RRB Group D Official Paper (Held On: 09 Feb, 2026 Shift 1) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of the following quantities determines the magnitude of the buoyant force on a body?

(a) Surface area of the body
(b) Weight of the body
(c) Density of the fluid and volume displaced
(d) Temperature of the fluid

Q2. The SI unit of average speed is:

(a) km/hr
(b) m/s^2
(c) cm/s
(d) m/s

Q3. If the distance-time graph of an object is a straight line parallel to the time axis, what is the object's speed?

(a) Uniform
(b) Increasing
(c) Non-zero constant
(d) Zero

Q4. Which of the following salts will have a pH close to 7 when dissolved in water?

(a) Na2CO3
(b) NaCl
(c) CH3COONa
(d) NH4Cl

Q5. Which contraceptive method is most appropriate for a couple who wishes to avoid both hormonal and surgical methods?

(a) Inserting a copper-T
(b) Taking oral pills
(c) Using barrier methods like condoms
(d) Natural methods (periodic abstinence)

Q6. Copper reacts with moist carbon dioxide in the air and slowly loses its shiny brown surface and gains a _____ colour coating of basic copper carbonate.

(a) green
(b) reddish brown
(c) black
(d) white

Q7. What is the advantage of cross-breeding local and exotic cattle breeds?

(a) Lower adaptability to environment
(b) Faster reproduction rate
(c) Higher meat and milk yield
(d) Denser wool yield

Q8. In electrolytic refining, the impure metal is used as the:

(a) separator
(b) anode
(c) cathode
(d) electrolyte

Q9. A girl clapped her hands near a cliff and heard the echo after 8 s. What is the distance of the cliff from the girl if the speed of the sound is taken as 320 m s^(-1) ?

(a) 80 m
(b) 320 m
(c) 1280 m
(d) 640 m

Q10. Which of the following best explains the division of labour seen in multicellular organisms?

(a) Each body part is made up of a single cell
(b) Multicellular organisms have only one type of cell
(c) All cells perform the same function in an organism
(d) Different cells have specialized functions

Q11. The concentration of H^+ ions in a solution primarily determines its:

(a) Rate of solid crystal formation
(b) Degree of acidity in aqueous phase
(c) Extent of metallic bonding strength
(d) Level of gas compressibility factor

Q12. Arrange the following in the correct sequences of development after fertilisation in humans.

Embryo, Zygote and Foetus

(a) Foetus - Embryo - Zygote
(b) Zygote - Foetus - Embryo
(c) Embryo - Foetus - Zygote
(d) Zygote - Embryo - Foetus

Q13. Two children of the same parents resemble each other but are not exactly alike because _____.

(a) they show different combinations of the genetic variation existing in their parents
(b) their parents show very little genetic variation
(c) each of them shows variation in their DNA copying mechanisms
(d) each of them inherits all genetic characters from one parent only

Q14. What type of image is always formed by a concave lens, no matter where the object is placed?

(a) Virtual, inverted, and enlarged
(b) Real, erect, and same size
(c) Virtual, erect, and diminished
(d) Real, inverted, and enlarged

Q15. Which of the following circuit elements is used to vary the amount of current following through a closed circuit?

(a) Plug key
(b) Ammeter
(c) Rheostat
(d) Voltmeter

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Q16. Which of the following plants is a weed?

(a) Pisum sativum
(b) Oryza sativa
(c) Cyperus rotundus
(d) Vigna unguiculata

Q17. How is the change in Gravitational Potential Energy (Δ PE_g) of a system related to the work (W_g) done by the gravitational force?

(a) W_g = 0
(b) W_g = -Δ PE_g
(c) The two are unrelated
(d) W_g = Δ PE_g

Q18. A compound is a substance in which elements are:

(a) Easily separable
(b) Physically mixed in any ratio
(c) Mixed temporarily
(d) Chemically combined in fixed proportion

Q19. Corrosion of iron is commonly known as rusting, and it requires:

(a) moisture and high acidity
(b) water and atmospheric oxygen
(c) iron and very cold temperatures
(d) salt and strong acid presence

Q20. The law of conservation of mass states that:

(a) Matter can be created in reactions
(b) Mass always decreases during a reaction
(c) Mass can neither be created nor destroyed in a chemical reaction
(d) Matter can be destroyed during reactions

Q21. What is the method of removal of metabolic waste in many unicellular organisms?

(a) Through a simple diffusion process
(b) Through filtration through kidneys
(c) Through the use of special organs
(d) Through osmosis

Q22. If the current in a straight conductor is doubled, the magnetic field at a given distance from it:

(a) Halves
(b) Remains the same
(c) Doubles
(d) Becomes zero

Q23. Which statement best describes the Law of Constant Proportion of the compound water?

(a) The properties of compounds are the same as those of elements.
(b) A chemical compound always contains the same elements combined in a fixed ratio by mass.
(c) Elements combine in any ratio to form compounds.
(d) The total mass of products is always greater than reactants in a reaction.

Q24. The random wavering or flickering of objects viewed through a turbulent stream of hot air rising above a fire or radiator is an effect of _____.

(a) Heat radiation causing visual distortion
(b) Diffraction of light
(c) Tyndall effect
(d) Atmospheric refraction on a small scale

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Q25. A decrease in oxygen availability in the environment is most likely to first impact which step of aerobic respiration in animal cells?

(a) Lactic acid fermentation
(b) Krebs cycle
(c) Glycolysis
(d) Electron transport chain

MATHEMATICS

Q26. An 11-digit number 8732326687X is divisible by 18. What is the value of X?

(a) 5
(b) 3
(c) 2
(d) 1

Q27. A runs 5over 2 times as fast as B. If A gives B a start of 80 meters, how far from A′s starting point should the winning post be so that A and B reach it at the same time?

(a) 1331/3 m
(b) 170 m
(c) 1812/3 m
(d) 176 m

Q28. The angle of elevation of the top of a tower from a point on the ground 48 m from the foot of the tower is 30°. Find the height of the tower in metres.

(a) 16√3
(b) 12√3
(c) 4√3
(d) 14√3

Q29. What is the L.C.M. of 45, 63 and 81?

(a) 2545
(b) 2455
(c) 2385
(d) 2835

Q30. A shopkeeper marks an article at Rs. x and offers a discount of 54% on the marked price. He sells it for Rs. 437 after charging VAT of 52% on the discounted price. What is the value of x?

(a) 600
(b) 200
(c) 500
(d) 625

Q31. By how much is 60% of 45 greater than 1/5 of 45?

(a) 12
(b) 16
(c) 15
(d) 18

Q32. The average price of three items of furniture is Rs. 16,425. If their prices are in the ratio 3 : 5 : 7, the price of the costliest item (in Rs.) will be:

(a) 9,855
(b) 22,995
(c) 5,475
(d) 7,665

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Q33. The volume of a solid cylinder is 2926 cm^3 and its height is 19 cm. What is the total surface area of the solid cylinder?

(Use π = 22/7)

(a) 1121 cm2
(b) 1144 cm2
(c) 1175 cm2
(d) 1106 cm2

Q34. Find the single discount equivalent to two successive discounts of 5% and 8%.

(a) 10.8%
(b) 12.6%
(c) 14.63%
(d) 14.67%

Q35. The average of 6.5, 10.7, 20.2 and a is 17. The value of a is:

(a) 32.6
(b) 29.6
(c) 31.6
(d) 30.6

Q36. Rs. 8,442 is divided among S, B, and C in such a way that if Rs. 7, Rs. 73, and Rs. 68 be deducted from their respective shares, they have money in the ratio 6 : 7 : 16. Find the difference between the B's and C's original shares.

(a) Rs. 2,524
(b) Rs. 2,674
(c) Rs. 2,624
(d) Rs. 2,569

Q37. The cost of 4 keychains and 3 wallets is Rs. 75. The cost of 2 keychains and 2 wallets is Rs. 48.

What is the cost of 3 keychains and 1 wallet?

(a) Rs. 32
(b) Rs. 24
(c) Rs. 30
(d) Rs. 34

Q38. The ratio of the present ages of two friends, A and B, is 3:4. Four years ago, the ratio of their ages was 7:10. Find their present ages.

(a) 12 years and 16 years
(b) 21 years and 28 years
(c) 18 years and 24 years
(d) 15 years and 20 years

Q39. A store originally sold a jacket for Rs. 120. After a 15% increase in price, what is the new price of the jacket?

(a) Rs. 138
(b) Rs. 18
(c) Rs. 120
(d) Rs. 102

Q40. The volume (in m^3) of a cube with edges of 19 m is:

(a) 6957
(b) 6748
(c) 6696
(d) 6859

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Q41. A sold an article to B at a loss of 12%. B sold it to C at a profit of 20%. If C paid Rs. 1,122 to B, find the cost price of the article for A.

(a) Rs. 999.70
(b) Rs. 1,062.50
(c) Rs. 1,038.80
(d) Rs. 985.30

Q42. The compound interest on Rs. 5,625 for 6 months at 16% per annum, interest being compounded quarterly is:

(a) Rs. 459
(b) Rs. 746
(c) Rs. 702
(d) Rs. 955

Q43. Simplify $(6pq + 14q)^2 - (6pq - 14q)^2$.

(a) 168p2q2
(b) 168pq2
(c) 336pq2
(d) 336p2q

Q44. If the numerator of a fraction is increased by 25% and the denominator is decreased by 9%, the value of new fraction becomes 5/7. Which of the following is the correct statement w.r.t. the original fraction?

(a) The difference between denominator and numerator is 12
(b) The sum of numerator and denominator is 37
(c) The numerator is greater than denominator by 10
(d) The value of denominator is 13

Q45. Arman runs 8.8 km in 1 hour 20 minutes. How long will he take to run 26.4 km at double the previous speed?3797

(a) 23/4 hours
(b) 2 hours
(c) 3 hours
(d) 11/2 hours

Q46. Solve the following.

$[1/6 \times \{(36 \div 6) + (9 \div 3) - 3\} + 18]$

(a) 23
(b) 26
(c) 20
(d) 19

Q47. If the ages of 2 members of a family are in the ratio 6:1, and the average of their ages is 35 years. Find the total of their ages after 11 years.

(a) 92 years
(b) 82 years
(c) 88 years
(d) 83 years

Q48. A field is in the shape of a quadrilateral. One of its diagonals is 10 m long. The perpendicular distances from the other two vertices to this diagonal are 12 m and 13 m, respectively. What is the area of the field?

(a) 125 m^2
(b) 100 m^2
(c) 130 m^2
(d) 110 m^2

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Q49. P and Q together can fill a cistern with water in 8 hours. If P alone can fill the cistern with water in 20 hours, then in how many hours will Q alone fill three-fourth of the same cistern with water?1241

(a) 21
(b) 10
(c) 11
(d) 20

Q50. Three people, X, Y and Z, are working together to plant trees in a garden. X and Y together can complete the job in 20 days. Y and Z together can complete the job in 24 days. Z and X together can complete the job in 30 days.

How long will it take for X, Y and Z working together to complete the job?3212

(a) 16 days
(b) 18 days
(c) 14 days
(d) 12 days

GENERAL INTELLIGENCE & REASONING

Q51. What should come in place of the question mark (?) in the given series?

173 166 159 152 145 ?

(a) 139
(b) 138
(c) 137
(d) 136

Q52. What will come in the place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

97 − 46 + 12 ÷ 8 × 2 = ?

(a) 95
(b) 97
(c) 99
(d) 102

Q53. Mr. Apso starts from point A and drives 7 km towards north. He then takes a right turn, drives 4 km, turns right and drives 9 km. He then takes a right turn and drives 8 km. He takes a final right turn, drives 2 km and stops at point P. How far (shortest distance) and towards which direction should he drive in order to reach point A again? (All turns are 90-degree turns only unless specified.) 474

(a) 4 km to the east
(b) 2 km to the west
(c) 5 km to the east
(d) 3 km to the west

Q54. Each of the digits in the number 7231456 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) Two
(b) None
(c) Three
(d) One

Q55. In a certain code language, 'chase clouds away' is coded as 'hl mt dv' and 'clouds block sun' is coded as 'ya co hl'. How is 'clouds' coded in the given language?

(a) hl
(b) mt
(c) dv
(d) ya

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Q56. RUOT is related to VYSX in a certain way based on the English alphabetical order. In the same way, MPJO is related to QTNS. To which of the given options is HKEJ related, following the same logic?

(a) LOIM
(b) LPIM
(c) LOIN
(d) LPIN

Q57. Seven people, N, O, P, Q, R, S and T are sitting in a straight row, facing north. Only four people sit to the right of S. T sits second to the left of N. R sits fourth to the left of P. Q sits to the immediate right of S. Who sits at the extreme left end of the line?

(a) Q
(b) R
(c) T
(d) O

Q58. Based on the English alphabetical order, three of the following four are alike in a certain way and thus form a group. Which is the one that does not belong to that group?

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

(a) JOR
(b) GKN
(c) TXA
(d) YCF

Q59. In a row of 55 people facing north, Tanmay sits 18^(th) from the left end. If only 17 people sit between Yash and Tanmay, then what is Yash's position from the right end of the row?

(a) 20th
(b) 21st
(c) 18th
(d) 19th

Q60. This question is based on the five, three-digit numbers given below.

(Left) 687 652 691 287 286 (Right)

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

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

What will be the resultant if the second digit of the highest number is added to the third digit of the lowest number?2425

(a) 15
(b) 17
(c) 16
(d) 19

Q61. EADI is related to KGJO in a certain way based on the English alphabetical order. In the same way, IEHM is related to OKNS. To which of the following is MILQ related to, following the same logic?

(a) SORW
(b) SPRW
(c) SORX
(d) SPRX

Q62. VTQS is related to PNKM in a certain way. In the same way, PMKF is related to JGEZ. To which of the given options is ROLG related, following the same logic?

(a) LIFA
(b) LJEB
(c) MJEM
(d) MIFA

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Q63. In a certain code language, ‘FIRM’ is coded as ‘5713’ and ‘MEAN’ is coded as ‘2148’. What is the code for ‘M’ in the given code language?

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

Q64. T, U, V, W, X and Y are sitting around a circular table facing the centre. Y is an immediate neighbour of both T and V. U is sitting to the immediate right of V. W is sitting second to the left of Y. How many people sit between X and Y when counted from the right of X?

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

Q65. In a row of 85 students facing north, Rohan’s position is 35th from the left and Shekhar’s position is 25th from the right. Kuldeep is sitting exactly between both of them. Find the position of Kuldeep from Rohan when counted to the right of Rohan.

(a) 14th
(b) 12th
(c) 15th
(d) 13th

Q66. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only.)

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

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

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

Q67. 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.)

(14 280 5)

(7 336 12)

(a) 12 578 10
(b) 18 876 9
(c) 13 992 11
(d) 21 336 4

Q68. Refer to the following letter series and answer the question.

(Left) M R Y T O N B F W A H L D X G Z J Q V E P K (Right)

How many vowels are there in the above series?5696

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

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Q69. 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 from commonly known facts, decide which of the given conclusion(s) logically follow(s) from the statements.

Statements: All cushions are pillows. No pillow is a blanket. Some blankets are envelopes.

Conclusion I: Some envelopes are pillows.

Conclusion II: No cushion is a blanket.

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

Q70. This question is based on the five, three-digit numbers given below.

(Left) 423 253 174 324 749 (Right)

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

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

If 2 is added to the first digit of every number, in how many numbers will the first digit be exactly divisible by the second digit?15147

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

Q71. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

MJB 9, QNF 16, URJ 23, YVN 30, ?9648

(a) AYR 37
(b) CYR 42
(c) CZR 37
(d) BZS 36

Q72. In a certain code language,

A + B means ‘A is the son of B’,

A - B means ‘A is the brother of B’,

A x B means ‘A is the wife of B’, and

A ÷ B means ‘A is the father of B’.

Based on the above, how is D related to J if ‘D ÷ F x G + H - J’?

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

Q73. Based on the alphabetical order, three of the following four are alike in a certain way and thus form a group. Which is the one that does not belong to that group?

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

(a) TSQ
(b) ONL
(c) BAY
(d) GFE

Q74. What should come in place of ? in the given series in order to make it logically complete?

JF125 KE64 MC27 PZ8 ?3863

(a) TV8
(b) SV1

(c) TV1
(d) TW1

Q75. What should come in place of '?' in the given series?

158 171 186 204 226 ?

(a) 249
(b) 255
(c) 253
(d) 251

Q76. Find out the correct alternative that when filled in the blanks in the same sequence will make the series logically complete.

BA_C F_HG _ILK NM_O R_TS

(a) DIJPQ
(b) DEJPP
(c) DEJPQ
(d) DELPQ

Q77. A,B,C,D,E,F and G are sitting in a straight line facing North.

Only E sits to the left of B. Only four people sit between E and C. Only G sits between F and D and F is not an immediate neighbor of C.

How many people sit to the right of D?

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

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

99 ÷ 3 − 15 ÷ 5 + 156 × 2 − 12 × 4 − 16 ÷ 8 + 11 = ?

(a) 361
(b) 390
(c) 414
(d) 449

Q79. What should come in place of the question mark (?) in the given series?

79 83 92 108 133?

(a) 168
(b) 171
(c) 170
(d) 169

Q80. Read the given statements and conclusions carefully. You have to take the given statements to be true even if they seem to be at variance from commonly known facts. You have to decide which conclusion/s logically follow/s from the given statements.

Statements: All lotions are creams. All creams are shampoos. No cream is a facewash.

Conclusion (I) : No shampoo is a facewash.

Conclusion (II) : No lotion is a facewash.

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

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GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. What major reform did the Government of India implement to simplify workers' rights and labour law compliance in 2025?

(a) Merger of 29 labour laws into four Labour Codes
(b) Expansion of the Minimum Wages Act only
(c) Elimination of trade unions and withdrawal of their legal recognition
(d) Introduction of universal basic income

Q82. Who among the following was appointed as the Chief Justice of India with effect from 24 November 2025?

(a) Justice D.Y. Chandrachud
(b) Justice Sanjiv Khanna
(c) Justice B.R. Gavai
(d) Justice Surya Kant

Q83. Which Indian state finished at the top of the medal tally in the Khelo India Para Games 2025?

(a) Tamil Nadu
(b) Haryana
(c) Maharashtra
(d) Uttar Pradesh

Q84. The National Frequency Allocation Plan, 2025 (NFAP-2025) primarily deals with the allocation of which of the following?

(a) Postal codes
(b) Railway land-use frequencies
(c) Electric vehicle charging bands
(d) Radio-frequency spectrum

Q85. In 2025, which legendary Indian cricketer was inducted into the ICC Hall of Fame along with Matthew Hayden and Hashim Amla?

(a) Virat Kohli
(b) MS Dhoni
(c) Sourav Ganguly
(d) Rahul Dravid

Q86. What is the maximum financial support provided for new construction of a tribal homestay unit under the Swadesh Darshan Scheme in April 2025?

(a) Rs. 4 Lakh
(b) Rs. 5 Lakh
(c) Rs. 7 Lakh
(d) Rs. 3 Lakh

Q87. The DRAVYA portal, launched in 2025 as a digital knowledge repository for medicinal substances, was initiated by which ministry?

(a) Ministry of Biotechnology
(b) Ministry of Ayush
(c) Ministry of Pharmaceuticals
(d) Ministry of Education

Q88. What is the role of the Centralised Information Management System (CIMS) which was available to the regulated entities (REs) on or before May 13, 2025?

(a) Tracking mobile apps
(b) Managing digital data
(c) Filing complaints online
(d) Monitoring tax payments

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Q89. Which types of equipment were included in the new defence acquisitions approved by India's Defence Acquisition Council in 2025?

(a) Amphibious warships, missiles and swarm drones
(b) Aircraft carriers and long-range cruise missiles
(c) Submarines and satellite-based surveillance systems
(d) Stealth fighter jets and hypersonic glide vehicles

Q90. Who among the following is known affectionately as "Bihar Kokila" and "Swar Kokila"?

(a) Sharda Sinha
(b) Chandan
(c) Bharat Byas
(d) Payal Singh

Q91. In October 2025, which of the following cities of Vietnam hosted the high-level signing ceremony of the United Nations Convention against Cybercrime, where 72 UN member states signed the deal?

(a) Can Tho
(b) Vinh
(c) Dalat
(d) Hanoi

Q92. Who was awarded the Sahitya Akademi Award 2024 for his book "Ik Hor Ashwthama" in the Dogri language?

(a) Chaman Arora
(b) Shiv Kumar Batalvi
(c) Jaswant Singh
(d) Dalip Kaur Tiwana

Q93. The 9th Asian Winter Games were held in February, 2025, with athletes from 34 countries, in:

(a) Uzbekistan
(b) China
(c) Qatar
(d) Kyrgystan

Q94. Which javelin thrower became the first from India to throw beyond 90 m internationally in May 2025?

(a) Shivpal Singh
(b) Abdul Khaliq
(c) Neeraj Chopra
(d) Sachin Yadav

Q95. Which of the following ranked as the top national park, with a score of 92.7%, in the Union Environment Ministry's Management Effectiveness Evaluation for the 2020-25 cycle?

(a) Eravikulam National Park
(b) Bandipur National Park
(c) Kanha National Park
(d) Manas National Park

Q96. The Right to Disconnect Bill, 2025, seeks to establish which principle in the modern digital workplace?

(a) Employer control over digital platforms
(b) Clear work–life boundaries
(c) Uniform labour laws
(d) Mandatory overtime compensation

Q97. What percentage of districts in the North Eastern Region showed an increase in their composite SDG Index score as per the second edition of the North Eastern Region (NER) District Sustainable Development Goals (SDG) Index Report (2023-24) released by NITI Aayog in July 2025?

(a) 0.85

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(b) 0.75
(c) 0.65
(d) 0.95

Q98. At which event did the Vice-President of India, C. P. Radhakrishnan, deliver an inaugural address emphasizing that climate action is an opportunity, not a constraint?
(a) Bharat Climate Forum 2026
(b) India Energy Summit 2026
(c) International Solar Alliance Meet 2026
(d) Global Green Growth Forum 2026

Q99. During the August 2025 Monetary Policy Committee (MPC) review, what revision did the Reserve Bank of India (RBI) make to its inflation forecast for FY 2025-26?
(a) Slashed sharply to 2.5%
(b) Revised upward to 4.5%
(c) Lowered to 3.1%
(d) Kept unchanged at 3.7%

Q100. Which landmark treaty was adopted by WHO member states on 20 May 2025, aiming to strengthen global pandemic preparedness?
(a) WHO Pandemic Agreement
(b) Global Health Security Pact
(c) Global Vaccine Agreement
(d) International Health Regulations (IHR)

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (c) Density of the fluid and volume displaced

The correct answer is Density of the fluid and volume displaced.

