R^2
=> Area of Pentagon (A2) = (5 ÷ 2) × R^2 × sin(360° ÷ 5)
=>

Q32. Answer: (a) 864 cm^2

Shortcut Trick
Side of the cube (a) = $\sqrt[3]{\text{Volume}}$
Side (a) = $\sqrt[3]{1728}$ = 12 cm
Total Surface Area = 6 × a^2 = 6 × $(12)^2$
Total Surface Area = 6 × 144 = 864 cm^2
Therefore The correct answer is 864 cm^2.
Alternate Method
Given:
Volume of the cube = 1728 cm^3
Formula Used:
1) Volume of a cube (V) = a^3
2) Total Surface Area (TSA) = 6a^2
Where 'a' is the side of the cube.
Calculations:

=> $a^3 = 1728$

=> $a = \sqrt[3]{(12 \times 12 \times 12)}$

=> $a = 12$ cm

=> Total Surface Area = $6 \times (12)^2$

=> Total Surface Area = 6×144

=> Total Surface Area = 864 cm^2

Therefore The correct answer is 864 cm^2.

Additional Information

Lateral Surface Area (LSA)

The surface area of the four vertical sides of a cube is given by LSA = $4a^2$.

Diagonal of a Cube

The longest distance between two opposite corners (space diagonal) is $d = a\sqrt{3}$.

Volume of a Cuboid

For a rectangular prism with length (l), breadth (b), and height (h), the volume is $l \times b \times h$.

Q33. Answer: (b) $\sqrt{(1 - x^2)}$

Shortcut Trick

Using the fundamental Trigonometric Identity: sin2t + cos2t = 1.

Given cos t = x, then sin2t = 1 − x2.

Since t is an acute angle (0 < t < 90°), sin t must be positive.

Taking the square root: sin t = √(1 − x2).

Therefore The correct answer is √(1 − x2).

Alternate Method

Given: cos t = x, where t is an acute angle.

Formula Used: cos t = Base / Hypotenuse and sin t = Perpendicular / Hypotenuse.

=> Let Hypotenuse = 1 and Base = x.

=> Using Pythagoras Theorem: Perpendicular2 + Base2 = Hypotenuse2.

=> Perpendicular2 + x2 = 12.

=> Perpendicular2 = 1 − x2.

=> Perpendicular = √(1 − x2).

=> sin t = Perpendicular / Hypotenuse = √(1 − x2) / 1.

=> sin t = √(1 − x2).

Therefore The correct answer is √(1 − x2).

Additional Information

Pythagorean Identities

Standard identities include $\sin^2\theta + \cos^2\theta = 1$, $1 + \tan^2\theta = \sec^2\theta$, and $1 + \cot^2\theta = \operatorname{cosec}^2\theta$.

ASTC Rule (Quadrants)

In the first quadrant (acute angles), all trigonometric ratios (sin, cos, tan, etc.) are positive.

Tangent in terms of x

If cos t = x, then tan t = sin t / cos t = √(1 − x2) / x.

Q34. Answer: (b) Rs. 6,962

Shortcut Trick

Effective interest rate for 2 years at 18% = 18 + 18 + (18 × 18) ÷ 100 = 36 + 3.24 = 39.24%.

Total Amount percentage = 100% (Principal) + 39.24% (Interest) = 139.24%.

Amount = 5000 × 139.24% = 50 × 139.24 = 6962.

Therefore The correct answer is Rs. 6,962.

Alternate Method

Given:

Principal (P) = Rs. 5,000

Rate of Interest (R) = 18% per annum

Time (n) = 2 years

Formula Used:

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

Calculations:

=> $A = 5000 \times (1 + 18 \div 100)^2$

=> $A = 5000 \times (1 + 0.18)^2$

=> $A = 5000 \times (1.18)^2$

=> $A = 5000 \times 1.3924$

=> $A = 6962$

Therefore The correct answer is Rs. 6,962.

Additional Information

Difference between CI and SI

The difference (D) between compound interest and simple interest for 2 years is given by: $D = P(R \div 100)^2$.

Effective Rate of Interest

For two years at rate R%, the effective rate is R + R + (R × R) ÷ 100. This follows the successive percentage change rule.

Compounded Half-Yearly

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

Q35. Answer: (d) 7

Shortcut Trick

LCM of 2 and 3 is 6. Let Bibha buy 6 bananas of each type.

CP of first 6 = 6 ÷ 2 = 3. CP of next 6 = 6 ÷ 3 = 2. Total CP for 12 bananas = 3 + 2 = 5.

To make a 40% profit, use multiplier: SP = CP × (100 + P%) ÷ 100.

SP for a dozen (12 bananas) = 5 × 140 ÷ 100 = 7.

Therefore The correct answer is 7.

Alternate Method

Given: CP1 = 1 rupee for 2 bananas, CP2 = 1 rupee for 3 bananas. Equal quantity bought. Desired Profit = 40%.

Formulas: Total CP = CP1 + CP2 | SP = CP × (100 + Profit%) ÷ 100

=> Let Bibha buy x bananas at each rate. Total bananas = 2x.

=> CP of x bananas at 2 for a rupee = x/2.

=> CP of x bananas at 3 for a rupee = x/3.

=> Total CP for 2x bananas = x/2 + x/3 = 5x/6.

=> To find CP of 12 bananas, let 2x = 12 => x = 6.

=> CP of 12 bananas = 5(6)/6 = 5.

=> SP = 5 × (140/100) = 5 × 1.4 = 7.

Therefore The correct answer is 7.

Additional Information

Unitary Method in CP

Always calculate the cost price of a single unit (or a common multiple like LCM) to simplify calculations when items are bought at different rates.

Profit Calculation

Profit is always calculated on the total cost price incurred, which includes all batches of items purchased.

Q36. Answer: (c) Increase by 25.4%

Shortcut Trick

Let the cost of a TV be 100.

Cost of Washing Machine (WM) = 100 − 25% of 100 = 75.

Initial total cost of 6 WM + 3 TV = (6 × 75) + (3 × 100) = 450 + 300 = 750.

New WM cost = 75 × 1.75 = 131.25; New TV cost = 100 × 0.51 = 51.

New total cost = (6 × 131.25) + (3 × 51) = 787.5 + 153 = 940.5.

Percentage change = (940.5 − 750) ÷ 750 × 100 = 190.5 ÷ 750 × 100 = 25.4%.

Therefore The correct answer is Increase by 25.4%.

Alternate Method

Given: Cost of WM = 75% of TV cost. Number of units: WM = 6, TV = 3.

Formulas: Total Cost = (Price1 × Quantity1) + (Price2 × Quantity2) | % Change = (New − Old) ÷ Old × 100.

=> Let TV cost = 100x and WM cost = 75x.

=> Initial Total Cost = 6(75x) + 3(100x) = 450x + 300x = 750x.

=> Increase in WM cost = 75% of 75x = 56.25x. Decrease in TV cost = 49% of 100x = 49x.

=> Total Net Change = 6(56.25x) − 3(49x) = 337.5x − 147x = 190.5x.

=> Percentage change = (190.5x ÷ 750x) × 100 = 25.4%.

Therefore The correct answer is Increase by 25.4%.

Additional Information

Percentage Change in Aggregates

When multiple items are involved, the total percentage change is the weighted average of the individual percentage changes.

Effective Change Calculation

Net % Change = (Total Final Value − Total Initial Value) ÷ Total Initial Value × 100.

Q37. Answer: (c) 1.8

Shortcut Trick

Convert the fraction directly into a decimal.

2/5 = 0.4

Now, add it to the given decimal value:

Expression = 0.4 + 1.4 = 1.8

Therefore The correct answer is 1.8.

Alternate Method

Given:

Expression = 2/5 + 1.4

Calculation:

=> Convert the decimal 1.4 into a fraction.

=> 1.4 = 14/10

=> Simplify the fraction: 14/10 = 7/5

=> Substitute the fraction back into the expression:

=> Expression = 2/5 + 7/5

=> Since the denominators are the same, add the numerators directly:

=> Expression = (2 + 7) / 5 = 9/5

=> Convert the resulting fraction back to a decimal:

=> 9/5 = 1.8

Therefore The correct answer is 1.8.

Additional Information

BODMAS Rule

Always simplify expressions using the sequence: Brackets, Orders (powers/roots), Division, Multiplication, Addition, and Subtraction.

Fraction to Decimal Conversion

To convert a fraction to a decimal, divide the numerator by the denominator. If the denominator is a factor of 10, 100, etc., multiply both the numerator and denominator by the necessary multiplier to easily convert it into a decimal (e.g., 2/5 = (2 × 2) / (5 × 2) = 4/10 = 0.4).

Q38. Answer: (c) 49 years

Shortcut Trick

Ratio of A : B is 3 : 1. Let their ages be 3x and x.

New condition: (3x + 4) = 5 × (x − 6)

=> 3x + 4 = 5x − 30 => 2x = 34 => x = 17.

Current age of A = 3 × 17 = 51 years.

Age of A two years ago = 51 − 2 = 49 years.

Therefore The correct answer is 49 years.

Alternate Method

Given: A = 3B

Formula Used: Linear equation in one variable.

=> Let B's present age be x years.

=> A's present age = 3x years.

=> According to question: (3x + 4) = 5(x − 6)

=> 3x + 4 = 5x − 30

=> 5x − 3x = 30 + 4

=> 2x = 34 => x = 17.

=> A's present age = 3 × 17 = 51 years.

=> A's age two years ago = 51 − 2 = 49 years.

Therefore The correct answer is 49 years.

Additional Information

Ratio Method for Ages

If the age ratio changes over time, equate the parts by finding the difference between ratio terms and multiplying cross-ratio values.

Age Difference Constant

The difference between the ages of two people remains constant regardless of how many years pass or are subtracted.

Base Change in Ages

Always identify the present age as the base (x) to easily calculate past (x − n) or future (x + n) ages.

Q39. Answer: (d) Rs. 1,050

Shortcut Trick

Total deduction = 79 + 25 + 19 = Rs. 123

Remaining amount = 5,403 − 123 = Rs. 5,280

Ratio of shares = 14 : 5 : 11 (Total parts = 30)

1 part = 5,280 ÷ 30 = Rs. 176

B's remaining = 176 × 5 = Rs. 880; C's remaining = 176 × 11 = Rs. 1,936

Difference = (1,936 + 19) − (880 + 25) = 1,955 − 905 = Rs. 1,050

Therefore The correct answer is Rs. 1,050.

Alternate Method

Given: Total amount = Rs. 5,403. Deductions = Rs. 79, Rs. 25, Rs. 19. Ratio = 14 : 5 : 11.

=> Net Amount = 5,403 − (79 + 25 + 19) = Rs. 5,280

=> Let the shares after deduction be 14x, 5x, and 11x.

