RRB Group D Official Paper (Held On: 30 Dec, 2025 Shift 3) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. An object is placed at infinity in front of a concave mirror. Where is the image formed?

(a) At the principal focus (F)
(b) At the pole (P)
(c) At the centre of curvature (C)
(d) Behind the mirror

Q2. Growing wheat and mustard simultaneously on the same piece of land is an example of which of the following?

(a) Crop rotation
(b) Jhum cultivation
(c) Mixed cropping
(d) Monoculture cropping

Q3. Match the following synthetic indicators and colour changes.

Column A (Indicator)	Column B (Colour Change)
A. Red litmus	1. Turns blue in base
B. Blue litmus	2. Turns red in acid
C. Phenolphthalein	3. Colourless in acid, pink in base
D. Methyl orange	4. Red in acid, yellow in base

(a) A-4; B-3; C-2; D-1
(b) A-3; B-4; C-1; D-2
(c) A-1; B-2; C-3; D-4
(d) A-2; B-1; C-3; D-4

Q4. Which method is used to extract metals that are high in the reactivity series?

(a) Heating with carbon
(b) Calcination
(c) Electrolytic reduction
(d) Roasting

Q5. As the chest cavity becomes larger, air is _____ into the lungs and fills the expanded _____.

(a) absorbed; diaphragm
(b) pulled; alveoli
(c) pushed; bronchi
(d) forced; ribs

Q6. The emergent ray from a rectangular glass slab is:

(a) Bent away from the normal
(b) Parallel to the incident ray
(c) Bent towards the normal
(d) Perpendicular to the incident ray

Q7. Which two forms of energy are collectively known as mechanical energy?

(a) Heat and Light energy
(b) Electrical energy and Magnetic energy
(c) Chemical energy and Nuclear energy
(d) Kinetic and Potential energy

Q8. Which of the following statements is/are true when two different resistors R1 and R2 are connected in parallel to one another in a circuit?

(i) The potential difference across each of them is same.
(ii) The current through both of them will be the same.
(iii) Their equivalent resistance is equal to R1 + R2.

(a) Only (ii)
(b) Both (ii) and (iii)
(c) Both (i) and (iii)
(d) Only (i)

Q9. Which acid does NOT give hydrogen gas when treated with metal because of its oxidising nature?

(a) Sulphuric acid
(b) Nitric acid
(c) Acetic acid
(d) Hydrochloric acid

Q10. Which of the following statements about evaporation is true?

(a) It requires no heat
(b) It occurs only at boiling point
(c) It occurs only at the surface of the liquid
(d) It occurs throughout the liquid

Q11. Match the following body parts with the types of epithelial tissue found in them.

Body parts	Epithelial tissue
A. Kidney tubules	1. Stratified squamous epithelial
B. Surface of skin	2. Cuboidal epithelium
C. Lung alveoli	3. Ciliated columnar epithelium
D. Respiratory tract lining	4. Simple squamous epithelium

(a) A-2, B-3, C-4, D-1
(b) A-4, B-2, C-3, D-1
(c) A-2, B-1, C-4, D-3
(d) A-1, B-2, C-3, D-4

Q12. Who first observed the densely stained reticular structures near the nucleus, now known as Golgi bodies?

(a) Robert Hooke
(b) Anton van Leeuwenhoek
(c) Camillo Golgi
(d) Matthias Schleiden

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Q13. Which of the following is a displacement reaction?

(a) Zn + CuSO4 → ZnSO4 + Cu
(b) CaCO3 → CaO + CO2
(c) AgNO3 + NaCl → AgCl + NaNO3
(d) NaOH + HCl → NaCl+H2O

Q14. The slope of a distance-time graph represents the:

(a) speed of the object
(b) acceleration of the object
(c) force on the object
(d) distance covered

Q15. If an object's velocity changes uniformly over a period of time, how can the average velocity during that time be calculated?

(a) By dividing the final velocity by the initial velocity
(b) By adding the initial velocity to twice the final velocity
(c) By subtracting the initial velocity from the final velocity
(d) By taking the arithmetic mean of the initial and final velocities

Q16. What is the atomic mass of magnesium?

(a) 1
(b) 24
(c) 6
(d) 14

Q17. A 100 W bulb is connected to a 220 V supply. The current through the bulb is approximately:

(a) 0.45 A
(b) 2.2 A
(c) 0.91 A
(d) 1.1 A

Q18. Which process involves the breakdown of uterine walls when the egg is NOT fertilised?

(a) Menopause
(b) Incubation
(c) Menstruation
(d) Fertilisation

Q19. Which of the following processes occurs before fertilisation in sexually reproducing plants?

(a) Seed development
(b) Fruit formation
(c) Embryo formation
(d) Pollination

Q20. Which of the following is the correct reason for constructing the ceilings of large halls in a curved shape?

(a) To reduce construction cost
(b) To allow sound to distribute evenly in the hall
(c) To provide more storage space above the ceiling
(d) To reduce the overall height of the hall

Q21. If the stamens of a flower are non-functional, which process will NOT be done?

(a) Fruit dispersal
(b) Pollen production
(c) Bud protection
(d) Ovule development

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Q22. How many carbon atoms are present in a benzene ring?

(a) 4
(b) 8
(c) 5
(d) 6

Q23. Select the correct pair of example of 'sublimation'.

(a) Camphor and napthalene
(b) Sugar and napthalene
(c) Dry ice and salt
(d) Salt and camphor

Q24. What are animals used for tilling, irrigation and carting referred to as?

(a) Carnivorous animals
(b) Wild animals
(c) Draught animals
(d) Milch animals

Q25. Which of the following natural phenomena CANNOT be explained by the Universal Law of Gravitation?

(a) Tides in the ocean
(b) Attraction between magnets
(c) Revolution of the Moon around the Earth
(d) Falling of an apple from a tree

MATHEMATICS

Q26. What is the least number that should be added to 517 so that the number obtained is exactly divisible by 15, 25 and 8?

(a) 81
(b) 86
(c) 82
(d) 83

Q27. A grandfather is five times as old as his grandson. In ten years, he will be only three times as old as his grandson would then be. If the grandfather's cousin is five years older than him, then how old was the cousin three years ago?

(a) 54 years
(b) 51 years
(c) 52 years
(d) 55 years

Q28. The monthly incomes of two friends Mohan and David, are in the ratio 5 : 9, respectively, and each of them saves Rs. 48,000 every month. If the ratio of their monthly expenditure is 2 : 4, find the monthly income of Mohan(in Rs.).

(a) 3,36,000
(b) 2,39,000
(c) 2,41,000
(d) 2,40,000

Q29. Simplify:

$\sqrt{50} + \sqrt{8}$

(a) $\sqrt{78}$
(b) $\sqrt{68}$
(c) $\sqrt{98}$
(d) $\sqrt{58}$

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Q30. Ajeet got a new table at 20% discount. If Ajeet did not get any discount, Ajeet would have to pay Rs. 6,925 extra. So how much did Ajeet pay for the table?

(a) Rs. 27,700
(b) Rs. 27,698
(c) Rs. 27,702
(d) Rs. 27,701

Q31. A can do a piece of work in 12 days by working 6 hours per day. B can do the same piece of work in 18 days by working 8 hours per day.. If both work together 71/9 hours per day, then in how many days they can complete the same piece of work ?

(a) 61/4
(b) 51/4
(c) 53/4
(d) 63/4

Q32. The amount on a sum of Rs. 3,200 at 10% per annum compound interest, compounded annually, in 2 years will be:

(a) Rs. 3,872
(b) Rs. 4,648
(c) Rs. 3,189
(d) Rs. 3,871

Q33. If 50 litres of a mixture of milk and water contains 12% of water. How much water should be added to make the water 20% in the new mixture?

(a) 6 litres
(b) 3 litres
(c) 5 litres
(d) 2 litres

Q34. If the radius of a sphere is 30 cm, then its surface area is:

(a) 3600 π cm^2
(b) 3612 π cm2
(c) 900 π cm2
(d) 1800 π cm2

Q35. P and Q together can fill a cistern with water in 14 hours. If P alone can fill the cistern with water in 28 hours, then in how many hours will Q alone fill one-fourth of the same cistern with water?

(a) 8
(b) 14
(c) 7
(d) 15

Q36. How many seconds will a boy take to run one complete round around a square field of side 25 metres, if he runs at a speed of 3 km/hr?

(a) 100
(b) 110
(c) 130
(d) 120

Q37. The taxi charges in a city consist of a fixed charge together with the charge for the distance covered. For a distance of 20 km, the charge paid is Rs. 200 and for a distance of 25 km, the charge paid is Rs. 245. How much does a person have to pay for covering a distance of 1 km?

(a) Rs. 29
(b) Rs. 27
(c) Rs. 31
(d) Rs. 25

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Q38. Find the value of $(2x+3)^2 - (2x-3)^2 - 24x$

(a) 2x
(b) 4x
(c) 1
(d) 0

Q39. The average price of three items of furniture is Rs. 16,650. If their prices are in the ratio 3 : 5 : 7, the price of the costliest item (in Rs.) is:

(a) 7,770
(b) 5,550
(c) 9,990
(d) 23,310

Q40. Find the mode of the given data 22, 16, 17, 49, 7, 16, 45, 17, 7, 6, 16, 17, 22, 7, 16, and 44.

(a) 16
(b) 17
(c) 7
(d) 22

Q41. The Rajdhani Express and Garib Rath Express run in the same direction with speeds of 115 km/hr and 61 km/hr, respectively, and their lengths are the same. What is the length of the Rajdhani Express if it completely crosses the Garib Rath Express in 116 seconds?

(a) 870 m
(b) 873 m
(c) 868 m
(d) 877 m

Q42. The expenditure of Sudha is 100% more than her savings. If her expenditure decreases by 2% and savings increase by 22%, then by what percentage does her income increase?

(a) 6%
(b) 3%
(c) 10%
(d) 2%

Q43. If $\sin\theta = 3/5$, what is the value of $\cos^2\theta$?

(a) 3/5
(b) 16/25
(c) 9/25
(d) 4/5

Q44. The sides of a triangle are 41 cm, 84 cm and 85 cm. What is the length of its altitude corresponding to the side with the length of 84 cm?

(a) 24 cm
(b) 14 cm
(c) 20 cm
(d) 40 cm

Q45. The length, breadth and height of a cuboid are in the ratio 2/3 : 1/4 : 5/6. If the length, breadth and height of the cuboid are increased by 25%, 331/3% and 40%, respectively, then the volume of the new cuboid is how many times the volume of original cuboid?

(a) 7/3 times
(b) 4/3 times
(c) 3 times
(d) 5/3 times

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Q46. A shopkeeper buys a laptop for Rs. 40,000 and sells it for Rs. 45,000. What is the percentage profit made by the shopkeeper?

(a) 10.5%
(b) 13.5%
(c) 12.5%
(d) 17.5%

Q47. Rs. 7,085 is divided among X, Y and Z in such a way that if Rs. 92, Rs. 9 and Rs. 48 are deducted from their respective shares, they have money in the ratio 3:15:16. Find the difference between Y's and Z's original shares.

(a) Rs. 54
(b) Rs. 104
(c) Rs. 243
(d) Rs. 254

Q48. The sum of the first 21 prime numbers is:

(a) 710
(b) 712
(c) 709
(d) 717

Q49. If P : 14 :: 57 : 21, then find the value of P.

(a) 41
(b) 35
(c) 38
(d) 36

Q50. A dealer purchased an AC for Rs. 1,848. After allowing a discount of 58% on its marked price, he still gains 63%. Find the marked price of the AC.

(a) Rs. 7,172
(b) Rs. 7,219
(c) Rs. 7,066
(d) Rs. 7,216

GENERAL INTELLIGENCE & REASONING

Q51. This question is based on the five, three-digit numbers given below.

(Left) 756 325 685 458 359 (Right)

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

(NOTE: All operations to be done from left to right.)

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

(a) 12
(b) 13
(c) 11
(d) 10

Q52. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

ADG : CFI

FLR : HNT

(a) KEQ : MGS
(b) MDR : SEI
(c) VES : TEY
(d) NDR : FTS

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Q53. All 38 students in a class are standing in a row, facing north. Ayush is 16^(th) from the right end while Meena is 21^(st) from the left end. How many people stand between Ayush and Meena?

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

Q54. Ridam starts from Point A and drives 45 km towards East. He then takes a right turn, drives 48 km, turns right and drives 51 km. He then takes a right turn and drives 63 km. He takes a final right turn, drives 6 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90-degree turns only, unless specified.)

(a) 14 km to the South
(b) 16 km to the north
(c) 17 km to the north
(d) 15 km to the South

Q55. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only).Counting to be done from left to right only.

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

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

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

Q56. 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 pans are cups.

All cups are bottles.

Some cups are mugs.

Conclusions:

(I) Some bottles are mugs.

(II) Some pans are mugs.

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

Q57. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

BAN EDQ HGT KJW ?

(a) NMH
(b) NMZ
(c) NZM
(d) NMJ

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

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

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

(a) None

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

Q59. Select the triad which follows the same pattern as that followed by the two triads given below. Both triads follow the same pattern.

MV-OX-QS

OX-QZ-SU

(a) LT-MU-OR
(b) LT-MV-OR
(c) KT-MV-OQ
(d) KT-MV-OR

Q60. In a certain code language,

A + B means ‘A is the son of B’,

A - B means ‘A is the brother of B’,

A x B means ‘A is the wife of B’ and

A & B means ‘A is the father of B’.

How is T related to M if ‘T + O - R x N & M’?

(a) Brother's son
(b) Mother's brother
(c) Mother's brother's son
(d) Mother's sister's son

Q61. What should come in place of the question mark (?) in the given series?

7 9 12 17 26 ?

(a) 43
(b) 48
(c) 40
(d) 45

Q62. A, B, C, D, E, and L are sitting around a circular table facing the centre. Only two people are sitting between A and B when counted from the left of B. C is sitting to the immediate right of A. D is an immediate neighbour of both E and B. Who are the immediate neighbours of C?

(a) L and A
(b) A and E
(c) B and L
(d) E and L

Q63. In a certain code language, 'TMCB' is coded as '76' and 'GKIR' is coded as '90'. What is the code for 'VAPD' in that language?

(a) 80
(b) 88
(c) 86
(d) 91

Q64. What should come in place of the question mark (?) in the given series?

6, 13, 21, 30, 40, ?

(a) 54
(b) 53
(c) 52
(d) 51

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Q65. Each of the digits in the number 268745913 is arranged in ascending order from left to right. Which of the following digits will be third from the left in the new number thus formed?

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

Q66. Based on the English alphabetical order, three of the following four letter-clusters are alike in a certain way and thus form a group. Which letter-cluster DOES NOT belong to that group?

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

(a) TYBF
(b) VACG
(c) EJLP
(d) QVXB

Q67. Which numbers should come in place of the question marks (?) in the same sequence to make the series logically complete?

101 103 ? 107 109 ?

(a) 105 and 113, respectively
(b) 105 and 111, respectively
(c) 105 and 101, respectively
(d) 107 and 111, respectively

Q68. Which of the given letter-number clusters will replace the question mark (?) in the following series to make it logically complete?

IHD 78 EDZ 87 AZV 96 WVR 105 ?

(a) SRN 114
(b) SQM 113
(c) SBL 113
(d) SSM 114

Q69. Six people, A, B, C, D, E and F, are sitting in a row, facing north. A sits to the immediate left of D. C sits third to the left of E. C is an immediate neighbour of D. F sits to the immediate left of B. How many people sit between E and F?

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

Q70. If 1 is added to each odd digit and 1 is subtracted from each even digit in the number 24583671, what will be the sum of the digits which are second from the left and second from the right in the new number thus formed?

(a) 11
(b) 12
(c) 10
(d) 13

Q71. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

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

(42, 14, 13.8)

(54, 18, 17.8)

(a) (255, 85, 83.8)
(b) (213, 71, 69.8)
(c) (126, 42, 40.8)

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(d) (63, 21, 20.8)

Q72. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which letter-cluster pair DOES NOT belong to that group?

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

(a) EW – BB
(b) KM – HR
(c) HK – DP
(d) QC – NH

Q73. 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 golds are hives.

No hive is a cow.

Conclusions:

(I): No gold is a cow.

(II): Some cows are hives.

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

Q74. E, F, G, H, P, Q, and R, are sitting around a circular table facing the centre. Only three people sit between H and R when counted from the right of R. Q sits second to the left of R. G sits fourth to the right of Q. F is an immediate neighbour of Q. P is NOT an immediate neighbour of H. Who sits second to the right of P?

(a) Q
(b) G
(c) F
(d) E

Q75. Umesh starts from Point Y and drives 83 km towards south. He then takes a left turn, drives 31 km, turns left and drives 45 km. He then takes a left turn and drives 55 km. He takes a right turn, drives 38 km. He then turns left, drives 16 km to stop at Point Z. How far (shortest distance) and towards which direction should he drive in order to reach Point Y again?

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

(a) 43 km towards west
(b) 41 km towards west
(c) 38 km towards east
(d) 40 km towards east

Q76. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

88 - 36 × 9 + 4 ÷ 3 = ?

(a) 70
(b) 80
(c) 75
(d) 90

Q77. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

CJT : FLU

EIM : HKN

(a) ZOT:FSA
(b) BSR:ODU
(c) NPT:QRU
(d) NPR:VCX

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

(Left) 7 1 4 3 6 2 7 9 6 5 1 1 7 7 3 2 5 5 3 6 6 5 6 2 1 9 1 (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) 5
(b) 7
(c) 6
(d) 8

Q79. All 35 students in a class are standing in a row, facing north. Veer is 14^(th) from the right end, while Maya is 20^(th) from the left end. How many people stand between Veer and Maya?

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

Q80. In a certain code language, ‘bow elk door’ is coded as ' xz vo ts' and ‘door mug blue’ is coded as ‘zj xz hf’. How is ‘door’ coded in the given language?

(a) zj
(b) vo
(c) ts
(d) xz

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. The Greenhouse Gases Emission Intensity Target Rules, 2025, targets the specify values for which of the following compliance years?

(a) 2030–31 and 2035–36
(b) 2026–27 and 2027–28
(c) 2027–28 and 2028–29
(d) 2025–26 and 2026–27

Q82. Where was the 2025 AAU Sullivan Award ceremony held?

