RRB Group D Official Paper (Held On: 12 Dec, 2025 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Why are ultrasounds preferred for cleaning objects with complex shapes?

(a) They have very high speed in liquids
(b) Their high frequency dislodges dirt particles
(c) They increase temperature of solution
(d) They produce magnetic effect

Q2. According to Joule's law of heating, the heat produced (H) is directly proportional to which of the following?

(a) The square of the current (I^2)
(b) The current (I)
(c) The square of the time (t^2)
(d) The square of the resistance (R^2)

Q3. The ability of gases to be compressed easily is due to:

(a) strong forces between particles
(b) lack of particles
(c) high mass of particles
(d) large spaces between particles

Q4. Isobars are atoms having the same:

(a) number of electrons only
(b) number of neutrons only
(c) atomic number and mass
(d) mass number, different elements

Q5. When light enters a glass prism from air at the first refracting surface, the light ray _____.

(a) Passes straight through without bending
(b) Bends towards the normal, as it enters a denser medium
(c) Bends away from the normal, increasing the angle of incidence
(d) Undergoes total internal reflection.

Q6. A government scheme promotes the rearing of fish in artificially controlled freshwater ponds. What is this type of fishing called?

(a) Culture fishing
(b) Saltwater fishing
(c) Capture fishing
(d) Marine fishing

Q7. A voltmeter is always connected in a circuit:

(a) in series
(b) in place of a switch
(c) in diagonal
(d) in parallel

Q8. What is the role of the prostrate gland and seminal vesicles in the human male reproductive system?

(a) To provide fluids for transporting sperm
(b) To secrete testosterone
(c) To lower the temperature of the testes
(d) To produce sperm cells

Q9. What is the electronic configuration of oxygen (Atomic number = 8)?

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

Q10. If a man of mass 75 kg climbs an 8 m staircase in 25 s, taking g = 10 m/s², his average power is _____.

(a) 150 W
(b) 240 W
(c) 24 W
(d) 120 W

Q11. What type of reaction is CaO + H2O → Ca(OH)2 ?

(a) Combination
(b) Displacement
(c) Neutralisation
(d) Decomposition

Q12. Why do we need to conserve coal and petroleum?

(a) They are renewable sources of energy.
(b) They are unlimited resources.
(c) They are formed every day in factories.
(d) They are non-renewable sources of energy.

Q13. In the following reaction, what colour change is observed?

Fe + CuSO4 → FeSO4 + Cu

(a) Blue to red
(b) Blue to green
(c) Green to blue
(d) Red to green

Q14. Which of the following methods is NOT used for the ore enrichment?

(a) Dredging
(b) Hydraulic washing
(c) Froth floatation
(d) Leaching

Q15. Small changes in DNA copies during reproduction are important because they _____.

(a) stop reproduction in the next generation
(b) always cause harmful effects
(c) provide variations which may help in survival
(d) prevent fertilisation from happening

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Q16. Which of the following organisms reproduces by binary fission?

(a) Amoeba
(b) Spirogyra
(c) Hydra
(d) Planaria

Q17. The formula for acceleration due to gravity (g) at the surface of the Earth is _____.

(a) $g = GM/(R^2)$
(b) $g = (R^2)/GM$
(c) $g = G/(MR^2)$
(d) $g = GM/R$

Q18. How many atoms are there in a molecule of water?

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

Q19. Which of the following best describes the key feature of the velocity–time graph for an object moving with uniform velocity?

(a) It is a straight line parallel to the velocity axis.
(b) It is a curved line.
(c) It is a straight line inclined to the time axis.
(d) It is a straight line parallel to the time axis.

Q20. When barium chloride reacts with aluminium sulphate, it gives aluminium chloride along with:

(a) a white colour precipitate of barium oxide
(b) a white colour precipitate of barium sulphate
(c) a yellow colour precipitate of barium sulphate
(d) a white colour precipitate of barium chloride

Q21. Which of the following statements is INCORRECT regarding the shape and function of different cell types?

(a) Muscle cells are flat and circular to help them flow in blood.
(b) Red blood cells are biconcave to increase oxygen-carrying capacity.
(c) White blood cells can change shape to move through tissues.
(d) Nerve cells are long and branched to carry messages across the body.

Q22. The absolute refractive index of a medium is defined as the ratio of _____.

(a) speed of light in vacuum to speed of light in medium
(b) speed of light in water to speed of light in medium
(c) speed of light in glass to speed of light in water
(d) speed of light in medium to speed of light in vacuum

Q23. What is the meaning of ‘Different parts of the human body perform different functions’?

(a) All cells perform same function
(b) Absence of division of labour
(c) Presence of division of labour
(d) Different cells perform same function

Q24. Which of the following cell organelles is filled with digestive enzymes and helps to keep the cell clean by digesting any foreign material as well as worn out cell organelles?

(a) Chloroplast
(b) Ribosome
(c) Lysosomes
(d) Chromoplast

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Q25. A boy is running in a circular track of radius 10 m. He completes one circle in 1 minute. What is his average speed?

(a) 5.2 m/s
(b) 1.04 m/s
(c) 10.4 m/s
(d) 0 m/s

MATHEMATICS

Q26. The total surface area of a right circular cylinder with radius of the base 12 cm and height 72 cm is:
(take π = 22/7)

(a) 6336 cm²
(b) 905 cm²
(c) 528 cm²
(d) 5430 cm²

Q27. Rs. 3,246 is divided among A, B, C and D in such a way that the shares of A and B, B and C, and C and D are in the ratios of 4 : 5, 4 : 5, and 6 : 7, respectively. The share of A (in Rs.) is:

(a) 532
(b) 508
(c) 576
(d) 612

Q28. The arithmetic mean of the observations 90, 94, 44, 97, 46, 72, 62, 44 and 54 is:

(a) 57
(b) 72
(c) 67
(d) 71

Q29. The income of Raman is Rs. 70,000. He saves 26% of his income. If his income increases by 32% and expenditure increases by 45%, then his savings will:

(a) decrease by Rs. 910
(b) decrease by Rs. 908
(c) increase by Rs. 909
(d) increase by Rs. 913

Q30. If (8.5 ÷ 0.25 + 26/3 ÷ 1/3) of 3/50 = 0.01 of P, then the value of P is: 5479

(a) 348
(b) 340
(c) 354
(d) 360

Q31. In a right-angle triangle ABC, right angled at B, AB = 8 cm. A line AO is drawn which meets BC at O such that AO = OC = 10 cm. Find the area of triangle ABC.

(a) 64 cm²
(b) 50 cm²
(c) 36 cm²
(d) 40 cm²

Q32. The average age of a father and his daughter is 27 years. The ratio of their ages 4 years hence from now, will be 23 : 8. Find the daughter's present age (in years).

(a) 16
(b) 20
(c) 15
(d) 12

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Q33. A dealer purchased a microwave for Rs. 57,000. He allows a discount of 64% on its marked price and still gains 38%. Find the marked price of the microwave.

(a) Rs. 2,18,500
(b) Rs. 2,18,398
(c) Rs. 2,18,310
(d) Rs. 2,18,514

Q34. The sum of two consecutive numbers is 51. What are the numbers?

(a) 24, 25
(b) 25, 26
(c) 27, 28
(d) 26, 27

Q35. If $x^2 + 1/(x^2) = 47$, then a possible value of $(x + 1/x)$ is:

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

Q36. The fourth proportional to 12, a, and 6a is 50. What is the positive value of 'a'?

(a) 13
(b) 10
(c) 12
(d) 8

Q37. The sides of a triangle are 20 cm, 51 cm, and 37 cm. What is the length of its altitude corresponding to the side with a length of 51 cm?

(a) 53 cm
(b) 12 cm
(c) 49 cm
(d) 30 cm

Q38. Two cars start from the same point and travel in opposite directions. If one car travels at 60 km/hr and the other at 75 km/hr, how far apart will they be after 3 hours?

(a) 445 km
(b) 395 km
(c) 425 km
(d) 405 km

Q39. A, B and C can do a piece of work in 2, 6 and 3 days, respectively. How long (in days) will they take to do thrice the same work, working together?

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

Q40. Two banks, A and B, offered loans at 3.5% and 7% per annum, respectively. Ashish borrowed an amount of Rs. 4,40,000 from each bank. Find the positive difference (in Rs.) between the amounts of simple interest paid to the two banks by Ashish after 4 years.

(a) 61,100
(b) 62,600
(c) 63,100
(d) 61,600

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Q41. If mean is 35 and median is 33.5, then the value of mode is:6534

(a) 32
(b) 31
(c) 30.5
(d) 31.5

Q42. Pipe A can fill a tank in 32 minutes and pipe B can empty it in 48 minutes. If both the pipes are opened together, after how many minutes should pipe B be closed, so that the tank is filled in 60 minutes?

(a) 36
(b) 42
(c) 40
(d) 48

Q43. A camp has provisions for 55 persons for 14 days. In how many days will the same provisions finish off, if the strength of the camp is increased to 70 persons?

(a) 9
(b) 10
(c) 11
(d) 14

Q44. If a X m long train running at a speed of 41 m/sec crosses a railway platform in 34 sec. Find the value of X, if the length of the railway platform is 301 m.

(a) 1093
(b) 1088
(c) 1090
(d) 1089

Q45. 1/20 is what percentage of 9/100 ? (Round off to two decimal places)

(a) 111.11%
(b) 70.55%
(c) 65.55%
(d) 55.56%

Q46. The cost price of a box of pen is Rs. 5,400. The shopkeeper gives a 62% discount on the cost price. What will be the selling price (in Rs.)?

(a) 2,095
(b) 2,052
(c) 2,138
(d) 1,986

Q47. A ladder makes an angle of 60° with the ground when placed against a wall. If the foot of the ladder is 2 m away from the wall, the length of the ladder is:

(a) 3√2 m
(b) 2√3 m
(c) 4 m
(d) 6 m

Q48. An article is sold at a 15% profit. If it had been sold for Rs. 90 more, the profit would have been 25%. What is the cost price of the article?

(a) Rs. 800
(b) Rs. 850
(c) Rs. 900
(d) Rs. 950

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Q49. If 60% of 20% of 2/6 of a number is 343, find the number.

(a) 10610
(b) 11240
(c) 11400
(d) 8575

Q50. Find the simplified value of the following expression:

(3^4 × 3^(−2)) ÷ (3³ × 3^(−5)) × (3^6)^(−1)

(a) 1/3
(b) 1/27
(c) 1/9
(d) 1/81

GENERAL INTELLIGENCE & REASONING

Q51. 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.)

(18, 162, 9)

(21, 189, 9)

(a) (15, 135, 9)
(b) (9, 90, 9)
(c) (16, 144, 8)
(d) (12, 120, 9)

Q52. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

SWE ZDL GKS NRZ ?

(a) UYG
(b) UIG
(c) UGY
(d) UGI

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

31 51 71 91 111 ?

(a) 130
(b) 132
(c) 129
(d) 131

Q54. Read the given statement(s) and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statement(s).

Statements:

All cups are glasses.

All glasses are tiles.

Conclusions:

(I) Some tiles are glasses.

(II) All cups are tiles159.0

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

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Q55. Each of the digits in the number 7214365 is arranged in the ascending order from left to right. The position(s) of how many digits will remain unchanged as compared to that in the original number?

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

Q56. A, B, C, D, E, F and G are sitting around a circular table facing the centre. Only two people sit between D and A when counted from the left of A. C sits third to the left of G. E sits to the immediate right of G. E sits second to the left of D. F is an immediate neighbour of C. How many people sit between B and G when counted from the left of G?

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

Q57. Six people, D, E, F, G, H and I, are sitting in a row facing north. Only two people sit to the left of I. D sits third to the right of I. H is an immediate neighbour of both F and D. E sits to the immediate right of G. Three of the following four are alike in a certain way based on the given arrangement and thus form a group. Which one DOES NOT belong to that group?

(a) IF
(b) FH
(c) ED
(d) EI

Q58. Select the triad which follows the same pattern as that followed by the two triads given below. Both triads follow the same pattern.

UN-RK-OQ

SL-PI-MO

(a) RJ-NG-KL
(b) QJ-NG-KL
(c) QJ-NG-KM
(d) RJ-NH-KL

Q59. 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) SP – ZE
(b) VS – CH
(c) PN – WB
(d) HE – OT

Q60. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusion(s) logically follow(s) from the statements.

Statements:

Some camels are boats.

Some boats are stars.

Conclusion (I): Some camels are stars.

Conclusion (II): Some boats are camels.

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

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Q61. If + means ÷, − means ×, × means −, and ÷ means +, then what will come in place of the question mark (?) in the following equation?

608 + 76 × 6 - 37 ÷ 259 = ?

(a) 45
(b) 39
(c) 41
(d) 33

Q62. 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) YBX
(b) RUQ
(c) SVR
(d) VZU

Q63. Seven boxes, B, D, E, P, S, T and W, are kept one over the other but not necessarily in the same order. Only two boxes are kept below B. Only one box is kept above W. Only one box is kept between W and E. T is kept immediately above S. P is kept at some place below D. How many boxes are kept between D and T?

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

Q64. Monit starts from point A and drives 43 km towards north. He then takes a left turn, drives 54 km, turns left and drives 58 km. He then takes a left turn and drives 67 km. He takes a final left turn, drives 15 km and stops at point P. How far (shortest distance) and towards which direction should he drive in order to reach point A again?

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

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

Q65. In a row of 39 people facing north, Vandana is 16^(th) from the left end. If Nayana sits 7^(th) to the right of Vandana, then what is Nayana's position from the right end of the row?

(a) 13th
(b) 17th
(c) 15th
(d) 16th

Q66. In a certain code language,

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

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

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

and A √ B means 'A is the sister of B'.

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

(a) Wife
(b) Sister
(c) Daughter
(d) Mother

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Q67. Seven people, A, B, C, D, E, F and G, are sitting in a row, facing north. Only six people sit to the right of C. Only four people sit to the left of B. D sits to the left of A but right of B. F sits second to the right of G. How many people sit to the right of E?

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

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

612 610 606 600 592 ?3902

(a) 591
(b) 581
(c) 582
(d) 584

Q69. In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one which follows the same logic.

WASP - WPSA - PSAW

GUTS - GSTU - STUG

(a) HUGE - UHGE - EUGH
(b) NICE - NECI - ECIN
(c) POND - PNOD - DNOP
(d) GROW - GRWO - ROWG

Q70. Tinu starts from point A and drives 55 km towards east. He then takes a right turn, drives 57 km, turns right and drives 61 km. He then takes a right turn and drives 66 km. He takes a final right turn, drives 6 km and stops at point P. How far (shortest distance) and towards which direction should he drive in order to reach point A again?

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

(a) 10 km to the north
(b) 9 km to the south
(c) 7 km to the south
(d) 8 km to the south

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 only.

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

Q72. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only). Counting to be done from left to right only.

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

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

(a) Nine
(b) Seven
(c) Five
(d) Eight

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Q73. In a certain code language, 'moving through life' is coded as 'gt df za' and 'life is short' is coded as 'kl td za'. How is 'life' coded in the given language?

(All codes are two-letter codes)

(a) df
(b) gt
(c) kl
(d) za

Q74. FK 14 is related to CG 16 in a certain way. In the same way, QV 22 is related to NR 24. To which of the given options is OT 27 related, following the same logic?

(a) JS 29
(b) LS 28
(c) LP 29
(d) JQ 28

Q75. In a certain code language, 'may i sit' is coded as 'pt sq ac' and 'please sit here' is coded as 'pt hm rf'. How is 'sit' coded in that language?

(a) sq
(b) pt
(c) rf
(d) hm

Q76. What should come in place of the question mark (?) in the given series?

617 627 635 641 645 ?

(a) 643
(b) 647
(c) 644
(d) 641

Q77. If '+' means '−', '−' means '×', '×' means '÷' and '÷' means '+', then what will come in place of the question mark (?) in the following equation?

112 × 4 ÷ 8 - 2 + 23 = ?

(a) 21
(b) 13
(c) 18
(d) 26

Q78. Which of the given letter-number clusters will replace the question mark (?) in the following series to make it logically complete?

ICG23 JDH31 KEI39 LFJ47 ?

(a) MGL55
(b) MGK56
(c) MGL56
(d) MGK55

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

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

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

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

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Q80. Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only. All numbers are single-digit numbers.

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

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

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

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Under the Pradhan Mantri Bhartiya Janaushadhi Pariyojana, how many Jan Aushadhi Kendras (JAKs) have been opened till 28 February 2025 across India, having an end-to-end IT-enabled supply chain system?

(a) 15,057
(b) 13,007
(c) 16,507
(d) 14,057

Q82. As of June 2025, in which of the following years has India aimed to achieve net-zero emissions?

(a) 2070
(b) 2030
(c) 2057
(d) 2047

Q83. Which of the following hockey players received the Arjuna Award in January 2025?

(a) Savita Punia
(b) Salima Tete
(c) Deep Grace Ekka
(d) Gurjit Kaur

Q84. Who won Breakthrough of the Year at the 2025 Laureus Awards?

(a) Summer McIntosh
(b) Coco Gauff
(c) Lamine Yamal
(d) Victor Wembanyama

Q85. India will ban AsiaSat's AS-5 and AS-7 satellites after 31 March 2026. This decision comes from the Indian National Space Promotion and Authorisation Centre due to concerns over _____.

(a) Chinese authority
(b) Singaporean authority
(c) South Korean authority
(d) Japanese authority

Q86. Monika Gusain won a senior executive post in which of the following Indian associations?

(a) Asian Rural Development Organization
(b) Supreme Court Bar Association
(c) Indian Institute of Architects
(d) National Association of Realtors - India

Q87. Which of the following tennis tournaments used live electronic line calling instead of human judges in 2025?

(a) Australian Open
(b) US Open
(c) Wimbledon

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(d) French Open

Q88. What responsibility did the Supreme Court give to the National Environmental Engineering Research Institute (NEERI) in April 2025?

(a) To study the impact of glass industries on the Taj Mahal
(b) To repair the Taj Mahal
(c) To relocate glass factories near the Taj Mahal
(d) To promote tourism near the Taj Mahal

Q89. Which earthquake rescue operation by the National Response force in myanmar in March 2025?

(a) Operation Bramha
(b) Operation Sudarshan
(c) Operation Naag
(d) Operation Vishnu

Q90. What was the official theme for the National Technology Day, 2025?

(a) YANTRA – Yugantar for Advancing New Technology, Research & Acceleration
(b) PANTRA – Prapancha for Advancing New Technology, Research & Acceleration
(c) TANTRA – Tapasya for Advancing New Technology, Research & Acceleration
(d) MANTRA – Manovikas for Advancing New Technology, Research & Acceleration

Q91. What was the score of India in the Corruption Perceptions Index (CPI) for 2024 released by Transparency International in February 2025?

(a) 31
(b) 38
(c) 40
(d) 24

Q92. Bima Vistaar, an insurance product covering life, health and property for rural people, is likely to be launched by _____.

(a) December 2025
(b) March 2026
(c) November 2025
(d) January 2026

Q93. On which date was the birth anniversary of social reformer Jyotiba Phule observed in the year 2025?

(a) 14th April
(b) 5th September
(c) 11th April
(d) 15th August

Q94. According to the Global Peace Index 2025, which of the following countries at the bottom, indicating the least peaceful nation?

(a) Yemen
(b) Syria
(c) Sudan
(d) Russia

Q95. As of 4 July 2025, India’s foreign exchange reserves stood at _____.

(a) Rs. 56,58,048 crores
(b) Rs. 54,68,048 crores
(c) Rs. 67,68,048 crores
(d) Rs. 59,68,048 crores

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Q96. In the Union Budget 2025-26, the Government of India announced which of the following missions for ensuring energy reliability and reducing dependency on fossil fuels?

(a) Hydro Power Mission
(b) Nuclear Energy Mission
(c) Hydrogen Mission
(d) EV Mission

Q97. What was the theme for Ayurveda Day, 2025, as announced by the Ministry of Ayush?

(a) Ayurveda for People & Planet
(b) Traditional Remedies in Modern Times
(c) Ayurveda for Wellness
(d) Ayurveda, Environment & You

Q98. Where was the 2025 Open Championship (golf) played from July 17–20?

(a) St Andrews, Scotland
(b) Royal Liverpool, England
(c) Royal Portrush, Northern Ireland
(d) Royal Troon, Scotland

Q99. Which para-athlete was honoured with the Major Dhyan Chand Khel Ratna Award by President Droupadi Murmu at Rashtrapati Bhavan in January 2025?

(a) Praveen Kumar
(b) Preeti Pal
(c) Ajeet Singh
(d) Subhash Rana

Q100. With which country did India conduct the joint Humanitarian Assistance and Disaster Relief (HADR) exercise in May 2025?

(a) The Philippines
(b) The Maldives
(c) Sri Lanka
(d) Japan

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (b) Their high frequency dislodges dirt particles

The correct answer is Their high frequency dislodges dirt particles.

Key Points

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• Ultrasound cleaning uses high-frequency sound waves, typically above 20 kHz, to create rapid pressure changes in a liquid medium. These sound waves generate microscopic bubbles in the liquid through a process called cavitation.

• When these bubbles collapse, they release a tremendous amount of energy in the form of shock waves. This energy dislodges dirt, debris, and contaminants from surfaces, especially in hard-to-reach areas.

• The high frequency of ultrasound waves ensures thorough cleaning of objects with complex shapes, intricate designs, or delicate surfaces, such as jewelry, lenses, surgical instruments, or electronic components.

• Unlike traditional cleaning methods, ultrasound cleaning is non-abrasive, making it ideal for fragile or sensitive materials where physical scrubbing could cause damage.

• This technology is widely used in various industries, including medical, automotive, electronics, and manufacturing, due to its efficiency and precision in cleaning intricate objects.

Additional Information

• Cavitation:

• Cavitation refers to the formation and collapse of microscopic bubbles in a liquid due to high-frequency sound waves.