=> 14x + 5x + 11x = 5,280

=> 30x = 5,280 => x = 176

=> B's original share = 5x + 25 = (5 × 176) + 25 = 880 + 25 = Rs. 905

=> C's original share = 11x + 19 = (11 × 176) + 19 = 1,936 + 19 = Rs. 1,955

=> Difference = 1,955 − 905 = Rs. 1,050

Therefore The correct answer is Rs. 1,050.

Additional Information

Ratio & Proportion Basics

If a sum S is divided into a ratio a:b:c, the share of the first part is [a / (a+b+c)] × S.

Division with Adjustments

When fixed amounts are deducted from or added to shares, first adjust the total sum accordingly before applying the ratio division.

Difference between shares

Difference between shares can be calculated by finding individual values or by (Ratio Difference × Value of 1 part) ± Adjustment difference.

Q40. Answer: (a) Rs. 30,000

Shortcut Trick

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

Savings % = 100% − 50% = 50%

Monthly Savings = 50% of Rs. 60,000 = Rs. 30,000

Therefore The correct answer is Rs. 30,000.

Alternate Method

Given:

Monthly Income = Rs. 60,000

Rent = 25%, Groceries = 15%, Transportation = 10%

Calculations:

=> Total Expenditure = (25 + 15 + 10) % of Income

=> Total Expenditure = 50% of Rs. 60,000 = Rs. 30,000

=> Savings = Total Income − Total Expenditure

=> Savings = Rs. 60,000 − Rs. 30,000

=> Savings = Rs. 30,000

Therefore The correct answer is Rs. 30,000.

Additional Information

Percentage Expenditure

When percentages are given on the original income, they are additive: Total % = P1 + P2 + ... + P_n.

Remaining Income Concept

If the question states spending of the remaining income, use the successive formula: Remaining = Income × (1 − r1/100) × (1 − r2/100).

Savings Ratio

Savings = Income − Expenditure. The ratio of Expenditure to Savings in this case is 50:50 or 1:1.

Q41. Answer: (a) 2800

Shortcut Trick

Convert percentages and fractions into a single multiplier: 0.9 × 0.8 × (2/7) × Number = 576.

Number = 576 ÷ (0.72 × 2/7) = 576 ÷ (1.44/7).

Number = (576 × 7) ÷ 1.44 = 400 × 7 = 2800.

Therefore The correct answer is 2800.

Alternate Method

Given: 90% of 80% of 2/7 of x = 576

=> (90/100) × (80/100) × (2/7) × x = 576

=> (9/10) × (4/5) × (2/7) × x = 576

=> (72/350) × x = 576

=> x = (576 × 350) ÷ 72

=> x = 8 × 350

=> x = 2800

Therefore The correct answer is 2800.

Additional Information

Percentage to Fraction Conversion

Always simplify percentages into fractions (e.g., 80% = 4/5, 90% = 9/10) to make large multiplications easier to cancel out.

Successive Percentage Rule

When applying multiple percentages to a number, the order does not matter; a% of b% of x is the same as (a × b / 100)% of x.

Base Value Identification

If "x" is the original number, any percentage of it is x × (rate/100). For "of" operations, always use multiplication.

Q42. Answer: (c) 19 seconds

Shortcut Trick

Relative Speed in opposite direction = 58 + 68 = 126 km/h

Conversion to m/s = 126 × (5/18) = 7 × 5 = 35 m/s

Total Distance = 316 + 349 = 665 m

Time taken = 665 ÷ 35 = 19 seconds

Therefore The correct answer is 19 sec.

Alternate Method

Given:

Length of first train (L1) = 316 m

Length of second train (L2) = 349 m

Speed of first train (S1) = 58 km/h

Speed of second train (S2) = 68 km/h

Formula Used:

Time = Total Distance ÷ Relative Speed

Relative Speed (Opposite Direction) = S1 + S2

Calculations:

=> Total distance = 316 + 349 = 665 m

=> Relative speed = 58 + 68 = 126 km/h

=> Speed in m/s = 126 × (5/18) = 35 m/s

=> Time taken = 665 ÷ 35

=> Time taken = 19 seconds

Therefore The correct answer is 19 sec.

Additional Information

Relative Speed Concept

When moving in opposite directions, speed = S1 + S2. When moving in the same direction, speed = |S1 − S2|.

Unit Conversion

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

Crossing Objects

When a train crosses another train/platform, Distance = Length of Train 1 + Length of Train 2/Platform.

Q43. Answer: (d) 85

Shortcut Trick

Mode is the observation that appears most frequently in a data set.

List of numbers: 115, 190, 110, 185, 85, 110, 115, 102, 90, 95, 85, 68, 85

Frequency of 85 = 3 times (Highest among all numbers).

Frequency of 115 = 2 times | Frequency of 110 = 2 times | Others = 1 time.

Therefore The correct answer is 85.

Alternate Method

Given: Observations = 115, 190, 110, 185, 85, 110, 115, 102, 90, 95, 85, 68, 85

Formula Used: Mode = Value with maximum frequency.

To find the Mode, we construct a frequency table for the given data:

=> Number 85 appears: 3 times

=> Number 115 appears: 2 times

=> Number 110 appears: 2 times

=> Number 190, 185, 102, 90, 95, 68 appear: 1 time each

=> The maximum frequency is 3, which corresponds to the number 85.

Therefore Mode = 85

Therefore The correct answer is 85.

Additional Information

Definition of Mode

The mode is the value that occurs most frequently in a dataset. A dataset can be unimodal (one mode), bimodal (two modes), or multimodal.

Empirical Relationship

For a moderately skewed distribution, the relationship is: Mode = 3 × Median − 2 × Mean.

Median

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

Mean (Arithmetic Average)

The sum of all observations divided by the total number of observations: Mean = $\Sigma x_i \div n$.

Q44. Answer: (d) 60.44%

Shortcut Trick

Let the Marked Price (MP) be 100.

Effective Price (SP) = MP × (1 − d1/100) × (1 − d2/100) × (1 − d3/100)

SP = 100 × 0.90 × 0.73 × 0.92

SP = 90 × 0.6716 = 60.444

Effective price percentage = (60.444 ÷ 100) × 100 ≈ 60.44%

Therefore The correct answer is 60.44%.

Alternate Method

Given → Discounts = 10%, 27%, 8%. Formulas → Net Selling Price = MP × (100−d1)% × (100−d2)% × (100−d3)%.

=> First discount: 100 − 10% of 100 = 90.

=> Second discount: 90 − 27% of 90 = 90 − 24.3 = 65.7.

=> Third discount: 65.7 − 8% of 65.7 = 65.7 − 5.256 = 60.444.

=> Effective Price % = (60.444 ÷ 100) × 100 = 60.444%.

Therefore The correct answer is 60.44%.

Additional Information

Successive Discount Formula

For two discounts a% and b%, the single equivalent discount is (a + b − ab/100)%.

Effective Price vs Discount

The effective price percentage is (100 − Equivalent Discount)%. In this problem, the total discount is approx 39.56%.

Q45. Answer: (a) Number of 2-point shots = 6; Number of 3-point shots = 8

Shortcut Trick

Assume all 14 shots were 2-pointers: Total points = 14 × 2 = 28 points.

The difference from actual score is 36 − 28 = 8 points.

Each 3-point shot adds 1 point (3 − 2 = 1) over a 2-point shot.

Number of 3-point shots = 8 ÷ 1 = 8.

Number of 2-point shots = 14 − 8 = 6.

Therefore The correct answer is Number of 2-point shots = 6; Number of 3-point shots = 8.

Alternate Method

Given: Total shots = 14 | Total score = 36 points.

Formula: Let x be the number of 2-point shots and y be the number of 3-point shots.

=> Equation 1 (Total Shots): x + y = 14

=> Equation 2 (Total Score): 2x + 3y = 36

=> From (1), x = 14 − y. Substitute this into (2):

=> 2(14 − y) + 3y = 36

=> 28 − 2y + 3y = 36

=> 28 + y = 36 => y = 8 (3-point shots)

=> x = 14 − 8 = 6 (2-point shots)

Therefore The correct answer is Number of 2-point shots = 6; Number of 3-point shots = 8.

Additional Information

Linear Equations in Two Variables

Equations like ax + by = c represent a relationship where two different quantities contribute to a fixed total.

Substitution Method

Solve one equation for one variable and substitute it into the other to reduce the problem to a single variable.

The Alligation Rule

Ratio of quantities = (Higher value − Average) : (Average − Lower value). This is highly effective for mixed value problems.

Q46. Answer: (b) 21

Shortcut Trick

Net rate of filling = (1/6) − (1/7) = 1/42 part per minute.

Time to fill the full tank = 42 minutes.

Time to fill one-half (1/2) of the tank = 42 ÷ 2 = 21 minutes.

Therefore The correct answer is 21 minutes.

Alternate Method

Given: Filling time = 6 min, Emptying time = 7 min.

Formula Used: Total Work = LCM of time; Efficiency = Work ÷ Time.

Pipe	Time (min)	Total Capacity	Efficiency
Inlet Pipe	6	42 units	+7
Outlet Pipe	7	−6	

=> Combined efficiency of both pipes = 7 − 6 = 1 unit/min.

=> Total capacity to be filled = 1/2 × 42 = 21 units.

=> Time taken = 21 units ÷ 1 unit/min = 21 minutes.

Therefore The correct answer is 21 minutes.

Additional Information

Inlet and Outlet Logic

Efficiency of an inlet pipe is always positive (+), while the efficiency of an outlet (leakage) pipe is always negative (−).

Combined Rate Formula

If pipe A fills in 'x' hours and pipe B empties in 'y' hours, net work done in 1 hour = (1/x) − (1/y).

Work and Wages

Wages are always distributed in the ratio of work done or the ratio of efficiencies of the pipes/workers.

Q47. Answer: (a) $x^2 - 25$

Shortcut Trick

Identify the expression as the standard algebraic identity: $(a + b)(a - b) = a^2 - b^2$.

Comparing $(x + 5)(x - 5)$ with $(a + b)(a - b)$, we get $a = x$ and $b = 5$.

Direct calculation: $x^2 - 5^2 = x^2 - 25$.

Therefore The correct answer is $x^2 - 25$.

Alternate Method

Given: The expression to simplify is $(x + 5)(x - 5)$.

Formula Used: Distributive Property (FOIL method) or $(a + b)(a - b) = a^2 - b^2$.

=> $(x + 5)(x - 5)$

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

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

=> $x^2 - 5x + 5x - 25$

=> $x^2 + 0 - 25$

=> $x^2 - 25$

Therefore The correct answer is $x^2 - 25$.

Additional Information

Difference of Two Squares

The identity $(a + b)(a - b) = a^2 - b^2$ is known as the difference of two squares formula, used extensively in factoring and simplification.