Key Points

• Archimedes' Principle states that when a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.

• The magnitude of the buoyant force (also known as upthrust) is determined by the formula: $F = \rho \times V \times g$, where ρ (rho) is the density of the fluid, V is the volume of the displaced fluid, and g is the acceleration due to gravity.

• The surface area of the body does not affect the magnitude of the buoyant force directly; only the submerged volume matters. Hence, option 1 is incorrect.

• The weight of the body determines whether the object will sink or float when compared to the buoyant force, but it does not determine the magnitude of the buoyant force itself. Hence, option 2 is incorrect.

• The density of the fluid and the volume of the displaced fluid are the primary physical quantities that define how much upward

force is exerted. Hence, option 3 is correct.

• The temperature of the fluid can indirectly affect buoyancy by changing the fluid's density, but it is not a direct variable in the primary buoyancy equation. Hence, option 4 is incorrect.

Additional Information

• Buoyancy is the tendency of a fluid to exert an upward force on an object placed in it. This phenomenon is why objects feel lighter when submerged in water.

• Factors affecting Buoyant Force:

• Volume of the object submerged: As the volume of the solid submerged in the liquid increases, the buoyant force increases. Once the object is completely immersed, the force remains constant.

• Density of the liquid: A liquid with a higher density exerts more buoyant force than a liquid with a lower density. For example, it is easier to float in seawater (higher density) than in freshwater.

• Applications of Buoyancy:

• Ships and Submarines: Large ships are designed with hollow hulls to displace a massive volume of water, generating enough buoyant force to counteract their weight.

• Hot Air Balloons: The density of the hot air inside the balloon is less than the density of the surrounding cool air, creating an upward buoyant force that allows it to rise.

• Hydrometers: These are instruments used to measure the density or specific gravity of liquids based on the concept of buoyancy.

Important Points

• Conditions for Floating and Sinking:

• If the Buoyant Force is greater than the Weight of the object, the object will rise and float.

• If the Buoyant Force is equal to the Weight of the object, the object remains suspended in the fluid.

• If the Buoyant Force is less than the Weight of the object, the object will sink.

• Apparent Weight: When an object is in a fluid, its weight appears to be less than its actual weight in air. This is because the buoyant force acts in the opposite direction to gravity. Apparent Weight = Actual Weight - Buoyant Force.

• The concept of buoyancy was discovered by Archimedes of Syracuse in the 3rd century BC.

Q2. Answer: (d) m/s

The correct answer is m/s.

Key Points

• Average speed is defined as the total distance traveled by an object divided by the total time elapsed to cover that distance.

• In the International System of Units (SI), the standard unit for length (distance) is the meter (m) and the standard unit for time is the second (s).

• Since speed is the ratio of distance to time, its derived SI unit is meters per second, mathematically expressed as m/s or ms^-¹. Hence, option 4 is correct.

• The unit km/hr (kilometers per hour) is a practical unit often used in vehicles and daily transport, but it is not the standard SI unit. Hence, statement 1 is incorrect in the context of SI units.

• The unit m/s² represents acceleration, which measures the rate of change of velocity over time. Hence, statement 2 is incorrect.

• The unit cm/s (centimeters per second) belongs to the CGS (Centimeter-Gram-Second) system of units, not the SI system. Hence, statement 3 is incorrect.

Additional Information

• Scalar Quantity: Average speed is a scalar quantity, meaning it only has magnitude and no specific direction. Unlike velocity, it does not account for the displacement or the path's direction.

• Dimensional Formula: The dimensional formula for speed is [M^0 L¹ T^-¹]. This indicates that speed depends on length (L) and inverse time (T), with no dependence on mass (M).

• Unit Conversion: It is frequently necessary to convert between different units of speed. To convert from km/hr to m/s, we multiply by a factor of 5/18 (since 1000m / 3600s = 5/18). Conversely, to convert m/s to km/hr, we multiply by 18/5.

• Instantaneous Speed vs. Average Speed: While average speed looks at the entire journey, instantaneous speed refers to the speed of an object at a specific moment in time, often measured by a speedometer in a car.

Important Points

• Distance vs. Displacement: It is important to distinguish between speed and velocity. Average speed uses total distance, whereas average velocity is calculated using total displacement divided by total time.

• Uniform Motion: If an object covers equal distances in equal intervals of time, it is said to be in uniform motion, and its instantaneous speed will be equal to its average speed throughout the journey.

• Mathematical Expression: The formula for average speed is written as: v = Δd / Δt, where v is the average speed, Δd is the total

distance, and Δt is the total time taken.

Q3. Answer: (d) Zero

The correct answer is Zero.

Key Points

• A distance-time graph is a graphical representation used in physics to show how the distance traveled by an object changes with respect to time. The time is usually plotted on the X-axis and the distance is plotted on the Y-axis.

• When the distance-time graph is a straight line parallel to the time axis, it implies that the distance value on the Y-axis does not change even as time (on the X-axis) continues to increase.

• The slope of a distance-time graph represents the speed of the object. Mathematically, the slope is calculated as the change in distance divided by the change in time (Speed = Δd / Δt).

• In the case of a horizontal line, the change in distance (Δd) is 0. Therefore, the speed of the object is 0 divided by the change in time, which results in a speed of Zero.

• This state indicates that the object is stationary or at rest. It is located at a specific position away from the origin, but its position does not shift over time. Hence, the correct answer is Zero.

Additional Information

• Uniform Speed:

• If the distance-time graph is a straight line passing through the origin with a specific inclination (slope), it represents Uniform Speed.

• In this scenario, the object covers equal distances in equal intervals of time. The speed remains constant and non-zero throughout the motion.

• Non-Uniform Speed (Acceleration):

• If the distance-time graph is a curve (such as a parabola), it represents non-uniform motion.

• A curve indicates that the speed of the object is changing at every point in time, meaning the object is either accelerating or decelerating.

• Comparison with Velocity-Time Graph:

• It is crucial to distinguish between different types of motion graphs. In a velocity-time graph, a straight line parallel to the time axis represents constant velocity (where acceleration is zero), not zero speed.

• However, in a distance-time graph, that same horizontal line strictly means the object is not moving.

• Physical Significance of the Origin:

• The origin (0,0) typically represents the starting point or the reference point from which measurement begins.

• If the horizontal line is exactly on the time axis (where distance = 0), the object is at rest at the reference point itself. If the line is above the axis, the object is at rest at a certain fixed distance from the reference point.

Important Points

• Scalar vs Vector: Distance is a scalar quantity, and speed is the magnitude of velocity. Because distance can never decrease over time, a distance-time graph can never have a negative slope (it cannot go downwards).

• Slope Analysis: The steeper the slope of the line in a distance-time graph, the higher the speed of the object. A vertical line (parallel to the distance axis) is physically impossible, as it would imply infinite speed (covering distance in zero time).

• Calculation: To find the speed from a linear graph, pick two points (t1, d1) and (t2, d2) and use the formula v = (d2 - d1) / (t2 - t1). For a horizontal line, d2 always equals d1, making the numerator zero.

Q4. Answer: (b) NaCl

The correct answer is NaCl.

Key Points

• Sodium Chloride (NaCl) is a neutral salt formed by the neutralization reaction between a strong acid and a strong base.

• It is synthesized from Hydrochloric acid (HCl), which is a strong acid, and Sodium hydroxide (NaOH), which is a strong base.

• When NaCl is dissolved in water, it dissociates completely into its constituent ions, Na+ and Cl-. Neither of these ions reacts significantly with water (hydrolysis) to produce excess H+ or OH- ions.

• Because there is no significant hydrolysis, the concentration of hydrogen ions and hydroxide ions remains balanced, resulting in a pH of approximately 7 at 25 degrees Celsius. Hence, the statement regarding NaCl is correct.

• The pH scale measures the acidity or alkalinity of a solution, where 7 is considered neutral, values below 7 are acidic, and values above 7 are basic.

Additional Information

• Sodium Carbonate (Na2CO3):

• This salt is formed from a strong base (NaOH) and a weak acid (H2CO3 - Carbonic acid).

• In an aqueous solution, the carbonate ion (CO3 2-) undergoes hydrolysis to produce hydroxide ions (OH-).

• Consequently, the solution becomes basic, and the pH is greater than 7. Hence, the option Na2CO3 is incorrect for a pH of 7.

• Sodium Acetate (CH3COONa):

• It is the product of a strong base (NaOH) and a weak acid (CH3COOH - Acetic acid).

• The acetate ion (CH3COO-) reacts with water to form acetic acid and hydroxide ions.

• This increases the OH- concentration, making the solution alkaline with a pH typically around 8.9. Hence, the option CH3COONa is incorrect.

• Ammonium Chloride (NH4Cl):

• This salt is formed from a weak base (NH4OH - Ammonium hydroxide) and a strong acid (HCl).

• The ammonium ion (NH4+) undergoes hydrolysis in water, releasing H+ ions into the solution.

• This makes the resulting solution acidic, with a pH usually between 4.5 and 6.0. Hence, the option NH4Cl is incorrect.

Important Points

• Salt Hydrolysis: This is a chemical reaction in which the cations or anions of a salt react with water to affect the pH of the solution.

• Strong Electrolytes: Salts like NaCl are strong electrolytes that ionize completely in water.

• Predicting pH:

• Strong Acid + Strong Base = Neutral Solution (pH = 7).

• Strong Acid + Weak Base = Acidic Solution (pH < 7).

• Weak Acid + Strong Base = Basic Solution (pH > 7).

• Weak Acid + Weak Base = pH depends on the relative strengths of the acid and base.

• Year and Context: The understanding of acids and bases was significantly advanced by the Arrhenius theory in the late 19th century and later by the Bronsted-Lowry and Lewis definitions in the early 20th century (around 1923).

Q5. Answer: (c) Using barrier methods like condoms

The correct answer is Using barrier methods like condoms.

Key Points

• Barrier methods are a category of contraception that prevents pregnancy by physically blocking the sperm from reaching and fertilizing the egg.

• Condoms are the most common type of barrier method and are made of thin latex or polyurethane sheaths. They are highly effective when used correctly and do not require any hormonal alterations to the body or surgical procedures like vasectomy or tubectomy. Hence, statement 3 is correct.

• Unlike intrauterine devices (IUDs) or pills, barrier methods are used only during sexual intercourse, making them a "user-dependent" but non-invasive choice for couples.

• A unique and critical feature of condoms is their ability to provide protection against Sexually Transmitted Infections (STIs), including HIV/AIDS, which other methods like Copper-T or pills do not offer.

• These methods are easily accessible, do not require a medical prescription in many countries, and have no systemic side effects associated with hormonal imbalances.

Additional Information

• Oral Contraceptive Pills:

• These are hormonal methods that typically contain a combination of estrogen and progesterone.

• They work by inhibiting ovulation (the release of an egg) and altering the cervical mucus to prevent sperm penetration.

• Since the user wishes to avoid hormonal methods, this is not the appropriate choice. Hence, statement 2 is incorrect.

• Copper-T (IUD):

• The Copper-T is an Intrauterine Device inserted into the uterus by a healthcare professional.

• While the standard Copper-T is non-hormonal (it uses copper ions to suppress sperm motility), its insertion is a clinical procedure that some couples may find too invasive, even if it is not classified as a major permanent surgery. However, there are also hormonal IUDs (like LNG-20). Hence, statement 1 is less appropriate compared to condoms for those avoiding all clinical interventions.

• Natural Methods (Periodic Abstinence):

• These involve tracking the menstrual cycle to avoid coitus during the fertile period (usually day 10 to 17 of the cycle).

• While they are non-hormonal and non-surgical, they have a very high failure rate compared to barrier methods due to irregularities in ovulation. Hence, statement 4 is a possible but less reliable method.

• Surgical Methods:

• These include Vasectomy for males and Tubectomy for females.

• They are permanent sterilization techniques that involve cutting or tying the vas deferens or fallopian tubes. Because the couple wishes to avoid surgical methods, these are excluded.

Important Points

• Efficacy: The effectiveness of condoms is approximately 82% to 98% depending on "typical use" versus "perfect use."

• Material: Most condoms are made of latex, but for individuals with latex allergies, options made of polyisoprene or polyurethane are available.

• Dual Protection: Health organizations like the WHO emphasize barrier methods for "dual protection"—preventing both unintended pregnancy and infection transmission.

• Demographics: Barrier methods are widely used in India and globally due to their low cost and privacy.

Q6. Answer: (a) green

The correct answer is green.

Key Points

• Copper is a lustrous, reddish-brown metal that reacts slowly with the environment when exposed to moist air for a prolonged period.

• The metal reacts with moist carbon dioxide and oxygen present in the atmosphere, leading to the formation of a green-colored layer on its surface.

• This green coating is chemically known as basic copper carbonate, which is a mixture of copper carbonate ($CuCO_3$) and copper hydroxide ($Cu(OH)_2$). Hence, the statement regarding the green color is correct.

• The chemical reaction can be represented as: $2Cu + H_2O + CO_2 + O_2 \rightarrow Cu(OH)_2 + CuCO_3$.

• The formation of this layer is a classic example of corrosion, where the metal loses its shiny brown surface and develops a dull finish.

Additional Information

• Corrosion of Silver:

• Silver articles become black after some time when exposed to air.

• This happens because silver reacts with sulphur (often in the form of hydrogen sulphide) in the air to form a coating of silver sulphide (Ag_2S).

• Corrosion of Iron (Rusting):

• When iron is exposed to moist air for a long time, it acquires a coating of a brown flaky substance called rust.

• Chemically, rust is hydrated ferric oxide ($Fe_2O_3.xH_2O$). Unlike the green coating on copper, rust is porous and causes the metal to deteriorate continuously.

• Properties of Copper:

• Copper is an excellent conductor of heat and electricity, making it essential for electrical wiring and cookware.

• It is highly malleable and ductile, allowing it to be drawn into thin wires or beaten into sheets.

• The statue of liberty in the USA is a famous example of copper corrosion; it was originally brown but turned green over decades due to the formation of basic copper carbonate and other salts.

Important Points

• Prevention of Corrosion:

• Corrosion can be prevented by methods such as painting, oiling, greasing, or galvanizing.

• Galvanization is a method of protecting steel and iron from rusting by coating them with a thin layer of zinc.

• Alloying is another very good method of improving the properties of a metal. For example, brass is an alloy of copper and zinc, while bronze is an alloy of copper and tin.

• Chemical Nature:

• The green patina formed on copper is basic in nature. It can often be cleaned using weak acids like citric acid (found in lemon or tamarind), which dissolves the basic copper carbonate.

Q7. Answer: (c) Higher meat and milk yield

The correct answer is Higher meat and milk yield.

Key Points

• Cross-breeding in cattle is the mating of two different breeds—typically an indigenous (local) breed and an exotic (foreign) breed—to produce a hybrid offspring that inherits the desirable traits of both parents.

• The main objective of cross-breeding is to combine the high milk production and long lactation periods of exotic breeds with the disease resistance and heat tolerance of local breeds.

• Exotic breeds like Holstein-Friesian and Jersey are globally recognized for their massive milk yields, often producing significantly more than local tropical breeds.

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• Indigenous breeds such as Sahiwal, Gir, and Red Sindhi possess a natural immunity to local parasites and can thrive in high-temperature environments where exotic breeds might struggle.

• The resulting cross-breed (hybrid) typically shows Hybrid Vigor or Heterosis, leading to higher meat and milk yield compared to the local parent and better environmental survival than the exotic parent. Hence, option 3 is the correct advantage.

• While pure exotic breeds might have Lower adaptability to local harsh environments, cross-breeding actually aims to improve adaptability compared to the pure exotic type. Hence, option 1 is incorrect.

Additional Information

• Exotic Breeds and Origins:

• Holstein-Friesian: Originating from the Netherlands, this breed is the highest milk producer in the world, often yielding over 7,000 to 10,000 liters per lactation cycle.

• Jersey: Native to the Jersey Island in the United Kingdom, these cattle produce milk with a high butterfat content and are smaller in size.

• Brown Swiss: Originating from Switzerland, they are known for being sturdy and having a high milk protein content.

• Indigenous Indian Breeds:

• Sahiwal: Predominantly found in Punjab and Rajasthan, it is considered the best indigenous dairy breed in India.

• Gir: Hailing from the Gir forests of Gujarat, this breed is famous for its tolerance to stress and resistance to various tropical diseases.

• Tharparkar: A dual-purpose breed from the Thar Desert known for its ability to produce milk under drought-like conditions.

• Notable Indian Cross-breeds:

• Karan Fries: Developed at the National Dairy Research Institute (NDRI) in Karnal, Haryana, by crossing Tharparkar with Holstein-Friesian.

• Karan Swiss: Another NDRI success, created by crossing Sahiwal cows with Brown Swiss bulls.

• Frieswal: A cross-breed between Holstein-Friesian and Sahiwal, developed primarily for Military Dairy Farms in India.

Important Points

• Lactation Period: The period during which a cow produces milk after giving birth. Exotic breeds often have a lactation period exceeding 300 to 305 days, whereas local breeds may have shorter cycles.

• Artificial Insemination (AI): A technique widely used in India to facilitate cross-breeding by injecting semen from high-quality exotic bulls into local cows, managed by agencies like the National Dairy Development Board (NDDB).

• Dual-Purpose Breeds: Some cattle are bred for both milk production and draught power (work in fields), such as the Haryana and Ongole breeds.

• Government Initiatives: The Rashtriya Gokul Mission was launched in 2014 to conserve and develop indigenous bovine breeds and improve milk productivity through scientific methods.

Q8. Answer: (b) anode

The correct answer is anode.

Key Points

• Electrolytic refining is one of the most widely used techniques for the purification of impure metals such as Copper, Zinc, Tin, Nickel, Silver, and Gold.

• In this process, a thick block of the impure metal is used as the anode, which is the positively charged electrode. Hence, the correct answer is anode.

• A thin strip of pure metal is used as the cathode, which is the negatively charged electrode.

• The electrolyte used in the process is a water-soluble salt (aqueous solution) of the same metal that is being refined, often acidified to increase conductivity.

• When an electric current is passed through the electrolyte, the impure metal from the anode dissolves into the electrolyte solution in the form of metal ions.

• Simultaneously, an equivalent amount of pure metal from the electrolyte is deposited onto the cathode.

Additional Information

• Mechanism of Refining:

• At the anode, oxidation takes place. The metal atoms lose electrons to become ions: M → M^{n+} + ne−.

• At the cathode, reduction takes place. The metal ions gain electrons to become pure metal atoms: M^{n+} + ne− → M.

• Anode Mud:

• During the process, soluble impurities go into the solution, whereas insoluble impurities settle down at the bottom of the anode.

• These collected impurities are known as anode mud. In the case of Copper refining, the anode mud often contains valuable metals like Antimony, Selenium, Tellurium, Silver, Gold, and Platinum, which helps recover the cost of the refining process.

• Example - Copper Refining:

• To refine Copper (Cu), the anode is made of blister copper (impure).

• The cathode is a thin sheet of pure copper.

• The electrolyte is a solution of Copper Sulphate ($CuSO_4$) acidified with Sulphuric Acid (H_2SO_4).

• This method can achieve a purity level of 99.95% to 99.99%.

• Role of Electrolyte:

• The electrolyte acts as a medium for the transfer of metal ions from the positive electrode to the negative electrode.

• The concentration of the metal ions in the electrolyte remains constant throughout the process because the rate of dissolution at the anode equals the rate of deposition at the cathode.

Important Points

• Voltage Control: The voltage applied during electrolytic refining is carefully controlled to ensure that only the desired metal is deposited at the cathode, leaving other metallic impurities either in the solution or as anode mud.

• Electro-winning vs. Electrolytic Refining: While electrolytic refining purifies a metal from an impure block, electro-winning involves the extraction of metals from their ores or compounds already dissolved in an electrolyte.

• Industrial Use: This process is critical in the electronics industry, where high-conductivity pure copper is required for wiring and integrated circuits.

Q9. Answer: (c) 1280 m

The correct answer is 1280 m.

Key Points

• An echo is the phenomenon of reflection of sound where the sound is heard again after hitting a distant object like a cliff, mountain, or large building.

• When a person claps their hands near a reflecting surface, the sound travels from the source to the surface and then reflects back to the person's ears. Therefore, the total distance covered by the sound wave is twice the distance between the person and the reflecting surface (2d).

• The basic formula for distance in terms of speed and time is: Distance = Speed × Time. In the case of an echo, the formula is modified to $2d = v \times t$, where v is the speed of sound and t is the total time taken for the echo to return.

• In the given problem, the speed of sound (v) is 320 m/s and the time (t) taken for the echo to be heard is 8 s.

• By substituting the values into the formula: $2d = 320 \times 8$. This results in $2d = 2560$ m.

• To find the one-way distance (d) from the girl to the cliff, we divide the total distance by 2: $d = 2560 / 2 = 1280$ m.

• Hence, the correct distance of the cliff from the girl is 1280 m.

Additional Information

• Persistence of Hearing: The sensation of sound remains in the human brain for about 0.1 seconds. To hear a distinct echo, the time interval between the original sound and the reflected sound must be at least 0.1 seconds.

• Minimum Distance for Echo: Based on the persistence of hearing and the speed of sound in air (roughly 344 m/s at room temperature), the minimum distance required between the source and the obstacle to hear an echo is 17.2 meters. If the distance is less than this, the sounds will overlap, a phenomenon known as reverberation.

• Factors Affecting Speed of Sound:

• Temperature: The speed of sound increases with an increase in temperature. For every 1 degree Celsius rise, the speed increases by approximately 0.6 m/s.

• Medium: Sound travels fastest in solids (like steel), slower in liquids (like water), and slowest in gases (like air). This is due to the elasticity and density of the medium.