(a) Los Angeles Convention Center
(b) New York Athletic Club
(c) Chicago Athletic Club
(d) Washington DC

Q83. Which of the following national parks emerged as one of the two top-performing protected areas in India, earning a Management Effectiveness Evaluation (MEE) score of 92.97%, in the assessment conducted by the Wildlife Institute of India in June 2025?

(a) Ranthambore National Park
(b) Dachigam National Park
(c) Great Himalayan National Park
(d) Nanda Devi National Park

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Q84. Where and when were the 2025 Juno Awards hosted?

(a) Ottawa, March 25
(b) Montreal, May 5
(c) Toronto, April 15
(d) Vancouver, March 30

Q85. Where was the first edition of the ‘Rising North East’ Investors Summit, 2025, held?

(a) Mumbai
(b) Guwahati
(c) New Delhi
(d) Kolkata

Q86. In the Global Innovation Index, 2025, India ranked first among which group of economies?

(a) Upper-middle income economies
(b) High-income economies
(c) Least developed economies
(d) Lower-middle income economies

Q87. Under which Article of the Indian Constitution has the Appropriation Bill (No.2), 2025, been passed in Parliament?

(a) Article 118
(b) Article 114
(c) Article 117
(d) Article 119

Q88. In 2025, which of the following cities hosted the 5^(th) edition of Lok Samvardhan Parv organised by the Ministry of Minority Affairs?

(a) Lucknow, Uttar Pradesh
(b) Kochi, Kerala
(c) Jaipur, Rajasthan
(d) Bhopal, Madhya Pradesh

Q89. Which of the following revolutionary books was authored by Veer Savarkar in 1923, whose birth anniversary was commemorated on 28th May 2025?

(a) Hindutva: Who is a Hindu?
(b) My Experiments with Truth
(c) The Discovery of India
(d) India Wins Freedom

Q90. Which of the following initiatives supports athletes’ training for Olympics and Paralympics as of 2025?

(a) Target Olympic Podium Scheme
(b) Come and Play Scheme
(c) Go and Play scheme
(d) National Sports Fund

Q91. What was the estimated loss of revenue to the government of Delhi due to the Liquor Policy Scam as per CAG report of 2025?

(a) Rs. 5,000 crores
(b) Rs. 2,000 crores
(c) Rs. 10,000 crores
(d) Rs. 20,000 crores

Q92. What is the significance of the 'R2 License' granted to Valueattics Reinsurance by the Insurance Regulatory and Development Authority of India (IRDAI) in March 2025?

(a) Approval to commence reinsurance business
(b) License to sell retail insurance policies directly

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(c) Regulatory clearance to acquire foreign branches
(d) Preliminary approval to begin banking operations

Q93. Which Grand Prix was won by Max Verstappen in 2025?
(a) Japan
(b) Bahrain
(c) Spain
(d) China

Q94. Which of the following states launched a flood-hazard zonation atlas as part of new disaster tools in mid-June 2025?
(a) Assam
(b) Karnataka
(c) Kerala
(d) Bihar

Q95. As of May 2025, what is the maximum FDI allowed through the Automatic Route in India's defense sector for companies seeking new industrial licenses?
(a) 51%
(b) 100%
(c) 49%
(d) 74%

Q96. Where was the second phase of the Khelo India Winter Games, 2025, held?
(a) Zanskar Valley, Ladakh
(b) Gulmarg, Jammu and Kashmir
(c) Auli, Uttarakhand
(d) Leh, Ladakh

Q97. 'Agnibaan - SOrTeD' (Sub-Orbital Technology Demonstrator) was launched on 30 May 2024 from India's first private launch pad called _____, established by Agnikul.
(a) Prithvi
(b) Kawach
(c) Taramandal
(d) Dhanush

Q98. What was the agriculture growth rate forecast for India in FY 2025 as per the Economic Survey 2024–25, released in January 2025?
(a) 5.2%
(b) 4.5%
(c) 2.5%
(d) 3.8%

Q99. The Indian Council of Arbitration (ICA) convened a Symposium-cum-Roundtable on 'Bridging Markets, Resolving Disputes via ADR in the India–Singapore Corridor' during which event?
(a) India Legal Week 2025
(b) International Arbitration Summit 2025
(c) Mediation Week 2025
(d) Singapore Convention Week 2025

Q100. Which veteran Indian actor-director, known as 'Bharat Kumar' for his patriotic films, passed away on 4 April 2025?
(a) Amitabh Bachchan
(b) Manoj Kumar
(c) Dilip Kumar
(d) Rajesh Khanna

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ANSWER KEY

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

SOLUTIONS

Q1. Answer: (a) At the principal focus (F)

The correct answer is At the principal focus (F).

Key Points

• When an object is placed at infinity in front of a concave mirror, the light rays originating from the object are considered parallel to the principal axis.

• According to the rules of ray optics, rays that are parallel to the principal axis of a concave mirror always pass through or converge at a single point called the principal focus (F) after reflection. Hence, statement 1 is correct.

• The image formed at the principal focus (F) has specific characteristics: it is real, inverted, and highly diminished to a point-size.

• An image is formed at the pole (P) only when the object is also located at the pole, which is not the case here. Hence, statement 2 is incorrect.

• If an object is placed at the centre of curvature (C), the image is formed exactly at the centre of curvature (C) and is of the same size. Hence, statement 3 is incorrect.

• An image is formed behind the mirror (virtual and erect) only when the object is placed between the pole (P) and the principal focus (F). Hence, statement 4 is incorrect.

Additional Information

• Concave Mirror:

• A concave mirror is also known as a converging mirror because it tends to collect and focus parallel light rays to a focal point.

• It is used in various applications such as shaving mirrors, headlights of vehicles, solar furnaces, and by dentists to see large images of teeth.

• Image Formation Cases for Concave Mirror:

• At Focus (F): When the object is at F, the image is formed at infinity and is highly magnified.

• Between C and F: When the object is between the centre of curvature and focus, the image is formed beyond C and is magnified.

• Beyond C: When the object is beyond C, the image is formed between C and F and is diminished.

• Between P and F: This is the only case where a concave mirror produces a virtual and erect image, which is magnified and behind the mirror.

Important Points

• Mirror Formula: The relationship between object distance (u), image distance (v), and focal length (f) is given by the formula $1/f = 1/v + 1/u$.

• Focal Length and Radius: The focal length (f) of a spherical mirror is exactly half of its radius of curvature (R), expressed as $f = R/2$.

• Sign Convention: According to the Cartesian sign convention, the focal length of a concave mirror is always taken as negative, while for a convex mirror, it is positive.

• Magnification: It is the ratio of the height of the image to the height of the object, also expressed as $m = -v/u$. A negative magnification indicates a real and inverted image.

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Q2. Answer: (c) Mixed cropping

The correct answer is Mixed cropping.

Key Points

• Mixed cropping is an agricultural practice where two or more crops are grown simultaneously on the same piece of land.

• This method is primarily used as a risk management strategy to ensure that even if one crop fails due to adverse weather conditions, pests, or diseases, the farmer can still harvest the other crop.

• Common combinations in India include Wheat + Mustard, Wheat + Gram, or Groundnut + Sunflower. In these cases, seeds are typically mixed before sowing, and there is no definite row pattern.

• Crop rotation is the practice of growing a series of different types of crops in the same area in sequential seasons. It is done to maintain soil fertility and break pest cycles, but since the crops are not grown simultaneously, statement 1 is incorrect.

• Jhum cultivation, also known as shifting cultivation or slash and burn agriculture, involves clearing a patch of forest land, burning the vegetation, and farming it for a few years before moving to a new plot. Hence, statement 2 is incorrect.

• Mixed cropping directly describes the simultaneous growth of wheat and mustard on one plot. Hence, statement 3 is correct.

• Monoculture cropping refers to the agricultural practice of growing only a single crop (such as corn, wheat, or rice) year after year on the same land. It lacks the biodiversity seen in mixed cropping. Hence, statement 4 is incorrect.

Additional Information

• Intercropping:

• While similar to mixed cropping, intercropping involves growing two or more crops simultaneously on the same field in a definite row pattern (e.g., a 1:1 or 1:2 ratio).

• It aims for better utilization of resources like sunlight, water, and nutrients, as the crops selected usually have different nutrient requirements or canopy heights.

• Shifting Cultivation (Jhum):

• This is widely practiced in the hilly regions of Northeast India (like Assam, Nagaland, and Manipur).

• While it provides subsistence, it is often associated with soil erosion and loss of forest cover when the fallow periods are shortened.

• Advantages of Mixed Cropping:

• It increases the yield per unit area and provides diversity in food supply for the farmer's family.

• Different crops have different root depths, which helps in efficient nutrient uptake from different layers of the soil.

• Leguminous crops (like gram) are often paired with cereals (like wheat) because they help in nitrogen fixation, improving soil health naturally.

Important Points

• Wheat (Triticum aestivum): It is a major Rabi crop in India, typically sown in October-November and harvested in March-April. It requires a cool growing season and bright sunshine at the time of ripening.

• Mustard (Brassica): It is an oilseed crop also grown during the Rabi season. It is often used in mixed cropping with wheat because both crops have similar climatic requirements but differ in their morphology.

• Sustainable Agriculture: Mixed cropping and crop rotation are considered key components of sustainable farming as they reduce the dependency on chemical fertilizers and synthetic pesticides.

Q3. Answer: (c) A-1; B-2; C-3; D-4

The correct answer is A-1, B-2, C-3, D-4.

Key Points

• Red Litmus: This is a natural indicator used to detect the presence of bases. In an acidic solution, it remains red, but it turns blue when introduced to a basic (alkaline) solution. Hence, A matches with 1 is correct.

• Blue Litmus: This indicator is used to test for acidity. In a basic solution, it remains blue, but it turns red when it comes into contact with an acidic solution. Hence, B matches with 2 is correct.

• Phenolphthalein: This is a well-known synthetic indicator often used in acid-base titrations. It is colourless in acidic or neutral environments and turns pink (or deep fuchsia) in basic solutions where the pH is above 8.2. Hence, C matches with 3 is correct.

• Methyl Orange: Another common synthetic indicator, it exhibits a clear color change based on the pH level. It turns red in acidic solutions (pH below 3.1) and turns yellow in basic or neutral solutions (pH above 4.4). Hence, D matches with 4 is correct.

• Indicators are essential tools in chemistry to determine the chemical nature of a substance without needing complex machinery. Hence, the correct match is A-1, B-2, C-3, D-4.

Additional Information

• Types of Indicators: Indicators are generally classified into three types: Natural, Synthetic, and Olfactory.

• Natural Indicators: These are derived from plants. Examples include Litmus (from Lichens), Turmeric, and Red Cabbage juice.

• Synthetic Indicators: These are prepared in laboratories. Examples include Phenolphthalein and Methyl Orange.

• Olfactory Indicators: These change their smell/odor in acidic or basic media. Common examples are onion, clove oil, and vanilla essence.

• The pH Scale: Developed by S.P.L. Sorensen in 1909, the pH scale measures the hydrogen ion concentration. It ranges from 0 to 14, where 7 is neutral, less than 7 is acidic, and more than 7 is basic.

• Universal Indicator: This is a mixture of several different indicators that shows different colours at different concentrations of hydrogen ions in a solution, allowing for a more precise determination of pH.

Important Points

• Litmus Extraction: Litmus solution is a purple dye extracted from Lichens, which belong to the division Thallophyta. It is the most commonly used acid-base indicator in laboratories worldwide.

• Turmeric as an Indicator: Turmeric remains yellow in the presence of acids but turns reddish-brown in the presence of a base. This is why a curry stain on a white shirt turns red when washed with soap (which is basic).

• Reaction in Neutral Solutions: Indicators like Methyl Orange and Phenolphthalein have specific transition ranges. For instance, distilled water (neutral) will not change the colour of phenolphthalein, keeping it colourless.

• Application: These indicators are vital in industries such as wastewater treatment, agriculture (soil testing), and medicine to monitor and control chemical reactions.

Q4. Answer: (c) Electrolytic reduction

The correct answer is Electrolytic reduction.

Key Points

• Metals located at the top of the reactivity series, such as Potassium (K), Sodium (Na), Calcium (Ca), Magnesium (Mg), and Aluminium (Al), are highly reactive and are never found in nature as free elements.

• These metals cannot be extracted from their compounds by heating with carbon. This is because these highly reactive metals have a much higher affinity for oxygen than carbon does, meaning carbon cannot act as a reducing agent for their oxides.

• The method used for the extraction of these high-reactivity metals is Electrolytic reduction. This process involves passing an electric current through the molten state of their ionic compounds (usually chlorides or oxides).

• During electrolysis, the metal ions (which are positively charged) are attracted to and deposited at the Cathode (the negatively charged electrode). For example, Sodium is obtained by the electrolysis of molten Sodium Chloride (NaCl).

• In the case of Aluminium, it is extracted from its ore through the Hall-Héroult process, which involves the electrolytic reduction of molten Alumina (Al_2O_3). Hence, the correct answer is Electrolytic reduction.

Additional Information

• Roasting:

• This process is primarily used for sulfide ores. It involves heating the ore strongly in the presence of excess air or oxygen.

• The goal is to convert sulfide ores into metal oxides, which are easier to reduce. For instance, Zinc sulfide (ZnS) is roasted to produce Zinc oxide (ZnO).

• Calcination:

• This method is used for carbonate ores or hydrated oxides. It involves heating the ore strongly in the absence or limited supply of air.

• During calcination, carbon dioxide or water vapor is expelled. For example, Zinc carbonate ($ZnCO_3$) is heated to obtain Zinc oxide (ZnO).

• Reduction with Carbon (Smelting):

• Metals in the middle of the reactivity series, such as Zinc (Zn), Iron (Fe), Tin (Sn), and Lead (Pb), are extracted using this method.

• Once the ores are converted to oxides via roasting or calcination, they are heated with carbon (coke), which acts as a reducing agent to produce the free metal.

• Reactivity Series Context:

• Metals at the bottom of the series, like Gold (Au) and Platinum (Pt), exist in their native state (free form) due to their lack of reactivity.

• Metals like Mercury (Hg) can be extracted simply by heating their sulfide ore, Cinnabar (HgS), in air without needing a separate reducing agent.

Important Points

• Cathode Reaction: In the extraction of Sodium, the reaction at the negative electrode is $Na^+ + e^- \rightarrow Na$.

• Anode Reaction: At the positive electrode, the non-metal (like Chlorine) is liberated: $2Cl^- \rightarrow Cl_2 + 2e^-$.

• The purity of metals obtained via electrolytic reduction is generally very high compared to those obtained by chemical reduction with carbon.

• The reactivity series is a crucial tool in metallurgy for determining the most economical and scientifically valid method for metal extraction.

Q5. Answer: (b) pulled; alveoli

The correct answer is pulled; alveoli.

Key Points

• The process of breathing, specifically inhalation (inspiration), is driven by changes in the volume and pressure of the chest cavity (thoracic cavity). When the diaphragm and external intercostal muscles contract, the chest cavity becomes larger.

• According to Boyle's Law, there is an inverse relationship between the volume and pressure of a gas. As the volume of the thoracic cavity increases, the internal air pressure within the lungs drops below the atmospheric pressure.

• Because air naturally flows from an area of higher pressure to an area of lower pressure, air is pulled into the lungs from the external environment. Hence, the first part of the statement is "pulled".

• Once the air enters the respiratory system, it passes through the trachea, bronchi, and bronchioles, finally reaching the alveoli. These are tiny, balloon-like air sacs that expand to accommodate the incoming air.

• The alveoli are the primary sites for gas exchange. Their walls are extremely thin, allowing oxygen to move into the blood and carbon dioxide to move out. Hence, the second part of the statement is "alveoli".

Additional Information

• Mechanism of Inhalation:

• During inspiration, the diaphragm (a dome-shaped muscle) flattens and moves downward. Simultaneously, the intercostal muscles pull the ribs upward and outward.

• This dual action expands the thoracic volume in both the vertical and anteroposterior planes, creating the negative pressure required to draw air in.

• Mechanism of Exhalation:

• Exhalation (expiration) is generally a passive process at rest. The diaphragm and intercostal muscles relax, causing the chest cavity to decrease in size.

• The elastic recoil of the lung tissue increases the internal pressure, causing air to be pushed out of the lungs.

• Structure of the Alveoli:

• The human lungs contain approximately 300 to 500 million alveoli, providing a massive surface area (about 70 to 100 square meters) for efficient gas exchange.

• They are coated with a substance called surfactant, which prevents the alveoli from collapsing by reducing surface tension.

• Respiratory Anatomy:

• Bronchi: These are the two large tubes that carry air from the trachea into the lungs. They branch into smaller bronchioles.

• Diaphragm: The most important muscle of respiration, separating the thoracic cavity from the abdominal cavity.

• Pleura: A double-layered serous membrane that encloses the lungs, ensuring they slide smoothly against the chest wall during expansion.

Important Points

• The average adult has a respiratory rate of 12 to 16 breaths per minute at rest.

• Boyle’s Law application: If volume doubles, pressure is halved. This principle is fundamental to the mechanical ventilation of the lungs.

• The partial pressure of oxygen in the alveoli is higher than in the pulmonary capillaries, which is why oxygen diffuses into the blood.

• Conversely, the partial pressure of carbon dioxide is higher in the blood than in the alveoli, facilitating its movement into the alveoli to be exhaled.

Q6. Answer: (b) Parallel to the incident ray

The correct answer is Parallel to the incident ray.

Key Points

• When a ray of light enters a rectangular glass slab, it undergoes refraction at two parallel surfaces: the air-glass interface and the glass-air interface.

• At the first surface, light travels from a rarer medium (air) to a denser medium (glass), causing the ray to bend towards the normal. Hence, statement 3 describes only the first stage of refraction.

• At the second surface, the light travels from the denser medium (glass) back into the rarer medium (air), causing the ray to bend away from the normal. Hence, statement 1 describes only the second stage of refraction.

• Because the opposite faces of the rectangular slab are parallel, the angle of incidence at the first surface is equal to the angle of refraction at the second surface, and the extent of bending is equal and opposite at both interfaces.

• As a result, the emergent ray emerges in a direction that is parallel to the incident ray, although it is shifted laterally. Hence, the correct answer is option 2.

