RRB Group D Official Paper (Held On: 09 Feb, 2026 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. Which of the following is an example of addition reaction?

(a) Chlorination of methane
(b) Hydrogenation of ethene
(c) Hydrolysis of acetic acid
(d) Dehydration of alcohol

Q2. Which of the following is NOT caused by atmospheric refraction?

(a) Sun appearing higher in sky than its actual geometric position
(b) Reddish colour of sun at sunrise / sunset
(c) Twinkling of stars
(d) Advanced sunrise and delayed sunset

Q3. The distance between the pole and focus of a concave mirror is 30 cm. A real and inverted image is formed by this mirror on a screen at 40 cm from the pole of this mirror. What will be the object distance?

(a) • 120/7 cm
(b) • 120/7 cm
(c) • 120 cm
(d) • 120 cm

Q4. In which state of matter is the space between particles maximum ?

(a) Liquid
(b) Gas
(c) All have equal space
(d) Solid

Q5. What is the most important condition for successful fragmentation reproduction in Spirogyra?

(a) Presence of reproductive organs in each fragment
(b) The ability of fragments to form seeds
(c) Each fragment possessing the capability to perform basic life functions
(d) Availability of a fully developed vascular system

Q6. Which cells in xylem are primarily responsible for the vertical transport of water and minerals in plants?

(a) Xylem fibres
(b) Companion cells
(c) Tracheids and vessels
(d) Sieve tubes

Q7. The heating effect of electric current is least in _____.

(a) Copper
(b) Iron
(c) Nichrome
(d) Tungsten

Q8. A race car starting from rest accelerates uniformly. If the car covers 22.5 m in the 5th second of its motion, what is the total distance covered at the end of 10 seconds?

(a) 450 m
(b) 250 m
(c) 375 m
(d) 300 m

Q9. What is the typical oxide used along with aluminium in a thermite reaction?

(a) Magnesium oxide
(b) Copper oxide
(c) Zinc oxide
(d) Iron (III) oxide

Q10. Which of the following types of ore is pyrite?

(a) Nitrate
(b) Sulphide
(c) Halide
(d) Oxide

Q11. If the velocity of a car increases from 20 m/s to 40 m/s in 4 seconds, the acceleration of the car is _____.

(a) 10 m/s
(b) 5 m/s^2
(c) 5 m/s
(d) 10 m/s^2

Q12. Which statement best defines a combination reaction?

(a) Two or more reactants combine to form a single product.
(b) One element displaces another element from its compound.
(c) Two compounds exchange ions to form new compounds.
(d) Two reactants break down into simpler products.

Q13. Imagine a country continues to use CFCs despite the global agreement. What could be the consequences for that country and the world?

(a) No effect, as other countries have stopped using CFCs
(b) Environmental harm and global criticism
(c) Faster industrial development
(d) Increase in rainfall

Q14. Which of the following conditions must be satisfied for work to be done according to science?

(a) Only the object moves, even if no force is applied.
(b) A force must act on an object, and the object must be displaced.
(c) Only a force is applied, even if the object does not move.
(d) The object is at rest, and a force is applied.

Q15. What role does the placenta play during the development of the embryo in the human female reproductive system?

(a) It facilitates the exchange of nutrients and wastes between mother and embryo.
(b) It is the location where fertilisation of egg and sperm occurs.
(c) It unites the two oviducts into the uterus.
(d) It produces eggs needed for fertilisation.

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Q16. An object is thrown vertically upwards and rises to a height of 20 m. What was the velocity with which the object was thrown? (Take g = 10 m/s²).

(a) 40 m/s
(b) 30 m/s
(c) 10 m/s
(d) 20 m/s

Q17. Baking soda releases which gas on heating?

(a) CO2
(b) H2
(c) N2
(d) O2

Q18. A flexible support to developing plant parts is provided by _____.

(a) Chlorenchyma
(b) Phloem
(c) Collenchyma
(d) Xylem

Q19. What is a colloidal solution?

(a) Uniform mixture with large particles
(b) Transparent mixture with gases only
(c) Mixture in which particles fully dissolve and settle
(d) Heterogeneous mixture with fine particles

Q20. Which of the following organisms shows the phenomenon of regeneration?

(a) House fly
(b) Honey bee
(c) Mosquito
(d) Planaria

Q21. Fill in the blanks with the correct sequence of organs.
Urine is formed in the _____ → passes through the ___ → stored in the ___ → and finally released through the _____.

(a) Ureter → Kidney → Urethra → Urinary bladder
(b) Urethra → Urinary bladder → Ureter → Kidney
(c) Urinary bladder → Kidney → Ureter → Urethra
(d) Kidney → Ureter → Urinary bladder → Urethra

Q22. Herbicides protect crops by _____.

(a) Killing fungi
(b) Killing insects
(c) Killing weeds
(d) Killing bacteria

Q23. In a longitudinal wave, particle's motion is _____.

(a) perpendicular to the wave motion
(b) random
(c) parallel to the wave direction
(d) circular

Q24. In household electricity supply, which of the following statements correctly describes the colour codes of the wires?

(a) The live wire is red, the neutral wire is black, and the earth wire is green
(b) The live wire is green, the neutral wire is red, and the earth wire is black
(c) The live wire is blue, the neutral wire is green, and the earth wire is red

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(d) The live wire is black, the neutral wire is green, and the earth wire is blue

Q25. When a drop of ink is added to water and left undisturbed, the ink gradually spreads throughout the water. Which property of matter does this observation best demonstrate?

(a) Continuous movement of particles
(b) Fixed positions of particles
(c) Attraction between particles
(d) Spaces between particles

MATHEMATICS

Q26. Find the value of $\sec^2 18° - \cot^2 72° + \sin^2 30° + \text{cosec}^2 60° - \text{cosec}^2 18° + \tan^2 72°$.

(a) 19/10
(b) 12/19
(c) 10/19
(d) 19/12

Q27. What is the mode of the following data?

85, 73, 89, 82, 67, 61, 78, 69, 86, 68, 64, 76, 64, 85, 68, 85, 68, 81, 68, 72, 64, 72, 76, 84, 88

(a) 89
(b) 68
(c) 85
(d) 73

Q28. The average of the first 16 odd natural numbers, is:

(a) 16
(b) 17
(c) 15.5
(d) 16.5

Q29. In an election held between two candidates, 75% voters cast their votes. Out of them 2% votes were declared invalid. One candidate got 9261 votes which was 75% of valid votes. In this election what was the total number of registered voters ?

(a) 17,560
(b) 17,500
(c) 17,800
(d) 16,800

Q30. The difference between a single discount of 46% and two successive discounts of 30% and 20% on the marked price of an article is Rs. 256. Find the marked price of the article (in Rs.).

(a) 12,600
(b) 12,200
(c) 12,800
(d) 12,400

Q31. A girl goes to school at a speed of 10 km/hr. She comes back with a speed of 40 km/hr. Find her average speed for the whole journey.

(a) 6 km/hr
(b) 13 km/hr
(c) 16 km/hr
(d) 21 km/hr

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Q32. Rs. 13,525 is divided among A, B, and C in such a way that if Rs. 29, Rs. 70, and Rs. 28 be deducted from their respective shares, they have money in the ratio 19 : 6 : 8. Find the difference between the B's and C's original shares.

(a) Rs. 762
(b) Rs. 712
(c) Rs. 662
(d) Rs. 770

Q33. A shopkeeper bought 10 kg wheat at Rs. 20 per kg and 15 kg wheat at Rs. 30 per kg and mixed them.

At what price per kg should he sell the mixed variety of wheat to earn 10% profit ?

(a) Rs. 29.60
(b) Rs. 28.60
(c) Rs. 27.60
(d) Rs. 26.60

Q34. Pipe A can fill a cistern in 15 minutes and Pipe B can fill it in 35 minutes, while Pipe C can empty the full cistern in 1 hour. If all the pipes are turned on at the same time, in how much time (in minutes) will the cistern be full?

(a) 128/11
(b) 1410/11
(c) 139/11
(d) 107/11

Q35. If 66% of the first number is equal to three-fifths of the second number, what is the ratio of the first number to the second number?

(a) 10 : 11
(b) 8 : 11
(c) 9 : 14
(d) 5 : 7

Q36. The ratio of incomes of two persons is 8:5 and the ratio of their expenditure is 2:1. If each of them manages to save Rs. 160 per month, find the difference of their monthly income.

(a) Rs. 220
(b) Rs. 260
(c) Rs. 200
(d) Rs. 240

Q37. Find the volume of a cuboid whose length, breadth and height are in the ratio 4 : 3 : 2 and total surface area is 832 cm^2.

(a) 1516 cm3
(b) 1586 cm3
(c) 1556 cm3
(d) 1536 cm3

Q38. Nine years ago, Asha was thrice as old as Bhawna. Seven years from now, Asha will be twice as old as Bhawna. Find the present age of Bhawna.

(a) 26 years
(b) 25 years
(c) 28 years
(d) 30 years

Q39. There are 156 boy students and 143 girl students in a school. The principal wants to divide them in sections, such that a section can have only boys or only girls. If all sections should have the same number of students, and the principal wants to have as fewer sections as possible, how many sections would be there in the school?

(a) 23
(b) 43

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(c) 25
(d) 45

Q40. The value of $13^3 - 8^3$ is:
(a) 1769
(b) 1685
(c) 1430
(d) 1725

Q41. If the radius of a sphere is 3 cm, then its surface area is:
(a) 72 π cm^2
(b) 49 π cm^2
(c) 98 π cm^2
(d) 36 π cm^2

Q42. Find the single discount equivalent to two successive discounts of 28% and 16%.
(a) 43.38%
(b) 39.92%
(c) 43.51%
(d) 39.52%

Q43. A sum of Rs. 15,000 is lent at the rate of 15% per annum compound interest, compounded annually for two years. What is the interest received (in Rs.) after two years?
(a) 4,973.75
(b) 4,837.50
(c) 5,137.25
(d) 4,738.25

Q44. Evaluate the given expression.
35 - [25 - {31 - (21 - 11 + 9)}]
(a) 22
(b) 21
(c) 25
(d) 19

Q45. Successive discounts of 40% and 15% are equivalent to a single discount of _____.
(a) 51%
(b) 49%
(c) 52%
(d) 50%

Q46. In a quadrilateral ABCD, angle A = 36° and angle B = 93°. The bisectors of angle C and angle D meet at O. What is the measure of angle DOC ?
(a) 69.5°
(b) 64.5°
(c) 62°
(d) 68°

Q47. The number of two-digit numbers divisible by 6 is:
(a) 16
(b) 12
(c) 15
(d) 18

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Q48. Rishi can do a piece of work in 11 days. Shan is 10% more efficient than Rishi. The number of days taken by Shan to do the same piece of work is:

(a) 11
(b) 15
(c) 20
(d) 10

Q49. A man loses 20% of his money. He then spends 25% of what remains. If he is left with Rs. 525, what was his original amount?

(a) Rs. 875
(b) Rs. 880
(c) Rs. 885
(d) Rs. 890

Q50. If the ratio of the the speeds of three cars is 2:3:5, then the ratio of the time taken by these three cars to travel the same distance is:

(a) 15 :10 : 6
(b) 6 : 10 : 15
(c) 10 : 15 : 6
(d) 10 : 6 : 15

GENERAL INTELLIGENCE & REASONING

Q51. Based on the English alphabetical order, three of the following four letter cluster pairs are alike in a certain way and thus form a group. Which is the one that does not belong to that group?

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

(a) OY - TD
(b) FS - KY
(c) BK - GP
(d) MP - RU

Q52. Refer to the following series and answer the question. (All numbers are single-digit numbers only) (Counting to be done from left to right only).

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

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

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

Q53. What will come in the place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

66 × 6 ÷ 3 − 128 ÷ 2 + 15 × 3 − 16 ÷ 2 + 17 = ?

(a) 239
(b) 224
(c) 299
(d) 245

Q54. Varun ranked 24th from the top and 47th from the bottom in his class. How many students are there in his class?

(a) 70
(b) 71
(c) 69
(d) 72

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Q55. A, B, C, D, E, F and G are sitting around a circular table facing the centre. F sits third to the right of G. A sits third to the right of F. C is the immediate neighbour of B and A. D sits third to the right of A.

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

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

Q56. Mohak starts from Point A and drives 12 km towards the South. He then takes a left turn, drives 11 km, turns left and drives 15 km. He then takes a left turn and drives 14 km. He takes a final left turn, drives 3 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90 degrees turns only unless specified)

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

Q57. A,B,C,D,E,F and G are sitting in a straight line facing North.

Only five people sit between D and C. E sits to the immediate left of C. Only one person sits between E and A. G sits at some place to the left of F but at some place to the right of B.

How many people sit to the right of A?

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

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

Statements: All shells are mats. All mats are lotions.

Conclusion (I): Some lotions are shells

Conclusion (II): No lotion is a shell

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

Q59. JLIU is related to EKGV in a certain way based on the English alphabetical order. In the same way, MWQE is related to HVOF. To which of the following is CBTJ related to, following the same logic ?

(a) ZNOP
(b) WOPK
(c) YQRP
(d) XARK

Q60. YOBD is related to IYLN in a certain way based on the English alphabetical order. In the same way, MCPR is related to WMZB. To which of the following options is QGTV related to, following the same logic?

(a) AXSW
(b) ADER
(c) ADRT
(d) AQDF

Q61. 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) DGK

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(b) FIN
(c) PSW
(d) JMQ

Q62. In a row of people all facing North, Alok is 12th from the right end. Pyush is 18th from the right end. Pyush is exactly between Alok and Priyanka. If Priyanka is 5th from the left end of the line, how many people are there in the row?
(a) 29
(b) 28
(c) 27
(d) 26

Q63. What should come in place of the question mark (?) in the given series?
61 66 72 77 83 ?6046
(a) 90
(b) 89
(c) 87
(d) 88

Q64. Rajesh starts from Point M and drives 13 km towards the north. Then he takes a right turn and drives 6 km, he turns right again and drives 5 km. Then he takes a left turn and drives 3 km, then he turns right and drives 10 km. He then takes a final right turn and drives 9 km and stops at Point N. How far (shortest distance) and towards which direction should he drive in order to reach Point M again? (All turns are 90-degree turns only unless specified.)
(a) 2 km towards the south
(b) 4 km towards the south
(c) 4 km towards the north
(d) 2 km towards the north

Q65. In a certain code language, ‘JARS’ is coded as ‘6428’ and ‘SIDE’ is coded as ‘5761’. What is the code for ‘S’ in the given code language?
(a) 8
(b) 5
(c) 7
(d) 6

Q66. If 1 is added to each even digit and 2 is subtracted from each odd digit in the number 8239847, how many digits will appear more than once in the new number thus formed?
(a) One
(b) Two
(c) None
(d) Three

Q67. BONZ is related to SFEQ in a certain way based on the English alphabetical order. In the same way, REDP is related to IVUG. To which of the following options is QDCO related, following the same logic?
(a) HFTY
(b) HTYU
(c) HUFT
(d) HUTF

Q68. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?
FCF 47 HEH 58 JGJ 69 LIL 80 ?6929
(a) NKN 91
(b) MJM 90
(c) MLM 91
(d) NKN 90

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Q69. Refer to the following number, symbol series and answer the question. Counting to be done from left to right only (all numbers are single digit numbers only).

(Left) # 5 1 & & 5 + 8 3 & * < \ 9 $ > > * 5 / 7 (Right)

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

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

Q70. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

All notepads are diaries.

All diaries are organisers.

Some organisers are planners.

Conclusions:

(I): All notepads are organisers.

(II): Some planners are notepads.

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

Q71. Refer to the following number series and answer the question that follows. Counting to be done from left to right only.

(All numbers are single-digit numbers only.)

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

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

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

Q72. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

15 - 3 - 45

12 - 4 - 48

(a) 5 - 6 - 36
(b) 41 - 3 - 113
(c) 10 - 2 - 30
(d) 31 - 2 - 62

Q73. A, B, C, D, E, F and G are sitting around a circular table facing the centre. D sits third to the right of C. E sits third to the left of C. B sits second to the left of D. G sits to the immediate left of A. How many people sit between F and G when counted from the left of F?

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

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Q74. Which of the following letter-clusters will replace the question mark (?) in the given series to make it logically complete?

PDH, RFJ, THL, VJN, ?

(a) XLP
(b) XMP
(c) XLO
(d) XMO

Q75. In a certain code language, 'touch snow gently' is coded as 'lu ek ag' and 'snow falls light' is coded as 'ph lu yn'. How is 'snow' coded in the given language?

(a) ek
(b) yn
(c) ph
(d) lu

Q76. Select the number from among the given options that can replace the question mark (?) in the following series.

121, 144, 169, 196, ?

(a) 125
(b) 215
(c) 115
(d) 225

Q77. What will come in the place of the question mark (?) in the following equation, if '+' and '−' are interchanged and '×' and '÷' are interchanged?

37 ÷ 5 - 91 + 16 × 4 = ?

(a) 272
(b) 268
(c) 274
(d) 270

Q78. Refer to the following number series and answer the question that follows. Counting to be done from left to right only. (All numbers are single-digit numbers only.)

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

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

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

Q79. In a certain code language,

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

A # B means 'A is the brother of B'

A × B means 'A is the wife of B'

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

Based on the above, how is L related to R if 'L@O+V#E×R'?

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

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

76 81 91 111 151 ?6044

(a) 232
(b) 233
(c) 230
(d) 231

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Which missile was successfully launched by DRDO from a rail-based mobile launcher under full operational conditions on 24 September 2025?

(a) BrahMos
(b) Prithvi-II
(c) Agni-Prime
(d) Agni-I

Q82. The BHARAT study, launched by the Indian Institute of Science (IISc), Bengaluru, in 2023, focuses on:

(a) Studying biomarkers of healthy aging, resilience, adversity, and transitions
(b) Promoting traditional wellness practices among senior citizens
(c) Surveying rural health infrastructure for elderly care
(d) Identifying economic patterns of India's aging population

Q83. Which four entertainment icons were honored with Oscars at the 2025 Governors Awards?

(a) Tom Cruise, Dolly Parton, Debbie Allen, Wynn Thomas
(b) George Lucas, Viola Davis, Michael Mann, Sofia Coppola
(c) Meryl Streep, Judi Dench, Clint Eastwood, Martin Scorsese
(d) Steven Spielberg, Angela Bassett, Benicio del Toro, Julie Taymor

Q84. Who won the prestigious Women Player of the Year Female award for FIH 2024?

(a) Ye Jiao
(b) Zoe Diaz
(c) Sarah Wilson
(d) Yibbi Jansen

Q85. At the 2025 Khelo India Youth Games, Bihar made a notable achievement. What was the total number of medals won by the state?

(a) 25
(b) 30
(c) 36
(d) 40

Q86. Which party held the Kaliganj seat in West Bengal during the by-polls held in June 2025?

(a) Aam Aadmi Party
(b) Trinamool Congress
(c) Biju Janata Dal
(d) Bharatiya Janata Party

Q87. In August 2025, which of the following banks declared the loan accounts of Reliance Communications and Anil Ambani as fraud, following a similar action by the State Bank of India (SBI)?

(a) ICICI Bank
(b) Punjab National Bank
(c) Indian Overseas Bank
(d) Bank of India

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Q88. In which competition did Parul Chaudhary break her national record in 2025?

(a) Indian National Championships
(b) Asian Athletics Championship
(c) Commonwealth Games
(d) Doha Diamond League

Q89. Which of the following neighboring countries of India had a ranking worse than India in the Sustainable Development Goals (SDG) Index in the 2025 edition of the Sustainable Development Report (SDR) released in June 2025?

(a) Nepal
(b) Pakistan
(c) Bhutan
(d) Sri Lanka

Q90. In May 2025, the Reserve Bank of India (RBI) initiated reviewing digital wallets linked to which of the following sectors after BluSmart shutdown?

(a) Travel bookings
(b) Electric vehicle services
(c) Healthcare
(d) Food delivery

Q91. In 2025, which country requested consultations with India at the World Trade Organization regarding trade measures on solar cells and modules?

(a) China
(b) Australia
(c) South Korea
(d) Brazil

Q92. The launch of “Mission Shakti 5.0” during International Girl Child Week (October 3–11, 2025) in Uttar Pradesh contributed mainly to progress in which of the following Sustainable Development Goals (SDGs)?

(a) Quality education
(b) Responsible consumption and production
(c) Gender equality
(d) Clean energy / sustainable energy

Q93. In 2025, India signed a $126.42 million loan agreement with which institution for the purpose of developing sustainable tourism infrastructure around Tehri Lake in Uttarakhand?

(a) New Development Bank
(b) International Monetary Fund
(c) World Bank
(d) Asian Development Bank

Q94. What was the main purpose of bringing the four Labour Codes into effect on 21 November 2025?

(a) Streamlining labour regulations
(b) Enhancing worker safety
(c) Introducing minimum wages
(d) Expanding 11 social security coverage

Q95. Which Indian state hosted the 2025 Asia Rugby U-20 Sevens Championship, which was held on August 9–10?

(a) Tamil Nadu
(b) Bihar
(c) Assam
(d) West Bengal

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Q96. As on 31st August 2025, how many total projects did NABARD sanction under term loans across 8 State Governments?

(a) 72
(b) 64
(c) 86
(d) 92

Q97. Who received the Hollywood Music in Media Awards 2024 for the film Aadujeevitham: The Goat Life?

(a) A.R. Rahman
(b) Ilaiyaraaja
(c) Himesh Reshammiya
(d) Shankar-Ehsaan-Loy

Q98. Which Indian Ministry released the first-ever monthly Periodic Labour Force Survey (PLFS) in April 2025?

(a) Ministry of Statistics and Programme Implementation
(b) Ministry of Labour and Employment
(c) Ministry of Finance
(d) Ministry of Home Affairs

Q99. Which of the following missions is the first space-based Indian mission to study the sun?

(a) AstroSat
(b) Chandrayaan-1
(c) Aditya L1
(d) Mangalyaan

Q100. In the context of 2025 discussions on global governance and foreign-policy literacy, which of the following books by Richard Haass is widely cited as a concise primer that helps general readers understand world politics and major global challenges?

(a) The New Map
(b) The Long Game
(c) The Future Is Asian
(d) The World: A Brief Introduction

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (b) Hydrogenation of ethene

The correct answer is Hydrogenation of ethene.

Key Points

• An addition reaction is a type of organic reaction where two or more molecules combine to form a single larger molecule, typically occurring in compounds with multiple bonds (double or triple bonds).

• Hydrogenation of ethene involves the addition of Hydrogen (H2) across the double bond of Ethene (C2H4) to form Ethane (C2H6) in the presence of a catalyst such as Nickel (Ni) or Palladium (Pd). Hence, the statement is correct.

• Chlorination of methane is a classic example of a substitution reaction, where a hydrogen atom in the Methane (CH4) molecule is replaced by a Chlorine (Cl) atom. Hence, the statement is incorrect.