• Humidity: Moist air is less dense than dry air, which causes sound to travel faster in humid conditions.

• Applications of Reflection: The principle of reflection of sound is used in Stethoscopes, Megaphones, and SONAR (Sound Navigation and Ranging) systems to detect underwater objects or measure the depth of the sea.

Important Points

• Unit of Speed: In scientific calculations, the speed of sound is typically measured in meters per second (m/s). Always ensure units are consistent before performing the calculation.

• Human Audibility Range: The human ear can hear sounds in the frequency range of 20 Hz to 20,000 Hz (20 kHz). Sounds with frequencies below 20 Hz are called infrasonic, and those above 20 kHz are ultrasonic.

• Echo vs. Reverberation: While an echo is a single reflection from a distant object, reverberation is the result of multiple reflections from nearby surfaces, leading to the persistence or "prolonging" of sound in an enclosed space.

• Calculation Tip: When solving echo problems, it is a common mistake to forget to divide the total distance by 2. Always remember that the time recorded is for the round trip of the sound wave.

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Q10. Answer: (d) Different cells have specialized functions

The correct answer is Different cells have specialized functions.

Key Points

• Multicellular organisms are composed of more than one cell, often numbering in the millions or billions. These organisms range from simple forms like fungi and algae to complex forms like plants and animals.

• The concept of division of labour in these organisms refers to the delegation of specific biological tasks to different groups of cells. This means that instead of a single cell performing all life processes, different cells are specialized to carry out specific roles. Hence, statement 4 is correct.

• In multicellular organisms, body parts are not made of a single cell but of vast clusters of cells working together. Hence, statement 1 is incorrect.

• These organisms possess a wide variety of cell types, such as nerve cells, muscle cells, and blood cells, rather than just one type. Hence, statement 2 is incorrect.

• Cells in a complex organism do not perform the same function; for instance, a muscle cell is designed for contraction and movement, while a neuron is designed to transmit electrical impulses. Hence, statement 3 is incorrect.

• The division of labour leads to increased efficiency, allowing the organism to perform complex survival activities simultaneously.

Additional Information

• Levels of Biological Organization:

• Cells: The basic structural and functional unit of life. In multicellular beings, cells undergo differentiation to become specialized.

• Tissues: A group of similar cells that work together to perform a particular function. Examples include connective tissue, epithelial tissue, and vascular tissue in plants.

• Organs: Different types of tissues group together to form an organ, such as the heart, lungs, or stomach, to conduct specific physiological tasks.

• Organ Systems: Multiple organs coordinate to form a system, like the digestive system or the respiratory system.

• Specialization Examples in Humans:

• Red Blood Cells (RBCs): Specialized to transport oxygen throughout the body using hemoglobin.

• White Blood Cells (WBCs): Part of the immune system, specialized to fight infections and foreign pathogens.

• Nerve Cells: Long and branched cells specialized for the rapid conduction of nerve impulses.

• Specialization in Plants:

• Xylem: Specialized tissue for the conduction of water and minerals from roots to leaves.

• Phloem: Specialized for the translocation of food (sucrose) from leaves to other parts of the plant.

• Guard Cells: Specialized cells in the epidermis of leaves that control the opening and closing of stomata for gas exchange.

• Comparison with Unicellular Organisms: In unicellular organisms (like Amoeba or Bacteria), a single cell performs all functions including digestion, respiration, and reproduction. There is no division of labour between cells, though there is a division of labour between organelles within that single cell.

Q11. Answer: (b) Degree of acidity in aqueous phase

The correct answer is Degree of acidity in aqueous phase.

Key Points

• The concentration of Hydrogen ions (H+) is the fundamental factor that determines the acidity of a solution. In an aqueous phase, acids release these ions, and their prevalence defines how acidic the substance is. Hence, statement 2 is correct.

• The rate of solid crystal formation is primarily governed by factors such as supersaturation, temperature, and nucleation sites, rather than the concentration of hydrogen ions. Hence, statement 1 is incorrect.

• The extent of metallic bonding strength is determined by the electrostatic attraction between metal cations and the delocalized sea of electrons, which is a characteristic of solid metals, not ion concentration in a solution. Hence, statement 3 is incorrect.

• The level of gas compressibility factor (Z) is a thermodynamic property of gases that describes how much a real gas deviates from ideal gas behavior under specific pressure and temperature conditions. Hence, statement 4 is incorrect.

• To measure this acidity, scientists use the pH scale, where pH is defined as the negative logarithm (base 10) of the H+ ion concentration.

Additional Information

• The pH Scale:

• Introduced by S.P.L. Sorensen in 1909, the pH scale typically ranges from 0 to 14.

• A pH of 7 represents a neutral solution (like pure water at 25 degrees Celsius).

• Solutions with a pH less than 7 are acidic (high H+ concentration), while those with a pH greater than 7 are basic or alkaline (low H+ concentration).

• Hydronium Ion (H3O+):

• In water, free H+ ions are highly reactive and do not exist alone; they bond with water molecules to form hydronium ions (H3O+).

• The concentration of H3O+ is what is actually measured when determining acidity in aqueous chemistry.

• Strong vs. Weak Acids:

• Strong acids, such as Hydrochloric acid (HCl) or Sulphuric acid (H2SO4), ionize 100 percent in aqueous solutions, yielding a very high H+ concentration.

• Weak acids, like Acetic acid (CH3COOH) found in vinegar, only partially ionize, resulting in a much lower concentration of hydrogen ions.

Important Points

• Biological Significance: Maintaining a specific H+ concentration is vital for life. For example, human blood must maintain a slightly alkaline pH between 7.35 and 7.45 for metabolic enzymes to function correctly.

• Environmental Impact: Acid rain, characterized by a pH lower than 5.6, occurs when sulphur dioxide and nitrogen oxides increase the H+ concentration in rainwater, damaging forests and aquatic ecosystems.

• Indicators: Substances like Litmus, Phenolphthalein, and Universal Indicator are used to provide a visual color change corresponding to the H+ ion level in a solution.

Q12. Answer: (d) Zygote - Embryo - Foetus

The correct answer is Zygote - Embryo - Foetus.

Key Points

• The developmental process in humans begins with fertilisation, which is the fusion of a sperm (male gamete) and an ovum (female gamete) to form a Zygote.

• Zygote: This is the first stage of a new individual. It is a single-celled structure containing the genetic material from both parents. The Zygote undergoes rapid mitotic cell division called cleavage as it moves toward the uterus.

• Embryo: Once the Zygote begins to divide and forms a ball of cells, it is called an Embryo. This stage typically lasts from the third week to the eighth week after fertilisation. During this period, the major organ systems and basic body structures begin to form.

• Foetus: From the ninth week of pregnancy until birth, the developing human is referred to as a Foetus. At this stage, the body parts like hands, legs, head, eyes, and ears become clearly identifiable and continue to grow and mature.

• The sequential transition follows the path of increasing complexity: Zygote (Unicellular) → Embryo (Multicellular, early organogenesis) → Foetus (recognizable human features).

• Hence, the correct answer is Zygote - Embryo - Foetus.

Additional Information

• Fertilisation:

• In humans, internal fertilisation occurs in the Fallopian tube (specifically the ampulla region).

• The resulting Zygote carries 46 chromosomes (23 from each parent) in the form of 23 pairs.

• Implantation:

• The Embryo travels to the uterus and attaches itself to the thick, nutrient-rich lining called the endometrium. This process is known as implantation and usually occurs about 6 to 9 days after fertilisation.

• Gestation Period:

• The total duration from fertilisation to birth is called the gestation period. In humans, this lasts approximately 9 months, 40 weeks, or about 280 days.

• The Placenta:

• During the embryonic and foetal stages, a special disc-like tissue called the placenta develops. Its primary functions include providing oxygen and nutrients to the developing foetus and removing carbon dioxide and waste products.

• Parturition:

• The process of delivery of the foetus (childbirth) at the end of the pregnancy is called parturition, which is induced by complex neuroendocrine mechanisms involving the hormone oxytocin.

Important Points

• Differentiation: While a Zygote is a single cell, the Embryo undergoes differentiation where cells start to specialize into different types (like nerve cells, muscle cells, etc.).

• Recognition: The Foetus stage is distinguished primarily by the fact that the organism looks recognizably human. By the end of the first trimester (approx. 12 weeks), most major organs are formed.

• Viviparous Nature: Humans are viviparous, meaning they give birth to live young ones rather than laying eggs. The Zygote-Embryo-Foetus sequence is a hallmark of this reproductive strategy.

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Q13. Answer: (a) they show different combinations of the genetic variation existing in their parents

The correct answer is they show different combinations of the genetic variation existing in their parents.

Key Points

• The primary reason siblings from the same parents are not identical is the process of sexual reproduction, which involves the shuffling of genetic material to create a unique genotype for each offspring.

• During the formation of gametes (sperm and egg cells), a process called meiosis occurs. In this process, homologous chromosomes undergo crossing over (recombination), where they exchange segments of DNA, ensuring that no two gametes are exactly the same. Hence, statement 1 is correct.

• Human beings possess 23 pairs of chromosomes (46 in total). Due to independent assortment during meiosis, there are over 8 million possible combinations of chromosomes that a single parent can pass on to a child, making the probability of two siblings (excluding identical twins) being identical virtually zero.

• While parents may share certain traits, they possess a vast amount of genetic variation within their alleles. If parents had "very little variation," siblings would look significantly more alike than they actually do. Hence, statement 2 is incorrect.

• DNA copying mechanisms are generally very high-fidelity. While small mutations can occur during DNA replication, these are not the primary cause of the broad phenotypic differences observed between siblings; the reshuffling of existing parental genes is the dominant factor. Hence, statement 3 is incorrect.

• In sexual reproduction, an offspring inherits exactly 50% of its genetic material from the mother and 50% from the father. Inheriting all characters from only one parent occurs in asexual reproduction (cloning). Hence, statement 4 is incorrect.

Additional Information

• Genes and Alleles: A gene is a specific segment of DNA that codes for a trait, while alleles are different versions of that same gene (e.g., blue eyes vs. brown eyes). Every individual has two alleles for each gene—one from each parent.

• Genotype vs. Phenotype: The genotype refers to the actual genetic makeup (the set of alleles), whereas the phenotype refers to the observable physical characteristics (height, eye color, hair texture) resulting from the interaction of the genotype with the environment.

• Identical Twins (Monozygotic): These are the only siblings who are genetically identical because they originate from a single zygote that splits into two embryos. Non-identical or fraternal twins (dizygotic) are the result of two separate eggs being fertilized by two separate sperm, making them genetically no more similar than regular siblings.

• Heredity: This is the passage of traits from parents to offspring. The study of heredity and variation is known as Genetics, a field pioneered by Gregor Mendel in the 19th century through his experiments with pea plants.

Important Points

• Crossing Over: Occurs during Prophase I of meiosis, where non-sister chromatids exchange genetic material, creating new combinations of genes on a single chromosome.

• Independent Assortment: Occurs during Metaphase I, where the orientation of homologous pairs is random, meaning the distribution of maternal and paternal chromosomes into gametes is independent of other pairs.

• Random Fertilization: The fact that any one of millions of sperm can fertilize any one egg further increases the genetic diversity of the resulting zygote.

Q14. Answer: (c) Virtual, erect, and diminished

The correct answer is Virtual, erect, and diminished.

Key Points

• A concave lens is a diverging lens that is thinner at the center and thicker at the edges. When parallel rays of light pass through it, they diverge away from the principal axis.

• Regardless of the object's position, a concave lens always forms a virtual image because the light rays never actually meet; they only appear to originate from a point behind the lens. Hence, statement 3 is correct.

• The image formed by a concave lens is always erect (upright) and never inverted. Hence, statements 1 and 4 are incorrect.

• The size of the image is always diminished (smaller than the object), no matter how close or far the object is placed from the optical center. Hence, statement 2 is incorrect.

• The image is consistently located between the optical center (O) and the principal focus (F1) on the same side of the lens as the object.

Additional Information

• Lens Formula and Sign Convention:

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

• For a concave lens, the focal length is always taken as negative. Since the image is virtual and on the same side as the object, v is also negative.

• Magnification (m):

• It is defined as the ratio of the height of the image (h') to the height of the object (h), represented as m = h'/h = v/u.

• For a concave lens, the magnification is always positive (indicating an erect image) and less than 1 (indicating a diminished image).

• Power of a Lens:

• The power (P) of a lens is the reciprocal of its focal length in meters (P = 1/f).

• The SI unit of power is Dioptre (D). A concave lens has a negative power because its focal length is negative.

• Applications:

• Correction of Myopia: Concave lenses are used in spectacles to correct short-sightedness (myopia), where a person can see nearby objects clearly but distant objects appear blurry.

• Peepholes: They are used in door viewers (peepholes) to provide a wide-angle, diminished view of the person outside.

• Optical Instruments: They are used in combination with other lenses in telescopes (like the Galilean telescope), binoculars, and cameras to eliminate certain optical aberrations.

Important Points

• Case 1: Object at Infinity: If the object is at an infinite distance, the rays arrive parallel. They diverge and appear to meet at the principal focus (F1). The image is highly diminished (point-sized), virtual, and erect.

• Case 2: Object between Infinity and Optical Center: The image is formed between the focus (F1) and the optical center (O). It is always diminished, virtual, and erect.

• Comparison with Convex Lens: Unlike the concave lens, a convex lens (converging lens) can form both real and virtual images, as well as magnified and diminished images, depending on the object's distance from the lens.

Q15. Answer: (c) Rheostat

The correct answer is Rheostat.

Key Points

• A Rheostat is a variable resistor used to control the flow of electric current by manually increasing or decreasing the resistance within a closed circuit.

• It functions based on the principle of Ohm’s Law, which states that current is inversely proportional to resistance when voltage remains constant. By sliding a wiper or contact along a resistance wire, the length of the path through which the current travels is altered, thereby changing the resistance (R) and the resulting current (I).

• It is an essential component in electrical laboratories and industrial applications where current regulation is required without interrupting the circuit operation.

• Unlike a standard resistor which has a fixed value, a rheostat allows for a continuous range of adjustment, making it ideal for controlling device outputs like motor speeds or heater intensities.

Additional Information

• Plug Key:

• A plug key is a basic circuit component used to make or break an electrical connection.

• When the plug is inserted, the circuit is closed and current flows; when removed, the circuit is open. It acts strictly as a switch and cannot vary the magnitude of the current. Hence, statement 1 is incorrect.

• Ammeter:

• An Ammeter is a measuring instrument used to determine the strength of electric current in a circuit, usually measured in Amperes.

• It is always connected in series with the circuit and is designed with very low internal resistance to ensure it does not significantly change the current it is trying to measure. Hence, statement 2 is incorrect.

• Voltmeter:

• A Voltmeter is used to measure the electrical potential difference (voltage) between two points in a circuit.

• It is connected in parallel with the component and possesses very high resistance to prevent current from being diverted through the meter. Hence, statement 4 is incorrect.

Important Points

• Construction: Most rheostats consist of a nichrome wire wound around a ceramic core, with a sliding metal contact that moves across the coils.

• Relationship with Length: The resistance of a conductor is directly proportional to its length. When the rheostat slider moves to include more wire in the circuit, the resistance increases and the current decreases.

• Applications: Common real-world examples of rheostats include volume control knobs on older radios, dimmer switches for household lighting, and speed controllers for fans or model trains.

• Circuit Symbol: In a circuit diagram, a rheostat is represented by a zigzag line with an arrow pointing through it or onto it, signifying its adjustable nature.

Q16. Answer: (c) Cyperus rotundus

The correct answer is Cyperus rotundus.

Key Points

• Cyperus rotundus, commonly known as purple nutsedge, nut grass, or coco-grass, is a species of sedge in the Cyperaceae family.

• It is classified as a weed because it grows aggressively in agricultural fields and competes with primary crops for essential resources like water, nutrients, and sunlight.

• The plant is native to India but has become a cosmopolitan species, found in over 90 countries. It is often cited as the "world's worst weed" due to its ability to infest more than 50 different crops globally.

• It possesses an extensive underground system consisting of rhizomes, tubers, and bulbs, which allow it to survive harsh conditions and regenerate even after the top growth is removed. Hence, statement 3 is the correct answer.

• The tubers of Cyperus rotundus are bitter but are sometimes used in traditional medicine or as a source of essential oils, despite its status as a notorious pest in farming.

Additional Information

• Pisum sativum:

• Commonly known as the garden pea, it belongs to the Fabaceae family.

• It is a leguminous crop widely cultivated for its edible seeds. It was the primary subject of Gregor Mendel's pioneering work on genetics in the 1860s.

• It is an important source of plant-based protein and is grown during the Rabi season in countries like India.

• Oryza sativa:

• Commonly known as Asian rice, it is a member of the Poaceae family (grass family).

• It is the most important staple food crop for more than half of the world's population, especially in East and South Asia.

• The cultivation of rice requires standing water and warm temperatures, making it a primary Kharif crop in tropical regions.

• Vigna unguiculata:

• Commonly known as the cowpea (or Lobia in India), it is a member of the Fabaceae family.

• It is a versatile pulse crop known for its drought tolerance and ability to fix atmospheric nitrogen in the soil through its roots.

• It is used for human consumption, fodder for livestock, and as a green manure to improve soil fertility.

• General Definition of a Weed:

• A weed is defined as a "plant out of place" or a plant growing where it is not wanted.

• Common characteristics of weeds include rapid growth, high reproductive rates, and the ability to thrive in disturbed ecosystems.

• Other examples of common weeds in India include Parthenium hysterophorus (Congress grass) and Eichhornia crassipes (Water Hyacinth).

Q17. Answer: (b) $W_g = -\Delta PE_g$

The correct answer is $W_g = -\Delta PE_g$.

Key Points

• The relationship between work and energy is fundamental in Classical Mechanics. For any conservative force, the work done (W) by the force is defined as the negative change in the potential energy (ΔPE) of the system.

• When an object is moved against the gravitational force (e.g., lifting it upward), the displacement is opposite to the direction of gravity. In this case, gravity does negative work, while the Gravitational Potential Energy of the system increases. Hence, option 2 is correct.

• Mathematically, if an object of mass (m) is moved from a height (h1) to (h2), the change in potential energy is $\Delta PE_g = mgh2 - mgh1$. The work done by gravity during this displacement is $W_g = -mg(h2 - h1)$.

• If gravity does positive work (e.g., an object falling downward), the displacement and force are in the same direction, which results in a decrease in the system's potential energy.

• This relationship ensures that the Total Mechanical Energy of an isolated system remains constant when only conservative forces are acting. Hence, option 4 is incorrect as it neglects the sign convention.

Additional Information

• Conservative Forces:

• A force is conservative if the work done by it in moving an object between two points is independent of the path taken.

• Examples include Gravitational force, Electrostatic force, and Spring force. For these forces, we can always define a Potential Energy function.

• In contrast, non-conservative forces like friction or air resistance depend on the path taken, and the energy is dissipated as heat.

• Work-Energy Theorem:

• This theorem states that the net work done by all forces (both conservative and non-conservative) on an object is equal to the change in its Kinetic Energy (ΔKE).

• In a vacuum where only gravity acts, $W_g = \Delta KE$. Since $W_g = -\Delta PE_g$, it follows that $\Delta KE = -\Delta PE_g$, or $\Delta KE + \Delta PE_g = 0$, representing the conservation of energy.

• SI Units and Scalar Nature:

• Both Work and Potential Energy are scalar quantities, meaning they have magnitude but no specific spatial direction, though they can have positive or negative values.

• The SI unit for both is the Joule (J), named after the English physicist James Prescott Joule.

Important Points

• Reference Level: The value of Potential Energy depends on the reference point (datum) chosen. Usually, the surface of the Earth is assigned a PE of zero. However, the change (ΔPE) remains the same regardless of the reference level.

• Gravity Constant: Near the Earth's surface, the acceleration due to gravity (g) is approximately 9.8 m/s^2. This value was famously studied by Galileo Galilei in the 16th century.

• Universal Gravitation: For objects far from Earth, the potential energy formula changes to $U = -GmM/r$, where G is the Gravitational Constant ($6.674 \times 10^{(-11)}$ Nm^2/kg^2), as formulated by Sir Isaac Newton in 1687.

• Sign Significance: The negative sign in $W_g = -\Delta PE_g$ is not just a mathematical artifact; it signifies that work is done against the field to store energy within it.

Q18. Answer: (d) Chemically combined in fixed proportion

The correct answer is Chemically combined in fixed proportion.

Key Points

• A compound is a substance formed when two or more chemical elements are chemically bonded together in a fixed proportion by mass.

• The constituent elements in a compound lose their individual properties. For example, Water (H_2O) is a liquid used to extinguish fires, even though it is composed of Hydrogen (a highly combustible gas) and Oxygen (a supporter of combustion).

• Elements in a compound are not easily separable by physical methods like filtration or handpicking because they are held together by strong chemical bonds. Separation requires chemical or electrochemical reactions. Hence, statement 1 is incorrect.

• A mixture consists of substances physically mixed in any ratio, whereas a compound must have a specific, constant ratio of its components. Hence, statement 2 is incorrect.

• The bonding in a compound is permanent and stable under standard conditions, not mixed temporarily. Hence, statement 3 is incorrect.

• The fixed proportion is a fundamental characteristic defined by the Law of Definite Proportions, which states that a chemical compound always contains its component elements in a fixed ratio by weight. Hence, statement 4 is correct.

Additional Information

• Chemical Bonding: The atoms in a compound are joined by either ionic bonds (electrostatic attraction between ions) or covalent bonds (sharing of electrons). These bonds determine the molecular structure and stability of the substance.

• Homogeneity: Every compound is a homogeneous substance. This means that no matter which part of the compound is sampled, the chemical composition and physical properties remain identical throughout.

• Energy Changes: The formation of a compound from its constituent elements usually involves a significant change in energy. Energy is either evolved (exothermic) or absorbed (endothermic) in the form of heat or light.

• Fixed Melting and Boiling Points: Unlike mixtures, which melt or boil over a range of temperatures, pure compounds have sharp and well-defined melting and boiling points. This serves as a primary method for purity testing in laboratories.

• Examples: Common examples include Sodium Chloride (NaCl), which always contains Sodium and Chlorine in a 1:1 atomic ratio, and Carbon Dioxide (CO_2), which always has 1 atom of Carbon for every 2 atoms of Oxygen.