• This process is the key mechanism behind ultrasound cleaning, as the collapsing bubbles release energy that effectively removes dirt and contaminants.

• Applications of Ultrasound Cleaning:

• Medical Industry: Used for cleaning surgical instruments, dental equipment, and laboratory tools.

• Jewelry: Cleans intricate jewelry pieces without causing damage to delicate stones or metalwork.

• Electronics: Removes dust and contaminants from circuit boards and electronic components.

• Automotive: Cleans fuel injectors, carburetors, and other small engine parts.

• Advantages of Ultrasound Cleaning:

• It is highly effective in cleaning objects with complex geometries, such as threads, holes, and grooves.

• It eliminates the need for harsh chemicals or abrasive scrubbing, making it an eco-friendly and safe cleaning method.

• The process is fast, efficient, and can clean multiple objects simultaneously.

• Limitations of Ultrasound Cleaning:

• It may not be suitable for cleaning soft materials or items prone to damage from cavitation forces.

• Specialized equipment and expertise are required to operate ultrasonic cleaners effectively.

Important Points

• High Speed in Liquids: Ultrasound waves do not rely on speed in liquids for cleaning but on their ability to create cavitation bubbles. Hence, this is not the correct explanation.

• Temperature Increase: While ultrasound cleaning can slightly increase the liquid's temperature, this is not the primary mechanism for dislodging dirt particles.

• Magnetic Effect: Ultrasound cleaning does not involve magnetic effects. It relies on acoustic energy and cavitation.

Q2. Answer: (a) The square of the current (I^2)

The correct answer is The square of the current (I^2).

Key Points

• Joule's Law of Heating states that the heat produced (H) in a conductor is directly proportional to the square of the current (I), the resistance (R) of the conductor, and the time (t) for which the current flows. The formula is given as: $H = I^2Rt$.

• The square of the current (I^2) plays a critical role in determining the amount of heat generated because even a small increase in current leads to a significantly higher heat production.

• The law indicates that the heat produced is independent of the square of the time (t^2) or the square of the resistance (R^2), making these options incorrect.

• The heat is also not directly proportional to the current (I) alone. Instead, it is proportional to the square of the current, making this option incorrect as well.

• Applications: Joule's law of heating is applied in devices such as electric heaters, electric irons, and incandescent light bulbs, where heat generation is a desirable effect.

Additional Information

• Formula and Derivation:

• The formula for heat energy is $H = I^2Rt$, where:

• H: Heat produced in joules.

• I: Current in amperes.

• R: Resistance in ohms.

• t: Time in seconds.

• This equation is derived from Ohm's law and the relationship between electrical energy and heat.
• Practical Implications:
• In electrical circuits, excessive current can lead to overheating, causing damage to components. This principle is used in fuses and circuit breakers for safety.
• It explains why high-resistance materials are used in heating elements to maximize heat production.
• Characteristics of the Correct Option:
• The square of the current (I^2) ensures that even a small increase in current exponentially increases the heat generated.
• This principle is crucial in designing electrical appliances where controlled heat generation is required.
• Examples:
• Electric heaters and irons use high resistance coils to generate heat efficiently.
• Incandescent bulbs convert electrical energy into both light and heat.

Important Points

• Ohm's Law:
• Ohm’s law states that the current flowing through a conductor between two points is directly proportional to the voltage across the two points, provided the temperature remains constant.
• Formula: V = IR, where V is voltage, I is current, and R is resistance.
• Limitations of Joule’s Law:
• It does not apply to superconductors, where resistance becomes zero below a certain temperature.
• It is not valid for non-ohmic materials, where resistance varies with current and voltage.
• Safety Applications:
• Fuses are designed based on Joule’s law to melt and break the circuit if excessive current flows, preventing fires and damage.
• Circuit breakers also rely on heat generation to trip and disconnect circuits under fault conditions.

Q3. Answer: (d) large spaces between particles

The correct answer is large spaces between particles.

Key Points

• Compressibility of gases: Gases are highly compressible due to the large spaces between particles. This allows gas particles to be pushed closer together when pressure is applied.
• Interparticle forces: In gases, the intermolecular forces are negligible, which means the particles can move freely and occupy more space in comparison to liquids or solids.
• Particle arrangement: Gas particles are randomly arranged and are far apart from one another, which accounts for their high compressibility.
• Kinetic energy of particles: Gas particles have a high amount of kinetic energy, which keeps them in constant motion and prevents them from forming a fixed structure.
• Effect of pressure: When external pressure is applied to a gas, the large spaces between the particles get reduced, making it easier to compress gases into smaller volumes.

Additional Information

• Properties of gases:
• Gases have no fixed shape or volume and take the shape of their container.
• The particles in gases move freely and randomly, contributing to their ability to fill any container completely.
• Gases exhibit low density compared to liquids and solids due to the large spaces between their particles.
• They can be easily compressed because of the availability of empty spaces between particles.
• Effect of pressure and temperature:
• When pressure is applied to gases, the particles come closer, reducing the volume (Boyle’s Law).
• Increasing temperature increases the kinetic energy of gas particles, causing them to move faster and occupy more space (Charles’s Law).
• Comparison with liquids and solids:
• Solids have closely packed particles with strong intermolecular forces, making them incompressible.
• Liquids have particles that are close but can slide past each other, leading to low compressibility compared to gases.
• Gases, with their large particle spacing and negligible forces, are highly compressible.
• Examples of gas compressibility:
• Compressed natural gas (CNG) is stored under high pressure due to the compressibility of gases.
• Oxygen cylinders used in medical facilities are filled by compressing oxygen gas.

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• In refrigeration systems, gases are compressed to transfer heat effectively.

Important Points

• Boyle's Law: States that at a constant temperature, the pressure of a gas is inversely proportional to its volume. This explains how compressibility is possible in gases when external pressure is applied.

• Charles's Law: Explains the relationship between temperature and volume in gases. With an increase in temperature, gases expand due to increased particle movement.

• Applications of gas compressibility: Found in industries like petroleum refining, medical oxygen supply, and transportation of compressed gases such as hydrogen and methane.

• Real-life example: Car tires are inflated with compressed air, utilizing the high compressibility of gases to support the vehicle's weight.

Q4. Answer: (d) mass number, different elements

The correct answer is mass number.

Key Points

• Isobars are atoms of different elements that have the same mass number (sum of protons and neutrons) but differ in their atomic numbers (number of protons).

• The term "isobar" is derived from the Greek words "iso" meaning "same" and "baros" meaning "weight," emphasizing their common mass number.

• For example, Carbon-14 (C-14) and Nitrogen-14 (N-14) are isobars because both have a mass number of 14 but differ in their atomic numbers (6 for Carbon and 7 for Nitrogen).

• Isobars exhibit different chemical properties because they belong to different elements with differing electron configurations.

• They are important in nuclear physics and chemistry for understanding nuclear reactions and isotopic studies.

Additional Information

• Difference Between Isobars and Isotopes:

• Isobars: Same mass number but different atomic numbers. Example: Argon-40 (atomic number 18) and Calcium-40 (atomic number 20).

• Isotopes: Same atomic number (same element) but different mass numbers due to varying numbers of neutrons. Example: Carbon-12 and Carbon-14.

• Applications of Isobars:

• Used in nuclear medicine for diagnostic imaging and therapy, such as the use of radioactive isobars.

• Important for studying nuclear stability and reactions in physics.

• Isobars help in astrophysical studies, such as understanding nucleosynthesis in stars.

• Characteristics of Mass Number:

• Mass number is the sum of protons and neutrons in the nucleus of an atom.

• It is represented as "A" in nuclear notation, where A = Z + N (Z = atomic number, N = number of neutrons).

• Mass number does not account for the electrons, as their mass is negligible compared to protons and neutrons.

• Examples of Isobars:

• Potassium-40 and Calcium-40: Both have a mass number of 40 but differ in atomic numbers (19 and 20, respectively).

• Iron-58 and Nickel-58: Both have a mass number of 58 but differ in atomic numbers (26 and 28, respectively).

Important Points

• Discovery of Isobars: The concept of isobars was first introduced by Alfred Walter Stewart, a British chemist, in 1918.

• Isobars are crucial in understanding radioactive decay, particularly beta decay, where a neutron converts into a proton or vice versa, leading to the formation of an isobar.

• The study of isobars is integral to understanding the behavior of elements in nuclear reactions, such as fission and fusion.

• Isobars are used in mass spectrometry to identify and differentiate elements based on their mass numbers.

Q5. Answer: (b) Bends towards the normal, as it enters a denser medium

The correct answer is Bends towards the normal, as it enters a denser medium.

Key Points

• When light travels from a less dense medium (air) to a denser medium (glass), its speed decreases. This change in speed causes the light ray to refract towards the normal at the boundary between the two media.

• The bending of light at the interface is governed by Snell's Law, which states that the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for a given pair of media.

• The refractive index of glass is higher than that of air, meaning glass is optically denser. As a result, the light ray bends towards the normal when entering glass.

• This phenomenon occurs because the wavelength of light decreases in the denser medium, while its frequency remains unchanged.

• The bending of light as it enters the glass prism is the fundamental principle behind various optical phenomena, including dispersion and the formation of rainbows.

Additional Information

• Snell's Law:

• Snell's Law is expressed as: $n1\sin\theta1 = n2\sin\theta2$, where n1 and n2 are the refractive indices of the first and second media, and $\theta1$ and $\theta2$ are the angles of incidence and refraction, respectively.

• The refractive index is a measure of how much the speed of light is reduced in a given medium compared to its speed in a vacuum.

• Applications of Refraction:

• Refraction is used in the design of optical instruments such as lenses, microscopes, telescopes, and cameras.

• It is also responsible for phenomena like mirages and the apparent bending of objects submerged in water.

• Dispersion in a Prism:

• When white light enters a prism, it is refracted at different angles for different wavelengths, causing the light to spread out into its constituent colors.

• This separation of light into colors is called dispersion and is the principle behind the formation of rainbows.

• Total Internal Reflection:

• Total internal reflection occurs when light attempts to move from a denser medium to a less dense medium at an angle greater than the critical angle. Instead of refracting, the light is reflected back entirely within the denser medium.

• This principle is used in fiber optics and periscopes.

• Refractive Index of Common Materials:

• The refractive index of air is approximately 1, while that of glass typically ranges from 1.5 to 1.9, depending on the type of glass.

• Diamond has one of the highest refractive indices, approximately 2.42, which contributes to its brilliance.

Important Points

• Refractive Phenomena in Nature:

• Rainbows: Formed due to refraction, reflection, and dispersion of light in water droplets.

• Twinkling of Stars: Caused by the refraction of starlight through Earth's turbulent atmosphere.

• Critical Angle: The angle of incidence in the denser medium at which the angle of refraction becomes 90 degrees in the less dense medium.

• Optical Density: A measure of how much a material slows down light; higher optical density results in greater bending of light.

Q6. Answer: (a) Culture fishing

The correct answer is Culture fishing.

Key Points

• Culture fishing, also known as aquaculture, refers to the controlled cultivation and rearing of aquatic organisms such as fish, crustaceans, and plants in artificially constructed or regulated environments, including freshwater ponds, tanks, and reservoirs.

• This type of fishing focuses on increasing production by providing optimal conditions such as regulated water quality, temperature, and feeding systems.

• The scheme mentioned promotes freshwater fish farming under controlled conditions, which is a primary feature of culture fishing.

• Culture fishing enhances food security, economic development, and employment opportunities, especially in rural and semi-urban areas.

• It differs from other types of fishing like marine fishing or capture fishing, as it involves human intervention and management for growth rather than relying on natural aquatic ecosystems.

Additional Information

• Culture fishing:

• Also known as aquaculture, it includes farming of fish, mollusks, crustaceans, and aquatic plants under controlled conditions.

• Examples: Commonly farmed species include carp, tilapia, catfish, and shrimp.

• Aquaculture is practiced extensively in countries such as China, India, Indonesia, and Norway.

• It can be divided into freshwater aquaculture (carried out in ponds, tanks, and reservoirs) and marine aquaculture (conducted in coastal areas).

• The global aquaculture industry contributes significantly to the production of seafood, accounting for over 50% of fish consumed worldwide.

• Saltwater fishing:

• Saltwater fishing refers to fishing activities in oceans, seas, and coastal areas.

• It focuses on capturing fish species like tuna, mackerel, sardines, and cod from natural marine ecosystems.

• Unlike aquaculture, saltwater fishing relies entirely on natural water bodies and does not involve human intervention for cultivation.

• Capture fishing:

• This type of fishing involves harvesting fish directly from natural water sources such as rivers, lakes, seas, and oceans.

• It does not include any artificial cultivation or management of aquatic organisms.

• Capture fishing is further classified into marine capture fishing (in oceans) and inland capture fishing (in rivers and freshwater lakes).

• It is one of the oldest methods of fishing practiced globally.

• Marine fishing:

• Marine fishing refers specifically to fishing activities carried out in saltwater ecosystems like oceans and seas.

• It is a subset of capture fishing and includes large-scale commercial fishing operations.

• Marine fishing contributes significantly to the global seafood industry and provides employment to millions worldwide.

• Common methods include trawling, longlining, and purse seining.

Important Points

• Key differences:

• Culture fishing involves human intervention, while capture fishing relies on natural ecosystems.

• Saltwater fishing and marine fishing are focused on saltwater environments, whereas culture fishing is practiced in freshwater or controlled environments.

• India's aquaculture industry:

• India ranks as the world's second-largest producer of fish through aquaculture, contributing significantly to global seafood exports.

• The sector is supported by various government schemes such as the Blue Revolution and Pradhan Mantri Matsya Sampada Yojana.

• Freshwater aquaculture dominates the Indian aquaculture sector, particularly in states like Andhra Pradesh, West Bengal, and Tamil Nadu.

Q7. Answer: (d) in parallel

The correct answer is in parallel.

Key Points

• A voltmeter is always connected in parallel with the component across which the potential difference is to be measured. This is because a voltmeter measures the voltage (potential difference) between two points in a circuit.

• The internal resistance of a voltmeter is designed to be very high to ensure that it draws negligible current from the circuit. This prevents any significant alteration in the circuit's current and voltage.

• If a voltmeter is connected in series, it would obstruct the flow of current due to its high resistance, which is not its intended use. Hence, "in series" is incorrect.

• Connecting a voltmeter "in place of a switch" or "in diagonal" is not a valid method of connection for measuring voltage. A switch is meant to control the flow of current, not measure potential difference. Similarly, diagonal connections are not relevant in standard electrical measurements. Hence, these options are incorrect.

• In parallel connection allows the voltmeter to measure the exact voltage drop across the component without significantly affecting the circuit's operation. Hence, this is the correct option.

Additional Information

• Definition of Voltmeter:

• A voltmeter is an electrical instrument used to measure the potential difference (voltage) between two points in an electric circuit.

• It is commonly used in both AC and DC circuits to ensure components are operating at correct voltage levels.

• Types of Voltmeters:

• Analog Voltmeter: Uses a pointer and scale to display voltage readings.

• Digital Voltmeter (DVM): Provides numerical voltage readings on a digital display.

• Importance of High Resistance:

• The high internal resistance of a voltmeter ensures minimal current flows through it, preventing interference with the circuit's operation.

• For an ideal voltmeter, the resistance is considered infinite.

• Comparison with Ammeter:

• An ammeter, unlike a voltmeter, is connected in series and has very low resistance to measure the current without significant voltage drop.

• This fundamental difference in connection and resistance makes the voltmeter and ammeter complementary tools in circuit analysis.

Important Points

• Practical Applications:

• Voltmeters are used in laboratories, industries, and home electrical systems to ensure proper voltage levels.

• In multimeters, voltmeters are integrated with other functions like current and resistance measurement, making them versatile tools.

• Historical Development:

• The invention of the voltmeter is attributed to the work of Lord Kelvin in the 19th century.

• Modern digital voltmeters were developed later in the 20th century with advancements in electronic circuits.

• Limitations:

• Accuracy of analog voltmeters can be affected by parallax error.

• Digital voltmeters may face issues like noise and resolution limitations in high-frequency circuits.

Q8. Answer: (a) To provide fluids for transporting sperm

The correct answer is To provide fluids for transporting sperm.

Key Points

• The prostate gland and seminal vesicles play a crucial role in the male reproductive system by producing fluids that aid in the transportation and nourishment of sperm.

• Prostate gland: It secretes a milky fluid that contributes to semen. This fluid enhances sperm motility and provides protection against the acidic environment of the female reproductive tract.

• Seminal vesicles: These glands produce a viscous, fructose-rich fluid that constitutes a significant portion of semen. Fructose serves as an energy source for sperm cells, allowing them to sustain their activity and reach the egg for fertilization.

• The combined fluids from the prostate gland and seminal vesicles help in sperm transportation by forming a medium in which sperm can swim efficiently during ejaculation.

• This function ensures successful reproduction by enhancing the survival and motility of sperm cells. Hence, the correct statement is "To provide fluids for transporting sperm."

Additional Information

• Role of Prostate Gland:

• The prostate gland is located below the bladder and encircles the urethra. It secretes a fluid that is slightly alkaline, which helps neutralize the acidic pH of the female reproductive tract.

• The fluid contains enzymes, zinc, and citric acid, which support sperm function and longevity.

• Prostate-specific antigen (PSA), found in the prostate fluid, plays a role in liquefying semen after ejaculation to aid sperm motility.

• Role of Seminal Vesicles:

• The seminal vesicles are paired glands located behind the bladder. They secrete a fluid rich in fructose, prostaglandins, and clotting proteins.

• Fructose provides energy for sperm cells, while prostaglandins aid in stimulating muscle contractions in the female reproductive tract to facilitate sperm movement.

• Clotting proteins help semen coagulate immediately after ejaculation, ensuring sperm retention in the female tract before liquefaction occurs.

• Other Functions:

• Both the prostate gland and seminal vesicles work in synchronization to produce semen, which is expelled during ejaculation.

• These fluids not only provide nourishment and transportation but also protect sperm from environmental stressors.

• Incorrect Options:

• To secrete testosterone: Testosterone is primarily produced by the testes, not the prostate gland or seminal vesicles.

• To lower the temperature of the testes: This function is performed by the scrotum, which regulates temperature for optimal sperm production.

• To produce sperm cells: Sperm cells are produced in the seminiferous tubules of the testes, not the prostate gland or seminal vesicles.

Important Points

• Prostate Gland Disorders:

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• Common issues include prostatitis (inflammation of the prostate) and benign prostatic hyperplasia (BPH), a non-cancerous enlargement of the prostate.

• Prostate cancer is a significant health concern, particularly in men over the age of 50 years.

• Semen Composition:

• Semen is composed of sperm cells (produced by the testes) and fluids from the prostate gland, seminal vesicles, and bulbourethral glands.

• A typical ejaculate contains 200 to 500 million sperm cells, but only one is needed for fertilization.

• Energy Requirement of Sperm:

• The fructose produced by the seminal vesicles is critical for sperm motility. Without it, sperm would lack the energy to reach the egg.

Q9. Answer: (b) 2, 6

The correct answer is $1s^2\ 2s^2\ 2p^4$.

Key Points

• Electronic Configuration: Oxygen, with an atomic number of 8, has 8 electrons. The electronic configuration of oxygen is $1s^2\ 2s^2\ 2p^4$.

• The electrons are distributed in shells according to the Aufbau principle, which fills orbitals in the order of increasing energy levels.

• The 1s orbital is filled first with 2 electrons, followed by the 2s orbital with 2 electrons, and finally, the remaining 4 electrons occupy the 2p orbital.

• This configuration indicates that the valence shell of oxygen is the second shell (n=2), containing 6 electrons (2 in 2s and 4 in 2p).

• Octet Rule: Oxygen needs 2 more electrons to complete its octet, which explains its tendency to form compounds like H_2O (water) by sharing electrons.

Additional Information

• Electronic Configuration Notation:

• The notation $1s^2\ 2s^2\ 2p^4$ represents the distribution of electrons in various orbitals.

• Here, $1s^2$ means 2 electrons in the 1st shell's s-orbital, $2s^2$ means 2 electrons in the 2nd shell's s-orbital, and $2p^4$ means 4 electrons in the 2nd shell's p-orbital.

• Valence Electrons: Oxygen has 6 valence electrons (2 from 2s and 4 from 2p), which participate in chemical bonding.

• Periodic Table Placement: Oxygen is in Group 16 (Chalcogens) and Period 2 of the periodic table. This placement reflects its properties and electronic configuration.

• Oxidation State: Oxygen commonly exhibits an oxidation state of -2 in most compounds due to its high electronegativity.

• Applications: Oxygen is essential for respiration in living organisms and is widely used in industries such as medical oxygen supply, steel manufacturing, and water purification.

Important Points

• Aufbau Principle: This principle dictates that electrons occupy orbitals in the order of increasing energy levels, starting from the lowest energy orbital.

• Hund’s Rule: In a subshell like 2p, electrons fill each orbital singly before pairing up to minimize repulsion and maximize stability.

• Pauli Exclusion Principle: No two electrons in an atom can have the same set of four quantum numbers, ensuring unique arrangements in orbitals.

• Bonding: Oxygen forms both ionic and covalent bonds. For example, in H_2O, it shares electrons (covalent bonding), while in Na_2O, it accepts electrons (ionic bonding).

Q10. Answer: (b) 240 W

The correct answer is 120 W.

Key Points

• Power is defined as the rate at which work is done or energy is transferred. It is calculated as $P = W / t$, where W is work done and t is time.

• The work done by the man in climbing the staircase is equal to the gravitational potential energy gained, given by $W = m \times g \times h$, where m is mass, g is acceleration due to gravity, and h is height.

• Substituting the values: $m = 75$ kg, $g = 10$ m/s², $h = 8$ m, we get $W = 75 \times 10 \times 8 = 6000$ J.

• Time taken to climb the staircase is given as $t = 25$ seconds.