• Dehydration of alcohol (e.g., ethanol to ethene) is an elimination reaction, where a molecule of water is removed from the substrate to form an alkene. Hence, the statement is incorrect.

• Hydrolysis of acetic acid (or reaction with water) generally refers to its dissociation into ions or its formation from an ester, but it does not represent a standard addition reaction across a carbon-carbon double bond. Hence, the statement is incorrect.

Additional Information

• Unsaturated Hydrocarbons: Compounds like alkenes and alkynes are classified as unsaturated because they contain double or triple bonds. These bonds serve as active sites for addition reactions.

• Saturated Hydrocarbons: Alkanes like methane and propane are saturated because they contain only single bonds. They typically undergo substitution reactions because there is no space to "add" more atoms without removing existing ones.

• Industrial Application: The hydrogenation process is widely used in the food industry to convert liquid vegetable oils (which are unsaturated) into solid fats (which are saturated), such as Vanaspati ghee.

• Role of Catalysts: Transition metals like Nickel, Platinum (Pt), and Palladium are essential in hydrogenation as they provide a surface for hydrogen gas to adsorb and react with the hydrocarbon, lowering the activation energy of the reaction.

Important Points

• Reaction Mechanism: The addition reaction specifically converts a pi bond into sigma bonds. In the case of ethene, the pi bond between the two carbon atoms breaks to accommodate two new Hydrogen atoms.

• Chlorination Conditions: For substitution to occur in methane, the presence of sunlight or ultraviolet (UV) light is usually required to break the Chlorine-Chlorine bond into free radicals.

• Health Context: While hydrogenation is useful for food stability, the process can sometimes lead to the formation of trans-fats, which are associated with health risks such as heart disease.

• Bromine Water Test: An addition reaction is often used to test for unsaturation. When bromine water is added to an alkene, the reddish-brown color disappears (decolorizes) as the bromine adds to the double bond.

Q2. Answer: (b) Reddish colour of sun at sunrise / sunset

The correct answer is Reddish colour of sun at sunrise / sunset.

Key Points

• Atmospheric Refraction is the phenomenon of bending of light as it passes through the layers of the earth's atmosphere which have different optical densities.

• Sun appearing higher in the sky: Due to atmospheric refraction, when the sun is near the horizon, the rays of light coming from it have to pass through layers of air with increasing refractive index. This causes the light to bend towards the normal, making the sun appear at a higher position than its actual geometric position. Hence, statement 1 is caused by atmospheric refraction.

• Reddish colour of the sun at sunrise/sunset: This phenomenon occurs due to the Scattering of Light (specifically Rayleigh Scattering). During sunrise and sunset, sunlight travels a longer distance through the atmosphere. The shorter wavelengths (blue and violet) are scattered away by the air molecules, while the longer wavelengths (red and orange) reach our eyes. Hence, statement 2 is NOT caused by atmospheric refraction.

• Twinkling of stars: Stars act as point sources of light located very far away. As the light enters the atmosphere, it undergoes continuous refraction due to changing temperature and density of air layers. This causes the apparent position and brightness of the star to fluctuate rapidly, creating the twinkling effect. Hence, statement 3 is caused by atmospheric refraction.

• Advanced sunrise and delayed sunset: The sun is visible to us about 2 minutes before the actual sunrise and 2 minutes after the actual sunset because of the bending of light. When the sun is slightly below the horizon, the atmosphere refracts the light downward toward the earth, allowing us to see the sun. Hence, statement 4 is caused by atmospheric refraction.

Additional Information

• Scattering of Light: This is the process where light rays are deviated from their straight path upon striking obstacles like dust particles, water droplets, or gas molecules in the atmosphere.

• Tyndall Effect: This is the scattering of light by colloidal particles. It explains why the path of a light beam becomes visible when passing through smoke or fog.

• Blue Color of Sky: During the day, the fine particles in the atmosphere scatter the blue light (shorter wavelength) more strongly than red light, which is why the sky appears blue to an observer on Earth.

• Refractive Index: It is a measure of how much the speed of light is reduced inside a medium. In the atmosphere, the refractive index increases as we move from the rarer upper layers to the denser lower layers near the Earth's surface.

Important Points

• Speed of Light: Light travels at approximately 3 × 10&sup8; m/s in a vacuum, but its speed decreases when it enters the Earth's atmosphere, causing it to refract.

• Mirage: Another famous example of atmospheric refraction (combined with Total Internal Reflection) is a mirage, commonly seen in deserts or on hot tar roads during summer.

• Visible Spectrum: The human eye can perceive wavelengths between approximately 400 nm (Violet) and 700 nm (Red). Red light has the longest wavelength and is scattered the least, which is why it is used for danger signals.

Q3. Answer: (d) • 120 cm

The correct answer is - 120 cm.

Key Points

• According to the New Cartesian Sign Convention, the focal length (f) of a concave mirror is always considered negative. In this problem, the distance between the pole and focus is given as 30 cm, so f = -30 cm.

• A real and inverted image is formed on a screen, which means the image is formed in front of the mirror. Therefore, the image distance (v) is also negative. Given the image is at 40 cm, we have v = -40 cm.

• The Mirror Formula relates the focal length, image distance, and object distance: 1/f = 1/v + 1/u. Hence, the formula application is essential for this calculation.

• Substituting the known values into the formula: 1/(-30) = 1/(-40) + 1/u. Rearranging for the object distance (u), we get 1/u = -1/30 - (-1/40), which simplifies to 1/u = -1/30 + 1/40.

• Finding the common denominator (120): 1/u = (-4 + 3) / 120 = -1 / 120. Therefore, u = -120 cm. The negative sign indicates that the object is placed 120 cm in front of the mirror. Hence, the statement regarding the object distance being -120 cm is correct.

Additional Information

• Concave Mirror: A concave mirror, or converging mirror, has a reflecting surface that is recessed inward. It reflects light inward to one focal point. These mirrors are used to focus light and are common in telescopes, shaving mirrors, and headlights.

• Nature of Images:

• If the object is placed beyond the Center of Curvature (C), the image is real, inverted, and diminished.

• If the object is between C and Focus (F), the image is real, inverted, and magnified.

• If the object is placed between the Pole (P) and F, the image is virtual, erect, and magnified.

• Cartesian Sign Convention:

• The object is always placed to the left of the mirror, making u always negative.

• Distances measured in the direction of incident light are positive, and those opposite are negative.

• The height measured upwards from the principal axis is positive, while downwards is negative.

Important Points

• Magnification (m): It is the ratio of the height of the image to the height of the object. It is also given by the formula m = -v/u. For real images, m is negative, and for virtual images, m is positive.

• Radius of Curvature (R): The distance from the pole to the center of curvature. There is a specific relationship where R = 2f. In this problem, the radius of curvature would be 60 cm.

• Real vs Virtual Image: A real image can be obtained on a screen because the light rays actually intersect. A virtual image cannot be obtained on a screen as the light rays only appear to diverge from a point behind the mirror.

• The unit of measurement must remain consistent throughout the calculation. Since the focal length and image distance were in cm, the result for the object distance is also in cm.

Q4. Answer: (b) Gas

The correct answer is Gas.

Key Points

• In the gaseous state, the intermolecular space between the particles is maximum. This is because the intermolecular forces of attraction between the particles are very weak or almost negligible compared to solids and liquids.

• Particles in a gas possess very high kinetic energy, which causes them to move randomly at high speeds in all directions. This rapid motion constantly pushes the particles away from each other, resulting in large empty spaces.

• Due to these maximum spaces, gases do not have a definite shape or a definite volume; they expand to fill whatever container they are placed in.

• The large distance between particles also makes gases highly compressible. For example, LPG (Liquefied Petroleum Gas) and CNG (Compressed Natural Gas) are stored by compressing large volumes of gas into small cylinders. Hence, option 2 is correct.

• In contrast, the space between particles is minimum in solids because of very strong cohesive forces that hold the particles in fixed positions. Hence, option 4 is incorrect.

• In liquids, the space between particles is intermediate—more than solids but significantly less than gases. Hence, option 1 is incorrect.

Additional Information

• Solid State:

• Particles are arranged in a closely packed manner, often in a regular crystal lattice.

• They have a definite shape, distinct boundaries, and fixed volumes.

• The diffusion rate in solids is extremely low due to the lack of space for particle movement.

• Liquid State:

• Particles have more freedom of movement than in solids, allowing liquids to flow and change shape.

• They have a fixed volume but take the shape of the container they occupy.

• The intermolecular force is strong enough to keep the particles together but not strong enough to keep them in a fixed position.

• Kinetic Theory of Matter:

• This theory states that all matter is made up of tiny particles that are in constant motion.

• As the temperature increases, the kinetic energy of the particles increases, which can lead to a change in the state of matter (e.g., melting or evaporation) by increasing the space between particles.

• Other States of Matter:

• Plasma: Often considered the fourth state of matter, it consists of super energetic and super excited particles in the form of ionized gases. It is found in stars and fluorescent tubes.

• Bose-Einstein Condensate (BEC): The fifth state of matter, formed by cooling a gas of extremely low density to super-low temperatures (near Absolute Zero).

Important Points

• Density: Usually, the density of a substance is maximum in its solid state and minimum in its gaseous state because density is inversely proportional to the volume occupied by the particles.

• Diffusion: The rate of diffusion is highest in gases because the particles move rapidly and there is a lot of space between them to mix with other particles.

• Brownian Motion: This refers to the zig-zag motion of particles, which is most observable in gases and liquids due to the available space for movement.

Q5. Answer: (c) Each fragment possessing the capability to perform basic life functions

The correct answer is Each fragment possessing the capability to perform basic life functions.

Key Points

• Spirogyra is a genus of filamentous green algae belonging to the order Zygnematales. It is widely known for its characteristic spiral or helical arrangement of chloroplasts.

• In Spirogyra, asexual reproduction occurs primarily through a process known as fragmentation. In this process, the vegetative body (filament) simply breaks into smaller pieces or fragments upon reaching maturity.

• The fundamental condition for successful fragmentation is that each fragment must contain the necessary cellular machinery to sustain itself. Because Spirogyra is a simple multicellular organism, each cell within the filament is relatively autonomous and capable of performing metabolism, growth, and cell division.

• Once a fragment is separated, it undergoes repeated mitotic cell divisions to develop into a full-sized, new filament. This allows the organism to multiply rapidly in favorable environmental conditions.

• Unlike higher plants, Spirogyra does not require specialized reproductive organs like flowers or seeds for this type of reproduction. As a member of the Thallophyta group, it also lacks a vascular system (xylem and phloem).

Additional Information

• Morphology and Structure: Spirogyra is often called "water silk" or "pond scum" due to its bright green, slimy appearance. The slipperiness is due to a thick mucilage coating on the outer cell wall, which protects the filament from epiphytes and pathogens.

• Habitat: It is typically found in freshwater environments such as ponds, lakes, and slow-moving streams. It thrives in clear, stagnant water where sunlight is abundant for photosynthesis.

• Sexual Reproduction: While fragmentation is the common asexual method, Spirogyra also reproduces sexually through a process called conjugation. This involves the fusion of two non-flagellated gametes (isogamy), resulting in the formation of a thick-walled zygospore that can survive harsh conditions.

• Chloroplasts and Pyrenoids: The chloroplasts are ribbon-shaped and contain small round bodies called pyrenoids. These pyrenoids are responsible for the storage of starch and the synthesis of proteins.

• Cell Wall Composition: The cell wall is composed of two distinct layers: an inner layer made of cellulose and an outer layer made of pectose. The pectose layer eventually turns into pectin and dissolves in water to form the slimy sheath.

Important Points

• Classification: It belongs to the Kingdom Plantae and the division Thallophyta. The name is derived from the Greek words "spira" (spiral) and "gyros" (circle).

• Regeneration Capability: The success of fragmentation is a testament to the high regenerative capacity of simple multicellular organisms. As long as a fragment contains at least one healthy cell with a nucleus and cytoplasm, it can regenerate an entire organism.

• Ecological Role: As a primary producer, Spirogyra plays a vital role in aquatic ecosystems by producing oxygen through photosynthesis and serving as a food source for various aquatic insects and small fish.

Q6. Answer: (c) Tracheids and vessels

The correct answer is Tracheids and vessels.

Key Points

• Xylem is a complex permanent tissue in vascular plants primarily responsible for the conduction of water and dissolved minerals from the roots to the rest of the plant.

• Tracheids and vessels are the two main types of conducting elements in the xylem. They are both dead cells at maturity and lack protoplasm, creating a hollow path for efficient liquid movement. Hence, option 3 is correct.

• Tracheids are elongated, tube-like cells with thick, lignified walls and tapering ends. Water moves between tracheids through pits in their cell walls. They are found in all vascular plants, including Pteridophytes and Gymnosperms.

• Vessels are long, cylindrical structures that result from the fusion of several cells called vessel members. These members are interconnected through perforation plates in their common walls, allowing for a more streamlined and high-volume vertical transport compared to tracheids.

• While Tracheids provide a degree of mechanical support, their primary function, alongside Vessels, is the ascent of sap. Most Angiosperms (flowering plants) possess both, whereas vessels are typically absent in most gymnosperms.

Additional Information

• Xylem Fibres: These cells have highly thickened walls and obliterated central lumens. Their primary function is to provide mechanical strength and structural support to the plant body, rather than active transport. Hence, option 1 is incorrect.

• Xylem Parenchyma: These are the only living cells in the xylem tissue. They are thin-walled and primarily involved in the storage of food materials like starch and fats, and the radial conduction of water.

• Sieve Tubes: These are the main conducting elements of the Phloem. They are long, tube-like structures arranged longitudinally, responsible for the transport of organic nutrients (food) from leaves to other parts. Hence, option 4 is incorrect.

• Companion Cells: These are specialized parenchymatous cells associated with sieve tube elements in the phloem. They help maintain the pressure gradient in the sieve tubes for food transport. Hence, option 2 is incorrect.

Important Points

• Lignification: The cell walls of tracheids and vessels are heavily impregnated with lignin, a complex polymer that provides rigidity and prevents the cells from collapsing under the negative pressure (tension) created by transpiration.

• Unidirectional Flow: Unlike the phloem, where transport can be multidirectional, the transport of water and minerals in the xylem is strictly unidirectional, moving from roots to shoots.

• Ascent of Sap: The movement of water through tracheids and vessels is driven by physical forces such as transpiration pull, capillary action, and root pressure. Transpiration pull is the primary driver in tall trees, pulling water upward through the continuous xylem columns.

Q7. Answer: (a) Copper

The correct answer is Copper.

Key Points

• The heating effect of electric current, also known as Joule heating, is governed by the formula H = I^2Rt, where H is the heat produced, I is the current, R is the resistance, and t is the time for which the current flows.

• According to this law, the amount of heat generated in a conductor is directly proportional to its electrical resistance. Therefore, a material with lower resistance will produce less heat when the same amount of current passes through it.

• Copper is known for having very low electrical resistivity (approximately 1.68 x 10^-8 Ohm-m at 20 degrees Celsius), which makes it an excellent conductor of electricity. Because its resistance is minimal, the heating effect is least in copper compared to the other options provided. Hence, statement 1 is correct.

• Iron has a significantly higher resistivity (about 1.0 x 10^-7 Ohm-m) than copper. This means an iron wire will offer more resistance to the flow of electrons and consequently generate more heat than a copper wire of the same dimensions. Hence, statement 2 is incorrect.

• Nichrome is an alloy of Nickel and Chromium designed specifically to have high resistance and a high melting point. It is used in heating elements like toasters and room heaters because it produces a large amount of heat. Hence, statement 3 is incorrect.

• Tungsten has a resistivity of approximately 5.6 x 10^-8 Ohm-m. While it is a good conductor, its resistance is still higher than that of copper, and it is famously used in incandescent bulb filaments because it can withstand high temperatures while producing light and heat. Hence, statement 4 is incorrect.

Additional Information

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• Electrical Resistivity: This is a fundamental property of a material that quantifies how strongly it resists or conducts electric current. It is denoted by the Greek letter rho (ρ). Metals like Silver and Copper have the lowest resistivity, making them the best conductors.

• Applications of Copper: Due to its high conductivity and low heat dissipation, copper is the primary material used in domestic electrical wiring, power cables, and printed circuit boards (PCBs). Using copper ensures that energy loss in the form of heat is minimized during transmission.

• Heating Elements (Nichrome): In appliances where heat is the desired output, materials with high resistivity are preferred. Nichrome is ideal for this because it does not oxidize easily at high temperatures, allowing it to remain functional even when glowing red hot in a heater.

• Tungsten in Bulbs: Tungsten is chosen for light bulb filaments not because it has the least heating effect, but because of its extremely high melting point (about 3422 degrees Celsius). This allows the filament to reach temperatures high enough to emit visible light without melting.

• Factors Influencing Resistance: The resistance of a conductor depends on its length, area of cross-section, the nature of the material, and temperature. For most metals, resistance increases as the temperature rises.

Important Points

• Silver is actually the best conductor of electricity, with even lower resistivity than copper. however, Copper is more widely used in electrical applications because it is much more cost-effective and abundant.

• The Joule effect is utilized in safety devices like Electric Fuses. A fuse wire is made of an alloy with a low melting point; when the current exceeds a safe limit, the heat produced melts the wire and breaks the circuit to prevent fire or damage.

• Power Loss: In large-scale power distribution, the heat generated in wires (I^2R loss) is a major concern. To reduce this, electricity is transmitted at high voltages and low currents over long distances using transformers.

Q8. Answer: (b) 250 m

The correct answer is 250 m.

Key Points

• To find the total distance, we first need to determine the acceleration of the race car using the formula for distance covered in the nth second of motion.

• The formula for the distance covered in the nth second is given by: Sn = u + a/2 (2n - 1), where u is the initial velocity, a is the uniform acceleration, and n is the time in seconds.

• Given that the car starts from rest, the initial velocity (u) is 0 m/s. The car covers 22.5 m in the 5th second (n = 5). Substituting these values: 22.5 = 0 + a/2 (2 * 5 - 1).

• Solving for acceleration: 22.5 = a/2 (9), which simplifies to 22.5 = 4.5a. Therefore, the acceleration (a) is 5 m/s².

• Now, to find the total distance covered at the end of 10 seconds, we use the second equation of motion: S = ut + 1/2 at².

• Substituting the known values (u = 0, a = 5, t = 10): S = (0 * 10) + 1/2 * 5 * (10)². This results in S = 1/2 * 5 * 100, which equals 250 m. Hence, the correct answer is 250 m.

Additional Information

• Equations of Motion:

• These equations describe the behavior of a physical system in terms of its motion as a function of time. They are valid only when the acceleration is constant (uniform).

• The three primary equations are: v = u + at, S = ut + 1/2 at², and v² = u² + 2aS.

• Uniform Acceleration:

• This occurs when the velocity of an object changes by an equal amount in every equal time interval. In this problem, the race car's acceleration remains 5 m/s² throughout the 10 seconds.

• Initial Velocity (u):

• In physics problems, the phrase "starting from rest" is a key indicator that the initial velocity is 0. If an object comes to a stop, the final velocity (v) becomes 0.

• Displacement vs. Distance:

• While often used interchangeably in straight-line motion without a change in direction, displacement is a vector quantity (shortest path), whereas distance is a scalar quantity (total path covered).

Important Points

• Nth second calculation: It is important to distinguish between the distance covered "in 10 seconds" and the distance covered "in the 10th second". The former is the cumulative sum from 0 to 10, while the latter is only the movement between second 9 and second 10.

• Units: Always ensure that the units are consistent. In this problem, distance is in meters (m) and time is in seconds (s), so the resulting acceleration is in meters per second squared (m/s²).

• Linear Relationship: For an object starting from rest with uniform acceleration, the total distance covered is directly proportional

to the square of the time (S prop. to t^2).

Q9. Answer: (d) Iron (III) oxide

The correct answer is Iron (III) oxide.

Key Points

• A thermite reaction is a highly exothermic chemical reaction between a metal powder and a metal oxide. The most common and typical version involves Aluminium powder and Iron (III) oxide (Fe_2O_3).

• In this process, Aluminium acts as a strong reducing agent because it has a higher affinity for oxygen than iron. It reduces the Iron (III) oxide to produce molten iron and Aluminium oxide (Al_2O_3).

• The reaction is represented by the chemical equation: $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe + Heat$. The heat generated is so intense that the iron produced is in a liquid (molten) state.

• Because of the production of molten iron, this reaction is extensively used for welding broken railway tracks and heavy machinery parts on-site where traditional welding is difficult.

• While other metal oxides like Copper oxide or Chromium oxide can technically undergo similar reactions with aluminium, Iron (III) oxide is the standard "thermite" component used in industrial and civil engineering applications. Hence, the correct answer is Iron (III) oxide.

Additional Information

• History and Discovery: The thermite process was discovered and patented by the German chemist Hans Goldschmidt in the year 1893. It is often referred to as the Goldschmidt reaction or the aluminothermic process.

• Temperature: The reaction can reach temperatures of approximately 2500°C (4500°F), which is sufficient to melt almost any metal.

• Ignition: Thermite is stable at room temperature and requires a very high activation energy to start. Typically, a Magnesium ribbon or a mixture of Potassium Permanganate and Glycerin is used as a fuse to provide the initial heat required for ignition.

• Applications:

• Railway Industry: Used for Thermite Welding (or Exothermic Welding) to join rails together, ensuring a smooth surface for trains.

• Military: Used in incendiary weapons and grenades to destroy enemy equipment, as the molten iron can melt through thick armor or engine blocks.

• Metallurgy: Employed in the reduction of ores for metals that are difficult to extract using carbon, such as Chromium and Manganese.

Important Points

• Redox Nature: The thermite reaction is a classic example of a Redox (Reduction-Oxidation) reaction and a displacement reaction, where a more reactive metal (Aluminium) displaces a less reactive metal (Iron) from its oxide.

• Reactivity Series: The success of the reaction depends on Aluminium being positioned higher than Iron in the reactivity series of metals.

• Safety: Due to the extreme temperatures and the fact that it is nearly impossible to extinguish once started (as it carries its own supply of oxygen within the metal oxide), it poses significant fire hazards and requires specialized safety protocols.

• States of Matter: The reactants are usually in powdered form to increase the surface area, ensuring a faster and more consistent reaction rate upon ignition.

Q10. Answer: (b) Sulphide

The correct answer is Sulphide.

Key Points

• Pyrite, chemically known as iron disulfide with the formula FeS_2, is the most common mineral in the sulfide group. Hence, Statement 2 is correct.

• It is widely distributed across various geological environments, including sedimentary, metamorphic, and igneous rocks.

• The mineral is characterized by its metallic luster and a pale brass-yellow color, which often leads to it being mistaken for gold.

• Due to this resemblance and its deceptive appearance, it is famously nicknamed Fool's Gold.

• The name is derived from the Greek word "pyrites lithos", which means "stone which strikes fire", referring to the sparks it produces when hit against steel or iron.

• Pyrite typically crystallizes in the isometric (cubic) system, frequently forming distinct cubic crystals with striated faces.