Important Points

• Law of Definite Proportions: Proposed by the French chemist Joseph Proust in 1799, this law is the cornerstone of stoichiometry. It implies that the mass ratio of elements in a compound like Ammonia (NH_3) is always 14:3 (Nitrogen to Hydrogen), regardless of how the compound is prepared.

• Physical vs Chemical Separation: While a mixture of Iron and Sulphur can be separated using a magnet, the compound Iron Sulphide (FeS) cannot be separated by a magnet because the Iron has chemically reacted with the Sulphur to form a new substance.

• Electrolysis: Some compounds, like Aluminium Oxide or Water, require the passage of an electric current (a process called electrolysis) to break the chemical bonds and retrieve the original elements.

• Representation: Every compound is represented by a chemical formula. This formula represents the number and type of atoms present in the smallest unit (molecule or formula unit) of the substance.

Q19. Answer: (b) water and atmospheric oxygen

The correct answer is water and atmospheric oxygen.

Key Points

• Rusting is a specific type of Corrosion that occurs specifically on the surface of Iron and its alloys, such as steel.

• For rusting to take place, two conditions are absolutely essential: the presence of Oxygen (usually from the Atmosphere) and the presence of Water or Moisture.

• Chemically, rusting is an Oxidation reaction where iron reacts with oxygen in the presence of water to form Hydrated Iron(III) Oxide, represented by the chemical formula $Fe_2O_3 \cdot nH_2O$.

• It is considered an Electrochemical Process because different areas of the metal surface act as Anodes and Cathodes, where electrons flow through the metal while ions move through the water film on the surface.

• If iron is kept in Vacuum (no air) or in Dry Air (no moisture), it will not rust; similarly, iron submerged in Boiled Distilled Water (where dissolved oxygen is removed) and sealed from air will also not rust.

Additional Information

• Factors Accelerating Rusting:

• The rate of rusting increases significantly in the presence of Electrolytes. For example, Saltwater (common in Coastal Areas) speeds up the electrochemical reaction, leading to faster degradation of ships and bridges.

• High Acidity (low pH) also accelerates the process because hydrogen ions facilitate the reduction of oxygen at the cathodic sites.

• Prevention Methods:

• Galvanization: This is a common method where a protective layer of Zinc is applied to iron or steel. Zinc is more reactive and acts as a Sacrificial Anode, corroding itself to protect the underlying iron.

• Alloying: Mixing iron with other elements like Chromium and Nickel creates Stainless Steel. Chromium forms a thin, invisible layer of Chromium Oxide that prevents oxygen and water from reaching the iron.

• Barrier Protection: Simple methods like Painting, Oiling, or Greasing the surface of the metal create a physical barrier that blocks contact with Atmospheric Oxygen and Moisture.

• Economic Impact: Corrosion is a major global issue, resulting in the loss of nearly 3% to 4% of a country's Gross Domestic Product (GDP) annually due to the replacement and maintenance of rusted infrastructure and machinery.

• Chemical Equation: The simplified reaction can be written as: $4Fe + 3O_2 + 2nH_2O \rightarrow 2Fe_2O_3 \cdot nH_2O$. This reddish-brown substance is flaky and porous, which allows the rusting process to continue deep into the metal until the object is completely destroyed.

Q20. Answer: (c) Mass can neither be created nor destroyed in a chemical reaction

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

Key Points

• The Law of Conservation of Mass states that in an isolated or closed system, matter is neither created nor destroyed during a chemical reaction or physical transformation.

• According to this law, the total mass of the reactants participating in a chemical reaction must be exactly equal to the total mass of the products formed.

• This principle was famously established and verified by the French chemist Antoine Lavoisier in 1789, marking a turning point from alchemy to modern chemistry.

• At the atomic level, the law implies that the number of atoms of each element remains constant; they are simply rearranged from one state or combination to another. Hence, the third option is correct.

• The statement that matter can be created or destroyed during reactions is scientifically incorrect in the context of chemical processes. Hence, statements 1, 2, and 4 are incorrect.

Additional Information

• Antoine Lavoisier (1743–1794):

• Often referred to as the Father of Modern Chemistry, he conducted meticulous experiments such as the combustion of phosphorus and sulfur to prove that mass is conserved.

• He demonstrated that even though substances change their state (e.g., solid to gas), the total weight remains unchanged if the gases are captured.

• Applications in Stoichiometry:

• The law serves as the fundamental basis for balancing chemical equations.

• For instance, in the formation of water (H_2O), the mass of Hydrogen (H_2) and Oxygen (O_2) used must match the mass of the water produced.

• Closed System vs. Open System:

• In a closed system, no matter can escape, making it easy to observe mass conservation.

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• In an open system, such as a burning log, mass might appear to decrease because carbon dioxide and water vapor escape into the atmosphere.

• Related Laws of Chemical Combination:

• Law of Definite Proportions: Proposed by Joseph Proust, stating that a chemical compound always contains exactly the same proportion of elements by mass.

• Law of Multiple Proportions: Proposed by John Dalton, stating that if two elements form more than one compound, the ratios of the masses of the second element that combine with a fixed mass of the first element will be small whole numbers.

Important Points

• Mass-Energy Equivalence: In modern physics, specifically nuclear reactions, mass and energy can be interconverted according to Albert Einstein's equation $E=mc^2$. However, in standard chemical reactions, the energy changes are so small that the change in mass is negligible.

• Historical Context: Before 1789, many scientists believed in the "phlogiston theory," which suggested that mass was lost during combustion because a substance called phlogiston was released. Lavoisier's discovery effectively disproved this theory.

• Practical Example: When 12 grams of Carbon reacts with 32 grams of Oxygen, it will always produce exactly 44 grams of Carbon Dioxide (CO2), provided the reaction goes to completion.

Q21. Answer: (a) Through a simple diffusion process

The correct answer is Through a simple diffusion process.

Key Points

• Unicellular organisms, such as Amoeba, Paramecium, and Bacteria, consist of a single cell that performs all vital biological functions including nutrition, respiration, and excretion.

• In these organisms, metabolic wastes (predominantly ammonia) are produced as by-products of cellular activities. Because they lack specialized excretory organs like kidneys, they rely on the physical process of diffusion.

• Simple diffusion is the movement of waste molecules from an area of higher concentration (inside the cell) to an area of lower concentration (the surrounding external environment) across the semi-permeable cell membrane.

• The high surface-area-to-volume ratio of unicellular organisms ensures that the entire body surface is in direct contact with the environment, making the diffusion process highly efficient for waste removal.

• Unlike complex animals that require circulatory systems and specialized organs, the metabolic waste in single-celled life forms is simply released into the surrounding water medium.

Additional Information

• Metabolic Waste: These are substances left over from metabolic processes (such as cellular respiration) which cannot be used by the organism and may be toxic if accumulated. Examples include carbon dioxide, water, and nitrogenous compounds.

• Osmoregulation vs. Excretion:

• While metabolic waste is removed via diffusion, many freshwater unicellular organisms use contractile vacuoles for osmoregulation.

• The contractile vacuole collects excess water that enters the cell through osmosis and pumps it out to prevent the cell from bursting.

• Excretory Mechanisms in Other Organisms:

• Flatworms: Use specialized cells called flame cells (protonephridia) for excretion.

• Earthworms: Utilize tubular structures called nephridia.

• Insects: Use Malpighian tubules to remove nitrogenous wastes.

• Vertebrates: Possess complex kidneys containing millions of functional units called nephrons to filter blood and produce urine.

• Diffusion vs. Osmosis:

• Diffusion refers to the movement of any substance (solute or gas) from high to low concentration.

• Osmosis is a specific type of diffusion referring only to the movement of water molecules through a semi-permeable membrane.

Important Points

• Ammonotelism: Most aquatic unicellular organisms are ammonotelic, meaning they excrete ammonia as their primary nitrogenous waste. Ammonia is highly toxic but very soluble in water, allowing it to diffuse quickly into the environment.

• Plasma Membrane Role: The plasma membrane acts as the primary interface for gas exchange and waste disposal. Carbon dioxide produced during respiration also leaves the cell via simple diffusion.

• Environmental Impact: The efficiency of diffusion is dependent on the concentration gradient; if the surrounding water is polluted or has high concentrations of waste, the unicellular organism may struggle to clear its internal metabolic by-products.

Q22. Answer: (c) Doubles

The correct answer is Doubles.

Key Points

• The magnetic field (B) produced by a straight current-carrying conductor at any given point is directly proportional to the magnitude of the electric current (I) passing through the conductor.

• Mathematically, according to Ampere's Circuital Law and the Biot-Savart Law, the magnetic field strength at a distance r from an infinitely long straight wire is given by the formula: B = (μ0 * I) / (2 * π * r).

• In this equation, μ0 is the permeability of free space, which is a constant value of 4π × 10^-^7 T·m/A.

• Since the magnetic field (B) is in the numerator and directly related to the current (I), any change in current results in a linear change in the field. If the current is doubled (2I), the new magnetic field becomes B' = (μ0 * 2I) / (2 * π * r) = 2B. Hence, the magnetic field doubles.

• If the current were halved, the magnetic field would also be halved. If the current were reduced to zero, the magnetic field would become zero. Therefore, options 1, 2, and 4 are incorrect based on the direct proportionality.

Additional Information

• Distance Relationship: The magnetic field is inversely proportional to the distance (r) from the wire. This means as you move further away from the conductor, the strength of the magnetic field decreases.

• Right-Hand Thumb Rule: To find the direction of the magnetic field lines, we use this rule. If the thumb of the right hand points in the direction of the current, then the curled fingers show the direction of the magnetic field lines encircling the wire.

• Shape of Field Lines: For a straight conductor, the magnetic field lines are in the form of concentric circles whose centers lie on the wire. These circles are perpendicular to the length of the conductor.

• Units of Measurement: The S.I. unit of magnetic field induction is the Tesla (T), named after Nikola Tesla. Another unit used is Gauss (G), where 1 Tesla = 10,000 Gauss.

• Nature of the Field: The magnetic field is a vector quantity, meaning it has both magnitude and direction.

Important Points

• Historical Discovery: In 1820, the Danish physicist Hans Christian Ørsted accidentally discovered that a compass needle was deflected when placed near a wire carrying an electric current, establishing the link between electricity and magnetism.

• Factors Affecting Field Strength: The strength of the magnetic field depends on the magnitude of current, the distance from the wire, and the permeability of the medium surrounding the wire.

• Applications: This fundamental principle is used in various electrical appliances and industrial machines, including electric motors, generators, transformers, and electromagnets used in medical imaging like MRI (Magnetic Resonance Imaging).

• Numerical Fact: If a wire carries a current of 1 Ampere, the magnetic field at a distance of 1 meter in a vacuum is exactly 2 × 10^-^7 Tesla.

Q23. Answer: (b) A chemical compound always contains the same elements combined in a fixed ratio by mass.

The correct answer is A chemical compound always contains the same elements combined in a fixed ratio by mass.

Key Points

• The Law of Constant Proportions, also known as the Law of Definite Proportions, states that in a chemical substance, the elements are always present in definite proportions by mass.

• This law was formulated by the French chemist Joseph Proust in 1799. It implies that regardless of the source or the method of preparation, a pure chemical compound will always consist of the same elements combined in the same fixed mass ratio.

• In the case of water (chemical formula H2O), the elements hydrogen and oxygen are always present in a ratio of 1:8 by mass. This means that if 9 grams of water is decomposed, 1 gram of hydrogen and 8 grams of oxygen are always obtained. Hence, statement 2 is correct.

• The properties of a compound are entirely different from the properties of its constituent elements. For example, hydrogen is combustible and oxygen supports combustion, but water is used to extinguish fires. Hence, statement 1 is incorrect.

• Elements do not combine in "any" ratio to form compounds; they follow stoichiometric laws. A mixture might have components in any ratio, but a chemical compound requires a fixed ratio. Hence, statement 3 is incorrect.

• The Law of Conservation of Mass states that mass is neither created nor destroyed in a chemical reaction; therefore, the total mass of products must be equal to the total mass of reactants. Hence, statement 4 is incorrect.

Additional Information

• Law of Conservation of Mass:

• Proposed by Antoine Lavoisier in 1789.

• It establishes that during any physical or chemical change, the total mass of the matter remains constant.

• This principle is fundamental to balancing chemical equations in chemistry.

• Law of Multiple Proportions:

• Proposed by John Dalton in 1803.

• It states that if two elements combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element are in the ratio of small whole numbers.

• Example: Carbon and oxygen can form Carbon Monoxide (CO) and Carbon Dioxide (CO2).

• Dalton's Atomic Theory:

• In 1808, John Dalton provided an explanation for the laws of chemical combination.

• One of his key postulates was that "the relative number and kinds of atoms are constant in a given compound," which supports the Law of Constant Proportions.

• Ammonia (NH3) Example:

• In Ammonia, nitrogen and hydrogen are always present in the ratio of 14:3 by mass.

• This remains true whether the ammonia is produced in a laboratory or obtained from atmospheric sources.

Important Points

• Calculation of Mass Ratio in Water:

• The atomic mass of Hydrogen is approximately 1 unit.

• The atomic mass of Oxygen is approximately 16 units.

• In H2O, there are 2 atoms of Hydrogen and 1 atom of Oxygen.

• Mass ratio = (2 x 1) : (1 x 16) = 2 : 16, which simplifies to 1 : 8.

• Exceptions to the Law:

• The law does not strictly hold for non-stoichiometric compounds (like some metal oxides) where the ratio of elements can vary slightly.

• It also does not account for isotopes. For example, water made with Deuterium (Heavy Water or D2O) will have a different mass ratio (2:8 or 1:4) compared to normal water.

• Scientific Significance:

• This law allowed chemists to determine atomic weights and understand the molecular structure of substances during the 19th century.

Q24. Answer: (d) Atmospheric refraction on a small scale

The correct answer is Atmospheric refraction on a small scale.

Key Points

• The wavering or flickering of objects seen through hot air is primarily caused by Atmospheric Refraction occurring on a local or small scale. This happens because the air just above a fire or radiator becomes significantly hotter than the surrounding air.

• Hot air is lighter and less dense than the cooler air above it, and it possesses a lower refractive index than the cooler air. Since the physical conditions of the air are not stationary due to convection and turbulence, the refractive index of the medium is constantly fluctuating.

• When light from an object passes through these layers of air with varying refractive indices, the path of the light rays is bent or refracted multiple times in random directions.

• As the optical density of the air through which the light passes changes rapidly, the apparent position of the object as seen by the eye fluctuates. This creates the visual effect of wavering or flickering. Hence, Option 4 is the correct statement.

• This phenomenon is an optical illusion caused by the medium (air) and not by any change in the object itself or the properties of the light source.

Additional Information

• Atmospheric Refraction: This refers to the deviation of light from a straight line as it passes through the atmosphere due to variations in air density as a function of altitude and temperature. On a large scale, it is responsible for the twinkling of stars and the early sunrise and delayed sunset (approximately 2 minutes difference).

• Tyndall Effect: This is the scattering of light by colloidal particles or very fine suspended particles in a medium, such as dust or smoke in the air. While it makes a beam of light visible, it does not cause the wavering of distant objects. Hence, Option 3 is incorrect.

• Diffraction of Light: This is the bending of light around the edges of an obstacle or through a small opening. It is a wave property of light that occurs when the obstacle size is comparable to the wavelength of light. It is not the cause of thermal flickering. Hence, Option 2 is incorrect.

• Heat Radiation: Heat is transferred from a fire through conduction, convection, and radiation (Infrared). While radiation carries energy, the visual distortion is a result of the air (the medium) through which the light travels, not the radiation process itself. Hence, Option 1 is incorrect.

• Refractive Index and Temperature: Generally, for gases like air, the refractive index is inversely proportional to the absolute temperature. As temperature increases, density decreases, leading to a lower refractive index.

Important Points

• Mirages: Another famous example of atmospheric refraction is a mirage, often seen on hot highways or in deserts. This is caused by the total internal reflection of light at the layers of air near the ground that have different temperature gradients.

• Optical Density: It is a measure of the speed of light in a medium. A medium with a higher refractive index is called optically denser, and light travels slower in it compared to an optically rarer medium.

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• Apparent Position: Due to refraction, objects in the sky (like the Sun or Stars) always appear slightly higher than their actual position because light bends toward the normal as it enters the denser layers of the Earth's atmosphere.

Q25. Answer: (d) Electron transport chain

The correct answer is Electron transport chain.

Key Points

• The Electron Transport Chain (ETC) is the final stage of aerobic respiration and is located in the inner mitochondrial membrane.

• Oxygen acts as the terminal electron acceptor in this process; it combines with electrons and hydrogen ions to form water (H2O).

• A decrease in oxygen availability immediately halts the flow of electrons through the protein complexes (Complex I to IV), as there is no molecule to receive them at the end of the chain. Hence, the statement regarding the Electron transport chain being the first impacted is correct.

• Without oxygen, oxidative phosphorylation cannot occur, leading to a sudden drop in the production of ATP (Adenosine Triphosphate), which is the primary energy currency of the cell.

• The failure of the ETC leads to an accumulation of NADH and FADH2, which are normally oxidized back into NAD+ and FAD to sustain other metabolic pathways.

Additional Information

• Glycolysis:

• This process occurs in the cytoplasm of the cell and involves the breakdown of glucose into two molecules of pyruvate.

• It is an anaerobic process, meaning it does not require oxygen to proceed. Therefore, it is not the first step impacted by a lack of oxygen. Hence, the statement regarding Glycolysis is incorrect.

• Krebs Cycle (Citric Acid Cycle):

• This cycle takes place in the mitochondrial matrix and produces CO2, ATP, NADH, and FADH2.

• While it does not use oxygen directly, it eventually stops because it requires NAD+ and FAD, which are only regenerated when the ETC is functioning. However, this is a secondary impact following the ETC failure. Hence, the statement regarding the Krebs cycle is incorrect.

• Lactic Acid Fermentation:

• In animal cells (especially skeletal muscle), when oxygen is limited, the cell resorts to fermentation to regenerate NAD+ so that glycolysis can continue.

• This is a consequence or an alternative pathway triggered by the lack of oxygen, rather than the "step of aerobic respiration" that is first negatively impacted. Hence, the statement regarding Lactic acid fermentation is incorrect.

• Cellular Respiration Facts:

• Aerobic respiration yields approximately 36 to 38 ATP per glucose molecule, whereas anaerobic respiration (fermentation) yields only 2 ATP.

• The mitochondria are known as the powerhouse of the cell because they host the Krebs Cycle and the ETC, where the majority of energy is harvested.

Important Points

• Hypoxia is the medical term for a condition where the body or a region of the body is deprived of adequate oxygen supply at the tissue level.

• The Chemiosmotic theory, proposed by Peter Mitchell in 1961, explains how the ETC creates a proton gradient across the inner mitochondrial membrane to drive ATP synthase.

• In the absence of oxygen, the proton motive force dissipates, which not only stops ATP production but can also lead to the formation of Reactive Oxygen Species (ROS) if oxygen levels are fluctuating or partially restored (reperfusion injury).

Q26. Answer: (c) 2

Shortcut Trick

A number is divisible by 18 if it is divisible by both 2 and 9.

Divisibility by 2 requires the last digit X to be even (0, 2, 4, 6, 8).

Among the given options (5, 3, 2, 1), only 2 is an even number.

Thus, X must be 2 to satisfy the first condition of divisibility by 18.

Therefore The correct answer is 2.

Alternate Method

Given number: 8732326687X

Condition: Number is divisible by 18.

Method: Check divisibility rules for 2 and 9 (since 18 = 2 × 9).

=> Divisibility by 9: Sum of digits must be divisible by 9.

=> Sum = 8 + 7 + 3 + 2 + 3 + 2 + 6 + 6 + 8 + 7 + X

=> Sum = 52 + X

=> The nearest multiple of 9 greater than 52 is 54 (9 × 6 = 54).

=> 52 + X = 54

=> X = 54 − 52 = 2

=> Divisibility by 2: The last digit X must be even. Since X = 2 is even, this condition is satisfied.

Therefore The correct answer is 2.

Additional Information

Divisibility by 9

A number is divisible by 9 if the sum of its digits is a multiple of 9.

Divisibility by 2

A number is divisible by 2 if its last digit is even, i.e., 0, 2, 4, 6, or 8.

Composite Divisibility Rule

If a number is divisible by two co-prime numbers a and b, then it is also divisible by their product (a × b).

Q27. Answer: (a) 1331/3 m

Shortcut Trick

Ratio of speeds A : B = 5 : 2

Ratio of distances A : B = 5 : 2 (since time is constant)

Difference in distance units = 5 − 2 = 3 units

According to question, 3 units = 80 m (head start)

Winning post distance (A's distance) = 5 units = (80 ÷ 3) × 5 = 133¹/3 m

Therefore The correct answer is 133¹/3 m.

Alternate Method

Given:

Speed of A = 5/2 × Speed of B

Head start given to B = 80 m

Formula Used:

Distance = Speed × Time

Calculations:

=> Speed of A / Speed of B = 5 / 2

=> Let the distance of the winning post from A's start be D meters.

=> Time taken by A = D ÷ Speed_A

=> Time taken by B = (D − 80) ÷ Speed_B

=> Since they reach at the same time: D / Speed_A = (D − 80) / Speed_B

=> D / (D − 80) = Speed_A / Speed_B = 5 / 2

=> 2 × D = 5 × (D − 80)

=> 2D = 5D − 400

=> 3D = 400

=> D = 400 / 3 = 133¹/3 m

Therefore The correct answer is 133¹/3 m.

Additional Information

Constant Time Property

If two bodies take the same time to cover different distances, the ratio of their distances is equal to the ratio of their speeds: D1/D2 = S1/S2.

Concept of Head Start

In a race of length L, if A gives B a start of x meters, A has to run L meters while B has to run only (L − x) meters.

Dead Heat

A race is said to end in a dead heat if all participants reach the winning post at exactly the same time.

Q28. Answer: (a) 16√3

Shortcut Trick

In a 30°−60°−90° triangle, the ratio of sides Height : Base : Hypotenuse is 1 : √3 : 2.

Side opposite to 60° (Base) = 48 m.