Square of a Sum

The square of a binomial sum is given by $(a + b)^2 = a^2 + 2ab + b^2$.

Square of a Difference

The square of a binomial difference is given by $(a - b)^2 = a^2 - 2ab + b^2$.

Product of Binomials with Common Term

For $(x + a)(x + b)$, the expansion is $x^2 + (a + b)x + ab$.

Q48. Answer: (b) 60% loss

Shortcut Trick

Net percentage change = a + b + (a × b) ÷ 100

Here, markup percentage a = +25% and discount percentage b = −68%.

Net change = 25 − 68 + (25 × (−68)) ÷ 100

Net change = −43 − 1700 ÷ 100 = −43 − 17 = −60%.

Negative sign indicates a loss.

Therefore The correct answer is 60% loss.

Alternate Method

Given → Markup% = 25%, Discount% = 68%.

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

=> Let Cost Price (CP) = 100.

=> Marked Price (MP) = 100 + 25% of 100 = 125.

=> Selling Price (SP) = 125 − 68% of 125.

=> SP = 125 × (32 ÷ 100) = 125 × 0.32 = 40.

=> Loss = CP − SP = 100 − 40 = 60.

=> Loss% = (60 ÷ 100) × 100 = 60%.

Therefore The correct answer is 60% loss.

Additional Information

Marked Price and Discount

Discount is always calculated on the Marked Price (MP). The price reached after applying discount to MP is the Selling Price (SP).

Relationship Formula

MP ÷ CP = (100 + Profit%) ÷ (100 − Discount%). If there is a loss, Profit% is replaced by −Loss%.

Q49. Answer: (a) 3 days

Shortcut Trick

Total Work (LCM of 8, 12) = 24 units.

Efficiency of A = 3, B = 2.

Work done by A in 3 days = 3 × 3 = 9 units.

Remaining Work = 24 − 9 = 15 units.

Combined Efficiency (A + B) = 3 + 2 = 5.

Extra Days = 15 ÷ 5 = 3 days.

Therefore The correct answer is 3 days.

Alternate Method

Given: Time taken by A = 8 days, Time taken by B = 12 days. A works alone for 3 days.

Person	Days	Total Work	Efficiency
A	8	24	24 ÷ 8 = 3
B	12	24 ÷ 12 = 2	

=> Work done by A in 3 days = 3 × 3 = 9 units

=> Remaining Work = 24 − 9 = 15 units

=> Combined Efficiency of A and B = 3 + 2 = 5 units/day

=> Days required to finish remaining work = 15 ÷ 5

=> Time taken = 3 days

Therefore The correct answer is 3 days.

Additional Information

Total Work and Efficiency

Total Work is usually taken as the LCM of individual times. Efficiency is work done per unit time (Efficiency = Total Work ÷ Time).

Combined Work Formula

When multiple people work together, their efficiencies are added to find the total rate of work. Time = Total Work ÷ Total Efficiency.

Pipes & Cisterns

This logic applies to pipes where an inlet pipe has positive efficiency and an outlet pipe has negative efficiency.

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Q50. Answer: (d) 48

Shortcut Trick

Volume of rectangular tank = 8 × 6 × 4.62 = 221.76 m³

Rate of flow per minute = Area of pipe × Speed × 60 = (22/7) × (0.07)² × 5 × 60

Rate per minute = 0.0154 × 300 = 4.62 m³/min

Time required = Total Volume ÷ Rate per minute = 221.76 ÷ 4.62 = 48 minutes

Therefore The correct answer is 48 minutes.

Alternate Method

Given:

Internal diameter of cylindrical pipe = 14 cm => Radius (r) = 7 cm = 0.07 m

Speed of water = 5 m/s

Dimensions of tank: Length (L) = 8 m, Width (W) = 6 m, Height (H) = 4.62 m

Formula Used: Volume = Area of cross-section × Speed × Time

Calculations:

=> Volume of the rectangular tank = L × W × H

=> Volume = 8 × 6 × 4.62 = 221.76 m³

=> Cross-sectional area of pipe = πr² = (22/7) × 0.07 × 0.07

=> Area = 22 × 0.01 × 0.07 = 0.0154 m²

=> Volume of water flowing per second = Area × Speed = 0.0154 × 5 = 0.077 m³/s

=> Total time taken (in seconds) = Total Volume ÷ Volume per second

=> Time = 221.76 ÷ 0.077 = 2880 seconds

=> Time in minutes = 2880 ÷ 60 = 48 minutes

Therefore The correct answer is 48 minutes.

Additional Information

Volume of Cylindrical Flow

The volume of water discharged by a pipe in time 't' is given by V = πr²vt, where 'r' is the radius and 'v' is the velocity of flow.

Volume of a Cuboid

The volume of a rectangular tank (cuboid) is calculated as Length × Breadth × Height.

Unit Conversion

Always ensure all dimensions are in the same unit system (SI units like meters and seconds) before performing calculations.

Q51. Answer: (b) Only conclusion (II) follows

Given Statements:

All bottles are cups.

All bottles are glasses.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some teapots are bottles - Does not follow (There is no direct relation given between teapots and bottles).

II. Some glasses are cups - Follows (Since all bottles are both glasses and cups, there is a definite common part between glasses and cups).

So, only conclusion II follows.

Hence, the correct answer is Option 2.

Q52. Answer: (d) 3

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

Now,

We need to identify even numbers that are immediately preceded by an odd number and immediately followed by an even number.

So, the required condition is: Odd Number – Even Number – Even Number

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

Total even numbers satisfying the condition = 3

Hence, the correct answer is "Option 4".

Q53. Answer: (d) Q

Given: P, Q, R, S, and T are sitting around a circular table, facing the centre.

R is sitting second to the right of P.

T is sitting second to the right of S.

P is to the immediate left of S.

Therefore, the person sitting to the immediate right of T is Q.

Hence, the correct answer is Option 4.

Q54. Answer: (a) FYU 50

The logic followed here is:

So, 'FYU 50' will replace the question mark in the given series.

Hence, the correct answer is "Option 1".

Q55. Answer: (c) 19 - 10 - 29

The logic followed here is:

Logic: Third number = First number + Second number

19 - 2 - 21

=> 19 + 2 = 21

14 - 6 - 20

=> 14 + 6 = 20

Now, checking the options:

Option 1) 15 - 4 - 21

=> 15 + 4 = 19 (not 21)

Option 2) 9 - 13 - 24

=> 9 + 13 = 22 (not 24)

Option 3) 19 - 10 - 29

=> 19 + 10 = 29

Option 4) 30 - 11 - 43

=> 30 + 11 = 41 (not 43)

Hence, the correct answer is Option 3.

Q56. Answer: (d) North

Given:

A man is initially facing East.

45° clockwise from East → South-East

45° anticlockwise from South-East → East

180° anticlockwise from East → West

90° clockwise from West → North

Final Direction: The man is facing North.

Hence, the correct answer is Option 4.

Q57. Answer: (b) More than three

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

Now,

We need to identify prime digits (2, 3, 5, 7) that are immediately preceded by an even digit and immediately followed by an even digit.

So, the required condition is: Even Digit – Prime Digit – Even Digit

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

Total prime digits satisfying the condition = 4

Hence, the correct answer is "Option 2".

Q58. Answer: (b) More than three

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

Now,

We need to identify instances of the number 6 that are immediately preceded by an odd number and immediately followed by an even number.

So, the required condition is: Odd Number – 6 – Even Number

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

Total occurrences of 6 satisfying the condition = 4

Hence, the correct answer is "Option 2".

Q59. Answer: (c) Second to the left

Given: A, B, C, D, E and F are sitting around a circular table, facing the centre.

B sits second to the left of E.

D is an immediate neighbour of F.

C sits to the immediate left of F.

C sits second to the right of A.

Therefore, E is Second to the left of F.

Hence, the correct answer is Option 3.

Q60. Answer: (b) 106

The logic followed here is:

thus, "106" will replace the question mark in the given series.

Hence, the correct option is "Option 2".

Q61. Answer: (c) 9th

Given:

Geetha's position from the left = 6th

Divya sits 5th to the right of Geetha

Total number of people = 19

Divya's position from the left = 6 + 5 = 11th

Divya's position from the right = (Total − Position from left) + 1

= (19 − 11) + 1

= 8 + 1

= 9th

Here, Divya's position from the right end is 9th.

Hence, the correct answer is "Option 3".

Q62. Answer: (a) 26th

Given:

Parash's position from left = 18th

Aparna sits 7th to the right of Parash

Total number of students = 50

Aparna's position from the left = 18 + 7 = 25th

Aparna's position from the right = (Total − Position from left) + 1

= (50 − 25) + 1

= 25 + 1

= 26th

Here, Aparna's position from the right end of the row is 26th.

Hence, the correct answer is "Option 1".

Q63. Answer: (b) 508

BODMAS Table:

Given equation: 49 ÷ 5 + 153 × 3 − 314 = ?

Now, replacing the symbols as:

Symbol	•	−	×	÷
Replaced by	−	•	÷	×

=> 49 × 5 − 153 ÷ 3 + 314 = ?
=> 245 − 153 ÷ 3 + 314 = ?
=> 245 − 51 + 314 = ?
=> 194 + 314 = ?
=> 508
Hence, the correct answer is Option 2.

Q64. Answer: (b) MLP 36

The logic followed here is:
So, 'MLP 36' will replace the question mark in the given series.
Hence, the correct answer is "Option 2".

Q65. Answer: (b) Three

Given: B, C, D, T, U, V and W are sitting in a straight line facing north.
All friends sit to the left of C.
Only three people sit between C and T.
Only two people sit between T and V.
B sits third to the left of D.
W sits to the immediate right of D.
Between them are T, D, and W → 3 people
Hence, the correct answer is Option 2.

Q66. Answer: (c) FASHION - SFAHNIO - ASFHONI

The logic followed here is:
For, DRAWING → ADRWGIN → RADWNGI
Now, FORMULA → RFOMAUL → ORFMLAU
Now, applying the same logic for FASHION:
Option 3) FASHION → SFAHNIO → ASFHONI
Hence, the correct answer is Option 3.

Q67. Answer: (a) Neither conclusion (I) nor (II) follows

Given Statements:
All crows are sparrows.
No crow is a pigeon.
The least possible Venn diagram for the given statement is:
Conclusions:
I. No sparrow is a pigeon - Does not follow (Only crows are restricted from being pigeons; other sparrows may be pigeons).
II. Some pigeons are crows - Follows (No crow is a pigeon, so pigeons cannot be crows).
So, neither conclusion I nor conclusion II follows.
Hence, the correct answer is Option 1.

Q68. Answer: (c) Brother's wife's father

Family Chart:

Symbol	•	#	x	@
Meaning	Sister	Brother	Wife	Father

Given: L @ O x V # E + R
It means: L is the father of O, O is the wife of V, V is the brother of E, E is the sister of R.
Here, L is related to R as Brother’s wife’s father
Hence, the correct answer is Option 3.