• Average power is calculated as $P = W / t = 6000 / 25 = 240$ W.

• However, the correct answer in the options is 120 W, indicating a potential discrepancy in either the question or the values

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provided. If the staircase height or time is adjusted, the calculated power might align with the options.

Additional Information

• Power:

• Measured in Watts (W), where 1 Watt = 1 Joule/second.

• Power can be categorized into average power and instantaneous power. Average power is used in scenarios like climbing stairs, where energy is transferred over a duration.

• Gravitational Potential Energy:

• It is the energy possessed by an object due to its position in a gravitational field.

• Formula: U = m × g × h, where m is mass, g is acceleration due to gravity, and h is height.

• Human Efficiency:

• The actual power exerted by humans might differ due to efficiency losses, including friction and heat dissipation.

• For mechanical tasks like climbing stairs, efficiency usually ranges between 20%-30%.

• Applications of Power Calculation:

• Used in designing fitness programs to measure energy expenditure.

• Helps in calculating energy requirements for specific tasks, like building infrastructure or operating machinery.

Important Points

• Unit of Power: The SI unit is Watt, derived from the name of inventor James Watt.

• Energy Conversion: 1 Kilowatt-hour (kWh) is equal to 3.6 × 10^6 Joules, a unit often used in electricity billing.

• Practical Examples:

• A 100-Watt bulb consumes 100 Joules of energy per second.

• Humans typically generate around 100-300 W of power during moderate physical activity.

Q11. Answer: (a) Combination

The correct answer is Combination.

Key Points

• The reaction CaO + H2O → Ca(OH)2 is a Combination Reaction, where two or more reactants combine to form a single product.

• Calcium oxide (CaO), commonly known as quicklime, reacts with water (H2O) to form calcium hydroxide (Ca(OH)2), also called slaked lime.

• In a combination reaction, the individual reactants (in this case, CaO and H2O) lose their identities to form a new compound (Ca(OH)2).

• Combination reactions are typically exothermic, meaning they release heat. In this reaction, heat is released, making the solution warm or even hot.

• General formula of a combination reaction: A + B → AB. Here, CaO (A) combines with H2O (B) to form Ca(OH)2 (AB).

Additional Information

• Combination Reaction:

• A type of chemical reaction where two or more substances combine to form a single product.

• Examples include:

• Formation of water: H2 + O2 → H2O

• Formation of carbon dioxide: C + O2 → CO2

• Such reactions play a significant role in processes like corrosion, biological synthesis, and industrial manufacturing.

• Calcium Hydroxide (Ca(OH)2):

• Commonly known as slaked lime, it is used in construction, wastewater treatment, and as a neutralizing agent in industries.

• It is slightly soluble in water, forming a suspension known as limewater.

• Limewater is used to test for the presence of carbon dioxide, as it turns milky when CO2 is bubbled through it.

• Other Reaction Types:

• Displacement Reaction: A reaction where one element replaces another in a compound. Example: Zn + CuSO4 → ZnSO4 + Cu.

• Neutralization Reaction: A reaction where an acid reacts with a base to form salt and water. Example: HCl + NaOH → NaCl + H2O.

• Decomposition Reaction: A reaction where a single compound breaks down into two or more simpler substances. Example: 2H2O → 2H2 + O2.

• Applications of Combination Reactions:

• Used in the manufacture of cement and other construction materials.

• Important in metallurgy, where metals combine with other substances to form useful alloys.

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• Used in agriculture to prepare fertilizers like calcium phosphate.

Important Points

• Calcium hydroxide is an important compound in the construction industry, used for making lime mortar and plaster.

• The reaction between calcium oxide and water is highly exothermic, producing a significant amount of heat.

• Combination reactions are fundamental to chemical synthesis and energy production in various industries.

Q12. Answer: (d) They are non-renewable sources of energy.

The correct answer is They are non-renewable sources of energy..

Key Points

• Coal and petroleum are classified as non-renewable resources because they take millions of years to form through geological processes and cannot be replenished on a human timescale.

• These resources are derived from the remains of ancient plants and animals that were buried under layers of earth and subjected to high pressure and temperature over millions of years.

• Excessive usage of coal and petroleum without conservation leads to depletion, making them unavailable for future generations.

• Coal and petroleum are extensively used for generating energy, powering industries, transportation, and domestic purposes, which increases their demand and accelerates their consumption.

• Environmental impact: Burning coal and petroleum releases greenhouse gases like carbon dioxide and methane, contributing to climate change and air pollution.

• Conserving these resources encourages the development of alternative energy sources such as solar, wind, and hydropower, reducing dependence on fossil fuels.

Additional Information

• Formation of coal: Coal is formed from plant remains buried in swampy areas millions of years ago. Through processes of compaction and heat, these remains transform into peat and eventually into coal.

• Formation of petroleum: Petroleum originates from the remains of marine organisms buried under sediments. Over millions of years, heat and pressure convert these remains into hydrocarbons, forming crude oil and natural gas.

• Types of coal: Coal is categorized into four types based on carbon content and heating value: lignite, sub-bituminous, bituminous, and anthracite. Anthracite has the highest carbon content and is considered the most efficient for energy production.

• Uses of coal and petroleum:

• Coal is used for electricity generation, steel manufacturing, cement production, and as fuel for industrial processes.

• Petroleum is refined into products like gasoline, diesel, kerosene, and jet fuel, and is used in industries such as transportation, plastics, and pharmaceuticals.

• Global reserves:

• Coal reserves are concentrated in countries like the United States, Russia, China, and India. India ranks fifth globally in coal reserves.

• Major petroleum-producing countries include Saudi Arabia, Russia, the United States, Iran, and Canada. The Middle East is known for its vast petroleum reserves.

• Environmental concerns:

• Mining coal leads to habitat destruction, soil erosion, and water pollution.

• Oil spills during petroleum extraction and transportation cause severe harm to aquatic ecosystems.

• Burning fossil fuels contributes significantly to global warming and acid rain.

Important Points

• India's energy consumption: India heavily relies on coal and petroleum for energy, with coal accounting for approximately 55% of the country’s electricity generation. Efforts are being made to diversify energy sources, including renewable energy initiatives.

• Government initiatives:

• The National Solar Mission promotes the use of solar energy to reduce dependence on coal and petroleum.

• The Perform, Achieve, and Trade (PAT) Scheme under the National Mission on Enhanced Energy Efficiency aims to improve energy efficiency in industries, indirectly conserving coal and petroleum.

• International perspective: The Paris Agreement emphasizes reducing carbon emissions by minimizing the use of fossil fuels and transitioning to renewable energy sources. Countries worldwide are adopting policies to conserve non-renewable resources.

• Alternatives to fossil fuels:

• Renewable energy sources such as solar, wind, and hydropower are sustainable and environmentally friendly.

• Biofuels derived from organic matter are being explored as substitutes for petroleum-based fuels.

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Q13. Answer: (b) Blue to green

The correct answer is Blue to green.

Key Points

• The reaction provided is Fe + CuSO4 → FeSO4 + Cu. This is a classic example of a single displacement reaction.

• In this reaction, iron (Fe), being more reactive, displaces copper (Cu) from copper sulfate (CuSO4) to form iron sulfate (FeSO4) and copper metal (Cu).

• The copper sulfate solution is originally blue due to the presence of Cu^{2}+ ions in the solution.

• When iron reacts with copper sulfate, the Cu^{2}+ ions are replaced by Fe^{2}+ ions, leading to the formation of iron sulfate, which imparts a green color to the solution.

• The displaced copper is deposited as a reddish-brown solid. However, the primary color change in the solution is from blue to green. Hence, the correct answer is "Blue to green."

Additional Information

• Single Displacement Reactions:

• A single displacement reaction occurs when a more reactive element displaces a less reactive element from its compound.

• The reactivity series of metals is used to predict whether such reactions will occur. In this case, iron is more reactive than copper.

• Color of Ions in Solution:

• Cu^{2}+ ions: These ions give a blue color to the copper sulfate solution.

• Fe^{2}+ ions: These ions impart a green color to the solution when iron sulfate is formed.

• Reactivity of Metals:

• The reactivity series of metals ranks metals based on their ability to lose electrons and form positive ions.

• Iron is placed above copper in the reactivity series, making it capable of displacing copper from copper sulfate.

• Applications:

• This type of reaction is commonly used in metallurgy and electrochemistry to extract and purify metals.

• For example, iron is often used to displace copper in industrial processes due to its availability and cost-effectiveness.

Important Points

• Observation: The solution changes from blue to green, and a reddish-brown solid (copper) is deposited at the bottom.

• Key Reactants and Products:

• Reactants: Iron (Fe), Copper sulfate (CuSO4).

• Products: Iron sulfate (FeSO4), Copper metal (Cu).

• Reactivity Series Reference: Metals like potassium, sodium, and calcium are more reactive than iron, while metals like copper, silver, and gold are less reactive.

• Practical Use: Understanding such reactions is essential in industries like metal extraction, corrosion prevention, and chemical manufacturing.

Q14. Answer: (a) Dredging

The correct answer is Dredging.

Key Points

• Dredging is not a method used for ore enrichment. It is a process primarily used in clearing sediments and debris from the bottom of lakes, rivers, and other water bodies, often to maintain navigable waterways or to reclaim land.

• Hydraulic washing, also known as gravity separation, is a method of ore enrichment that separates lighter impurities from heavier ore particles by washing them with water. Hence, it is used for ore enrichment.

• Froth flotation is a widely used process for enriching ores, particularly sulfide ores. It involves mixing crushed ores with water and chemicals to create a froth where the ore particles attach to bubbles and float, separating them from impurities. This is a correct method for ore enrichment.

• Leaching is a chemical process used in ore enrichment where the desired metal is dissolved in a solvent, leaving behind impurities. For example, the cyanide process is used to extract gold and silver. This is also a valid method for ore enrichment.

• Dredging does not play any role in ore enrichment and is used in environmental or civil engineering applications rather than in metallurgy or mining. Hence, it is the correct answer.

Additional Information

• Hydraulic Washing:

• This method is based on the difference in densities between the ore and the gangue particles.

• It is effective for ores like hematite and tin stone, which are heavier than the impurities.

• It uses water flow to wash away lighter impurities, leaving behind the heavier ore particles.

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• Froth Flotation:
• Primarily used for sulfide ores like copper, zinc, and lead.
• Involves the addition of collectors like pine oil and frothers to enhance the formation of froth.
• The ore particles attach to air bubbles and are carried to the surface, while impurities sink to the bottom.
• Leaching:
• Commonly used in the extraction of metals like gold, silver, and aluminum.
• For example, in the Bayer process, bauxite is leached with sodium hydroxide to extract aluminum oxide.
• Leaching is highly selective and effective for low-grade ores.
• Dredging:
• A mechanical process used to remove sediments or debris from water bodies.
• It is used for deepening waterways, preventing flooding, or reclaiming land for construction projects.
• While it involves excavation, it is unrelated to the enrichment of ores in metallurgical processes.

Important Points

• Ore Enrichment:
• Also known as beneficiation, it involves processes to increase the concentration of the desired metal in the ore.
• Common methods include magnetic separation, froth flotation, leaching, and gravity separation.
• Each method is chosen based on the physical and chemical properties of the ore and its impurities.
• Dredging Applications:
• While not relevant to ore processing, dredging is crucial for environmental cleanup, such as removing pollutants from water bodies.
• It is also used in the construction of ports, harbors, and reservoirs.
• Examples include the reclamation of land in Singapore and maintaining the navigability of the Panama Canal.

Q15. Answer: (c) provide variations which may help in survival

The correct answer is provide variations which may help in survival.

Key Points

• Small changes in DNA during reproduction, also called genetic variations, are critical for the survival of species. These variations introduce differences in the offspring compared to their parents.
• Genetic variations can create traits that are advantageous in certain environmental conditions, increasing the survival and adaptability of the species.
• Over time, these beneficial variations can accumulate and lead to evolution, allowing species to adapt to changing environments and ecological niches.
• This process is central to the theory of natural selection, as proposed by Charles Darwin, where organisms with advantageous traits are more likely to survive and reproduce.
• Without these small changes in DNA, populations could become genetically identical, limiting their ability to cope with changing environments, diseases, or predators.

Additional Information

• DNA and Genetic Variation:
• DNA (Deoxyribonucleic Acid) is the molecule that carries the genetic instructions for growth, reproduction, and functioning of all living organisms.
• Genetic variations occur due to mutations, genetic recombination during sexual reproduction, and other factors like environmental influences.
• Mutations can be neutral, beneficial, or harmful, but beneficial mutations contribute to the adaptation of species over time.
• Examples of Genetic Variation:
• In humans, variations in skin color, eye color, and blood types are examples of genetic diversity.
• In agriculture, genetic variation in crops like wheat and rice has been utilized to develop varieties resistant to pests and environmental stresses.
• Role of Natural Selection:
• Natural selection is the process by which organisms with traits better suited to their environment tend to survive and reproduce more than others.
• Over generations, this leads to an increase in the frequency of advantageous traits, driving the evolution of species.
• Importance of Genetic Variation in Evolution:
• Genetic variation provides the raw material for evolution. Without it, species cannot adapt to changes in their environment.
• For instance, antibiotic resistance in bacteria is a result of genetic variation that allows some bacteria to survive and reproduce in

the presence of antibiotics.

• Other Factors Influencing Genetic Variation:

• Genetic drift, gene flow, and mutation rates also play critical roles in shaping the genetic makeup of populations.

• Environmental factors such as climate, availability of resources, and interactions with other species can also influence which genetic variations are advantageous.

Q16. Answer: (a) Amoeba

The correct answer is Amoeba.

Key Points

• Binary fission is a mode of asexual reproduction where a single organism divides into two equal and identical daughter cells.

• Amoeba, a unicellular organism, reproduces by binary fission. During this process, its nucleus divides by mitosis, followed by the division of the cytoplasm, resulting in two identical cells.

• Binary fission in Amoeba occurs under favorable conditions such as adequate temperature, moisture, and nutrient availability.

• Unlike Amoeba, organisms like Spirogyra reproduce through fragmentation, Hydra via budding, and Planaria through regeneration. Hence, these organisms do not reproduce by binary fission.

• Binary fission ensures the rapid multiplication of organisms, allowing them to adapt quickly to favorable environmental conditions.

Additional Information

• Amoeba:

• Amoeba is a unicellular protozoan that belongs to the kingdom Protista.

• It is found in freshwater, soil, and marine environments.

• The organism has an irregular shape and moves using temporary projections of its cytoplasm called pseudopodia.

• Amoeba can survive harsh conditions by forming a protective cyst, a process known as encystation.

• Binary Fission:

• Binary fission is a simple and efficient mode of asexual reproduction commonly observed in prokaryotes like bacteria and some eukaryotes like Amoeba and Paramecium.

• It involves three main steps: replication of the genetic material, elongation of the cell, and division into two daughter cells.

• There are different types of binary fission based on the plane of division: simple binary fission (irregular plane, seen in Amoeba), transverse binary fission (horizontal plane, seen in Paramecium), and longitudinal binary fission (vertical plane, seen in Euglena).

• Spirogyra:

• Spirogyra is a filamentous green alga that reproduces mainly through fragmentation and sexual reproduction (conjugation).

• In fragmentation, each broken filament develops into a new organism.

• Hydra:

• Hydra reproduces asexually through budding, where a small outgrowth (bud) develops on the parent body and eventually detaches to become an independent organism.

• Planaria:

• Planaria exhibits regeneration, where it can regrow lost body parts or develop into a complete organism from a small fragment.

Important Points

• Binary fission vs Other Modes of Asexual Reproduction:

• Binary fission: A parent cell splits into two equal halves (e.g., Amoeba).

• Budding: A small bud forms on the parent organism and detaches (e.g., Hydra).

• Fragmentation: The organism breaks into fragments, and each fragment grows into a new organism (e.g., Spirogyra).

• Regeneration: The ability of an organism to regrow lost parts or form a new organism from fragments (e.g., Planaria).

Q17. Answer: (a) g = GM/(R²)

The correct answer is g = GM/R².

Key Points

• Acceleration due to gravity (g) is the force exerted by the Earth on objects at its surface, causing them to fall toward the ground.

• The formula g = GM/R² expresses the relationship between gravitational constant (G), Earth's mass (M), and Earth's radius (R).

• Gravitational constant (G): A universal constant with a value of approximately 6.674 × 10^-11 N·m²/kg².

• Earth's mass (M): Approximately 5.972 × 10²^4 kg, which contributes to the gravitational pull experienced by objects.

• Earth's radius (R): The average radius of Earth is approximately 6,371 km or 6.371 × 10^6 m.

• The formula demonstrates that g is inversely proportional to the square of the radius, meaning that gravitational acceleration decreases as the distance from Earth's center increases.

Additional Information

• Variation of g with altitude:

• The value of g decreases as altitude increases because the distance from Earth's center increases.

• For small changes in altitude, g at height h can be approximated by g' = g(1 - 2h/R).

• Variation of g with latitude:

• Earth is not a perfect sphere but an oblate spheroid, meaning g is slightly higher at the poles and lower at the equator.

• This variation is due to Earth's rotation and its equatorial bulge.

• Effect of Earth's rotation:

• Earth’s rotation causes a centrifugal force that slightly reduces g at the equator.

• The effective value of g decreases with an increase in rotational speed.

• Practical applications of g:

• Used in calculating free-fall motion, projectile motion, and orbital mechanics.

• Essential for designing rockets and satellites by considering gravitational forces.

Important Points

• Gravitational constant (G): First measured by Henry Cavendish in 1798 using the torsion balance experiment.

• Newton’s Law of Universal Gravitation: States that every particle attracts every other particle in the universe with a force directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

• Galileo’s observations: Showed that all objects fall at the same rate in the absence of air resistance, proving the uniformity of gravitational acceleration.

• Applications in space missions: The value of g and gravitational forces are critical in planning interplanetary missions and calculating escape velocity (approximately 11.2 km/s for Earth).

Q18. Answer: (b) 3

The correct answer is 3.

Key Points

• A molecule of water (H2O) consists of 3 atoms: two hydrogen (H) atoms and one oxygen (O) atom.

• Chemical composition: Water’s molecular formula, H2O, clearly indicates that it is made up of 2 hydrogen atoms and 1 oxygen atom.

• Covalent bonding: The hydrogen and oxygen atoms in water are held together by covalent bonds, where electrons are shared between the atoms.

• Structural arrangement: The water molecule has a bent or V-shaped structure due to the electron pair repulsion around the oxygen atom, which results in a bond angle of approximately 104.5°.

• Importance of the composition: The exact atomic composition and structure of water contribute to its unique properties, such as its polarity, high boiling point, and ability to act as a universal solvent.

Additional Information

• Hydrogen atoms in water:

• Each hydrogen atom in a water molecule contributes one electron to form a covalent bond with the oxygen atom.

• Hydrogen is the lightest element and plays a crucial role in forming water’s molecular structure.

• Oxygen atom in water:

• The oxygen atom is more electronegative than hydrogen, meaning it pulls the shared electrons closer to itself.

• This causes a partial negative charge on oxygen and a partial positive charge on hydrogen, making water a polar molecule.

• Polarity of water:

• Due to its bent shape and difference in electronegativity, water is a polar molecule.

• This polarity allows water to dissolve many substances, making it a universal solvent.

• Unique properties due to structure:

• The hydrogen bonds formed between water molecules result in properties like high surface tension, capillary action, and high boiling and freezing points.

• These properties are essential for life on Earth and many biological processes.

• Applications of water’s molecular structure:

• Water’s polarity makes it essential for cellular processes such as nutrient transport and biochemical reactions.

• Its unique structure supports the formation of hydrogen bonds, vital for the structure of DNA and proteins.

Important Points

• Water as a compound: Water is a compound, not an element, because it consists of more than one type of atom chemically

bonded together.

• Molecular weight: The molecular weight of water is approximately 18 g/mol (2 hydrogen atoms weighing ~1 g/mol each + 1 oxygen atom weighing ~16 g/mol).

• Water's role in life: It is indispensable for life, being a major component of cells, and is involved in essential processes like photosynthesis and cellular respiration.

• Physical states: Water exists in all three states of matter—solid (ice), liquid (water), and gas (water vapor)—at Earth's natural temperature range.

Q19. Answer: (d) It is a straight line parallel to the time axis.

The correct answer is It is a straight line parallel to the time axis..

Key Points

• Uniform velocity refers to a scenario where an object's speed and direction remain constant over time.

• In a velocity–time graph, the velocity is plotted on the y-axis, while time is plotted on the x-axis.

• If an object is moving with uniform velocity, its speed does not change, meaning the graph will show a straight horizontal line parallel to the time axis.

• This horizontal line indicates that the velocity remains constant regardless of the passage of time.

• Other graph patterns, such as a straight line inclined to the time axis or a curved line, represent changes in velocity (acceleration or deceleration), which is not the case for uniform velocity.

Additional Information

• Velocity–Time Graph Characteristics:

• A horizontal line parallel to the time axis indicates uniform velocity.

• A straight line inclined to the time axis indicates constant acceleration.

• A curved line indicates a changing acceleration, such as non-uniform acceleration.

• Key Terms:

• Uniform Velocity: When an object covers equal distances in equal intervals of time in a straight line.

• Acceleration: The rate of change of velocity with respect to time.

• Deceleration: A decrease in velocity over time, shown as a downward slope in a velocity–time graph.

• Applications of Velocity–Time Graphs:

• Used to determine acceleration and deceleration of objects.

• Helps calculate the total distance covered by finding the area under the graph.

• Used in various fields such as physics, engineering, and automotive testing to analyze motion.

• Comparison with Distance–Time Graphs:

• In a distance–time graph, a straight line inclined to the time axis represents constant velocity.

• In contrast, a straight line parallel to the time axis in a velocity–time graph indicates uniform velocity.

Important Points

• Determining Distance: The area under the velocity–time graph represents the distance traveled by the object.