√3 units = 48 m

1 unit (Height) = 48/√3 = (16 × 3)/√3 = 16√3 m.

Therefore The correct answer is 16√3.

Alternate Method

Given:

Distance of the point from the foot of the tower (Base) = 48 m

Angle of elevation (θ) = 30°

Formula used: tan θ = Perpendicular (Height) / Base

=> Let the height of the tower be h.

=> tan 30° = h / 48

=> 1/√3 = h / 48

=> h = 48 / √3

=> h = (16 × 3) / √3

=> h = 16√3 m

Therefore The correct answer is 16√3.

Additional Information

Trigonometric Ratios for Standard Angles

Standard values: tan 30° = 1/√3, tan 45° = 1, and tan 60° = √3.

Angle of Elevation

It is the angle formed by the line of sight with the horizontal when the object being viewed is above the horizontal level.

30°−60°−90° Triangle Property

The side opposite to 30° is x, the side opposite to 60° is x√3, and the hypotenuse is 2x.

Q29. Answer: (d) 2835

Shortcut Trick

Factorize the numbers using the largest common factor:

45 = 9 × 5

63 = 9 × 7

81 = 9 × 9

LCM = 9 × (Remaining factors: 5 × 7 × 9)

LCM = 9 × 315 = 2835

Therefore The correct answer is 2835.

Alternate Method

Given: Numbers 45, 63, and 81.

Formula Used: LCM by Prime Factorization Method (Product of highest powers of all prime factors).

=> Prime factors of 45 = 3 × 3 × 5 = $3^2 \times 5^1$

=> Prime factors of 63 = 3 × 3 × 7 = $3^2 \times 7^1$

=> Prime factors of 81 = 3 × 3 × 3 × 3 = 3^4

=> LCM = Highest powers of involved primes (3, 5, 7)

=> LCM = 3^4 × 5^1 × 7^1

=> LCM = 81 × 5 × 7

=> LCM = 81 × 35 = 2835

Therefore The correct answer is 2835.

Additional Information

HCF (Highest Common Factor)

The HCF is the largest positive integer that divides each of the numbers without a remainder. For 45, 63, and 81, the HCF is 9.

Relationship for Two Numbers

For any two positive integers a and b, HCF(a, b) × LCM(a, b) = a × b. This rule does not directly apply to more than two numbers.

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LCM of Fractions

LCM of Fractions = (LCM of Numerators) ÷ (HCF of Denominators). This is essential for simplifying fraction-based arithmetic.

Q30. Answer: (d) 625

Shortcut Trick

Use multiplying factors for discount and VAT: MP × (100 − D)% × (100 + VAT)% = Final SP

x × 0.46 × 1.52 = 437

x = 437 / (0.46 × 1.52)

x = 437 / 0.6992 = 625

Therefore The correct answer is 625.

Alternate Method

Given:

Marked Price (MP) = Rs. x

Discount = 54% | VAT = 52% | Final SP = Rs. 437

Formula Used:

Price after tax = Price before tax × (1 + Tax/100)

Selling Price before tax = MP × (1 − Discount/100)

=> Price after discount = Final SP ÷ (1 + VAT/100)

=> Price after discount = 437 ÷ 1.52 = 287.5

=> Marked Price (x) = Price after discount ÷ (1 − Discount/100)

=> x = 287.5 ÷ (1 − 0.54)

=> x = 287.5 ÷ 0.46

=> x = 625

Therefore The correct answer is 625.

Additional Information

Successive Percentage Change

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

Marked Price vs Selling Price

Discount is always calculated on the Marked Price (MP), while Profit or Loss is calculated on the Cost Price (CP).

VAT and Taxes

Value Added Tax (VAT) or GST is usually applied to the net selling price after all discounts have been deducted.

Q31. Answer: (d) 18

Shortcut Trick

Convert 1/5 to percentage: 1/5 × 100 = 20%.

Both percentages are calculated on the same base value (45).

Difference in percentage = 60% − 20% = 40%.

Required difference = 40% of 45.

Required difference = 0.4 × 45 = 18.

Therefore The correct answer is 18.

Alternate Method

Given: Main number = 45

Formula Used: Value = (Percentage/100) × Number | Value = Fraction × Number

=> First value = 60% of 45

=> First value = (60/100) × 45 = 0.6 × 45 = 27

=> Second value = 1/5 of 45

=> Second value = (1/5) × 45 = 9

=> Difference = 27 − 9

=> Difference = 18

Therefore The correct answer is 18.

Additional Information

Percentage to Fraction Conversion

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To convert a percentage to a fraction, divide by 100. Example: 60% = 60/100 = 3/5.

Fraction to Percentage Conversion

To convert a fraction to a percentage, multiply by 100. Example: 1/5 × 100 = 20%.

Common Base Property

If multiple percentages or fractions are applied to the same number, we can subtract or add the proportions directly before multiplying with the base value.

Q32. Answer: (b) 22,995

Shortcut Trick

Ratio of prices = 3 : 5 : 7 => Total ratio units = 3 + 5 + 7 = 15 units.

Total price = Average × Number of items = 16,425 × 3.

15 units = 16,425 × 3 => 5 units = 16,425.

1 unit = 3,285.

Costliest item (7 units) = 7 × 3,285 = 22,995.

Therefore The correct answer is 22,995.

Alternate Method

Given:

Average price of 3 items = Rs. 16,425

Ratio of prices = 3 : 5 : 7

Formula Used:

Total Value = Average × Number of items

Value of a part = (Ratio of that part / Sum of Ratios) × Total Value

Calculations:

Let the prices of the three items be 3x, 5x, and 7x.

=> Total Price = 3x + 5x + 7x = 15x

=> Average = Total Price ÷ 3

=> 16,425 = 15x ÷ 3

=> 16,425 = 5x

=> x = 16,425 ÷ 5

=> x = 3,285

=> Price of the costliest item = 7x

=> Price = 7 × 3,285

=> Price = 22,995

Therefore The correct answer is 22,995.

Additional Information

Average Concept

The average of a set of observations is the sum of observations divided by the total number of observations. Sum = Average × n.

Ratio and Proportion

If a total amount A is divided into parts according to ratio a : b : c, then the value of the largest part is [max(a,b,c) / (a+b+c)] × A.

Weighted Average

When items have different weights w1, w2, the combined average is (w1x1 + w2x2) ÷ (w1 + w2).

Q33. Answer: (b) 1144 cm2

Shortcut Trick

Total Surface Area of a cylinder is 2πr(h + r), which involves π (22/7).

The answer must be a multiple of 11.

Check options for 11 divisibility: 1144 → (1+4) − (1+4) = 0 (Divisible by 11).

Other options: 1121 (1), 1175 (2), 1106 (6) are not divisible by 11.

Therefore The correct answer is 1144 cm².

Alternate Method

Given:

Volume of cylinder (V) = 2926 cm³

Height (h) = 19 cm

Formula Used:

Volume (V) = $\pi r^2 h$

Total Surface Area (TSA) = $2\pi r(h + r)$

Calculations:

=> Volume = $\pi r^2 h = 2926$

=> $(22/7) \times r^2 \times 19 = 2926$

=> $r^2 = (2926 \times 7) / (22 \times 19)$

=> $r^2 = (154 \times 7) / 22$

=> $r^2 = 7 \times 7$

=> r = 7 cm

=> TSA = $2\pi r(h + r)$

=> TSA = $2 \times (22/7) \times 7 \times (19 + 7)$

=> TSA = 44×26

=> TSA = 1144 cm^2

Therefore The correct answer is 1144 cm^2.

Additional Information

Curved Surface Area (CSA)

The lateral surface area of a cylinder excluding its top and bottom bases is given by $2\pi rh$.

Total Surface Area (TSA)

The sum of the area of the curved surface and the areas of the two circular bases: TSA = $2\pi rh + 2\pi r^2 = 2\pi r(h + r)$.

Volume of Cylinder

The capacity or space occupied by a solid cylinder is V = $\pi r^2 h$.

Q34. Answer: (b) 12.6%

Shortcut Trick

Successive Discount Formula = $x + y - (x \times y)/100$

Where x = 5% and y = 8%

Net Discount = $5 + 8 - (5 \times 8)/100$

Net Discount = $13 - 40/100 = 13 - 0.4 = 12.6\%$

Therefore The correct answer is 12.6%.

Alternate Method

Given: First discount (d1) = 5%, Second discount (d2) = 8%

Formula: Final Selling Price = MP × (100 − d1)/100 × (100 − d2)/100

Let the Marked Price (MP) be 100 units.

=> Price after 1st discount = 100 − (5% of 100) = 100 − 5 = 95 units.

=> Final Selling Price (SP) after 2nd discount = 95 − (8% of 95)

=> SP = $95 - (8 \times 95)/100 = 95 - 7.6 = 87.4$ units.

=> Total Discount = MP − SP = 100 − 87.4 = 12.6 units.

=> Single Equivalent Discount % = $(12.6/100) \times 100 = 12.6\%$

Therefore The correct answer is 12.6%.

Additional Information

Successive Discount for Three Rates

For three discounts a%, b%, and c%, the net discount is calculated as $100 - [100 \times (1 - a/100) \times (1 - b/100) \times (1 - c/100)]$.

Profit/Loss and Discounts

Marked Price (MP) = CP × (100 + Profit%)/(100 − Discount%). This relates the cost price to the marked price via the profit and discount percentages.

Successive Percentage Change

The net change for successive increases/decreases x and y is given by the formula $x + y + (xy/100)$, where negative signs are used for decreases.

Q35. Answer: (d) 30.6

Shortcut Trick

Assume the average for all 4 numbers is 17.

Net deviation from the average must be 0.

Deviations: (6.5 − 17) = −10.5, (10.7 − 17) = −6.3, (20.2 − 17) = +3.2.

Sum of deviations = −10.5 − 6.3 + 3.2 = −13.6.

To balance, value of a = 17 + 13.6 = 30.6.

Therefore The correct answer is 30.6.

Alternate Method

Given:

Numbers = 6.5, 10.7, 20.2, and a

Average = 17

Total count (n) = 4

Formula:

Average = (Sum of observations) ÷ (Number of observations)

=> Average = (6.5 + 10.7 + 20.2 + a) ÷ 4

=> 17 = (37.4 + a) ÷ 4

=> 17 × 4 = 37.4 + a

=> 68 = 37.4 + a

=> a = 68 − 37.4

=> a = 30.6

Therefore The correct answer is 30.6.

Additional Information

Arithmetic Mean

The most common type of average, calculated by dividing the sum of all values by the total number of values.

Sum of Deviations

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

Weighted Average

Used when different values have different levels of importance or frequency: Average = $\sum(w_i \times x_i) \div \sum w_i$.

Q36. Answer: (d) Rs. 2,569

Shortcut Trick

Net Amount = 8442 − (7 + 73 + 68) = 8294

Total Ratio Units = 6 + 7 + 16 = 29 units

Value of 1 unit = 8294 ÷ 29 = 286

Ratio difference (C − B) = 16 − 7 = 9 units

Difference in shares = (9 × 286) + (68 − 73) = 2574 − 5 = 2569

Therefore The correct answer is Rs. 2,569.

Alternate Method

Given:

Total Amount = Rs. 8,442

Deductions: S = Rs. 7, B = Rs. 73, C = Rs. 68

New Ratio S : B : C = 6 : 7 : 16

Calculations:

=> Total Deductions = 7 + 73 + 68 = Rs. 148

=> Remaining amount = 8442 − 148 = Rs. 8,294

=> 29 units = 8294

=> 1 unit = 8294 ÷ 29 = 286

=> B's original share = (7 × 286) + 73 = 2002 + 73 = Rs. 2,075

=> C's original share = (16 × 286) + 68 = 4576 + 68 = Rs. 4,644

=> Difference = 4644 − 2075 = Rs. 2,569

Therefore The correct answer is Rs. 2,569.

Additional Information

Ratio Division with Constants

If (A−x):(B−y):(C−z) = a:b:c, then the sum (A+B+C) − (x+y+z) is distributed in the ratio a:b:c.

Difference between Shares

Difference between A and B = |(a × k + x) − (b × k + y)|, where k is the value of one ratio unit.

Compounded Ratio

The compounded ratio of a:b and c:d is (a×c):(b×d).

Q37. Answer: (c) Rs. 30

Shortcut Trick

From 2K + 2W = 48, we get 1 Keychain (K) + 1 Wallet (W) = 24.

Multiply by 3: 3K + 3W = 72.

Subtracting this from (4K + 3W = 75): (4K − 3K) = 75 − 72 => K = 3.

Since K + W = 24, then W = 24 − 3 = 21.

Cost of 3K + 1W = 3(3) + 21 = 9 + 21 = 30.

Therefore The correct answer is Rs. 30.

Alternate Method

Given:

4 × Cost of Keychain (K) + 3 × Cost of Wallet (W) = Rs. 75 --- (i)

2 × Cost of Keychain (K) + 2 × Cost of Wallet (W) = Rs. 48 --- (ii)

Formula Used:

Linear equations in two variables: a1x + b1y = c1 and a2x + b2y = c2

Calculations:

=> From (ii), divide by 2: K + W = 24

=> W = 24 − K --- (iii)

=> Substitute (iii) in (i): 4K + 3(24 − K) = 75

=> 4K + 72 − 3K = 75

=> K + 72 = 75

=> K = 75 − 72 = 3

=> Put K = 3 in (iii): W = 24 − 3 = 21

=> Required Cost = 3K + 1W

=> Required Cost = 3(3) + 21

=> Required Cost = 9 + 21 = 30

Therefore The correct answer is Rs. 30.

Additional Information

Elimination Method

A process of solving equations by adding or subtracting them to cancel out one variable, usually after multiplying one or both by constant factors.

Substitution Method

Expressing one variable in terms of the other from one equation and substituting this expression into the second equation.

Nature of Solutions

A system has a unique solution if a1/a2 ≠ b1/b2, no solution if a1/a2 = b1/b2 ≠ c1/c2, and infinite solutions if a1/a2 = b1/b2 = c1/c2.

Q38. Answer: (c) 18 years and 24 years

Shortcut Trick

Present Ratio = 3 : 4 (Difference = 1); Past Ratio (4 yrs ago) = 7 : 10 (Difference = 3).

Equalize differences by multiplying present ratio by 3 → 9 : 12.

Change in units: 9 − 7 = 2 units (or 12 − 10 = 2 units).

2 units = 4 years => 1 unit = 2 years.

Present ages: A = 9 × 2 = 18 years and B = 12 × 2 = 24 years.

Therefore The correct answer is 18 years and 24 years.

Alternate Method

Given: Present ratio of A and B = 3 : 4. Ratio 4 years ago = 7 : 10.

Formula: Age = Ratio Part × Common Multiplier (x).

Let the present ages of A and B be 3x and 4x respectively.

=> (3x − 4) / (4x − 4) = 7 / 10

=> 10 × (3x − 4) = 7 × (4x − 4)

=> 30x − 40 = 28x − 28

=> 30x − 28x = 40 − 28

=> 2x = 12

=> x = 6

=> Present age of A = 3 × 6 = 18 years

=> Present age of B = 4 × 6 = 24 years

Therefore The correct answer is 18 years and 24 years.

Additional Information

Constant Age Difference

The numerical difference between the ages of two individuals remains constant regardless of the number of years passed or preceding.

Ratio Balancing Method

If the difference between ratio parts is not the same, multiply the ratios by the difference of the opposite ratio to balance the units.

Future and Past Ages

If present age is x, age after n years = x + n; age n years ago = x − n.

Q39. Answer: (a) Rs. 138

Shortcut Trick

Original Price = 100% = Rs. 120

New Price after 15% increase = 115% of Original Price

New Price = 1.15 × 120

New Price = Rs. 138

Therefore The correct answer is Rs. 138.

Alternate Method

Given:

Original Price = Rs. 120

Percentage Increase = 15%

Formula Used:

New Price = Original Price + (Increase% × Original Price)

Calculations:

=> Amount of increase = 15% of 120

=> Amount of increase = (15 ÷ 100) × 120

=> Amount of increase = 0.15 × 120 = Rs. 18

=> New Price = 120 + 18

=> New Price = Rs. 138

Therefore The correct answer is Rs. 138.

Additional Information

Percentage Increase Formula

New Value = Original Value × (1 + r/100), where r is the percentage increase rate.

Successive Percentage Change

If a value is increased by x% and then y%, the net effective percentage change is [x + y + (xy/100)]%.

Fractional Conversion

An increase of 15% is equivalent to a multiplier of 23/20 (since 15% = 3/20 and 1 + 3/20 = 23/20).

Q40. Answer: (d) 6859

Shortcut Trick

Volume of a cube = $(\text{Side})^3$

Given side = 19 m, which ends in the digit 9.
The unit digit of 9^3 is 9 (9 × 9 × 9 = 729).
Therefore, the result must end with 9.
Only option (4) 6859 satisfies this condition.
Therefore The correct answer is 6859.
Alternate Method
Given: Edge of the cube (a) = 19 m
Formula Used: Volume of cube = a^3
=> Volume = 19^3
=> Volume = 19 × 19 × 19
=> Volume = 361 × 19
=> Volume = 6859 m^3
Therefore The correct answer is 6859.
Additional Information
Total Surface Area of Cube
The total surface area of a cube with side 'a' is given by $6a^2$.
Lateral Surface Area of Cube
The area of the four vertical faces is called the lateral surface area, calculated as $4a^2$.
Diagonal of a Cube
The longest rod that can be placed inside a cube is its diagonal, which is equal to $a\sqrt{3}$.
Perimeter of Cube
The sum of all the edge lengths of a cube is 12a.

Q41. Answer: (b) Rs. 1,062.50

Shortcut Trick
Successive multiplier = (1 − 0.12) × (1 + 0.20) = 0.88 × 1.2 = 1.056.
Let Cost Price of A be x.
x × 1.056 = 1,122.
x = 1,122 ÷ 1.056 = 1,062.50.
Therefore The correct answer is Rs. 1,062.50.
Alternate Method
Given: Loss % (A to B) = 12%, Profit % (B to C) = 20%, Amount paid by C = Rs. 1,122.
Formula: CP = SP ÷ [(1 ± R1/100) × (1 ± R2/100)]
=> Let CP for A = x
=> SP for A (which is CP for B) = x × (100 − 12) / 100 = 0.88x
=> SP for B (which is CP for C) = 0.88x × (100 + 20) / 100
=> 1,122 = 0.88x × 1.20
=> 1,122 = 1.056x
=> x = 1,122 / 1.056
=> x = 1,062.50
Therefore The correct answer is Rs. 1,062.50.
Additional Information
Successive Percentage Change
Net percentage change for two successive changes of a% and b% is given by [a + b + (ab/100)]%.
Cost Price Formula
To find CP when SP and Profit% are given: CP = [SP × 100] ÷ [100 + Profit%]. For loss, replace + with −.
Ratio Method
Convert percentages to fractions: 12% loss = 22/25 multiplier; 20% profit = 6/5 multiplier. Initial CP = Final SP × (25/22) × (5/6).

Q42. Answer: (a) Rs. 459

Shortcut Trick
For quarterly compounding, Rate = 16% ÷ 4 = 4% per quarter.

Time = 6 months = 2 quarters.
Effective interest rate for 2 quarters = 4 + 4 + (4 × 4)/100 = 8.16%.
CI = 5625 × 8.16% = 459.
Therefore The correct answer is Rs. 459.
Alternate Method
Given:
Principal (P) = Rs. 5,625
Rate (R) = 16% per annum
Time (T) = 6 months
Formula Used: Amount (A) = $P(1 + r/100)^n$; CI = A − P
Since interest is compounded quarterly:
=> Quarterly Rate (r) = 16% ÷ 4 = 4%
=> Number of quarters (n) = 6 months ÷ 3 months = 2
=> $A = 5625 \times (1 + 4/100)^2$
=> $A = 5625 \times (26/25) \times (26/25)$
=> $A = 5625 \times (676/625)$
=> $A = 9 \times 676 = 6084$
=> CI = 6084 − 5625 = 459
Therefore The correct answer is Rs. 459.
Additional Information
Quarterly Compounding
When interest is compounded quarterly, the annual rate is divided by 4 and the time in years is multiplied by 4.
Effective Rate of Interest
For two periods with rate r, the effective rate is r + r + (r × r)/100.
Compound Interest for Half-Yearly
If compounded half-yearly, the rate is halved (R/2) and the time is doubled (2T).

Q43. Answer: (c) 336pq2

Shortcut Trick
Apply algebraic identity: $(a + b)^2 - (a - b)^2 = 4ab$
Let a = 6pq and b = 14q
Required result = 4 × (6pq) × (14q)
=> $24 \times 14 \times p \times q \times q = 336pq^2$
Therefore The correct answer is $336pq^2$.
Alternate Method
Given: $(6pq + 14q)^2 - (6pq - 14q)^2$
Formula used: $x^2 - y^2 = (x + y)(x - y)$
=> [(6pq + 14q) + (6pq − 14q)] × [(6pq + 14q) − (6pq − 14q)]
=> [6pq + 14q + 6pq − 14q] × [6pq + 14q − 6pq + 14q]
=> [12pq] × [28q]
=> 12 × 28 × p × q × q
=> $336pq^2$
Therefore The correct answer is $336pq^2$.
Additional Information
Algebraic Identities of Squares
$(a + b)^2 = a^2 + b^2 + 2ab$ and $(a - b)^2 = a^2 + b^2 - 2ab$.
Sum and Difference of Squares
$(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$ while $(a + b)^2 - (a - b)^2 = 4ab$.
Factorization Identity
$a^2 - b^2 = (a + b)(a - b)$. This is useful for simplifying expressions involving difference of squares.

Q44. Answer: (a) The difference between denominator and numerator is 12

Shortcut Trick

Let original fraction be N/D.

New fraction = (125% of N) / (91% of D) = 5/7

N/D = (5/7) × (91/125)

N/D = (1/1) × (13/25) = 13/25

Denominator − Numerator = 25 − 13 = 12.

Therefore The correct answer is The difference between denominator and numerator is 12.

Alternate Method

Given:

Numerator increase = 25%

Denominator decrease = 9%

Resulting fraction = 5/7

Let the original fraction be x/y.