Additional Information

• Lateral Displacement:

• This refers to the perpendicular distance between the path of the incident ray (if produced forward) and the emergent ray.

• The magnitude of this displacement depends on the thickness of the glass slab, the refractive index of the glass, and the angle of incidence.

• A thicker slab or a higher refractive index (like using flint glass instead of crown glass) will result in a greater lateral shift.

• Snell's Law of Refraction:

• The relationship between the angles and refractive indices is given by n1 sin i = n2 sin r, where n is the refractive index, i is the angle of incidence, and r is the angle of refraction.

• For a standard glass slab, the refractive index is approximately 1.5, while for air, it is taken as 1.0.

• Optical Density and Speed of Light:

• Light travels slower in optically denser media. The speed of light in a vacuum is 3 x 10^8 m/s, but it slows down to about 2 x 10^8 m/s inside a glass slab.

• When the ray enters at 90 degrees (normal incidence), the angle of incidence is 0, and the ray passes through without any deviation or lateral displacement.

• Comparison with a Prism:

• Unlike a rectangular slab, the refracting surfaces of a triangular prism are not parallel. Therefore, the emergent ray is not parallel to the incident ray but is instead deflected by an angle of deviation.

Q7. Answer: (d) Kinetic and Potential energy

The correct answer is Kinetic and Potential energy.

Key Points

• Mechanical energy is the sum of potential energy and kinetic energy present in the components of a mechanical system. It is the energy associated with the motion and position of an object.

• Kinetic Energy is the form of energy that an object or a particle has by reason of its motion. If work, which transfers energy, is done on an object by applying a net force, the object speeds up and thereby gains kinetic energy.

• Potential Energy is the stored energy possessed by an object because of its position relative to others, stresses within itself, its electric charge, or other factors. The most common types are gravitational potential energy and elastic potential energy.

• The relationship is expressed by the formula: Mechanical Energy (E) = Kinetic Energy (K) + Potential Energy (U).

• When an object is in motion, it possesses Kinetic Energy, and when it is at a certain height or in a deformed state (like a stretched spring), it possesses Potential Energy. The combination of these two determines the total mechanical capacity of the object to do work. Hence, the correct answer is Kinetic and Potential energy.

Additional Information

• Kinetic Energy (KE):

• The numerical value of kinetic energy is calculated using the formula $K = 1/2\ mv^2$, where m is the mass of the object and v is its magnitude of velocity (speed).

• Examples include a moving car, flowing water in a river, or a flying bird. Since it depends on the square of velocity, doubling the speed quadruples the kinetic energy.

• Potential Energy (PE):

• Gravitational Potential Energy is calculated as U = mgh, where m is mass, g is the acceleration due to gravity (approximately 9.8 m/s^2 on Earth), and h is the height above a reference point.

• Elastic Potential Energy is stored in objects that can be compressed or stretched, such as rubber bands, springs, or a drawn archer's bow.

• Other Forms of Energy mentioned in options:

• Heat Energy: Also known as thermal energy, it arises from the internal motion of atoms and molecules within a substance.

• Chemical Energy: Energy stored in the bonds of chemical compounds, such as in batteries, food, or gasoline.

• Nuclear Energy: Energy released during nuclear fission or fusion, originating from the nucleus of an atom.

• Electrical Energy: Energy caused by the moving electric charges (electrons).

Important Points

• Law of Conservation of Mechanical Energy: In an isolated system where only conservative forces (like gravity) are acting, the total mechanical energy remains constant over time. This means the loss in potential energy is equal to the gain in kinetic energy, and vice versa.

• Unit of Energy: The SI unit for all forms of energy, including mechanical, kinetic, and potential, is the Joule (J). One Joule is defined as the work done by a force of one Newton acting through a distance of one meter.

• Work-Energy Theorem: This principle states that the net work done by all forces acting on an object is equal to the change in its kinetic energy.

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• Transformation Example: In a hydroelectric power plant, water stored at a height in a dam has high potential energy. As the water falls, this potential energy is converted into kinetic energy, which then turns turbines to produce electricity.

Q8. Answer: (d) Only (i)

The correct answer is Only (i).

Key Points

• In a parallel circuit, all components are connected across the same two nodes or points. This arrangement ensures that the potential difference (voltage) across each resistor remains exactly the same. Hence, statement (i) is correct.

• According to Ohm's Law, the current through a resistor is calculated by the formula I = V / R. Since the voltage (V) is constant for both resistors in parallel but their resistance values (R1 and R2) are different, the current flowing through each will be different. Hence, statement (ii) is incorrect.

• The equivalent resistance (Req) for resistors connected in parallel is given by the reciprocal formula: 1/Req = 1/R1 + 1/R2. The formula Req = R1 + R2 is only applicable when resistors are connected in series. Hence, statement (iii) is incorrect.

• In a parallel combination, the total current (Itotal) entering the junction is the sum of the individual currents passing through each branch (I1 + I2), following Kirchhoff's Current Law.

• Hence, the correct answer is Only (i).

Additional Information

• Parallel Combination of Resistors:

• In this configuration, the total conductance of the circuit increases because there are more paths for the electric charge to flow.

• The equivalent resistance of a parallel circuit is always less than the smallest individual resistance in that network.

• This type of connection is widely used in domestic household wiring. It allows each appliance (like fans, bulbs, or refrigerators) to be turned on or off independently without affecting others.

• Series Combination of Resistors:

• In a series circuit, there is only one path for the current to flow. Therefore, the current remains the same through all resistors.

• The total potential difference across the series combination is the sum of the potential differences across individual resistors (V = V1 + V2).

• The equivalent resistance increases as more resistors are added, calculated simply as R1 + R2 + ... + Rn.

Important Points

• Ohm's Law: Established by Georg Simon Ohm in 1827, it provides the fundamental relationship where Voltage (V) = Current (I) × Resistance (R).

• Power Dissipation: In a parallel circuit, the resistor with the lower resistance value will dissipate more power (heat) because Power (P) = V^2 / R, and the voltage is constant.

• Circuit Safety: Parallel circuits are preferred in buildings because if one component fails or a bulb fuses, the circuit remains closed for all other branches, ensuring the rest of the building still has power.

• SI Units: The unit of Resistance is the Ohm (Ω), Potential Difference is measured in Volts (V), and Current is measured in Amperes (A).

Q9. Answer: (b) Nitric acid

The correct answer is Nitric acid.

Key Points

• Nitric acid (HNO_3) is a powerful oxidizing agent. Unlike other mineral acids, when it reacts with most metals, it does not release hydrogen gas (H_2).

• This phenomenon occurs because the hydrogen gas produced during the initial reaction is immediately oxidized by the acid into water (H_2O). Hence, the statement regarding its oxidizing nature is correct.

• During this process, the Nitric acid itself undergoes reduction to form various nitrogen oxides, such as nitrogen dioxide (NO_2), nitric oxide (NO), or nitrous oxide (N_2O), depending on the concentration of the acid and the temperature.

• However, there are specific exceptions to this rule. When very dilute nitric acid (around 1% concentration) reacts with Magnesium (Mg) and Manganese (Mn), hydrogen gas is actually evolved.

• In contrast, metals like Copper, Silver, and Mercury react with concentrated nitric acid to yield salt, water, and nitrogen dioxide, but no hydrogen gas is liberated.

Additional Information

• Hydrochloric Acid (HCl):

• It is a strong acid and a major component of gastric acid in the human digestive system.

• When HCl reacts with active metals such as Zinc (Zn), Iron (Fe), or Aluminium (Al), it readily produces metal chlorides and evolves hydrogen gas. For example: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$.

• Sulphuric Acid (H_2SO_4):

• Known as the 'King of Chemicals', it is widely used in lead-acid batteries and fertilizer production.

• Dilute sulphuric acid reacts with metals positioned above hydrogen in the reactivity series to liberate hydrogen gas and form metal sulphates. However, concentrated sulphuric acid acts as an oxidizing agent and behaves differently, often producing sulphur dioxide (SO2).

• Acetic Acid (CH3COOH):

• This is a weak organic acid and the primary constituent of vinegar (typically 5-8% by volume).

• It reacts with metals like Magnesium or Zinc to form metal acetates and slowly releases hydrogen gas. Because it is a weak acid, the rate of hydrogen evolution is much slower compared to HCl or H2SO4.

• The Reactivity Series:

• The ability of an acid to displace hydrogen depends on the position of the metal in the activity series.

• Metals like Gold (Au) and Platinum (Pt) do not react with these individual acids and require Aqua Regia (a mixture of concentrated HCl and concentrated HNO3 in a 3:1 ratio) for dissolution.

Important Points

• Oxidation State: In Nitric acid, Nitrogen is in its maximum oxidation state of +5. This makes the molecule highly unstable and eager to accept electrons, facilitating its strong oxidizing properties.

• Industrial Use: Nitric acid is vital in the manufacture of explosives like TNT (Trinitrotoluene) and Nitroglycerin, as well as in the production of ammonium nitrate for agricultural fertilizers.

• Safety: Nitric acid is highly corrosive and can cause severe chemical burns. It turns human skin yellow upon contact due to a reaction with proteins known as the xanthoproteic reaction.

Q10. Answer: (c) It occurs only at the surface of the liquid

The correct answer is It occurs only at the surface of the liquid.

Key Points

• Evaporation is a type of vaporization that occurs on the surface of a liquid as it changes into the gas phase.

• It is strictly a surface phenomenon because only the molecules at the top layer of the liquid possess enough kinetic energy to overcome the intermolecular forces of attraction and escape into the atmosphere. Hence, statement 3 is correct.

• Contrary to some misconceptions, evaporation requires heat energy, known as the Latent Heat of Vaporization, which is absorbed from the surroundings or the liquid itself. Hence, statement 1 is incorrect.

• Evaporation can take place at any temperature below the boiling point of the liquid, whereas boiling only occurs at a specific, fixed boiling point. Hence, statement 2 is incorrect.

• While boiling is a bulk phenomenon that occurs throughout the entire volume of the liquid (indicated by the formation of bubbles), evaporation is limited to the surface. Hence, statement 4 is incorrect.

Additional Information

• Factors Affecting Evaporation:

• Surface Area: Since it is a surface phenomenon, an increase in the surface area leads to an increase in the rate of evaporation. For example, spreading out wet clothes helps them dry faster.

• Temperature: An increase in temperature provides more particles with enough kinetic energy to go into the vapor state, thereby increasing the rate.

• Humidity: This refers to the amount of water vapor present in the air. If humidity is high, the air cannot hold much more moisture, so the rate of evaporation decreases.

• Wind Speed: With an increase in wind speed, water vapor particles move away with the wind, decreasing the amount of water vapor in the surrounding area and increasing evaporation.

• Cooling Effect:

• One of the most important features of evaporation is that it causes cooling. As the liquid evaporates, it draws energy (heat) from the surface it is in contact with, resulting in a temperature drop.

• Examples: Human sweating helps regulate body temperature, and water kept in earthen pots (matkas) stays cool due to evaporation through porous walls.

• Molecular Mechanism:

• In a liquid, molecules are in constant motion with varying speeds. Only those at the surface with high velocity can break free from the cohesive forces of the liquid bulk. This explains why the remaining liquid becomes cooler, as the "hottest" (highest energy) molecules are the ones that leave first.

Important Points

• Difference between Evaporation and Boiling:

• Evaporation is a slow process, while boiling is a fast process.

• Evaporation occurs at the surface, whereas boiling occurs throughout the entire mass of the liquid.

• Evaporation leads to cooling, but boiling does not produce a cooling effect on the substance itself while it is being heated.

• Boiling happens only when the vapor pressure of the liquid equals the atmospheric pressure.

Q11. Answer: (c) A-2, B-1, C-4, D-3

The correct answer is A - 2, B - 1, C - 4, D - 3.

Key Points

• Kidney Tubules (Cuboidal Epithelium):

• The cuboidal epithelium consists of cube-like cells that are roughly as tall as they are wide.

• In the kidney tubules (specifically the proximal convoluted tubule), these cells often possess microvilli to facilitate secretion and absorption. Hence, A matches with 2 is correct.

• Surface of Skin (Stratified Squamous Epithelial):

• The skin is subjected to constant wear and tear; therefore, it is composed of stratified squamous epithelium, which consists of multiple layers of cells.

• The outermost layer of the skin is keratinized to provide a waterproof and protective barrier against mechanical injury and pathogens. Hence, B matches with 1 is correct.

• Lung Alveoli (Simple Squamous Epithelium):

• Simple squamous epithelium is a single layer of extremely thin and flat cells, forming a delicate lining.

• This tissue is found in the lung alveoli and blood vessels, where the transport of substances or gas exchange occurs through a selectively permeable surface. Hence, C matches with 4 is correct.

• Respiratory Tract Lining (Ciliated Columnar Epithelium):

• In the respiratory tract, the columnar epithelial cells possess hair-like projections called cilia on their outer surfaces.

• These cilia can move, and their rhythmic motion pushes mucus forward to clear the tract. Hence, D matches with 3 is correct.

Additional Information

• Classification of Epithelial Tissues:

• Epithelial tissues are classified based on the number of cell layers and the shape of the cells.

• Simple epithelium consists of a single layer of cells, typically found where absorption, secretion, or filtration occurs.

• Stratified epithelium consists of two or more layers of cells, primarily serving a protective function in areas prone to friction.

• Specialized Functions:

• Glandular Epithelium: Sometimes a portion of the epithelial tissue folds inward, forming multicellular glands responsible for secreting substances like sweat, oil, or digestive enzymes.

• Columnar Epithelium: Characterized by tall, pillar-like cells, it is found in the inner lining of the intestine where absorption and secretion are prominent.

• Structural Integrity:

• All epithelial cells are usually separated from the underlying tissue by an extracellular fibrous basement membrane.

• There is very little intercellular space between the cells, making them a continuous sheet that acts as a barrier to keep different body systems separate.

Important Points

• Simple Squamous: Located in Bowman's capsule and capillaries; functions include filtration.

• Simple Cuboidal: Located in thyroid vesicles and salivary gland ducts; functions include mechanical support.

• Stratified Squamous: Non-keratinized type is found in the esophagus and lining of the mouth.

• Ciliated Columnar: Also found in the fallopian tubes (oviducts) to help move the ovum toward the uterus.

Q12. Answer: (c) Camillo Golgi

The correct answer is Camillo Golgi.

Key Points

• Camillo Golgi, an Italian physician and pathologist, first observed the densely stained reticular structures near the nucleus of a cell in the year 1898.

• He discovered these structures while investigating the nervous system using a unique staining technique he developed, known as the "black reaction" (la reazione nera), which utilized silver nitrate.

• These reticular networks were later named Golgi bodies (also known as the Golgi apparatus or Golgi complex) in his honor.

• The Golgi apparatus is a membrane-bound organelle found in most eukaryotic cells and is characterized by a series of flattened, stacked pouches called cisternae.

• For his revolutionary work on the structure of the nervous system, Camillo Golgi was awarded the Nobel Prize in Physiology or Medicine in 1906, sharing it with Santiago Ramón y Cajal.

Additional Information

• Robert Hooke:

• In 1665, Robert Hooke observed thin slices of cork under a primitive compound microscope.

• He observed honeycomb-like structures and coined the term "cell" to describe them, although he was actually looking at the dead cell walls of plant tissue.

• Anton van Leeuwenhoek:

• Commonly known as the "Father of Microbiology," Leeuwenhoek was a Dutch scientist who, in 1674, was the first to observe and describe live cells.

• Using his high-quality single-lens microscopes, he discovered bacteria, protozoa (which he called "animalcules"), and human sperm cells.

• Matthias Schleiden:

• In 1838, Matthias Schleiden, a German botanist, concluded that all plant tissues are composed of cells.

• His work, along with that of Theodor Schwann, formed the basis of the Cell Theory, which states that the cell is the basic unit of life.

• Functions and Features of Golgi Bodies:

• The primary function of the Golgi apparatus is the packaging, modification, and sorting of proteins and lipids that are synthesized in the Endoplasmic Reticulum.

• It acts like a "post office" of the cell, tagging molecules with carbohydrates or phosphates to ensure they reach their correct destination, such as the cell membrane or lysosomes.

• It has a distinct polarity, with a cis face (receiving side near the ER) and a trans face (shipping side).

Q13. Answer: (a) Zn + CuSO4 → ZnSO4 + Cu

The correct answer is Zn + CuSO4 -> ZnSO4 + Cu.

Key Points

• A displacement reaction is a chemical reaction in which a more reactive element displaces a less reactive element from its compound. These reactions are also known as substitution reactions or single displacement reactions.

• In the reaction Zn + CuSO4 -> ZnSO4 + Cu, Zinc (Zn) is a more reactive metal than Copper (Cu). When Zinc is added to a blue solution of Copper (II) sulphate, it displaces the Copper atoms to form Zinc sulphate and solid Copper. Hence, statement 1 is correct.

• The reaction CaCO3 -> CaO + CO2 represents a decomposition reaction. In this process, a single reactant (Calcium Carbonate) breaks down into two or more simpler products (Calcium Oxide and Carbon Dioxide) upon the application of heat. Hence, statement 2 is incorrect.

• The reaction AgNO3 + NaCl -> AgCl + NaNO3 is an example of a double displacement reaction (specifically a precipitation reaction). Here, two compounds exchange ions to form two new compounds, resulting in the formation of an insoluble white precipitate of Silver Chloride (AgCl). Hence, statement 3 is incorrect.

• The reaction NaOH + HCl -> NaCl + H2O is a neutralization reaction. It occurs between a base (Sodium Hydroxide) and an acid (Hydrochloric Acid) to produce salt (Sodium Chloride) and water. This is also categorized as a type of double displacement. Hence, statement 4 is incorrect.

Additional Information

• Reactivity Series of Metals:

• The ability of one metal to displace another is determined by the reactivity series. This is a list of metals arranged in decreasing order of their reactivity.

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

• Zinc (Zn) is placed higher than Copper (Cu), Silver (Ag), and Gold (Au) in the series, which explains why Zinc can displace Copper from its salt solution.

• Observation in Displacement Reactions:

• In the Zn + CuSO4 reaction, the characteristic blue color of the CuSO4 solution fades and eventually becomes colorless as ZnSO4 is formed.