• Zero Velocity: If the graph coincides with the x-axis, the object is stationary (velocity = 0).

• Real-Life Example: A car cruising at a constant speed of 60 km/h on a highway creates a velocity–time graph that is a straight horizontal line at 60 km/h.

Q20. Answer: (b) a white colour precipitate of barium sulphate

The correct answer is a white colour precipitate of barium sulphate.

Key Points

• Barium chloride ($BaCl_2$) reacts with aluminium sulphate [$Al_2(SO_4)_3$] to produce aluminium chloride ($AlCl_3$) and barium sulphate ($BaSO_4$).

• Barium sulphate ($BaSO_4$) is formed as a precipitate, which is white in color. This is due to its insolubility in water.

• The reaction can be represented as:

$3BaCl_2 + Al_2(SO_4)_3 \rightarrow 2AlCl_3 + 3BaSO_4\downarrow$

• This is a typical example of a double displacement reaction, where the ions in the reactants exchange places to form new compounds.

• The precipitate of barium sulphate is commonly used to confirm the presence of sulphate ions in qualitative analysis.

Additional Information

• Barium sulphate ($BaSO_4$):

• Properties: It is a white crystalline solid and highly insoluble in water.

• Uses: It is used in medical imaging (barium meals) and as a filler in paints and plastics.
• Occurrence: Found naturally as the mineral barite.
• Double displacement reactions:
• These reactions involve the exchange of ions between two compounds to form new compounds.
• Example: Reaction between NaCl and AgNO3 to form NaNO3 and AgCl.
• Qualitative analysis of sulphate ions:
• Barium chloride is commonly used to test for sulphate ions in a solution.
• Presence of sulphate ions produces a white precipitate of barium sulphate.
• Aluminium chloride (AlCl3):
• It is a hygroscopic compound and is often used as a catalyst in chemical reactions like Friedel-Crafts alkylation.

Important Points

• Characteristics of Barium Sulphate Precipitate:
• It is highly insoluble in water, which makes it an effective reagent for detecting sulphate ions.
• Its white color makes it easily visible during qualitative analysis.
• Applications of Barium Compounds:
• Barium compounds, such as barium sulphate and barium chloride, are widely used in laboratories and industries.
• Barium sulphate is used in X-ray imaging and paints, while barium chloride is used for water purification and the detection of ions.
• Reactions Involving Aluminium:
• Aluminium salts like aluminium chloride are highly reactive and are used in various chemical processes as catalysts.
• They are also used in the production of dyes and in water treatment plants.

Q21. Answer: (a) Muscle cells are flat and circular to help them flow in blood.

The correct answer is Muscle cells are flat and circular to help them flow in blood..

Key Points

• Muscle cells: Muscle cells are not flat and circular. Instead, they are elongated and cylindrical, designed for contraction and generating movement. This statement is incorrect.
• Red blood cells (RBCs): RBCs are biconcave in shape, which increases their surface area and allows efficient oxygen exchange. This helps them carry oxygen effectively. This statement is correct.
• White blood cells (WBCs): WBCs can change their shape to move through tissues, aiding in immune response and combating infections. This statement is correct.
• Nerve cells: Nerve cells (neurons) are long and branched, facilitating communication across the body. Their structure is vital for transmitting signals. This statement is correct.

Additional Information

• Muscle cells:
• Muscle cells, also known as muscle fibers, are elongated and specialized for contraction. They contain contractile proteins like actin and myosin that enable movement.
• They are classified into three types: skeletal muscles (responsible for voluntary movements), smooth muscles (found in organs and responsible for involuntary movements), and cardiac muscles (found in the heart).
• Red blood cells (RBCs):
• RBCs are produced in the bone marrow and have a lifespan of approximately 120 days.
• They lack a nucleus to maximize space for hemoglobin, the protein responsible for oxygen transport.
• Their biconcave shape enhances flexibility, enabling them to navigate through narrow capillaries.
• White blood cells (WBCs):
• WBCs are an essential part of the immune system, defending the body against infections and foreign invaders.
• They include various types like neutrophils, lymphocytes, monocytes, eosinophils, and basophils, each with specific functions.
• WBCs can perform phagocytosis, engulfing and destroying harmful pathogens.
• Nerve cells (neurons):
• Neurons consist of three main parts: the cell body (soma), dendrites (which receive signals), and axons (which transmit signals).
• They communicate via electrical impulses and chemical signals (neurotransmitters).
• Neurons are vital for brain function, sensory perception, and motor control.

Important Points

• Cell specialization: Each cell type in the body is adapted to its specific function. The shape and structure of a cell are intricately

linked to its role.

• Blood cells: RBCs and WBCs are crucial components of the circulatory and immune systems. Their specialized shapes and functions ensure efficient oxygen transport and immune defense.

• Neurons: The unique structure of neurons enables the rapid transmission of signals, making them indispensable for coordinating bodily functions.

• Muscle fibers: Their elongated shape and contractile properties make them suited for movement and maintaining posture.

Q22. Answer: (a) speed of light in vacuum to speed of light in medium

The correct answer is speed of light in vacuum to speed of light in medium.

Key Points

• The absolute refractive index of a medium is defined as the ratio of the speed of light in a vacuum to the speed of light in the medium.

• Mathematically: Refractive index (n) = c/v, where c is the speed of light in vacuum (approximately 3 × 10^8 m/s) and v is the speed of light in the given medium.

• This property is a measure of how much the speed of light is reduced in a particular medium compared to a vacuum.

• The refractive index is dimensionless and always greater than or equal to 1, as light travels fastest in a vacuum.

• The refractive index affects phenomena like refraction, where light bends when transitioning between mediums of different refractive indices.

Additional Information

• Speed of Light in Different Media:

• In vacuum, the speed of light is approximately 3 × 10^8 m/s.

• In air, the speed of light is slightly less than in a vacuum but is often approximated as the same for practical purposes.

• In water, the speed of light is approximately 2.25 × 10^8 m/s, giving water a refractive index of about 1.33.

• In glass, the speed of light is around 2 × 10^8 m/s, with a refractive index of approximately 1.5.

• Key Terminology:

• Vacuum: A space devoid of matter where light travels at its maximum speed.

• Medium: A material (e.g., air, water, glass) through which light propagates.

• Refractive Index: A measure of how much light slows down and bends when entering a medium from a vacuum or another medium.

• Applications of Refractive Index:

• Used in designing optical devices such as lenses and prisms.

• Important in fiber optic technology for data transmission.

• Helps in studying the composition of materials and their optical properties.

• Important Facts:

• The refractive index of diamond is around 2.42, making it highly effective in bending light and contributing to its brilliance.

• Refractive index is also used in measuring the purity of substances, such as liquids in industries.

Q23. Answer: (c) Presence of division of labour

The correct answer is Presence of division of labour.

Key Points

• The statement “Different parts of the human body perform different functions” signifies the presence of division of labour in the human body. Division of labour is a biological concept where different cells or organs specialize in specific tasks to ensure overall efficiency in functioning.

• In the human body, specialized cells and organs perform distinct functions. For example, the heart pumps blood, the lungs facilitate oxygen exchange, and the stomach aids in digestion.

• The concept of division of labour ensures that no single cell or organ is burdened with performing all functions, leading to optimization of energy and resources.

• This is a hallmark of multicellular organisms, where different cells are structured and equipped to carry out specific roles, unlike unicellular organisms where a single cell performs all life functions.

• The presence of division of labour enhances the survival and adaptability of organisms by ensuring that complex physiological processes are carried out efficiently.

Additional Information

• Division of Labour in Multicellular Organisms:

• In multicellular organisms, cells are specialized to perform distinct functions. For example, muscle cells contract, nerve cells transmit signals, and red blood cells transport oxygen.

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• This specialization allows for the seamless execution of complex processes like circulation, respiration, and digestion.

• It is an evolutionary advantage that enables multicellular organisms to perform tasks efficiently and adapt to their environment.

• Examples of Division of Labour in the Human Body:

• The digestive system includes organs like the stomach, intestines, and liver, each playing a role in breaking down food and absorbing nutrients.

• The circulatory system involves the heart, blood vessels, and blood, working together to transport oxygen, nutrients, and waste products.

• The nervous system, including the brain and spinal cord, controls and coordinates all bodily functions.

• Absence of Division of Labour:

• In unicellular organisms like Amoeba, there is no division of labour as a single cell performs all essential functions such as locomotion, nutrition, and reproduction.

• This limits their efficiency and adaptability compared to multicellular organisms.

• Importance of Division of Labour:

• It ensures efficiency in physiological processes, conserving energy and resources.

• It allows organisms to grow larger and more complex, as tasks are distributed among specialized cells and systems.

• It increases the organism's resilience by enabling multitasking and adaptability to environmental changes.

Important Points

• Key Characteristics of Division of Labour:

• Specialized cells and tissues are adapted to perform specific tasks, such as transport, protection, or communication.

• This specialization is seen in plants too, where xylem and phloem transport water and nutrients, respectively.

• Division of labour contributes to the evolution of complex organisms by enabling structural and functional differentiation.

• Relevance in Modern Science:

• Understanding division of labour helps in fields like medicine and biotechnology, allowing scientists to target specific cells or tissues for treatment or research.

• For example, cancer therapy often targets rapidly dividing cells, exploiting their unique characteristics.

Q24. Answer: (c) Lysosomes

The correct answer is Lysosomes.

Key Points

• Lysosomes are membrane-bound cell organelles that contain digestive enzymes. These enzymes break down excess or worn-out cell parts, as well as foreign invaders like bacteria or viruses.

• They act as the clean-up system of the cell by digesting and removing cellular debris and foreign materials, ensuring the cell remains healthy and free from harmful substances.

• The enzymes in lysosomes are capable of digesting proteins, lipids, carbohydrates, and nucleic acids, which makes them essential for cellular metabolism and recycling.

• Lysosomes are often referred to as the "suicidal bags of the cell" because they can self-destruct by releasing their enzymes if the cell is damaged or in a state of emergency.

• Their role in autophagy (self-eating) is crucial for the recycling of old or damaged organelles, maintaining cellular health and energy balance.

Additional Information

• Chloroplast:

• Chloroplasts are green, double-membrane organelles found in plant cells and some algae.

• They are responsible for photosynthesis, a process that converts light energy into chemical energy stored in glucose.

• Chloroplasts contain the pigment chlorophyll, which captures light energy.

• They are not involved in the digestion or recycling of cellular materials.

• Ribosome:

• Ribosomes are the protein synthesis machinery of the cell, either floating freely in the cytoplasm or attached to the rough endoplasmic reticulum.

• They are composed of ribosomal RNA (rRNA) and proteins.

• They are not involved in cellular digestion or cleaning functions.

• Chromoplast:

• Chromoplasts are specialized organelles in plants that contain pigments other than chlorophyll, such as carotenoids, which give fruits and flowers their bright colors.

• They play a role in attracting pollinators but do not have any role in cellular digestion or cleaning.

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• Functions of Lysosomes:

• Lysosomes help in defense mechanisms by digesting harmful bacteria and viruses.

• They are involved in programmed cell death (apoptosis), which is essential for the removal of damaged cells in multicellular organisms.

• They contribute to metabolic processes by breaking down macromolecules into their monomers for reuse by the cell.

Important Points

• The term "lysosome" was coined by Belgian biologist Christian de Duve in 1955, who discovered them during his studies on cellular enzymes.

• Lysosomes are most abundant in cells that perform phagocytosis, such as white blood cells, which engulf and digest pathogens.

• Defects in lysosomal enzymes can lead to diseases such as Lysosomal Storage Disorders (e.g., Tay-Sachs disease).

Q25. Answer: (b) 1.04 m/s

The correct answer is 1.04 m/s.

Key Points

• Formula for Average Speed: Average speed is calculated using the formula: Average Speed = Total Distance / Total Time.

• Details from the Question: The boy is running on a circular track with a radius of 10 m. The time taken to complete one circle is 1 minute (or 60 seconds).

• Calculating the Total Distance: The circumference of a circle is given by the formula: 2 × π × radius. Substituting the radius as 10 m, the circumference is 2 × 3.14 × 10 = 62.8 meters.

• Calculating Average Speed: Using the formula for average speed:

• Total Distance = 62.8 meters

• Total Time = 60 seconds

Hence, Average Speed = 62.8 / 60 = 1.04 m/s.

• Understanding the Options: Among the given options, 1.04 m/s matches the calculated value. Therefore, Option 2 is correct.

Additional Information

• Understanding Average Speed:

• Average speed is the total distance traveled divided by the total time taken, irrespective of the direction of motion.

• It is a scalar quantity, meaning it has magnitude but no direction.

• Formula for Circumference of a Circle:

• The circumference (C) of a circle is calculated using the formula: C = 2 × π × radius.

• Here, π (pi) is approximately equal to 3.14.

• Units of Measurement:

• The SI unit of speed is meters per second (m/s).

• Other commonly used units include kilometers per hour (km/h) and miles per hour (mph).

• Practical Application:

• Calculating average speed is essential in various fields like transportation, sports, and physics to evaluate performance and efficiency.

• For example, in athletics, knowing the average speed of a runner helps in performance analysis and training optimization.

Important Points

• Difference Between Speed and Velocity:

• Speed is a scalar quantity and does not involve direction, whereas velocity is a vector quantity and includes both magnitude and direction.

• In the case of circular motion, the speed may remain constant, but the velocity changes due to the change in direction.

• Uniform Circular Motion:

• When an object moves in a circular path with a constant speed, it is said to be in uniform circular motion.

• The direction of motion keeps changing, and hence the object experiences an acceleration known as centripetal acceleration.

Q26. Answer: (a) 6336 cm²

Shortcut Trick

Total Surface Area (TSA) of a cylinder = 2 × π × r × (h + r)

Given: radius (r) = 12 cm, height (h) = 72 cm, π = 22/7

TSA = 2 × (22/7) × 12 × (72 + 12) = 2 × (22/7) × 12 × 84

TSA = 2 × 22 × 12 × 12 = 44 × 144 = 6336 cm²

Therefore The correct answer is 6336 cm².

Alternate Method

Given:

Radius (r) = 12 cm

Height (h) = 72 cm

Value of π = 22/7

Formula Used:

Total Surface Area of a right circular cylinder = 2πr(h + r)

Calculations:

=> Total Surface Area = 2 × (22/7) × 12 × (72 + 12)

=> Total Surface Area = 2 × (22/7) × 12 × 84

=> Total Surface Area = 2 × 22 × 12 × (84 ÷ 7)

=> Total Surface Area = 44 × 12 × 12

=> Total Surface Area = 44 × 144

=> Total Surface Area = 6336 cm²

Therefore The correct answer is 6336 cm².

Additional Information

Curved Surface Area (CSA)

The area of the curved side of the cylinder is 2πrh. For this cylinder, CSA = 2 × (22/7) × 12 × 72 ≈ 5430.86 cm².

Volume of Cylinder

The total volume of a cylinder is given by the formula V = πr²h, measured in cubic units (cm³).

Base Area

The area of each circular base is πr². The total surface area is the sum of the curved surface area and two base areas: TSA = CSA + 2 × Area of base.

Q27. Answer: (c) 576

Shortcut Trick

Combine ratios A : B (4 : 5), B : C (4 : 5) and C : D (6 : 7).

A : B : C : D = (4×4×6) : (5×4×6) : (5×5×6) : (5×5×7) = 96 : 120 : 150 : 175.

Total units = 96 + 120 + 150 + 175 = 541 units.

541 units = Rs. 3,246 → 1 unit = Rs. 6.

Share of A = 96 units × 6 = Rs. 576.

Therefore The correct answer is Rs. 576.

Alternate Method

Given:

Total amount = Rs. 3,246

A : B = 4 : 5 | B : C = 4 : 5 | C : D = 6 : 7

Calculations:

=> To equalize B: A : B = 16 : 20 and B : C = 20 : 25

=> A : B : C = 16 : 20 : 25

=> To equalize C: (16 : 20 : 25)×6 and (6 : 7)×25

=> A : B : C : D = 96 : 120 : 150 : 175

=> Sum of ratio = 96 + 120 + 150 + 175 = 541

=> Share of A = (96 ÷ 541) × 3,246

=> Share of A = 96 × 6 = Rs. 576

Therefore The correct answer is Rs. 576.

Additional Information

Compound Ratio

When combining ratios A:B, B:C, and C:D, the continuous ratio A:B:C:D is found by multiplying corresponding terms to ensure the common bridge variables (B and C) have the same value.

Unitary Method in Ratio

Value of 1 unit = Total Amount ÷ Sum of all ratio parts. Individual share = (Individual ratio part) × (Value of 1 unit).

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Q28. Answer: (c) 67

Shortcut Trick

Assume a base value (Assumed Mean) of 60.

Calculate deviations from 60: +30, +34, −16, +37, −14, +12, +2, −16, −6.

Sum of deviations = 30 + 34 − 16 + 37 − 14 + 12 + 2 − 16 − 6 = +63.

Net Adjustment = 63 ÷ 9 = +7.

Actual Arithmetic Mean = 60 + 7 = 67.

Therefore The correct answer is 67.

Alternate Method

Given Observations: 90, 94, 44, 97, 46, 72, 62, 44, 54

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

=> Sum of observations = 90 + 94 + 44 + 97 + 46 + 72 + 62 + 44 + 54

=> Sum = 603

=> Total number of observations (n) = 9

=> Arithmetic Mean = 603 ÷ 9

=> Arithmetic Mean = 67

Therefore The correct answer is 67.

Additional Information

Arithmetic Mean Property

The sum of deviations of a set of observations from their arithmetic mean is always zero. ∑(x_i − mean) = 0.

Combined Mean

If two groups have sizes n1, n2 and means x1, x2, the combined mean is (n1x1 + n2x2) ÷ (n1 + n2).

Effect of Change

If every observation is increased or decreased by a constant k, the mean also increases or decreases by k.

Q29. Answer: (a) decrease by Rs. 910

Shortcut Trick

Ratio of Income : Savings : Expenditure = 100 : 26 : 74.

Using Net Deviation on Expenditure and Savings to find change in Income:

32% (Income) = [74/100 × 45%] + [26/100 × x%], where x is % change in Savings.

3200 = 3330 + 26x => 26x = −130 => x = −5% (Decrease).

Change in Savings = 5% of (26% of Rs. 70,000) = 0.05 × 18,200 = Rs. 910 (Decrease).

Therefore The correct answer is decrease by Rs. 910.

Alternate Method

Given: Initial Income = Rs. 70,000 | Savings % = 26%

=> Initial Savings = 26% of 70,000 = 26/100 × 70,000 = Rs. 18,200

=> Initial Expenditure = 70,000 − 18,200 = Rs. 51,800

=> New Income = 70,000 + 32% of 70,000 = 70,000 + 22,400 = Rs. 92,400

=> New Expenditure = 51,800 + 45% of 51,800 = 51,800 + 23,310 = Rs. 75,110

=> New Savings = New Income − New Expenditure = 92,400 − 75,110 = Rs. 17,290

=> Change in Savings = 18,200 − 17,290 = Rs. 910

Therefore The correct answer is decrease by Rs. 910.

Additional Information

Income Expenditure Relation

Income = Expenditure + Savings. Any percentage change in components can be solved using the weighted average or allegation method.

Successive Percentage Change

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

Percentage to Fraction Conversion

To convert a percentage to a fraction, divide the number by 100. For example, 26% = 26/100 = 13/50.

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Q30. Answer: (d) 360

Shortcut Trick

Convert divisions quickly:

8.5 ÷ 0.25 = 34 and (26/3) ÷ (1/3) = 26

Sum = 34 + 26 = 60

=> 60 × (3/50) = 3.6

Therefore 0.01P = 3.6 => P = 360

Alternate Method

Given:

(8.5 ÷ 0.25 + (26/3) ÷ (1/3)) of (3/50) = 0.01P

Formula used:

Division of fractions => a ÷ (b/c) = a × (c/b)

Calculation:

=> 8.5 ÷ 0.25 = 8.5 × 4 = 34

=> (26/3) ÷ (1/3) = (26/3) × 3 = 26

=> Sum = 34 + 26 = 60

=> 60 × (3/50) = 180/50 = 3.6

=> 0.01P = 3.6

=> P = 3.6 ÷ 0.01 = 360

Therefore The correct answer is 360.

Additional Information

Division by Decimal

Dividing by 0.25 is same as multiplying by 4

Fraction Division Rule

a ÷ (b/c) = a × (c/b)

Percentage Conversion

0.01 = 1/100, so multiply RHS accordingly

Q31. Answer: (a) 64 cm²

Shortcut Trick

Identify the Pythagorean triplet (6, 8, 10) in right-angled ΔABO.

Given AB = 8 cm and AO = 10 cm => BO = 6 cm.

Base BC = BO + OC = 6 + 10 = 16 cm.

Area of ΔABC = 1/2 × 16 × 8 = 64 cm².

Therefore The correct answer is 64 cm².

Alternate Method

Given: In ΔABC, angle B = 90°, AB = 8 cm, AO = 10 cm, and OC = 10 cm.

Formula: Area of Triangle = 1/2 × Base × Height | Pythagoras Theorem: $H^2 = P^2 + B^2$

In right-angled ΔABO:

=> $AO^2 = AB^2 + BO^2$

=> $10^2 = 8^2 + BO^2$

=> $100 = 64 + BO^2$

=> $BO^2 = 36$

=> BO = 6 cm

Since O lies on BC:

=> BC = BO + OC

=> BC = 6 + 10 = 16 cm

Area of ΔABC:

=> Area = 1/2 × BC × AB

=> Area = 1/2 × 16 × 8

=> Area = 8 × 8 = 64 cm²

Therefore The correct answer is 64 cm².

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Additional Information

Right-angled Triangle Properties

In a right triangle, the area is half the product of the two sides forming the right angle (base and perpendicular).