=> According to the question:

=> [x × (100 + 25)/100] / [y × (100 − 9)/100] = 5/7

=> (x × 125/100) / (y × 91/100) = 5/7

=> 125x / 91y = 5/7

=> x/y = (5 × 91) / (7 × 125)

=> x/y = 455 / 875

=> x/y = 13 / 25

=> Original Numerator = 13, Original Denominator = 25

=> Checking statements:

=> Denominator − Numerator = 25 − 13 = 12

Therefore The correct answer is The difference between denominator and numerator is 12.

Additional Information

Percentage Change in Fractions

To find the original fraction given a percentage change, use the formula: Original × (New% Numerator / New% Denominator) = Final Fraction.

Proper and Improper Fractions

A fraction is proper if the numerator is less than the denominator (e.g., 13/25), and improper if the numerator is greater than or equal to the denominator.

Ratio Comparison

If the numerator increases and the denominator decreases, the value of the fraction always increases.

Q45. Answer: (b) 2 hours

Shortcut Trick

New distance is 3 times the old distance (26.4 ÷ 8.8 = 3).

New speed is 2 times the old speed.

Since Time = Distance ÷ Speed, the new time factor = 3 ÷ 2 = 1.5.

Initial time = 1 hour 20 minutes = 80 minutes.

New time = 80 × 1.5 = 120 minutes = 2 hours.

Therefore The correct answer is 2 hours.

Alternate Method

Given: Distance1 = 8.8 km, Time1 = 1 hour 20 min, Distance2 = 26.4 km, Speed2 = 2 × Speed1.

Formula used: Speed = Distance ÷ Time | Time = Distance ÷ Speed

=> Time1 = 1 + 20/60 = 1 + 1/3 = 4/3 hours

=> Speed1 = 8.8 ÷ (4/3) = (8.8 × 3) ÷ 4 = 2.2 × 3 = 6.6 kmph

=> Speed2 = 2 × 6.6 = 13.2 kmph

=> Time2 = Distance2 ÷ Speed2

=> Time2 = 26.4 ÷ 13.2 = 2 hours

Therefore The correct answer is 2 hours.

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Additional Information

Speed-Time-Distance Proportionality

When speed is constant, Distance prop. to Time. When distance is constant, Speed prop. to 1/Time. When time is constant, Distance prop. to Speed.

Average Speed

Average Speed = Total Distance ÷ Total Time. For two equal distances with speeds x and y, Average Speed = 2xy ÷ (x + y).

Unit Conversion

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

Q46. Answer: (d) 19

Shortcut Trick

Solve the innermost bracket expressions first: (36 ÷ 6) = 6 and (9 ÷ 3) = 3.

Simplify the terms inside the braces: {6 + 3 − 3} = 6.

Multiply the result by the outer fraction: 1/6 × 6 = 1.

Add the final constant term: 1 + 18 = 19.

Therefore The correct answer is 19.

Alternate Method

Given expression: [1/6 × {(36 ÷ 6) + (9 ÷ 3) − 3} + 18]

Method: Apply BODMAS rule (Brackets, Of, Division, Multiplication, Addition, Subtraction).

=> [1/6 × {6 + 3 − 3} + 18]

=> [1/6 × {9 − 3} + 18]

=> [1/6 × 6 + 18]

=> 1 + 18

=> 19

Therefore The correct answer is 19.

Additional Information

BODMAS Rule

It defines the order of operations: Brackets (), Orders (roots/powers), Division (÷), Multiplication (×), Addition (+), and Subtraction (−).

Types of Brackets

Solve brackets in the order: Parentheses (), then Curly Braces { }, and finally Square Brackets [].

Division Shortcut

Division is the same as multiplication by the reciprocal. For example, a ÷ b = a × (1/b).

Q47. Answer: (a) 92 years

Shortcut Trick

Total current age of 2 members = Average × Number of members = 35 × 2 = 70 years.

In 11 years, each member's age increases by 11.

Total increase in sum for 2 members = 2 × 11 = 22 years.

Total age after 11 years = Current sum + Total increase = 70 + 22 = 92 years.

Therefore The correct answer is 92 years.

Alternate Method

Given:

Ratio of ages = 6:1

Average age = 35 years

Formula used: Average = Sum of observations ÷ Total number of observations

Let the current ages of the two members be 6x and x respectively.

=> Average = (6x + x) ÷ 2 = 35

=> 7x ÷ 2 = 35

=> 7x = 70

=> x = 10

=> Present ages: Member 1 = 6 × 10 = 60 years | Member 2 = 1 × 10 = 10 years

=> Age of Member 1 after 11 years = 60 + 11 = 71 years

=> Age of Member 2 after 11 years = 10 + 11 = 21 years
=> Total age after 11 years = 71 + 21 = 92 years
Therefore The correct answer is 92 years.
Additional Information
Sum and Average Relation
Total sum of ages is always equal to the Average multiplied by the total number of individuals (Sum = Avg × n).
Future Sum of Ages
If there are 'n' people, the total sum of their ages after 't' years will increase by (n × t).
Ratio and Sum
If the ratio of two quantities is a:b, then their sum can be represented as k(a + b), where k is a constant factor.

Q48. Answer: (a) 125 m²

Shortcut Trick
Area of a general quadrilateral = 1/2 × Diagonal × (Sum of perpendiculars)
Diagonal (d) = 10 m, Perpendiculars h1 = 12 m, h2 = 13 m
Area = 1/2 × 10 × (12 + 13)
Area = 5 × 25 = 125 m²
Therefore The correct answer is 125 m².
Alternate Method
Given:
Length of diagonal (d) = 10 m
Perpendicular offsets (h1 and h2) = 12 m and 13 m
Formula Used:
Area of Quadrilateral = Area of Triangle1 + Area of Triangle2
Area = (1/2 × base × height1) + (1/2 × base × height2)
=> Area = 1/2 × d × (h1 + h2)
=> Area = 1/2 × 10 × (12 + 13)
=> Area = 5 × 25
=> Area = 125 m²
Therefore The correct answer is 125 m².
Additional Information
Area of Rhombus
When both diagonals are known, Area = 1/2 × d1 × d2.
Area of Trapezium
Area = 1/2 × (sum of parallel sides) × h, where h is the distance between them.
Area of Parallelogram
Area = base × height. Also, if two adjacent sides a, b and the angle θ between them are given, Area = ab sinθ.
Area of Cyclic Quadrilateral
Area = √[(s−a)(s−b)(s−c)(s−d)], where s is the semi-perimeter (a+b+c+d)/2.

Q49. Answer: (b) 10

Shortcut Trick
Total capacity of cistern = LCM (8, 20) = 40 units
Efficiency of (P + Q) = 40 ÷ 8 = 5 units/hr
Efficiency of P = 40 ÷ 20 = 2 units/hr
Efficiency of Q = (P + Q) − P = 5 − 2 = 3 units/hr
3/4th of capacity = 40 × 3/4 = 30 units
Time taken by Q = 30 ÷ 3 = 10 hours
Therefore The correct answer is 10.
Alternate Method
Given:
Time taken by (P + Q) = 8 hours

Time taken by P = 20 hours

Formula Used:

Total Work = Efficiency × Time

Pipes	Time (hr)	Work (LCM)	Efficiency
P	20	40	2
P + Q	8	5	

=> Efficiency of P = 40 ÷ 20 = 2

=> Combined Efficiency of P and Q = 40 ÷ 8 = 5

=> Efficiency of Q = 5 − 2 = 3

=> Total work to be done = 3/4 of the cistern capacity

=> Required Work = 40 × (3/4) = 30 units

=> Time taken by Q = Required Work ÷ Efficiency of Q

=> Time taken by Q = 30 ÷ 3 = 10 hours

Therefore The correct answer is 10.

Additional Information

Efficiency and Time Relationship

Efficiency is inversely proportional to the time taken. If P takes x hours and Q takes y hours, their efficiencies are 1/x and 1/y respectively.

Pipes and Cisterns Basic Formula

If an inlet pipe fills in A hours and another fills in B hours, they together fill in (A × B) ÷ (A + B) hours.

Negative Work (Outlet/Leakage)

If a pipe empties the tank, its efficiency is taken as negative in the total efficiency calculation.

Q50. Answer: (a) 16 days

Shortcut Trick

LCM of (20, 24, 30) = 120 units (Total Work).

Efficiencies: (X+Y) = 6, (Y+Z) = 5, (Z+X) = 4.

Combined efficiency 2(X+Y+Z) = 6 + 5 + 4 = 15.

Efficiency (X+Y+Z) = 15 ÷ 2 = 7.5.

Days taken = 120 ÷ 7.5 = 16 days.

Therefore The correct answer is 16 days.

Alternate Method

Given:

Time taken by (X + Y) = 20 days

Time taken by (Y + Z) = 24 days

Time taken by (Z + X) = 30 days

Formula used: Total Work = Time × Efficiency

Persons	Time	Work (LCM)	Efficiency
X + Y	20	120	6
Y + Z	24	5	
Z + X	30	4	

Calculations:

=> Total efficiency of (X+Y) + (Y+Z) + (Z+X) = 6 + 5 + 4

=> 2(X + Y + Z) efficiency = 15 units/day

=> (X + Y + Z) efficiency = 15 ÷ 2 = 7.5 units/day

=> Time taken by (X + Y + Z) together = Total Work ÷ Combined Efficiency

=> Time = 120 ÷ 7.5

=> Time = 16 days

Therefore The correct answer is 16 days.

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Additional Information

Pipes and Cisterns

This concept is identical to Time and Work, where an inlet pipe has positive efficiency and an outlet pipe (leak) has negative efficiency.

Work and Wages

Wages are always distributed in the ratio of the work actually done by each person (which is efficiency × time).

Combined Efficiency Rule

When individuals work in pairs (A+B, B+C, C+A), the sum of their efficiencies is twice the efficiency of all three working together: 2(A+B+C) = ΣEfficiencies.

Q51. Answer: (b) 138

The logic followed here is:

thus, "138" will replace the question mark in the given series.

Hence, the correct option is "Option 2".

Q52. Answer: (a) 95

BODMAS Table:

Decoding the given information:

Alphabet	•	−	×	÷
Meaning	−	•	÷	×

Now, replacing the sign from left to right using BODMAS Rule, we get:

=> 97 + 46 − 12 × 8 ÷ 2 = ?

=> 97 + 46 − 48 = ?

=> 143 − 48 = ?

=> 95

Hence, the correct option is "Option 1".

Q53. Answer: (a) 4 km to the east

The logic followed here is:

Given:

Mr. Apso starts from point A and drives 7 km towards north.

He then takes a right turn, drives 4 km, turns right and drives 9 km.

He then takes a right turn and drives 8 km.

He takes a final right turn, drives 2 km and stops at point P.

So, To reach Point A, he must go 4 km towards the East

Hence, the correct answer is Option 3.

Q54. Answer: (a) Two

The logic followed here is:

Given number: 7 2 3 1 4 5 6

Original number: 7 2 3 1 4 5 6

Digits arranged in ascending order: 1 2 3 4 5 6 7

Position	**Original Digit**	**New Digit**	**Status**
1	7	1	Changed
2	2	2	Unchanged
3	3	3	Unchanged
4	1	4	Changed
5	4	5	Changed
6	5	6	Changed
7	6	7	Changed

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Digits whose positions remain unchanged: 2, 3
Number of unchanged positions = 2
Hence, the correct answer is Option 1.

Q55. Answer: (a) hl

The logic followed here is:
Given:
'chase clouds away' → hl mt dv
'clouds block sun' → ya co hl
So, the code for clouds = hl.
Hence, the correct answer is Option 1.

Q56. Answer: (c) LOIN

The logic followed here is:
For RUOT → VYSX
Now, for MPJO → QTNS
Now, applying the same logic for HKEJ:
So, HKEJ → LOIN
Hence, the correct answer is "Option 3".

Q57. Answer: (d) O

Given: N, O, P, Q, R, S and T are sitting in a row facing north.
Only four people sit to the right of S.
T sits second to the left of N.
R sits fourth to the left of P.
Q sits to the immediate right of S
Now, The extreme left end is position 1 → O
Hence, the correct answer is "Option 4".

Q58. Answer: (a) JOR

The logic followed here is:
Option 1) JOR
Option 2) GKN
Option 3) TXA
Option 4) YCF
Here, JOR is odd from the given options.
Hence, the correct answer is "Option 1".

Q59. Answer: (a) 20th

Given:
Tanmay is 18th from the left end and there are 17 people between Tanmay and Yash in a row of 55 people.
Here, Yash's position from the left end = 18 + 17 + 1 = 36th
Now, Yash's position from the right end = 55 − 36 + 1 = 20th
So, Yash is 20th from the right end.
Hence, the correct answer is "Option 1".

Q60. Answer: (a) 15

Given: 687, 652, 691, 287, 286
Now, the second digit of the highest number and the third digit of the lowest number, then add them.
Highest number = 691

1st Digit	2nd Digit	3rd Digit
6	9	1

Second digit of highest number = 9

Lowest number = 286

1st Digit	2nd Digit	3rd Digit
2	8	6

Third digit of lowest number = 6

So, 9 + 6 = 15

Hence, the correct answer is Option 1.

Q61. Answer: (a) SORW

The logic followed here is:

For EADI → KGJO

Now, for IEHM → OKNS

Now, applying the same logic for MILQ:

So, MILQ → SORW

Hence, the correct answer is "Option 1".

Q62. Answer: (a) LIFA

The logic followed here is:

For VTQS → PNKM

Now, for PMKF → JGEZ

Now, applying the same logic for ROLG:

So, ROLG → LIFA

Hence, the correct answer is "Option 1".

Q63. Answer: (b) 1

The logic followed here is:

Given:

FIRM → 5713

MEAN → 2148

So, the code for M = 1.

Hence, the correct answer is Option 2.

Q64. Answer: (d) Two

Given: Six people T, U, V, W, X and Y are sitting around a circular table facing the centre.

Y is an immediate neighbour of both T and V.

U is sitting to the immediate right of V.

W is sitting second to the left of Y.

So, two people (U and V) sit between X and Y.

Hence, the correct answer is "Option 4".

Q65. Answer: (d) 13th

Given:

Rohan is 35th from the left end and Shekhar is 25th from the right end in a row of 85 students.

Here, Shekhar's position from the left end = (85 − 25) + 1 = 61st

Now, Number of students between Rohan and Shekhar = 61 − 35 = 26 − 1 = 25

Since Kuldeep sits exactly in the middle,

Kuldeep's position from Rohan = (25 + 1) ÷ 2 = 13th

So, Kuldeep is 13th from Rohan.

Hence, the correct answer is "Option 4".

Q66. Answer: (a) 6

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

Now, Remove all the odd numbers and find the 7th number from the right end.

After removing odd numbers: 4 2 4 8 6 2 6 4 8 6 2 4 2

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Direction	13th	12th	11th	10th	9th	8th	7th	6th	5th	4th	3rd	2nd	1st	Side
Left →	4	2	4	8	6	2	6	4	8	6	2	4	2	← Right

So, the 7th number from the right end = 6

Hence, the correct answer is Option 1.

Q67. Answer: (d) 21 336 4

The logic followed here is:

Logic: Second Number = First Number × Third Number × 4.

For, (14, 280, 5)

=> 14 × 5 = 70

=> 70 × 4 = 280

For, (7, 336, 12)

=> 7 × 12 = 84

=> 84 × 4 = 336

Now, checking the options:

Option 1) (12, 578, 10)

=> 12 × 10 = 120

=> 120 × 4 = 480 ≠ 578

Option 2) (18, 876, 9)

=> 18 × 9 = 162

=> 162 × 4 = 648 ≠ 876

Option 3) (13, 992, 11)

=> 13 × 11 = 143

=> 143 × 4 = 572 ≠ 992

Option 4) (21, 336, 4)

=> 21 × 4 = 84

=> 84 × 4 = 336 = 336

Therefore, the set (21, 336, 4) follows the same pattern.

Hence, the correct answer is Option 4.

Q68. Answer: (c) Three

The logic followed here is:

Given series: (Left) M R Y T O N B F W A H L D X G Z J Q V E P K (Right)

Vowels in English alphabet: A, E, I, O, U

(Left) M R Y T O N B F W A H L D X G Z J Q V E P K (Right)

Vowels found in the series: O, A, E

Number of vowels = 3

Hence, the correct answer is Option 3.

Q69. Answer: (b) Only Conclusion II follows.

Given Statements:

All cushions are pillows.

No pillows are blankets.

Some blankets are envelopes.

The least possible Venn diagram for the given statement is:

Conclusions:

I. Some envelopes are pillows – Does not follow (Envelopes may overlap only with blankets, and pillows are separate from blankets, so no definite overlap is established between envelopes and pillows).

II. No cushion is a blanket – Follows (Cushions are inside pillows and pillows do not overlap with blankets, so cushions cannot be blankets).

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So, only conclusion II follows.
Hence, the correct answer is "Option 2".

Q70. Answer: (a) One

The logic followed here is:
Given numbers: 423, 253, 174, 324, 749
Logic: Add 2 to the first digit of each number and check whether the result is exactly divisible by the second digit.
423 →
First digit + 2 = 4 + 2 = 6
6 is exactly divisible by 2
253 →
First digit + 2 = 2 + 2 = 4
4 is not exactly divisible by 5
174 →
First digit + 2 = 1 + 2 = 3
3 is not exactly divisible by 7
324 →
First digit + 2 = 3 + 2 = 5
5 is not exactly divisible by 2
749 →
First digit + 2 = 7 + 2 = 9
9 is not exactly divisible by 4
Only 423 satisfies the condition.
Hence, the correct answer is Option 1.

Q71. Answer: (c) CZR 37

The logic followed here is:
So, the missing term = CZR 37
Hence, the correct answer is Option 3.

Q72. Answer: (c) Brother's son's wife's father

Family Chart:
Decoding the Symbols:

Symbol	**•**	**−**	**×**	**÷**
Meaning	Son	Brother	Wife	Father

Given: D ÷ F × G + H − J
It means: D is the father of F, F is the wife of G, G is the son of H, and H is the brother of J.
Hence, D is J’s brother’s son’s wife’s father.
Hence, the correct answer is "Option 3".

Q73. Answer: (d) GFE

The logic followed here is:
Option 1) TSQ
Option 2) ONL
Option 3) BAY
Option 4) GFE
Here, GFE is odd from the given options.
Hence, the correct answer is "Option 4".

Q74. Answer: (c) TV1

The logic followed here is:
So, the missing term = TV1

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Hence, the correct answer is Option 3.

Q75. Answer: (c) 253

The logic followed here is:

thus, "253" will replace the question mark in the given series.

Hence, the correct option is "Option 3".

Q76. Answer: (c) DEJPQ

The logic followed here is:

BADC → BA_C F_HG _ILK NM_O R_TS

FEHG → BA_C F_HG _ILK NM_O R_TS

JILK → BA_C F_HG _ILK NM_O R_TS

NMPO → BA_C F_HG _ILK NM_O R_TS

RQTS → BA_C F_HG _ILK NM_O R_TS

Therefore, the sequence of letters to be filled is DEJPQ.

Hence, the correct answer is Option 3.

Q77. Answer: (c) 2

Given: A, B, C, D, E, F and G are sitting in a row facing north.

Only E sits to the left of B.

Only four people sit between E and C.

Only G sits between F and D and F is not an immediate neighbor of C.

Now,

People to the right of D (position 5) are: C and A → 2 people

Hence, the correct answer is "Option 3".

Q78. Answer: (c) 414

BODMAS Table:

Decoding the given information:

Alphabet	•	−	×	÷
Meaning	−	•	÷	×

Now, replacing the sign from left to right using BODMAS Rule, we get:

=> 99 × 3 + 15 × 5 − 156 ÷ 2 + 12 ÷ 4 + 16 × 8 − 11 = ?

=> 297 + 75 − 78 + 3 + 128 − 11 = ?

=> 372 − 78 + 3 + 128 − 11 = ?

=> 294 + 3 + 128 − 11 = ?

=> 297 + 128 − 11 = ?

=> 425 − 11 = ?

=> 414

Hence, the correct option is "Option 3".

Q79. Answer: (d) 169

The logic followed here is:

thus, "169" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q80. Answer: (c) Only conclusion (II) follows

Given Statements:

All shampoos are creams.

No creams are facewash.

Some lotions are creams.

The least possible Venn diagram for the given statement is:

Conclusions:

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I. No shampoo is a facewash – Does not follow (There is no direct relation is given between shampoos and facewash), so shampoos cannot be facewash).

II. No lotion is a facewash – Follow (All lotion are inside of the creams and no creams are facewash, so we cannot say all lotions are separated from facewash).

So, only conclusion II follows.

Hence, the correct answer is "Option 3".

Q81. Answer: (a) Merger of 29 labour laws into four Labour Codes

The correct answer is Merger of 29 labour laws into four Labour Codes.

Key Points

• The Government of India has undertaken a historic reform by consolidating 29 Central Labour Laws into four comprehensive Labour Codes to simplify compliance and modernize workers' rights.

• This reform aims to improve the Ease of Doing Business by reducing the complexity of multiple definitions and authorities, replacing them with a more streamlined and transparent framework.

• The four codes include the Code on Wages (2019), the Industrial Relations Code (2020), the Social Security Code (2020), and the Occupational Safety, Health and Working Conditions Code (2020). Hence, the main reform is the merger into four codes.

• The reform is designed to extend social security and minimum wage protections to over 50 crore workers in both the organized and unorganized sectors, including the burgeoning gig economy.

• Under these codes, the government has introduced one registration, one license, and one return for establishments, significantly reducing the administrative burden on employers while ensuring better enforcement of labor standards.

Additional Information

• Code on Wages, 2019:

• It amalgamates four major acts: the Minimum Wages Act (1948), the Payment of Wages Act (1936), the Payment of Bonus Act (1965), and the Equal Remuneration Act (1976).

• It introduces a statutory floor wage to be determined by the Central Government, ensuring that no state government sets a minimum wage below this threshold.

• Social Security Code, 2020:

• This code replaces 9 laws, including the Employees' Provident Fund Act and the Maternity Benefit Act.

• For the first time, it brings gig workers and platform workers under the ambit of social security schemes, such as life and disability cover.