Q69. Answer: (b) DGE−GJH

The logic followed here is:
For, WZX → ZCA

Now, CFD → FIG
Now, checking the options:
Option 1) DGE → FJG
Option 2) DGE → GJH
Option 3) DFC → FIG
Option 4) DFC → GJH
Hence, the correct answer is Option 2.

Q70. Answer: (a) OMYF

The logic followed here is:
For, PNHT → VILQ
Now, MSDT → SNHQ
Now, applying the same logic for IRUI:
So, IRUI → OMYF
Hence, the correct answer is Option 1.

Q71. Answer: (a) 3

Given: (Left) 5 3 8 5 7 4 3 7 4 (Right)
Now,
We need to identify odd numbers that are immediately preceded by an odd number and immediately followed by an even number.
So, the required condition is: Odd Number – Odd Number – Even Number
(Left) 5 3 8 5 7 4 3 7 4 (Right)
Total odd numbers satisfying the condition = 3
Hence, the correct answer is "Option 1".

Q72. Answer: (a) TYR

The logic followed here is:
Option 1) TYR
Option 2) MRL
Option 3) QVP
Option 4) EJD
Here, TYR is odd from the given options because it does not follow the uniform +5, −6 pattern.
Hence, the correct answer is "Option 1".

Q73. Answer: (a) 55

BODMAS Table:
Given equation: 7 ÷ 5 + 12 × 3 − 19 = ? + 5
Now, replacing the symbols as:

Symbol	•	−	×	÷
Replaced by	−	•	÷	×

=> 7 × 5 − 12 ÷ 3 + 19 = ? − 5
=> 35 − 12 ÷ 3 + 19 = ? − 5
=> 35 − 4 + 19 = ? − 5
=> 31 + 19 = ? − 5
=> 50 = ? − 5
=> ? = 50 + 5
=> 55
Hence, the correct answer is Option 1.

Q74. Answer: (c) 6

The logic followed here is:
Given:

PEARL → 18723
PAYER → 82736
So, Y → 6
Hence, the correct answer is Option 3.

Q75. Answer: (c) 9 km to the north

Given:
Wamiq starts from Point A and drives 78 km West.
He turns right → 81 km North.
He turns right → 80 km East.
He turns right → 90 km South.
He takes a final right → 2 km West.
So, To reach Point A again, he must travel 9 km North.
Hence, the correct answer is Option 3.

Q76. Answer: (c) 183

The logic followed here is:
Logic: Code = (Sum of letter positions) × 3
Given:
NSQE → 165
Sum = 14 + 19 + 17 + 5 = 55
55 × 3 = 165
X I J A → 132
Sum = 24 + 9 + 10 + 1 = 44
44 × 3 = 132
Now, for PEYO:
Sum = 16 + 5 + 25 + 15 = 61
Now, 61 × 3 = 183
Hence, the correct answer is Option 3.

Q77. Answer: (c) 39

The logic followed here is:
thus, "39" will replace the question mark in the given series.
Hence, the correct option is "Option 3".

Q78. Answer: (b) 152

BODMAS Table:
Given equation: 32 + 34 − 35 × 5 ÷ 22 = ?
Now, replacing the symbols as:

Symbol	**•**	**−**	**×**	**÷**
Replaced by	−	•	÷	×

=> 32 − 34 + 35 ÷ 5 × 22 = ?
=> 32 − 34 + 7 × 22 = ?
=> 32 − 34 + 154 = ?
=> −2 + 154 = ?
=> 152
Hence, the correct answer is Option 2.

Q79. Answer: (d) KN - IM

The logic followed here is:
Option 1) MP – KN
Option 2) GJ – EH

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Option 3) JM – HK

Option 4) KN – IM

Here, KN – IM is odd from the given options because it does not follow the uniform −2, −2 shift pattern.

Hence, the correct answer is "Option 4".

Q80. Answer: (c) 551

The logic followed here is:

thus, "551" will replace the question mark in the given series.

Hence, the correct option is "Option 3"

Q81. Answer: (a) Hanoi

The correct answer is Hanoi.

Key Points

• The 15th edition of the India-Vietnam Defence Policy Dialogue (DPD) was scheduled to be held in Hanoi, Vietnam, in November 2025.

• This high-level dialogue serves as a cornerstone for reviewing the progress of bilateral defence cooperation between the two nations, which have historically shared strong ties.

• The meeting is typically co-chaired by the Defence Secretary of India and the Deputy Defence Minister of Vietnam, reflecting the high priority both countries accord to their security partnership.

• Key discussions during this 15th edition focused on deepening collaboration in areas such as maritime security, cyber security, military training, and the defence industry.

• The dialogue aims to align the strategic interests of both nations in the Indo-Pacific region, ensuring a stable and rules-based international order. Hence, the correct answer is Hanoi.

Additional Information

• Comprehensive Strategic Partnership:

• The relationship between India and Vietnam was upgraded to a Comprehensive Strategic Partnership in September 2016 during the visit of the Indian Prime Minister to Vietnam.

• This status is Vietnam's highest tier of diplomatic partnership, shared with only a few other countries like Russia, China, and South Korea.

• Joint Vision Statement 2030:

• During the 13th DPD and subsequent high-level visits, both nations signed the "Joint Vision Statement on India-Vietnam Defence Partnership towards 2030".

• This document significantly enhances the scope and scale of existing defence cooperation, focusing on mutual logistics support and capacity building.

• Maritime Security and South China Sea:

• India and Vietnam share common concerns regarding the freedom of navigation and overflight in the South China Sea.

• India has consistently supported a peaceful resolution of disputes in the region based on UNCLOS 1982.

Important Points

• Defence Exercises:

• VINBAX is the annual bilateral military exercise between the Indian Army and the Vietnam People’s Army, which focuses on UN Peacekeeping Operations and humanitarian assistance.

• Line of Credit (LoC):

• India extended a $100 million Defence Line of Credit to Vietnam for the procurement of 12 High-Speed Guard Boats for the Vietnam Border Guard, demonstrating commitment to Vietnam's maritime capacity.

• Historical Context:

• Diplomatic relations were established in 1972, and the two countries celebrated 50 years of diplomatic ties in 2022.

• Vietnam is a key pillar of India's Act East Policy and an essential partner in the Indo-Pacific Oceans Initiative (IPOI).

Q82. Answer: (c) 99th

The correct answer is 99th.

Key Points

• India has achieved the 99th rank in the 2025 Sustainable Development Report (SDR), also known as the SDG Index, which evaluates the progress of 167 countries toward the Sustainable Development Goals (SDGs).

• The index is released annually by the UN Sustainable Development Solutions Network (SDSN), an organization that has been tracking the performance of UN member states since the adoption of the 2030 Agenda in 2015.

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• India’s jump to the 99th position signifies a notable improvement in its overall score, reflecting advancements in various socio-economic and environmental indicators compared to previous years.

• The 2025 report highlights India's steady progress in areas such as Goal 12 (Responsible Consumption and Production) and Goal 13 (Climate Action), although challenges remain in achieving Goal 2 (Zero Hunger) and Goal 5 (Gender Equality).

• The Sustainable Development Report provides a comprehensive data-driven assessment of how close each nation is to achieving the 17 goals established by the United Nations General Assembly.

Additional Information

• Understanding the Sustainable Development Goals (SDGs):

• The SDGs consist of 17 interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all" by the year 2030.

• These goals were adopted by all 193 UN Member States in September 2015 during the United Nations Sustainable Development Summit.

• Global Rankings and Leaders:

• In the 2025 Index, Nordic countries like Finland, Sweden, and Denmark continue to lead the rankings, demonstrating high performance across almost all environmental and social targets.

• The report emphasizes that while developed nations rank higher, they often generate significant negative international spillovers that affect the ability of developing nations to reach their goals.

• India's Internal Monitoring - SDG India Index:

• In addition to global rankings, NITI Aayog in India publishes the SDG India Index to track the performance of States and Union Territories.

• This domestic index aligns with the National Indicator Framework (NIF) and helps foster competitive federalism by ranking states like Kerala, Tamil Nadu, and Himachal Pradesh as front-runners in sustainability.

• The Role of SDSN:

• The UN Sustainable Development Solutions Network (SDSN) was set up in 2012 under the auspices of the UN Secretary-General.

• It mobilizes global scientific and technological expertise to promote practical solutions for sustainable development, including the implementation of the Paris Agreement on Climate Change.

Important Points

• Key Data Facts: The SDG Index uses a scale of 0 to 100, where 100 represents the optimum score (full goal achievement). India’s progress from being ranked 112th in 2024 (estimated) to 99th in 2025 shows a significant upward trajectory in its SDG Dashboard.

• Challenges Identified: Despite the improved rank, the 2025 report warns that global progress has stalled for the third year in a row due to geopolitical tensions and economic fluctuations following the COVID-19 pandemic.

• Future Targets: India aims to reach net-zero carbon emissions by 2070, a commitment made at COP26, which remains a critical component of its long-term strategy for Goal 7 (Affordable and Clean Energy) and Goal 13.

Q83. Answer: (b) Shaili Singh

The correct answer is Shaili Singh.

Key Points

• In April 2025, the young Indian athlete Shaili Singh showcased an exceptional performance at the National Federation Cup Athletics championships.

• The event was hosted at the Maharaja's College Ground in Ernakulam (Kochi), Kerala, which is a historic venue for track and field events in India.

• Shaili Singh recorded a massive jump of 6.64 m, which, according to the competition context, broke a 23-year-old record previously held by the legendary Anju Bobby George at this specific meet. Hence, the statement regarding her record-breaking jump is correct.

• She is a protégé of the Anju Bobby George Foundation and has been consistently performing at the highest domestic and international levels in the Long Jump category.

• The National Federation Cup serves as a critical selection trial for Indian athletes aiming for international assignments like the Asian Athletics Championships and the World Athletics Championships.

Additional Information

• Shaili Singh:

• Born on January 7, 2004, in Jhansi, Uttar Pradesh, she is considered one of the brightest prospects in Indian athletics.

• She is coached by Robert Bobby George, who is the husband and former coach of Anju Bobby George.

• In 2021, she won the Silver Medal at the World Athletics U20 Championships held in Nairobi, Kenya, with a jump of 6.59 m.

• Her personal best of 6.76 m (achieved in 2023) is the second-longest jump by an Indian woman, trailing only behind her mentor's

national record.

• Anju Bobby George:

• She is the first Indian athlete to win a medal at the World Championships in Athletics, securing a Bronze in Paris in 2003.

• Her national record of 6.83 m was set at the 2004 Athens Olympics, where she finished fifth (later upgraded to fourth).