• A reddish-brown deposit of Copper metal can be seen on the Zinc strip or at the bottom of the beaker.

• Types of Displacement:

• Single Displacement: One element replaces another in a compound (e.g., Fe + CuSO4 -> FeSO4 + Cu).

• Double Displacement: Two compounds exchange their cations and anions to form new products (e.g., BaCl2 + Na2SO4 -> BaSO4 + 2NaCl).

Important Points

• Reactivity Order: The general order of reactivity for common metals is K > Na > Ca > Mg > Al > Zn > Fe > Pb > [H] > Cu > Hg >

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Ag > Au.

• Non-Metal Displacement: Displacement reactions are not limited to metals. For example, a more reactive halogen can displace a less reactive halogen from its halide (e.g., Cl2 + 2KI -> 2KCl + I2).

• Applications: These reactions are widely used in metallurgy for the extraction of metals, in thermite welding (where Aluminum displaces Iron from its oxide), and in electrochemical cells.

• Law of Conservation of Mass: Every chemical equation must be balanced to satisfy this law, ensuring the number of atoms of each element remains the same before and after the reaction.

Q14. Answer: (a) speed of the object

The correct answer is speed of the object.

Key Points

• A distance-time graph is a graphical representation used to show how the distance traveled by an object changes over a specific period of time.

• In this graph, distance is typically plotted on the vertical axis (y-axis), and time is plotted on the horizontal axis (x-axis).

• The slope (also known as the gradient) of a line on any graph is calculated as the vertical change divided by the horizontal change (Rise/Run).

• For a distance-time graph, the slope is equal to the change in distance divided by the change in time. Mathematically, this is the formula for speed (Speed = Distance / Time). Hence, the correct answer is speed of the object.

• If the slope is a straight line passing through the origin, it indicates that the object is moving at a constant speed.

• A steeper slope represents a higher speed, whereas a gentler slope represents a lower speed.

Additional Information

• Acceleration of the object:

• Acceleration is the rate of change of velocity per unit of time.

• It is represented by the slope of a velocity-time graph, not a distance-time graph.

• If a distance-time graph is a curve (such as a parabola), it indicates that the speed is changing, which implies the object is undergoing acceleration.

• Force on the object:

• According to Newton's Second Law of Motion, Force (F) is equal to the product of mass (m) and acceleration (a).

• While force influences the motion depicted on a graph, it is not directly read from the slope of a simple distance-time graph without knowing the mass.

• Distance covered:

• The total distance covered by an object at any specific time is represented by the magnitude of the y-coordinate at that point on the graph.

• It is a scalar quantity that refers to "how much ground an object has covered" during its motion.

• Types of Motion on Distance-Time Graphs:

• Stationary Object: Represented by a horizontal line where the slope is zero.

• Uniform Motion: Represented by a straight slanted line indicating constant speed.

• Non-Uniform Motion: Represented by a curved line, showing that the speed is either increasing or decreasing.

Important Points

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

• The slope of a displacement-time graph represents the velocity of the object, which is a vector quantity (includes direction).

• The area under a velocity-time graph represents the total displacement or distance traveled by the object during a time interval.

• In kinematics, these graphs are essential for visualizing the equations of motion developed by Sir Isaac Newton.

Q15. Answer: (d) By taking the arithmetic mean of the initial and final velocities

The correct answer is By taking the arithmetic mean of the initial and final velocities.

Key Points

• When an object's velocity changes at a constant rate, it is said to be in uniform acceleration. In such cases, the average velocity for a specific time interval is calculated as the arithmetic mean of its initial velocity and final velocity.

• The mathematical expression for this calculation is Average Velocity = (u + v) / 2, where u represents the initial velocity at the start of the time period and v represents the final velocity at the end of that period.

• This specific formula is only applicable when the acceleration is uniform (constant). If the acceleration varies over time, the average velocity must be calculated using the total displacement divided by the total time taken.

• The arithmetic mean effectively balances the velocity over the duration, providing a representative value of the motion throughout the period of time.

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• Dividing the final velocity by the initial velocity or subtracting them (which gives the change in velocity) does not provide the average state of motion. Hence, taking the arithmetic mean is the correct method.

Additional Information

• Velocity and its nature:

• Velocity is a vector quantity, meaning it possesses both magnitude and direction. This distinguishes it from speed, which is a scalar quantity.

• The SI unit for measuring velocity is meters per second (m/s). Other commonly used units include kilometers per hour (km/h).

• Uniform Acceleration:

• An object is under uniform acceleration if its velocity changes by equal amounts in equal intervals of time.

• A common example of uniform acceleration is the motion of a freely falling body under gravity, where the acceleration is approximately 9.8 m/s² on Earth.

• Equations of Motion:

• For objects moving with uniform acceleration in a straight line, three fundamental equations relate velocity, time, displacement, and acceleration.

• The first equation is $v = u + at$, the second is $s = ut + \frac{1}{2}at^2$, and the third is $v^2 = u^2 + 2as$. These were formulated by Isaac Newton.

• Average Speed vs. Average Velocity:

• Average Speed is the total distance traveled divided by the total time taken. It does not account for direction.

• Average Velocity is defined as the total displacement (the shortest path between initial and final positions) divided by the total time. If an object returns to its starting point, its average velocity is zero, regardless of the distance covered.

Important Points

• Key distinctions in motion:

• In Uniform Motion, the velocity remains constant over time, meaning the acceleration is zero. In this case, the average velocity is simply the constant velocity itself.

• In Non-Uniform Motion, the velocity changes at a non-constant rate. The simple arithmetic mean formula $(u+v)/2$ cannot be used here; instead, calculus or the total displacement/total time method is required.

• The term Instantaneous Velocity refers to the velocity of an object at a specific point in time, which can be found by taking the derivative of the position with respect to time.

Q16. Answer: (b) 24

The correct answer is 24.

Key Points

• Magnesium is a chemical element represented by the symbol Mg and possesses an atomic number of 12.

• The atomic mass of an element is the weighted average mass of the atoms of an element measured in atomic mass units (amu). For Magnesium, the standard atomic mass is approximately 24.305 u, which is rounded to 24 in most basic chemical calculations.

• The mass of an atom is primarily concentrated in its nucleus, which contains protons and neutrons. Magnesium typically has 12 protons and 12 neutrons, resulting in a mass number of 24. Hence, the option 24 is correct.

• Magnesium is classified as an Alkaline Earth Metal and is found in Group 2 and Period 3 of the Modern Periodic Table.

• It is the eighth most abundant element in the Earth's crust by mass and is essential for all living cells, playing a major role in biological functions.

Additional Information

• Understanding the other options:

• 1: This is the approximate atomic mass of Hydrogen (H), the lightest element in the periodic table. Hence, this statement is incorrect regarding Magnesium.

• 6: This is the atomic number of Carbon (C). The atomic mass of Carbon is actually 12. Hence, this statement is incorrect regarding Magnesium.

• 14: This is the atomic mass of Nitrogen (N). Nitrogen has an atomic number of 7. Hence, this statement is incorrect regarding Magnesium.

• Isotopes of Magnesium:

• Naturally occurring magnesium is composed of three stable isotopes: Mg-24, Mg-25, and Mg-26.

• Mg-24 is the most abundant isotope, making up about 79% of natural magnesium, which is why the average atomic mass is closest to 24.

• Physical and Chemical Properties:

• Magnesium is a shiny gray solid at room temperature and has a relatively low density compared to other metals.

• It is highly reactive, particularly with halogens and acids, and it burns with a brilliant white light when ignited in air, a property

used in fireworks and marine flares.

Important Points

• Electronic Configuration: The electronic configuration of Magnesium is [Ne] $3s^2$ or 2, 8, 2. It has 2 valence electrons in its outermost shell.

• Valency: Because it easily loses its two valence electrons to achieve a stable octet, the valency of magnesium is +2.

• Biological Importance: Magnesium is a critical component of chlorophyll, the green pigment in plants responsible for photosynthesis. In the human body, it is a cofactor in more than 300 enzyme systems that regulate diverse biochemical reactions, including protein synthesis and muscle function.

• Industrial Uses: It is widely used in alloying with aluminum to create lightweight and strong materials for the aerospace and automotive industries.

• Discovery: Magnesium was first isolated by Sir Humphry Davy in 1808 through the process of electrolysis.

Q17. Answer: (a) 0.45 A

The correct answer is 0.45 A.

Key Points

• The relationship between Electric Power (P), Voltage (V), and Electric Current (I) is given by the formula: P = V x I.

• In this question, the Power of the bulb is given as 100 W and the Voltage of the supply is 220 V.

• To find the Current, the formula is rearranged as I = P / V.

• By substituting the given values: I = 100 W / 220 V.

• The calculation results in 10 / 22, which simplifies to 5 / 11, or approximately 0.4545 A.

• Rounding to two decimal places, the current through the bulb is 0.45 A.

Additional Information

• Electric Power (P): It is the rate at which electrical energy is consumed or transferred in an electric circuit. The SI unit of power is the Watt (W), which is equivalent to one Joule per second.

• Electric Current (I): This is the rate of flow of electric charge through a conductor. The SI unit is the Ampere (A). It is measured using a device called an Ammeter, which is always connected in series in a circuit.

• Potential Difference (V): Also known as voltage, it is the work done to move a unit charge from one point to another. The SI unit is the Volt (V), and it is measured using a Voltmeter connected in parallel.

• Resistance (R): Using Ohm's Law and the power formula, we can also calculate the resistance of the bulb. Since P = V^2 / R, the resistance is R = V^2 / P. For a 100 W bulb at 220 V, the resistance is (220 x 220) / 100, which equals 484 Ohms.

Important Points

• In India, the standard domestic AC supply voltage is 220 V with a frequency of 50 Hz.

• The current calculated (0.45 A) represents the RMS (Root Mean Square) value of the current, which is typically used for Alternating Current (AC) ratings in household appliances.

• As the Wattage of a bulb increases while the Voltage remains constant, the Current drawn by the bulb also increases proportionally, leading to lower Resistance.

• Electric bulbs containing Tungsten filaments operate based on the heating effect of electric current, where the filament reaches high temperatures to emit light.

Q18. Answer: (c) Menstruation

The correct answer is Menstruation.

Key Points

• Menstruation is the periodic shedding of the lining of the uterus (the endometrium) that occurs in women and some primate species when an ovum (egg) released during the ovulation phase is not fertilized by a sperm.

• During each menstrual cycle, the body prepares for a potential pregnancy by thickening the uterine wall with blood-rich tissue to provide nutrients for a developing embryo.

• If fertilisation does not take place, the levels of the hormones estrogen and progesterone drop significantly. This hormonal decline signals the body to break down and expel the thickened endometrial lining. Hence, the statement regarding the breakdown of uterine walls is describing menstruation.

• The process typically results in a discharge consisting of blood, mucosal tissue, and the unfertilized egg, which leaves the body through the vagina.

• A normal menstrual cycle occurs approximately every 28 days, though it can vary between 21 to 35 days depending on the individual's health and age.

Additional Information

• Menopause:

• This refers to the time in a woman's life when menstrual periods stop permanently. It is typically diagnosed after a woman has gone 12 months without a period.

• It usually occurs between the ages of 45 and 55 years. During this transition, the ovaries stop releasing eggs and produce much lower levels of estrogen and progesterone.

• Fertilisation:

• This is the process where a male gamete (sperm) and a female gamete (egg or ovum) fuse to form a single cell called a zygote.

• In humans, this usually occurs in the fallopian tube. Once fertilisation happens, the uterine wall does not break down; instead, it remains thick to support the implantation of the embryo.

• Incubation:

• In biology, incubation is the process by which certain oviparous (egg-laying) animals, such as birds and reptiles, keep their eggs at a specific temperature to ensure the proper development of the embryo until hatching.

• In medicine, it can also refer to the incubation period, which is the time between exposure to a pathogen (like a virus or bacteria) and the appearance of the first symptoms of a disease.

Important Points

• Phases of the Menstrual Cycle: The cycle is divided into four main phases: the menstrual phase (bleeding), the follicular phase (egg development), ovulation (release of the egg), and the luteal phase (preparation of the uterine lining).

• Menarche: The first occurrence of menstruation is called menarche, which typically happens during puberty, between the ages of 10 and 15.

• Corpus Luteum: This is a temporary endocrine structure in the ovary that produces high levels of progesterone. If fertilization does not occur, the corpus luteum degenerates, leading to the onset of menstruation.

• Endometrium: The innermost layer of the uterus. It is highly vascularized and its primary function is to provide a site for the implantation of a blastocyst.

Q19. Answer: (d) Pollination

The correct answer is Pollination.

Key Points

• Pollination is the biological process of transferring pollen grains from the anther (the male reproductive part) to the stigma (the female reproductive part) of a flower.

• In the life cycle of sexually reproducing plants, pollination is categorized as a pre-fertilization event. It is the essential prerequisite that brings the male gametes in proximity to the female gamete located within the ovule. Hence, statement 4 is correct.

• Once pollination is successful, the pollen grain germinates on the stigma, producing a pollen tube that travels down the style to reach the ovary for the fusion of gametes.

• Processes such as Embryo formation, Seed development, and Fruit formation occur only after the successful fusion of gametes (fertilization). These are termed post-fertilization changes. Hence, statements 1, 2, and 3 are incorrect.

Additional Information

• Types of Pollination:

• Self-pollination: This occurs when pollen grains are transferred from the anther to the stigma of the same flower or another flower on the same plant (e.g., Pea plants).

• Cross-pollination: This involves the transfer of pollen grains from the anther of one flower to the stigma of a flower on a different plant of the same species. It promotes genetic variation.

• Fertilization and Zygote:

• Fertilization is the process where the male gamete fuses with the egg cell to form a diploid zygote.

• In Angiosperms (flowering plants), Double Fertilization occurs, where one male gamete fuses with the egg and another fuses with the secondary nucleus to form the Endosperm, which provides nutrition.

• Embryo formation (Embryogenesis):

• After fertilization, the zygote divides mitotically to become an embryo. This embryo contains the radicle (future root) and plumule (future shoot).

• Development of Seed and Fruit:

• Following fertilization, the ovule matures and hardens its integuments to become a seed.

• Simultaneously, the ovary wall thickens and ripens to become the pericarp of the fruit. Ethylene is the primary plant hormone responsible for fruit ripening.

Important Points

• Pollinating Agents: Plants utilize various agents for pollination. Abiotic agents include wind (Anemophily) and water (Hydrophily). Biotic agents include insects (Entomophily), birds (Ornithophily), and bats (Chiropterophily).

• Significance of Pollination: It ensures the continuity of species and is vital for the production of crops and seeds. Without

pollinators like bees, global food security would be severely compromised.

• Morphological Changes: After fertilization, parts of the flower such as the sepals, petals, and stamens typically wither and fall off, as their primary role in attracting pollinators is complete.

Q20. Answer: (b) To allow sound to distribute evenly in the hall

The correct answer is To allow sound to distribute evenly in the hall.

Key Po0ints

• The ceilings of large concert halls, cinema halls, and conference rooms are made curved so that sound waves, after reflecting from the ceiling, reach all corners of the hall.

• A curved ceiling (specifically a concave surface) acts as a large sound reflector. When sound waves hit the curved surface, they are reflected back in a way that distributes the energy uniformly across the seating area. Hence, the reason is to allow sound to distribute evenly.

• The primary physics principle involved is the reflection of sound. Just like light, sound follows the law where the angle of incidence is equal to the angle of reflection.

• Without a curved ceiling, sound might only reach the front rows clearly, while the back rows might experience "dead zones" or very faint sound levels.

• The design ensures that the intensity of the sound remains consistent for every audience member, regardless of their location in the hall.

Additional Information

• Reverberation:

• In a large hall, sound can persist due to repeated reflections from the walls, ceiling, and floor. This persistence of sound is known as reverberation.

• If the reverberation time is too long, the sound becomes blurred and distorted. To control this, architects use sound-absorbent materials like compressed fiberboard, rough plaster, or heavy curtains on the walls.

• Soundboards:

• In some auditoriums, a curved soundboard is placed behind the speaker or the stage. The speaker is positioned at the focus of this concave board so that sound waves are reflected as parallel beams toward the audience.

• Echo vs. Reflection:

• An echo is a distinct reflected sound heard after a specific interval. To hear a clear echo, the minimum distance between the source and the reflecting surface must be approximately 17.2 meters (assuming the speed of sound is 344 m/s at 22 degrees Celsius).

• The sensation of sound persists in the human brain for about 0.1 seconds.

• Multiple Reflection Applications:

• Stethoscopes: Use the principle of multiple reflection of sound to transport the sound of the patient’s heartbeat to the doctor's ears through a tube.

• Megaphones and Horns: These are designed to send sound in a particular direction by using multiple reflections within a conical opening, preventing the sound from spreading in all directions.

• Acoustic Design Materials:

• Apart from structural shapes, materials like perforated cardboard and soft carpets are used to manage acoustic properties and reduce unwanted noise in professional environments.

Q21. Answer: (b) Pollen production

The correct answer is Pollen production.

Key Points

• The stamen is the male reproductive organ of a flower, responsible for the generation of male gametes. It typically consists of a stalk-like filament and a pollen-bearing anther.

• The primary function of the anther is the production of pollen grains. These grains contain the male genetic material necessary for the fertilization of the ovules.

• If the stamens are non-functional or damaged, the biological machinery required to synthesize and mature pollen will fail. Consequently, the flower will be unable to participate as a male donor in the pollination process. Hence, the process that will NOT be done is pollen production.

• A flower that lacks functional stamens is often referred to as pistillate or imperfect, as it only contains the female reproductive parts.

• In many plant species, the stamen also serves to attract pollinators through its color or by providing pollen as a food source, though its metabolic priority remains microsporogenesis (pollen formation).

Additional Information

• Bud Protection:

• This process is primarily the responsibility of the sepals, which collectively form the calyx.

• The sepals are the outermost whorl of a flower and protect the delicate inner reproductive organs during the bud stage from desiccation and physical damage. Hence, statement 3 is incorrect in the context of stamen function.

• Ovule Development:

• This occurs within the ovary, which is the basal part of the pistil or carpel (the female reproductive organ).

• Ovules contain the female gametophyte. Their development is independent of the stamen's functionality, although they require pollen for subsequent fertilization. Hence, statement 4 is incorrect.