• Industrial Relations Code, 2020:

• It consolidates the Trade Unions Act (1926), Industrial Employment (Standing Orders) Act (1946), and Industrial Disputes Act (1947).

• It increases the threshold for establishments to lay off workers without prior government permission from 100 to 300 employees.

• OSH Code, 2020:

• The Occupational Safety, Health and Working Conditions Code merges 13 labor laws related to factories, mines, and construction workers.

• It mandates free health check-ups once a year for employees above a certain age and formalizes the appointment letters for all workers.

Important Points

• Digitization of Compliance: The Ministry of Labour and Employment has integrated these reforms with the Shram Suvidha Portal to facilitate online inspection and grievance redressal.

• Unorganized Sector Focus: The e-Shram portal was launched to create a National Database of Unorganized Workers (NDUW), which helps in the direct delivery of social security benefits.

• Fixed-Term Employment: The codes introduce fixed-term employment, allowing employers to hire workers for a specific duration with the same statutory benefits as permanent employees, ensuring flexibility and fairness.

• Gender Neutrality: The reforms emphasize gender equality by allowing women to work in all establishments at night (between 7 PM and 6 AM) subject to their consent and safety arrangements.

Q82. Answer: (d) Justice Surya Kant

The correct answer is Justice Surya Kant.

Key Points

• Justice Surya Kant was appointed as the Chief Justice of India (CJI) with effect from 24 November 2025.

• He succeeded Justice B.R. Gavai, whose tenure as the Chief Justice concluded on 23 November 2025.

• Justice Surya Kant was elevated as a Judge of the Supreme Court of India on 24 May 2019.

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• Before joining the Supreme Court, he served as the Chief Justice of the Himachal Pradesh High Court and as a Judge of the Punjab and Haryana High Court.

• His appointment was made by the President of India under Article 124 of the Constitution, following the established convention of appointing the senior-most Supreme Court judge as the Chief Justice of India.

• Hence, the correct answer is Option 4 – Justice Surya Kant.

Additional Information

• Justice D.Y. Chandrachud:

• Served as the 50th Chief Justice of India from 9 November 2022 to 10 November 2024.

• Justice Sanjiv Khanna:

• Served as the 51st Chief Justice of India from 11 November 2024 to 13 May 2025.

• Justice B.R. Gavai:

• Served as the 52nd Chief Justice of India from 14 May 2025 to 23 November 2025.

Important Points

• Chief Justice of India (from 24 November 2025): Justice Surya Kant.

• Immediate Predecessor: Justice B.R. Gavai.

• Appointment Effective From: 24 November 2025.

• Constitutional Provision: Article 124 of the Constitution of India.

Q83. Answer: (b) Haryana

The correct answer is Haryana.

Key Points

• Haryana finished at the top of the medal tally in the Khelo India Para Games (KIPG) 2025.

• The state secured the highest number of medals across various para sports, showcasing outstanding performances by its para-athletes.

• Tamil Nadu and Maharashtra were among the other leading performers in the Games, but Haryana emerged as the overall champion.

• The Khelo India Para Games 2025 were organized to promote sports among persons with disabilities and to identify talented para-athletes for national and international competitions.

• Hence, the correct answer is Option 2 – Haryana.

Additional Information

• The Khelo India Para Games are conducted under the Khelo India Programme of the Ministry of Youth Affairs and Sports.

• The Games provide a national platform for para-athletes to compete in multiple disciplines, including athletics, badminton, powerlifting, table tennis, archery, shooting, and other para sports.

• The event aims to encourage greater participation in sports among persons with disabilities and strengthen India's para-sports ecosystem.

Important Points

• Top State: Haryana.

• Event: Khelo India Para Games 2025.

• Organised by: Ministry of Youth Affairs and Sports, Government of India.

• Objective: To promote para sports, identify talented athletes, and prepare them for international competitions such as the Paralympic Games, Asian Para Games, and World Para Championships.

• Exam Tip: Remember that Haryana topped the medal tally at the Khelo India Para Games 2025, continuing its strong performance in national sporting events.

• Correct Answer: Option 2 – Haryana.

Q84. Answer: (d) Radio-frequency spectrum

The correct answer is Radio-frequency spectrum.

Key Points

• The National Frequency Allocation Plan, 2025 (NFAP-2025) is a regulatory document issued by the Department of Telecommunications (DoT), under the Ministry of Communications, which provides the central framework for the allocation and assignment of the radio-frequency spectrum in India.

• It defines which portions of the electromagnetic spectrum are reserved for specific types of services, such as mobile telephony (5G, 6G), broadcasting, satellite communications, and defense purposes. Hence, the option regarding radio-frequency spectrum is correct.

• The plan is periodicially updated to align India's spectrum usage with the international standards set by the International

Telecommunication Union (ITU) during the World Radiocommunication Conference (WRC).

• NFAP-2025 specifically aims to support the deployment of next-generation technologies by identifying new frequency bands for broadband wireless access and Low Earth Orbit (LEO) satellite constellations.

• By organizing the spectrum, the government ensures that wireless signals do not interfere with each other, maximizing the efficiency and security of the nation's digital infrastructure.

Additional Information

• Radio-frequency (RF) Spectrum:

• The RF spectrum refers to the range of electromagnetic waves between 3 kHz and 300 GHz. It is a finite natural resource owned by the public and managed by the state.

• In India, the Wireless Planning and Coordination (WPC) Wing of the DoT is the national authority for frequency management.

• Department of Telecommunications (DoT):

• The DoT is responsible for formulating policies and licensing for telecom services. It conducts spectrum auctions to allocate frequencies to private players like Airtel, Jio, and Vi.

• ITU and WRC:

• The International Telecommunication Union (ITU) is a United Nations specialized agency. The WRC is held every three to four years to review and revise the Radio Regulations, which then serve as a template for the National Frequency Allocation Plan.

• Analysis of Other Options:

• Postal codes: These are part of the Postal Index Number (PIN) system managed by the Department of Posts for logistics and mail delivery. Hence, this statement is incorrect.

• Railway land-use frequencies: While railways use specific frequencies for signaling (like GSM-R), the NFAP is a broader plan for all sectors, and "land-use" is a matter of infrastructure planning, not frequency allocation. Hence, this statement is incorrect.

• Electric vehicle (EV) charging bands: EV charging involves power electronics and electrical grid standards (such as CCS or CHAdeMO) rather than the radio-frequency spectrum allocation. Hence, this statement is incorrect.

Q85. Answer: (b) MS Dhoni

The correct answer is MS Dhoni.

Key Points

• Former Indian captain MS Dhoni was inducted into the ICC Hall of Fame in 2025.

• He was honoured alongside several cricketing legends, including Matthew Hayden (Australia) and Hashim Amla (South Africa).

• MS Dhoni is regarded as one of the greatest captains in cricket history, having led India to:

• ICC T20 World Cup (2007)

• ICC Cricket World Cup (2011)

• ICC Champions Trophy (2013)

• He is the only captain to have won all three major ICC white-ball trophies.

• Hence, the correct answer is Option 2 – MS Dhoni.

Additional Information

• ICC Hall of Fame:

• Established by the International Cricket Council (ICC) to honour cricketers who have made exceptional contributions to the sport.

• Players are inducted after retirement based on their outstanding achievements and impact on international cricket.

• MS Dhoni's Major Achievements:

• Captain of India's 2007 ICC T20 World Cup-winning team.

• Captain of India's 2011 ICC Cricket World Cup-winning team.

• Captain of India's 2013 ICC Champions Trophy-winning team.

Important Points

• ICC Hall of Fame 2025 inductee from India: MS Dhoni.

• He was inducted along with Matthew Hayden and Hashim Amla.

Q86. Answer: (b) Rs. 5 Lakh

The correct answer is Rs. 5 Lakh.

Key Points

• The government provides a maximum financial support of Rs. 5 Lakh for the new construction of a Tribal Homestay unit to promote sustainable tourism in indigenous areas.

• This initiative is part of the Swadesh Darshan Scheme (specifically under the SD 2.0 framework and related tribal development modules) aimed at enhancing the Socio-economic conditions of tribal communities.

• The primary objective of providing this Financial Assistance is to create Livelihood Opportunities for tribal families by allowing them to showcase their Culture, Heritage, and Traditions to domestic and international tourists.

• By April 2025, the guidelines emphasize that these homestays must adhere to Sustainable Tourism standards, ensuring minimal environmental impact while maximizing community benefits.

• The Ministry of Tourism, in collaboration with the Ministry of Tribal Affairs, facilitates the identification of beneficiaries, focusing on Particularly Vulnerable Tribal Groups (PVTGs) and other marginalized tribal hamlets.

Additional Information

• Swadesh Darshan 2.0 (SD 2.0):

• Launched to move away from theme-based circuits toward Destination-centric tourism development.

• It focuses on Integrated Development of tourist destinations with a focus on Sustainability and Responsibility.

• The scheme encourages the Vocal for Local campaign by promoting indigenous crafts and stay options.

• Financial Bifurcation for Homestays:

• While New Construction receives up to Rs. 5 Lakh, the Upgradation or Renovation of existing tribal houses into homestays is typically eligible for a lower subsidy, often capped at Rs. 3 Lakh.

• This funding is usually disbursed in Installments based on the progress of construction and adherence to specified Architectural Designs that reflect local tribal aesthetics.

• PM-JANMAN Connection:

• The Pradhan Mantri Janjati Adivasi Nyaya Maha Abhiyan (PM-JANMAN), launched in November 2023 with a budget of over Rs. 24,000 Crore, complements the Swadesh Darshan goals by improving basic infrastructure like Roads, Electricity, and Housing in tribal areas, making homestays more viable.

Important Points

• Eligibility and Implementation:

• Beneficiaries must be Permanent Residents of the tribal area and possess Valid Land Records or certificates from local tribal councils.

• The State Tourism Departments act as the nodal agencies for the Verification of applications and the Monitoring of the construction phase.

• Promotion of Niche Tourism:

• Tribal homestays are categorized under Niche Tourism, specifically Eco-Tourism and Ethno-Tourism, which are seeing a high growth rate in India as of 2024-2025.

• The scheme also provides for Capacity Building, where tribal hosts are trained in Hospitality, Hygiene, and Digital Marketing to manage their units effectively.

Q87. Answer: (b) Ministry of Ayush

The correct answer is Ministry of Ayush.

Key Points

• The DRAVYA portal (Digital Repository of Ayurveda, Siddha, Unani, and Homoeopathy medicinal plants) was launched in 2025 to serve as a comprehensive digital knowledge repository for medicinal substances.

• The portal was officially initiated and launched by the Ministry of Ayush to centralize information related to traditional Indian medicine systems.

• It was developed under the supervision of the National Medicinal Plants Board (NMPB), which is the nodal agency for medicinal plants in India.

• The primary objective of DRAVYA is to provide a reliable database containing botanical descriptions, chemical constituents, therapeutic uses, and pharmacological data for over 3,000 species of medicinal plants.

• By digitizing traditional knowledge, the portal aims to facilitate scientific research, standardize herbal formulations, and support the growth of the Ayush industry globally.

Additional Information

• Ministry of Ayush:

• This ministry was established on November 9, 2014, by the Government of India to revive and promote traditional systems of healthcare.

• The acronym AYUSH stands for Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homoeopathy.

• The ministry focuses on upgrading educational standards, quality control of drugs, and increasing the availability of medicinal plant raw materials.

• National Medicinal Plants Board (NMPB):

• Formed in November 2000, the NMPB functions under the Ministry of Ayush.

• It is responsible for coordinating all matters related to medicinal plants, including policy-making, conservation, cultivation, and

sustainable management across various states in India.

• The NMPB also promotes in-situ and ex-situ conservation of rare and endangered medicinal species.

Important Points

• Digital Infrastructure: The DRAVYA portal is a key component of the Digital India mission, ensuring that ancient Ayurvedic texts and tribal medical knowledge are preserved and accessible in a modern format.

• Digital Herbarium: It functions as a Digital Herbarium, allowing botanists and researchers to study high-resolution images and taxonomic details of plants without needing physical samples.

• Global Reach: The portal assists in international trade by providing regulatory bodies and pharmaceutical companies with verified data on the safety and efficacy of Indian medicinal herbs.

• Sustainability: By mapping the geographical distribution of plants, the platform helps the Ministry of Ayush monitor the supply chain and prevent the over-exploitation of natural resources.

Q88. Answer: (b) Managing digital data

The correct answer is Managing digital data.

Key Points

• The Centralised Information Management System (CIMS) is the Reserve Bank of India's (RBI) advanced data warehouse, specifically designed for managing digital data and regulatory reporting across the financial sector.

• Launched by RBI Governor Shaktikanta Das in June 2023, the platform serves as a modern replacement for the previous eXtensible Business Reporting Language (XBRL)-based reporting system.

• The primary function of CIMS is to handle Big Data, enabling the RBI to perform sophisticated data analysis and econometric modeling to support monetary policy and financial stability.

• Regulated Entities (REs), such as Commercial Banks and NBFCs, are required to use this system to submit various statutory and supervisory returns, ensuring a more streamlined and automated flow of information.

• By May 13, 2025, the transition for various categories of Regulated Entities to this centralized platform ensures that all critical financial data is handled through a standardized digital architecture, reducing manual intervention.

• The system leverages Artificial Intelligence (AI) and Machine Learning (ML) to process and validate granular data, which helps in identifying systemic risks and monitoring the health of the Indian economy.

Additional Information

• Regulated Entities (REs):

• These are financial institutions that fall under the direct supervision of the Reserve Bank of India.

• Examples include Public Sector Banks, Private Sector Banks, Foreign Banks, Regional Rural Banks (RRBs), and Non-Banking Financial Companies (NBFCs).

• The CIMS platform ensures these entities provide high-quality data for better regulatory oversight.

• Transition from XBRL to CIMS:

• The XBRL system was the standard for many years, but it faced limitations regarding data granularity and the speed of processing large datasets.

• CIMS provides a more flexible data structure, allowing the RBI to collect data at a much more detailed level (transaction-level in some cases) compared to the aggregate data collected previously.

• Features of CIMS:

• The platform includes a Data Lake that stores both structured and unstructured data.

• It facilitates Straight Through Processing (STP), which minimizes human errors by allowing the direct transfer of data from the banks' internal systems to the RBI's server.

• It provides self-service analytics for REs, allowing them to view their own submitted data and trends.

Important Points

• Regulatory Compliance: Compliance with the CIMS reporting framework is mandatory under the Banking Regulation Act, 1949, and the RBI Act, 1934.

• Data Security: Given the sensitive nature of the financial data, CIMS employs high-level encryption and security protocols to prevent cyber threats and unauthorized access.

• Economic Impact: By providing the Central Bank with real-time data, CIMS helps in the timely identification of Non-Performing Assets (NPAs) and ensures the liquidity and solvency of the banking system.

• Timeline: The RBI has followed a phased implementation approach, moving different reports and returns (like the CRILC or Liquidity Coverage Ratio returns) into CIMS over the years 2023, 2024, and 2025.

Q89. Answer: (a) Amphibious warships, missiles and swarm drones

The correct answer is Amphibious warships, missiles and swarm drones.

Key Points

• In January and February 2025, the Defence Acquisition Council (DAC), which is the highest decision-making body of the Ministry of Defence in India, approved several capital acquisition proposals worth over Rs 1.4 lakh crore to modernize the armed forces.

• The approval included the procurement of Amphibious warships, specifically Landing Platform Docks (LPDs), which are crucial for the Indian Navy to conduct amphibious operations, transport main battle tanks, and provide disaster relief. Hence, the inclusion of amphibious warships is a correct component.

• The DAC also cleared the acquisition of advanced missile systems, including indigenous Short-Range Surface-to-Air Missiles (SRSAM) and variants of the BrahMos cruise missile, to strengthen the strike capability and air defense of the Indian Navy and Indian Army. Hence, the inclusion of missiles is a correct component.

• A significant highlight of the 2025 approvals was the push for swarm drones. These are clusters of Unmanned Aerial Vehicles (UAVs) that use Artificial Intelligence (AI) to coordinate and overwhelm enemy air defenses or conduct mass surveillance. Hence, the inclusion of swarm drones is a correct component.

• The entire package was designed under the Buy (Indian-IDDM) category, which stands for Indigenously Designed, Developed, and Manufactured, ensuring that the technology and production remain within India.

• Hence, the correct answer is Amphibious warships, missiles and swarm drones.

Additional Information

• Defence Acquisition Council (DAC):

• The DAC was formed in 2001 following the recommendations of the Group of Ministers on Reforming the National Security System after the Kargil War.

• It is headed by the Union Defence Minister and includes the Chief of Defence Staff (CDS) and the chiefs of the Army, Navy, and Air Force.

• Its primary function is to give Acceptance of Necessity (AoN) to various defense procurement projects.

• Amphibious Operations and LPDs:

• Landing Platform Docks (LPDs) are massive vessels capable of carrying helicopters, landing crafts, and hundreds of marines.

• They serve as a mobile sea base and are essential for India's security strategy in the Indian Ocean Region (IOR), particularly for protecting island territories like the Andaman and Nicobar Islands.

• Swarm Drone Technology:

• Swarm drones represent the future of asymmetric warfare. They communicate via mesh networks and can perform "saturated strikes" that are difficult for traditional radar and anti-aircraft guns to stop.

• The Indian Army has been integrating these into its mechanized forces to enhance reconnaissance and offensive power along the Line of Actual Control (LAC).

• Atmanirbhar Bharat in Defence:

• The Government of India has issued several Positive Indigenisation Lists, which specify hundreds of items that the Armed Forces must procure only from domestic industry.

• The Defence Acquisition Procedure (DAP) 2020 further incentivizes local production and the participation of private sector players alongside Defence Public Sector Undertakings (DPSUs) like HAL and DRDO.

Important Points

• Key Technology Features:

• The missiles approved in 2025 feature high precision-guidance systems and electronic counter-countermeasures (ECCM) to bypass enemy jamming.

• The Amphibious warships are expected to have a displacement of over 20,000 tonnes and will be built by Indian shipyards such as Mazagon Dock Shipbuilders Limited (MDL) or Garden Reach Shipbuilders & Engineers (GRSE).

• Drones approved include Loitering Munitions, which act as "suicide drones," staying in the air for extended periods before diving onto a target.

• Strategic Impact:

• These acquisitions help India counter the growing influence of the People's Liberation Army Navy (PLAN) in the Indian Ocean.

• By focusing on missiles and drones, India is transitioning from conventional force structures to technology-intensive military capabilities.

Q90. Answer: (a) Sharda Sinha

The correct answer is Sharda Sinha.

Key Points

• Sharda Sinha was a legendary Indian folk and classical singer hailing from the state of Bihar, widely celebrated as the "Bihar Kokila" (Nightingale of Bihar).

• She was also affectionately known as "Swar Kokila" due to her soulful and melodious voice that defined the cultural landscape of North India for decades.

• Born on October 1, 1952, in the Supaul district of Bihar, she became a towering figure in preserving and promoting the folk

traditions of the region.

• She is most famous for her iconic Chhath Puja songs, which have become an inseparable part of the festival's celebrations globally.

• Her immense contribution to the arts was recognized by the Government of India with the Padma Shri in 1991 and the Padma Bhushan in 2018.

• She passed away on November 5, 2024, at the age of 72, marking the end of an era in Indian folk music.

Additional Information

• Linguistic Mastery:

• Sharda Sinha primarily performed in regional languages such as Maithili, Bhojpuri, and Magahi.

• By singing in these dialects, she played a pivotal role in bringing the rural heritage of Bihar and Eastern Uttar Pradesh to the national and international stage.

• Bollywood and Mainstream Success:

• She lent her voice to several hit Bollywood songs, most notably "Kahe Toh Se Sajna" in the 1989 blockbuster Maine Pyar Kiya.

• Other famous tracks include "Taar Bijli" from the film Gangs of Wasseypur - Part 2 (2012) and songs in the movie Hum Aapke Hain Koun..!

• Cultural Impact:

• Her renditions of vivah geet (wedding songs) and sohar (songs celebrating the birth of a child) are staples in households across Bihar.

• She is credited with reviving the popularity of traditional folk instruments and keeping ancient oral traditions alive through her recordings.

Important Points

• Awards and Honors:

• In addition to the Padma awards, she was a recipient of the Sangeet Natak Akademi Award in 2006.

• She was also honored with the Bihar Ratna, the highest civilian honor bestowed by the State Government of Bihar.

• Educational Background:

• Beyond her musical career, she was an academician who served as a Professor of Music at Women’s College, Samastipur.

• She held a Master’s degree in Music and a Ph.D., emphasizing her deep theoretical and practical understanding of Hindustani Classical Music.

• Association with Chhath Puja:

• Her song "Uga Ho Suraj Dev" is considered a cultural anthem for the Chhath Mahaparv, a festival dedicated to the Sun God.

• Her voice is often cited as the bridge that connects the Bihari diaspora to their roots during traditional festivities.

Q91. Answer: (d) Hanoi

The correct answer is Hanoi.

Key Points

• In October 2025, the city of Hanoi, Vietnam, served as the venue for the high-level signing ceremony of the United Nations Convention against Cybercrime.

• A total of 72 UN member states participated in the ceremony to sign the landmark deal, signaling a unified global effort to combat digital crimes.

• This convention represents the first legally binding global treaty specifically designed to address the complexities of cybercrime and electronic evidence sharing.

• The choice of Hanoi as the host city highlights Vietnam's growing influence and commitment to international cybersecurity and digital governance.

• The signing ceremony followed years of intensive negotiations aimed at creating a standardized legal framework for extradition and mutual legal assistance in cyber-related offenses.

Additional Information

• The UN Convention against Cybercrime:

• The process was initiated by General Assembly Resolution 74/247, which established an Ad Hoc Committee to draft a comprehensive international convention.

• The final draft of the treaty was approved in August 2024 in New York before being opened for signature in Hanoi in 2025.

• It aims to bridge the gap between different national legislations, providing a common ground for prosecuting hacking, online fraud, and identity theft.

• Vietnam's Digital Strategy:

• Hosting this event aligns with Vietnam's National Digital Transformation Program, which seeks to secure the country's digital economy.

• As an active member of ASEAN, Vietnam has been a vocal proponent of regional cooperation in information security and data protection.