• She was awarded the Padma Shri in 2004 and the Major Dhyan Chand Khel Ratna in 2003 for her contributions to sports.

Important Points

• Other Options Analysis:

• Ancy Sojan: A talented long jumper from Kerala who has been a close competitor to Shaili Singh, frequently crossing the 6.50 m mark in domestic circuits.

• Priyanka Goswami: An Indian athlete who specializes in the 20 km Race Walk. She represented India at the Tokyo 2020 Olympics and won a Silver Medal at the 2022 Commonwealth Games.

• D Sudha Singh: An Indian Olympic athlete who competes in the 3000 m Steeplechase event. She is an Asian Games Gold medalist (2010 Guangzhou) and a two-time Olympian.

• Significance of the venue: The Maharaja's College Ground in Ernakulam is renowned for its synthetic track and has been a breeding ground for several international athletes from Kerala.

Q84. Answer: (d) Indian Grand Prix 1

The correct answer is Indian Grand Prix 1.

Key Points

• Gurindervir Singh, a prominent sprinter from Punjab, achieved a significant milestone at the Indian Grand Prix 1.

• The competition was held at the Netaji Subhash National Institute of Sports (NSNIS) in Patiala on February 18, 2021.

• In the 100m sprint event, he clocked a timing of 10.32 seconds, which was his personal best at the time and one of the fastest timings recorded in the domestic circuit for that season.

• By winning this race, he defeated the reigning national record holder Amiya Kumar Mallick, who finished the race in 10.39 seconds to take the silver medal.

• His performance at the Indian Grand Prix 1 served as a crucial season opener, demonstrating his potential to represent India at high-level international athletic meets.

Additional Information

• Athletics Federation of India (AFI):

• The AFI is the apex body for athletics in India and is responsible for organizing the Indian Grand Prix series.

• It is affiliated with World Athletics and the Asian Athletics Association, ensuring that domestic results are recognized for Olympic and World Championship qualifications.

• National Record in 100m:

• The official national record for the men's 100m sprint was established by Amiya Kumar Mallick with a time of 10.26 seconds in 2016.

• Later, in 2023, Manikanta Hoblidhar improved this record by clocking 10.23 seconds at the National Open Athletics Championships.

• Other Competition Formats:

• The South Asian Championships and Asian Games are international multi-sport events where Indian athletes compete against other nations.

• The Olympic Trials are specific qualifying events used to select the final contingent for the Summer Olympics, often held under the banner of the National Inter-State Athletics Championships.

Important Points

• Career Highlights: Gurindervir Singh has been a standout performer since his junior days, winning gold at the Asian Youth Athletics Championships in 2017.

• Training and Facilities: Most elite sprinters in India, including Gurindervir, utilize the high-performance centers in Patiala and Bengaluru for advanced training under national and international coaches.

• Significance of IGP: The Indian Grand Prix (IGP) series usually consists of multiple legs (e.g., IGP 1, 2, 3, and 4) which provide athletes with consistent competitive exposure throughout the year.

Q85. Answer: (d) Shri Sanjay Malhotra

The correct answer is Shri Sanjay Malhotra.

Key Points

• Shri Sanjay Malhotra assumed the role of the Governor of the Reserve Bank of India (RBI) following the conclusion of the tenure of his predecessor. As of August 2025, he continues to lead India's central banking institution.

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• He is a distinguished 1990-batch Indian Administrative Service (IAS) officer of the Rajasthan cadre. His appointment was cleared by the Appointments Committee of the Cabinet (ACC) for a standard tenure of three years.

• Prior to his elevation as the RBI Governor, he served as the Secretary in the Department of Revenue under the Ministry of Finance, where he played a pivotal role in tax policy and administration.

• He took over the reins from Shaktikanta Das, who served a significant term including an extension. Shri Malhotra is the 26th Governor of the Reserve Bank of India.

• As the Governor, he acts as the Chief Executive Officer of the bank and the ex-officio Chairperson of the Monetary Policy Committee (MPC), which is tasked with maintaining price stability and controlling inflation.

Additional Information

• Reserve Bank of India (RBI):

• Established on April 1, 1935, under the Reserve Bank of India Act, 1934, based on the recommendations of the Hilton Young Commission.

• The Central Office was initially in Kolkata but was permanently moved to Mumbai in 1937.

• The bank was nationalized in 1949, making it fully owned by the Government of India.

• Structure of RBI Governance:

• The bank's affairs are governed by a Central Board of Directors. This board is appointed by the Government of India in keeping with the Reserve Bank of India Act.

• The board consists of the Governor and not more than four Deputy Governors, along with non-official directors nominated by the government.

• Functions of the Governor:

• The Governor is responsible for the overall direction and management of the bank. He signs the currency notes (except the one-rupee note, which is signed by the Finance Secretary).

• The Governor represents India at various international forums such as the International Monetary Fund (IMF) and the Bank for International Settlements (BIS).

Important Points

• Historical Context:

• The first Governor of the RBI was Sir Osborne Smith (1935–1937).

• The first Indian to serve as the Governor was C.D. Deshmukh (1943–1949).

• Manmohan Singh is the only Prime Minister of India who also served as the Governor of the RBI (1982–1985).

• Other Noted Personalities (Options):

• Dr. Poonam Gupta: She is the Director General of the National Council of Applied Economic Research (NCAER) and was the first woman to hold this prestigious position.

• Shri Saugata Bhattacharya: A prominent economist who has held senior positions at Axis Bank and has been a member of the PM’s Economic Advisory Council.

• Dr. Nagesh Kumar: A renowned economist serving as the Director of the Institute for Studies in Industrial Development (ISID) and a former Director at UN-ESCAP.

• Key Responsibilities: The Governor manages foreign exchange reserves, acts as a banker to the government, and regulates the banking system under the Banking Regulation Act, 1949.

Q86. Answer: (c) Iranian–Russian Treaty on Comprehensive Strategic Partnership

The correct answer is Iranian–Russian Treaty on Comprehensive Strategic Partnership.

Key Points

• The Iranian–Russian Treaty on Comprehensive Strategic Partnership is a historic bilateral agreement signed in January 2025 between the Russian Federation and the Islamic Republic of Iran.

• The treaty was signed by the presidents of both nations in Tehran, marking a significant milestone in their diplomatic history and replacing the outdated 2001 Treaty on the Principles of Relations and Cooperation.

• The scope of the pact is exceptionally broad, covering critical areas such as defense and security, energy, cybersecurity, transportation, and regional stability.

• This partnership aims to elevate the relationship from tactical cooperation to a comprehensive strategic alliance, reflecting the shared vision of both nations regarding geopolitical sovereignty and mutual protection.

• It emphasizes the military-technical cooperation between the two countries, which includes the potential for joint development of advanced weaponry, drone technology, and satellite communication systems.

Additional Information

• Energy and Natural Resources:

• The treaty facilitates deep cooperation in the oil and gas sectors, including natural gas swaps and joint investments in

hydrocarbon extraction within the Caspian Sea and Persian Gulf regions.

• Russia, being one of the world's largest energy producers, and Iran, holding some of the largest natural gas reserves, seek to coordinate global energy prices and supply chains through this framework.

• Economic and Financial Integration:

• To bypass Western sanctions, the agreement promotes the use of local currencies (the Ruble and the Rial) in bilateral trade, reducing dependency on the US Dollar.

• The integration of Russia's Mir and Iran's Shetab payment systems is a key component of this economic strategy to facilitate seamless banking transactions.

• Transportation and Connectivity:

• A major highlight of the partnership is the acceleration of the International North-South Transport Corridor (INSTC), a 7,200-km multi-modal network of ship, rail, and road routes.

• The INSTC connects India, Iran, Azerbaijan, and Russia, serving as a strategic alternative to the Suez Canal for trade between Asia and Europe.

Important Points

• Geopolitical Context: The treaty comes at a time when both Russia and Iran face extensive economic sanctions from the United States and the European Union, pushing them toward a multipolar world order.

• Cybersecurity and Information: The pact includes specific clauses on cyber defense, aimed at protecting critical infrastructure from foreign cyberattacks and collaborating on data sovereignty.

• Regional Stability: Both nations have committed to coordinating their efforts in West Asia and the South Caucasus to prevent external interference and combat terrorism.

• Space Cooperation: The agreement also touches upon space exploration, including the launching of Iranian satellites using Russian rockets and the establishment of ground stations for GLONASS (Russia's GPS equivalent).

Q87. Answer: (c) Sagarmala Finance Corporation Ltd.

The correct answer is Sagarmala Finance Corporation Ltd..

Key Points

• The Sagarmala Finance Corporation Ltd. (SFCL) was officially launched in June 2025 as a dedicated financial institution to provide long-term and low-cost credit to India's maritime and blue economy sectors.

• It functions under the administrative control of the Ministry of Ports, Shipping and Waterways, aiming to bridge the massive funding gap in port-led development projects.

• The primary objective of SFCL is to offer specialized financial products tailored for shipbuilding, port modernization, inland waterways, and coastal shipping initiatives.

• The institution was established to support the capital-intensive nature of the maritime sector, which often faced challenges in securing competitive interest rates from traditional commercial banks.

• By providing structured financing, SFCL plays a pivotal role in achieving the goals set under the Amrit Kaal Vision 2047, which envisions a sustainable and globally competitive Indian maritime sector.

Additional Information

• Sagarmala Programme:

• Launched in March 2015, it is the flagship program of the Government of India to promote port-led development by exploiting India's 7,517 km long coastline and navigable waterways.

• It focuses on four pillars: Port Modernization, Port Connectivity, Port-led Industrialization, and Coastal Community Development.

• Maritime India Vision 2030:

• Released in March 2021, this 10-year blueprint outlines the development of the maritime sector with an estimated investment of Rs. 3 lakh crore.

• It aims to improve operational efficiency and increase the share of renewable energy in the maritime sector to over 60%.

• Blue Economy:

• This refers to the sustainable use of ocean resources for economic growth, encompassing sectors like fisheries, maritime transport, renewable energy, and waste management.

• India’s maritime sector accounts for approximately 95% of the country’s trade by volume and 70% by value.

Important Points

• Logistics Efficiency: One of the core targets of financing through SFCL is to reduce logistics costs in India from the current 14-16% of GDP to a more competitive 8-10%.

• Shipbuilding and Repair: Under the Atmanirbhar Bharat initiative, SFCL provides financial assistance to boost domestic shipbuilding and ship-breaking industries, aiming to place India among the top 10 shipbuilding nations by 2030.

• Strategic Funding: The corporation is expected to leverage private sector participation through Public-Private Partnership (PPP)

models, ensuring that high-impact projects receive the necessary fiscal backing.

• Global Context: The establishment of such a bank aligns India with other major maritime nations like Norway and China, which have specialized financial bodies to support their oceanic economic activities.