• Fruit Dispersal:

• Fruit dispersal is a post-fertilization process where the matured ovary (fruit) spreads seeds to new locations.

• This process is facilitated by wind, water, animals, or gravity and does not rely on the current functionality of the stamens, which usually wither away after pollination. Hence, statement 1 is incorrect.

• Flower Structure:

• A complete flower consists of four whorls: Calyx (sepals), Corolla (petals), Androecium (stamens), and Gynoecium (carpels).

• The Androecium represents the male reproductive part, while the Gynoecium represents the female reproductive part.

Important Points

• Pollen Grains: These are microscopic structures that vary in shape and size depending on the species. They carry the sperm cells to the stigma of a flower.

• Filament and Anther: The filament provides support and positions the anther for optimal pollen dispersal by wind or insects. The anther usually contains four pollen sacs (microsporangia).

• Sterile Stamens: In some flowers, stamens may be naturally non-functional; these are called staminodes. They often evolve to look like petals to help attract pollinators but do not produce pollen.

Q22. Answer: (d) 6

The correct answer is 6.

Key Points

• Benzene is a fundamental organic chemical compound with the chemical formula C6H6. This indicates that it is composed of 6 carbon atoms and 6 hydrogen atoms.

• The structure of benzene is unique as it consists of six carbon atoms joined in a planar ring, forming a perfect hexagon. Each carbon atom is further bonded to a single hydrogen atom.

• It is categorized as an aromatic hydrocarbon (or arene) because of the specific stability and bonding pattern found within its cyclic structure.

• The bonds between the carbon atoms are neither strictly single nor double; instead, they represent a resonance hybrid where the pi electrons are delocalized across the entire ring.

• Due to this delocalization, all carbon-carbon bond lengths in benzene are equal, measuring approximately 139 pm, which is intermediate between a single bond and a double bond.

Additional Information

• Discovery and History: Benzene was first isolated by the English scientist Michael Faraday in 1825 from the oily residue left over from the production of illuminating gas. Later, in 1865, the German chemist August Kekulé proposed the cyclic structure that we recognize today.

• Physical Properties: At room temperature, benzene is a colorless, highly flammable liquid with a characteristic sweet smell. It has a melting point of 5.5 °C and a boiling point of 80.1 °C.

• Industrial Applications: Benzene is a crucial industrial precursor used in the synthesis of various chemicals. It is used to produce ethylbenzene (for styrene and plastics), cumene (for resins), and cyclohexane (for nylon). It is also a component in the manufacture of synthetic fibers, detergents, drugs, and pesticides.

• Health and Safety: It is important to note that benzene is classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC). Long-term exposure is known to cause leukemia and other blood-related disorders.

• Solubility: Benzene is non-polar and is only slightly soluble in water, but it is highly soluble in other organic solvents such as alcohol, ether, and acetone.

Important Points

• Hybridization: Each of the 6 carbon atoms in benzene undergoes sp2 hybridization. This allows for the formation of three sigma bonds (two with adjacent carbons and one with a hydrogen) and leaves one unhybridized p-orbital to form the delocalized pi system.

• Bond Angles: Because of the sp2 hybridization and the hexagonal symmetry, all C-C-C and H-C-C bond angles in the benzene molecule are exactly 120 degrees.

• Hückel's Rule: Benzene follows Hückel's Rule for aromaticity, which states that a cyclic, planar molecule with 4n + 2 pi electrons

(where n is an integer) is aromatic. For benzene, n = 1, resulting in 6 pi electrons.

• Electrophilic Substitution: Unlike alkenes, benzene does not typically undergo addition reactions; instead, it primarily undergoes electrophilic aromatic substitution. This allows the ring to maintain its aromatic stability while replacing a hydrogen atom with another functional group.

Q23. Answer: (a) Camphor and napthalene

The correct answer is Camphor and napthalene.

Key Points

• Sublimation is a chemical process where a substance transitions directly from the solid phase to the gas phase without passing through the intermediate liquid phase.

• Camphor is a transparent or white waxy solid with a strong aromatic odor. It is a terpenoid that readily undergoes sublimation at room temperature and standard atmospheric pressure. Hence, statement 1 is correct regarding camphor.

• Naphthalene is an organic compound with the formula C10H8. It is most commonly known as the primary ingredient in mothballs. Because it is composed of non-polar molecules held together by weak van der Waals forces, it sublimes easily into a toxic gas to repel moths. Hence, statement 1 is also correct regarding naphthalene.

• Salt (specifically Sodium Chloride) and Sugar (Sucrose) do not exhibit sublimation under normal conditions. Salt has a very high melting point of about 801 degrees Celsius, and Sugar typically melts or decomposes (caramelizes) when heated rather than subliming. Hence, statements 2, 3, and 4 are incorrect because they include non-sublimable substances like salt or sugar.

• The pair Camphor and naphthalene is the most accurate example because both substances share the specific physical property of having a high vapor pressure at low temperatures, allowing them to turn into vapors directly.

Additional Information

• Dry Ice: This is the solid form of Carbon Dioxide (CO2). It is one of the most common examples of sublimation used in refrigeration and theatrical fog effects. It sublimes at a temperature of -78.5 degrees Celsius (-109.3 degrees Fahrenheit).

• Ammonium Chloride: This is a white crystalline salt that is highly soluble in water. In a laboratory setting, Ammonium Chloride (NH4Cl) is frequently used to demonstrate sublimation, as it appears to sublime upon heating (though it actually undergoes thermal decomposition into Ammonia and Hydrogen Chloride gas which then recombines).

• Iodine: At standard temperature, Iodine exists as dark-gray/purple-black lustrous solids. When heated gently, it produces a distinct violet-colored vapor through the process of sublimation.

• Anthracene: A solid polycyclic aromatic hydrocarbon consisting of three fused benzene rings. It is used in the production of the red dye alizarin and is another classic example of a substance that undergoes sublimation.

• Deposition: This is the reverse process of sublimation. It occurs when a gas transforms directly into a solid without becoming a liquid. A common natural example of this is the formation of frost on a window or snow in clouds.

Important Points

• Vapor Pressure: Sublimation occurs when the vapor pressure of a solid substance is high enough that molecules can escape into the gas phase even at temperatures below the melting point.

• Triple Point: In a phase diagram, sublimation happens at temperatures and pressures below the triple point of a substance, which is the specific condition where all three phases (solid, liquid, and gas) coexist in equilibrium.

• Applications: The principle of sublimation is utilized in freeze-drying (lyophilization) of food and pharmaceuticals. By freezing the material and then reducing the surrounding pressure, the frozen water (ice) sublimes directly into vapor, preserving the structure and nutritional value of the product.

• Purification: Sublimation is also a technique used by chemists to purify compounds. A solid is heated to vaporize it, and the vapor is then condensed onto a cold surface, leaving non-volatile impurities behind.

Q24. Answer: (c) Draught animals

The correct answer is Draught animals.

Key Points

• Draught animals, also known as beasts of burden, are domesticated animals specifically kept and trained to perform physical labor rather than for producing food or milk.

• In the context of agriculture, these animals are indispensable for tilling (ploughing the fields), which helps in preparing the soil for sowing seeds.

• For irrigation, draught animals are used to operate traditional systems like the Persian wheel (also called rahat), which lifts water from wells to the fields.

• The function of carting involves using animals like oxen, bulls, and camels to pull carts and wagons for the transportation of agricultural produce, construction materials, and people.

• Common examples of draught animals include bullocks, horses, donkeys, mules, camels, and water buffaloes. Hence, the description provided in the question correctly identifies Draught animals.

Additional Information

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• Milch Animals:

• These are animals primarily reared for milk production.

• Examples include cows, female buffaloes, and goats.

• In India, some breeds are classified as dual-purpose breeds, where the females are good milch producers and the males are sturdy draught animals.

• Wild Animals:

• These species live in their natural habitat and are not domesticated for human utility.

• Animals such as lions, tigers, and leopards fall into this category. They are not used for tilling or carting due to their nature and lack of domestication.

• Carnivorous Animals:

• This is a classification based on dietary habits, referring to animals that exclusively or primarily eat meat.

• While some draught animals can be large, they are typically herbivores (plant-eaters) because herbivorous animals are easier to domesticate for labor.

Important Points

• Economic Significance: In many developing countries, draught animal power (DAP) provides a sustainable and renewable source of energy for small-scale farmers who cannot afford mechanized equipment like tractors.

• Notable Breeds: In India, specific draught breeds of cattle like Nagori, Malvi, Hallikar, and Khillari are famous for their strength, speed, and stamina.

• Legal Protection: To ensure the welfare of these animals, the Government of India enacted the Prevention of Cruelty to Animals Act in 1960, which regulates the working hours and load limits for draught animals.

• Environmental Impact: Using draught animals is an eco-friendly alternative to machinery, as it does not consume fossil fuels and reduces the carbon footprint of farming operations.

Q25. Answer: (b) Attraction between magnets

The correct answer is Attraction between magnets.

Key Points

• The Universal Law of Gravitation, formulated by Sir Isaac Newton in 1687, states that every particle of matter in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

• Tides in the ocean are primarily caused by the gravitational pull of the Moon and the Sun acting on the Earth's water bodies. As the Earth rotates, this pull creates the periodic rise and fall of sea levels. Hence, statement 1 is correct (it is explained by gravitation).

• Attraction between magnets is a phenomenon governed by the electromagnetic force, specifically magnetic fields generated by moving electric charges or intrinsic magnetic moments of electrons. While magnets have mass and exert a negligible gravitational pull on each other, the force that causes them to snap together is not gravity. Hence, statement 2 is incorrect (it cannot be explained by gravitation).

• The revolution of the Moon around the Earth is maintained by the gravitational force of the Earth, which provides the necessary centripetal force to keep the Moon in its nearly circular orbit. Hence, statement 3 is correct (it is explained by gravitation).

• The falling of an apple from a tree toward the ground is the classic example used to describe Earth's gravity. The Earth exerts an attractive force on the mass of the apple, causing it to accelerate at approximately 9.8 m/s^2. Hence, statement 4 is correct (it is explained by gravitation).

• The mathematical expression for this law is $F = G(m1m2/r^2)$, where G is the Universal Gravitational Constant.

Additional Information

• Fundamental Forces of Nature:

• There are four fundamental forces: Gravitational Force, Electromagnetic Force, Strong Nuclear Force, and Weak Nuclear Force.

• Gravitational Force is the weakest of the four but has an infinite range and is always attractive.

• Electromagnetic Force acts between charged particles and can be either attractive or repulsive. It is significantly stronger than gravity at small scales.

• Newton's Principia Mathematica:

• Newton published his findings in the Philosophiæ Naturalis Principia Mathematica in July 1687, which laid the foundations for classical mechanics.

• The law explains not only terrestrial motion but also the motion of planets in the solar system, verifying Kepler's laws of planetary motion.

• Universal Gravitational Constant (G):

• The value of G was first accurately measured by Henry Cavendish in 1798 using a torsion balance.

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• The modern accepted value is approximately 6.674 × 10^-11 N?m²/kg².

Important Points

• Difference between 'G' and 'g':

• G is the Universal Gravitational Constant and remains the same everywhere in the universe.

• g is the acceleration due to gravity, which varies depending on the location (e.g., it is different on the Moon compared to Earth).

• Inverse Square Law:

• Because the force is inversely proportional to the square of the distance, doubling the distance between two objects reduces the gravitational pull to one-fourth of its original strength.

• Centripetal Force in Orbits:

• In the case of satellites or planets, the gravitational force acts as the centripetal force, which is required for curved motion. Without this force, objects would move in a straight line due to inertia.

Q26. Answer: (d) 83

Shortcut Trick

Find the LCM of 15, 25, and 8.

LCM (15, 25, 8) = 600.

The number to be added = LCM − Given Number (if the number is just below the LCM).

Number to be added = 600 − 517 = 83.

Therefore The correct answer is 83.

Alternate Method

Given: Number = 517, Divisors = 15, 25, 8.

Step 1: Calculate the Least Common Multiple (LCM) of divisors.

=> 15 = 3 × 5

=> 25 = 5^2

=> 8 = 2^3

=> LCM = $2^3 \times 3 \times 5^2 = 8 \times 3 \times 25 = 600$.

Step 2: Find the difference between the LCM and the given number.

=> Required number = 600 − 517

=> Required number = 83.

Therefore The correct answer is 83.

Additional Information

LCM (Least Common Multiple)

The smallest positive integer that is divisible by each of the given numbers. It is used to find a common scale for different values.

Divisibility Rule for 15

A number is divisible by 15 if it is divisible by both 3 (sum of digits is multiple of 3) and 5 (ends in 0 or 5).

Divisibility Rule for 8

A number is divisible by 8 if its last three digits are divisible by 8.

Q27. Answer: (c) 52 years

Shortcut Trick

Ratio of Grandfather (GF) to Grandson (GS): Now = 5 : 1, after 10 years = 3 : 1.

Equating the ratio difference: (5−1) = 4; (3−1) = 2. Multiply second ratio by 2 → 6 : 2.

Change in ratio units (6−5 or 2−1) = 1 unit. Given 1 unit = 10 years.

GF current age = 5 × 10 = 50 years. Cousin age = 50 + 5 = 55 years.

Cousin 3 years ago = 55 − 3 = 52 years.

Therefore The correct answer is 52 years.

Alternate Method

Given: Ratio of Grandfather to Grandson is 5 : 1. After 10 years, ratio becomes 3 : 1. Cousin is 5 years older than Grandfather.

Formula Used: Age Equation method.

=> Let Grandson's present age be x and Grandfather's age be 5x.

=> After 10 years: (5x + 10) = 3 × (x + 10)

=> 5x + 10 = 3x + 30

=> 2x = 20 => x = 10

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=> Grandfather's present age = 5 × 10 = 50 years.

=> Cousin's present age = 50 + 5 = 55 years.

=> Cousin's age 3 years ago = 55 − 3 = 52 years.

Therefore The correct answer is 52 years.

Additional Information

Ratio Difference Method

When the time gap is the same for two people, the difference in their ratio parts must be made equal to maintain a constant age gap.

Linear Equation in Ages

Always define the present age as the base variable (x) to simplify past or future age expressions.

Constant Age Difference

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

Q28. Answer: (d) 2,40,000

Shortcut Trick

Incomes of Mohan and David are in ratio 5 : 9.

Expenditure ratio is 2 : 4, which simplifies to 1 : 2.

Cross-multiplication method: (5 × 2 − 9 × 1) units = Rs. 48,000 × (2 − 1).

1 unit = Rs. 48,000.

Mohan's income = 5 units = 5 × Rs. 48,000 = Rs. 2,40,000.

Therefore The correct answer is Rs. 2,40,000.

Alternate Method

Given: Ratio of Income = 5 : 9, Savings = Rs. 48,000 each, Ratio of Expenditure = 2 : 4.

Formula Used: Income − Savings = Expenditure

=> Let Mohan's income be 5x and David's income be 9x.

=> (5x − 48000) / (9x − 48000) = 2 / 4

=> (5x − 48000) / (9x − 48000) = 1 / 2

=> 2 × (5x − 48000) = 1 × (9x − 48000)

=> 10x − 96000 = 9x − 48000

=> 10x − 9x = 96000 − 48000

=> x = 48000

=> Mohan's income = 5 × 48000 = Rs. 2,40,000.

Therefore The correct answer is Rs. 2,40,000.

Additional Information

Income-Expenditure Relationship

Basic identity: Income = Expenditure + Savings. For two people, use (I1 − S1)/(I2 − S2) = E1/E2.

Ratio Balancing

If savings are equal, ensure the difference between income ratio parts and expenditure ratio parts is equal by multiplying ratios with appropriate factors.

Proportion Rule

If a/b = c/d, then a × d = b × c. This cross-multiplication is the most efficient way to solve linear ratio equations.

Q29. Answer: (c) √98

Shortcut Trick

Break the numbers into products of perfect squares: √50 = 5√2 and √8 = 2√2.

Combine the like terms by adding the coefficients: 5√2 + 2√2 = 7√2.

To match the options, convert back to a pure surd: 7√2 = √(7² × 2) = √(49 × 2) = √98.

Therefore The correct answer is √98.

Alternate Method

Given: √50 + √8

Formula: √(a² × b) = a√b

=> √(25 × 2) + √(4 × 2)

=> 5√2 + 2√2

=> (5 + 2)√2
=> 7√2
=> √(7² × 2)
=> √(49 × 2)
=> √98
Therefore The correct answer is √98.
Additional Information
Addition of Surds
Only like surds (surds with the same radicand) can be added or subtracted: x√a ± y√a = (x ± y)√a.
Mixed Surd to Pure Surd
A mixed surd k√x can be expressed as a pure surd by squaring the coefficient and moving it inside: √(k² × x).
Multiplication Rule
For any non-negative numbers a and b, the square root of their product is the product of their square roots: √(a × b) = √a × √b.

Q30. Answer: (a) Rs. 27,700

Shortcut Trick
Discount of 20% is equal to the extra amount of Rs. 6,925.
Ratio of Discount to Selling Price = 20 : (100 − 20) = 20 : 80 = 1 : 4.
Since 1 unit = Rs. 6,925, then 4 units = 4 × 6,925.
Ajeet paid = Rs. 27,700.
Therefore The correct answer is Rs. 27,700.
Alternate Method
Given → Discount Percentage = 20% | Extra Amount (Discount Value) = Rs. 6,925.
Formulas: Discount = MP − SP | Discount% = (Discount ÷ MP) × 100 | SP = MP × (100 − D%) ÷ 100.
=> Let the Marked Price (MP) be x.
=> 20% of x = 6,925.
=> (20 ÷ 100) × x = 6,925 => x = 6,925 × 5 = Rs. 34,625.
=> Selling Price (SP) = MP − Discount = 34,625 − 6,925.
=> SP = Rs. 27,700.
Therefore The correct answer is Rs. 27,700.
Additional Information
Marked Price & Discount
The Marked Price is the price listed on the product. Discount is always calculated on the Marked Price to arrive at the Selling Price.
Percentage Increase/Decrease
If a value is decreased by r%, the new value is (100 − r)% of the original value.