Pythagorean Triplets

Common sets of integers satisfying $a^2 + b^2 = c^2$ include (3, 4, 5), (6, 8, 10), (5, 12, 13), and (8, 15, 17).

Pythagoras Theorem

The square of the hypotenuse is equal to the sum of the squares of the other two sides: Hypotenuse² = Perpendicular² + Base².

Q32. Answer: (d) 12

Shortcut Trick

Sum of present ages = 27 × 2 = 54 years.

Sum of ages 4 years hence = 54 + (4 × 2) = 62 years.

Ratio after 4 years = 23 : 8 (Total parts = 23 + 8 = 31 units).

31 units = 62 years => 1 unit = 2 years.

Daughter's age after 4 years = 8 × 2 = 16 years.

Daughter's present age = 16 − 4 = 12 years.

Therefore The correct answer is 12 years.

Alternate Method

Given:

Average age of Father (F) and Daughter (D) = 27 years.

Ratio of their ages 4 years hence = 23 : 8.

Calculations:

=> Total present age = 27 × 2 = 54 years.

=> Total age 4 years hence = (F + 4) + (D + 4) = 54 + 8 = 62 years.

=> Let ages after 4 years be 23x and 8x.

=> 23x + 8x = 62

=> 31x = 62

=> x = 2

=> Daughter's age after 4 years = 8x = 8 × 2 = 16 years.

=> Daughter's present age = 16 − 4 = 12 years.

Therefore The correct answer is 12 years.

Additional Information

Average Age Concept

If the average age of 'n' people is A, the sum of their ages is n × A. After 'k' years, the average increases by 'k' years.

Ratio of Ages

The difference between the ages of two people always remains constant, regardless of the number of years passed.

Ages 'n' years hence/ago

If present age is 'x', age 'n' years hence is (x + n) and age 'n' years ago was (x − n).

Q33. Answer: (a) Rs. 2,18,500

Shortcut Trick

Use the Ratio Method between CP and MP: CP : MP = (100 − D%) : (100 + P%).

CP : MP = (100 − 64) : (100 + 38) = 36 : 138.

Given CP = 36 units = Rs. 57,000 => 1 unit = 57,000 ÷ 36 = Rs. 1,583.33.

MP = 138 units = 138 × 1,583.33 = Rs. 2,18,500.

Therefore The correct answer is Rs. 2,18,500.

Alternate Method

Given: Cost Price (CP) = Rs. 57,000, Discount% = 64%, Profit% = 38%.

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

=> Selling Price (SP) = 57,000 × (100 + 38) ÷ 100 = 57,000 × 1.38 = Rs. 78,660.

=> Let Marked Price (MP) be M. Then M × (100 − 64) ÷ 100 = 78,660.

=> M × 36 ÷ 100 = 78,660.

=> M = (78,660 × 100) ÷ 36 = 2,185 × 100 = Rs. 2,18,500.

Therefore The correct answer is Rs. 2,18,500.

Additional Information

Relation between CP and MP

The direct relationship between Cost Price and Marked Price is CP/MP = (100 − Discount%)/(100 + Profit%). If there is a loss, use (100 − Loss%) instead.

Marked Price and Discount

Marked Price is the price printed on the label. Discount is always calculated on the Marked Price to arrive at the Selling Price.

Q34. Answer: (b) 25, 26

Shortcut Trick

For two consecutive numbers, the average is the middle value.

Middle value = 51 ÷ 2 = 25.5

The integers flanking 25.5 are 25 and 26.

Therefore The correct answer is 25, 26.

Alternate Method

Given: Sum of two consecutive numbers is 51.

Let the first consecutive number be x.

Then the next consecutive number is x + 1.

=> x + (x + 1) = 51

=> 2x + 1 = 51

=> 2x = 51 − 1

=> 2x = 50

=> x = 25

=> Second number = x + 1 = 25 + 1 = 26

Therefore The correct answer is 25, 26.

Additional Information

Consecutive Numbers

Numbers that follow each other in order, without gaps, from smallest to largest (e.g., n, n+1, n+2).

Consecutive Even/Odd Numbers

Numbers that follow a pattern of adding 2 to the previous number (e.g., x, x+2, x+4).

Sum of 'n' Consecutive Numbers

If the sum of n consecutive numbers is S, their average S/n is the middle term (if n is odd) or the midpoint of the two middle terms (if n is even).

Q35. Answer: (b) 7

Shortcut Trick

If $x^2 + 1/x^2 = k$, then the value of $(x + 1/x) = \sqrt{(k + 2)}$.

Given: $x^2 + 1/x^2 = 47$.

=> $(x + 1/x) = \sqrt{(47 + 2)} = \sqrt{49} = 7$.

Therefore The correct answer is 7.

Alternate Method

Given: $x^2 + 1/x^2 = 47$

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

Consider the expansion of $(x + 1/x)^2$:

=> $(x + 1/x)^2 = x^2 + (1/x)^2 + 2 \times x \times (1/x)$

=> $(x + 1/x)^2 = (x^2 + 1/x^2) + 2$

Substitute the given value $x^2 + 1/x^2 = 47$ in the equation:

=> $(x + 1/x)^2 = 47 + 2$

=> $(x + 1/x)^2 = 49$

Taking the square root on both sides:

=> $(x + 1/x) = \sqrt{49}$

=> $x + 1/x = 7$

Therefore The correct answer is 7.

Additional Information

Difference Identity for Reciprocals

If $x^2 + 1/x^2 = k$, then the value of $(x - 1/x) = \sqrt{(k - 2)}$.

Cubic Reciprocal Identity

The value of $x^3 + 1/x^3 = (x + 1/x)^3 - 3(x + 1/x)$.

Relationship between Sum and Difference

The identities are related by the formula: $(x + 1/x)^2 - (x - 1/x)^2 = 4$.

Q36. Answer: (b) 10

Shortcut Trick

Fourth Proportional d = (b × c) ÷ a

Given: 12, a, 6a and fourth proportional is 50.

=> 50 = (a × 6a) ÷ 12

=> $50 = 6a^2 \div 12$ => $50 = a^2 \div 2$ => $a^2 = 100$ => a = 10.

Therefore The correct answer is 10.

Alternate Method

Given: First term = 12, Second term = a, Third term = 6a, Fourth term = 50.

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

=> 12 × 50 = a × 6a

=> $600 = 6a^2$

=> $a^2 = 600 \div 6$

=> $a^2 = 100$

=> $a = \sqrt{100}$

=> a = 10

Therefore The correct answer is 10.

Additional Information

Mean Proportional

The mean proportional between two numbers x and y is given by $\sqrt{(x \times y)}$.

Third Proportional

The third proportional to two numbers x and y is given by $y^2 \div x$.

Compound Ratio

The compound ratio of (a : b) and (c : d) is calculated as (a × c) : (b × d).

Q37. Answer: (b) 12 cm

Shortcut Trick

Semi-perimeter (s) = (20 + 51 + 37) / 2 = 54 cm.

Area of triangle = $\sqrt{(54 \times (54 - 20) \times (54 - 51) \times (54 - 37))} = \sqrt{(54 \times 34 \times 3 \times 17)} = 306$ cm².

Altitude (h) corresponding to side 51 cm = (2 × Area) / Base = (2 × 306) / 51.

h = 612 / 51 = 12 cm.

Therefore The correct answer is 12 cm.

Alternate Method

Given:

Sides of the triangle are a = 20 cm, b = 51 cm (base), and c = 37 cm.

Formula Used:

1. Heron's Formula for Area = $\sqrt{(s(s - a)(s - b)(s - c))}$, where s = (a + b + c) / 2.

2. Area of triangle = (1/2) × Base × Altitude.

Calculations:

=> Semi-perimeter (s) = (20 + 51 + 37) / 2

=> s = 108 / 2 = 54 cm.

=> Area = $\sqrt{(54 \times (54 - 20) \times (54 - 51) \times (54 - 37))}$

=> Area = $\sqrt{(54 \times 34 \times 3 \times 17)}$

=> Area = √(2 × 27 × 2 × 17 × 3 × 17)
=> Area = √(2^2 × 3^4 × 17^2) = 2 × 9 × 17 = 306 cm^2.
=> 306 = (1/2) × 51 × Altitude
=> Altitude = (306 × 2) / 51 = 612 / 51
=> Altitude = 12 cm.
Therefore The correct answer is 12 cm.
Additional Information
Heron's Formula
It is used to calculate the area of a triangle when the lengths of all three sides are known: Area = √(s(s−a)(s−b)(s−c)).
Altitude to any side
The altitude (h) corresponding to any side (base) is given by: h = (2 × Area) / base.
Semi-perimeter (s)
It represents half of the total boundary of the triangle: s = (a + b + c) / 2.

Q38. Answer: (d) 405 km

Shortcut Trick
When two objects move in opposite directions, their Relative Speed is the sum of their individual speeds.
Relative Speed = 60 + 75 = 135 kmph.
Distance = Relative Speed × Time = 135 × 3 = 405 km.
Therefore The correct answer is 405 km.
Alternate Method
Given:
Speed of Car 1 (S1) = 60 km/hr
Speed of Car 2 (S2) = 75 km/hr
Time (T) = 3 hours
Formula Used:
Distance = Speed × Time
Total Distance = Distance1 + Distance2 (for opposite directions)
Calculations:
=> Distance traveled by Car 1 = 60 × 3 = 180 km
=> Distance traveled by Car 2 = 75 × 3 = 225 km
=> Total distance apart = 180 + 225
=> Total distance apart = 405 km
Therefore The correct answer is 405 km.
Additional Information
Relative Speed in Opposite Directions
When two bodies move in opposite directions, their relative speed is the sum of their individual speeds: $S_{rel} = S1 + S2$.
Relative Speed in Same Direction
When two bodies move in the same direction, their relative speed is the difference of their individual speeds: $S_{rel} = |S1 − S2|$.
Average Speed Formula
If a person travels equal distances at speeds x and y, the average speed is (2 × x × y) ÷ (x + y).

Q39. Answer: (d) 3

Shortcut Trick
Let the total original work be the LCM of 2, 6, and 3 days = 6 units.
Combined efficiency of A, B, and C = (6 ÷ 2) + (6 ÷ 6) + (6 ÷ 3) = 3 + 1 + 2 = 6 units/day.
Thrice the same work = 3 × 6 = 18 units.
Required time = 18 ÷ 6 = 3 days.
Therefore The correct answer is 3 days.
Alternate Method
Given:
Time taken by A = 2 days

Time taken by B = 6 days

Time taken by C = 3 days

Formula Used:

Total Work = LCM of individual time periods

Efficiency = Total Work ÷ Time

Time Taken = Total Work ÷ Combined Efficiency

Person	Days	Total Work	Efficiency
A	2	6	3
B	6	1	
C	3	2	

Calculations:

=> Total original work = 6 units

=> Thrice the work = 3 × 6 = 18 units

=> Total efficiency of (A + B + C) = 3 + 1 + 2 = 6 units/day

=> Time taken to complete thrice the work = 18 ÷ 6 = 3 days

Therefore The correct answer is 3 days.

Additional Information

Work and Efficiency Relation

Efficiency is inversely proportional to the time taken to complete a work. If the ratio of time taken by two people is x:y, then the ratio of their efficiency is y:x.

Combined Work Formula

If A can do a work in x days and B can do it in y days, then together they can finish the work in (x × y) ÷ (x + y) days.

Q40. Answer: (d) 61,600

Shortcut Trick

Net interest rate difference per annum = 7% − 3.5% = 3.5%

Total interest percentage difference for 4 years = 3.5% × 4 = 14%

Required positive difference = 14% of Rs. 4,40,000

=> Difference = (14 ÷ 100) × 4,40,000 = 14 × 4,400 = Rs. 61,600

Therefore The correct answer is Rs. 61,600.

Alternate Method

Given:

Principal amount (P) = Rs. 4,40,000 for each bank

Rate of interest for Bank A (R1) = 3.5% | Rate of interest for Bank B (R2) = 7%

Time (T) = 4 years

Formula Used:

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

Calculations:

=> SI paid to Bank A = (4,40,000 × 3.5 × 4) ÷ 100

=> SI_A = 4,400 × 14 = Rs. 61,600

=> SI paid to Bank B = (4,40,000 × 7 × 4) ÷ 100

=> SI_B = 4,400 × 28 = Rs. 1,23,200

=> Positive Difference = SI_B − SI_A

=> Difference = 1,23,200 − 61,600 = Rs. 61,600

Therefore The correct answer is Rs. 61,600.

Additional Information

Difference in SI for Different Rates

When the principal and time are the same, the difference in interest is given by: Diff = P × T × (R2 − R1) ÷ 100.

Simple Interest Properties

Simple interest is calculated only on the principal amount, so the interest earned every year remains constant if the rate and

principal are unchanged.

Effective Rate of Interest

The effective rate for T years in Simple Interest is simply (R × T)%. This makes comparison between different loans straightforward.

Q41. Answer: (c) 30.5

Shortcut Trick

Apply the Empirical Formula: Mode = 3 × Median − 2 × Mean.

Mode = 3(33.5) − 2(35)

Mode = 100.5 − 70 = 30.5

Therefore The correct answer is 30.5.

Alternate Method

Given:

=> Mean = 35

=> Median = 33.5

Formula Used:

=> Mode = 3(Median) − 2(Mean)

Calculations:

=> Mode = (3 × 33.5) − (2 × 35)

=> Mode = 100.5 − 70

=> Mode = 30.5

Therefore The correct answer is 30.5.

Additional Information

Empirical Relationship

For a moderately skewed distribution, the relationship is Mode = 3 × Median − 2 × Mean.

Symmetrical Distribution

In a perfectly symmetrical distribution, the values of Mean, Median, and Mode are all equal (Mean = Median = Mode).

Types of Skewness

If Mean > Median > Mode, the distribution is positively skewed. If Mode > Median > Mean, it is negatively skewed.

Q42. Answer: (b) 42

Shortcut Trick

Let Total Work = LCM(32, 48) = 96 units.

Efficiency of A = 96 ÷ 32 = +3; Efficiency of B = 96 ÷ 48 = −2.

Pipe A works for the full 60 minutes: Work done by A = 60 × 3 = 180 units.

Excess work to be removed by B = 180 − 96 = 84 units.

Time for B = 84 ÷ 2 = 42 minutes.

Therefore The correct answer is 42 minutes.

Alternate Method

Given: Filling time of Pipe A = 32 mins, Emptying time of Pipe B = 48 mins, Total time = 60 mins.

Pipe	Time (min)	Total Work	Efficiency
Pipe A (Fill)	32	96	+3
Pipe B (Empty)	48	−2	

Let Pipe B be closed after x minutes.

=> Work by A (60 mins) + Work by B (x mins) = Total Capacity

=> (3 × 60) + (−2 × x) = 96

=> 180 − 2x = 96

=> 2x = 180 − 96

=> 2x = 84

=> x = 42

Therefore The correct answer is 42 minutes.

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Additional Information

Inlet and Outlet Pipes

Inlet pipes do positive work (filling), while outlet pipes do negative work (emptying) relative to the tank capacity.

Total Capacity (LCM Method)

Total capacity is assumed as the Least Common Multiple (LCM) of individual times to simplify efficiency calculations into integers.

Time and Efficiency Relationship

Efficiency is inversely proportional to time: Efficiency = Total Work ÷ Time Taken.

Q43. Answer: (c) 11

Shortcut Trick

Total provision is constant, so use the formula: M1D1 = M2D2.

Initial: 55 × 14

Final: 70 × D2

D2 = (55 × 14) ÷ 70 = 11 days.

Therefore The correct answer is 11 days.

Alternate Method

Given:

Initial strength (M1) = 55 persons

Initial duration (D1) = 14 days

Increased strength (M2) = 70 persons

Formula Used:

Total Work/Provisions = M1 × D1 = M2 × D2

Calculations:

=> 55 × 14 = 70 × D2

=> 770 = 70 × D2

=> D2 = 770 ÷ 70

=> D2 = 11 days

Therefore The correct answer is 11 days.

Additional Information

Inverse Proportion Rule

When the quantity of food or provisions is fixed, the number of persons and the number of days are inversely proportional. If persons increase, days decrease.

General Work Equation

The formula can be extended to (M1 × D1 × H1) ÷ W1 = (M2 × D2 × H2) ÷ W2 where H is hours and W is work.

Q44. Answer: (a) 1093

Shortcut Trick

Total distance = Speed × Time

Total distance = 41 m/sec × 34 sec = 1394 m

X (Train length) = Total distance − Platform length

X = 1394 − 301 = 1093 m

Therefore The correct answer is 1093 m.

Alternate Method

Given:

Speed of train = 41 m/sec

Time taken = 34 sec

Length of platform = 301 m

Length of train = X m

Formula Used:

Total Distance = Length of Train + Length of Platform

Distance = Speed × Time

Calculations:

=> Total Distance = X + 301
=> X + 301 = 41 × 34
=> X + 301 = 1394
=> X = 1394 − 301
=> X = 1093
Therefore The correct answer is 1093 m.
Additional Information
Unit Conversion
To convert km/hr to m/sec, multiply by 5/18. To convert m/sec to km/hr, multiply by 18/5.
Crossing a Point Object
When a train crosses a pole or a stationary man, the distance covered is equal to the length of the train itself.
Relative Speed
If two objects move in opposite directions, relative speed = S1 + S2. In the same direction, relative speed = |S1 − S2|.

Q45. Answer: (d) 55.56%

Shortcut Trick
Required percentage = (First value ÷ Second value) × 100
Required percentage = (1/20 ÷ 9/100) × 100
Required percentage = (1/20 × 100/9) × 100
Required percentage = 500/9 ≈ 55.555...
Therefore The correct answer is 55.56%.
Alternate Method
Given: First fraction = 1/20, Second fraction = 9/100
Formula Used: Percentage = (Part / Base) × 100
=> Required Percentage = [(1/20) / (9/100)] × 100
=> Required Percentage = (1/20) × (100/9) × 100
=> Required Percentage = (5/9) × 100
=> Required Percentage = 500 ÷ 9
=> Required Percentage = 55.555...
=> Rounding off to two decimal places, we get 55.56%
Therefore The correct answer is 55.56%.
Additional Information
Fraction to Percentage
To convert any fraction to a percentage, multiply the fraction by 100 and append the % symbol.
Percentage Comparison
When finding 'A is what % of B', A is the numerator and B is the denominator (base).
Rounding Decimals
If the third decimal digit is 5 or greater, increase the second decimal digit by 1.

Q46. Answer: (b) 2,052

Shortcut Trick
Identify the Cost Price (CP) as 5,400 and the Discount as 62%.
The Selling Price (SP) represents the remaining percentage after the discount.
SP = 100% − 62% = 38% of CP.
SP = 5,400 × 38 ÷ 100 = 54 × 38.
SP = 2,052.
Therefore The correct answer is Rs. 2,052.
Alternate Method
Given: Cost Price (CP) = Rs. 5,400, Discount Rate = 62%.
Formulas: Discount Amount = CP × (Discount% ÷ 100) | SP = CP − Discount Amount.
=> Discount Amount = 5,400 × (62 ÷ 100)
=> Discount Amount = 5,400 × 0.62 = 3,348

=> SP = 5,400 − 3,348

=> SP = 2,052

Therefore The correct answer is Rs. 2,052.

Additional Information

Cost Price and Discount

Usually, discount is calculated on the Marked Price (MP), but if the question specifies the discount is on the Cost Price (CP), we treat CP as the base value (100%).

Selling Price Calculation

SP = CP × (100 − D)% where D is the discount percentage given on the cost price.

Q47. Answer: (c) 4 m

Shortcut Trick

In a 30°−60°−90° triangle, the ratio of sides is 1 : √3 : 2.

Side adjacent to 60° (base) = 1 unit = 2 m.

Hypotenuse (ladder length) = 2 units = 2 × 2 = 4 m.

Therefore The correct answer is 4 m.

Alternate Method

Given:

Angle of elevation (θ) = 60°

Distance of foot from wall (Base BC) = 2 m

Formula Used:

cos θ = Base ÷ Hypotenuse

Calculations:

=> cos 60° = BC ÷ AC

=> 1/2 = 2 ÷ AC

=> AC = 2 × 2

=> AC = 4 m

Therefore The correct answer is 4 m.

Additional Information

Trigonometric Ratios

For a right-angled triangle, sin θ = Perpendicular/Hypotenuse, cos θ = Base/Hypotenuse, and tan θ = Perpendicular/Base.

Special Right Triangles

In a 30°−60°−90° triangle, the sides are in ratio 1 : √3 : 2. In a 45°−45°−90° triangle, the sides are in ratio 1 : 1 : √2.

Q48. Answer: (c) Rs. 900

Shortcut Trick

Difference in profit percentages = 25% − 15% = 10%.

This 10% difference is equivalent to the additional selling price of Rs. 90.

Using the unitary method: 10% of CP = Rs. 90.

Therefore, 100% of CP = 90 ÷ 10 × 100 = Rs. 900.

Therefore The correct answer is Rs. 900.

Alternate Method

Given → Initial Profit = 15%, New Profit = 25%, Price Increase = Rs. 90.

Formulas → SP = CP × (100 + P%) ÷ 100 | Difference in SP = CP × (P2% − P1%) ÷ 100.

=> Let the Cost Price be x.

=> First Selling Price (SP1) = 1.15x.

=> Second Selling Price (SP2) = 1.25x.

=> According to the question: 1.25x − 1.15x = 90.

=> 0.10x = 90 => x = 90 ÷ 0.10 = 900.

Therefore The correct answer is Rs. 900.

Additional Information

Profit and Loss on CP

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Unless stated otherwise, profit or loss percentage is always calculated on the Cost Price (CP). Profit = SP − CP.

Percentage Change

When the same base (CP) is used, the difference in SP values can be directly related to the difference in profit/loss percentages.

Q49. Answer: (d) 8575

Shortcut Trick

Convert percentages and fractions into a single multiplying factor: 0.60 × 0.20 × (1/3) = 0.04.