Additional Information

• Nitrate Ores:

• These are minerals where nitrogen and oxygen form the NO_3 ion. Because they are highly water-soluble, they are rarely found in large deposits except in arid regions.

• An example is Chile Saltpeter (Sodium Nitrate, $NaNO_3$), found in the Atacama Desert. Pyrite does not contain nitrate groups. Hence, Statement 1 is incorrect.

• Halide Ores:

• These minerals are defined by the presence of halogen elements such as fluorine, chlorine, bromine, or iodine as the primary anions.

• Examples include Halite (Rock Salt, NaCl), Fluorite (CaF2), and Cryolite (Na3AlF6). Pyrite is not a halide mineral. Hence, Statement 3 is incorrect.

• Oxide Ores:

• In these ores, oxygen is the main anion combined with one or more metals.

• Common examples include Hematite (Fe2O3), Magnetite (Fe3O4), and Bauxite (Al2O3.nH2O). Although Pyrite contains iron, its primary anion is sulfur, not oxygen. Hence, Statement 4 is incorrect.

Important Points

• Industrial Uses: Despite being an iron mineral, pyrite is not used as a primary source of iron for steel production because the sulfur content is difficult and expensive to remove. It is primarily used for the commercial production of sulfuric acid (H2SO4).

• Physical Properties: Pyrite has a Mohs hardness of 6 to 6.5, whereas real gold is much softer with a hardness of 2.5 to 3. Its streak is greenish-black to brownish-black, unlike gold's golden-yellow streak.

• Environmental Impact: When pyrite is exposed to air and water during mining, it reacts to form sulfuric acid and ferric hydroxide, leading to a phenomenon known as Acid Mine Drainage (AMD), which can severely pollute local waterways.

• Detection: In mineralogy, pyrite is often used as a pathfinder mineral in the exploration of gold, copper, and zinc deposits.

Q11. Answer: (b) 5 m/s²

p data-end="57" data-start="0">The correct answer is 5 m/s².

Key Points

• Acceleration is defined as the rate of change of velocity of an object with respect to time.

• To find the acceleration in this problem, we use the standard formula: a = (v - u) / t, where v is the final velocity, u is the initial velocity, and t is the time taken.

• Based on the question, the Initial Velocity (u) is 20 m/s and the Final Velocity (v) is 40 m/s.

• The Time interval (t) given for this change is 4 seconds.

• Substituting the values into the formula: a = (40 - 20) / 4. This results in 20 / 4, which equals 5.

• The unit of velocity is m/s and time is s, therefore the SI unit for acceleration is m/s² (meters per second squared). Hence, the correct answer is 5 m/s².

Additional Information

• Concept of Acceleration:

• Acceleration is a vector quantity, meaning it has both magnitude and direction.

• If the velocity of an object increases, the acceleration is positive and acts in the direction of motion.

• If the velocity of an object decreases, it is known as deceleration or retardation, and the value is negative.

• In uniform circular motion, even if the speed is constant, the object is accelerating because its direction is constantly changing.

• Velocity and Speed:

• Velocity is the displacement of an object per unit time. It is different from speed because speed is a scalar quantity and does not account for direction.

• The average velocity can be calculated by dividing the total displacement by the total time taken.

• Newton's Second Law of Motion:

• The force (F) acting on an object is equal to the mass (m) of that object times its acceleration (a). The formula is written as F = ma.

• This law highlights that acceleration is directly proportional to the net force and inversely proportional to the mass.

Important Points

• Units of Measurement:

• It is crucial to distinguish between m/s (unit of velocity/speed) and m/s² (unit of acceleration).

• Option 3 mentions 5 m/s, which is a velocity value, not an acceleration value. Always check the numerical value along with its unit.

• Equations of Motion:

• The formula used (v = u + at) is the first equation of motion for objects moving with uniform acceleration.

• Other equations include s = ut + 1/2 at² (for distance) and v² = u² + 2as (relating velocity, acceleration, and distance).

• These equations were formulated to describe the kinematics of particles moving in a straight line.

Q12. Answer: (a) Two or more reactants combine to form a single product.

The correct answer is Two or more reactants combine to form a single product.

Key Points

• A combination reaction, which is also frequently referred to as a synthesis reaction, is a fundamental chemical process where two or more simple substances (either elements or compounds) react together to generate a single, more complex product. Hence, statement 1 is correct.

• The general symbolic representation for a combination reaction is A + B → AB, where the reactants A and B merge their atomic or molecular structures to form the new substance AB.

• A well-known example of this reaction is the burning of coal in the presence of oxygen. When carbon (C) reacts with oxygen (O2), it produces carbon dioxide (CO2) as the sole product.

• Another classic demonstration involves magnesium ribbon. When magnesium (Mg) is heated in air, it combines with oxygen to form a white powder known as magnesium oxide (MgO).

• The reaction between quicklime (calcium oxide, CaO) and water (H2O) to form slaked lime (calcium hydroxide, Ca(OH)2) is a vigorous combination reaction that releases a significant amount of thermal energy.

Additional Information

• Exothermic Nature: A significant number of combination reactions are exothermic in nature, meaning they involve the evolution of heat. This happens because the energy released during the formation of new bonds in the product is greater than the energy required to break the bonds in the reactants.

• Displacement Reaction: This occurs when a more reactive element removes or displaces a less reactive element from its compound. For example, when iron (Fe) is placed in a copper sulfate (CuSO4) solution, it displaces copper. Hence, statement 2 describes a displacement reaction and is incorrect for this context.

• Double Displacement Reaction: This type of reaction involves an exchange of ions between two different compounds to form two new compounds. These often result in the formation of an insoluble solid called a precipitate. Hence, statement 3 describes a double displacement reaction and is incorrect for this context.

• Decomposition Reaction: This is essentially the reverse of a combination reaction. In a decomposition reaction, a single reactant breaks down into two or more simpler substances, usually requiring energy in the form of heat, light, or electricity. Hence, statement 4 relates to a decomposition process and is incorrect for this context.

Important Points

• Classification of Combination Reactions:

• Between two elements: For instance, hydrogen (H2) gas combining with chlorine (Cl2) gas to form hydrogen chloride (HCl).

• Between two compounds: For example, the reaction between ammonia (NH3) and hydrogen chloride (HCl) to form ammonium chloride (NH4Cl).

• Between an element and a compound: Such as carbon monoxide (CO) reacting with oxygen (O2) to produce carbon dioxide (CO2).

• Industrial Significance: Combination reactions are the backbone of many industrial processes, such as the Haber Process for the synthesis of ammonia (NH3) from nitrogen and hydrogen, which is vital for fertilizer production.

• Bond Formation: In these reactions, the chemical potential energy of the system typically decreases as the atoms achieve a more stable configuration in the single product formed.

Q13. Answer: (b) Environmental harm and global criticism

The correct answer is Environmental harm and global criticism.

Key Points

• The continued use of Chlorofluorocarbons (CFCs) leads to the severe depletion of the Ozone Layer located in the stratosphere. This layer acts as a shield, absorbing the majority of the Sun's harmful ultraviolet (UV) radiation. Hence, the statement regarding environmental harm is correct.

• The Montreal Protocol, an international treaty signed in September 1987, mandates the phase-out of Ozone-Depleting Substances (ODS). Any country that continues to use CFCs violates this global consensus, leading to diplomatic isolation and global criticism. Hence, the statement regarding global criticism is correct.

• Exposure to increased UV-B radiation due to ozone thinning is linked to higher incidences of skin cancer, cataracts, and weakened immune systems in humans.

• CFCs are also highly potent greenhouse gases. Their continued emission would accelerate global warming, as they have a Global Warming Potential (GWP) thousands of times higher than carbon dioxide (CO2).

• Non-compliance with the Montreal Protocol can result in trade sanctions and the loss of financial assistance from the Multilateral Fund, which helps developing nations transition to ozone-friendly technologies.

Additional Information

• Chemical Composition of CFCs:

• CFCs are organic compounds that contain carbon, chlorine, and fluorine. They were widely used as refrigerants, propellants in aerosol cans, and solvents.

• Because they are non-flammable and non-toxic at the ground level, they were considered "miracle chemicals" until their impact on the stratosphere was discovered.

• The Ozone Hole:

• The most significant depletion of ozone occurs over Antarctica during the spring, leading to what is commonly known as the Ozone Hole.

• In 1985, scientists from the British Antarctic Survey first reported the dramatic thinning of the ozone layer, which spurred the creation of the Vienna Convention.

• Mechanism of Destruction:

• When CFCs reach the stratosphere, UV radiation breaks them down, releasing chlorine atoms.

• A single chlorine atom can destroy over 100,000 ozone molecules (O3) before it is removed from the atmosphere.

• Alternatives to CFCs:

• Initial replacements were Hydrochlorofluorocarbons (HCFCs), which also deplete ozone but to a lesser extent.

• The current industry standard involves Hydrofluorocarbons (HFCs); however, while they do not deplete ozone, they are strong greenhouse gases. This led to the Kigali Amendment in 2016 to phase down HFCs.

Important Points

• Atmospheric Lifetime: CFCs are extremely stable and can remain in the atmosphere for 50 to 100 years, meaning the damage caused today will persist for several generations.

• Ecological Impact: Increased UV radiation harms phytoplankton, the foundation of the marine food chain, and reduces the yield of sensitive crops like rice, wheat, and soybeans.

• Vienna Convention (1985): This was the first international framework for the protection of the ozone layer, which later led to the legally binding Montreal Protocol.

• World Ozone Day: Celebrated annually on September 16 to commemorate the date of the signing of the Montreal Protocol and to spread awareness about ozone preservation.

Q14. Answer: (b) A force must act on an object, and the object must be displaced.

The correct answer is A force must act on an object, and the object must be displaced.

Key Points

• In the field of Physics, the term Work describes a specific process where energy is transferred. For work to be scientifically recognized as "done," two essential conditions must be simultaneously satisfied: an external Force must be applied, and the object must undergo Displacement in the direction of the force.

• A force must act on an object to initiate or change its state of motion. If there is no force, no scientific work can be attributed to an agent. Hence, statement 1 is incorrect.

• The object must move through a certain distance, known as displacement. If an individual exerts a massive amount of force against a stationary wall and the wall does not move, the displacement is zero, and thus no work is done. Hence, statement 3 and statement 4 are incorrect.

• The correct scientific condition requires both the presence of an acting force and a resulting displacement. Hence, statement 2 is correct.

• Furthermore, for work to be non-zero, the force must have a component that is not perpendicular to the direction of motion. If the force is applied at 90 degrees to the displacement, the work done is zero.

Additional Information

• Mathematical Formula: The amount of work done is calculated using the formula $W = Fs \cos \theta$, where W is work, F is the magnitude of the force, s is the displacement, and θ is the angle between the force and the displacement vectors.

• SI Unit: The standard unit of work is the Joule (J). One Joule is defined as the work done when a force of one Newton (N) displaces an object by one meter (m).

• Nature of Quantity: Work is a scalar quantity. While both force and displacement are vector quantities, their dot product (work) only has magnitude and no direction.

• Types of Work:

• Positive Work: When the force and displacement are in the same direction (angle 0°), such as an object falling under gravity.

• Negative Work: When the force acts opposite to the direction of motion (angle 180°), such as the force of friction acting on a moving vehicle.

• Zero Work: When there is no displacement, or when the force is perpendicular to the displacement (angle 90°), such as a satellite orbiting Earth in a circular path.

Important Points

• Work-Energy Theorem: This principle states that the net work done on an object is equal to the change in its Kinetic Energy. This

establishes a direct link between motion and the work performed by forces.

• CGS Unit: In the Centimetre-Gram-Second system, the unit of work is the Erg. One Joule is equivalent to 10^7 Ergs.

• Historical Context: The concept of work was developed by mathematicians and physicists like Gaspard-Gustave de Coriolis in the 1820s to describe the "weight lifted through a height."

• Examples in Daily Life: Pulling a trolley, lifting a book from the floor, or stretching a spring are all examples where work is done because a force results in displacement. However, standing still while holding a heavy suitcase is not considered work in physics because the displacement is zero.

Q15. Answer: (a) It facilitates the exchange of nutrients and wastes between mother and embryo.

The correct answer is It facilitates the exchange of nutrients and wastes between mother and embryo.

Key Points

• The placenta is a specialized, temporary organ that develops in the uterus of a human female during pregnancy. It acts as a structural and functional unit between the developing embryo (fetus) and the maternal body.

• Its primary function is to facilitate the exchange of essential substances; it provides oxygen and nutrients such as glucose and amino acids from the mother to the embryo. Hence, statement 1 is correct.

• The placenta is also responsible for the removal of carbon dioxide and excretory waste materials produced by the embryo, ensuring a healthy internal environment for growth.

• Structurally, it contains villi on the embryonic side, which are surrounded by blood spaces on the maternal side. This configuration provides a massive surface area for the diffusion of nutrients and waste.

• The placenta is connected to the embryo through the umbilical cord, which helps in the transport of substances to and from the embryo.

Additional Information

• Fertilisation Site:

• Fertilisation, the fusion of egg and sperm, occurs in the Fallopian tube (also known as the oviduct), specifically in the ampullary region. The placenta does not play a role in the fertilisation process itself. Hence, statement 2 is incorrect.

• Uterus Structure:

• The uterus is the muscular organ where the embryo is implanted and developed for 9 months. While the uterus receives the two oviducts, the placenta is an organ attached to the uterine wall and not the structure that unites the oviducts. Hence, statement 3 is incorrect.

• Production of Gametes:

• The ovaries are the primary reproductive organs responsible for producing eggs (ova) and hormones like estrogen and progesterone. The placenta does not produce eggs. Hence, statement 4 is incorrect.

• Endocrine Function:

• The placenta also functions as an endocrine tissue and produces several hormones like Human Chorionic Gonadotropin (hCG), Human Placental Lactogen (hPL), estrogens, and progestogens, which are essential for maintaining the pregnancy.

Important Points

• The gestation period in humans is approximately 280 days or 40 weeks.

• During the first trimester, the placenta becomes the main source of progesterone, taking over the role from the corpus luteum in the ovary.

• The umbilical cord typically contains three blood vessels: two umbilical arteries and one umbilical vein.

• Antibodies (specifically IgG) can cross the placenta from the mother to the fetus, providing passive immunity to the newborn.

Q16. Answer: (d) 20 m/s

The correct answer is 20 m/s.

Key Points

• To find the initial velocity of the object, we use the equations of motion under uniform acceleration. In this case, the acceleration is the acceleration due to gravity (g).

• Given data from the problem:

• The maximum height (s) reached by the object is 20 m.

• The final velocity (v) at the maximum height is 0 m/s (since the object momentarily stops before falling back).

• The acceleration (a) is equal to -g because the object is moving upwards against gravity. Given g = 10 m/s², so a = -10 m/s².

• We use the Third Equation of Motion: $v^2 = u^2 + 2as$.

• Substituting the values: $0^2 = u^2 + 2(-10)(20)$.

• $0 = u^2 - 400$.

• $u^2 = 400$.

• u = √400 = 20 m/s.

• Therefore, the initial velocity (u) with which the object was thrown is 20 m/s. Hence, the calculation confirms option 4 is correct.

Additional Information

• Equations of Motion:

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

• First Equation: $v = u + at$ (Relates velocity and time).

• Second Equation: $s = ut + \frac{1}{2}at^2$ (Relates displacement and time).

• Third Equation: $v^2 = u^2 + 2as$ (Relates velocity and displacement).

• Acceleration due to Gravity:

• The standard value of gravity on Earth is approximately 9.8 m/s^2, but for competitive exams and ease of calculation, it is often taken as 10 m/s^2.

• It is a vector quantity directed towards the center of the Earth.

• Sign Convention in Kinematics:

• When an object is thrown vertically upwards, the direction of motion is positive, but gravity acts downwards, making acceleration negative.

• When an object falls downwards, both the displacement and acceleration can be considered in the same direction (usually taken as positive or negative depending on the chosen frame of reference).

Important Points

• Time of Ascent: The time taken to reach the maximum height can be calculated using the formula $t = u / g$. For this problem, $t = 20 / 10 = 2$ seconds.

• Maximum Height Formula: A shortcut formula derived from the third equation is $H = u^2 / 2g$.

• By plugging in the values: $20 = u^2 / (2 \times 10)$ leads to $u^2 = 400$, which gives $u = 20$ m/s.

• Symmetry of Motion: In the absence of air resistance, the time of ascent is equal to the time of descent, and the object will hit the ground with the same speed it was thrown with (20 m/s).

Q17. Answer: (a) CO2

The correct answer is CO2.

Key Points

• Baking soda is chemically known as Sodium Bicarbonate or Sodium Hydrogen Carbonate, represented by the chemical formula NaHCO3.

• When Sodium Bicarbonate is subjected to heating, it undergoes a process called thermal decomposition. This reaction typically becomes significant at temperatures above 50 degrees Celsius (122 degrees Fahrenheit).

• The thermal decomposition reaction of baking soda produces three distinct products: Sodium Carbonate (Na2CO3), Water vapor (H2O), and Carbon Dioxide (CO2).

• The chemical equation for this process is: 2 NaHCO3 + heat → Na2CO3 + H2O + CO2.

• The release of Carbon Dioxide (CO2) gas is the fundamental reason baking soda is used as a leavening agent in the food industry. As the gas is released during baking, it gets trapped in the dough or batter, causing it to expand and rise, resulting in a fluffy and porous texture.

Additional Information

• Physical Properties: Sodium Bicarbonate is a white crystalline solid, though it usually appears as a fine powder. It has a slightly alkaline, bitter taste and is monoclinic in its crystalline form.

• Industrial Production: The Solvay process is the primary industrial method for producing Sodium Bicarbonate. This process, established in the 1860s, involves the reaction of sodium chloride, ammonia, and carbon dioxide in water to precipitate NaHCO3.

• Medical Applications: It is widely used as an antacid to treat acidosis and heartburn. When ingested, it reacts with Hydrochloric acid (HCl) in the stomach to neutralize pH levels, producing NaCl, H2O, and CO2.

• Fire Extinguishers: Baking soda is a common component in dry chemical fire extinguishers (BC rated). When discharged onto a fire, the heat of the flames triggers the release of CO2, which acts to displace oxygen and smother the fire.

• Cleaning and Deodorizing: Due to its mild abrasive nature and ability to neutralize odors, it is used extensively in household cleaning, laundry, and even in personal care products like toothpaste and deodorants.

Important Points

• pH and Nature: Sodium Bicarbonate is amphoteric, meaning it can react with both acids and bases. However, in an aqueous solution, it is mildly basic with a pH of approximately 8.3.

• Reaction with Acids: In addition to heat, baking soda releases CO2 instantly when it comes into contact with acids like acetic acid (vinegar) or citric acid (lemon juice). This is a popular experiment used to demonstrate chemical reactions in science

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• Baking Soda vs. Baking Powder: Baking soda requires an acidic ingredient (like yogurt, buttermilk, or molasses) to activate its leavening power at room temperature. In contrast, baking powder contains both sodium bicarbonate and a dry acidic salt (like cream of tartar), requiring only moisture and heat to react.

• Environmental and Safety: It is considered environmentally friendly and non-toxic. For storage, it should be kept in a cool, dry place, as humidity can cause it to lose its potency over time by initiating slow decomposition.

Q18. Answer: (c) Collenchyma

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

Key Points

• Collenchyma is a specialized simple permanent tissue that provides mechanical support and flexibility (elasticity) to various developing plant parts such as the young stem and petiole of a leaf.

• The cells of collenchyma are living, elongated, and characteristically thickened at the corners due to the deposition of cellulose, hemicellulose, and pectin.

• Its primary function is to allow easy bending in various parts of a plant (like tendrils and stems of climbers) without breaking. Hence, the correct answer is Collenchyma.

• This tissue is generally absent in monocotyledonous plants and is typically found in the hypodermis of dicotyledonous stems.

• The intercellular spaces in collenchyma tissue are either very small or totally absent because of the heavy pectic deposits at the cell corners.

Additional Information

• Parenchyma and Chlorenchyma:

• Parenchyma is the most common simple permanent tissue consisting of relatively unspecialized cells with thin cell walls.

• When parenchyma contains chlorophyll and performs photosynthesis, it is called Chlorenchyma. In aquatic plants, large air cavities are present in parenchyma to help them float, known as aerenchyma.

• Sclerenchyma:

• Unlike collenchyma, sclerenchyma is a dead tissue at maturity. It makes the plant hard and stiff.

• The walls of sclerenchyma cells are thickened due to lignin, a chemical substance which acts as cement and hardens them. It is found in husks of coconuts and vascular bundles.

• Complex Permanent Tissues (Xylem and Phloem):

• Xylem and Phloem are examples of complex tissues because they consist of more than one type of cell working together as a unit.

• Xylem is responsible for the conduction of water and minerals from roots to leaves. It also provides mechanical strength to the plant body.

• Phloem transports food materials (sucrose) prepared in the leaves to other parts of the plant. Unlike xylem, materials can move in both directions in phloem.

Important Points

• Types of Collenchyma:

• Based on the pattern of pectin deposition, it can be classified into Angular collenchyma (thickening at corners), Lacunar collenchyma (thickening around intercellular spaces), and Lamellar collenchyma (thickening in tangential walls).

• Difference between Support Tissues:

• Collenchyma provides flexible support to living and growing regions.

• Sclerenchyma provides rigid support to non-growing or mature plant parts.

Q19. Answer: (d) Heterogeneous mixture with fine particles

The correct answer is Heterogeneous mixture with fine particles.

Key Points

• A colloid is a heterogeneous mixture in which one substance consisting of microscopically dispersed insoluble particles (the dispersed phase) is suspended throughout another substance (the dispersion medium).

• The particle size in a colloidal solution is intermediate between a true solution and a suspension, generally ranging from 1 nanometer to 1000 nanometers. These fine particles are small enough that they do not settle out upon standing but large enough to scatter light. Hence, option 4 is correct.

• In a suspension, the particles are large (typically greater than 1000 nm) and will eventually settle due to gravity. Colloids do not settle, which distinguishes them from suspensions. Hence, option 1 is incorrect.

• A colloidal solution is usually translucent or opaque because the particles are large enough to scatter light (the Tyndall effect). It is not a transparent mixture limited only to gases; it can involve solids and liquids as well. Hence, option 2 is incorrect.

• In a true solution, the solute particles fully dissolve and are molecular or ionic in size (less than 1 nm). Because colloidal particles

are insoluble and stay suspended without settling, they do not follow the behavior of a true solution or a settling suspension. Hence, option 3 is incorrect.

Additional Information

• The Tyndall Effect: This is a defining feature of colloidal solutions where a beam of light becomes visible as it passes through the mixture. The fine particles scatter the light rays, a phenomenon not seen in true solutions because their particles are too small.

• Brownian Motion: Colloidal particles exhibit a continuous, random, zig-zag motion known as Brownian motion. This motion is caused by the constant bombardment of the dispersed particles by the molecules of the dispersion medium, which helps keep the particles in suspension and prevents them from settling.