• Participation Scope:

• While 72 states signed the document in Hanoi, the treaty remains open for further signatures at the United Nations Headquarters to ensure near-universal participation.

Important Points

• International Cooperation: The treaty establishes mechanisms for 24/7 points of contact between nations to facilitate the rapid preservation of electronic data during criminal investigations.

• Human Rights Safeguards: During the drafting and signing in Hanoi, significant emphasis was placed on ensuring that the treaty includes safeguards to protect privacy and freedom of expression.

• Capacity Building: A core pillar of the convention signed in 2025 is providing technical assistance and training to developing nations to help them implement effective cybersecurity measures.

• Implementation: Following the signing, the treaty will enter into force once it is ratified by the required number of national governments, transitioning from a signed agreement to an active international law.

Q92. Answer: (a) Chaman Arora

The correct answer is Chaman Arora.

Key Points

• Chaman Arora has been conferred with the prestigious Sahitya Akademi Award 2024 for his literary contribution to the Dogri language.

• He received this recognition for his book titled "Ik Hor Ashwthama", which is a significant work in contemporary Dogri literature.

• The Sahitya Akademi announced its annual awards for 2024 on December 20, 2024, honoring writers across 24 Indian languages.

• The selection for the award was made based on the recommendations of a three-member jury in the respective languages, following the rules and procedures laid down by the Akademi.

• Chaman Arora's work "Ik Hor Ashwthama" reflects deep cultural and social narratives relevant to the Dogra community and the Jammu region.

Additional Information

• Sahitya Akademi Award:

• Established in 1954, it is a literary honor in India conferred annually by the Sahitya Akademi (India's National Academy of Letters).

• The award is presented to the most outstanding books of literary merit published in any of the major Indian languages.

• Initially, the award amount was Rs. 5,000, but it has been increased over the years and currently stands at Rs. 1,00,000 along with an engraved copper plaque and a shawl.

• The Akademi recognizes 24 languages, including the 22 languages listed in the Eighth Schedule of the Constitution, plus English and Rajasthani.

• Dogri Language:

• Dogri is primarily spoken in the Jammu region of Jammu and Kashmir, as well as parts of Himachal Pradesh and Punjab.

• It was included in the Eighth Schedule of the Indian Constitution in 2003 through the 92nd Constitutional Amendment Act.

• It is one of the five official languages of the Union Territory of Jammu and Kashmir.

• Other Options:

• Shiv Kumar Batalvi: A legendary Punjabi poet who became the youngest recipient of the Sahitya Akademi Award in 1967 for his epic verse play "Loona".

• Dalip Kaur Tiwana: A renowned Punjabi novelist and short-story writer who won the Sahitya Akademi Award in 1971 for her novel "Eho Hamara Jeevana".

• Jaswant Singh: While a common name, in the context of literature, Jaswant Singh Kanwal was a famous Punjabi writer who received the Sahitya Akademi Award in 1996 for his novel "Taushali Di Hansi".

Q93. Answer: (b) China

The correct answer is China.

Key Points

• The 9th Asian Winter Games were held in Harbin, the capital city of Heilongjiang Province in China, during February 2025.

• This edition of the games saw participation from athletes representing 34 National Olympic Committees (NOCs), reflecting the widespread growth and interest in winter sports across the Asian continent.

• The event officially commenced on February 7, 2025, and concluded on February 14, 2025, featuring a wide array of competitions in both ice and snow disciplines.

• Harbin, famously known as the "Ice City," became the first city to host the Asian Winter Games twice, having previously hosted the 3rd edition in 1996.

• The games were organized under the slogan "Dream of Winter, Love among Asia," aimed at promoting unity and the spirit of sportsmanship among participating nations.

Additional Information

• Host Selection and History:

• The Olympic Council of Asia (OCA) officially awarded the hosting rights to Harbin during its 42nd General Assembly held in Bangkok in July 2023.

• China has previously hosted the Asian Winter Games in 1996 (Harbin) and 2007 (Changchun), making the 2025 event the third time the country has hosted this prestigious regional competition.

• Mascots and Symbols:

• The official mascots for the 2025 Games were Binbin and Nini, two Siberian tiger cubs designed to represent the unique wildlife and cultural heritage of Northeast China.

• The emblem, titled "Breakthrough," depicted a short-track speed skater in motion, combined with the form of a lilac flower (the city flower of Harbin).

• Venues and Events:

• The ice sports, including Curling, Figure Skating, and Ice Hockey, were centered in Harbin's urban area, while snow sports like Alpine Skiing and Snowboarding were held in the Yabuli mountain region.

• The competition included 6 sports, 11 disciplines, and 64 events, providing a platform for top-tier winter athletes from Asia.

Important Points

• Environmental Sustainability: The 2025 Harbin Games emphasized a "Green" philosophy, utilizing energy-efficient technologies for ice production and repurposing existing venues to minimize the ecological footprint.

• Future Outlook: Following the 2025 games in China, the 10th Asian Winter Games are scheduled to be held in Trojena, Saudi Arabia, in 2029, marking the first time the event will be held in Western Asia.

• Economic Impact: The event significantly boosted tourism in Heilongjiang, showcasing China's advanced infrastructure and its capability to host world-class sporting events following the success of the 2022 Beijing Winter Olympics.

Q94. Answer: (c) Neeraj Chopra

The correct answer is Neeraj Chopra.

Key Points

• Neeraj Chopra made history in May 2025 by becoming the first Indian javelin thrower to breach the 90-meter mark in an international athletics meet.

• This milestone is considered the "gold standard" in international javelin throw, placing him among the elite group of athletes known as the 90m club.

• Prior to this achievement, his personal best and the National Record stood at 89.94 meters, which he recorded at the Stockholm Diamond League in Sweden on June 30, 2022.

• His consistent performance in global circuits like the Diamond League and World Athletics Championships has made him the most successful Indian track and field athlete in history.

• The 90m throw was a long-anticipated goal for the athlete, who had previously come within centimeters of the mark on multiple occasions. Hence, the correct answer is Neeraj Chopra.

Additional Information

• Neeraj Chopra's Profile:

• Born on December 24, 1997, in Khandra village, Panipat district, Haryana.

• He holds the rank of Subedar in the Indian Army (Rajputana Rifles).

• He rose to global prominence after winning the Gold Medal at the Tokyo 2020 Olympics with a throw of 87.58m, becoming the first Indian to win a gold in track and field.

• Major Career Milestones:

• Won the Gold Medal at the 2023 World Athletics Championships in Budapest with a throw of 88.17m.

• Became the first Indian to win the Diamond League Trophy in 2022.

• Awarded the Major Dhyan Chand Khel Ratna in 2021 and the Padma Shri in 2022.

• Other Options Context:

• Shivpal Singh: An Indian javelin thrower who represented India at the Tokyo Olympics and has a personal best of 86.23m achieved in 2019.

• Kishore Jena: A rising star who won the Silver Medal at the 2022 Asian Games with a personal best of 87.54m.

• Abdul Khaliq: Known as the "Flying Bird of Asia," he was a legendary Pakistani sprinter of the 1950s, not a javelin thrower.

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Important Points

• World Record Context:

• The World Record in men's javelin throw is 98.48 meters, set by Jan Zelezny of the Czech Republic in 1996.

• Crossing the 90m barrier is a feat achieved by fewer than 25 athletes in the history of the sport under current javelin specifications.

• Javelin Specifications:

• The men's javelin weighs exactly 800 grams and measures between 2.6 and 2.7 meters in length.

• The center of gravity was moved forward in 1986 to reduce the flight distance for safety reasons after Uwe Hohn threw 104.80m.

Q95. Answer: (a) Eravikulam National Park

The correct answer is Eravikulam National Park.

Key Points

• Eravikulam National Park, located in the Idukki district of Kerala, has been ranked as the top national park in India with a score of 92.7% in the Management Effectiveness Evaluation (MEE) for the 2020-25 cycle.

• The MEE is a tool used by the Ministry of Environment, Forest and Climate Change (MoEFCC) to assess how well protected areas are being managed and whether they are achieving their conservation objectives.

• The evaluation process is conducted by the Wildlife Institute of India (WII) and follows the framework provided by the IUCN World Commission on Protected Areas (WCPA).

• The 2022-23 report (for the 5th cycle) evaluated 128 National Parks and Wildlife Sanctuaries across the country, focusing on 30 parameters including planning, inputs, process, and conservation outcomes.

• Eravikulam National Park is famous for being the natural habitat of the Nilgiri Tahr, an endangered mountain goat. It also houses Anamudi, the highest peak in South India, standing at an elevation of 2,695 meters. Hence, the correct answer is Eravikulam National Park.

Additional Information

• Bandipur National Park:

• Located in the state of Karnataka, it was established in 1974 as a tiger reserve under Project Tiger.

• It is a part of the Nilgiri Biosphere Reserve and is known for its significant population of Tigers and Asian Elephants.

• It shares its boundaries with Nagarhole National Park, Mudumalai Wildlife Sanctuary, and Wayanad Wildlife Sanctuary.

• Kanha National Park:

• Situated in Madhya Pradesh, it is the largest national park in the state and was created on 1 June 1955.

• It is well-known for successfully conserving the Barasingha (Swamp Deer), which is also the official mascot of the park ("Bhoorsingh the Barasingha").

• The park provided the inspiration for Rudyard Kipling’s famous novel, "The Jungle Book".

• Manas National Park:

• Located in the Himalayan foothills of Assam, it is a UNESCO World Heritage Site, a Project Tiger reserve, and an Elephant Reserve.

• It is renowned for its rare and endangered endemic wildlife such as the Assam Roofed Turtle, Hispid Hare, Golden Langur, and Pygmy Hog.

• The park is contiguous with the Royal Manas National Park in Bhutan.

• Management Effectiveness Evaluation (MEE) Framework:

• India adopted the MEE framework in 2006 to bring transparency and accountability to the management of its Protected Area (PA) network.

• The evaluation divides parks into categories such as 'Very Good' (score above 75%), 'Good' (60-75%), 'Satisfactory' (40-59%), and 'Poor' (below 40%).

• The 5th cycle of evaluation showed a significant improvement in the management standards of Indian wildlife habitats compared to previous decades.

Important Points

• Periyar Tiger Reserve, also located in Kerala, emerged as the best-managed tiger reserve in the same evaluation cycle with a score of 94.38%.

• The state of Kerala has consistently performed well in MEE rankings, highlighting effective conservation strategies and community participation in forest management.

• The Neelakurinji flower, which blooms once every 12 years, is another major attraction of Eravikulam National Park, turning the hills blue during its blooming season.

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Q96. Answer: (b) Clear work–life boundaries

The correct answer is Clear work–life boundaries.

Key Points

• The Right to Disconnect Bill, 2025, is a legislative proposal designed to address the challenges of the Modern Digital Workplace, where technology often blurs the lines between professional and personal life.

• The primary objective of the bill is to establish Clear work–life boundaries by legally recognizing an employee's right to ignore work-related communications, such as Emails, WhatsApp messages, and Phone calls, outside of their stipulated Working Hours. Hence, option 2 is correct.

• It seeks to empower Employees to disconnect from their work without the fear of disciplinary action or professional Retaliation from their Employers.

• The bill proposes that organizations must define specific "Out-of-Office" periods and negotiate terms of engagement that respect the Privacy and personal time of the workforce.

• This principle is aimed at tackling the "Always-On" culture, which has been exacerbated by the rise of Remote Work and Telecommuting, ensuring that the digital tools meant for efficiency do not lead to perpetual Work Cycles.

Additional Information

• Global Context and Origin:

• France became the first country to implement such a law in January 2017, mandating companies with more than 50 employees to establish periods when staff should not send or receive emails.

• Other nations like Italy, Spain, Ireland, Portugal, and recently Australia (in 2024) have introduced similar legal frameworks to protect the Digital Wellbeing of workers.

• Impact on Mental Health:

• Constant connectivity is a major contributor to Work-Related Stress, Burnout, and Mental Fatigue.

• By enforcing Work-Life Balance, the bill aims to reduce Anxiety levels and improve the Sleep Quality of employees who are otherwise tethered to their devices 24/7.

• Productivity and Retention:

• Research indicates that workers who have sufficient Recovery Time are more Productive, Creative, and Engaged during their active hours.

• Establishing these boundaries helps in Employee Retention as workers feel more respected and less prone to Exhaustion.

• Legislative History in India:

• In India, the concept gained traction when a Private Member's Bill, titled the Right to Disconnect Bill, 2018, was introduced in the Lok Sabha by MP Supriya Sule.

• The 2025 version of the bill represents a renewed effort to modernize Labour Laws in the context of the Gig Economy and widespread Digital Transformation.

Important Points

• Key Provisions: The bill often includes the creation of an Employee Welfare Committee within companies to monitor compliance and resolve disputes regarding after-hours communication.

• Exemptions: Most versions of the Right to Disconnect legislation allow for exceptions during Emergencies or critical Operational Requirements, provided they are clearly defined in the Employment Contract.

• Digital Rights: This bill is considered a significant step in the evolution of Digital Rights, acknowledging that in a Hyper-Connected world, the right to be "offline" is essential for Human Dignity.

Q97. Answer: (a) 0.85

The correct answer is 0.85.

Key Points

• The NITI Aayog released the second edition of the North Eastern Region (NER) District Sustainable Development Goals (SDG) Index Report (2023-24) in July 2024, showcasing the progress of districts in the region.

• According to the official report, 85% (which corresponds to the value 0.85) of the districts in the North Eastern Region showed an increase in their composite SDG Index scores compared to the first edition.

• The index is a collaborative effort between NITI Aayog, the Ministry of Development of North Eastern Region (MDoNER), and the United Nations Development Programme (UNDP).

• This edition of the index covered 103 districts across the eight states of the region, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura.

• The assessment is based on 84 indicators that span 15 out of the 17 global SDGs, providing a comprehensive view of social, economic, and environmental development at the district level.

• The improvement in the scores of 0.85 of the districts highlights the success of targeted interventions and localized monitoring of development targets.

Additional Information

• Sustainable Development Goals (SDGs):

• The SDGs are a set of 17 global goals adopted by the United Nations in 2015 as a universal call to action to end poverty and protect the planet by 2030.

• In India, NITI Aayog is the nodal agency responsible for monitoring the progress of these goals at the national and sub-national levels through various indices.

• Performance Categorization:

• Districts are categorized based on their scores: Aspirant (0–49), Performer (50–64), Front Runner (65–99), and Achiever (100).

• In the 2023-24 report, no districts fell into the Aspirant category, indicating a significant upward shift in development standards across the region.

• State-wise Highlights:

• Sikkim and Mizoram have consistently emerged as top performers in the region. Districts like East Sikkim have often secured the highest positions in the rankings.

• The index facilitates competitive federalism by encouraging states and districts to improve their performance through data-driven governance.

Important Points

• Indicators and Framework: The framework for the NER District SDG Index is aligned with the National Indicator Framework (NIF) of the Ministry of Statistics and Programme Implementation (MoSPI).

• Policy Significance: The improvement in 85% of districts is attributed to the successful implementation of flagship schemes such as Jal Jeevan Mission, Pradhan Mantri Awas Yojana (PMAY), and Ayushman Bharat in the North Eastern Region.

• Data Reliability: The index utilizes the latest available data from Central Ministries and State Governments, ensuring a robust and transparent evaluation of regional disparities.

• Regional Development: The focus on the North East is a core part of India's Act East Policy, aiming to integrate the region's economy and infrastructure with the rest of the country and neighboring nations.

Q98. Answer: (a) Bharat Climate Forum 2026

The correct answer is Bharat Climate Forum 2026.

Key Points

• The Vice-President of India, C. P. Radhakrishnan, delivered the inaugural address at the Bharat Climate Forum 2026, which serves as a premier platform for discussing India's climate resilience and sustainable growth.

• During his speech, he emphasized that climate action should be perceived as a strategic opportunity for economic transformation and technological innovation, rather than a constraint or a burden on national development.

• The forum brought together policymakers, industry leaders, and international experts to deliberate on the roadmap for achieving Net Zero emissions while maintaining high economic productivity.

• C. P. Radhakrishnan highlighted that the transition to a green economy is a pathway to creating millions of green jobs and enhancing India's energy security through domestic renewable energy sources.

• He further noted that India is one of the few large economies on track to meet its Nationally Determined Contributions (NDCs), setting a global benchmark for environmental leadership.

Additional Information

• India's Panchamrit Goals:

• Announced at COP26, India's climate strategy includes reaching a non-fossil energy capacity of 500 GW by 2030.

• The nation aims to fulfill 50% of its energy requirements from renewable energy sources by the year 2030.

• A major target is the reduction of total projected carbon emissions by one billion tonnes from now until 2030.

• The ultimate goal is for India to achieve the target of Net Zero emissions by the year 2070.

• C. P. Radhakrishnan:

• He is a prominent Indian politician who has served in significant constitutional roles, including the Governor of Maharashtra and holding additional charges for states like Telangana and Jharkhand.

• Known for his focus on administrative efficiency and social welfare, his transition to the role of Vice-President (as per the 2026 context) underscores his continued influence in national policy.

• National Green Hydrogen Mission:

• Launched by the Government of India with an initial outlay of Rs. 19,744 crore, this mission aims to make India a global hub for Green Hydrogen production.

• It targets the development of at least 5 MMT (Million Metric Tonne) of green hydrogen production capacity per annum by 2030.

• LiFE Movement:

• The Lifestyle for Environment (LiFE) initiative was introduced by Prime Minister Narendra Modi to encourage individuals to lead a

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life that is mindful of resource consumption and waste reduction.

• It promotes the concept of a circular economy where products are reused and recycled to minimize the environmental footprint.

Q99. Answer: (c) Lowered to 3.1%

The correct answer is Lowered to 3.1%.

Key Points

• During the August 2025 meeting of the Monetary Policy Committee (MPC), the Reserve Bank of India (RBI) reviewed the domestic and global economic conditions to set the path for the upcoming quarters.

• A major highlight of this review was the revision of the inflation forecast for the Financial Year 2025-26 (FY26).

• The RBI officially lowered the projected CPI (Consumer Price Index) inflation for FY 2025-26 to 3.1%. Hence, the correct answer is Lowered to 3.1%.

• This downward revision from previous estimates suggests that the central bank anticipates a significant cooling of price pressures, likely due to improved supply-side management, stable crude oil prices, and a favorable monsoon impact on food prices.

• The MPC, led by the RBI Governor, emphasized that maintaining price stability is crucial for sustaining the GDP growth momentum of the Indian economy.

Additional Information

• Monetary Policy Committee (MPC):

• The MPC is a six-member statutory body constituted by the Central Government under Section 45ZB of the amended RBI Act, 1934.

• It consists of three members from the RBI (including the Governor) and three external members appointed by the government.

• The primary objective of the MPC is to determine the Policy Repo Rate required to contain inflation within the specified target level.

• Inflation Targeting Framework:

• India adopted a Flexible Inflation Targeting (FIT) framework in 2016.

• The Government of India, in consultation with the RBI, has set a target for CPI inflation at 4%, with an upper tolerance limit of 6% and a lower tolerance limit of 2%.

• A forecast of 3.1% for FY 2025-26 indicates that the RBI expects inflation to stay well below its median target of 4%.

• Consumer Price Index (CPI):

• CPI is the primary measure used by the RBI to monitor retail inflation.

• It tracks the change in the price of a basket of goods and services consumed by households, including food, fuel, clothing, and housing.

Important Points

• Implications of the Forecast:

• A lower inflation forecast of 3.1% provides the RBI with more room to consider interest rate cuts (reducing the Repo Rate) to stimulate investment and consumption.

• It signals to the financial markets that the "war on inflation" is yielding results, leading to potentially lower bond yields and reduced borrowing costs for corporations and individuals.

• Economic Context:

• The August 2025 review is a pivotal moment as it sets the expectations for the second half of the decade.

• The focus remains on the "withdrawal of accommodation" stance or shifting towards a "neutral" stance if the inflation trajectory remains consistently low near the 3.1% mark.

• The FY 2025-26 period is expected to witness the full impact of previous policy measures and global economic stabilization.

Q100. Answer: (a) WHO Pandemic Agreement

The correct answer is WHO Pandemic Agreement.

Key Points

• The WHO Pandemic Agreement is a landmark international treaty adopted by the 194 Member States of the World Health Organization (WHO) on 20 May 2025 to ensure better global coordination against future health crises.

• The agreement was developed to address the systemic failures exposed during the COVID-19 pandemic, specifically focusing on Pandemic Prevention, Preparedness, and Response (PPPR).

• It was negotiated through the Intergovernmental Negotiating Body (INB), a special drafting group established by the World Health Assembly (WHA) in December 2021.

• A primary pillar of the treaty is equity, aimed at ensuring that low- and middle-income nations have equitable access to medical countermeasures like vaccines, therapeutics, and diagnostics.

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• The agreement is rooted in Article 19 of the WHO Constitution, which allows the Assembly to adopt legally binding conventions or agreements for the global community.

Additional Information

• Pathogen Access and Benefit-Sharing (PABS) System: This is a core component of the treaty that mandates the sharing of pathogens with pandemic potential while ensuring that the resulting benefits (like patents or vaccine doses) are shared fairly with the international community.

• One Health Approach: The agreement integrates the One Health concept, recognizing that the health of humans, animals, and environments are interconnected, which is crucial for preventing zoonotic diseases.

• Sovereignty: The treaty explicitly reaffirms the sovereign right of nations to manage their own public health policies, provided they fulfill their responsibilities under the global framework.

• International Health Regulations (IHR): The WHO Pandemic Agreement works in tandem with the updated IHR (2005), which focuses on surveillance and notification of localized disease outbreaks before they become global pandemics.

Important Points

• Sustainable Financing: The treaty proposes a financing mechanism to help developing countries build their laboratory capacities, surveillance systems, and healthcare workforces.

• Technology Transfer: It encourages voluntary technology transfer and the waiving of certain Intellectual Property (IP) rights during emergencies to boost local manufacturing of life-saving drugs.

• Timeline: Following its adoption in May 2025, the agreement requires a specific number of ratifications by national parliaments to officially enter into force as international law.

• Transparency: Member states are committed to greater transparency regarding their national stockpiles and clinical trial data to prevent hoarding and misinformation during a health emergency.

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