Q31. Answer: (d) 63/4

Shortcut Trick
Total hours for A = 12 × 6 = 72 hours
Total hours for B = 18 × 8 = 144 hours
Combined efficiency (LCM = 144): A(2) + B(1) = 3 units/hour
Total time needed = 144 ÷ 3 = 48 hours
Days required working 64/9 hours per day = 48 ÷ (64/9) = 6.75 days
Therefore The correct answer is 6(3/4) days.
Alternate Method
Given: A takes 12 days at 6 hrs/day. B takes 18 days at 8 hrs/day. Combined work rate is 7(1/9) hrs/day.
Formula Used: Total Work = Days × Hours/day × Efficiency

Person	Total Hours	Total Work	Efficiency
A	72	144	2
B	144	1	

=> Total efficiency of A + B = 2 + 1 = 3 units/hr
=> Total hours required = 144 ÷ 3 = 48 hours
=> Hours per day = 7(1/9) = 64/9 hours
=> Number of days = 48 ÷ (64/9) = 48 × (9/64)
=> Number of days = 3 × (9/4) = 27/4 = 6(3/4) days
Therefore The correct answer is 6(3/4) days.
Additional Information
Man-Hour-Day Formula
The relationship between work, men, days, and hours is given by (M1×D1×H1)/W1 = (M2×D2×H2)/W2.
Efficiency and Time
Efficiency is inversely proportional to the time taken to complete a task. Total Work = Efficiency × Time.

Q32. Answer: (a) Rs. 3,872

Shortcut Trick
Effective Compound Interest rate for 2 years at 10% = 10 + 10 + (10 × 10)/100 = 21%.
Total Amount percentage = 100% (Principal) + 21% (Interest) = 121%.
Required Amount = 121% of Rs. 3,200 = 1.21 × 3200 = Rs. 3,872.
Therefore The correct answer is Rs. 3,872.
Alternate Method
Given:
Principal (P) = Rs. 3,200
Rate (R) = 10% per annum
Time (n) = 2 years
Formula Used:
Amount (A) = $P(1 + R/100)^n$
Calculations:
=> $A = 3200 \times (1 + 10/100)^2$
=> $A = 3200 \times (110/100)^2$
=> $A = 3200 \times (11/10) \times (11/10)$
=> $A = 3200 \times (121/100)$
=> $A = 32 \times 121$
=> A = Rs. 3,872
Therefore The correct answer is Rs. 3,872.
Additional Information
Compound Interest Formula
Interest is calculated on the principal and the accumulated interest of previous periods: $CI = P[(1 + R/100)^n - 1]$.
Difference between CI and SI for 2 Years
The difference between compound interest and simple interest for two years is given by: Difference = $P(R/100)^2$.
Effective Rate of Interest
For two successive cycles of R% interest, the effective rate is $[2R + (R^2/100)]$%.

Q33. Answer: (c) 5 litres

Shortcut Trick
Quantity of milk remains constant.
Initial Milk % = 100 − 12 = 88% | Final Milk % = 100 − 20 = 80%.
New Total Mixture = (Initial Quantity × Initial Milk %) ÷ Final Milk %
New Total = (50 × 88) ÷ 80 = 55 litres.
Water added = 55 − 50 = 5 litres.
Therefore The correct answer is 5 litres.
Alternate Method
Given:
Initial Volume = 50 litres | Water % = 12%

=> Initial Water = 12% of 50 = (12/100) × 50 = 6 litres.
=> Initial Milk = 50 − 6 = 44 litres.
=> Let x litres of water be added.
=> New Total Volume = 50 + x
=> New Water Content = 6 + x
=> According to question: (6 + x) / (50 + x) = 20 / 100
=> (6 + x) / (50 + x) = 1 / 5
=> 5 × (6 + x) = 1 × (50 + x)
=> 30 + 5x = 50 + x
=> 4x = 20
=> x = 5 litres.
Therefore The correct answer is 5 litres.
Additional Information
Rule of Constant Quantity
When only one component of a mixture is added or removed, the quantity of the other component remains constant throughout the process.
Alligation Method
This can be solved using Alligation by taking Water %: (12% initial) mixed with (100% pure water) to get (20% final concentration).
Mixture Ratio Change
If initial ratio is a:b and x quantity of 'b' is added, make the 'a' parts equal in both ratios to find the change in 'b' units.

Q34. Answer: (a) 3600 π cm²

Shortcut Trick
Directly apply the Surface Area formula: Area = 4 × π × (Radius)².
Square the Radius: 30² = 900.
Multiply by 4: 4 × 900 = 3600.
Keep the answer in terms of π as per the options.
Therefore The correct answer is 3600π cm².
Alternate Method
Given:
Radius of the Sphere (r) = 30 cm
Formula Used:
Surface Area of a Sphere = 4πr²
Calculations:
=> Surface Area = 4 × π × (30)²
=> Surface Area = 4 × π × (30 × 30)
=> Surface Area = 4 × π × 900
=> Surface Area = 3600π cm²
Therefore The correct answer is 3600π cm².
Additional Information
Volume of a Sphere
The total space occupied by a sphere is given by the formula V = (4/3)πr³.
Surface Area of Hemisphere
For a hemisphere, the Curved Surface Area (CSA) is 2πr² and the Total Surface Area (TSA) is 3πr².
Ratio of Surface Area to Volume
For any sphere, the ratio of its Surface Area to its Volume is 3/r.

Q35. Answer: (c) 7

Shortcut Trick
Total Capacity (LCM of 14, 28) = 28 units.
Efficiency of (P + Q) = 28 ÷ 14 = 2 units/hour.
Efficiency of P = 28 ÷ 28 = 1 unit/hour.

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Efficiency of Q = 2 − 1 = 1 unit/hour.
Time for Q to fill 1/4th cistern = (28 ÷ 4) ÷ 1 = 7 hours.
Therefore The correct answer is 7 hours.
Alternate Method
Given:
Time taken by P and Q = 14 hours
Time taken by P alone = 28 hours
Formula Used:
Total Work = Efficiency × Time
Efficiency of Q = Efficiency of (P+Q) − Efficiency of P

Person	Days	Total Work	Efficiency
P + Q	14	28	2
P	28	1	

=> Efficiency of Q = 2 − 1 = 1 unit/hour
=> Total work to be done by Q = 1/4 × Total Capacity
=> Work for Q = 28 ÷ 4 = 7 units
=> Time taken by Q = 7 ÷ 1 = 7 hours
Therefore The correct answer is 7 hours.
Additional Information
Pipes and Cisterns Logic
Filling pipes have positive efficiency, while drainage or leak pipes have negative efficiency.
Efficiency and Time Relationship
Efficiency is inversely proportional to the time taken to complete a specific task (E prop. to 1/T).
Combined Work Formula
If two pipes fill a tank in x and y hours respectively, they together fill it in (x × y) ÷ (x + y) hours.

Q36. Answer: (d) 120

Shortcut Trick
Total distance for one round = 4 × 25 = 100 m.
Speed in m/s = 3 × (5/18) = 5/6 m/s.
Time = Distance ÷ Speed = 100 ÷ (5/6) = 100 × (6/5) = 120 seconds.
Therefore The correct answer is 120 seconds.
Alternate Method
Given: Side of square field = 25 m, Speed = 3 km/hr.
Formula Used: Perimeter of square = 4 × Side; Time = Distance ÷ Speed; 1 km/hr = 5/18 m/s.
=> Total Distance = 4 × 25 = 100 m
=> Speed in m/s = 3 × (5/18) = 5/6 m/s
=> Time = 100 ÷ (5/6)
=> Time = (100 × 6) ÷ 5
=> Time = 600 ÷ 5 = 120 seconds
Therefore The correct answer is 120 seconds.
Additional Information
Unit Conversion
To convert km/hr to m/s, multiply by 5/18. To convert m/s to km/hr, multiply by 18/5.
Square Properties
Perimeter of a square is 4a and Area is a^2, where 'a' is the length of the side.
Speed-Distance-Time
The basic relationship is Distance = Speed × Time. Ensure all units are in the same system (SI or Metric) before calculation.

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Q37. Answer: (a) Rs. 29

Shortcut Trick

Extra distance covered = 25 − 20 = 5 km

Extra charge paid = Rs. 245 − Rs. 200 = Rs. 45

Charge per km = 45 ÷ 5 = Rs. 9/km

Fixed charge = Total charge (20 km) − (20 × 9) = 200 − 180 = Rs. 20

Charge for 1 km = Fixed charge + (1 × 9) = 20 + 9 = Rs. 29

Therefore The correct answer is Rs. 29.

Alternate Method

Given:

Charge for 20 km = Rs. 200

Charge for 25 km = Rs. 245

Formula Used:

Total Charge = Fixed Charge + (Distance × Rate per km)

Calculations:

Let Fixed Charge be F and Rate per km be R.

=> F + 20R = 200 --- (i)

=> F + 25R = 245 --- (ii)

Subtracting (i) from (ii):

=> 5R = 45

=> R = 9

Substitute R in (i):

=> F + 20(9) = 200

=> F + 180 = 200

=> F = 20

Charge for 1 km:

=> Total = F + 1(R) = 20 + 9

=> Total = Rs. 29

Therefore The correct answer is Rs. 29.

Additional Information

Linear Equation Modeling

Problems involving a constant base and a variable rate are solved using the linear form y = mx + c, where c is the fixed component and m is the variable rate.

Unitary Method in Charges

When the difference between two totals is divided by the difference in quantities, it directly yields the variable rate per unit.

Applications

This logic applies to electricity bills (Fixed meter rent + units consumed) and library fines (Fixed base + daily charges).

Q38. Answer: (d) 0

Shortcut Trick

Apply the Algebraic Identity: $(a + b)^2 - (a - b)^2 = 4ab$.

Here, a = 2x and b = 3.

The difference $(2x + 3)^2 - (2x - 3)^2 = 4 \times (2x) \times (3) = 24x$.

Substituting back into the expression: 24x − 24x = 0.

Therefore The correct answer is 0.

Alternate Method

Given: $(2x + 3)^2 - (2x - 3)^2 - 24x$

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

=> Expand $(2x + 3)^2 = (2x)^2 + 2 \times (2x) \times 3 + 3^2 = 4x^2 + 12x + 9$

=> Expand $(2x - 3)^2 = (2x)^2 - 2 \times (2x) \times 3 + 3^2 = 4x^2 - 12x + 9$

=> Substitute these expansions: $(4x^2 + 12x + 9) - (4x^2 - 12x + 9) - 24x$

=> $4x^2 + 12x + 9 - 4x^2 + 12x - 9 - 24x$

=> $(4x^2 - 4x^2) + (12x + 12x - 24x) + (9 - 9)$

=> 0 + 0 + 0 = 0

Therefore The correct answer is 0.

Additional Information

Difference of Two Squares Identity

The identity $(a + b)^2 - (a - b)^2 = 4ab$ is useful for quickly solving algebraic simplifications involving binomial squares.

Sum of Two Squares Identity

Another common identity is $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$, which cancels the middle product term (2ab).

BODMAS Rule

When simplifying polynomial expressions, always solve bracketed powers (exponents) first, then addition and subtraction from left to right.

Q39. Answer: (d) 23,310

Shortcut Trick

Ratio of the prices = 3 : 5 : 7.

Average of the ratio parts = (3 + 5 + 7) ÷ 3 = 5 parts.

Given value of 5 parts = Rs. 16,650 => 1 part = 16,650 ÷ 5 = Rs. 3,330.

Price of the costliest item (7 parts) = 7 × 3,330 = Rs. 23,310.

Therefore The correct answer is Rs. 23,310.

Alternate Method

Given:

Average price of 3 items = Rs. 16,650

Ratio of their prices = 3 : 5 : 7

Formula Used:

Average = Sum of all observations ÷ Total number of observations

Average (5 parts) = Rs. 16,650 3x Item 1 5x Item 2 7x Item 3 Costliest = ?

Calculations:

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

=> Sum of their prices = 3x + 5x + 7x = 15x

=> Average price = 15x ÷ 3 = 5x

=> As per the given information, 5x = 16,650

=> x = 16,650 ÷ 5 = 3,330

=> The costliest item represents the largest ratio part (7x).

=> Price of the costliest item = 7 × 3,330 = 23,310

Therefore The correct answer is Rs. 23,310.

Additional Information

Arithmetic Progression in Averages

When a given set of numbers are in an arithmetic sequence (like 3x, 5x, 7x having a common difference of 2x), their average is exactly equal to the middle term. Here, the average directly becomes 5x.

Weighted Average

When different groups have different averages, the overall average is given by the formula: A = (N1A1 + N2A2) ÷ (N1 + N2), where N represents the number of elements and A represents their respective averages.

Properties of Ratio

A ratio a : b remains unchanged if both terms are multiplied or divided by the same non-zero number. Thus, their actual absolute values can be represented as ax and bx by multiplying with a common variable x.

Q40. Answer: (a) 16

Shortcut Trick

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

Count the occurrences of each number: 16 repeats 4 times, while 17 repeats 3 times and 7 repeats 3 times.

Since 16 has the highest frequency (4), it is the mode of the given data.

Therefore The correct answer is 16.

Alternate Method

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Given Data: 22, 16, 17, 49, 7, 16, 45, 17, 7, 6, 16, 17, 22, 7, 16, 44
Formula Used: Mode = Value with the Maximum Frequency
To find the mode, let us calculate the frequency of each distinct value in the set:
=> Frequency of 6 = 1
=> Frequency of 7 = 3
=> Frequency of 16 = 4
=> Frequency of 17 = 3
=> Frequency of 22 = 2
=> Frequency of 44 = 1
=> Frequency of 45 = 1
=> Frequency of 49 = 1
=> Maximum Frequency is 4, which corresponds to the value 16.
Therefore The correct answer is 16.
Additional Information
Empirical Relationship
For a moderately skewed distribution, the relationship is: Mode = 3 × Median − 2 × Mean.
Bimodal and Multimodal Data
A data set with two values having the highest frequency is called bimodal. If there are more than two, it is multimodal.
Mean and Median
Mean is the average (Sum ÷ Count), and Median is the middle value when data is arranged in ascending order.

Q41. Answer: (a) 870 m

Shortcut Trick
Relative speed in same direction = 115 − 61 = 54 kmph.
Relative speed in m/s = 54 × (5/18) = 15 m/s.
Total distance covered = Speed × Time = 15 × 116 = 1740 m.
Length of one train = Total Distance ÷ 2 = 1740 ÷ 2 = 870 m.
Therefore The correct answer is 870 m.
Alternate Method
Given:
Speed of Rajdhani Express (S1) = 115 km/hr
Speed of Garib Rath Express (S2) = 61 km/hr
Time taken to cross (T) = 116 seconds
Let the length of each train be 'L' meters.
Formula Used:
Distance = Relative Speed × Time
Calculations:
=> Relative Speed (V_(rel)) = S1 − S2 = 115 − 61 = 54 km/hr
=> V_(rel) in m/s = 54 × (5/18) = 15 m/s
=> Total Distance = L + L = 2L
=> 2L = 15 × 116
=> 2L = 1740
=> L = 870 m
Therefore The correct answer is 870 m.
Additional Information
Relative Speed Concept
When two objects move in the same direction, relative speed = S1 − S2. When they move in opposite directions, relative speed = S1 + S2.
Unit Conversion
To convert km/hr to m/s, multiply by 5/18. To convert m/s to km/hr, multiply by 18/5.
Train Crossing Distance
When a train crosses another train, the total distance covered is the sum of the lengths of both trains (L1 + L2).

Q42. Answer: (a) 6%

Shortcut Trick

Let Savings = 1 unit. Expenditure (100% more) = 2 units. Income = 1 + 2 = 3 units.

Net % change in Income = (Expenditure % change × Expenditure + Savings % change × Savings) ÷ Total Income

Net change = (−2% × 2 + 22% × 1) ÷ 3 = (−4 + 22) ÷ 3 = 18% ÷ 3 = 6%

Therefore The correct answer is 6%.

Alternate Method

Given: Expenditure is 100% more than Savings. Expenditure decrease = 2%, Savings increase = 22%.

Formula: Income = Expenditure + Savings

=> Let Savings = 100

=> Expenditure = 100 + 100% of 100 = 200

=> Initial Income = 100 + 200 = 300

=> New Savings = 100 + 22% of 100 = 122

=> New Expenditure = 200 − 2% of 200 = 200 − 4 = 196

=> New Income = 122 + 196 = 318

=> Increase in Income = 318 − 300 = 18

=> % Increase = (18 ÷ 300) × 100 = 6%

Therefore The correct answer is 6%.

Additional Information

Income-Expenditure Concept

Income is always the sum of Expenditure and Savings. Any change in Income is the weighted average of changes in Expenditure and Savings.

Percentage Change

Percentage change = (New Value − Old Value) ÷ Old Value × 100. Always ensure the base is the original value.

Alligation in Income

Alligation can be used where Expenditure % change and Savings % change are the components and Income % change is the mean value.

Q43. Answer: (b) 16/25

Shortcut Trick

Using the fundamental trigonometric identity: $\cos^2\theta = 1 - \sin^2\theta$

Given $\sin\theta = 3/5$, we get:

$\cos^2\theta = 1 - (3/5)^2 = 1 - 9/25 = 16/25$

Therefore The correct answer is 16/25.

Alternate Method

Given: $\sin\theta = 3/5$

Formula Used:

In a right-angled triangle, $\sin\theta$ = Perpendicular / Hypotenuse

By Pythagoras theorem: $\text{Base}^2 = \text{Hypotenuse}^2 - \text{Perpendicular}^2$

$\cos\theta$ = Base / Hypotenuse

Calculations:

=> Perpendicular (P) = 3

=> Hypotenuse (H) = 5

=> Base (B) = $\sqrt{(5^2 - 3^2)} = \sqrt{(25 - 9)} = \sqrt{16} = 4$

=> $\cos\theta$ = Base / Hypotenuse = 4/5

=> $\cos^2\theta = (4/5)^2 = 16/25$

Therefore The correct answer is 16/25.

Additional Information

Trigonometric Identities

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

Pythagorean Triplets

Common integer sets that satisfy the Pythagoras theorem are (3, 4, 5), (5, 12, 13), (8, 15, 17), and (7, 24, 25).

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Q44. Answer: (d) 40 cm

Shortcut Trick

Find semi-perimeter (s): s = (41 + 84 + 85) ÷ 2 = 105 cm.