• Classification of Colloids: Colloids are categorized based on the state of the dispersed phase and dispersion medium:

• Aerosol: Liquid or solid in gas (e.g., fog, mist, smoke).

• Emulsion: Liquid in liquid (e.g., milk, face cream, butter).

• Sol: Solid in liquid (e.g., mud, paints, milk of magnesia).

• Gel: Liquid in solid (e.g., jelly, cheese, curd).

• Foam: Gas in liquid (e.g., shaving cream, whipped cream).

• Historical Context: The term "colloid" was first coined by the Scottish scientist Thomas Graham in 1861. He derived the name from the Greek word "kolla," meaning glue, as many early colloids studied had glue-like properties.

• Stability and Charge: Colloidal particles often carry an electric charge (either positive or negative), which is uniform across all particles in a specific colloid. This like-charge creates repulsion between particles, preventing them from aggregating and contributing to the stability of the solution.

Important Points

• Filtration: Unlike suspensions, colloidal particles cannot be separated from the mixture by ordinary filtration because they are small enough to pass through the pores of filter paper. However, they can be separated using ultra-filtration or centrifugation.

• Applications: Colloids are vital in various industries and biological processes. For example, the blood in our bodies is a colloidal system. They are also used in the purification of water (using alum to coagulate impurities), the tanning of leather, and the manufacture of medicines and cosmetics.

• Blue Color of the Sky: The blue appearance of the sky is actually a result of the scattering of light by colloidal dust particles and water molecules present in the atmosphere, illustrating the Tyndall effect on a massive scale.

Q20. Answer: (d) Planaria

The correct answer is Planaria.

Key Points

• Regeneration is a type of asexual reproduction in which an organism has the ability to give rise to a new individual from its body parts. If the individual is somehow cut or broken into many pieces, many of these pieces grow into separate individuals.

• Planaria is a genus of flatworms belonging to the phylum Platyhelminthes. They are widely cited in biological studies for their remarkable ability to regenerate lost body parts. Hence, the option Planaria is correct.

• This phenomenon is carried out by specialized cells called neoblasts. These are pluripotent stem cells that have the capacity to proliferate and differentiate into any of the 30 to 40 different cell types found in a planarian's body.

• In Planaria, even a tiny fragment (as small as 1/279th of the original worm) can regenerate into a complete, well-proportioned organism within a span of roughly one to two weeks.

• Unlike many other animals, Planaria maintain a large population of these stem cells throughout their adult life, which allows them to constantly renew their tissues and organs.

Additional Information

• Insects (House fly, Honey bee, Mosquito):

• These organisms belong to the phylum Arthropoda and class Insecta. While they undergo metamorphosis (either complete or incomplete), their regenerative capacity is extremely limited compared to Planaria.

• In insects like the House fly or Mosquito, regeneration is usually restricted to the repair of specific tissues or, in some species, the regrowth of limbs during larval stages or nymphal stages. However, an adult insect cannot regenerate its entire body from a fragment. Hence, options 1, 2, and 3 are incorrect.

• Hydra:

• Similar to Planaria, Hydra (phylum Cnidaria) also exhibits a high degree of regeneration. It uses regenerative cells for reproduction through budding and can regrow from small pieces of its body.

• Types of Regeneration:

• Morphallaxis: This involves the reorganization of existing tissues into new structures. It is primarily seen in Hydra.

• Epimorphosis: This involves the proliferation of new cells (blastema formation) to replace lost parts, commonly seen in the regeneration of a Salamander's limb or a Lizard's tail.

• Evolutionary Significance:

• Regeneration is an important survival mechanism. While simple organisms like Planaria and sponges show extensive regeneration, higher vertebrates have largely lost this ability, focusing instead on wound healing and tissue repair.

Important Points

• Platyhelminthes: Also known as flatworms, these are acoelomate, triploblastic, and bilaterally symmetrical organisms. Planaria is often used as a model organism in genetics and developmental biology.

• Stem Cell Research: The study of Planaria regeneration provides vital insights into human regenerative medicine, as scientists attempt to understand how stem cells can be triggered to repair human organs or spinal cord injuries.

• Asexual Reproduction: In addition to regeneration following injury, some Planaria species use binary fission (splitting themselves in half) as a natural method of population growth.

Q21. Answer: (d) Kidney → Ureter → Urinary bladder → Urethra

The correct answer is Kidney → Ureter → Urinary bladder → Urethra.

Key Points

• The human excretory system consists of a pair of kidneys, a pair of ureters, a urinary bladder, and a urethra. Its primary role is to filter out nitrogenous wastes and maintain osmoregulation.

• Kidney: Urine formation starts here through the filtration of blood. The kidneys extract waste products such as urea and excess salts from the bloodstream to form urine.

• Ureter: These are long, muscular tubes that carry urine from the renal pelvis of each kidney to the urinary bladder. Urine moves through these tubes via peristalsis.

• Urinary bladder: This is a hollow, muscular sac-like organ that stores urine temporarily. It expands as it fills and sends signals to the brain when it needs to be emptied.

• Urethra: This is the final canal through which urine is expelled from the body. The process of releasing urine is scientifically known as micturition.

• The correct physiological sequence for the passage of urine is Kidney (formation) → Ureter (conduction) → Urinary bladder (storage) → Urethra (excretion). Hence, the sequence Kidney → Ureter → Urinary bladder → Urethra is correct.

Additional Information

• The Kidneys:

• Each kidney contains approximately 1 million functional units called nephrons.

• The nephron is responsible for three main processes: glomerular filtration, tubular reabsorption, and tubular secretion.

• The kidneys also produce hormones like erythropoietin, which stimulates the production of red blood cells.

• The Ureters:

• These tubes are approximately 25 to 30 cm in length.

• They enter the bladder at an oblique angle to prevent the backflow (reflux) of urine toward the kidneys.

• The Urinary Bladder:

• An average adult bladder can hold between 400 ml to 600 ml of urine before the urge to urinate becomes strong.

• The bladder wall contains a specialized muscle called the detrusor muscle, which contracts during urination.

• The Urethra:

• In females, the urethra is much shorter (about 4 cm), while in males, it is longer (about 20 cm) and also serves as a passage for semen.

• The flow of urine is controlled by internal and external urethral sphincters.

Important Points

• Urine Composition: Healthy human urine typically consists of about 95% water and 5% organic/inorganic wastes like urea, creatinine, ammonia, and uric acid.

• Daily Output: An average adult human excretes about 1 to 1.5 liters of urine per 24 hours, though this varies based on fluid intake and environmental conditions.

• pH Level: Urine is generally slightly acidic, with an average pH of 6.0, but it can range from 4.5 to 8.0 depending on diet and health status.

• Diseases: Malfunctions in this sequence can lead to conditions like Kidney Stones (calculi), Urethritis (inflammation of the urethra), or Cystitis (inflammation of the bladder).

Q22. Answer: (c) Killing weeds

The correct answer is Killing weeds.

Key Points

• Herbicides, also commonly known as weedkillers, are a specific type of pesticide used to kill or inhibit the growth of undesired plants, known as weeds.

• The primary function of herbicides in agriculture is to eliminate competition; weeds compete with crops for vital resources such as water, soil nutrients, sunlight, and spatial area.

• By removing these competitors, herbicides ensure that the primary crop receives the maximum available resources, which directly leads to an increase in crop yield and overall quality of the harvest. Hence, the statement "Killing weeds" is correct.

• Herbicides are classified into two main types: Selective herbicides, which control specific weed species while leaving the desired crop relatively unharmed, and Non-selective herbicides (often called total weedkillers), which kill all plant material they contact.

• The application of these chemicals is a critical component of modern industrial agriculture, allowing for large-scale monoculture and reducing the need for manual weeding or intensive tillage.

Additional Information

• Fungicides: These are chemical compounds or biological organisms used to kill or inhibit fungi or fungal spores. Fungal diseases can cause devastating losses in crops like wheat, rice, and potatoes (e.g., Late Blight). Common examples include Bordeaux mixture and Sulfur-based sprays.

• Insecticides: These are substances used to kill insects. They include ovicides and larvicides used against insect eggs and larvae, respectively. These are used to protect crops from pests like aphids, locusts, and bollworms. A well-known historical example is DDT, though many modern versions like Neonicotinoids are now more common.

• Bactericides: These are chemicals used specifically to control bacterial plant diseases. While less common than fungicides, they are used to treat conditions like citrus canker or fire blight in orchards. Many bactericides are copper-based or involve antibiotics like streptomycin.

• Rodenticides: These are a category of pest control chemicals intended to kill rodents (rats and mice) that might consume crops in the field or damage stored grains in warehouses.

Important Points

• Modes of Action: Herbicides work through various biological mechanisms, such as inhibiting photosynthesis, disrupting cell division, or interfering with the synthesis of essential amino acids.

• Timing of Application: They can be applied as Pre-planting (incorporated into the soil before sowing), Pre-emergence (applied before the weed or crop sprouts), or Post-emergence (applied after the plants are visible).

• Popular Examples: 2,4-D is one of the oldest and most widely used selective herbicides in the world, primarily used to control broadleaf weeds. Glyphosate is a famous non-selective systemic herbicide used extensively in no-till farming.

• Environmental Impact: Excessive use of herbicides can lead to soil degradation, water contamination, and the development of herbicide-resistant weeds (often called superweeds), which poses a challenge for sustainable agriculture.

Q23. Answer: (c) parallel to the wave direction

The correct answer is parallel to the wave direction.

Key Points

• In a longitudinal wave, the particles of the medium vibrate or oscillate in a direction that is parallel to the direction of energy transport. This means if the wave moves from left to right, the particles of the medium oscillate back and forth along the same left-to-right axis.

• These waves are characterized by the formation of compressions and rarefactions. Compressions are regions where the particles are closest together (high pressure), while rarefactions are regions where the particles are farthest apart (low pressure).

• A classic example of a longitudinal wave is a sound wave traveling through a medium like air, water, or steel. When a sound wave travels, the air molecules move back and forth, creating pressure variations that our ears detect.

• Longitudinal waves can propagate through solids, liquids, and gases. This is because these waves depend on the elasticity of volume of the medium, and all three states of matter possess this property.

• In seismology, the P-waves (Primary waves) generated during an earthquake are longitudinal waves. They are the fastest seismic waves and can travel through both the liquid outer core and the solid mantle of the Earth.

Additional Information

• Transverse Waves: Unlike longitudinal waves, in a transverse wave, the particles of the medium move perpendicular to the direction of the wave motion. Examples include light waves, radio waves, and waves produced in a plucked guitar string.

• Mechanical Waves: Both longitudinal and transverse waves (when traveling through a medium) are types of mechanical waves. These waves require a material medium (solid, liquid, or gas) for their propagation and cannot travel through a vacuum.

• Wave Parameters:

• Wavelength: In a longitudinal wave, it is the distance between two consecutive compressions or two consecutive rarefactions.

• Frequency: This refers to the number of oscillations per unit time. It is measured in Hertz (Hz).

• Amplitude: In these waves, amplitude refers to the maximum displacement of the particles from their mean equilibrium position.

• Speed of Sound: The speed of a longitudinal sound wave depends on the density and elasticity of the medium. Sound travels fastest in solids, followed by liquids, and is slowest in gases. For instance, the speed of sound in steel is approximately 5960 m/s, while in air at 20 degrees Celsius, it is about 343 m/s.

Important Points

• Wave Equation: The relationship between the velocity (v), frequency (f), and wavelength (λ) is expressed by the fundamental formula v = f × λ. This applies to all wave types, including longitudinal ones.

• Slinky Example: A common classroom demonstration of a longitudinal wave involves a Slinky spring. By pushing and pulling the end of the spring along its length, a pulse of compression moves down the spring, demonstrating parallel particle motion.

• Ultrasound: These are longitudinal waves with frequencies higher than the upper limit of human hearing (greater than 20,000 Hz). They are widely used in medical imaging and industrial non-destructive testing.

• Infrasound: These are longitudinal waves with frequencies below 20 Hz. They are often produced by large-scale natural phenomena like volcanic eruptions or avalanches.

Q24. Answer: (a) The live wire is red, the neutral wire is black, and the earth wire is green

The correct answer is The live wire is red, the neutral wire is black, and the earth wire is green.

Key Points

• In a typical domestic electrical circuit, three separate wires are utilized to ensure the safe and functional delivery of electricity: the live wire, the neutral wire, and the earth wire.

• The live wire (also known as the phase wire) is traditionally color-coded red in India. This wire is at a high potential, usually 220V relative to the ground. Hence, the statement describing the live wire as red is correct.

• The neutral wire is traditionally color-coded black. This wire completes the circuit by providing a return path for the current and is generally at zero potential. Hence, the statement describing the neutral wire as black is correct.

• The earth wire is color-coded green (or sometimes a combination of green and yellow in modern contexts). It is a safety wire used to connect the metallic casing of appliances to the ground. Hence, the statement describing the earth wire as green is correct.

• The standard potential difference (voltage) between the live and neutral wires in Indian households is 220 Volts with a frequency of 50 Hz.

Additional Information

• Functions of the Wires:

• Live Wire: It is the source of current coming into the house from the power station or transformer. It is the wire that carries the voltage and is connected to fuses or Circuit Breakers (MCB).

• Neutral Wire: It serves as the exit point for the current, maintaining the flow of electricity. While it is ideally at 0V, it can carry current if the circuit is active.

• Earth Wire: It provides a low-resistance path for leakage current. If the insulation of the live wire fails and touches the metal body of an appliance, the current flows into the ground, preventing a fatal electric shock to the user.

• Modern International Color Coding:

• In recent years, many countries, including India, have started adopting the international standard (IEC 60446).

• In this new system, the Live wire is Brown, the Neutral wire is Blue, and the Earth wire remains Green-Yellow.

• However, for most traditional installations and general examinations, the Red-Black-Green convention remains the standard reference.

• Safety Components:

• The Electric Fuse is a critical safety device connected in series with the live wire to protect against short-circuits or overloading.

• A Miniature Circuit Breaker (MCB) is a modern alternative to fuses that automatically switches off the circuit during abnormal current conditions.

Important Points

• Short Circuiting: This occurs when the live wire and the neutral wire come into direct contact due to damaged insulation, leading to a sudden, massive surge in current and potential fires.

• Overloading: This happens when too many high-power appliances (like air conditioners, heaters, and geysers) are connected to a single circuit, exceeding the wire's current-carrying capacity.

• Safety Tip: Switches should always be connected to the live wire so that when the switch is off, the appliance is completely disconnected from the high-voltage supply.

Q25. Answer: (a) Continuous movement of particles

The correct answer is Continuous movement of particles.

Key Points

• The observation of ink spreading in water is a classic demonstration of the continuous movement of particles of matter. According to the Kinetic Molecular Theory, particles of matter are never at rest; they are in constant, random motion.

• This spontaneous intermixing of particles of two different types of matter on their own is called diffusion. In this case, the ink particles move and distribute themselves among the water particles.

• The movement happens because particles possess Kinetic Energy. As the ink is added, its particles collide with the water molecules, leading to a uniform distribution over time, even without stirring. Hence, statement 1 is correct.

• While there are spaces between particles, the act of "spreading" or "traveling" throughout the liquid specifically highlights the kinetic nature (movement) rather than just the existence of gaps.

• Particles in liquids have enough kinetic energy to slide past one another, which allows for the fluidity and the diffusion process observed in the experiment.

Additional Information

• Characteristics of Particles of Matter:

• Particles of matter are very small, often beyond our imagination.

• They have spaces between them (intermolecular spaces), which is why we can dissolve salt or sugar in water without a significant increase in volume.

• They attract each other due to intermolecular forces. The strength of this attraction varies from one substance to another (strongest in solids, weakest in gases).

• They are continuously moving, and this movement increases with an increase in temperature.

• Diffusion in Different States:

• Gases: Diffusion is fastest in gases because particles move at high speeds and have large spaces between them. An example is the smell of perfume or cooking food spreading in a room.

• Liquids: Diffusion is slower than in gases but faster than in solids. The spreading of ink or potassium permanganate in water are primary examples.

• Solids: Diffusion in solids is extremely slow. An example is chalk marks left on a blackboard for a long time becoming difficult to erase because particles diffuse into the surface.

Important Points

• Effect of Temperature: The rate of diffusion is directly proportional to temperature. On heating, particles gain more Kinetic Energy and move faster, causing the ink or salt to spread more quickly in hot water compared to cold water.

• Brownian Motion: This phenomenon is closely related to the continuous movement of particles. It was first observed by Robert Brown in 1827 while looking at pollen grains in water. It describes the zig-zag, random motion of microscopic particles.

• Concentration Gradient: Diffusion always occurs from an area of higher concentration to an area of lower concentration until a uniform distribution (equilibrium) is reached.

• Fixed Positions: Statement 2 is incorrect because if particles had fixed positions, the matter would be a rigid solid at absolute zero temperature, and the ink would stay exactly where it was dropped.

• Attraction Between Particles: While attraction (Statement 3) exists, it actually acts against diffusion by trying to keep the particles of the same substance together. Diffusion occurs because the kinetic energy of the particles is sufficient to overcome some of these attractive forces.

Q26. Answer: (d) 19/12

Shortcut Trick

Use complementary angle relations: cot 72° = tan 18° and tan 72° = cot 18°.

Group terms: $(\sec^2 18° - \tan^2 18°) + (\cot^2 18° - \operatorname{cosec}^2 18°) + \sin^2 30° + \operatorname{cosec}^2 60°$.

Apply identities: $(1) + (-1) + \sin^2 30° + \operatorname{cosec}^2 60°$.

Value = $0 + (1/2)^2 + (2/\sqrt{3})^2 = 1/4 + 4/3$.

Total = $(3 + 16) / 12 = 19/12$.

Therefore The correct answer is 19/12.

Alternate Method

Given: $\sec^2 18° - \cot^2 72° + \sin^2 30° + \operatorname{cosec}^2 60° - \operatorname{cosec}^2 18° + \tan^2 72°$

Formula Used: $\cot(90° - \theta) = \tan\theta$ | $\tan(90° - \theta) = \cot\theta$ | $\sec^2\theta - \tan^2\theta = 1$ | $\operatorname{cosec}^2\theta - \cot^2\theta = 1$

=> $\sec^2 18° - \tan^2(90° - 72°) + \sin^2 30° + \operatorname{cosec}^2 60° - \operatorname{cosec}^2 18° + \cot^2(90° - 72°)$

=> $\sec^2 18° - \tan^2 18° + \sin^2 30° + \operatorname{cosec}^2 60° - \operatorname{cosec}^2 18° + \cot^2 18°$

=> $(\sec^2 18° - \tan^2 18°) + \sin^2 30° + \operatorname{cosec}^2 60° - (\operatorname{cosec}^2 18° - \cot^2 18°)$

=> $1 + (1/2)^2 + (2/\sqrt{3})^2 - 1$

=> $1/4 + 4/3$

=> $(3 + 16) / 12$

=> $19/12$

Therefore The correct answer is 19/12.

Additional Information

Complementary Angle Identities

For angles adding to 90°, ratios convert: sin ↔ cos, tan ↔ cot, sec ↔ cosec.

Pythagorean Identities

The three basic identities are $\sin^2\theta + \cos^2\theta = 1$, $\sec^2\theta - \tan^2\theta = 1$, and $\text{cosec}^2\theta - \cot^2\theta = 1$.

Reciprocal Trigonometric Values

Standard values for common angles: sin 30° = 1/2, cos 30° = √3/2, tan 30° = 1/√3, and their reciprocals.

Q27. Answer: (b) 68

Shortcut Trick

Mode is the observation that occurs most frequently in the data set.

Count occurrences: 68 appears 4 times.

Count occurrences: 85 appears 3 times.

Count occurrences: 64 appears 3 times.

Other values (72, 76, etc.) occur only 1 or 2 times.

Therefore The correct answer is 68.

Alternate Method

Given data: 85, 73, 89, 82, 67, 61, 78, 69, 86, 68, 64, 76, 64, 85, 68, 85, 68, 81, 68, 72, 64, 72, 76, 84, 88

Formula Used: Mode = Value with the maximum frequency.

=> Frequency of 61 = 1

=> Frequency of 64 = 3

=> Frequency of 68 = 4

=> Frequency of 72 = 2

=> Frequency of 76 = 2

=> Frequency of 85 = 3

=> All other values (67, 69, 73, 78, 81, 82, 84, 86, 88, 89) occur 1 time each.

=> The value 68 occurs the most number of times (4).

Therefore The correct answer is 68.

Additional Information

Empirical Formula

For a moderately skewed distribution, the relationship between Mean, Median, and Mode is: Mode = (3 × Median) − (2 × Mean).

Bimodal and Multimodal Data

If two or more values have the same maximum frequency, the data set is said to be bimodal (two modes) or multimodal (multiple modes).

Mean and Median

Mean is the average calculated by Σx ÷ n. Median is the middle value of the data set when arranged in ascending or descending order.

Q28. Answer: (a) 16

Shortcut Trick

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

Here, the total number of terms (n) = 16.

Average = 16.

Therefore The correct answer is 16.

Alternate Method

Given: n = 16 odd natural numbers.

Formula: Average of an Arithmetic Progression (A.P.) = (First term + Last term) ÷ 2

=> First odd natural number (a) = 1

=> 16^(th) odd natural number (l) = a + (n − 1) × d = 1 + (16 − 1) × 2 = 31

=> Total Sum = (n ÷ 2) × (a + l) = (16 ÷ 2) × (1 + 31) = 8 × 32 = 256

=> Average = Total Sum ÷ n = 256 ÷ 16 = 16

Therefore The correct answer is 16.

Additional Information

Average of Even Numbers

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

Average of Consecutive Natural Numbers

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

Sum of First n Odd Numbers

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

Average of Squares

The average of squares of first n natural numbers is [(n + 1)(2n + 1)] ÷ 6.

Q29. Answer: (d) 16,800

Shortcut Trick

Let the total number of registered voters be X.

Apply the successive percentage factors: X × (Cast%) × (Valid%) × (Candidate Share%) = 9261

=> X × 75/100 × 98/100 × 75/100 = 9261

=> X × 3/4 × 49/50 × 3/4 = 9261

=> X × 441/800 = 9261 => X = 21 × 800 = 16800

Therefore The correct answer is 16,800.

Alternate Method

Given:

Votes cast = 75% of Registered Voters

Invalid votes = 2% of cast votes => Valid votes = 98% of cast votes

Candidate share = 75% of valid votes = 9261

Formula: Registered Voters = (Winner Votes × 100 × 100 × 100) ÷ (Cast% × Valid% × Share%)

=> Total Voters = (9261 × 100 × 100 × 100) ÷ (75 × 98 × 75)

=> Total Voters = (9261 × 4 × 50 × 4) ÷ (3 × 49 × 3)

=> Total Voters = (9261 × 800) ÷ (9 × 49)

=> Total Voters = (9261 × 800) ÷ 441

=> Total Voters = 21 × 800

=> Total Voters = 16800

Therefore The correct answer is 16,800.