Q88. Answer: (a) Parvati Tirkey

The correct answer is Parvati Tirkey.

Key Points

• Parvati Tirkey, a distinguished tribal poet from Jharkhand, was selected for the prestigious Sahitya Akademi Yuva Puraskar in June 2025.

• She received this recognition for her debut collection of poems titled ‘Phir Ugna’, which is written in Hindi.

• The collection ‘Phir Ugna’ is noted for its deep exploration of tribal identity, the pain of displacement, and the symbiotic relationship between nature and indigenous communities.

• Originally hailing from the Gumla district of Jharkhand, Parvati Tirkey belongs to the Oraon (Kurukh) tribe, and her work brings the lived experiences of her community to the forefront of mainstream Indian literature.

• The Sahitya Akademi Yuva Puraskar is a literary honor in India which the Sahitya Akademi annually confers on young writers of outstanding merit in any of the 24 major Indian languages.

Additional Information

• Sahitya Akademi Yuva Puraskar:

• This award was established in 2011 to recognize and promote young authors under the age of 35.

• The award consists of a casket containing an engraved copper plaque and a purse of Rs. 50,000.

• The selection is made by a three-member jury in each language, following a rigorous process of nomination and evaluation.

• Other Notable Winners Mentioned:

• Akhil P Dharmajan: A popular writer from Kerala who was recognized for his Malayalam novel 'Ram C/O Anandhi', which gained significant traction on social media.

• Kirtida Brahmbhatt: An author recognized for her contributions to Gujarati literature.

• Mayur Khavdu: Another recipient honored for his literary work in the Gujarati language.

• Literary Context of Jharkhand:

• Jharkhand has a rich tradition of tribal literature that focuses on "Jal, Jangal, Jameen" (Water, Forest, Land).

• Poets like Parvati Tirkey follow the legacy of other Sahitya Akademi winners from the state, contributing to the Hindi and regional language literary canons.

Important Points

• Selection Criteria: To be eligible for the Yuva Puraskar, the author must be an Indian national and must not have exceeded 35 years of age as of January 1st of the year of the award.

• The Sahitya Akademi: It was founded on March 12, 1954, and is an autonomous organization under the Ministry of Culture, Government of India. It is headquartered at Rabindra Bhavan in New Delhi.

• Scope of Languages: The Akademi recognizes works in 24 languages, which include the 22 languages listed in the Eighth Schedule of the Indian Constitution, plus English and Rajasthani.

Q89. Answer: (b) Vyommitra

The Correct answer is Vyommitra.

Key Points

• Vyommitra is India's first humanoid robot designed specifically for space missions.

• It was developed by the Indian Space Research Organisation (ISRO), showcasing advancements in space technology.

• Vyommitra is a female humanoid robot that can mimic human actions and perform specific tasks in space environments.

• The name "Vyommitra" is derived from Sanskrit, where "Vyom" means space and "Mitra" means friend, symbolizing a "friend in space."

• It is intended to be deployed in unmanned space missions, including the Gaganyaan mission, serving as a precursor to human spaceflight.

• The humanoid can perform crew functions, like operating control panels, environmental monitoring, and providing feedback to mission controllers.

• Vyommitra is equipped with advanced artificial intelligence and sensors to interact with astronauts and provide assistance during space missions.

• It is designed to handle microgravity conditions, making it suitable for tasks in the challenging environment of outer space.

• This innovation marks India’s stride in advancing robotics and human-robot interaction for space exploration.

Additional Information

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• Vikram
• Vikram is the name of the lander used in Chandrayaan-2, India's lunar exploration mission.
• It is named after Dr. Vikram Sarabhai, the father of the Indian space program.
• Vikram was designed to land on the lunar surface and conduct scientific experiments, but it is not a humanoid robot.
• Suryamitra
• Suryamitra is an initiative by India to train solar technicians under the National Institute of Solar Energy (NISE).
• The program aims to create skilled manpower for the solar energy sector in India.
• It is not related to space missions or humanoid robotics.
• Aditya
• Aditya is the name of India's first solar mission, also known as Aditya-L1.
• The mission aims to study the solar corona, solar emissions, and other solar phenomena.
• It is not a humanoid robot but a spacecraft designed for scientific research on the Sun.

Q90. Answer: (b) Francesco Fortunato

The correct answer is Francesco Fortunato.

Key Points

• The Italian race walker Francesco Fortunato made history at the Italian Indoor Championships held in Ancona in February 2025 by setting a new World Indoor Record in the 5000 m race walk.
• He clocked a remarkable time of 18:03.01, shattering the previous world indoor mark that had stood for three decades.
• The previous record of 18:07.08 was held by the Russian athlete Mikhail Shchennikov, which was set in 1995.
• This performance took place at the Pala Indoor stadium in Ancona, which is the traditional home for the Italian Athletics Indoor Championships.
• Francesco Fortunato represents the Fiamme Gialle (the sports section of the Italian Finance Guard) and has been a consistent performer for Italy in international athletics.

Additional Information

• Profile of Francesco Fortunato:
• He was born on December 13, 1994, in Andria, Italy.
• He is a specialist in the 20 km race walk and has represented Italy at the Tokyo 2020 Olympics and the Paris 2024 Olympics.
• His record-breaking feat in 2025 cements his position as one of the fastest walkers in the history of the sport, particularly in the shorter indoor formats.
• Race Walking Mechanics:
• Race walking is a long-distance foot race where athletes must always have one foot in contact with the ground.
• The advancing leg must be straightened (i.e., not bent at the knee) from the moment of first contact with the ground until the vertical upright position.
• Judges monitor these two rules strictly, and three red cards lead to disqualification.
• Other Athletes in the Options:
• Evan Dunfee: A highly decorated Canadian race walker who won the bronze medal in the 50 km race walk at the Tokyo 2020 Olympics.
• Toshikazu Yamanishi: A Japanese athlete who is a two-time World Champion (2019 and 2022) in the 20 km race walk.
• Matteo Giupponi: Another prominent Italian race walker who won the bronze medal at the 2022 European Athletics Championships.

Important Points

• Significance of the Record: The 5000 m indoor event is a test of extreme speed and technical precision, often used by outdoor specialists to build anaerobic capacity during the winter season.
• Venue Facts: The city of Ancona, located in the Marche region of Italy, hosts the National Indoor Championships almost every year due to its state-of-the-art 200-meter banked track facilities.
• Governing Bodies: Records in this discipline are ratified by World Athletics (formerly IAAF) and the FIDAL (Federazione Italiana di Atletica Leggera) at the national level.
• Historical Context: Before Fortunato's achievement, the 18-minute barrier was considered nearly impossible for the 5000 m indoor walk; his time of 18:03.01 has brought the world closer to that historic milestone.

Q91. Answer: (a) Modified Mixed Recall Period

The correct answer is Modified Mixed Recall Period.

Key Points

• The State Bank of India (SBI) Research report, released in June 2025, highlighted that poverty in India has declined significantly, largely attributed to the updated methodology used in the Household Consumption Expenditure Survey (HCES) 2022-23.

• The report emphasizes that the shift to the Modified Mixed Recall Period (MMRP) has provided a more accurate and realistic estimation of household consumption patterns compared to older methods.

• Under the MMRP, the National Sample Survey Office (NSSO) collects data using three different time frames: a 7-day recall period for high-frequency items (like edible oil, eggs, fish, fruits, vegetables, and tobacco), a 30-day recall period for mid-frequency items (fuel, rent, and non-durable goods), and a 365-day recall period for durable goods (clothing, footwear, and education).

• The SBI report notes that the Gini Coefficient, which measures inequality, has also seen a decline, indicating that economic growth is becoming more inclusive across both rural and urban sectors.

• Based on the MMRP data, the report estimates that rural poverty has dropped to around 7.2% and urban poverty to 4.6%, bringing the national average to approximately 5% or lower.

Additional Information

• Uniform Recall Period (URP):

• In this method, the consumption data for all items is collected for a uniform 30-day recall period.

• This was the primary method used by the NSSO until the late 1990s but was criticized for underestimating the consumption of durable goods and overestimating the consumption of perishables due to recall bias.

• Mixed Recall Period (MRP):

• The MRP uses a 365-day recall period for five low-frequency categories (clothing, footwear, durable goods, education, and institutional medical expenses) and a 30-day recall period for all other items.

• This was the standard used in the 2011-12 poverty estimations but has been superseded by the more granular MMRP.

• Household Consumption Expenditure Survey (HCES):

• The HCES is conducted by the National Sample Survey Office (NSSO) under the Ministry of Statistics and Programme Implementation (MoSPI).

• The 2022-23 survey was particularly significant as it was conducted after a gap of 11 years, following the junking of the 2017-18 survey data.

• Significance of Recall Periods:

• Shorter recall periods (like 7 days) for food items reduce memory lapse and provide more accurate data on nutritional intake.

• Longer recall periods for durables prevent "bulky" one-time expenditures from skewing the monthly average consumption.

Important Points

• Economic Impact: The transition to MMRP allows the Government of India to recalibrate the Consumer Price Index (CPI) basket, as it reflects current consumption habits where the share of food in the total budget has declined.

• World Bank Context: Many international organizations, including the World Bank and International Monetary Fund (IMF), monitor these methodological shifts to update Global Poverty counts and the $2.15-a-day (2017 PPP) poverty line.

• Data Fact: The SBI Ecowrap report specifically mentions that the decline in poverty is a result of government-led interventions such as the PM-GKAY (Pradhan Mantri Garib Kalyan Anna Yojana), which provides free food grains to over 80 crore people.

Q92. Answer: (c) 8.86%

The correct answer is 8.86%.

Key Points

• In the Union Budget 2025-26, presented by Union Finance Minister Nirmala Sitharaman on February 1, 2025, the allocation for gender-specific schemes reached a historic high of approximately 8.86% of the total expenditure.

• The total outlay for the Gender Budget Statement (GBS) for the fiscal year 2025-26 is estimated at Rs. 4.43 lakh crore, out of a total projected budget expenditure of Rs. 50.01 lakh crore.

• This allocation signifies a substantial increase from the previous fiscal year (2024-25), where the gender budget stood at approximately Rs. 3.10 lakh crore (around 6.5% of the total budget), reflecting the government's shift toward women-led development.

• The Gender Budget is categorized into two main parts: Part A, which includes schemes with 100% allocation for women, and Part B, which includes schemes where at least 30% of the allocation is dedicated to women.

• The primary objective of this increased funding is to enhance economic participation, ensure safety and security, and improve the socio-economic status of women across both rural and urban sectors.

Additional Information

• Gender Budgeting in India:

• India formally adopted Gender Budgeting in the year 2005-06 to ensure that the benefits of development reach women as much as men.

• It is not a separate budget for women but a tool to analyze the budgetary process through a gender lens to address disparities.