Calculate Area using Heron's formula: √[105 × (105 − 41) × (105 − 84) × (105 − 85)] = √[105 × 64 × 21 × 20] = 1680 cm².

Altitude to base 84 cm = (2 × Area) ÷ Base = (2 × 1680) ÷ 84 = 40 cm.

Therefore The correct answer is 40 cm.

Alternate Method

Given: Sides of the triangle are a = 41 cm, b = 84 cm, and c = 85 cm.

Formula Used: Heron's Formula for Area (A) = √[s(s − a)(s − b)(s − c)] and Area = (1/2) × base × altitude.

=> Semi-perimeter s = (41 + 84 + 85) ÷ 2 = 210 ÷ 2 = 105 cm

=> Area = √[105 × (105 − 41) × (105 − 84) × (105 − 85)]

=> Area = √[105 × 64 × 21 × 20]

=> Area = √[21 × 5 × 64 × 21 × 5 × 4]

=> Area = 21 × 5 × 8 × 2 = 1680 cm²

=> Let the altitude corresponding to side 84 cm be h.

=> 1680 = (1/2) × 84 × h

=> 1680 = 42 × h

=> h = 1680 ÷ 42 = 40 cm

Therefore The correct answer is 40 cm.

Additional Information

Heron's Formula

Used to find the area of a triangle when all three sides are known: Area = √[s(s−a)(s−b)(s−c)], where s is the semi-perimeter.

Altitude of a Triangle

The perpendicular segment from a vertex to the opposite side. Area = (1/2) × base × altitude.

Pythagorean Property

For a right-angled triangle with sides a, b and hypotenuse c, $a^2 + b^2 = c^2$. The triangle in this problem is not a right triangle as $41^2 + 84^2 \neq 85^2$.

Q45. Answer: (a) 7/3 times

Shortcut Trick

The volume ratio depends only on the multiplicative increase of each dimension.

Length increase: 25% → Factor = 1 + 1/4 = 5/4

Breadth increase: 33 1/3% → Factor = 1 + 1/3 = 4/3

Height increase: 40% → Factor = 1 + 2/5 = 7/5

Net Volume Factor = (5/4) × (4/3) × (7/5) = 7/3

Therefore The correct answer is 7/3 times.

Alternate Method

Given:

Ratio of Length (L) : Breadth (B) : Height (H) = 2/3 : 1/4 : 5/6

Percent changes: L (+25%), B (+33 1/3%), H (+40%)

Calculations:

=> Simplify ratio L : B : H by multiplying by LCM(3, 4, 6) = 12:

=> L = (2/3) × 12 = 8, B = (1/4) × 12 = 3, H = (5/6) × 12 = 10

=> Original Volume (V1) = 8 × 3 × 10 = 240 units³

=> New Length (L') = 8 + 25% of 8 = 8 + 2 = 10

=> New Breadth (B') = 3 + 33 1/3% of 3 = 3 + 1 = 4

=> New Height (H') = 10 + 40% of 10 = 10 + 4 = 14

=> New Volume (V2) = 10 × 4 × 14 = 560 units³

=> Ratio V2 / V1 = 560 / 240 = 56 / 24 = 7 / 3

Therefore The correct answer is 7/3 times.

Additional Information

Total Surface Area of Cuboid

The total surface area is given by 2(LB + BH + HL). It represents the sum of areas of all 6 faces.

Diagonal of a Cuboid

The longest rod that can be placed inside a cuboid is its diagonal, calculated as $\sqrt{(L^2 + B^2 + H^2)}$.

Successive Percentage Change

When three dimensions change by x%, y%, and z%, the net volume change factor is (1 + x/100)(1 + y/100)(1 + z/100).

Q46. Answer: (c) 12.5%

Shortcut Trick

Profit = Selling Price (SP) − Cost Price (CP) = 45,000 − 40,000 = 5,000.

Profit% = (Profit ÷ CP) × 100.

Profit% = (5,000 ÷ 40,000) × 100 = (1 ÷ 8) × 100.

We know the fraction 1/8 is equivalent to 12.5%.

Therefore The correct answer is 12.5%.

Alternate Method

Given:

Cost Price (CP) of the laptop = Rs. 40,000

Selling Price (SP) of the laptop = Rs. 45,000

Formulas:

Profit = SP − CP

Profit% = (Profit ÷ CP) × 100

Steps:

=> Total Profit = 45,000 − 40,000 = 5,000

=> Profit Percentage = (5,000 ÷ 40,000) × 100

=> Profit Percentage = (5 ÷ 40) × 100

=> Profit Percentage = 1/8 × 100 = 12.5%

Therefore The correct answer is 12.5%.

Additional Information

Cost Price (CP)

The price at which an article is purchased. Overhead expenses like transport are added to it.

Selling Price (SP)

The price at which an article is sold to a customer.

Gain or Loss

If SP > CP, it is a Gain. If CP > SP, it is a Loss. Both are always calculated on the Cost Price unless specified otherwise.

Q47. Answer: (c) Rs. 243

Shortcut Trick

Total deduction = 92 + 9 + 48 = Rs. 149.

Remaining sum = 7085 − 149 = Rs. 6936.

Ratio = 3 : 15 : 16 → Total units = 3 + 15 + 16 = 34.

1 unit = 6936 ÷ 34 = Rs. 204.

Difference between Y and Z shares = (16 − 15) units + (48 − 9) = 1 × 204 + 39 = Rs. 243.

Therefore The correct answer is Rs. 243.

Alternate Method

Given: Total amount = Rs. 7,085. Deductions: X = Rs. 92, Y = Rs. 9, Z = Rs. 48. New ratio = 3 : 15 : 16.

Calculations:

=> Net Amount = 7085 − (92 + 9 + 48) = 7085 − 149 = Rs. 6936

=> Total Ratio Parts = 3 + 15 + 16 = 34 units

=> Value of 1 unit = 6936 ÷ 34 = Rs. 204

=> Y's share after deduction = 15 × 204 = Rs. 3060

=> Z's share after deduction = 16 × 204 = Rs. 3264

=> Y's original share = 3060 + 9 = Rs. 3069

=> Z's original share = 3264 + 48 = Rs. 3312

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=> Difference = 3312 − 3069 = Rs. 243

Therefore The correct answer is Rs. 243.

Additional Information

Ratio and Proportion

Ratio represents the relative size of two or more values. To find the actual value, multiply each part of the ratio by a common constant k.

Deduction in Ratios

When specific amounts are deducted from shares, the total sum is reduced by the sum of all deductions before applying the ratio division.

Difference between Original Shares

Difference = (New share difference) ± (Difference in deductions). Always calculate original shares individually or adjust the unit difference carefully.

Q48. Answer: (b) 712

Shortcut Trick

List the first 21 prime numbers: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73.

Group them for faster addition: (2+3+5+7+11+13+17+19+23+29) + (31+37+41+43+47+53+59+61+67+71) + 73.

Sum = 129 + 510 + 73 = 712.

Therefore The correct answer is 712.

Alternate Method

Given: Find the sum of the first 21 prime numbers.

Primes: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73.

2 + 3 + ... + 71 + 712

=> Sum of first 5: 2 + 3 + 5 + 7 + 11 = 28

=> Sum of next 5: 13 + 17 + 19 + 23 + 29 = 101

=> Sum of next 5: 31 + 37 + 41 + 43 + 47 = 199

=> Sum of next 5: 53 + 59 + 61 + 67 + 71 = 311

=> Total Sum = 28 + 101 + 199 + 311 + 73 = 712

Therefore The correct answer is 712.

Additional Information

Prime Numbers

A prime number is a natural number greater than 1 that has no positive divisors other than 1 and itself. The only even prime number is 2.

Sum of Primes up to N

There is no simple algebraic formula for the sum of the first n prime numbers; it must be calculated by listing and summing the terms.

Primality Test

To check if a number n is prime, test for divisibility by all primes less than or equal to √n.

Q49. Answer: (c) 38

Shortcut Trick

In a proportion a : b :: c : d, the product of means equals the product of extremes.

Product of extremes = P × 21

Product of means = 14 × 57

P = (14 × 57) ÷ 21 = (2 × 57) ÷ 3 = 2 × 19 = 38

Therefore The correct answer is 38.

Alternate Method

Given: P : 14 :: 57 : 21

Formula Used: a/b = c/d

=> P / 14 = 57 / 21

=> P = (57 / 21) × 14

=> P = (19 / 7) × 14

=> P = 19 × 2

=> P = 38

Therefore The correct answer is 38.

Additional Information

Fourth Proportional

If a, b, c, d are in proportion, then d is called the fourth proportional, where d = (b × c) ÷ a.

Mean Proportional

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

Third Proportional

If a, b, c are in continued proportion (a:b :: b:c), then c is the third proportional, c = b^2 ÷ a.

Q50. Answer: (a) Rs. 7,172

Shortcut Trick

Use the ratio formula: CP : MP = (100 − Discount%) : (100 + Profit%).

CP : MP = (100 − 58) : (100 + 63) = 42 : 163.

Given Cost Price (CP) = 42 units = 1,848.

1 unit = 1,848 ÷ 42 = 44.

Marked Price (MP) = 163 units = 163 × 44 = 7,172.

Therefore The correct answer is Rs. 7,172.

Alternate Method

Given: CP = Rs. 1,848, Discount = 58%, Profit = 63%.

Formulas: SP = CP × (100 + Profit%) ÷ 100 | MP = SP × 100 ÷ (100 − Discount%)

=> Selling Price (SP) = 1,848 × (100 + 63) ÷ 100 = 1,848 × 1.63 = 3,012.24

=> Marked Price (MP) = SP × 100 ÷ (100 − 58) = 3,012.24 × 100 ÷ 42

=> MP = 301,224 ÷ 42 = 7,172.

Therefore The correct answer is Rs. 7,172.

Additional Information

Marked Price & Discount

Discount is always calculated on the Marked Price (MP) to arrive at the Selling Price (SP). Formula: SP = MP − Discount.

Relation between CP and MP

When both profit and discount percentages are known, the direct relation is: MP ÷ CP = (100 + Profit%) ÷ (100 − Discount%).

Q51. Answer: (c) 11

The logic followed here is:

Given numbers: 756, 325, 685, 458, 359

Now, Arranging in descending order: 756, 685, 458, 359, 325

Highest number = 756

→ Third digit = 6

Lowest number = 325

→ Third digit = 5

Result = 6 + 5 = 11

Hence, the correct answer is Option 3.

Q52. Answer: (a) KEQ : MGS

The logic followed here is:

For, ADG → CFI

For, FLR → HNT

Now, checking all options:

Option 1) KEQ : MGS

Option 2) MDR : SEI

Option 3) VES : TEY

Option 4) NDR : FTS

Hence, the correct answer is "Option 1".

Q53. Answer: (a) 1

Given: Meena is 21st from the left and Ayush is 16th from the right.
Convert Ayush's position from right to left:
Ayush's position from left = (38 − 16) + 1 = 23rd
Now positions are:
Meena = 21st from left
Ayush = 23rd from left
Number of persons between them = (23 − 21) − 1 = 1
So, there is 1 person between Meena and Ayush.
Hence, the odd one out is Option 1.

Q54. Answer: (d) 15 km to the South

Given:
Ridam starts from A and drives 45 km East.
He turns right → 48 km South.
He turns right → 51 km West.
He turns right → 63 km North.
He takes a final right turn → 6 km East and reaches P.
So, To reach A from P → move 15 km South.
Hence, the correct answer is Option 4.

Q55. Answer: (b) More than three

Given: (Left) 7 4 1 2 4 9 7 5 3 6 1 5 2 7 4 5 8 3 9 6 5 7 3 9 1 4 2 (Right)
Now,
Odd numbers, which are immediately preceded by an even number and also immediately followed by an odd number.
So, Needed pattern is: Even Number - Odd Number - Odd Number
(Left) 7 4 1 2 4 9 7 5 3 6 1 5 2 7 4 5 8 3 9 6 5 7 3 9 1 4 2 (Right)
So, total valid odd numbers = 4(More than three)
Hence, the correct answer is Option 2.

Q56. Answer: (d) Only conclusion (I) follows.

Given Statements:
All pans are cups.
All cups are bottles.
Some cups are mugs.
The least possible Venn diagram for the given statement is:
Conclusions:
I. Some bottles are mugs - Follows (Some cups are mugs and all cups are bottles, therefore some bottles are mugs).
II. Some pans are mugs - Does not follow (No definite relation is given between pans and mugs).
So, only conclusion I follows.
Hence, the correct answer is Option 4.

Q57. Answer: (b) NMZ

The logic followed here is:
So, the next term = NMZ
Hence, the correct answer is Option 2.

Q58. Answer: (c) Three

Given: (Left) 6 4 9 2 3 2 7 7 9 8 3 8 7 9 9 9 7 9 5 8 9 9 1 (Right)
Now,
Odd numbers, which are immediately preceded by an even number and also immediately followed by an odd number.
So, Needed pattern is: Even Number - Odd Number - Odd Number
(Left) 6 4 9 2 3 2 7 7 9 8 3 8 7 9 9 9 7 9 5 8 9 9 1 (Right)

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So, total valid odd numbers = 3

Hence, the correct answer is Option 3.

Q59. Answer: (c) KT-MV-OQ

The logic followed here is:

For, MV − OX − QS

For, OX − QZ − SU

Now, checking all options:

Option 1) LT-MU-OR

Option 2) LT-MV-OR

Option 3) KT-MV-OQ

Option 4) KT-MV-OR

Hence, the correct answer is "Option 3".

Q60. Answer: (c) Mother's brother's son

Family Chart:

Decoding the Symbols:

Symbol	•	−	x	&
Meaning	Son	Brother	Wife	Father

Given: T + O − R x N & M

It means: T is the son of O, O is the brother of R, R is the wife of N, and N is the father of M.

Thus, T is the son of M’s mother’s brother.

Hence, the correct answer is "Option 3".

Q61. Answer: (a) 43

The logic followed here is:

thus, "43" will replace the question mark in the given series.

Hence, the correct option is "Option 1".

Q62. Answer: (a) L and A

Given: A, B, C, D, E and L are sitting around a circular table facing the centre.

Only two people sit between A and B when counted from the left of B.

C sits to the immediate right of A.

D is an immediate neighbour of both E and B.

Immediate neighbours of C: A and L

Hence, the correct answer is "Option 1".

Q63. Answer: (c) 86

The logic followed here is:

Logic: Add the positional values of all the letters in the word and then multiply the total by 2.

For, TMCB → 76

=> T = 20, M = 13, C = 3, B = 2

=> 20 + 13 + 3 + 2 = 38

=> 38 × 2 = 76

For, GKIR → 90

=> G = 7, K = 11, I = 9, R = 18

=> 7 + 11 + 9 + 18 = 45

=> 45 × 2 = 90

Now, applying the same pattern to VAPD:

=> V = 22, A = 1, P = 16, D = 4

=> 22 + 1 + 16 + 4 = 43

=> 43 × 2 = 86

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Hence, the correct answer is Option 3.

Q64. Answer: (d) 51

The logic followed here is:

thus, "51" will replace the question mark in the given series.

Hence, the correct option is "Option 4".

Q65. Answer: (b) 3

Given number: 268745913

Logic:

Arrange all digits in ascending order from left to right.

Original number: 2 6 8 7 4 5 9 1 3

Original Digits	Rearranged Digits
2	1
6	2
8	3
7	4
4	5
5	6
9	7
1	8
3	9

New number: 1 2 3 4 5 6 7 8 9

Now, Third digit from the left = 3

Hence, the correct answer is Option 2.

Q66. Answer: (a) TYBF

The logic followed here is based on the alphabetical position pattern:

Option 1: EJLP

Option 2: VACG

Option 3: QVXB

Option 4: TYBF

Thus, TYBF does not belong to the group.

Hence, the odd one out is Option 4.

Q67. Answer: (b) 105 and 111, respectively

The logic followed here is:

thus, "105 and 111" will replace the question mark in the given series.

Hence, the correct option is "Option 2".

Q68. Answer: (a) SRN 114

The logic followed here is:

So, the next term = SRN 114

Hence, the correct answer is Option 1.

Q69. Answer: (d) One

Given: Six people A, B, C, D, E and F are sitting in a row facing north.

A sits to the immediate left of D.

C sits third to the left of E.

C is an immediate neighbour of D.

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F sits to the immediate left of B.
Number of people between F and E = only B → 1 person
Hence, the correct answer is "Option 4".

Q70. Answer: (a) 11

Given number: 24583671
Logic:
Add 1 to each odd digit
Subtract 1 from each even digit
Original number: 2 4 5 8 3 6 7 1

Digit	Type	Operation	New Digit
2	Even	2 − 1	1
4	Even	4 − 1	3
5	Odd	5 + 1	6
8	Even	8 − 1	7
3	Odd	3 + 1	4
6	Even	6 − 1	5
7	Odd	7 + 1	8
1	Odd	1 + 1	2

New number: 1 3 6 7 4 5 8 2
Second digit from the left = 3
Second digit from the right = 8
Sum = 3 + 8 = 11
Hence, the correct answer is Option 1.

Q71. Answer: (d) (63, 21, 20.8)

The logic followed here is:
Logic: second number = (first number ÷ 3) and third number = (second number − 0.2)
For, (42, 14, 13.8)
=> 42 ÷ 3 = 14
=> 14 − 0.2 = 13.8
For, (54, 18, 17.8)
=> 54 ÷ 3 = 18
=> 18 − 0.2 = 17.8
Now, checking the options using the same pattern:
Option 1) (255, 85, 83.8)
=> 255 ÷ 3 = 85
=> 85 − 0.2 = 84.8 ≠ 83.8
Option 2) (213, 71, 69.8)
=> 213 ÷ 3 = 71
=> 71 − 0.2 = 70.8 ≠ 69.8
Option 3) (126, 42, 40.8)
=> 126 ÷ 3 = 42
=> 42 − 0.2 = 41.8 ≠ 40.8
Option 4) (63, 21, 20.8)
=> 63 ÷ 3 = 21
=> 21 − 0.2 = 20.8
Hence, the correct answer is Option 4.