Additional Information

Election Vote Distribution

Total Registered = Cast + Not Cast; Cast = Valid + Invalid. Calculations are always performed on Valid votes unless specified otherwise.

Successive Percentage Method

When multiple changes occur on a base value, the final value = Initial × (a/100) × (b/100) × (c/100). This is the fastest way to solve election and population problems.

Valid vs Invalid Ratio

If p% are invalid, then valid votes = Total Cast × (100 − p)/100.

Q30. Answer: (c) 12,800

Shortcut Trick

Effective successive discount of 30% and 20% = 30 + 20 − (30 × 20)/100 = 44%

Difference in discount percentages = 46% − 44% = 2%

Given that 2% of the Marked Price = Rs. 256

Marked Price (100%) = (256 ÷ 2) × 100 = Rs. 12,800

Therefore The correct answer is Rs. 12,800.

Alternate Method

Given:

Single discount = 46%

Successive discounts = 30% and 20%

Difference in discount amount = Rs. 256

Formula Used:

Equivalent discount for two successive discounts a% and b% = (a + b − ab/100)%

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Selling Price (SP) = Marked Price (MP) × (100 − Discount%)/100
=> Effective discount of 30% and 20% = (30 + 20 − (30 × 20)/100)%
=> Effective discount = 50 − 6 = 44%
=> Difference between first and second discount scenarios = 46% − 44% = 2%
=> According to the problem: 2% of Marked Price = 256
=> Marked Price = (256 × 100) ÷ 2
=> Marked Price = 128 × 100 = 12,800
Therefore The correct answer is Rs. 12,800.
Additional Information
Single Equivalent Discount Formula
For two successive discounts of x% and y%, the single equivalent discount is (x + y − xy/100)%.
Relationship between MP and SP
The Selling Price after a discount d% on Marked Price is calculated as: SP = MP × (100 − d)/100.
Successive Discounts (Three or more)
For three successive discounts d1, d2, and d3, the final SP is MP × (1 − d1/100) × (1 − d2/100) × (1 − d3/100).

Q31. Answer: (c) 16 km/hr

Shortcut Trick
When the distance is the same for both journeys, use the Harmonic Mean formula:
Average Speed = (2 × s1 × s2) / (s1 + s2)
=> Average Speed = (2 × 10 × 40) / (10 + 40)
=> Average Speed = 800 / 50 = 16 km/hr.
Therefore The correct answer is 16 km/hr.
Alternate Method
Given:
Speed while going (s1) = 10 km/hr
Speed while returning (s2) = 40 km/hr
Formula Used:
Average Speed = Total Distance ÷ Total Time
Let the distance between home and school be the LCM of 10 and 40, which is 40 km.
=> Distance (D) = 40 km
=> Time taken while going (t1) = Distance / s1 = 40 / 10 = 4 hours
=> Time taken while returning (t2) = Distance / s2 = 40 / 40 = 1 hour
=> Total Distance = 40 + 40 = 80 km
=> Total Time = 4 + 1 = 5 hours
=> Average Speed = 80 / 5 = 16 km/hr
Therefore The correct answer is 16 km/hr.
Additional Information
Average Speed for different distances
When distances are not equal, use the general formula: Average Speed = (d1 + d2 + ... + d_n) / (t1 + t2 + ... + t_n).
Three equal distances
If a journey is divided into three equal parts covered at speeds x, y, and z, the average speed is (3xyz) / (xy + yz + zx).
Speed Conversion
To convert speed from km/hr to m/s, multiply the value by 5/18. To convert from m/s to km/hr, multiply by 18/5.

Q32. Answer: (d) Rs. 770

Shortcut Trick
Total deduction = 29 + 70 + 28 = Rs. 127
Remaining amount = 13,525 − 127 = Rs. 13,398
Sum of ratio parts = 19 + 6 + 8 = 33 units
1 unit = 13398 ÷ 33 = 406
Difference (B & C) = |(8 × 406 + 28) − (6 × 406 + 70)| = 812 − 42 = 770

Therefore The correct answer is Rs. 770.

Alternate Method

Given:

Total amount = Rs. 13,525

Deductions from A, B, C = Rs. 29, Rs. 70, Rs. 28

Ratio after deduction = 19 : 6 : 8

Sum of remaining amount = 13,525 − (29 + 70 + 28)

=> 13,525 − 127 = 13,398

=> Let the shares after deduction be 19x, 6x, and 8x.

=> 19x + 6x + 8x = 13,398

=> 33x = 13,398

=> x = 13,398 ÷ 33 = 406

=> B's original share = 6x + 70 = 6 × 406 + 70 = 2,436 + 70 = 2,506

=> C's original share = 8x + 28 = 8 × 406 + 28 = 3,248 + 28 = 3,276

=> Difference = 3,276 − 2,506 = 770

Therefore The correct answer is Rs. 770.

Additional Information

Ratio and Proportion Basics

A ratio a : b indicates that for every 'a' units of the first quantity, there are 'b' units of the second. To find individual values, divide the total sum by the sum of ratio parts (a + b) to find the value of one unit.

Handling Deductions in Ratios

When fixed amounts are deducted from shares to reach a specific ratio, subtract the total deduction from the grand total before applying the ratio distribution formula.

Unitary Method in Ratios

Value of 'n' parts = (Total Value ÷ Total Ratio Parts) × n. This is the fastest way to calculate individual components in banking exams.

Q33. Answer: (b) Rs. 28.60

Shortcut Trick

Ratio of quantities = 10 : 15 = 2 : 3

Weighted Average CP = [(2 × 20) + (3 × 30)] ÷ (2 + 3)

=> 130 ÷ 5 = Rs. 26 per kg

Selling price for 10% profit = 26 × 110% = Rs. 28.60

Therefore The correct answer is Rs. 28.60.

Alternate Method

Given:

Quantity1 = 10 kg, Price1 = Rs. 20/kg

Quantity2 = 15 kg, Price2 = Rs. 30/kg

Desired Profit = 10%

Formula Used:

Total CP = (Q1 × P1) + (Q2 × P2)

Selling Price (SP) = CP_(avg) × (100 + Profit%)/100

=> Total cost of 10 kg wheat = 10 × 20 = Rs. 200

=> Total cost of 15 kg wheat = 15 × 30 = Rs. 450

=> Total CP of 25 kg mixture = 200 + 450 = Rs. 650

=> Cost price per kg of mixture = 650 ÷ 25 = Rs. 26

=> To earn 10% profit, SP = 26 + (10% of 26)

=> SP = 26 + 2.60 = Rs. 28.60

Therefore The correct answer is Rs. 28.60.

Additional Information

Weighted Average

The average price of a mixture is calculated as (n1c1 + n2c2) ÷ (n1 + n2), where n is quantity and c is cost.

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Profit Percentage

Profit is always calculated on the Cost Price (CP). Selling Price = CP × (100 + Profit%) ÷ 100.

Alligation Rule

It is a shorter way to find the ratio in which two ingredients are mixed: (Higher Price − Mean Price) : (Mean Price − Lower Price).

Q34. Answer: (a) 128/11

Shortcut Trick

Total capacity = LCM of (15, 35, 60) = 420 units.

Efficiencies: A = 420/15 = 28 | B = 420/35 = 12 | C = −420/60 = −7 (Outlet).

Combined Efficiency (A + B + C) = 28 + 12 − 7 = 33 units/min.

Required time = 420 ÷ 33 = 140/11 minutes.

Time = 12^8/11 minutes.

Therefore The correct answer is 12^8/11 minutes.

Alternate Method

Given:

Time for Pipe A = 15 mins

Time for Pipe B = 35 mins

Time for Pipe C (Emptying) = 1 hour = 60 mins

Formula used: Net Efficiency = Efficiency of A + Efficiency of B − Efficiency of C

Pipes	Time	Capacity	Efficiency
A (Fill)	15	420	28
B (Fill)	35	12	
C (Empty)	60	−7	

Combined efficiency of A + B + C = 28 + 12 − 7 = 33 units/min

=> Total capacity = LCM(15, 35, 60) = 420 units

=> Time to fill cistern = Capacity ÷ Combined Efficiency

=> Time = 420 ÷ 33

=> Time = 140 ÷ 11

=> Time = 12^8/11 minutes

Therefore The correct answer is 12^8/11 minutes.

Additional Information

Inlet and Outlet Pipes

Work done by an inlet pipe is always taken as positive, whereas work done by an outlet pipe is taken as negative.

Net Work Formula

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

Efficiency Relation

Efficiency is inversely proportional to the time taken to complete the work (Efficiency prop. to 1/Time).

Q35. Answer: (a) 10 : 11

Shortcut Trick

Convert both values to a common form (percentage).

66% of 1^(st) Number = (3/5 × 100)% of 2^(nd) Number

66% of 1^(st) Number = 60% of 2^(nd) Number

Ratio (1^(st) : 2^(nd)) = Inverse of their coefficients = 60 : 66

Simplifying by dividing by 6 => 10 : 11

Therefore The correct answer is 10 : 11.

Alternate Method

Given:

Percentage of first number = 66%

Fraction of second number = 3/5

Formula:

Value = (Percentage/100) × Number | Ratio A : B = A/B

Let the first number be x and the second number be y.

=> 66% of x = (3/5) of y

=> (66/100) × x = (3/5) × y

=> (33/50) × x = (3/5) × y

=> x/y = (3/5) ÷ (33/50)

=> x/y = (3/5) × (50/33)

=> x/y = (1 × 10) / (1 × 11)

=> x/y = 10/11

Therefore The correct answer is 10 : 11.

Additional Information

Percentage to Fraction Conversion

To convert x% to a fraction, divide by 100: x/100. Conversely, multiply a fraction by 100 to get the percentage.

Ratio Balancing Rule

If m × A = n × B, then the ratio A : B is equal to n : m. This is known as the inverse coefficient rule.

Simplifying Ratios

A ratio a : b can be simplified by dividing both terms by their Highest Common Factor (HCF) to reach the simplest form.

Q36. Answer: (d) Rs. 240

Shortcut Trick

Income ratio = 8 : 5 and Expenditure ratio = 2 : 1

Savings are same (Rs. 160), use cross-product method:

| (8 × 1) − (5 × 2) | units = | 160 × (1 − 2) |

=> | 8 − 10 | units = | −160 | => 2 units = 160

=> 1 unit = 80

Difference in income = (8 − 5) = 3 units = 3 × 80 = Rs. 240

Therefore The correct answer is Rs. 240.

Alternate Method

Given: Ratio of Incomes = 8 : 5, Ratio of Expenditures = 2 : 1, Individual Savings = Rs. 160.

Formula: Income − Expenditure = Savings

Let the incomes be 8x and 5x.

Let the expenditures be 2y and y.

=> 8x − 2y = 160 ... (i)

=> 5x − y = 160 => y = 5x − 160 ... (ii)

Substituting the value of y from equation (ii) into equation (i):

=> 8x − 2(5x − 160) = 160

=> 8x − 10x + 320 = 160

=> −2x = 160 − 320

=> −2x = −160 => x = 80

=> Monthly income of first person = 8 × 80 = Rs. 640

=> Monthly income of second person = 5 × 80 = Rs. 400

=> Difference = 640 − 400 = Rs. 240

Therefore The correct answer is Rs. 240.

Additional Information

Income, Expenditure and Savings

The basic relationship is Income = Expenditure + Savings. If savings are equal for both parties, the difference in income units is proportional to the difference in expenditure units after scaling.

Ratio Balancing

To solve without algebra, multiply the expenditure ratio by a factor so that the difference (Income Unit − Expenditure Unit) is equal for both persons.

Proportion Rule

If A:B is the ratio of two quantities, the difference is expressed as |A − B| units. To find the real value, multiply this unit difference

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by the value of 1 unit.

Q37. Answer: (d) 1536 cm3

Shortcut Trick

Total Surface Area (TSA) ratio units = 2 × (4×3 + 3×2 + 2×4) = 52 units²

Scaling factor squared (x^2) = Total Area ÷ Ratio units = 832 ÷ 52 = 16

Linear scaling factor (x) = √16 = 4 cm

Volume ratio units = 4 × 3 × 2 = 24 units³

Actual Volume = 24 × $(x)^3$ = 24 × 4^3 = 24 × 64 = 1536 cm³

Therefore The correct answer is 1536 cm³.

Alternate Method

Given:

Ratio of length (L) : breadth (B) : height (H) = 4 : 3 : 2

Total Surface Area (TSA) = 832 cm²

Formula Used:

Total Surface Area of cuboid = 2(LB + BH + HL)

Volume of cuboid = L × B × H

Calculations:

=> Let Length (L) = 4x, Breadth (B) = 3x, and Height (H) = 2x

=> 2[(4x × 3x) + (3x × 2x) + (2x × 4x)] = 832

=> 2[$12x^2$ + $6x^2$ + $8x^2$] = 832

=> 2[$26x^2$] = 832

=> $52x^2$ = 832

=> x^2 = 832 ÷ 52 = 16

=> x = √16 = 4

=> L = 4 × 4 = 16 cm

=> B = 3 × 4 = 12 cm

=> H = 2 × 4 = 8 cm

=> Volume = 16 × 12 × 8

=> Volume = 1536 cm³

Therefore The correct answer is 1536 cm³.

Additional Information

Lateral Surface Area (LSA)

The surface area of the four vertical walls of the cuboid is 2h(l + b).

Diagonal of a Cuboid

The length of the longest rod that can fit in a cuboid is √(l^2 + b^2 + h^2).

Properties of a Cube

A cube is a special cuboid where l = b = h = a. TSA = $6a^2$ and Volume = a^3.

Q38. Answer: (b) 25 years

Shortcut Trick

Ratio (A : B) 9 yrs ago = 3 : 1 (Difference = 2)

Ratio (A : B) 7 yrs hence = 2 : 1 × 2 = 4 : 2 (Difference = 2)

Total time gap = 9 + 7 = 16 years

Unit difference in B's ratio = 2 − 1 = 1 unit

=> 1 unit = 16 years

Bhawna's age 9 yrs ago = 1 unit = 16 years

Bhawna's present age = 16 + 9 = 25 years

Therefore The correct answer is 25 years.

Alternate Method

Given: 9 years ago Asha = 3 × Bhawna. 7 years hence Asha = 2 × Bhawna.

Let the present age of Bhawna be B and Asha be A.

=> (A − 9) = 3(B − 9)
=> A − 9 = 3B − 27
=> A = 3B − 18 — (i)
=> (A + 7) = 2(B + 7)
=> A + 7 = 2B + 14
=> A = 2B + 7 — (ii)
Equating (i) and (ii):
=> 3B − 18 = 2B + 7
=> 3B − 2B = 7 + 18
=> B = 25 years
Therefore The correct answer is 25 years.
Additional Information
Constant Age Difference
The difference between the ages of two individuals always remains the same, regardless of how many years pass.
Ratio Balancing
In age problems involving ratios, multiply the ratios by the difference of the other ratio to equalize the unit gaps between years.
Average Age Property
If the average age of a group of n people is X, then after k years, the new average age will be X + k.

Q39. Answer: (a) 23

Shortcut Trick
To minimize sections, maximize students per section using HCF.
Students per section = HCF(156, 143)
156 = 13 × 12 and 143 = 13 × 11 => HCF = 13
Number of sections = (156 ÷ 13) + (143 ÷ 13)
Number of sections = 12 + 11 = 23
Therefore The correct answer is 23.
Alternate Method
Given:
Number of boy students = 156
Number of girl students = 143
Condition: Each section must have same number of students and contain only boys or girls.
Formula Used:
To have the fewest sections, the size of each section must be the Highest Common Factor (HCF) of the number of boys and girls.
Total Sections = (Number of Boys ÷ HCF) + (Number of Girls ÷ HCF)
Calculations:
=> Prime factors of 156 = 2 × 2 × 3 × 13
=> Prime factors of 143 = 11 × 13
=> Common factor (HCF) = 13
=> Number of boy sections = 156 ÷ 13 = 12
=> Number of girl sections = 143 ÷ 13 = 11
=> Total number of sections = 12 + 11
=> Total sections = 23
Therefore The correct answer is 23.
Additional Information
Highest Common Factor (HCF)
It is the largest positive integer that divides each of the integers without a remainder. It is used to find the maximum size for equal grouping.
Least Common Multiple (LCM)
LCM is the smallest positive integer that is divisible by both a and b. It is used for problems involving cycles or meeting times.
HCF × LCM Property
For two numbers a and b, Product of numbers = HCF(a, b) × LCM(a, b).

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Q40. Answer: (b) 1685

Shortcut Trick

Unit digit calculation: Unit digit of 13^3 is 7 ($3^3 = 27$).

Unit digit of 8^3 is 2 ($8^3 = 512$).

Difference in unit digits = 7 − 2 = 5.

Comparing options, only 1685 and 1725 end in 5.

Since $13^3 - 8^3 = 2197 - 512 = 1685$.

Therefore The correct answer is 1685.

Alternate Method

Given: $13^3 - 8^3$

Formula used: $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

Here, a = 13 and b = 8

=> $(13 - 8) \times (13^2 + 13 \times 8 + 8^2)$

=> $5 \times (169 + 104 + 64)$

=> 5×337

=> 1685

Therefore The correct answer is 1685.

Additional Information

Sum of Cubes Identity

The sum of two cubes is given by $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$.

Difference of Squares

The difference of two squares is given by $a^2 - b^2 = (a - b)(a + b)$.

Common Cubes

$11^3 = 1331$, $12^3 = 1728$, $13^3 = 2197$, $14^3 = 2744$, $15^3 = 3375$.

Q41. Answer: (d) 36 π cm²

Shortcut Trick

Surface area of a sphere = 4 × Area of its great circle

Area of great circle = π × (radius)² = π × 3² = 9π

Surface Area = 4 × 9π = 36π cm²

Therefore The correct answer is 36 π cm².

Alternate Method

Given: Radius of the sphere (r) = 3 cm

Formula Used: Total Surface Area of a Sphere = $4\pi r^2$

=> Surface Area = $4 \times \pi \times (3)^2$

=> Surface Area = $4 \times \pi \times 9$

=> Surface Area = 36π cm²

Therefore The correct answer is 36 π cm².

Additional Information

Volume of a Sphere

The amount of space occupied by a sphere is given by $V = (4/3)\pi r^3$.

Surface Area of a Hemisphere

Curved Surface Area (CSA) = $2\pi r^2$ and Total Surface Area (TSA) = $3\pi r^2$.

Ratio of Surface Area to Volume

For a sphere, the ratio of its surface area to its volume is 3/r.

Q42. Answer: (d) 39.52%

Shortcut Trick

Single equivalent discount formula for two successive discounts a% and b%:

Equivalent Discount = [a + b − (a × b / 100)]%

=> Equivalent Discount = [28 + 16 − (28 × 16 / 100)]%

=> Equivalent Discount = [44 − 4.48]% = 39.52%

Therefore The correct answer is 39.52%.
Alternate Method
Given: First discount (d1) = 28%, Second discount (d2) = 16%
Formula: Final Price = MP × (100 − d1)/100 × (100 − d2)/100
=> Let the Marked Price (MP) be 100 units.
=> Price after 1^(st) discount = 100 − (28% of 100) = 100 − 28 = 72 units.
=> Price after 2^(nd) discount = 72 − (16% of 72)
=> Second discount amount = (16 × 72) / 100 = 1152 / 100 = 11.52 units.
=> Final Selling Price (SP) = 72 − 11.52 = 60.48 units.
=> Total Discount = MP − SP = 100 − 60.48 = 39.52 units.
=> Single Equivalent Discount Percentage = (39.52 / 100) × 100 = 39.52%
Therefore The correct answer is 39.52%.
Additional Information
Three Successive Discounts
If three discounts a%, b%, and c% are given, the equivalent discount is 1 − [(1 − a/100)(1 − b/100)(1 − c/100)] × 100.
Successive Percentage Increase
For two successive increases of x% and y%, the effective increase is [x + y + (xy/100)]%.
Relation between SP, MP and Discount
Selling Price (SP) = Marked Price (MP) × (100 − Discount%)/100.

Q43. Answer: (b) 4,837.50

Shortcut Trick
Effective Rate of interest for 2 years = R + R + (R × R)/100
Effective Rate = 15 + 15 + (15 × 15)/100 = 32.25%
Total Interest = 15000 × 32.25%
Total Interest = 150 × 32.25 = 4837.50
Therefore The correct answer is Rs. 4,837.50.
Alternate Method
Given:
Principal (P) = Rs. 15,000
Rate (R) = 15% per annum
Time (n) = 2 years
Formula Used:
Amount (A) = $P(1 + R/100)^n$
Compound Interest (CI) = A − P
=> Amount (A) = $15000 \times (1 + 15/100)^2$
=> $A = 15000 \times (1.15)^2$
=> A = 15000 × 1.3225
=> A = 19837.50
=> Interest = 19837.50 − 15000
=> Interest = 4837.50
Therefore The correct answer is Rs. 4,837.50.
Additional Information
Compound Interest Formula
CI = $P[(1 + R/100)^n - 1]$, where P is principal, R is rate, and n is time in years.
Difference between CI and SI
The difference for 2 years is given by CI − SI = $P(R/100)^2$.
Half-Yearly Compounding
If interest is compounded half-yearly, the rate becomes R/2 and the time becomes 2n.

Q44. Answer: (a) 22

Shortcut Trick

Solve following BODMAS order from inner to outer brackets:

Parentheses: (21 − 11 + 9) = 19

Curly Braces: {31 − 19} = 12

Square Brackets: [25 − 12] = 13

Final calculation: 35 − 13 = 22

Therefore The correct answer is 22.

Alternate Method

Given expression: 35 − [25 − {31 − (21 − 11 + 9)}]

Formula used: BODMAS Rule (Brackets, Of, Division, Multiplication, Addition, Subtraction)

=> 35 − [25 − {31 − (10 + 9)}]

=> 35 − [25 − {31 − 19}]

=> 35 − [25 − 12]

=> 35 − 13

=> 22

Therefore The correct answer is 22.

Additional Information

BODMAS / VBODMAS Rule

It defines the order of operations: V (Vinculum/Bar), B (Brackets), O (Of), D (Division), M (Multiplication), A (Addition), S (Subtraction).

Types of Brackets

Brackets must be opened in this specific order: Vinculum (line), then Circular brackets (), then Curly braces {}, and finally Square brackets [].

Addition and Subtraction Priority

When only addition and subtraction remain, operations are performed strictly from left to right to ensure accuracy.

Q45. Answer: (b) 49%

Shortcut Trick

Net Discount Formula for two successive discounts a% and b%:

Net Discount = [a + b − (a × b / 100)]%

Here, a = 40 and b = 15

Net Discount = [40 + 15 − (40 × 15 / 100)]% = [55 − 6]% = 49%

Therefore The correct answer is 49%.