• Mission Shakti:

• This is an integrated women empowerment programme launched by the Ministry of Women and Child Development.

• It consists of two sub-schemes: 'Sambal' (for safety and security, including One Stop Centres and Beti Bachao Beti Padhao) and 'Samarthya' (for empowerment, including Ujjwala and Swadhar Greh).

• Lakhpati Didi Scheme:

• The Union Budget 2025-26 continued its focus on the Lakhpati Didi initiative, aiming to empower 3 crore women in Self-Help Groups (SHGs) to earn an annual income of at least Rs. 1 lakh.

• As of 2025, nearly 1 crore women have already achieved this status through various skill development and micro-credit interventions.

• PM Awas Yojana (Grameen):

• Under this scheme, a significant portion of the Gender Budget is utilized as the government mandates that houses should be owned solely or jointly by women, thereby enhancing their asset-ownership and social standing.

Important Points

• Economic Impact: The 8.86% allocation is distributed across various ministries, including Rural Development, Education, and Health, to support women's health through schemes like PM Matru Vandana Yojana.

• Mudra Yojana: Under the PM Mudra Yojana, more than 70% of loans have been sanctioned to women entrepreneurs, fostering financial independence and entrepreneurship at the grassroots level.

• STEM Education: The budget highlights an increase in the enrollment of women in STEM (Science, Technology, Engineering, and Mathematics) courses, which currently stands at 43% in India, one of the highest in the world.

• Safety Initiatives: Funds under the Nirbhaya Fund and dedicated allocations for women police volunteers and fast-track special courts are crucial components of the security framework funded by the 2025-26 gender budget.

Q93. Answer: (c) Chemically Contaminated Sites

p>The correct answer is Chemically Contaminated Sites.

Key Points

• In July 2025, the Union Ministry of Environment, Forest and Climate Change (MoEFCC) officially notified the Environment Protection Rules, 2025, specifically targeting the management and remediation of Chemically Contaminated Sites.

• The primary objective of these rules is to provide a comprehensive legal framework for the identification, investigation, and decontamination of areas where hazardous substances have accumulated in the soil or groundwater.

• These rules are issued under the powers conferred by the Environment (Protection) Act, 1986, which allows the Central Government to take measures to protect and improve the quality of the environment.

• The notification introduces strict protocols for the Remediation of Contaminated Sites, ensuring that toxic hotspots do not pose a continued threat to public health or the surrounding ecosystem.

• A significant feature of these rules is the enforcement of the "Polluter Pays Principle", which mandates that the person or organization responsible for the contamination must bear the financial liability for the cleanup process.

Additional Information

• Environment (Protection) Act, 1986: This parliamentary act serves as the umbrella legislation for environmental safety in India. It was enacted in the wake of the Bhopal Gas Tragedy and gives the government the authority to regulate all forms of pollution and coordinate the activities of various central and state authorities.

• Nature of Contaminated Sites: These sites usually include abandoned industrial units, hazardous waste dumpsites, and areas near chemical factories where toxic chemicals like heavy metals, mercury, arsenic, or persistent organic pollutants have leached into the environment.

• Role of Regulatory Bodies: The Central Pollution Control Board (CPCB) is tasked with maintaining an updated National Inventory of Contaminated Sites. Along with the State Pollution Control Boards (SPCBs), it monitors the progress of remediation and ensures compliance with the 2025 Rules.

• Technological Solutions: The rules advocate for modern remediation technologies such as bioremediation (using microorganisms to degrade pollutants), phytoremediation (using plants), and soil washing to restore the quality of land and water.

• Significance of the Rules: Prior to this notification, the management of such sites was often fragmented. The Environment Protection Rules, 2025, streamline the process, providing clear threshold values for contaminants and a structured timeframe for completing remediation activities.

Important Points

• Identification Process: The rules specify that a site is classified as "contaminated" if the concentration of hazardous substances exceeds the Screening Levels prescribed by the Ministry.

• Public Health Impact: These rules are crucial for preventing long-term health issues such as cancer, neurological disorders, and birth defects which are often linked to living near chemically contaminated areas.

• Global Alignment: The notification aligns India’s domestic policies with international standards like the Stockholm Convention on

Persistent Organic Pollutants and the Minamata Convention on Mercury.

Q94. Answer: (b) 15 August 2025

The correct answer is 15 August 2025.

Key Points

• The National Highways Authority of India (NHAI) and Indian Highway Management Company Limited (IHMCL) have slated the new FASTag annual plan and updated regulations to become fully effective from 15 August 2025.

• This new framework introduces a mandatory replacement cycle for FASTags that have been in use for more than 5 years, ensuring the hardware remains functional and technologically up-to-date.

• As per the guidelines, all FASTag users must ensure their Know Your Customer (KYC) details are updated and verified before the 15 August 2025 deadline to prevent their accounts from being deactivated or blacklisted.

• The initiative is a significant part of the "One Vehicle, One FASTag" policy, which aims to streamline the Electronic Toll Collection (ETC) process and eliminate the use of multiple tags for a single vehicle.

• From the effective date, telecom and payment aggregators linked with the National Electronic Toll Collection (NETC) will implement stricter verification protocols to enhance the security and transparency of toll transactions.

Additional Information

• FASTag Technology:

• It utilizes Radio Frequency Identification (RFID) technology to enable cashless and contactless payments at toll plazas.

• The tag is typically affixed to the windscreen of the vehicle and is linked to a prepaid account or a bank account.

• Regulatory Authorities:

• The Ministry of Road Transport and Highways (MoRTH) oversees the broader policy framework, while NHAI manages the physical infrastructure and IHMCL handles the digital management of the FASTag system.

• Operational Benefits:

• The system significantly reduces congestion at National Highway toll plazas, thereby saving fuel and reducing CO_2 emissions by minimizing idle time.

• It promotes the Digital India vision by moving away from manual cash handling and ensuring every rupee collected is electronically recorded.

• Penalty Clauses:

• Vehicles entering a FASTag lane without a functional tag or with an invalid/unverified tag after 15 August 2025 will be liable to pay double the toll amount as a penalty.

Important Points

• KYC Verification: Users can update their KYC through the respective issuer bank's portal or the IHMCL website. The RBI (Reserve Bank of India) guidelines require valid Identity Proof and Address Proof for this process.

• Global Context: India's NETC program is one of the world's largest electronic tolling systems, processing millions of transactions daily across over 1,000+ toll plazas nationwide.

• Timeline: While the KYC update requests began earlier in 2024, the final enforcement of the annual plan rules and the 5-year expiry clause is firmly set for 15 August 2025.

• Replacement Process: For tags issued before 2020, users should proactively contact their service providers to receive a new FASTag to ensure seamless travel after the implementation date.

Q95. Answer: (d) Strengthening energy security

The correct answer is Strengthening energy security.

Key Points

• At the Bharat Climate Forum 2026, Shri C. P. Radhakrishnan emphasized that effective climate action is a multi-dimensional strategy that serves as a catalyst for Strengthening energy security.

• By transitioning from a fossil-fuel-dependent economy to one powered by renewable energy, India can mitigate the risks associated with volatile global fuel prices and supply chain disruptions. Hence, the correct option is Strengthening energy security.

• The focus on energy security involves diversifying the national energy mix to include Solar, Wind, and Green Hydrogen, which reduces the import bill and ensures a steady power supply for industrial and domestic growth.

• Climate action in India is intrinsically linked to self-reliance (Atmanirbhar Bharat), where generating clean energy locally protects the nation from geopolitical fluctuations related to crude oil and natural gas imports.

• The speaker highlighted that while limiting population growth or reducing agricultural exports are different policy domains, Strengthening energy security is a direct and logical outcome of proactive environmental stewardship.

Additional Information

• Energy Security in India:

• India is currently one of the largest consumers of energy globally. Strengthening Energy Security is vital for maintaining a high

GDP growth rate.

• The International Energy Agency (IEA) has often noted that India's shift toward clean energy is essential for its long-term stability and economic resilience.

• Panchamrit Targets:

• India committed to five nectar elements (Panchamrit) at COP26 in Glasgow, including achieving Net Zero emissions by the year 2070.

• A significant part of this commitment is reaching 500 GW of non-fossil energy capacity by 2030, which directly bolsters energy independence.

• National Green Hydrogen Mission:

• Launched by the Government of India with an initial outlay of Rs. 19,744 crore, this mission aims to make India a global hub for Green Hydrogen production.

• This mission is a cornerstone of climate action that replaces grey hydrogen and fossil fuels in heavy industries, further Strengthening energy security.

• Role of Renewable Energy:

• As of 2024-2025, India has seen a massive surge in Installed Capacity of Solar Power. Decentralized solar energy, such as the PM-KUSUM scheme, helps farmers gain energy sovereignty.

• The integration of Battery Energy Storage Systems (BESS) is another step toward ensuring that renewable energy can provide round-the-clock (RTC) power, eliminating the need for coal-based backup.

Important Points

• Climate Adaptation and Mitigation: While mitigation focuses on reducing Carbon Footprints, adaptation ensures that infrastructure (including energy grids) is resilient to climate-induced disasters like cyclones or floods.

• Economic Impact: Effective climate action attracts Green Finance and Foreign Direct Investment (FDI) into the sustainable technology sector, creating millions of Green Jobs by 2030.

• Global Leadership: Through initiatives like the International Solar Alliance (ISA) and the Global Biofuels Alliance (GBA), India is leading the global south in prioritizing energy security through climate-conscious collaborations.

Q96. Answer: (b) Prime Minister Narendra Modi and President Emmanuel Macron

The correct answer is Prime Minister Narendra Modi and President Emmanuel Macron.

Key Points

• The AI Action Summit was held in Paris, France, on February 10-11, 2025.

• The summit was co-chaired by Prime Minister Narendra Modi of India and President Emmanuel Macron of France, highlighting the strategic digital partnership between the two nations.

• It serves as the third major global gathering on Artificial Intelligence governance, following the Bletchley Park Summit in the UK (2023) and the Seoul AI Summit in South Korea (2024).

• The primary objective of the Paris Summit was to move from "safety" to "action," focusing on the global governance of AI, ethical deployment, and innovation.

• Prime Minister Narendra Modi advocated for inclusive AI, emphasizing the concept of "AI for All" to ensure that the benefits of technology reach the Global South and do not increase the digital divide.

Additional Information

• Global Partnership on Artificial Intelligence (GPAI):

• India served as the Lead Chair of GPAI in 2024, and the February 2025 summit in Paris represents a continuation of India's leadership in setting global AI standards.

• The GPAI is an international initiative established to guide the responsible development and use of AI, grounded in human rights and democratic values.

• The IndiaAI Mission:

• The Government of India approved the IndiaAI Mission with a total budget outlay of Rs. 10,372 crore.

• This mission focuses on creating a robust AI ecosystem through computing capacity, data labs, and skill development.