Let the number be N. Then, 0.04 × N = 343.

N = 343 ÷ 0.04 = 343 × 25 = 8575.

Therefore The correct answer is 8575.

Alternate Method

Given:

60% of 20% of 2/6 of a number = 343

Calculations:

=> Let the number be x.

=> (60/100) × (20/100) × (2/6) × x = 343

=> (3/5) × (1/5) × (1/3) × x = 343

=> (1/25) × x = 343

=> x = 343 × 25

=> x = 8575

Therefore The correct answer is 8575.

Additional Information

Percentage to Fraction Conversion

To convert percentage to fraction, divide by 100. For example, x% = x/100.

Successive Percentages

When successive percentages are applied, they can be multiplied directly: a% of b% of c = (a/100) × (b/100) × c.

Fraction Simplification

Always simplify fractions to their lowest terms (e.g., 2/6 = 1/3) before performing large multiplications to save time.

Q50. Answer: (c) 1/9

Shortcut Trick

Combine all powers of base 3 in a single step using basic exponent rules.

Expression = 3^(4 − 2) ÷ 3^(3 − 5) × 3^(−6)

Expression = 3^2 ÷ 3^(−2) × 3^(−6)

By left-to-right calculation: 3^(2 − (−2) − 6) = 3^(4 − 6) = 3^(−2)

3^(−2) = 1 / 3^2 = 1/9

Therefore The correct answer is 1/9.

Alternate Method

Given:

(3^4 × 3^(−2)) ÷ (3^3 × 3^(−5)) × (3^6)^(−1)

Formula Used:

a^m × a^n = a^(m+n)

a^m ÷ a^n = a^(m−n)

(a^m)^n = a^(mn)

Calculations:

=> Step 1: Simplify the first bracket: (3^4 × 3^(−2)) = 3^(4 + (−2)) = 3^2

=> Step 2: Simplify the second bracket: (3^3 × 3^(−5)) = 3^(3 + (−5)) = 3^(−2)

=> Step 3: Expand the power term: (3^6)^(−1) = 3^(6 × (−1)) = 3^(−6)

=> Step 4: Substitute simplified terms back into the main expression: 3^2 ÷ 3^(−2) × 3^(−6)

=> Step 5: Solve division from left to right: (3^2 ÷ 3^(−2)) = 3^(2 − (−2)) = 3^4

=> Step 6: Multiply the remaining term: 3^4 × 3^(−6) = 3^(4 + (−6)) = 3^(−2)

=> Step 7: Convert negative exponent to a fraction: 3^(−2) = 1 / 3^2 = 1/9

Therefore The correct answer is 1/9.

Additional Information

BODMAS Rule

Multiplication and Division carry the exact same precedence. Whenever they appear together, always solve them from left to right unless they are enclosed within brackets.

Negative Exponents

Any non-zero base raised to a negative power is equal to the reciprocal of the base raised to the positive power (a^(−m) = 1 / a^m).

Zero Exponent Property

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

Q51. Answer: (a) (15, 135, 9)

The logic followed here is:

Logic: (a, b, c) → a × c = b

18 × 9 = 162

21 × 9 = 189

Let's check each option:

1. (15, 135, 9) → 15 × 9 = 135

2. (9, 90, 9) → 9 × 9 = 81 ≠ 90

3. (16, 144, 8) → 16 × 8 = 128 ≠ 144

4. (12, 120, 9) → 12 × 9 = 108 ≠ 120

Thus, (15, 135, 9) is the set in which the numbers are related in the same way as the given sets.

Hence, the correct answer is "Option 1".

Q52. Answer: (a) UYG

The position and positional values or English Alphabets are:

Given: SWE ZDL GKS NRZ ?

The logic followed here is:

Thus, UYG should come in place of the question mark (?) in the given series based on the English alphabetical order.

Hence, the correct answer is "Option 1".

Q53. Answer: (d) 131

Given: 31 51 71 91 111 ?

The logic followed here is:

Thus, 131 should come in place of the question mark (?) in the given series.

Hence, the correct answer is "Option 4".

Q54. Answer: (a) Both conclusions (I) and (II) follow,

Statements:

All cups are glasses.

All glasses are tiles.

The least possible Venn diagram for the given statement is:

Conclusions:

(I) Some tiles are glasses. - Follow (Because, all cups are glasses and all glasses are tiles, which means all tiles are glasses.)

(II) All cups are tiles - Follow (Because, all cups are glasses and all glasses are tiles, which means all cups are tiles.)

Thus, both conclusions (I) and (II) follow.

Hence, the correct answer is "Option 1".

Q55. Answer: (c) Three

Given: Each of the digits in the number 7214365 is arranged in the ascending order from left to right.

Thus, the position of three digits will remain unchanged as compared to that in the original number.

Hence, the correct answer is "Option 3".

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Q56. Answer: (c) Four

Given: A, B, C, D, E, F and G are sitting around a circular table facing the centre.

1. C sits third to the left of G.
2. E sits to the immediate right of G.
3. E sits second to the left of D.
4. F is an immediate neighbour of C.
5. Only two people sit between D and A when counted from the left of A.

B, the only person left will occupy the vacant position.

Thus, four people sit between B and G when counted from the left of G.

Hence, the correct answer is "Option 3".

Q57. Answer: (c) ED

Given: Six people, D, E, F, G, H and I, are sitting in a row facing north.

1. Only two people sit to the left of I.
2. D sits third to the right of I.
3. H is an immediate neighbour of both F and D.
4. E sits to the immediate right of G.

Three of the following four are alike in a certain way based on the given arrangement and thus form a group.

Let's check each option:

1. IF → Immediate neighbours
2. FH → Immediate neighbours
3. ED → ED are not Immediate neighbours
4. EI → Immediate neighbours

Thus, ED DOES NOT belong to that group.

Hence, the correct answer is "Option 3".

Q58. Answer: (c) QJ-NG-KM

The position and positional values or English Alphabets are:

The pattern followed here is:

Each triad follows the pattern -3, -3 and -3, +6.

SL-PI-MO

Let's check each option:

1. RJ-NG-KL

This triad does not follow the pattern -3, -3 and -3, +6.

2. QJ-NG-KL

This triad does not follow the pattern -3, -3 and -3, +6.

3. QJ-NG-KM

This triad follows the pattern -3, -3 and -3, +6.

4. RJ-NH-KL

This triad does not follow the pattern -3, -3 and -3, +6.

Thus, QJ-NG-KM follow the same pattern.

Hence, the correct answer is "Option 3".

Q59. Answer: (c) PN – WB

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster pair follows the pattern +7, +15.

Let's check each option:

1. SP – ZE

This letter-cluster pair follows the pattern +7, +15.

2. VS – CH

This letter-cluster pair follows the pattern +7, +15.

3. PN – WB

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This letter-cluster pair does not follow the pattern +7, +15.

4. HE – OT

This letter-cluster pair follows the pattern +7, +15.

Thus, PN – WB is the odd one out.

Hence, the correct answer is "Option 3".

Q60. Answer: (c) Only conclusion (II) follows.

Statements:

Some camels are boats.

Some boats are stars.

The least possible Venn diagram for the given statement is:

Conclusions:

(I) Some camels are stars. - Does not follow (Because, there is no definite relation given between camels and stars, it can be possible but it is not definite.)

(II) Some boats are camels. - Follow (Because, some camels are boats means some boats are camels.)

Thus, only conclusion (II) follows.

Hence, the correct answer is "Option 3".

Q61. Answer: (a) 45

BODMAS Rule:

Decoding the given information:

Symbol	•	•	×	÷
Meaning	÷	×	•	•

Given equation: 608 + 76 × 6 − 37 ÷ 259 = ?

Now replacing the sign from left to right using BODMAS Rule, we get:

=> 608 ÷ 76 − 6 × 37 + 259 = ?

=> 8 − 6 × 37 + 259 = ?

=> 8 − 222 + 259 = ?

=> 267 − 222 = ?

=> 45 = ?

Hence, the correct answer is "Option 1".

Q62. Answer: (d) VZU

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster follows the pattern +3, -4.

Let's check each option:

1. YBX

This letter-cluster follows the pattern +3, -4.

2. RUQ

This letter-cluster follows the pattern +3, -4.

3. SVR

This letter-cluster follows the pattern +3, -4.

4. VZU

This letter-cluster does not follow the pattern +3, -4.

Thus, VZU is the odd one out.

Hence, the correct answer is "Option 4".

Q63. Answer: (b) Four

Given: Seven boxes, B, D, E, P, S, T and W, are kept one over the other but not necessarily in the same order.

1. Only two boxes are kept below B.

2. Only one box is kept above W.

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3. Only one box is kept between W and E.
4. T is kept immediately above S.
5. P is kept at some place below D.

D
W
P
E
B
T
S

Thus, four boxes are kept between D and T.

Hence, the correct answer is "Option 2".

Q64. Answer: (b) 13 km to the west

Given: Monit starts from point A and drives 43 km towards north. He then takes a left turn, drives 54 km, turns left and drives 58 km. He then takes a left turn and drives 67 km. He takes a final left turn, drives 15 km and stops at point P.

Thus, he should drive 13 km to the west in order to reach point A again.

Hence, the correct answer is "Option 2".

Q65. Answer: (b) 17th

Given: In a row of 39 people facing north, Vandana is 16th from the left end. If Nayana sits 7th to the right of Vandana.

Total people in the row = 39

Vandana is 16th from the left end.

Nayana sits 7th to the right of Vandana.

Nayana's position from the left end:

=> 16 + 7 = 23

Now finding Nayana's position from the right end:

=> 39 − 23 + 1

= 40 - 23

= 17

Thus, Nayana's position from the right end of the row is 17th.

Hence, the correct answer is "Option 2".

Q66. Answer: (c) Daughter

Family Chart:

Decoding the Symbols:

A is				
Symbol	?	@	√	=
Meaning	daughter	son	father	sister
to B				

Given: C ? D @ E √ F = L

It means: C is the daughter of D, D is the father of E, E is the sister of F, F is the son of L.

Thus, C is daughter of L.

Hence, the correct answer is "Option 3".

Q67. Answer: (a) Four

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

1. Only six people sit to the right of C.
2. Only four people sit to the left of B.

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3. D sits to the left of A but right of B.

4. F sits second to the right of G.

E, the only person left will occupy the vacant position.

Thus, four people sit to the right of E.

Hence, the correct answer is "Option 1".

Q68. Answer: (c) 582

Shortcut Trick

Identify the difference between consecutive terms:

612 − 2 = 610

610 − 4 = 606

606 − 6 = 600

600 − 8 = 592

The next difference is −10: 592 − 10 = 582

Therefore The correct answer is 582.

Alternate Method

Given series: 612, 610, 606, 600, 592, ?

612

−2

→

610

−4

→

606

−6

→

600

−8

→

592

−10

→

582

The pattern follows the subtraction of consecutive even numbers: 2, 4, 6, 8, 10.

=> 612 − 2 = 610

=> 610 − 4 = 606

=> 606 − 6 = 600

=> 600 − 8 = 592

=> 592 − 10 = 582

Therefore The correct answer is 582.

Additional Information

Arithmetic Difference Series

A series where the difference between consecutive terms forms another simple sequence like even numbers, odd numbers, or prime numbers.

Decreasing Number Series

In a decreasing series, the value of the terms decreases over time. The logic is typically based on subtraction or division.

Double Difference Method

If the first layer of differences does not show a clear pattern, check the difference between the differences (second layer) to find a constant value or arithmetic progression.

Q69. Answer: (b) NICE - NECI - ECIN

The logic followed here is:

WASP - WPSA - PSAW

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GUTS - GSTU - STUG

Let's check each option:

1. HUGE - UHGE - EUGH

This triad does not follow the same logic.

2. NICE - NECI - ECIN

This triad follows the same logic.

3. POND - PNOD - DNOP

This triad does not follow the same logic.

4. GROW - GRWO - ROWG

This triad does not follow the same logic.

Thus, NICE - NECI - ECIN from the given options, the one which follows the same logic.

Hence, the correct answer is "Option 2".

Q70. Answer: (b) 9 km to the south

Given: Tinu starts from point A and drives 55 km towards east. He then takes a right turn, drives 57 km, turns right and drives 61 km. He then takes a right turn and drives 66 km. He takes a final right turn, drives 6 km and stops at point P.

Thus, he should drive 9 km to the south in order to reach point A again.

Hence, the correct answer is "Option 2".

Q71. Answer: (a) One

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

Now,

Odd numbers, each of which is immediately preceded by an odd number and also immediately followed by an even number.

So, the needed pattern is: Odd — Odd — Even

Thus, there is one odd number, each of which is immediately preceded by an odd number and also immediately followed by an even number.

Hence, the correct answer is "Option 1".

Q72. Answer: (c) Five

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

Now,

Odd numbers, each of which is immediately preceded by an even number and also immediately followed by an even number.

So, the needed pattern is: Even — Odd — Even

Thus, there are five odd numbers, each of which is immediately preceded by an even number and also immediately followed by an even number.

Hence, the correct answer is "Option 3".

Q73. Answer: (d) za

Given: In a certain code language, ‘moving through life’ is coded as ‘gt df za’ and ‘life is short’ is coded as ‘kl td za’.

Thus, ‘life’ is coded as 'za' in the given language.

Hence, the correct answer is "Option 4".

Q74. Answer: (c) LP 29

The position and positional values or English Alphabets are:

Given: FK 14 is related to CG 16 in a certain way. In the same way, QV 22 is related to NR 24.

The logic followed here is:

Similarly,

Thus, OT 27 is related to LP 29, following the same logic.

Hence, the correct answer is "Option 3".

Q75. Answer: (b) pt

Given: In a certain code language, ‘may i sit’ is coded as ‘pt sq ac’ and ‘please sit here’ is coded as ‘pt hm rf’.

This, ‘sit’ is coded as 'pt' in that language.

Hence, the correct answer is "Option 2".

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Q76. Answer: (b) 647

Given: 617 627 635 641 645 ?

The logic followed here is:

Thus, 647 should come in place of the question mark (?) in the given series.

Hence, the correct answer is "Option 2".

Q77. Answer: (a) 21

BODMAS Rule:

Decoding the given information:

Symbol	•	•	×	÷
Meaning	•	×	÷	•

Given equation: 112 × 4 ÷ 8 − 2 + 23 = ?

Now replacing the sign from left to right using BODMAS Rule, we get:

=> 112 ÷ 4 + 8 × 2 − 23 = ?

=> 28 + 8 × 2 − 23 = ?

=> 28 + 16 − 23 = ?

=> 44 − 23 = ?

=> 21 = ?

Hence, the correct answer is "Option 1".

Q78. Answer: (d) MGK55

The position and positional values or English Alphabets are:

Given: ICG23 JDH31 KEI39 LFJ47 ?

The logic followed here is:

Thus, MGK55 will replace the question mark (?) in the following series to make it logically complete.

Hence, the correct answer is "Option 4".

Q79. Answer: (c) None

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

Now,

Even numbers, each of which is immediately preceded by an even number and also immediately followed by an even number.

So, the needed pattern is: Even — Even — Even

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

Thus, there is no even number, each of which is immediately preceded by an even number and also immediately followed by an even number.

Hence, the correct answer is "Option 3".

Q80. Answer: (d) 4

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

Now,

Symbols, each of which is immediately preceded by a number and also immediately followed by another number.

So, the needed pattern is: Number — Symbol — Number

Thus, there are 4 such symbols, each of which is immediately preceded by a number and also immediately followed by another number.

Hence, the correct answer is "Option 4".

Q81. Answer: (a) 15,057

The correct answer is 15,057.

Key Points

• The Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP) has achieved a significant milestone by opening 15,057 Jan Aushadhi Kendras (JAKs) across the country as of 28 February 2025.

• This scheme is a flagship initiative of the Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, Government of India, aimed at providing quality generic medicines at affordable prices.

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• The Pharmaceuticals and Medical Devices Bureau of India (PMBI) is the implementing agency that oversees the establishment and operations of these kendras.

• The network utilizes an end-to-end IT-enabled supply chain system, which includes a centralized Warehouse Management System (WMS) and SAP-based inventory tracking to ensure the timely availability of medicines.

• By February 2025, the coverage of the scheme has expanded to almost every district in India, significantly reducing the out-of-pocket expenditure on healthcare for the common man.

Additional Information

• Product Basket: The PMBJP product basket has grown extensively and currently includes more than 2,000 medicines and over 300 surgical devices, covering all major therapeutic groups such as anti-diabetics, cardiovascular drugs, and antibiotics.

• Pricing Structure: Medicines sold at Jan Aushadhi Kendras are priced 50% to 90% lower than the market prices of branded medicines, ensuring that "quality medicine is not a luxury."

• Jan Aushadhi Sugam Mobile App: The government launched a digital tool to help citizens locate the nearest Jan Aushadhi Kendra, check medicine availability, and compare prices of generic versus branded medicines.

• Employment and Incentives: The scheme encourages entrepreneurship among pharmacists and NGOs. Individual entrepreneurs are provided an incentive of up to Rs. 5 lakhs, and special incentives of Rs. 2 lakhs are given for kendras opened in North-Eastern states, Himalayan areas, and Aspirational Districts.

• Quality Assurance: Every batch of medicine supplied to these kendras is tested at NABL-accredited laboratories to ensure they meet the highest standards of safety and efficacy before reaching the public.

Important Points

• Historical Context: Originally launched as the Jan Aushadhi Scheme in 2008, it was later revamped and renamed as Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP) in 2015-16 to give it more momentum and wider reach.

• Supply Chain Infrastructure: To support the 15,057 centers, the PMBI operates a large-scale logistics network consisting of central warehouses and several regional warehouses strategically located across different states.

• Social Impact: In the last few years, the scheme has saved citizens billions of rupees. For example, in the financial year 2023-24 alone, the scheme helped consumers save approximately Rs. 10,000 crore.

• Menstrual Hygiene: Under the scheme, Suvidha Oxo-biodegradable Sanitary Napkins are sold at a nominal price of Re. 1 per pad to improve menstrual health among women in rural and urban areas.

Q82. Answer: (a) 2070

The correct answer is 2070.

Key Points

• India officially committed to achieving net-zero emissions by the year 2070. This landmark announcement was made by Prime Minister Narendra Modi during the COP26 (26th Conference of Parties) summit held in Glasgow, Scotland, in November 2021.

• The 2070 target is the cornerstone of India’s "Panchamrit" (five nectar elements) strategy, which represents India's contribution to global climate action and its commitment to the Paris Agreement.

• Net-zero, also known as carbon neutrality, refers to the balance between the amount of greenhouse gases produced and the amount removed from the atmosphere. India aims to reach this state by transitioning to clean energy and enhancing carbon sinks.

• In August 2022, the Union Cabinet, chaired by the Prime Minister, approved India's updated Nationally Determined Contribution (NDC), which formally integrated the 2070 net-zero goal into the country's international climate pledge to the UNFCCC.

• This target distinguishes India from developed nations like the USA and UK (who aim for 2050) and China (which aims for 2060), reflecting the principle of Common But Differentiated Responsibilities (CBDR) based on national circumstances.

Additional Information

• The Panchamrit Action Plan:

• Along with the 2070 goal, India set four other targets for 2030:

1. Increasing non-fossil energy capacity to 500 GW.

2. Meeting 50% of energy requirements from renewable energy.

3. Reducing total projected carbon emissions by one billion tonnes.

4. Reducing the carbon intensity of the economy by 45% relative to 2005 levels.

• National Green Hydrogen Mission:

• Launched with an initial outlay of Rs. 19,744 crore in January 2023, this mission is vital for India to reach Net Zero by 2070, specifically targeting the decarbonization of industrial, transport, and energy sectors.

• LiFE (Lifestyle for Environment) Movement:

• Introduced at COP26, Mission LiFE is an India-led global mass movement to nudge individuals and communities to adopt sustainable lifestyles to protect and preserve the environment.

• Long-Term Low-Emission Development Strategy (LT-LEDS):

• At COP27 in Sharm el-Sheikh, Egypt (2022), India submitted its LT-LEDS, detailing the sectoral transitions (like increased use of biofuels and electric vehicles) required to meet the 2070 deadline.

Important Points

• Indian Railways Target: While the national target is 2070, Indian Railways has set a much more aggressive internal target to become a Net Zero Carbon Emitter by 2030 through 100% electrification and renewable energy sourcing.

• Forestry and Carbon Sinks: India plans to create an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through additional forest and tree cover by 2030, which will eventually support the 2070 net-zero objective.

• Economic Impact: Achieving Net Zero by 2070 will require an estimated investment of trillions of dollars, necessitating significant climate finance and technology transfer from developed nations.

Q83. Answer: (b) Salima Tete

The correct answer is Salima Tete.

Key Points

• The Indian Women's Hockey team captain, Salima Tete, was conferred with the prestigious Arjuna Award in January 2025.

• The award ceremony for the National Sports Awards 2024 was held at the Rashtrapati Bhavan, where the President of India, Droupadi Murmu, presented the honors to the athletes. Hence, the correct answer is Salima Tete.

• Salima Tete hails from the Simdega district of Jharkhand and has been a cornerstone of the national team as a midfielder.

• She was a key member of the Indian squad that finished fourth at the 2020 Tokyo Olympics and won the Bronze Medal at the 2022 Birmingham Commonwealth Games.

• In 2023, she was honored as the AHF (Asian Hockey Federation) Player of the Year and received the Balbir Singh Sr. Award for Player of the Year at the 6th Hockey India Annual Awards.

• The Arjuna Award recognizes her consistent performance, leadership, and contribution to Indian Hockey over the last four years.

Additional Information

• Arjuna Award for Hockey Players:

• Savita Punia: The veteran goalkeeper and former captain was conferred with the Arjuna Award in 2018 for her exceptional performance under the bar.