Alternate Method

Given:

First discount (d1) = 40%

Second discount (d2) = 15%

Formula: Final Selling Price = Marked Price × (1 − d1/100) × (1 − d2/100)

Let the Marked Price (MP) be 100 units.

=> Price after 1st discount = 100 − (40% of 100)

=> Price after 1st discount = 100 − 40 = 60 units

=> Price after 2nd discount = 60 − (15% of 60)

=> Price after 2nd discount = 60 − (15/100 × 60)

=> Price after 2nd discount = 60 − 9 = 51 units

=> Single Equivalent Discount = (MP − Final Price) / MP × 100

=> Single Equivalent Discount = (100 − 51) / 100 × 100

=> Single Equivalent Discount = 49%

Therefore The correct answer is 49%.

Additional Information

Three Successive Discounts

For three successive discounts a%, b%, and c%, calculate the net of a and b first, then use that result with c using the formula x +

y − xy/100.

Marked Price and Selling Price Relation

Selling Price = MP × (100 − d1)/100 × (100 − d2)/100. This is useful for large number calculations.

Successive Percentage Increase

If values increase successively, use the formula: a + b + (ab / 100)% for the overall percentage change.

Q46. Answer: (b) 64.5°

Shortcut Trick

Angle between bisectors of angle C and angle D in a quadrilateral = (angle A + angle B) ÷ 2

Given: angle A = 36° and angle B = 93°

angle DOC = (36° + 93°) ÷ 2

angle DOC = 129° ÷ 2 = 64.5°

Therefore The correct answer is 64.5°.

Alternate Method

Given: angle A = 36°, angle B = 93°, CO and DO are bisectors of angle C and angle D.

Formula: Sum of angles in a quadrilateral = 360° | Sum of angles in a triangle = 180°

=> angle A + angle B + angle C + angle D = 360°

=> 36° + 93° + angle C + angle D = 360°

=> 129° + angle C + angle D = 360°

=> angle C + angle D = 360° − 129° = 231°

=> Divide by 2: (angle C + angle D) / 2 = 231° / 2 = 115.5°

=> In ΔDOC, angle DOC + angle OCD + angle ODC = 180°

=> angle DOC + (angle C / 2) + (angle D / 2) = 180°

=> angle DOC + 115.5° = 180°

=> angle DOC = 180° − 115.5° = 64.5°

Therefore The correct answer is 64.5°.

Additional Information

Sum of Interior Angles

For any n-sided polygon, the sum of interior angles is (n − 2) × 180°.

Angle Bisector Relation

In a quadrilateral, the angle between the internal bisectors of two opposite angles is half the difference of the other two angles.

Cyclic Quadrilateral

In a cyclic quadrilateral, opposite angles are supplementary, meaning their sum is always 180°.

Q47. Answer: (c) 15

Shortcut Trick

Smallest two-digit multiple of 6 = 12

Largest two-digit multiple of 6 = 96

Total numbers (n) = [(Last Term − First Term) ÷ Common Difference] + 1

Total numbers (n) = [(96 − 12) ÷ 6] + 1

n = [84 ÷ 6] + 1 = 14 + 1 = 15

Therefore The correct answer is 15.

Alternate Method

Given: Two-digit numbers range from 10 to 99. We need to find multiples of 6 in this range.

Formula used: n^(th) term of an Arithmetic Progression (A.P.), a_n = a + (n − 1)d

=> First term (a) = 12

=> Last term (a_n) = 96

=> Common difference (d) = 6

=> 96 = 12 + (n − 1) × 6

=> 96 − 12 = (n − 1) × 6

=> 84 = (n − 1) × 6

=> n − 1 = 84 ÷ 6

=> n − 1 = 14

=> n = 14 + 1 = 15

Therefore The correct answer is 15.

Additional Information

Arithmetic Progression (AP)

A sequence of numbers where the difference between consecutive terms is constant, denoted as 'd'.

Sum of n terms of AP

The sum S_n can be calculated using S_n = (n ÷ 2)[2a + (n − 1)d] or S_n = (n ÷ 2)[a + l].

Divisibility Rule of 6

A number is divisible by 6 if it is divisible by both 2 (ends in even digit) and 3 (sum of digits is divisible by 3).

Q48. Answer: (d) 10

Shortcut Trick

Efficiency ratio of Rishi : Shan = 100 : 110 = 10 : 11.

Since Efficiency is inversely proportional to Time, Time ratio = 11 : 10.

Rishi takes 11 units of time, which is given as 11 days.

Therefore 1 unit = 1 day.

Shan takes 10 units of time = 10 × 1 = 10 days.

Therefore The correct answer is 10.

Alternate Method

Given: Rishi completes work in 11 days. Shan is 10% more efficient than Rishi.

Let efficiency of Rishi = 10 units/day.

=> Efficiency of Shan = 10 + (10% of 10) = 11 units/day.

=> Total Work = Efficiency of Rishi × Time taken by Rishi

=> Total Work = 10 × 11 = 110 units.

Person	Time	Total Work	Efficiency
Rishi	11	110	10
Shan	?	11	

=> Time taken by Shan = Total Work ÷ Efficiency of Shan

=> Time = 110 ÷ 11 = 10 days.

Therefore The correct answer is 10.

Additional Information

Efficiency and Time Relationship

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

Work Formula

Total Work = Efficiency × Time. This remains constant for a specific piece of work regardless of who performs it.

Percentage Efficiency Increase

If A is k% more efficient than B, then Efficiency_A = Efficiency_B × (1 + k/100).

Q49. Answer: (a) Rs. 875

Shortcut Trick

Total remaining fraction = (1 − 1/5) × (1 − 1/4) = 4/5 × 3/4 = 3/5

Here, 3 units represent the remaining amount Rs. 525.

1 unit = 525 ÷ 3 = 175

Original amount (5 units) = 175 × 5 = Rs. 875

Therefore The correct answer is Rs. 875.

Alternate Method

Given:

Loss percentage = 20%

Expenditure from remainder = 25%

Final amount left = Rs. 525

Formula Used:

Final Value = Initial Value × (100 − R1)/100 × (100 − R2)/100

Calculations:

Let the original amount be Rs. x.

=> Amount left after 20% loss = x − (20/100) × x = 0.8x

=> Amount spent from remainder = 25% of 0.8x = (25/100) × 0.8x = 0.2x

=> Final amount left = 0.8x − 0.2x = 0.6x

=> 0.6x = 525

=> x = 525 ÷ 0.6

=> x = 5250 ÷ 6

=> x = 875

Therefore The correct answer is Rs. 875.

Additional Information

Successive Percentage Change

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

Successive Discounts

Two successive discounts of x% and y% are equivalent to a single discount of (x + y − xy/100)%.

Percentage to Fraction Conversion

To simplify calculations, use 20% = 1/5 and 25% = 1/4 to find the multipliers directly.

Q50. Answer: (a) 15 :10 : 6

Shortcut Trick

When distance is constant, the ratio of time is the inverse of the ratio of speed.

Ratio of speeds = 2 : 3 : 5

Ratio of times = (3 × 5) : (2 × 5) : (2 × 3)

Ratio of times = 15 : 10 : 6

Therefore The correct answer is 15 : 10 : 6.

Alternate Method

Given:

Ratio of speeds of three cars (S1 : S2 : S3) = 2 : 3 : 5

Distance (D) = Constant for all three cars

Formula Used:

Time (T) = Distance (D) ÷ Speed (S)

Calculations:

=> T1 : T2 : T3 = (D/S1) : (D/S2) : (D/S3)

=> T1 : T2 : T3 = (1/2) : (1/3) : (1/5)

=> To simplify, multiply each term by the LCM of 2, 3, and 5.

=> LCM(2, 3, 5) = 30

=> T1 : T2 : T3 = (1/2 × 30) : (1/3 × 30) : (1/5 × 30)

=> T1 : T2 : T3 = 15 : 10 : 6

Therefore The correct answer is 15 : 10 : 6.

Additional Information

Inverse Proportionality

When the product of two variables is constant (Distance = Speed × Time), the variables are inversely proportional; as speed increases, time decreases.

Average Speed

For two equal distances covered at speeds x and y, Average Speed = 2xy ÷ (x + y).

Unit Conversion

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

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Q51. Answer: (b) FS - KY

The logic followed here is based on the alphabetical position pattern:

Option 1: OY - TD

Option 2: FS - KY

Option 3: BK - GP

Option 4: MP - RU

Thus, FS - KY does not follow this uniform shift.

Hence, the odd one out is Option 2.

Q52. Answer: (a) Two

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

Now,

Numbers which are immediately preceded by an even number and also immediately followed by an even number.

So, Needed pattern is: Even - Odd - Even.

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

Only two such patterns exist.

Hence, the correct answer is 'Option 1'.

Q53. Answer: (c) 299

BODMAS Table:

Decoding the given information:

Alphabet	•	−	×	÷
Meaning	−	•	÷	×

Now, replacing the sign from left to right using BODMAS Rule, we get:

=> 66 ÷ 6 × 3 + 128 × 2 − 15 ÷ 3 + 16 × 2 − 17 = ?

=> 33 + 256 − 5 + 32 − 17 = ?

=> 289 − 5 + 32 − 17 = ?

=> 284 + 32 − 17 = ?

=> 316 − 17 = ?

=> 299

Hence, the correct option is "Option 3".

Q54. Answer: (a) 70

Given:

Varun’s rank from the top = 24th, rank from the bottom = 47th.

Total number of students = 24 + 47 – 1 = 70.

So, there are 70 students in the class.

Hence, the correct answer is "Option 1".

Q55. Answer: (d) Five

Given: A, B, C, D, E, F and G are sitting around a circular table facing the centre.

F sits third to the right of G.

A sits third to the right of F.

D sits third to the right of A.

C is the immediate neighbour of both B and A.

Total people between E and D = 5

Hence, the correct answer is "Option 4".

Q56. Answer: (d) 3 km to the east

The logic followed here is:

Given:

Mohak drives 12 km South

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He turns left → 11 km East
He turns left → 15 km North
He turns left → 14 km West
He turns left → 3 km South
So, To reach Point A, he must go 3 km East.
Hence, the correct answer is Option 4.

Q57. Answer: (c) 3

Given: A, B, C, D, E, F and G are sitting in a straight line facing North.
Only five people sit between D and C.
E sits to the immediate left of C.
Only one person sits between E and A.
G sits at some place to the left of F but at some place to the right of B.
Now, people to the right of A: F, E, C → 3 people
Hence, the correct answer is "Option 3".

Q58. Answer: (b) Only conclusion (I) follows

Given Statements:
All shells are mats.
All mats are lotions.
The least possible Venn diagram for the given statements is:
Conclusions:
I. Some lotions are shells → Follows (Since all shells are lotions, there must be some overlap between lotions and shells.)
II. No lotion is a shell → Does not follow (This contradicts the fact that all shells are included within lotions.)
So, only conclusion I follows.
Hence, the correct answer is "Option 2".

Q59. Answer: (d) XARK

The logic followed here is:
For, JLIU → EKGV
For, MWQE → HVOF
Now, applying the same pattern to CBTJ:
So, CBTJ → XARK
Hence, the correct answer is Option 4.

Q60. Answer: (d) AQDF

The logic followed here is:
For, YOBD → IYLN
For, MCPR → WMZB
Now, applying the same pattern to QGTV:
So, QGTV → AQDF
Hence, the correct answer is Option 4.

Q61. Answer: (b) FIN

The logic followed here is based on the alphabetical position pattern:
Option 1: DGK
Option 2: FIN
Option 3: PSW
Option 4: JMQ
Thus, FIN does not follow the uniform pattern of +3, +4.
Hence, the odd one out is Option 2.

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Q62. Answer: (b) 28

Given:
Alok is 12th from the right end, Pyush is 18th from the right end,
and Pyush is exactly midway between Alok and Priyanka.
Priyanka is 5th from the left end.
Distance between Alok and Pyush = 18 − 12 = 6
So, Priyanka's position from the right end = 18 + 6 = 24
Total number of people = 5 + 24 − 1 = 28
So, there are 28 people in the row.
Hence, the correct answer is "Option 2".

Q63. Answer: (d) 88

The logic followed here is:
thus, "88" will replace the question mark in the given series.
Hence, the correct option is "Option 4".

Q64. Answer: (d) 2 km towards the north

The logic followed here is:
Given:
Rajesh drives 13 km North
He turns right → 6 km East
He turns right → 5 km South
He turns left → 3 km East
He turns right → 10 km South
He turns right → 9 km West
So, To reach Point M, he must go 2 km North.
Hence, the correct answer is Option 4.

Q65. Answer: (d) 6

The logic followed here is:
Given:
STAR → S(19) + T(20) + A(1) + R(18) = 58
HERO → H(8) + E(5) + R(18) + O(15) = 46
Now,
ACTOR → A(1) + C(3) + T(20) + O(15) + R(18) = 57
Hence, the correct answer is "Option 4".

Q66. Answer: (b) Two

Given number: 8239847
Logic:
Add 1 to each even digit
Subtract 2 from each odd digit
Original number: 8 2 3 9 8 4 7

Digit	Type	Operation	New Digit
8	Even	8 + 1	9
2	Even	2 + 1	3
3	Odd	3 − 2	1
9	Odd	9 − 2	7
8	Even	8 + 1	9
4	Even	4 + 1	5

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7	Odd	7 − 2	5

New number: 9 3 1 7 9 5 5 → 9317955

Digit	Frequency
9	2 times
3	1 time
1	1 time
7	1 time
5	2 times

Digits appearing more than once: 9 and 5

Hence, the correct answer is Option 2.

Q67. Answer: (d) HUTF

The logic followed here is:

For, BONZ → SFEQ

For, REDP → IVUG

Now, applying the same pattern to QDCO:

So, QDCO → HUTF

Hence, the correct answer is Option 4.

Q68. Answer: (a) NKN 91

The logic followed here is:

So, 'NKN 91' will replace the question mark in the given series.

Hence, the correct answer is "Option 3".

Q69. Answer: (a) Three

Given: # 5 1 & & 5 + 8 3 & * < \ 9 $ > > * 5 / 7

Now,

We need to find symbols that are immediately preceded by another symbol and immediately followed by a number.

So, Needed pattern is: Symbol - Symbol - Number.

(Left) # 5 1 & & 5 + 8 3 & * < \ 9 $ > > * 5 / 7 (Right)

Total valid occurrences = 3.

Hence, the correct answer is 'Option 1.

Q70. Answer: (a) Only conclusion (I) follows

Given Statements:

All notepads are diaries.

All diaries are organisers.

Some organisers are planners.

The least possible Venn diagram for the given statements is:

Conclusions:

I. All notepads are organisers → Follows (Since Notepads subset of Diaries and Diaries subset of Organisers, therefore Notepads subset of Organisers)

II. Some planners are notepads → Does not follow (There is no definite overlap between planners and notepads; planners only partially overlap with organisers)

So, only conclusion I follows.

Hence, the correct answer is "Option 1".

Q71. Answer: (c) 1

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

Now,

An odd number must be immediately preceded by an even number and immediately followed by an even number.

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So, Needed pattern is: Even - Odd - Even.
(Left) 8 7 4 1 5 7 4 8 6 6 6 2 5 5 8 4 3 9 4 3 1 7 7 5 1 2 5 (Right)
Only one such pattern exists in the entire series.
Hence, the correct answer is 'Option 3'.

Q72. Answer: (d) 31 - 2 - 62

The logic followed here is:
Logic: Third Number = First Number × Second Number.
For, 15 - 3 - 45
=> 15 × 3 = 45
For, 12 - 4 - 48
=> 12 × 4 = 48
Now, checking the options using the same pattern:
Option 1) 5 - 6 - 36
=> 5 × 6 = 30 ≠ 36
Option 2) 41 - 3 - 113
=> 41 × 3 = 123 ≠ 113
Option 3) 10 - 2 - 30
=> 10 × 2 = 20 ≠ 30
Option 4) 31 - 2 - 62
=> 31 × 2 = 62
Hence, the correct answer is Option 4.

Q73. Answer: (b) Three

Given: A, B, C, D, E, F and G are sitting around a circular table facing the centre.
D sits third to the right of C.
E sits third to the left of C.
B sits second to the left of D.
G sits to the immediate left of A.
Total people between F and G = 3
Hence, the correct answer is "Option 2".

Q74. Answer: (a) XLP

The logic followed here is:
So, 'XLP' will replace the question mark in the given series.
Hence, the correct answer is "Option 1".

Q75. Answer: (d) lu

Given:
“touch snow gently” → “lu ek ag”
“snow falls light” → “ph lu yn”
So, the code for snow = lu
Hence, the correct answer is Option 4.

Q76. Answer: (d) 225

The logic followed here is:
thus, "225" will replace the question mark in the given series.
Hence, the correct option is "Option 4".

Q77. Answer: (a) 272

BODMAS Table:
Decoding the given information:

Alphabet	•	−	×	÷

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Meaning	−	•	÷	×

Now, replacing the sign from left to right using BODMAS Rule, we get:

=> 37 ÷ 5 − 91 + 16 × 4 = ?

=> 7.4 − 91 + 64 = ?

=> 71.4 − 91 = ?

=> 272

Hence, the correct option is "Option 1".

Q78. Answer: (b) 1

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

Now,

An odd number must be immediately preceded by an odd number and immediately followed by an odd number.

So, Needed pattern is: Odd - Odd - Odd.

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

Only one valid triplet satisfies the condition.

Hence, the correct answer is 'Option 2'.

Q79. Answer: (c) Wife's father

Family Chart:

Decoding the Symbols:

Symbol	•	#	×	@
Meaning	Sister	Brother	Wife	Father

Given: L @ O + V # E × R

It means: L is the father of O, O is the sister of V, V is the brother of E, and E is the wife of R.

So, L is the wife’s father of R.

Hence, the correct answer is "Option 3".

Q80. Answer: (d) 231

The logic followed here is:

thus, "231" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q81. Answer: (c) Agni-Prime

The correct answer is Agni-Prime.

Key Points

• The Defence Research and Development Organisation (DRDO) successfully flight-tested the Agni-Prime (also known as Agni-P) missile on 24 September 2025.

• This specific test was significant as it was conducted from a rail-based mobile launcher, enhancing the strategic flexibility and survivability of the missile system by allowing it to be moved across the country’s vast railway network.

• The launch was carried out under full operational conditions, validating the reliability of the entire weapon system, including the propulsion, control systems, and navigation technologies.

• The mission met all objectives, confirming the high degree of accuracy and precision of the missile. This test represents a major milestone in India’s transition toward modern canisterized missile systems.

• The flight test took place at the Dr. APJ Abdul Kalam Island located off the coast of Odisha, which is the primary site for India's strategic missile testing.

Additional Information

• Agni-Prime Missile Features:

• Type: It is a two-stage solid-propellant ballistic missile that belongs to the new generation of the Agni series.

• Range: It has a strike range of 1,000 to 2,000 kilometers, making it a medium-range ballistic missile (MRBM).

• Canisterization: The missile is canisterized, meaning it is stored in a sealed tube. This allows for easier transport, longer shelf life, and significantly reduces the time required for launch.

• Navigation: It incorporates advanced Ring Laser Gyro-based Inertial Navigation Systems (RINS) and Micro Navigation Systems (MINS) for superior guidance.

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• Strategic Significance:

• Agni-Prime is designed to replace the aging Agni-I and Agni-II missiles in the Indian inventory.

• The rail-based launcher capability ensures that the missile can be hidden and moved quickly, making it harder for enemy reconnaissance to track and target India's nuclear deterrent.

• It contributes to India’s policy of Credible Minimum Deterrence and its "No First Use" nuclear doctrine.

• Evolution of Agni Series:

• The Agni missiles were developed under the Integrated Guided Missile Development Programme (IGMDP), spearheaded by Dr. APJ Abdul Kalam.

• The family includes variants ranging from the short-range Agni-I (700 km) to the Intercontinental Ballistic Missile (ICBM) Agni-V (over 5,000 km).

• Unlike the older liquid-fuel missiles, modern Agni-Prime uses composite motor casings and advanced materials to reduce weight and increase efficiency.

Important Points

• DRDO: Headquartered in New Delhi, it is the R&D wing of the Ministry of Defence. It was formed in 1958 by merging the Technical Development Establishment and the Directorate of Technical Development and Production.

• Operational Readiness: Full operational condition tests are usually conducted by the Strategic Forces Command (SFC) in coordination with DRDO to ensure that the user (the military) is capable of handling the equipment in real-world scenarios.

• Mobility: While road-mobile launchers are common, rail-mobile versions provide an extra layer of strategic depth because of India's extensive railway infrastructure, allowing for rapid redeployment across thousands of kilometers.

Q82. Answer: (a) Studying biomarkers of healthy aging, resilience, adversity, and transitions

The correct answer is Studying biomarkers of healthy aging, resilience, adversity, and transitions.

Key Points

• The BHARAT study (Biomarkers of Healthy Aging, Resilience, Adversity, and Transitions) was launched by the Centre for Brain Research (CBR), an autonomous center of the Indian Institute of Science (IISc), Bengaluru, in 2023.

• The primary focus of this study is to identify biological markers (biomarkers) that correlate with healthy brain aging and to understand how certain individuals remain resilient against cognitive decline despite various adversities.

• It is a longitudinal study, meaning it tracks the same group of individuals over an extended period to observe changes in cognitive health, brain structure, and lifestyle factors.

• The initiative aims to address the growing challenge of neurodegenerative disorders such as Alzheimer’s disease and dementia within the specific context of the Indian population. Hence, the correct answer is option 1.

• By studying the resilience and transitions of the aging brain, the researchers hope to develop better diagnostic tools and preventative strategies tailored to Indian genetics and lifestyle.

Additional Information

• Centre for Brain Research (CBR):

• The CBR was established at IISc Bengaluru through a generous philanthropic contribution from Mr. Kris Gopalakrishnan, the co-founder of Infosys.

• The center focuses on finding solutions for brain-related disorders that affect the elderly, particularly those leading to cognitive impairment.

• Target Demographic:

• The BHARAT study typically recruits participants aged 45 years and above to capture the early transitions into the aging phase.

• This demographic is critical because pathological changes in the brain often begin decades before clinical symptoms of dementia appear.

• Methodology and Technology:

• The study employs state-of-the-art technologies, including 3-Tesla MRI scanners for neuroimaging, genomic sequencing, and proteomic analysis from blood samples.

• Participants undergo rigorous neuropsychological assessments to evaluate memory, attention, and executive functions.

• Significance for India:

• With India’s aging population expected to reach nearly 20% of the total population by 2050, research into healthy aging is a national priority.

• The study accounts for unique Indian socio-economic factors, dietary habits, and environmental exposures that differ significantly from the Western cohorts usually studied in global health research.

• Longitudinal Cohort Studies:

• Similar to the Srinivaspura Aging, Neuro Epidemiology and Genetics (SAGE) study, BHARAT creates a massive database of clinical and biological data to serve as a resource for future drug development and public health policy.

Important Points

• The IISc was founded in 1909 and is consistently ranked as one of India's premier institutes for scientific research.