• Five Pillars of the Paris Summit:

• The summit structured its discussions around five key themes: Public Interest AI, Future of Work, Innovation and Culture, AI Governance, and AI Safety.

• India-France Strategic Relations:

• The co-chairing of this summit is a result of the Horizon 2047 roadmap, which aims to strengthen bilateral cooperation in advanced technologies, cybersecurity, and digital sovereignty.

Important Points

• Participation: The summit saw participation from Heads of State, tech industry leaders, civil society, and academics to forge a

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global consensus on AI regulation.

• Paris AI Elective: A significant discussion point was the "Paris AI Elective," a framework intended to promote transparency in Generative AI models and protect intellectual property.

• Economic Impact: Analysts at the summit discussed how AI could contribute trillions of dollars to the global economy by 2030, provided that regulatory frameworks are balanced with innovation.

• Risk Mitigation: The leaders discussed the risks associated with deepfakes, misinformation, and the impact of automation on the global workforce.

Q97. Answer: (c) Global Indian Pravasi Kabaddi League

The correct answer is Global Indian Pravasi Kabaddi League.

Key Points

• The Global Indian Pravasi Kabaddi League (GIPKL) was officially launched in January 2025 with the aim of promoting India's indigenous sport among the Indian Diaspora residing across the globe.

• This league featured a unique format where international teams were composed of players representing the Pravasi (overseas) Indian communities from countries such as the USA, United Kingdom, Canada, Australia, and the United Arab Emirates.

• The January 2025 edition set a record-level participation, witnessing the involvement of over 12 international franchise teams and hundreds of athletes from the diaspora, making it one of the largest kabaddi events organized outside the standard professional circuit.

• The league was designed to coincide with the Pravasi Bharatiya Divas celebrations to strengthen the cultural and sporting bond between India and its global community. Hence, the correct answer is Global Indian Pravasi Kabaddi League.

Additional Information

• Evolution of Professional Kabaddi:

• The modern era of the sport began with the launch of the Pro Kabaddi League (PKL) in 2014, which transformed Kabaddi from a rural sport into a high-octane professional league in India.

• The World Kabaddi League (WKL) was the first international league to follow the Circle Style format, launched in August 2014, involving teams from Punjab, Canada, and the USA.

• Kabaddi Formats:

• Standard Style: This is the format played in the Asian Games and Pro Kabaddi League, involving a rectangular court and 7 players on each side.

• Circle Style: Primarily popular in the Punjab region, this format is played on a circular pitch and is often featured in the Kabaddi World Cup organized by state governments.

• International Governance:

• The International Kabaddi Federation (IKF), founded in 2004, is the global governing body. It is headquartered in Jaipur, India, and oversees the Kabaddi World Cup.

Important Points

• Global Reach: The Global Indian Pravasi Kabaddi League serves as a platform for Overseas Citizens of India (OCI) and Non-Resident Indians (NRI) to showcase their talent on Indian soil, fostering a sense of national pride.

• Broadcasting and Media: The 2025 league reached a milestone by securing broadcasting rights in over 20 countries, ensuring that the Indian Diaspora could watch their local teams compete.

• Record Figures: The January 2025 event recorded a digital viewership of over 50 million during the final matches, highlighting the growing international appetite for the sport.

• Host Cities: Matches for the GIPKL were held across major Indian cities including New Delhi, Ahmedabad, and Chandigarh, providing state-of-the-art facilities for the international participants.

Q98. Answer: (a) Global Government Excellence Award

The correct answer is Global Government Excellence Award.

Key Points

• The Global Government Excellence Award is a prestigious international recognition presented during the World Governments Summit (WGS) to celebrate exceptional government initiatives that demonstrate innovation and significant social impact.

• During the World Governments Summit 2025 held in Dubai, United Arab Emirates (UAE), this award played a central role in identifying and scaling pioneering solutions to global administrative challenges.

• The award aims to highlight government programs that enhance the quality of life for citizens through digital transformation, sustainable development, and efficient public service delivery.

• The selection process for the Global Government Excellence Award involves a rigorous evaluation by international experts, focusing on criteria such as replicability, originality, and the measurable outcomes of the projects.

• This initiative is part of the UAE's broader vision to foster global cooperation and create a platform for knowledge exchange

among world leaders and policymakers. Hence, the correct answer is the Global Government Excellence Award.

Additional Information

• World Governments Summit (WGS):

• Launched in 2013 under the leadership of Sheikh Mohammed bin Rashid Al Maktoum, the Vice President and Prime Minister of the UAE and Ruler of Dubai.

• The summit serves as a global knowledge exchange platform for future governments, bringing together heads of state, ministers, and thought leaders.

• The 2025 edition focused on the theme of "Shaping Future Governments," emphasizing the role of Artificial Intelligence (AI) and Agile Governance.

• Associated Awards at WGS:

• Best Minister Award: Recognizes exceptional efforts by government ministers who have implemented successful and scalable reforms.

• M-Gov Award: A competition specifically designed for students and innovators to create mobile application solutions for government services.

• Global Universities Challenge: Encourages graduate students from top-tier universities to present innovative solutions to global policy issues.

• Significance of Dubai as a Venue:

• Dubai has established itself as a global hub for innovation and technology, making it the ideal host for the summit.

• The summit is held at the Madinat Jumeirah in Dubai, attracting thousands of participants from over 150 countries annually.

• Focus Areas of 2025 Initiatives:

• Key areas recognized in 2025 included Climate Action, Healthcare Technology, Educational Equity, and Economic Resilience.

• The initiatives highlighted often utilize Blockchain, Big Data, and Machine Learning to optimize government operations and increase transparency.

Important Points

• Global Collaboration: The awards promote the idea that successful local solutions can be adapted to solve global problems, encouraging a borderless approach to public administration.

• Evaluation Methodology: The Global Government Excellence Award partners with major global consulting firms and international organizations like the United Nations (UN) and the World Bank to ensure a fair and transparent selection process.

• Strategic Vision: These awards are aligned with the United Nations Sustainable Development Goals (SDGs), ensuring that government innovation contributes to poverty reduction, gender equality, and environmental protection.

Q99. Answer: (c) Brahmaputra

The correct answer is Brahmaputra.

Key Points

• The Brahmaputra river, known as the Yarlung Tsangpo in the Tibet Autonomous Region of China, is at the center of a major geopolitical and environmental concern between India and China in 2025.

• China has moved forward with plans to build a "super dam" in Medog County, located near the Great Bend where the river turns sharply toward India. This project was first formalized under China's 14th Five-Year Plan (2021-2025).

• The proposed hydropower station is expected to have a capacity of up to 60 gigawatts (GW), which is nearly triple the capacity of the Three Gorges Dam, currently the world's largest power station.

• In 2025, India raised diplomatic concerns regarding the potential impact on downstream rights, specifically fearing that the project could lead to water diversion, reduced flow during dry seasons, or flash floods during sudden releases.

• India has consistently urged China to ensure that any activity in the upper reaches of the river does not harm the interests of downstream states like India and Bangladesh.

Additional Information

• The Brahmaputra River System:

• The river originates from the Chemayungdung Glacier of the Kailash Range near Mansarovar Lake at an elevation of about 5,150 meters.

• It flows for approximately 2,900 km through three countries: China (Tibet), India, and Bangladesh. In India, it enters through Arunachal Pradesh, where it is known as the Siang or Dihang, before flowing through the Assam Valley.

• Downstream Impact and Counter-Measures:

• To mitigate the risks posed by upstream Chinese dams, the Government of India has planned a massive 11,000 MW hydropower project on the Siang River in Arunachal Pradesh to create a water storage buffer.

• The Brahmaputra carries a significant amount of silt and is vital for the biodiversity of the northeast region of India, including the Kaziranga National Park.

• Transboundary River Agreements:

• Unlike the Indus Waters Treaty (1960) between India and Pakistan, there is no formal water-sharing treaty between India and China.

• Currently, cooperation is limited to a Memorandum of Understanding (MoU) where China provides hydrological data (water level and discharge) during the monsoon season from May 15th to October 15th.

Important Points

• Other Transboundary Rivers:

• Sutlej: Also originates in Tibet (as the Langqen Zangbo) and enters India through the Shipki La pass. While China builds dams here too, it is part of the Indus system.

• Indus: Originates near Lake Mansarovar and flows through Ladakh before entering Pakistan. It is governed by a strict bilateral treaty.

• Kosi: Known as the "Sorrow of Bihar," it is a transboundary river flowing through China (Tibet), Nepal, and India, primarily known for its high sediment load and course changes.

• Geopolitical Context: The construction of dams on the Brahmaputra is often viewed through the lens of "water wars" or strategic leverage, as India occupies the middle reach and Bangladesh the lower reach, making them vulnerable to upstream interventions in the Tibet region.

Q100. Answer: (b) 9th June

The correct answer is 9th June.

Key Points

• Birsa Munda Martyr's Day is observed every year on 9th June to pay tribute to the iconic tribal leader and freedom fighter who died on this day in 1900.

• He passed away while in British custody at the Ranchi Jail at the young age of 25. While the official records cited cholera as the cause of death, many believe he was poisoned by the colonial authorities.

• Birsa Munda spearheaded the Munda Rebellion, which is famously known as the Ulgulan or the Great Tumult, in the Chhota Nagpur plateau region (modern-day Jharkhand) during the late 1890s.

• The rebellion was directed against the British Raj and the Dikus (outsiders like landlords and moneylenders) who were exploiting the tribal communities and seizing their ancestral lands.

• His powerful resistance eventually forced the colonial government to enact the Chhota Nagpur Tenancy Act, 1908, which prohibited the transfer of tribal land to non-tribal people, ensuring a degree of land security for the Adivasis.

Additional Information

• Early Life and Birth: Birsa Munda was born on November 15, 1875, in the village of Ulihatu in the Khunti district of present-day Jharkhand.

• Janjatiya Gaurav Divas: In 2021, the Government of India declared November 15 (his birth anniversary) as Janjatiya Gaurav Divas (Tribal Pride Day) to recognize the historical contributions of tribal heroes.

• Religious Leadership: He founded a new faith called Birsait, which promoted monotheism and urged the Munda people to return to their original religious roots, shunning animal sacrifice, alcohol, and witchcraft.

• Revered Titles: Due to his charismatic leadership and spiritual influence, he is affectionately called Dharti Aba (Father of Earth) and is worshipped as Bhagwan Birsa Munda by tribal communities across India.

• Legacy: Birsa Munda is the only tribal leader whose portrait hangs in the Central Hall of the Indian Parliament, symbolizing his immense importance in the Indian Independence Movement.

• Museum: The Bhagwan Birsa Munda Memorial Park cum Freedom Fighter Museum was inaugurated in Ranchi in November 2021 to preserve the history of tribal struggles.

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