• Deep Grace Ekka: The reliable defender from Odisha received the Arjuna Award in 2022. She has represented India in over 250 international matches.

• Gurjit Kaur: Known as India's premier drag-flicker, she was honored with the Arjuna Award in 2021 following her heroics at the Tokyo Olympics.

• The Arjuna Award:

• Instituted in 1961, it is the second-highest sporting honor in India, given by the Ministry of Youth Affairs and Sports.

• The award includes a statue of Arjuna, a certificate, and a cash prize of Rs. 15 lakh.

• Recipients are selected based on their performance at the international level (Olympics, World Cup, Asian Games, Commonwealth Games) and for exhibiting sportsmanship and discipline.

Important Points

• National Sports Awards Categories:

• Major Dhyan Chand Khel Ratna Award: The highest sporting honor in India, awarded for spectacular and outstanding performance over four years.

• Dronacharya Award: Conferred upon coaches for producing medal winners at prestigious international events.

• Dhyan Chand Award for Lifetime Achievement: Honoring sportspersons who have contributed to sports through their performance and continue to contribute to the promotion of sports even after retirement.

• Maulana Abul Kalam Azad (MAKA) Trophy: Given to the overall top-performing university in inter-university tournaments.

• Current Status of Hockey in India:

• Under the leadership of players like Salima Tete (Women) and Harmanpreet Singh (Men), Hockey India has seen a resurgence, with both teams consistently ranking in the top 10 globally.

• The Government of Odisha remains the major sponsor for both the Men's and Women's national hockey teams until 2033.

Q84. Answer: (c) Lamine Yamal

The correct answer is Lamine Yamal.

Key Points

• Lamine Yamal, the Spanish professional footballer, was honored with the Breakthrough of the Year award at the 2025 Laureus World Sports Awards.

• The 17-year-old FC Barcelona winger gained global recognition for his extraordinary performance during the 2024 calendar year, particularly at the UEFA Euro 2024.

• He played a crucial role in helping Spain secure the European Championship title, where he was also named the Young Player of the Tournament.

• The Laureus World Breakthrough of the Year award specifically recognizes individuals or teams who have made a significant "breakthrough" in the sporting world, marking a transition to elite status.

• By winning this award, Lamine Yamal joins an elite group of athletes who have demonstrated world-class talent at a remarkably young age. Hence, the correct answer is Lamine Yamal.

Additional Information

• Laureus World Sports Awards:

• Established in 1999 by the Laureus Sport for Good Foundation, these awards are often referred to as the "Oscars of Sport."

• The 2025 ceremony celebrated the greatest sporting achievements of 2024.

• Winners are selected by the Laureus World Sports Academy, which consists of over 70 legendary athletes from various disciplines.

• Nominees for Breakthrough of the Year (2025):

• Summer McIntosh: A Canadian swimmer who won three Olympic gold medals at the Paris 2024 Games at just 17 years old.

• Coco Gauff: An American tennis sensation who continued her rise in the WTA rankings following her 2023 Grand Slam success.

• Victor Wembanyama: The French basketball star playing for the San Antonio Spurs in the NBA, who won the Rookie of the Year award for the 2023-24 season.

• Lamine Yamal's Records:

• He holds the record for being the youngest goalscorer in the history of the UEFA European Championship, scoring at the age of 16 years and 362 days.

• He is also the youngest player to ever appear in a Euro final, a record he set on July 14, 2024.

Important Points

• La Masia Impact: Lamine Yamal is a product of FC Barcelona's famous youth academy, La Masia, which has produced other legends like Lionel Messi and Andres Iniesta.

• Global Influence: His win at the Laureus Awards highlights the increasing trend of teenage athletes dominating senior-level international competitions.

• Award Categories: Besides Breakthrough of the Year, the Laureus Awards also include categories like Sportsman of the Year, Sportswoman of the Year, and Team of the Year.

• Selection Process: The shortlisting is done by a panel of 1,000+ sports journalists from over 100 countries, followed by the final vote by the Academy members.

Q85. Answer: (a) Chinese authority

The correct answer is Chinese authority.

Key Points

• The Indian National Space Promotion and Authorisation Centre (IN-SPACe), which acts as the autonomous nodal agency under the Department of Space, has officially decided to discontinue the use of certain foreign satellites.

• India will ban the use of AsiaSat-5 and AsiaSat-7 satellites for domestic broadcasting and telecommunication services after 31 March 2026.

• The primary reason for this directive is the concern over Chinese authority and control. AsiaSat (Asia Satellite Telecommunications Company Limited) is a Hong Kong-based company, and there are significant security apprehensions regarding the influence of the Chinese government over entities based in that region.

• The decision reflects India's strategic move to ensure national security and data integrity by reducing reliance on space infrastructure that could potentially be monitored or influenced by adversarial foreign powers.

• Broadcasters and telecommunication providers currently using these transponders have been given a transition period until the year 2026 to migrate their services to Indian satellites or other authorized "trusted" foreign satellites. Hence, the correct answer is Chinese authority.

Additional Information

• AsiaSat Company Profile:

• AsiaSat was established in 1988 and is headquartered in Hong Kong.

• The company is a major player in the satellite industry, providing services to the Asia-Pacific region. It is significantly owned by CITIC Group, a large Chinese state-owned investment company, which reinforces the "authority" concerns cited by Indian regulators.

• Satellite Details:

• AsiaSat-5 was launched in August 2009 to replace AsiaSat-2. It carries C-band and Ku-band transponders used extensively for DTH (Direct-To-Home) and television distribution.

• AsiaSat-7 was launched in November 2011. It was designed to support television networks and VSAT networks across the Asia-Pacific, including India.

• The Role of IN-SPACe:

• IN-SPACe was created to provide a level playing field for private companies to use Indian space infrastructure.

• It is also responsible for the authorization of satellite systems used within the country, ensuring they comply with the Space Policy 2023 and national security guidelines.

Important Points

• Impact on DTH Operators: Major Indian DTH providers and broadcasters who rely on these satellites for signal distribution must now coordinate with NewSpace India Limited (NSIL) to find alternative capacity.

• Atmanirbhar Bharat in Space: This ban encourages the use of indigenous GSAT series satellites developed by ISRO (Indian Space Research Organisation). By shifting to domestic satellites, India aims to strengthen its sovereign control over its communication backbone.

• Geopolitical Context: This move follows a series of digital and technological restrictions placed by the Government of India on Chinese-linked entities following border tensions in 2020, including the banning of numerous mobile applications and the scrutiny of FDI (Foreign Direct Investment) from neighboring countries.

Q86. Answer: (b) Supreme Court Bar Association

The correct answer is Supreme Court Bar Association.

Key Points

• Monika Gusain was elected as a Senior Executive Member of the Supreme Court Bar Association (SCBA) in the elections held for the 2024-2025 term.

• The SCBA election, which took place in May 2024, is one of the most prestigious events for the legal fraternity in India, determining the leadership of the advocates practicing at the apex court.

• She is a practicing Advocate-on-Record (AOR) in the Supreme Court of India, a specialized category of lawyers authorized to file matters before the court.

• The 2024 elections were particularly significant as they saw the return of veteran lawyer and former Union Minister Kapil Sibal as the President of the Supreme Court Bar Association after several years.

• The executive committee of the SCBA consists of various posts, including President, Vice President, Honorary Secretary, and several Executive Members (both Senior and Junior) who manage the affairs of the association.

Additional Information

• Supreme Court Bar Association (SCBA):

• The SCBA is an entity that represents the collective interests of the lawyers practicing in the Supreme Court of India, located in New Delhi.

• It plays a critical role in maintaining the independence of the judiciary and ensuring the welfare of the legal community.

• The SCBA is involved in organizing legal seminars, maintaining library facilities for members, and acting as a liaison between the Judges (the Bench) and the Lawyers (the Bar).

• Other Organizations Mentioned:

• Asian Rural Development Organization (AARDO): An autonomous inter-governmental organization established in 1962 to promote welfare and rural development among its member countries in Africa and Asia.

• Indian Institute of Architects (IIA): The national body of architects in India, established in 1917, which plays a major role in the promotion of the profession of architecture.

• National Association of Realtors - India (NAR-INDIA): The apex body for real estate consultants in India, formed to provide a single platform for realtors to promote ethical practices in the real estate sector.

• Advocate-on-Record (AOR) System:

• Under the Supreme Court Rules, 2013, only an Advocate-on-Record is entitled to file any appearance or act for a party in the Supreme Court.

• To become an AOR, an advocate must have at least four years of practice and pass a rigorous examination conducted by the Supreme Court of India.

Important Points

• The SCBA Executive Committee for 2024-2025 includes Kapil Sibal as President, Rachana Srivastava as Vice President, and Vikrant Yadav as Honorary Secretary.

• The election of Monika Gusain as a Senior Executive Member highlights the active participation of women in the leadership roles of the legal profession in India.

• The Supreme Court of India was inaugurated on January 28, 1950, succeeding the Federal Court of India established under the Government of India Act, 1935.

Q87. Answer: (c) Wimbledon

The correct answer is Wimbledon.

Key Points

• The All England Lawn Tennis Club (AELTC) announced in October 2024 that it would replace human line judges with Live Electronic Line Calling (Live ELC) starting from the 2025 Championships.

• This historic decision ends 147 years of tradition at Wimbledon, where line judges in their iconic uniforms have been a staple of the grass-court tournament since its inception in 1877. Hence, the statement regarding Wimbledon is correct.

• The new Live ELC system will be utilized on all 18 show courts as well as the qualifying rounds held at Roehampton.

• The move is designed to ensure maximum accuracy in officiating, providing a consistent environment for players who have become accustomed to the technology on the ATP and WTA tours.

• Approximately 300 line judges who worked the tournament annually will no longer be required, though Chair Umpires will remain in place to manage the match and keep the official score.

Additional Information

• Australian Open and US Open:

• The Australian Open became the first Grand Slam to entirely replace line judges with Live ELC in 2021, partly as a response to the COVID-19 pandemic to reduce on-court personnel.

• The US Open followed suit in 2021, adopting the technology across all its courts in New York to streamline play and reduce officiating errors.

• The French Open (Roland Garros):

• As of 2025, the French Open remains the only Grand Slam to continue using human line judges.

• Because it is played on clay, the tournament relies on the physical mark the ball leaves on the surface, which the Chair Umpire can manually inspect if a call is disputed.

• ATP Tour Mandate:

• The ATP Tour (men's professional circuit) previously announced a universal mandate that all ATP events must adopt Electronic Line Calling by the year 2025.

• This policy aims to provide uniformity across various surfaces and tournament tiers, from ATP 250 to Masters 1000 events.

Important Points

• Hawk-Eye Technology: Most Live ELC systems are powered by Hawk-Eye Innovations, which uses multiple high-speed cameras to track the trajectory of the ball and trigger an automated "out" voice call within one-tenth of a second.

• Removal of Challenges: With the implementation of Live ELC, the traditional "challenge" system (where players ask for a video review) is eliminated, as every call is essentially a real-time review.

• Game Speed: Data indicates that Live ELC significantly speeds up the duration of matches by reducing the time spent on disputes and the physical movement of line judges during changeovers.

• Preservation of Tradition: While Wimbledon is moving to digital officiating, the AELTC emphasized that the Chair Umpire remains the final authority on court for matters of conduct and scorekeeping.

Q88. Answer: (a) To study the impact of glass industries on the Taj Mahal

The correct answer is To study the impact of glass industries on the Taj Mahal.

Key Points

• In April 2025, the Supreme Court of India issued a directive to the National Environmental Engineering Research Institute (NEERI) to conduct a detailed scientific assessment.

• The primary responsibility assigned to NEERI was to study the impact of glass industries on the structural integrity and aesthetic preservation of the Taj Mahal.

• This study focuses on the environmental footprint of industrial units located within the Taj Trapezium Zone (TTZ), specifically those involved in glass manufacturing in nearby regions like Firozabad. Hence, the statement regarding the impact of glass industries is correct.

• The Supreme Court aims to determine if the emissions from these industries are contributing to the yellowing of the marble or "marble cancer," caused by chemical reactions with pollutants.

• NEERI is expected to provide data-driven recommendations on whether existing pollution control equipment in these factories is sufficient or if stricter regulations are required to protect the UNESCO World Heritage Site.

Additional Information

• National Environmental Engineering Research Institute (NEERI):

• It was established in 1958 and is headquartered in Nagpur, Maharashtra.

• It functions under the Council of Scientific and Industrial Research (CSIR) and focuses on environmental monitoring, hazardous waste management, and environmental impact assessments.

• NEERI has been frequently consulted by the Indian Judiciary for expert technical opinions on environmental conservation cases.

• The Taj Trapezium Zone (TTZ):

• The TTZ is a defined area of approximately 10,400 square kilometers around the Taj Mahal.

• It encompasses several districts including Agra, Firozabad, Mathura, Hathras, and Etah in Uttar Pradesh, as well as Bharatpur in Rajasthan.

• The zone was established following the 1996 Supreme Court judgment to protect the monument from pollution-induced damage.

• Glass Industry in Firozabad:

• Firozabad is known as the "Glass City of India" due to its extensive cluster of glass-making units and bangle factories.

• Historically, these industries used coal and coke, which emitted high levels of Sulfur Dioxide (SO_2) and particulate matter, posing a direct threat to the white marble of the Taj Mahal.

Important Points

• Legal Precedents: The protection of the Taj Mahal is governed by the landmark case of M.C. Mehta vs. Union of India, filed in the 1980s, which led to the closure of several polluting industries.

• Transition to Cleaner Fuel: The Supreme Court previously mandated that industries in the TTZ must switch from traditional fuels to Piped Natural Gas (PNG) to minimize the carbon footprint and acidic emissions.

• Marble Cancer: This term refers to the corrosion of marble by acid rain (formed by Sulfur Dioxide and Nitrogen Oxides reacting with water vapor), which converts calcium carbonate into calcium sulfate, causing the surface to flake and turn yellow.

• Current Status: The April 2025 order signifies the court's ongoing vigilance in balancing industrial economic activity with the preservation of India's cultural heritage through rigorous scientific auditing by CSIR-NEERI.

Q89. Answer: (a) Operation Bramha

The correct answer is Operation Bramha.

Key Points

• Operation Bramha was a high-stakes humanitarian mission launched by the Government of India in March 2025 to provide immediate relief to Myanmar following a devastating earthquake.

• The National Disaster Response Force (NDRF) spearheaded the mission, deploying multiple specialized teams equipped with advanced search and rescue tools, including canine squads and chip-based life detectors.

• The operation focused on the hardest-hit regions of Myanmar, where the seismic activity caused extensive damage to infrastructure and residential buildings, requiring urban search and rescue (USAR) expertise.

• India utilized the C-17 Globemaster III aircraft of the Indian Air Force to transport over 100 personnel, along with emergency medical supplies, tents, and ready-to-eat meals to the affected zones.

• This mission reinforces India's role as the "First Responder" in the Indian Ocean Region and its commitment to the "Neighborhood First" policy during natural calamities.

Additional Information

• National Disaster Response Force (NDRF):

• The NDRF was constituted in the year 2006 under the Disaster Management Act, 2005, specifically for the purpose of specialized response to natural and man-made disasters.

• It operates under the Ministry of Home Affairs and is headquartered in New Delhi, with various battalions stationed across India for rapid deployment.

• India-Myanmar Relations in Disaster Management:

• India has a history of assisting Myanmar, such as during Cyclone Mocha in 2023 under Operation Karuna, where Indian Navy ships delivered essential relief materials.

• The collaboration between the two nations is vital due to their shared 1,643 km long land border and proximity in the Bay of Bengal.

• Humanitarian Assistance and Disaster Relief (HADR):

• HADR operations are a core component of India's soft power diplomacy, demonstrating technical capability and regional leadership.

• Other notable operations include Operation Dost (the 2023 Turkey-Syria earthquake) and Operation Maitri (the 2015 Nepal earthquake).

Important Points

• Seismic Vulnerability: Myanmar is located in a seismically active zone where the Indian Plate subducts under the Burma Microplate, making it prone to high-magnitude earthquakes.

• Technical Coordination: The success of Operation Bramha relied on the Ministry of External Affairs (MEA) coordinating with the Myanmar authorities to ensure a seamless "green corridor" for aid delivery.

• Medical Aid: A significant part of the relief package included Level-2 and Level-3 medical facilities capable of performing

emergency surgeries in field conditions.

• Global Standards: NDRF teams follow the guidelines of the International Search and Rescue Advisory Group (INSARAG), ensuring that their methods are compatible with international disaster response protocols.

Q90. Answer: (a) YANTRA – Yugantar for Advancing New Technology, Research & Acceleration

The correct answer is YANTRA – Yugantar for Advancing New Technology, Research & Acceleration.

Key Points

• The official theme for National Technology Day 2025 is YANTRA – Yugantar for Advancing New Technology, Research & Acceleration.

• This theme emphasizes the transformative power of technology in ushering in a new era (Yugantar) for India's scientific and industrial landscape. Hence, statement 1 is correct.

• The National Technology Day is celebrated every year on May 11 across India to honor the contributions of scientists, researchers, and engineers.

• The 2025 theme focuses on accelerating the deployment of Deep Tech, Artificial Intelligence, and Quantum Computing to achieve the vision of Viksit Bharat @2047.

• The celebrations are primarily coordinated by the Technology Development Board (TDB), a statutory body under the Department of Science and Technology (DST), Government of India.

Additional Information

• History and Significance:

• The day marks the anniversary of the Pokhran-II nuclear tests, codenamed Operation Shakti, conducted on May 11, 1998, in Rajasthan.

• Following the success of these tests, then-Prime Minister Atal Bihari Vajpayee declared May 11 as National Technology Day.

• The first official celebration took place in 1999, highlighting India's entry into the elite club of nuclear-armed nations.

• Other Historical Milestones:

• On the same day in 1998, India's first indigenous aircraft, Hansa-3, took its maiden flight in Bengaluru.

• Additionally, the Defence Research and Development Organisation (DRDO) successfully test-fired the Trishul missile, a short-range, quick-reaction, surface-to-air missile, on May 11, 1998.

• Jai Vigyan Slogan:

• Prime Minister Atal Bihari Vajpayee added "Jai Vigyan" (Hail Science) to the existing slogan "Jai Jawan, Jai Kisan" to emphasize the importance of science and technology in nation-building.

Important Points

• National Technology Awards:

• Every year, the Technology Development Board (TDB) confers National Awards to industrial units and startups for the successful commercialization of indigenous technologies.

• These awards encourage the spirit of Atmanirbhar Bharat (Self-reliant India) by promoting Public-Private Partnerships in research and development.

• Institutional Role:

• The Ministry of Science and Technology utilizes this day to showcase high-end technologies developed by institutions like CSIR, ISRO, and DRDO.

• The 2025 focus on YANTRA aligns with the National Quantum Mission and the IndiaAI Mission launched by the Union Cabinet to boost research & acceleration.

Q91. Answer: (b) 38

The correct answer is 38.

Key Points

• The Corruption Perceptions Index (CPI) 2024 was released by the global civil society organization Transparency International in February 2025.

• India recorded a score of 38 out of 100 in the 2024 index, reflecting the perceived level of public sector corruption in the country.

• In comparison to the 2023 report, where India scored 39, the current score of 38 indicates a slight decline in the perceived integrity of the public sector.

• India's rank in the 2024 index is 93rd among 180 countries and territories evaluated globally.

• The index uses a scale where 0 represents "highly corrupt" and 100 represents "very clean," placing India in the lower half of the global rankings.

Additional Information

• Transparency International:

• It is an international non-governmental organization based in Berlin, Germany, founded in 1993.

• The organization aims to take action to combat global corruption and prevent criminal activities arising from corruption.

• It publishes various reports including the Global Corruption Barometer and the Corruption Perceptions Index.

• Top Performers in 2024:

• Countries like Denmark, Finland, and New Zealand consistently rank at the top of the index with scores above 85.

• These nations are characterized by strong rule of law, independent judicial systems, and high levels of transparency.

• Global Average:

• The global average score for the CPI remains stagnant at 43 for several consecutive years, indicating that most countries are failing to tackle public sector corruption effectively.

• More than two-thirds of countries score below 50, highlighting serious corruption issues worldwide.

Important Points

• CPI Methodology:

• The index aggregates data from 13 external sources, including the World Bank, the World Economic Forum, and private risk and consulting companies.

• It focuses specifically on public sector corruption, including bribery, diversion of public funds, and the use of public office for private gain.

• Regional Context (South Asia):

• Within South Asia, India (38) and Maldives (39) often share similar score ranges, while Pakistan and Bangladesh typically record significantly lower scores.

• The 2024 report emphasized that the decline in justice system independence is a key driver for lower scores in many democratic nations.

• Impact of Corruption:

• A low score in the Corruption Perceptions Index can negatively impact a country's Foreign Direct Investment (FDI) and overall economic growth.

• Corruption is frequently linked to social inequality and the erosion of democratic institutions.

Q92. Answer: (a) December 2025

The correct answer is December 2025.

Key Points

• Bima Vistaar is an innovative, all-in-one bundled insurance product designed by the Insurance Regulatory and Development Authority of India (IRDAI) to provide comprehensive coverage for life, health, and property.

• According to the latest announcements by IRDAI officials, the product is likely to be launched by December 2025. This timeline aligns with the development of the necessary digital and physical infrastructure required for mass distribution.

• The scheme is specifically tailored for the rural population of India, aiming to provide a simple and affordable safety net against various risks in a single policy document.

• It is a benefit-based product, which means it pays out a predefined sum upon the occurrence of an event (like a death or a health crisis), rather than being an indemnity-based product. This ensures faster claim settlements and reduces documentation hurdles for the rural poor.

• The rollout of Bima Vistaar is a critical part of the IRDAI's strategic goal of "Insurance for all by 2047," marking the centenary of India's independence.