• According to the Dementia in India 2020 report, an estimated 5.3 million people above age 60 had dementia in India, a number expected to double by 2050.

• The BHARAT study contributes to the Global Brain Health initiative by providing data from the Global South, which is currently underrepresented in genomic and aging research.

• The term "Biomarkers" in this context refers to measurable indicators such as blood proteins or brain volume changes that can predict disease risk.

Q83. Answer: (a) Tom Cruise, Dolly Parton, Debbie Allen, Wynn Thomas

The correct answer is Tom Cruise, Dolly Parton, Debbie Allen, and Wynn Thomas.

Key Points

• The Academy of Motion Picture Arts and Sciences (AMPAS) announced the recipients for the 15th Annual Governors Awards, which are honorary Oscars recognizing extraordinary lifetime achievement in the film industry.

• Tom Cruise was selected to receive the Jean Hersholt Humanitarian Award for his extensive philanthropic efforts and his significant contributions to the global film industry, particularly his role in revitalizing theatrical exhibition in the post-pandemic era.

• Dolly Parton, a legendary country music singer, songwriter, and actress, was honored with an Honorary Award for her seven-decade-long career and her massive influence on film through music and screen presence, including her Oscar-nominated work in films like 9 to 5.

• Debbie Allen was recognized with an Honorary Award for her multi-faceted career as a director, choreographer, and actress, acknowledging her legacy in dance-heavy productions and her mentorship through the Debbie Allen Dance Academy.

• Wynn Thomas, a trailblazing production designer, received an Honorary Award for his groundbreaking work in cinema, notably being the first African American production designer to achieve major acclaim through collaborations on films like Do the Right Thing and A Beautiful Mind.

• These icons were selected by the Academy's Board of Governors for their profound impact on the arts and sciences of motion pictures.

Additional Information

• Governors Awards:

• The Governors Awards is an annual event held by AMPAS where three specific awards are presented: the Honorary Award, the Jean Hersholt Humanitarian Award, and the Irving G. Thalberg Memorial Award.

• Unlike the competitive Oscars, these are non-competitive awards decided by a vote of the Board of Governors to honor individuals who have made indelible marks on the industry over their entire careers.

• The Jean Hersholt Humanitarian Award:

• This award is given to an individual in the motion picture industry whose humanitarian efforts have brought credit to the industry.

• Notable past recipients include Angelina Jolie, Oprah Winfrey, and Elizabeth Taylor.

• The Honorary Award:

• The Honorary Oscar is given for "extraordinary distinction in lifetime achievement, exceptional contributions to the state of motion picture arts and sciences, or for outstanding service to the Academy."

• This award bypasses the traditional nomination process and is represented by the iconic statuette.

• Timing and Significance:

• The Governors Awards ceremony is typically held in November or January, separate from the main Academy Awards telecast, to allow for longer tributes to the legends of cinema.

• The 2025 cycle of awards (presented in late 2024) serves as a precursor to the 97th Academy Awards.

Important Points

• Tom Cruise: Known for the Mission: Impossible franchise and Top Gun: Maverick, his award highlights his stewardship of the cinematic experience during the COVID-19 crisis.

• Dolly Parton: Her Imagination Library and her Grammy-winning musical legacy have made her a global cultural ambassador.

• Debbie Allen: A former Kennedy Center Honoree, she has directed numerous episodes of Grey's Anatomy and starred in the iconic series Fame.

• Wynn Thomas: His work on Hidden Figures (2016) and Malcolm X (1992) showcases his ability to define the visual language of historical and contemporary stories.

Q84. Answer: (d) Yibbi Jansen

The correct answer is Yibbi Jansen.

Key Points

• The International Hockey Federation (FIH) officially announced the winners of the FIH Hockey Stars Awards 2024 on November

8, 2024, naming Yibbi Jansen of the Netherlands as the FIH Women Player of the Year.

• Yibbi Jansen played an instrumental role in the Netherlands women's team securing the gold medal at the Paris 2024 Olympics.

• During the Paris 2024 Olympic Games, Jansen showcased her dominance by finishing as the tournament's top scorer with 9 goals, primarily through her world-class drag-flicking expertise.

• She has been a consistent performer in the FIH Pro League and was a key factor in the Dutch team’s continued dominance in international hockey over the past year.

• The award is a testament to her technical skills and scoring ability, making her one of the most feared penalty corner specialists in the world.

Additional Information

• Other Major FIH 2024 Award Winners:

• FIH Men's Player of the Year: Harmanpreet Singh, the captain of the Indian Men's Hockey Team, won this award for the third time after leading India to a bronze medal at the Paris 2024 Olympics and finishing as the tournament's leading scorer with 10 goals.

• FIH Goalkeeper of the Year: In the men's category, PR Sreejesh (India) was honored for his stellar performance in his final international season. In the women's category, Ye Jiao (China) won the award for her incredible saves that propelled China to an Olympic silver medal.

• FIH Rising Star of the Year: The women’s award went to Zoe Diaz of Argentina, while the men’s award was secured by Sufyan Khan of Pakistan.

• FIH Coach of the Year: Alyson Annan (China) was named the best women’s coach, and Jeroen Delmee (Netherlands) was named the best men’s coach.

• International Hockey Federation (FIH):

• The FIH is the global governing body for field hockey, headquartered in Lausanne, Switzerland.

• It was founded on 7 January 1924 in Paris to ensure hockey was included in the Olympic Games.

• The federation currently oversees major tournaments including the Hockey World Cup, the FIH Pro League, and the Olympic hockey competitions.

Important Points

• Selection Process: The FIH Hockey Stars Awards winners are determined by a comprehensive voting system that includes National Associations (represented by team captains and coaches), fans, players, and media members.

• Dutch Dominance: With Yibbi Jansen winning the Player of the Year, the Netherlands continues its streak of having at least one female player on the podium for over a decade, reflecting the country's status as a powerhouse in women's field hockey.

• Sarah Wilson: It is important to note that Sarah Wilson (Option 3) is a highly respected international umpire from Scotland and was not a candidate for the Player of the Year award.

• Olympic Legacy: The 2024 awards were heavily influenced by performances at the Paris 2024 Olympics, which remains the most prestigious stage for field hockey athletes.

Q85. Answer: (c) 36

The correct answer is 36.

Key Points

• At the 2025 Khelo India Youth Games (KIYG), the host state Bihar delivered an impressive performance, securing a total of 36 medals.

• The medal tally for Bihar included 5 Gold, 9 Silver, and 22 Bronze medals, marking a significant milestone in the state's sporting history.

• With this performance, Bihar secured the 15th position in the overall medal standings, showcasing the results of improved sports infrastructure and training programs within the state.

• The 7th edition of the Khelo India Youth Games was hosted by Bihar for the first time, with events organized across multiple cities including Patna, Rajgir, Gaya, and Muzaffarpur.

• The games were held from January 19 to January 30, 2025, and featured over 5,000 athletes competing in 25 different sports disciplines.

Additional Information

• Khelo India Youth Games (KIYG):

• The Khelo India initiative was introduced by the Ministry of Youth Affairs and Sports to revive the sports culture in India at the grass-root level.

• The first edition was held in New Delhi in 2018 under the name Khelo India School Games.

• The 2025 edition held in Bihar was the seventh installment of this prestigious national multisport event.

• Mascot and Identity:

• The official mascot for the 2025 KIYG was 'Gaur', representing the state animal of Bihar, symbolizing strength and resilience.

• The logo and anthem for the games were unveiled by Chief Minister Nitish Kumar to promote the theme of "Yuva Shakti" (Youth Power).

• Overall Winners:

• Maharashtra continued its dominance in the competition, finishing at the top of the medal table, followed by Haryana and Tamil Nadu.

• The games included traditional Indian sports like Gatka, Kalaripayattu, Thang-Ta, and Mallakhamba alongside mainstream Olympic sports.

Important Points

• Infrastructure Development: The State Sports Academy and Bihar Sports University in Rajgir served as the primary hub for many high-profile events, reflecting the state's investment in world-class facilities.

• Sports Policy: The Bihar government recently implemented a "Medal Lao, Naukri Pao" (Bring Medal, Get Job) policy, which significantly boosted the morale of local athletes participating in the 2025 games.

• Historical Context: This was the first major national multisport event of this scale hosted by Bihar, involving the active participation of 36 States and Union Territories.

• Economic Impact: Hosting the Khelo India Youth Games contributed to the local economy and promoted Bihar as a potential destination for national and international sporting events in the future.

Q86. Answer: (b) Trinamool Congress

The correct answer is Trinamool Congress.

Key Points

• The Trinamool Congress (TMC) emerged victorious in the Kaliganj assembly constituency during the by-elections held in June 2025. This win allowed the party to retain its political influence in the Nadia district of West Bengal.

• The Kaliganj seat is a crucial segment within the West Bengal Legislative Assembly, and the by-poll was necessitate by the vacancy created in the seat prior to the scheduled general assembly elections.

• The election was conducted under the supervision of the Election Commission of India, which ensured that the Model Code of Conduct was followed throughout the campaigning and polling period.

• The Trinamool Congress candidate defeated the nearest rival from the Bharatiya Janata Party (BJP), marking a significant trend in the local political landscape of West Bengal during the 2025 mid-term assessments.

• This victory for the TMC reinforced the leadership of Mamata Banerjee, the Chief Minister of West Bengal, highlighting the party's continued grassroots support in rural and semi-urban pockets.

Additional Information

• All India Trinamool Congress (AITC):

• Founded on January 1, 1998, by Mamata Banerjee after splitting from the Indian National Congress.

• The party has been in power in West Bengal since 2011, ending the 34-year rule of the Left Front.

• Its official election symbol is the "Jora Ghas Phul" (Twin Flowers in Grass), and it currently holds the status of a prominent state party with significant influence in national politics.

• West Bengal Legislative Assembly:

• The Vidhan Sabha of West Bengal consists of 294 elected members.

• The term of the assembly is five years, and the Governor of the state holds the power to dissolve it under specific constitutional conditions.

• The Kaliganj seat is one of the constituencies that historically sees intense competition between the TMC, BJP, and the Left-Congress alliance.

• By-elections (By-polls):

• By-polls are specialized elections held to fill a vacancy that arises when a sitting member of the Legislative Assembly or Parliament dies, resigns, or is disqualified.

• These elections are essential for maintaining the full democratic representation of a constituency within the legislature.

Important Points

• Election Commission of India (ECI): Established under Article 324 of the Constitution of India, it is the autonomous constitutional authority responsible for administering election processes in India at both the national and state levels.

• Demographics and Geography: The Kaliganj constituency is situated in the Nadia district, which shares a border with Bangladesh. This geographical location often makes issues like border security, migration, and rural development central to the election manifestos of parties like the Trinamool Congress and BJP.

• Voter Turnout: High voter participation is a characteristic feature of West Bengal elections, often exceeding 80%, reflecting the deep-rooted political consciousness of the citizens in the state.

Q87. Answer: (d) Bank of India

The correct answer is Bank of India.

Key Points

• In August 2025, the Bank of India (BOI) officially classified the loan accounts of Reliance Communications (RCom) and its subsidiary, Reliance Telecom, as fraud.

• This decision by the public sector lender followed a similar move by the State Bank of India (SBI) and Canara Bank, which had previously tagged these accounts due to significant financial irregularities.

• The classification was triggered by the findings of a forensic audit conducted by BDO India, which uncovered evidence of fund diversion and unauthorized transactions within the Anil Ambani-led companies.

• The Bank of India has a substantial exposure to Reliance Communications, with outstanding dues estimated to be in the range of several thousand crores, contributing to the company's total debt of approximately Rs 46,000 crore.

• Under Reserve Bank of India (RBI) guidelines, once an account is declared fraud, the bank is required to report it to the Central Fraud Registry and provide 100% provisioning for the outstanding amount over a specific period.

Additional Information

• Reliance Communications (RCom):

• Once a leading telecom operator in India, RCom was part of the Reliance Group headed by Anil Ambani.

• The company faced severe financial distress due to high competition and debt, eventually filing for insolvency under the National Company Law Tribunal (NCLT) in 2019.

• The Role of SBI in the Case:

• As the lead lender in the consortium, the State Bank of India played a pivotal role in the forensic investigation.

• SBI was among the first major banks to categorize the RCom accounts as fraudulent, setting a precedent for other lenders like Bank of India and Indian Overseas Bank.

• Insolvency and Bankruptcy Code (IBC), 2016:

• The IBC provides a time-bound process for resolving insolvency and bankruptcy cases in India.

• Despite being under the Corporate Insolvency Resolution Process (CIRP) for years, the recovery for lenders in the RCom case has remained slow due to various legal hurdles and litigation.

Important Points

• Forensic Audit Impact: The forensic audit is a critical tool used by financial institutions to detect malpractice. In the case of Anil Ambani's firms, the audit revealed that funds were moved to related parties without proper commercial justification.

• Legal Implications for Promoters: When a bank declares an account as fraud, the promoters and directors face restricted access to institutional finance and may be subjected to investigations by agencies like the Central Bureau of Investigation (CBI) and the Enforcement Directorate (ED).

• Banking Sector Stability: Such classifications are part of the RBI's efforts to clean up Non-Performing Assets (NPAs) and ensure transparency in the Indian banking system.

• Classification Timeline: While SBI initiated the process earlier, the formal declaration by Bank of India in 2025 reinforces the collective stance of the consortium of lenders against the defaulting entity.

Q88. Answer: (b) Asian Athletics Championship

The correct answer is Asian Athletics Championship.

Key Points

• Parul Chaudhary, the prominent Indian distance runner, showcased an exceptional performance at the Asian Athletics Championship in 2025, where she successfully broke her previous National Record.

• She competes primarily in the 3000m steeplechase and the 5000m events, and her record-breaking feat in 2025 further solidified her position as one of India's elite track athletes.

• The Asian Athletics Championship is a biennial event organized by the Asian Athletics Association, and the 2025 edition served as a crucial platform for athletes to qualify for the World Athletics Championships.

• During the competition, Parul Chaudhary demonstrated superior stamina and tactical awareness, surpassing the timing she had previously set at international meets like the World Championships and Asian Games.

• Her achievement in 2025 is a testament to her consistent training and the support provided by the Athletics Federation of India (AFI) to promote long-distance running in the country.

Additional Information

• Athlete Profile:

• Parul Chaudhary was born on April 15, 1995, in Meerut, Uttar Pradesh. She comes from a modest background and has risen through the ranks of Indian athletics through sheer perseverance.

• She gained international fame during the 2022 Asian Games (held in 2023) in Hangzhou, China, where she won the Gold Medal

in the 5000m race and a Silver Medal in the 3000m steeplechase.

• She is the first Indian woman to win a Gold Medal in the 5,000 meters event at the Asian Games, marking a historic moment for Indian Athletics.

• National Records:

• Before her 2025 achievement, Parul held the national record in the 3000m steeplechase with a time of 9:15.31, set during the World Athletics Championships 2023 in Budapest.

• She also holds the national record for the women's 5000m and the 3000m (non-steeplechase) events, making her a versatile multi-record holder in India.

• Asian Athletics Championship:

• The 26th edition of the Asian Athletics Championship was scheduled for 2025 in Gwangju, South Korea.

• This championship is the premier athletics event in Asia, featuring participation from over 40 countries across the continent.

Important Points

• Training and Support: Parul Chaudhary has been supported by the Target Olympic Podium Scheme (TOPS), an initiative by the Ministry of Youth Affairs and Sports, Government of India, to provide assistance to top athletes for Olympic preparations.

• Significance of 2025: The year 2025 is pivotal for track athletes as it leads into the preparation cycle for the 2026 Asian Games and the 2028 Los Angeles Olympics.

• Specialization: Her ability to maintain a high pace in the steeplechase, which involves clearing hurdles and water jumps, distinguishes her from traditional flat-track runners.

• Competition Context: While she has participated in the Doha Diamond League and Commonwealth Games in the past, her record-shattering performance in the specific context of the 2025 calendar occurred at the Asian Athletics Championship.

Q89. Answer: (b) Pakistan

p>The correct answer is Pakistan.

Key Points

• The Sustainable Development Report (SDR) 2025, released in June 2025, provides a comprehensive assessment of the progress made by 193 UN Member States towards achieving the Sustainable Development Goals (SDGs).

• In the 2025 edition of the index, India secured a rank of 109th globally. While India has shown progress in certain areas like climate action and basic infrastructure, it continues to face challenges in goals related to hunger, gender equality, and quality education.

• Among India's neighbors, Pakistan had a ranking significantly worse than India, placed at the 137th position. This indicates that Pakistan is lagging behind in the majority of the 17 Sustainable Development Goals compared to other South Asian nations.

• In contrast, other neighboring countries such as Bhutan, Sri Lanka, and Nepal performed better than India in the 2025 SDR. Bhutan usually maintains a high rank due to its focus on environmental conservation and social well-being, while Nepal and Sri Lanka have shown resilience in social indicators despite economic fluctuations.

• The Sustainable Development Index score for India was approximately 64.0, whereas Pakistan scored lower, reflecting a wider gap in achieving the 2030 Agenda targets.

Additional Information

• Sustainable Development Solutions Network (SDSN):

• The SDR is published annually by the UN Sustainable Development Solutions Network (SDSN), which has been operating under the auspices of the UN Secretary-General since 2012.

• The report is led by Professor Jeffrey Sachs and provides a data-driven ranking to help countries identify gaps in their sustainable development strategies.

• The 17 SDGs:

• The Sustainable Development Goals were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet, and ensure peace and prosperity by 2030.

• Key goals include Goal 1: No Poverty, Goal 5: Gender Equality, Goal 13: Climate Action, and Goal 16: Peace, Justice, and Strong Institutions.

• Regional Performance in South Asia:

• South Asia remains a region with diverse performance levels. While Bhutan and Maldives often lead the regional charts, Pakistan and Afghanistan consistently rank at the bottom due to political instability and economic crises.

• India's performance is critical to the global success of the SDGs because of its massive population and economic footprint.

Important Points

• The SDG Index score can be interpreted as the percentage of SDG achievement. A score of 100 indicates that all goals have been fully met.

• For the 2025 report, the global average progress has been noted as stagnant or slow since 2020, primarily due to the long-term impacts of global health crises and geopolitical conflicts.

• Finland, Sweden, and Denmark continue to occupy the top three positions in the global rankings for 2025, having achieved or being on track to achieve most of the targets.

• The June 2025 report emphasizes the need for increased financial architecture reform to help developing nations like India and Pakistan bridge the funding gap required for green transitions and social safety nets.

Q90. Answer: (b) Electric vehicle services

The correct answer is Electric vehicle services.

Key Points

• In May 2025, the Reserve Bank of India (RBI) initiated a rigorous audit and review of digital wallets specifically linked to the Electric vehicle services sector.

• The move was prompted by the sudden operational shutdown of BluSmart, which was a major player in the EV ride-hailing and charging infrastructure ecosystem.

• The central bank's intervention focused on the Prepaid Payment Instruments (PPI) used by EV service providers to manage customer balances for ride bookings and battery charging.

• The investigation aimed to determine if Electric vehicle services providers were maintaining escrow accounts correctly to safeguard user deposits, as mandated by the Payment and Settlement Systems Act.

• This regulatory action highlights the RBI's concern regarding the financial stability of fintech-integrated mobility platforms and the protection of consumer interest in the event of corporate insolvency.

Additional Information

• Electric Vehicle Services: This industry encompasses e-mobility solutions, including electric cabs, bike-sharing, and public charging stations. These services often require users to maintain a "walled garden" balance in a closed-loop or semi-closed-loop wallet.

• BluSmart: Recognized as a pioneer in all-electric ride-sharing in India, it operated a large fleet and massive charging hubs. Its closure in the 2025 timeline created a ripple effect in the green mobility market, leading to concerns over unrecovered user funds.

• PPI Guidelines: The Reserve Bank of India issues Master Directions on Prepaid Payment Instruments, which regulate how companies can issue wallets and how they must store the money received from the public.

• Digital Payment Ecosystem: The integration of fintech within Electric vehicle services is part of a broader trend to streamline micro-transactions, though it introduces new layers of regulatory risk that the RBI monitors closely.

Important Points

• Consumer Redressal: Following the BluSmart incident, the RBI emphasized that Electric vehicle services must have a transparent refund mechanism for any unutilized balances stored in digital wallets.

• Interoperability: A key feature discussed during the 2025 review was the potential requirement for wallet interoperability, allowing EV users to transfer balances between different charging or ride-hailing service providers.

• Compliance Audits: Companies in the EV sector are now required to submit periodic System Audit Reports (SAR) to the RBI to ensure their digital payment infrastructure meets cybersecurity and financial safety standards.

• Financial Solvency: The central bank has suggested that non-banking entities in the Electric vehicle services space might need to maintain higher net worth requirements to continue offering wallet-based services.

Q91. Answer: (a) China

The correct answer is China.

Key Points

• In early 2025, China formally requested consultations with India at the World Trade Organization (WTO) concerning India’s trade measures on solar cells and solar modules.

• This request marks the official commencement of a legal dispute within the WTO dispute settlement framework, where China challenged India's domestic protectionist policies.

• The primary focus of China’s complaint is the Approved List of Models and Manufacturers (ALMM) and the high Basic Customs Duty (BCD) imposed by the Government of India.

• China argues that these measures provide an unfair advantage to Indian domestic manufacturers and are inconsistent with India’s obligations under the General Agreement on Tariffs and Trade (GATT) 1994 and the Agreement on Trade-Related Investment Measures (TRIMs).

• Consultations are the first stage of the WTO process, allowing the involved member countries to discuss the matter and find a solution without proceeding to formal litigation.

Additional Information

• Basic Customs Duty (BCD): In April 2022, India implemented a BCD of 40% on imported solar modules and 25% on solar cells to reduce dependency on imports, particularly from China, and promote the Atmanirbhar Bharat initiative.

• Approved List of Models and Manufacturers (ALMM): Managed by the Ministry of New and Renewable Energy (MNRE), this list ensures that only certified domestic manufacturers can supply components for government-subsidized projects, effectively acting

as a non-tariff barrier.

• Production Linked Incentive (PLI) Scheme: To support the local industry against foreign competition, India introduced the PLI scheme for High-Efficiency Solar PV Modules with an outlay of over Rs. 24,000 crore.

• WTO Dispute Settlement Process: If the consultations between India and China do not reach a resolution within 60 days, China may request the WTO to establish a dispute settlement panel to adjudicate the matter.

• India's Renewable Energy Target: India has set an ambitious goal of reaching 500 GW of non-fossil energy capacity by 2030, making the solar supply chain a critical point of national economic interest.

Important Points

• Global Solar Market Dynamics: China currently dominates over 80% of the global solar manufacturing supply chain, leading to trade tensions not just with India, but also with the United States and the European Union.

• Previous WTO Disputes: India has previously lost a case at the WTO against the USA regarding Domestic Content Requirements (DCR) under the Jawaharlal Nehru National Solar Mission in 2016.

• Strategic Autonomy: The Indian government maintains that these measures are essential for energy security and to prevent dumping of cheap components that could stifle the growth of nascent domestic industries.

• Import Data: Despite high duties, India remains a significant importer of solar components, with imports from China totaling billions of US Dollars annually due to the massive scale of Indian solar installations.

Q92. Answer: (c) Gender equality

The correct answer is Gender equality.

Key Points

• Mission Shakti 5.0 was launched by the Government of Uttar Pradesh during International Girl Child Week, which was celebrated from October 3 to October 11, 2025.

• The mission is a flagship initiative aimed at enhancing the safety, dignity, and self-reliance of women and girls, often summarized under the vision of Nari Shakti.

• This initiative directly aligns with Sustainable Development Goal 5 (SDG 5), which seeks to achieve Gender Equality and empower all women and girls globally.

• During the launch, the Chief Minister of Uttar Pradesh emphasized the integration of technology and community policing to reduce crimes against women and ensure a secure environment.

• The 5.0 version of the mission focuses on grassroots reach, utilizing 604 pink booths and dedicated women help desks at every police station to provide immediate assistance. Hence, the correct answer is Gender equality.

Additional Information

• Evolution of Mission Shakti:

• The mission was first launched in October 2020 in response to the need for a comprehensive safety net for women in Uttar Pradesh.

• It operates on a three-pillar strategy: Suraksha (Safety), Samman (Dignity), and Swavalamban (Self-reliance).

• Sustainable Development Goal 5 (SDG 5):

• SDG 5 is one of the 17 Sustainable Development Goals established by the United Nations in 2015.

• Its targets include ending all forms of discrimination and violence against women, as well as ensuring equal opportunities for leadership at all levels of decision-making.

• Key Components of Mission Shakti 5.0:

• The phase involved awareness campaigns across 75 districts, targeting schools, colleges, and public spaces to educate girls about their legal rights.

• Significant focus is placed on the promotion of helpline numbers such as 1090 (Women Power Line), 181 (Women Helpline), and 112 (Emergency Response Support System).

• Financial empowerment is promoted through the BC Sakhi (Business Correspondent Sakhi) program and Self-Help Groups (SHGs), fostering economic independence.

• International Girl Child Day:

• Observed annually on October 11, this day highlights the challenges girls face while promoting their empowerment and the fulfillment of their human rights.

Important Points

• Impact on Education: While the primary goal is Gender Equality, the mission indirectly supports SDG 4 (Quality Education) by creating a safe environment that encourages girls to attend schools and higher education institutions without fear.

• Nari Shakti Vandan Adhiniyam: The mission echoes the spirit of the Women's Reservation Bill (2023), which aims to provide 33% reservation for women in the Lok Sabha and State Legislative Assemblies, further cementing political gender equality in India.

• Operational Data: Since its inception, Mission Shakti has led to the establishment of specialized courts for the speedy trial of

cases related to POCSO and crimes against women, significantly improving the conviction rate in the state.

Q93. Answer: (d) Asian Development Bank

The correct answer is Asian Development Bank.

Key Points

• In January 2025, the Government of India signed a $126.42 million loan agreement with the Asian Development Bank (ADB) to enhance the tourism potential of Uttarakhand.

• The primary objective of this loan is to develop sustainable, inclusive, and climate-resilient tourism infrastructure around the iconic Tehri Lake (Tehri Reservoir).

• The project, titled the Integrated Tehri Lake Development Project, aims to transform the region into a premier destination for adventure tourism and water sports.

• Key components of the agreement include the construction of a world-class water sports academy, ferry terminals, eco-friendly resorts, and public amenities to attract both domestic and international tourists.

• The project emphasizes environmental sustainability by integrating solid waste management systems and sewage treatment plants to protect the ecosystem of the Bhagirathi River and the reservoir.

• This initiative is expected to boost the local economy by creating employment opportunities for the youth and women of the Tehri Garhwal district through skill development programs.

Additional Information

• Asian Development Bank (ADB):

• Established in 1966, the ADB is a regional development bank headquartered in Mandaluyong, Philippines.

• As of 2025, it has 69 member countries, with 49 from within the Asia-Pacific region.

• The current President of ADB is Masatsugu Asakawa. Its main goal is to eradicate extreme poverty while promoting social and economic development.

• Tehri Lake and Dam:

• The Tehri Dam is the highest dam in India and one of the highest in the world, located on the Bhagirathi River in Uttarakhand.

• The Tehri Reservoir, often called Tehri Lake, is a massive man-made lake covering an area of approximately 42 square kilometers.

• It is a significant source of hydroelectric power (with a capacity of 2,400 MW) and provides drinking water and irrigation to several states in North India.

• Tourism in Uttarakhand:

• Known as "Devbhoomi" (Land of the Gods), Uttarakhand is a major hub for spiritual tourism, trekking, and wildlife.

• The state government has been focusing on diversifying tourism beyond religious circuits to include wellness tourism and adventure sports to increase the GSDP (Gross State Domestic Product).

Important Points

• Climate Resilience: The project incorporates climate-smart design features to withstand the specific geographical challenges of the Himalayan region, such as landslides and seismic activity.

• Institutional Support: The Department of Economic Affairs (DEA) under the Ministry of Finance acted as the nodal agency for the Government of India in finalizing this multilateral funding.

• Local Community Engagement: A significant portion of the project is dedicated to community-based tourism, ensuring that local homestays and small businesses benefit directly from the increased tourist footfall.

Q94. Answer: (a) Streamlining labour regulations

The correct answer is Streamlining labour regulations.

Key Points

• The primary objective of implementing the four Labour Codes is to streamline labour regulations by consolidating and simplifying 29 central labour laws into four concise codes.

• This massive reform is designed to improve the Ease of Doing Business in India by reducing the multiplicity of definitions, authorities, and compliance requirements that previously burdened the industrial sector.

• The four codes include: The Code on Wages, 2019; The Industrial Relations Code, 2020; The Code on Social Security, 2020; and The Occupational Safety, Health and Working Conditions Code, 2020.

• By bringing these codes into effect, the Government of India aims to modernize the labour market, making it more flexible and responsive to the needs of a 21st-century economy while ensuring worker rights are protected under a unified legal framework.

• The consolidation helps in removing obsolete provisions and overlapping jurisdictions, thereby fostering a more transparent and efficient industrial environment.

Additional Information

• Code on Wages, 2019:

• This code replaces four laws: the Minimum Wages Act, 1948, the Payment of Wages Act, 1936, the Payment of Bonus Act, 1965, and the Equal Remuneration Act, 1976.

• It universalizes the right to minimum wages and timely payment of wages to all employees, regardless of the sector or wage ceiling.

• Industrial Relations Code, 2020:

• It consolidates the Trade Unions Act, 1926, the Industrial Employment (Standing Orders) Act, 1946, and the Industrial Disputes Act, 1947.

• The code seeks to balance industrial peace with employer flexibility, particularly regarding the thresholds for layoffs and retrenchment in establishments.

• Code on Social Security, 2020:

• It integrates nine laws, such as the Employees' Provident Fund Act and the Maternity Benefit Act.

• A major feature is the extension of social security to unorganized workers, gig workers, and platform workers, recognizing modern forms of employment.

• Occupational Safety, Health and Working Conditions Code, 2020:

• This code subsumes 13 labour laws related to the safety and health of workers in factories, mines, and plantations.

• It introduces a single registration for establishments instead of multiple licenses, facilitating administrative efficiency.

Important Points

• Historical Context: The recommendation for consolidating labour laws was first proposed by the Second National Commission on Labour in 2002, highlighting the need for simplification and rationalization.

• Implementation Agency: The Ministry of Labour and Employment is the nodal ministry responsible for the formulation and notification of rules under these codes.

• Technological Integration: The codes emphasize the use of web-based inspections and electronic filing of returns to reduce human interface and corruption.

• One Nation, One Definition: One of the critical achievements of these codes is the standardization of the definition of "Wage" across all four codes, which eliminates legal ambiguity and litigation.

Q95. Answer: (b) Bihar

The correct answer is Bihar.

Key Points

• The 2025 Asia Rugby U-20 Sevens Championship was hosted by the Indian state of Bihar, marking a significant milestone for the sport in the region.

• The international event took place in the capital city, Patna, specifically at the Pataliputra Sports Complex, which is equipped with world-class facilities for such competitions.

• The championship was held over two days, on August 9 and August 10, 2025, featuring intense matches among the top youth teams in Asia.

• The tournament was organized through a collaborative effort between Asia Rugby, the Indian Rugby Football Union (Rugby India), and the Government of Bihar.

• It showcased competitions in both the Men's and Women's categories, providing a platform for emerging talent from countries across the continent to compete at a high level.

Additional Information

• Rugby India (Indian Rugby Football Union):

• This is the governing body for Rugby Union in India, founded in 1968 and affiliated with World Rugby.

• The current President of Rugby India is the well-known actor and former rugby player Rahul Bose, who has been instrumental in promoting the sport.

• The organization is responsible for managing the Indian National Teams across various age groups and formats, including Sevens and Fifteens.

• Asia Rugby:

• It is the formal governing body for the sport in Asia and is one of the regional associations under World Rugby.

• Headquartered in Dubai, United Arab Emirates, it oversees more than 30 member unions across the continent.

• The organization conducts various annual tournaments, including the Asia Rugby Championship and the Asia Rugby Sevens Series.

• Bihar's Sports Initiatives:

• The Government of Bihar has been actively investing in sports infrastructure to transform the state into a sports hub in Eastern India.

• The selection of Bihar as a host for an international rugby event highlights the state's success in developing a strong rugby

culture, especially at the grassroots level.

• The Sports Authority of Bihar has launched several schemes to identify and train young athletes for national and international platforms.

Important Points

• Tournament Format: The U-20 Sevens format involves 7 players per side playing in two halves of 7 minutes each, known for its high speed and tactical complexity.

• Participating Nations: Major rugby-playing nations in Asia, including Hong Kong China, Thailand, Malaysia, Uzbekistan, and Sri Lanka, frequently participate in these championships to secure continental rankings.

• Economic and Social Impact: Hosting an event of this magnitude in 2025 boosted local tourism in Patna and inspired thousands of school and college students in Bihar to take up the sport.

• Venue Details: The Pataliputra Sports Complex is a multi-use stadium that has previously hosted major events like the Women's World Cup Kabaddi and various Pro Kabaddi League matches.

Q96. Answer: (c) 86

The correct answer is 86.

Key Points

• NABARD (National Bank for Agriculture and Rural Development) has officially sanctioned a cumulative total of 86 projects as of 31st August 2025.

• These projects have been distributed across 8 State Governments in India to boost regional development and rural growth.

• The financial assistance provided for these 86 projects falls under the category of term loans, which are designed for long-term capital expenditure in the rural sector.

• The primary focus of these sanctioned projects involves the enhancement of rural infrastructure, irrigation systems, and agricultural logistics.

• This initiative is part of NABARD's ongoing commitment to providing financial support to state-led developmental programs that improve the livelihood of the rural population. Hence, the correct answer is 86.

Additional Information

• About NABARD:

• NABARD was established on 12 July 1982 based on the recommendations of the B. Sivaraman Committee.

• It functions as the apex development bank in India, headquartered in Mumbai, with a mandate to promote sustainable and equitable agriculture and rural development.

• The institution is fully owned by the Government of India after the RBI divested its entire stake.

• Term Loans for State Governments:

• Term loans are provided to State Governments to fund various projects under the Rural Infrastructure Development Fund (RIDF) and other specialized funds like the Long Term Irrigation Fund (LTIF).

• The tenure for such loans typically varies depending on the specific fund, often ranging from 7 to 15 years, including a grace period.

• The interest rates on these loans are generally linked to the Bank Rate or specific benchmarks set by the Government of India.

• Project Categories:

• Sanctioned projects usually cover sectors such as Rural Connectivity (roads and bridges), Social Sector (schools, public health centers), and Agriculture and Allied Sectors (micro-irrigation, animal husbandry).

• The 86 projects sanctioned as of August 2025 aim to bridge the infrastructure gap and improve the credit absorption capacity of the targeted 8 states.

Important Points

• Strategic Impact: The sanctioning of 86 projects reflects a proactive fiscal approach to rural empowerment. By targeting 8 State Governments, NABARD ensures a decentralized development model that addresses specific regional needs.

• Monitoring Mechanism: Projects sanctioned under these term loans are subject to on-site monitoring and periodic reviews by NABARD officers to ensure timely completion and quality assurance.

• Economic Significance: These investments play a crucial role in increasing the Gross State Domestic Product (GSDP) of the participating states by creating employment opportunities and improving market access for farmers.

Q97. Answer: (a) A.R. Rahman

The correct answer is A.R. Rahman.

Key Points

• Legendary Indian composer A.R. Rahman has won the Hollywood Music in Media Award (HMMA) 2024 for his exceptional work in the film Aadujeevitham: The Goat Life.

• He received the award in the category of 'Score - Independent Film (Foreign Language)', adding another prestigious international

accolade to his career.

• The 15th edition of the Hollywood Music in Media Awards was held in November 2024 at The Avalon Hollywood in Los Angeles, USA.

• The film Aadujeevitham: The Goat Life is a survival drama directed by Blessy and stars Prithviraj Sukumaran in the lead role. It is based on the 2008 novel of the same name by Benyamin.

• The soundtrack and background score by A.R. Rahman were praised for capturing the emotional and harrowing journey of the protagonist, blending Middle Eastern musical elements with Indian sensibilities. Hence, the correct answer is A.R. Rahman.

Additional Information

• A.R. Rahman:

• Born as A. S. Dileep Kumar on January 6, 1967, in Chennai, Tamil Nadu.

• He is popularly known as the "Mozart of Madras" and has won two Academy Awards (Oscars), two Grammy Awards, a BAFTA, and a Golden Globe for his work in Slumdog Millionaire (2008).

• He was awarded the Padma Bhushan, India's third-highest civilian award, in 2010.

• Hollywood Music in Media Awards (HMMA):

• It is an organization that honors original music (song and score) in all forms of visual media, including feature films, TV shows, video games, and documentaries.

• It is considered a significant precursor to the Golden Globes and Academy Awards in the music categories.

• The Film - Aadujeevitham:

• It is a Malayalam language film released in March 2024.

• The story depicts the life of Najeeb Mohammed, an Indian immigrant worker in Saudi Arabia who is forced into slavery as a goat herder in the desert.

• The film became one of the highest-grossing Malayalam films of all time.

• Other Options:

• Ilaiyaraaja: A legendary composer often referred to as "Isaignani" (musical genius), known for his prolific work in South Indian cinema with over 7,000 songs.

• Shankar-Ehsaan-Loy: A famous Indian musical trio consisting of Shankar Mahadevan, Ehsaan Noorani, and Loy Mendonsa, widely known for their Bollywood soundtracks.

• Himesh Reshammiya: A well-known Indian playback singer, music director, and actor known for his distinct high-pitched voice and numerous hit albums in the 2000s.

Important Points

• International Recognition: The HMMA win for Aadujeevitham marks a significant moment for Regional Indian Cinema on the global stage.

• Category Distinction: While major Hollywood films compete in main categories, the Foreign Language category specifically highlights excellence in non-English global cinema.

• Collaborations: A.R. Rahman has frequently collaborated with director Blessy and the performance of Prithviraj Sukumaran was enhanced significantly by the atmospheric score.

Q98. Answer: (a) Ministry of Statistics and Programme Implementation

The correct answer is Ministry of Statistics and Programme Implementation.

Key Points

• The Ministry of Statistics and Programme Implementation (MoSPI) released the first-ever monthly Periodic Labour Force Survey (PLFS) in April 2025, marking a significant shift in how labor data is tracked in India.

• The National Sample Survey Office (NSSO), which is the statistical arm under MoSPI, is responsible for conducting these surveys and processing the data to reflect current employment trends.

• This move from quarterly (for urban areas) and annual reports to monthly reports was initiated to provide real-time insights into the Indian economy, allowing for more agile and evidence-based policy interventions.

• The PLFS serves as the primary source of official data on employment and unemployment indicators, including the Labour Force Participation Rate (LFPR) and Unemployment Rate (UR) across various age groups and educational levels.

• The launch of the monthly series in April 2025 aims to capture seasonal variations in the workforce more accurately, particularly in sectors like agriculture and construction. Hence, the correct answer is Ministry of Statistics and Programme Implementation.

Additional Information

• Ministry of Statistics and Programme Implementation (MoSPI):

• It came into existence as an independent Ministry on 15th October 1999 after the merger of the Department of Statistics and the Department of Programme Implementation.

• The Ministry has two wings: one relating to Statistics and the other relating to Programme Implementation.

• The National Statistical Office (NSO) consists of the Central Statistical Office (CSO) and the National Sample Survey Office (NSSO).

• Periodic Labour Force Survey (PLFS):

• The PLFS was launched by the NSO in April 2017 to estimate the key employment and unemployment indicators in a shorter time interval for urban areas and annually for both rural and urban areas.

• It uses a rotational panel sampling design in urban areas to measure short-term changes in labor indicators.

• Before 2017, the NSSO used to conduct quinquennial (every five years) surveys on employment and unemployment.

• Important Labor Indicators:

• Labour Force Participation Rate (LFPR): It is defined as the percentage of persons in the labour force (working or seeking or available for work) in the population.

• Worker Population Ratio (WPR): It is defined as the percentage of employed persons in the population.

• Unemployment Rate (UR): It is defined as the percentage of persons unemployed among the persons in the labour force.

Important Points

• NSSO Functions: The National Sample Survey Office is mandated to conduct large-scale sample surveys in diverse fields on an all-India basis. It plays a vital role in providing data for the Sustainable Development Goals (SDG) monitoring framework.

• Data Frequency: The transition to monthly releases in 2025 aligns India with global best practices followed by developed economies like the USA and European Union countries, where labor data is a monthly high-frequency indicator.

• Policy Impact: High-frequency labor data helps the Ministry of Finance and the Reserve Bank of India (RBI) in making critical decisions regarding monetary policy and fiscal stimulus by identifying stress in the labor market early.

• National Statistical Commission (NSC): The NSC is an autonomous body formed in June 2005 under the recommendation of the Rangarajan Commission to reduce the problems faced by statistical agencies in the country regarding data collection.

Q99. Answer: (c) Aditya L1

The correct answer is Aditya L1.

Key Points

• Aditya-L1 is the first space-based Indian mission to study the Sun. It is an observatory-class mission designed to provide a comprehensive understanding of solar dynamics.

• The spacecraft was successfully launched by the Indian Space Research Organisation (ISRO) on September 2, 2023, using the PSLV-C57 launch vehicle.

• The mission is positioned in a halo orbit around the Lagrange point 1 (L1) of the Sun-Earth system, which is located approximately 1.5 million kilometers from Earth.

• Being placed at the L1 point allows the satellite to observe the Sun continuously without any occultation or eclipses, providing a major advantage in monitoring solar activities in real-time.

• The primary scientific objectives include studying the solar corona (the outermost layer), the chromosphere, and the photosphere, as well as investigating coronal mass ejections (CMEs), solar flares, and space weather.

Additional Information

• AstroSat:

• Launched in September 2015, it is India’s first dedicated multi-wavelength space observatory.

• It carries five scientific payloads to observe the universe in Optical, Ultraviolet, and X-ray regions of the electromagnetic spectrum simultaneously.

• Chandrayaan-1:

• Launched in October 2008 via PSLV-C11, it was India's first mission to the Moon.

• The mission is famous for discovering the presence of water molecules (H_2O) and hydroxyl (OH) on the lunar surface.

• Mangalyaan (Mars Orbiter Mission):

• Launched on November 5, 2013, it was India’s first interplanetary mission.

• India became the first nation to reach the Martian orbit in its maiden attempt and the fourth space agency in the world to reach Mars.

• Lagrange Points:

• These are specific positions in space where the gravitational pull of two large masses precisely equals the centripetal force required for a small object to move with them.

• There are five Lagrange points (L1 to L5) for the Sun-Earth system. L1 is the most significant for solar observations.

Important Points

• Scientific Payloads of Aditya L1:

• The spacecraft carries seven payloads. Four of these are remote sensing payloads (VELC, SUIT, SoLEXS, HEL1OS) that look directly at the Sun.

• The other three are in-situ payloads (ASPEX, PAPA, Advanced Tri-axial High Resolution Digital Magnetometers) that study the local environment at the L1 point.

• Visible Emission Line Coronagraph (VELC): This is the primary payload designed by the Indian Institute of Astrophysics (IIA), Bengaluru, to study the solar corona and the dynamics of coronal mass ejections.

• Solar Ultraviolet Imaging Telescope (SUIT): Developed by the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, it images the solar photosphere and chromosphere in near Ultraviolet wavelengths.

• The mission duration is expected to be approximately 5 years, providing long-term data on the 11-year solar cycle.

Q100. Answer: (d) The World: A Brief Introduction

The correct answer is The World: A Brief Introduction.

Key Points

• The World: A Brief Introduction, published in 2020, is written by Richard Haass to address the "gap" in foreign-policy literacy among the general public.

• The book serves as a concise primer that explains the essential history, geography, and political science concepts necessary to understand the modern world.

• It covers the evolution of the international system starting from the Peace of Westphalia in 1648, through the World Wars and the Cold War, up to the current era of globalization.

• The text details major global challenges such as climate change, cybersecurity, pandemics, and nuclear proliferation, making it a critical resource for 2025 discussions on global governance.

• Haass argues that in an interconnected world, an informed citizenry is vital for a functioning democracy, as domestic stability is increasingly linked to international events.

Additional Information

• Richard Haass:

• He is an American diplomat who served as the President of the Council on Foreign Relations (CFR) for twenty years, from 2003 to 2023.

• He has held senior positions in the U.S. State Department and served as a special assistant to President George H.W. Bush.

• The New Map: Energy, Climate, and the Clash of Nations:

• This book was authored by Daniel Yergin in 2020.

• It focuses on how the shale revolution and the transition to renewable energy are altering the geopolitical landscape between the United States, Russia, and China.

• The Long Game: China's Grand Strategy to Displace American Order:

• Written by Rush Doshi and published in 2021.

• It provides an analysis of China's long-term strategic intentions to reshape the global order.

• The Future Is Asian:

• Authored by Parag Khanna in 2019.

• It explores the "Asianization" of the world, highlighting the economic and cultural pivot toward the Asian continent in the 21st century.

Important Points

• World Order: A central theme in Richard Haass's work is the maintenance of international order and the prevention of global disarray.

• Bill of Obligations: In 2023, Haass released "The Bill of Obligations: The Ten Habits of Good Citizens," which shifts the focus toward domestic civic responsibilities in the United States.

• Foreign Policy Literacy: The concept refers to the basic knowledge required to evaluate how a country interacts with the world, a skill Haass considers mandatory for voters in the modern era.

• Council on Foreign Relations (CFR): Founded in 1921, it is one of the most influential think tanks in the world specializing in U.S. foreign policy and international affairs.

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