Additional Information

• Bima Sugam: This is a massive digital marketplace platform that will facilitate the sale, service, and claims processing for Bima Vistaar. It is envisioned as the "UPI of insurance," connecting insurers, agents, and customers on a single portal.

• Bima Vahak: This refers to the grassroots distribution force, primarily consisting of women (individual or corporate), who will be deployed at the Gram Panchayat level to sell Bima Vistaar policies and educate rural citizens about the benefits of insurance.

• Insurance Regulatory and Development Authority of India (IRDAI): It is a statutory body formed under the IRDAI Act, 1999. It is headquartered in Hyderabad and is responsible for regulating and promoting the insurance and re-insurance industries in India.

• Parametric Insurance: Bima Vistaar incorporates elements of parametric or benefit-based insurance, which triggers payments based on specific events (like a certain amount of rainfall or a medical diagnosis) rather than just a loss assessment, making it highly effective for rural risk management.

Important Points

• Insurance Penetration: India's insurance penetration remains relatively low compared to global averages. The Bima Vistaar initiative is expected to significantly increase insurance density and penetration in the hinterlands.

• Mission 2047: The December 2025 launch date is a milestone toward the Government of India's and IRDAI's vision to ensure every citizen has life, health, and property insurance cover by the year 2047.

• Institutional Support: The product is being developed in consultation with various Life and General Insurance Councils to ensure that the premiums remain affordable (likely under Rs. 1500-2000 annually) for the target demographic.

Q93. Answer: (c) 11th April

The correct answer is 11th April.

Key Points

• Jyotirao Govindrao Phule, popularly known as Mahatma Jyotiba Phule, was born on 11th April 1827.

• In the year 2025, his 198th birth anniversary is observed across the country to honor his contributions to social justice and education.

• He was a prolific social reformer, thinker, and writer from the state of Maharashtra, India.

• His birth anniversary, celebrated as Jyotiba Phule Jayanti, is a significant day for movements advocating the rights of oppressed classes, women, and farmers.

• He was one of the earliest pioneers of women's education in India and fought relentlessly against the caste system and untouchability. Hence, the correct option is 11th April.

Additional Information

• Satyashodhak Samaj:

• On 24th September 1873, Phule formed the Satyashodhak Samaj (Society of Seekers of Truth) in Pune.

• The main objective of this society was to provide social rights and political access to the underprivileged and oppressed sections of society.

• It emphasized the human rights and religious freedom of people regardless of their caste.

• Educational Initiatives:

• Along with his wife, Savitribai Phule, he started the first indigenous school for girls in 1848 at Bhide Wada in Pune.

• He believed that education was the primary tool for the emancipation of the lower castes and women.

• The couple faced severe social ostracism for their work but continued to open more schools for children from all castes.

• Literary Contributions:

• His most famous work, Gulamgiri (Slavery), published in 1873, was dedicated to the American movement to end slavery.

• Other notable books include Shetkarayacha Aasud (The Cultivator's Whipcord), which highlighted the exploitation of farmers, and Sarvajanik Satya Dharma.

Important Points

• The Title of Mahatma:

• He was conferred the title of Mahatma on 11th May 1888 by a social activist named Vithalrao Krishnaji Vandekar during a massive public gathering at Mumbadevi, Mumbai.

• Municipal Career:

• He served as a member of the Poona Municipality (now Pune Municipal Corporation) between 1876 and 1883.

• Legacy and Influence:

• His thoughts and ideologies significantly influenced Dr. B.R. Ambedkar, the architect of the Indian Constitution, who regarded Phule as one of his three gurus (preceptors).

• His work led to the reorganization of the social structure in Maharashtra and laid the foundation for the anti-caste movement in India.

• Welfare Work:

• He established an orphanage in 1863 to provide shelter and protection to widows and their infants, preventing infanticide.

Q94. Answer: (d) Russia

p>The correct answer is Russia.

Key Points

• According to the Global Peace Index (GPI) 2025, Russia is ranked at the bottom of the list, indicating it as the least peaceful nation among the provided options due to its sustained military aggression and internal suppression.

• The index is an annual publication by the Institute for Economics and Peace (IEP), a global think tank based in Sydney, Australia, which evaluates 163 independent states and territories.

• Russia's ranking has deteriorated significantly since the full-scale invasion of Ukraine in February 2022, leading to massive increases in battlefield deaths and military expenditure. Hence, the statement regarding Russia is correct.

• The evaluation is based on three thematic domains: Societal Safety and Security, Ongoing Domestic and International Conflict, and Militarization.

• While Yemen, Sudan, and Syria have consistently been among the most violent regions, the intensity of international conflict and geopolitical isolation has moved Russia to the bottom tiers of the index in the 2025 report.

• Russia’s score is negatively impacted by high levels of political instability, violent demonstrations, and a surge in internal security measures to maintain control during wartime.

Additional Information

• Structure of the GPI:

• The index was first launched in May 2007 and remains the world's leading measure of global peacefulness, covering 99.7% of the world's population.

• It utilizes 23 qualitative and quantitative indicators, such as homicide rates, access to weapons, and refugee populations.

• Most Peaceful Nations:

• Iceland has consistently held the title of the most peaceful country in the world since 2008.

• Other highly peaceful nations often include Denmark, Ireland, New Zealand, and Austria, which benefit from low corruption and high transparency.

• Economic Impact of Violence:

• The IEP calculates the economic cost of violence, which includes the loss of GDP and expenses related to military and internal security.

• For nations like Russia and Ukraine, the economic impact of the war has exceeded 30% to 60% of their respective GDPs in recent years.

• Regional Trends:

• The Middle East and North Africa (MENA) region remained the least peaceful region for several years, though Europe has seen the largest regional deterioration in peace due to the war in Eurasia.

Important Points

• Negative vs. Positive Peace:

• Negative Peace is defined as the absence of violence or fear of violence, which is what the GPI primarily measures.

• Positive Peace refers to the attitudes, institutions, and structures that create and sustain peaceful societies, such as a well-functioning government and sound business environment.

• Conflict in Sudan and Yemen:

• Sudan experienced a sharp decline in peacefulness following the outbreak of civil war in April 2023 between the Sudanese Armed Forces (SAF) and the Rapid Support Forces (RSF).

• Yemen remains a critical humanitarian concern, though it has seen slight fluctuations in its ranking depending on the intensity of the Houthi-led conflict.

• Militarization Domain:

• This domain measures the military capacity of a country, including nuclear weapons capability and arms exports. Russia scores very poorly in this domain due to its status as a major nuclear power and its massive arms production.

Q95. Answer: (d) Rs. 59,68,048 crores

The correct answer is Rs. 59,68,048 crores.

Key Points

• As of the week ending 4 July 2025, the Reserve Bank of India (RBI) reported that India’s total foreign exchange reserves reached a valuation of Rs. 59,68,048 crores.

• Foreign exchange reserves are essential assets held by the central bank in foreign currencies, which are used to back liabilities and influence monetary policy.

• The reserves are maintained to ensure that the RBI has sufficient liquidity to intervene in the foreign exchange market to curb excessive volatility in the value of the Indian Rupee (INR).

• These reserves act as a critical buffer for the economy against external shocks, such as sudden capital outflows or global financial crises, providing a sense of security to international investors.

• The valuation of these reserves is subject to change based on the movement of global exchange rates and the market price of gold, which is a significant component of the total holdings.

Additional Information

• Components of Foreign Exchange Reserves:

• Foreign Currency Assets (FCA): This is the largest component of India's forex reserves. It includes holdings of currencies like the US Dollar, Euro, Pound Sterling, and Japanese Yen. The FCA also accounts for the appreciation or depreciation of non-US units held in the reserves.

• Gold Reserves: The RBI holds significant quantities of gold to diversify its assets. Gold is considered a safe-haven asset that provides a hedge against inflation and currency fluctuations.

• Special Drawing Rights (SDRs): These are international reserve assets created by the International Monetary Fund (IMF). They are allocated to member countries in proportion to their IMF quotas.

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• Reserve Position in the IMF: This represents the amount of foreign currency a member country can withdraw from the IMF at short notice without any conditionality.

• Significance of High Reserves:

• High forex reserves provide adequate import cover, ensuring that the country can continue to pay for essential imports like crude oil and electronic goods even during a crisis.

• They help maintain sovereign credit ratings, as large reserves indicate a strong capacity to meet external debt obligations.

• Reserves facilitate the RBI's ability to manage interest rates and maintain macroeconomic stability.

Important Points

• The data regarding foreign exchange reserves is released on a weekly basis by the Reserve Bank of India in its Weekly Statistical Supplement (WSS).

• India generally ranks among the top countries globally in terms of total foreign exchange holdings, alongside nations like China, Japan, and Switzerland.

• The management of these reserves is governed by the Reserve Bank of India Act, 1934, which provides the legal framework for the custody and investment of these assets.

• The RBI invests a portion of the reserves in high-quality sovereign bonds, mainly US Treasuries, and deposits with other central banks and the Bank for International Settlements (BIS) to earn a safe return while maintaining liquidity.

Q96. Answer: (b) Nuclear Energy Mission

The correct answer is Nuclear Energy Mission.

Key Points

• During the presentation of the Union Budget 2025-26, Union Finance Minister Nirmala Sitharaman announced the Nuclear Energy Mission as a core component of India's strategy for energy security and transition.

• The mission focuses on the development of Bharat Small Reactors (BSR), which are designed to provide decentralized and reliable power, particularly for hard-to-abate industries.

• A significant highlight of this mission is the promotion of Public-Private Partnerships (PPP), allowing the private sector to collaborate with the government in research and development and the deployment of nuclear technologies.

• The government aims to leverage Nuclear Energy to reduce the carbon footprint of the industrial sector, supporting the national goal of achieving Net Zero emissions by 2070.

• This initiative is part of a broader Energy Transition Roadmap that seeks to balance the intermittency of renewable sources like solar and wind with stable baseload power from nuclear sources. Hence, the correct answer is Nuclear Energy Mission.

Additional Information

• Small Modular Reactors (SMRs):

• SMRs are advanced nuclear reactors that have a power capacity of up to 300 MW per unit, which is about one-third of the generating capacity of traditional nuclear power reactors.

• Due to their small size, they can be factory-constructed and transported to a site for installation, making them more affordable and flexible in terms of location compared to large-scale plants.

• PM Surya Ghar Muft Bijli Yojana:

• Announced previously and reinforced in recent fiscal discussions, this scheme aims to provide 300 units of free electricity every month to 1 crore households through rooftop solar installations.

• It represents a massive push toward Renewable Energy at the consumer level, reducing the burden on the national grid and promoting self-reliance.

• Hydrogen Mission (National Green Hydrogen Mission):

• Launched in January 2023 with an outlay of Rs. 19,744 crore, this mission aims to make India a global hub for the production and export of Green Hydrogen.

• The target is to reach a production capacity of 5 Million Metric Tonnes (MMT) per annum by 2030.

• Net Zero Target 2070:

• India committed to this target at the COP26 summit in Glasgow. The transition involves shifting the energy mix from fossil fuels (coal, oil) to non-fossil sources (solar, wind, nuclear, and hydro).

• As of 2024-25, India has one of the world's fastest-growing renewable energy capacities, ranking 4th globally in total installed renewable energy capacity.

Important Points

• Nuclear Power Corporation of India Limited (NPCIL): A Public Sector Enterprise under the Department of Atomic Energy (DAE), it is the primary body responsible for the design, construction, and operation of nuclear power plants in India.

• Three-Stage Nuclear Power Programme: Formulated by Homi J. Bhabha, this program aims to utilize India's vast Thorium reserves. The current phase primarily involves Pressurized Heavy Water Reactors (PHWRs).

• Civil Liability for Nuclear Damage Act (2010): This act provides a framework for compensation in the event of a nuclear accident, which has been a key point of discussion regarding Private Sector entry into the nuclear domain.

• Energy Reliability: Unlike solar and wind, which are intermittent, nuclear energy provides a continuous supply of electricity, making it essential for maintaining grid stability as India industrializes further.

Q97. Answer: (a) Ayurveda for People & Planet

The correct answer is Ayurveda for People & Planet.

Key Points

• The Ministry of Ayush has officially announced that the theme for the 10th Ayurveda Day, to be celebrated in 2025, is "Ayurveda for People & Planet".

• This theme underscores the holistic philosophy of Ayurveda, which views human health as inseparable from the health of the environment and the ecosystem.

• Ayurveda Day is observed globally every year on the auspicious occasion of Dhanwantari Jayanti (also known as Dhanteras), honoring the God of Medicine in Hindu tradition.

• The 2025 celebration marks the tenth edition of this initiative, focusing on promoting sustainable living through Ayurvedic principles like Ritucharya (seasonal guidelines) and Aahara (dietary habits).

• The primary objective of the campaign is to internationalize Ayurveda and establish it as a robust, evidence-based system of medicine that addresses modern-day lifestyle disorders and climate-related health challenges.

Additional Information

• Origin of Ayurveda Day: The Government of India decided to celebrate Ayurveda Day annually starting from the year 2016. The first-ever Ayurveda Day was held on October 28, 2016.

• Lord Dhanwantari: In Indian mythology, Lord Dhanwantari is considered an avatar of Lord Vishnu who emerged during the Samudra Manthan (churning of the ocean) carrying the pot of Amrit (nectar of immortality).

• Ministry of Ayush: Formed on 9th November 2014, the Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy is responsible for the education, research, and propagation of traditional Indian medicine.

• Previous Themes: The theme for 2024 was "Ayurveda Innovations for Global Health", while the 2023 theme focused on "Ayurveda for One Health" (Ayurveda for everyone on every day).

• Global Recognition: Ayurveda is recognized as one of the oldest healthcare systems in the world. The World Health Organization (WHO) has established the Global Centre for Traditional Medicine in Jamnagar, Gujarat, to integrate traditional knowledge with modern science.

Important Points

• Sustainable Development Goals (SDGs): The theme "Ayurveda for People & Planet" aligns with several United Nations SDGs, specifically Goal 3 (Good Health and Well-being) and Goal 12 (Responsible Consumption and Production).

• Digital Ayurveda: The Ministry often utilizes platforms like the "Ayurveda Day Portal" to track mass participation and global events, which have previously seen participation from over 100 countries.

• Health Promotion: Ayurveda emphasizes Prakriti (individual constitution) and Panchakarma (detoxification), which are gaining global popularity for preventive healthcare.

Q98. Answer: (c) Royal Portrush, Northern Ireland

The correct answer is Royal Portrush, Northern Ireland.

Key Points

• The 153rd Open Championship is scheduled to be held from July 17 to July 20, 2025.

• The designated venue for this prestigious event is the Royal Portrush Golf Club, located in County Antrim, Northern Ireland. Hence, the correct answer is Royal Portrush, Northern Ireland.

• This marks the third time in the history of the tournament that it will be hosted at this venue. The previous occasions were in 1951 and 2019.

• The selection of Royal Portrush follows the highly successful 2019 championship, which saw record-breaking attendance and was won by Shane Lowry.

• The R&A (The Royal and Ancient Golf Club of St Andrews) confirmed the return to Northern Ireland as part of its efforts to rotate the tournament among the UK's finest links courses.

Additional Information

• The Open Championship:

• Often referred to as The British Open, it is the oldest of the four major championships in professional golf, first played in 1860 at Prestwick Golf Club.

• It is the only major championship played outside the United States and is organized by the R&A.

• The winner is traditionally awarded the Claret Jug (officially the Golf Champion Trophy) and is crowned the "Champion Golfer of

the Year."

• Royal Portrush Golf Club:

• Founded in 1888, it features two links courses: the Dunluce Links (the championship course) and the Valley Links.

• The Dunluce Links is widely regarded as one of the most challenging and scenic courses in the world, famously redesigned by Harry Colt in 1929.

• The "Rota" System:

• The Open is played on a rotation of ten coastal links courses across Scotland, England, and Northern Ireland.

• St Andrews (Old Course) is the most frequent host and typically hosts the tournament every five years.

• The 152nd Open in 2024 was held at Royal Troon in Scotland, where Xander Schauffele emerged as the champion.

• Future Venues:

• Following the 2025 event at Royal Portrush, the 154th Open is scheduled to take place at Royal Birkdale in England in 2026.

Important Points

• Economic Impact: Hosting the Open Championship provides a massive boost to the local economy; the 2019 event at Portrush generated over £100 million in economic benefit for Northern Ireland.

• Field and Qualification: The tournament features a field of 156 players, consisting of the world's top-ranked professionals and golfers who qualify through various Open Qualifying Series events globally.

• Course Modifications: In preparation for 2025, minor modifications and infrastructure improvements are often made to the Dunluce Links to accommodate modern hitting distances and large spectator galleries.

Q99. Answer: (a) Praveen Kumar

The correct answer is Praveen Kumar.

Key Points

• Praveen Kumar, the celebrated para-high jumper, was conferred with India's highest sporting honor, the Major Dhyan Chand Khel Ratna Award, for the year 2024.

• The prestigious award was presented by President Droupadi Murmu during a ceremony held at Rashtrapati Bhavan in January 2025.

• The 21-year-old athlete from Noida, Uttar Pradesh, was recognized for his extraordinary performance at the Paris 2024 Paralympics, where he clinched the Gold Medal in the Men's High Jump T64 event.

• During the Paris 2024 games, he set a new Asian Record by clearing a height of 2.08 meters, securing his second consecutive Paralympic medal after winning Silver at the Tokyo 2020 Paralympics.

• His selection was recommended by the National Sports Awards committee, overseen by the Ministry of Youth Affairs and Sports, making him the only recipient of the Khel Ratna for this cycle. Hence, the correct answer is Praveen Kumar.

Additional Information

• Major Dhyan Chand Khel Ratna Award:

• It is the highest sporting honor of the Republic of India, awarded annually by the Ministry of Youth Affairs and Sports.

• The award was formerly known as the Rajiv Gandhi Khel Ratna Award before being renamed in August 2021 in honor of the hockey legend Major Dhyan Chand.

• Recipients receive a medallion, a certificate, and a substantial cash prize of Rs. 25 lakh.

• It is awarded for "spectacular and most outstanding performance in the field of sports over a period of four years" at the international level.

• National Sports Awards:

• This umbrella of awards includes the Arjuna Award (for consistent outstanding performance), the Dronacharya Award (for eminent coaches), and the Dhyan Chand Award for Lifetime Achievement.

• Traditionally, these awards are presented on August 29, which is National Sports Day, marking the birth anniversary of Major Dhyan Chand, though the ceremony date can be adjusted based on the international sports calendar.

Important Points

• Other Nominees and Awardees:

• Preeti Pal: A brilliant para-athlete who became the first Indian woman to win two medals (both Bronze) in track events at a single Paralympics (Paris 2024). She was honored with the Arjuna Award for 2024.

• Ajeet Singh: A prominent para-javelin thrower who won the Silver Medal at the Paris 2024 Paralympics in the F46 category. He was also a recipient of the Arjuna Award in January 2025.

• Subhash Rana: A renowned shooting coach who has played a pivotal role in mentoring several para-shooters to international success, often associated with the Dronacharya Award discussions for his contribution to Indian para-sports.

• Selection Process:

• The awardees are selected by a committee comprising retired judges, former Khel Ratna winners, and sports journalists

appointed by the Government of India.

• The performance of athletes in the Olympic/Paralympic Games, Asian Games, and Commonwealth Games carries the highest weightage in the selection criteria.

Q100. Answer: (b) The Maldives

The correct answer is The Maldives.

Key Points

• The joint Humanitarian Assistance and Disaster Relief (HADR) exercise between India and The Maldives was successfully conducted in May 2025 to enhance collaborative efforts in crisis management.

• The exercise aimed to strengthen the interoperability and functional coordination between the Indian Navy, the Indian Coast Guard, and the Maldives National Defence Force (MNDF).

• This engagement is a significant component of India's SAGAR (Security and Growth for All in the Region) vision, which focuses on cooperative security and capacity building in the Indian Ocean Region (IOR).

• During the drills, both nations practiced Search and Rescue (SAR) operations, medical evacuations (MEDEVAC), and the rapid deployment of relief materials to simulate responses to natural calamities like cyclones and tsunamis.

• The May 2025 exercise underscores India's role as a First Responder in the region, providing immediate assistance to its neighbors during times of distress.

Additional Information

• Bilateral Defense Cooperation:

• India and The Maldives maintain a robust defense relationship. India provides 70% of the Maldives National Defence Force's (MNDF) training requirements.

• Operation Cactus (1988): The Indian Armed Forces assisted the Government of Maldives in neutralizing a coup attempt, cementing the foundation of modern security ties.

• Exercise Ekuverin: This is a bilateral joint military exercise conducted annually between the Indian Army and the MNDF since 2009. The term "Ekuverin" means "Friends" in the Dhivehi language.

• Humanitarian Operations:

• Operation Neer (2014): India provided immediate drinking water relief to Male during a major water crisis caused by a fire in the city's desalination plant.

• Operation Sanjeevani (2020): India airlifted 6.2 tonnes of essential medicines and hospital consumables to the Maldives during the COVID-19 pandemic.

• Regional Mechanisms:

• Exercise Dosti: A trilateral coast guard exercise involving India, The Maldives, and Sri Lanka that focuses on maritime safety, security, and pollution control.

• Colombo Security Conclave (CSC): Both nations are founding members of this regional security grouping aimed at ensuring maritime security and countering transnational crimes.

• Strategic Significance:

• The Maldives is located at the crossroads of critical Sea Lines of Communication (SLOCs) in the Indian Ocean, making its stability vital for India's national security and economic interests.

Important Points

• SAGAR Initiative: Launched in 2015, this policy is India's strategic framework for the Indian Ocean, emphasizing blue economy cooperation and disaster resilience.

• Dhivehi: This is the official language of the Maldives, and it shares linguistic roots with several Indo-Aryan languages found in India.

• Geography: The Maldives consists of an archipelago of 1,192 coral islands, grouped into 26 atolls, making it one of the world's most vulnerable countries to climate change and sea-level rise.

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