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Q72. Answer: (c) HK – DP

The logic followed here is based on the alphabetical position pattern:

Option 1: EW – BB

Option 2: KM – HR

Option 3: QC – NH

Option 4: HK – DP

Thus, HK – DP does not follow the given pattern.

Hence, the odd one out is Option 4.

Q73. Answer: (d) Only conclusion (I) follows

Given Statements:

All golds are hives.

No hive is a cow.

The least possible Venn diagram for the given statement is:

Conclusions:

I. No gold is a cow - Follows (All golds are hives and no hive is a cow, therefore no gold is a cow).

II. Some cows are hives - Does not follow (The statement clearly says no hive is a cow).

So, only conclusion I follows.

Hence, the correct answer is Option 4.

Q74. Answer: (d) E

Given: E, F, G, H, P, Q and R are sitting around a circular table facing the centre.

Only three people sit between H and R when counted from the right of R.

Q sits second to the left of R.

G sits fourth to the right of Q.

F is an immediate neighbour of Q.

P is not an immediate neighbour of H.

So, second to the right of P is E.

Hence, the correct answer is "Option 4".

Q75. Answer: (d) 40 km towards east

Given:

Umesh starts from Y and drives 83 km South.

He turns left → 31 km East.

He turns left → 45 km North.

He turns left → 55 km West.

He turns right → 38 km North.

He turns left → 16 km West and stops at Z.

So, To reach Y from Z → move 40 km East.

Hence, the correct answer is Option 4.

Q76. Answer: (b) 80

BODMAS Table:

Given equation: 88 − 36 × 9 + 4 ÷ 3 = ?

Now, replacing the symbols as:

Symbol	•	−	×	÷
Replaced by	−	•	÷	×

=> 88 + 36 ÷ 9 − 4 × 3 = ?

=> 88 + 4 − 4 × 3 = ?

=> 88 + 4 − 12 = ?

=> 92 − 12 = ?

=> 80

Hence, the correct answer is Option 2.

Q77. Answer: (c) NPT:QRU

The logic followed here is:

For, CJT → FLU

For, EIM → HKN

Now, checking all options:

Option 1) ZOT : FSA

Option 2) BSR : ODU

Option 3) NPT : QRU

Option 4) NPR : VCX

Hence, the correct answer is "Option 3".

Q78. Answer: (c) 6

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

Now,

Odd numbers, which are immediately preceded by an odd number and also immediately followed by an odd number.

So, Needed pattern is: Odd Number - Odd Number - Odd Number

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

So, total valid odd numbers = 6

Hence, the correct answer is Option 3.

Q79. Answer: (b) 1

Given: Maya is 20th from the left and Veer is 14th from the right.

Convert Veer's position to left end:

Veer's position from left = (35 + 1) − 14 = 22nd

Now positions are:

Maya = 20th from left

Veer = 22nd from left

Number of persons between them = (22 − 20) − 1 = 1

So, the number of persons between Maya and Veer is 1.

Hence, the odd one out is Option 2.

Q80. Answer: (d) xz

The logic followed here is:

Given:

bow elk door → xz vo ts

door mug blue → zj xz hf

So, door → xz

Hence, the correct answer is Option 4.

Q81. Answer: (d) 2025–26 and 2026–27

The correct answer is 2025–26 and 2026–27.

Key Points

• The Ministry of Power, in consultation with the Bureau of Energy Efficiency (BEE), has notified the Greenhouse Gases Emission Intensity Target Rules to establish a structured pathway for reducing industrial emissions in India.

• These rules specifically define the emission intensity targets for the compliance years 2025–26 and 2026–27. This period marks the initial phase of mandatory compliance under the broader Carbon Credit Trading Scheme (CCTS) launched in 2023.

• The targets are part of the transition of several industrial sectors from the Perform, Achieve and Trade (PAT) scheme to a comprehensive carbon market mechanism. These rules aim to align industrial output with India's climate commitments.

• Under these rules, Obligated Entities in sectors such as Iron and Steel, Cement, Aluminium, Pulp and Paper, and Petrochemicals are required to limit their greenhouse gas emissions per unit of production.

• The emission intensity is calculated based on tonnes of carbon dioxide equivalent (tCO2e) per unit of product, ensuring that even as production scales up, the carbon footprint per unit decreases.

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Additional Information

• Carbon Credit Trading Scheme (CCTS):

• Launched under the Energy Conservation Act, 2001 (as amended in 2022), the CCTS is designed to create a domestic carbon market in India to incentivize Greenhouse Gas (GHG) reduction.

• Entities that exceed their targets can earn Carbon Credit Certificates (CCCs), while those failing to meet them must purchase credits from the market to remain compliant.

• Bureau of Energy Efficiency (BEE):

• The BEE serves as the administrator for the Indian Carbon Market (ICM). It is responsible for developing the trajectories, monitoring emissions, and maintaining the registry of Carbon Credit Certificates.

• The National Steering Committee for Indian Carbon Market (NSCICM), chaired by the Secretary of the Ministry of Power and the Secretary of the Ministry of Environment, Forest and Climate Change, provides oversight.

• International Commitments:

• These rules are a critical step toward achieving India's Nationally Determined Contributions (NDCs) under the Paris Agreement, which includes reducing the emission intensity of its GDP by 45% by 2030 compared to 2005 levels.

• This initiative also supports India's long-term goal of achieving Net Zero emissions by the year 2070, as announced at COP26 in Glasgow.

• Greenhouse Gases Covered:

• The rules track various GHGs beyond just carbon dioxide, including Methane (CH4), Nitrous Oxide (N2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur Hexafluoride (SF6), all converted to a CO2 equivalent value.

Q82. Answer: (b) New York Athletic Club

The correct answer is New York Athletic Club.

Key Points

• The AAU James E. Sullivan Award ceremony for the year 2025 was hosted at the New York Athletic Club (NYAC), located in Manhattan, New York City.

• This event marks the 95th anniversary of the award, which has been presented annually since 1930 by the Amateur Athletic Union (AAU).

• The New York Athletic Club is a historic venue that has a long-standing relationship with the AAU, frequently serving as the site for this prestigious presentation due to its deep roots in American amateur sports.

• The ceremony honors the most outstanding amateur athlete in the United States, evaluating candidates not only on their athletic prowess but also on their character, leadership, and sportsmanship.

• Finalists for the 2025 award represent a diverse range of sports, including collegiate athletics, Olympic disciplines, and youth sports programs across the United States.

Additional Information

• History of the Award:

• The award was established in 1930 and named after James E. Sullivan, one of the primary founders of the Amateur Athletic Union and a former president of the organization.

• The inaugural winner was the legendary golfer Bobby Jones, who set the standard for the type of excellence and integrity the award seeks to recognize.

• The New York Athletic Club (NYAC):

• Founded in 1868, the NYAC is one of the world's premier private athletic clubs. Its members have collectively won over 270 Olympic medals.

• The City House, located at 180 Central Park South, is the primary location for high-profile galas and award ceremonies like the Sullivan Award.

• Selection Process:

• The winner is determined through a voting process that includes the AAU Sullivan Award Executive Committee, previous winners, members of the national media, and a public fan vote.

• This multi-tiered voting system ensures that the recipient is widely recognized as the premier amateur athlete of the year.

• Legacy of Winners:

• Notable past recipients include Wilma Rudolph (Track and Field), Carl Lewis (Track and Field), Peyton Manning (Football), Michael Phelps (Swimming), and Caitlin Clark (Basketball).

• Winning the Sullivan Award is often considered the highest honor an amateur athlete can receive in the United States, comparable to the "Oscar" of the amateur sporting world.

Important Points

• The Amateur Athletic Union (AAU) was founded in 1888 and is one of the largest non-profit volunteer sports organizations in the

United States, dedicated to the promotion and development of amateur sports and physical fitness programs.

• The Sullivan Award is unique because it transcends individual sports, allowing a gymnast to compete against a wrestler or a basketball player for the same title based on their overall impact on society and their sport.

• The 2025 ceremony continues the tradition of highlighting the importance of amateurism in an era where professional and collegiate sports landscapes are rapidly changing with NIL (Name, Image, and Likeness) regulations.

Q83. Answer: (b) Dachigam National Park

The correct answer is Dachigam National Park.

Key Points

• In the assessment conducted by the Wildlife Institute of India (WII) released in June 2025, Dachigam National Park achieved an exceptional Management Effectiveness Evaluation (MEE) score of 92.97%.

• This score places it as one of the top two performing protected areas in the country, reflecting outstanding administrative and ecological management.

• The MEE process is a globally recognized tool used to evaluate the management of National Parks and Wildlife Sanctuaries, focusing on design, appropriateness, and delivery of conservation objectives.

• The evaluation highlights the park's success in habitat restoration, wildlife protection, and community engagement programs within the Jammu and Kashmir region.

• The high performance in the 2025 cycle underscores the efficiency of the Department of Wildlife Protection in maintaining the fragile Himalayan ecosystem.

Additional Information

• Dachigam National Park:

• Located in the Zabarwan Range of the Himalayas, approximately 22 kilometers from Srinagar.

• It was established in 1910 as a protected area and was later declared a National Park in 1981.

• The name Dachigam signifies "Ten Villages," referring to the relocation of ten villages to establish the park.

• It is the primary habitat of the Hangul (also known as the Kashmiri Stag), which is Critically Endangered and the State Animal of Jammu and Kashmir.

• Other Protected Areas Mentioned:

• Ranthambore National Park: Located in Rajasthan, it is one of the most prominent Tiger Reserves in India, known for its significant Bengal Tiger population.

• Great Himalayan National Park (GHNP): Located in Himachal Pradesh, it was established in 1984 and is a UNESCO World Heritage Site recognized for its high-altitude biodiversity.

• Nanda Devi National Park: Situated in Uttarakhand, it is part of the Nanda Devi and Valley of Flowers National Parks UNESCO World Heritage Site and surrounds the peak of Nanda Devi.

Important Points

• Wildlife Institute of India (WII): An autonomous institution under the Ministry of Environment, Forest and Climate Change (MoEFCC), established in 1982 and headquartered in Dehradun.

• MEE Parameters: The evaluation uses a framework of 30 indicators across six elements: context, planning, inputs, process, outputs, and outcomes.

• Conservation Success: The 92.97% score is a testament to the rigorous anti-poaching measures and scientific monitoring techniques implemented to protect the alpine and sub-alpine forests.

• Flora and Fauna: Apart from the Hangul, the park hosts Himalayan Black Bear, Leopards, and rare birds like the Monal Pheasant and Crimson Tragopan.

Q84. Answer: (d) Vancouver, March 30

The correct answer is Vancouver, March 30.

Key Points

• The 54th annual Juno Awards are scheduled to be held on March 30, 2025. This date marks the culmination of Juno Week, which features various musical events and showcases.

• The prestigious ceremony will take place in Vancouver, British Columbia. This city was selected to highlight the vibrant music scene of the West Coast. Hence, the combination of Vancouver and March 30 is correct.

• The primary venue for the awards broadcast is Rogers Arena, a major sports and entertainment hub in Vancouver. It has previously hosted numerous high-profile international events and concerts.

• It has been officially announced that Nelly Furtado, the celebrated Canadian singer-songwriter, will return to host the 2025 ceremony, following her successful hosting stint in 2024.

• The event is produced by Insight Productions in association with The Canadian Academy of Recording Arts and Sciences (CARAS) and will be broadcast across Canada on CBC and CBC Gem.

Additional Information

• History and Nomenclature: The awards were established in 1970 as the Gold Leaf Awards. They were renamed the Juno Awards in 1971 to honor Pierre Juneau, the first chairperson of the CRTC and a key advocate for Canadian content regulations.

• CARAS: The Canadian Academy of Recording Arts and Sciences is the governing body that administers the awards. Its mission is to promote and celebrate Canadian music and artists on both national and international stages.

• Hosting Legacy: Vancouver has a long history with the ceremony, having previously hosted the event in 1991, 1998, 2009, and 2018. The 2025 edition marks the fifth time the city has served as the host.

• Category Scope: The Juno Awards feature over 40 categories, ranging from Artist of the Year and Album of the Year to specialized genres such as Reggae Recording of the Year and Traditional Roots Album of the Year.

• Juno Week Events: Leading up to the main telecast, Juno Week includes the Juno Cup (a celebrity hockey game), Juno Fest, and the Juno Songwriters' Circle, which benefit MusiCounts, a music education charity.

Important Points

• Economic Impact: Hosting the Juno Awards typically generates significant economic activity for the host city. In previous years, the event has contributed over $10 million to the local economy through tourism, hospitality, and event production.

• The MusiCounts Initiative: A portion of the proceeds from Juno events goes to MusiCounts, which helps provide musical instruments and equipment to schools and communities across Canada.

• Previous Host: The 2024 Juno Awards were held in Halifax, Nova Scotia, on March 24, 2024, where artists like Tate McRae and Charlotte Cardin were major winners.

• Nomination Process: Eligibility for the 2025 awards generally requires recordings to have been released during the eligibility period, typically spanning from September of the previous year to November of the current year.

Q85. Answer: (c) New Delhi

The correct answer is New Delhi.

Key Points

• The first edition of the ‘Rising North East’ Investors Summit was held in New Delhi in 2025.

• The summit was organized by the Ministry of Development of North Eastern Region (MDoNER) in collaboration with industry partners to attract domestic and international investments to North East India.

• The primary objective of the event was to showcase the untapped economic potential of the eight North Eastern states, highlighting them as the new engine of India's growth.

• The summit provided a strategic platform for investors, policymakers, and state governments to interact and discuss projects in sectors such as infrastructure, renewable energy, and tourism.

• The event emphasizes the government's commitment to the 'Act East Policy', aiming to integrate the North Eastern Region (NER) with the economies of South East Asia.

Additional Information

• Significance of the North Eastern Region (NER):

• The NER comprises Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura.

• Prime Minister Narendra Modi has often referred to these states as 'Ashtalakshmi', symbolizing the eight forms of prosperity that the region brings to India.

• The region is strategically important as it shares international borders with Bhutan, China, Myanmar, and Bangladesh.

• Key Investment Sectors:

• Agri-Horticulture: The region is a global hub for organic farming, particularly for ginger, turmeric, and exotic fruits.

• Connectivity: Significant investments are being made in railway expansion, air connectivity (UDAN scheme), and national highways to reduce the geographical isolation of the region.

• Tourism: With its diverse ethnic cultures and biodiversity hotspots, the region offers immense potential for eco-tourism and adventure tourism.

• Government Initiatives:

• PM-DevINE: The Prime Minister’s Development Initiative for North Eastern Region is a central scheme aimed at funding infrastructure and social development projects.

• North East Industrial Development Scheme (NEIDS): This scheme provides incentives to MSMEs and large industries to set up units in the region, including income tax exemptions and capital investment subsidies.

Important Points

• Venue Details: The summit in New Delhi was held at Bharat Mandapam, which serves as a premier venue for high-level international summits and exhibitions in the National Capital.

• Focus on Sustainability: A major theme of the 2025 summit was Sustainable Development, ensuring that industrial growth in the North East does not compromise the region's fragile ecology.

• International Collaboration: Delegations from Japan and ASEAN countries often participate in such summits due to their existing investment interests in road projects and cross-border trade in the region.

Q86. Answer: (d) Lower-middle income economies

The correct answer is Lower-middle income economies.

Key Points

• According to the Global Innovation Index (GII) 2025, India continues to be a global leader in innovation among lower-middle income economies, securing the 1st rank within this specific income group.

• The index is published annually by the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations based in Geneva, Switzerland.

• In addition to its income group leadership, India also holds the top position in the Central and Southern Asia region, a rank it has maintained for several consecutive years.

• The GII 2025 report highlights that India is one of the few emerging economies that consistently performs above expectations relative to its level of economic development. Hence, the statement regarding its rank in the lower-middle income group is correct.

• India's performance is particularly strong in indicators such as ICT services exports, venture capital received, and the quality of its universities.

Additional Information

• Global Innovation Index (GII): It is a comprehensive tool used by policymakers and business leaders to assess the innovation landscape of roughly 130+ economies. It was first launched in 2007 to determine how to measure innovation beyond traditional metrics like R&D spending.

• Structure of GII: The index is calculated based on the average of two sub-indices: the Innovation Input Sub-Index (which measures elements of the economy that enable innovation) and the Innovation Output Sub-Index (which measures the actual results of innovation activities).

• The Seven Pillars: The GII framework relies on seven pillars: Institutions, Human capital and research, Infrastructure, Market sophistication, Business sophistication, Knowledge and technology outputs, and Creative outputs.

• World Bank Income Classifications: The World Bank divides economies into four groups based on Gross National Income (GNI) per capita: Low-income, Lower-middle income, Upper-middle income, and High-income. India falls into the lower-middle income category.

• Growth Trajectory: India has shown remarkable progress in the GII over the last decade, jumping from the 81st rank in 2015 to within the top 40 globally by 2024-2025, driven by the Startup India initiative and digital transformations.

Important Points

• Key Strengths: India ranks 1st globally in ICT services exports as a percentage of total trade. It also shows high performance in domestic market scale and science and engineering graduates.

• Innovation Overperformers: WIPO identifies countries that perform better on innovation than their GDP would suggest as "Innovation Achievers." India has held this status for over 13 consecutive years.

• Regional Impact: India's innovation ecosystem, centered around hubs like Bengaluru, Delhi, and Mumbai, significantly influences the Central and Southern Asian innovation trends, encouraging neighboring countries to invest more in intellectual property and tech-startups.

• Policy Drivers: Major government schemes such as Digital India, the Atal Innovation Mission (AIM), and the National Education Policy (NEP) 2020 are cited as critical drivers for the improvement in India’s global innovation standing.

Q87. Answer: (b) Article 114

The correct answer is Article 114.

Key Points

• The Appropriation Bill (No.2), 2025 is passed in Parliament under the provisions of Article 114 of the Constitution of India.

• Article 114 mandates that no money shall be withdrawn from the Consolidated Fund of India except under appropriation made by law passed in accordance with the provisions of this article.

• The Appropriation Bill is introduced in the Lok Sabha only after the Demands for Grants have been voted upon and passed by the house as per Article 113.

• This specific bill, Appropriation Bill (No.2), 2025, authorizes the Government of India to utilize funds for the Financial Year 2025-26 to meet the expenditure charged on the Consolidated Fund and the grants made by the Lok Sabha.

• The passage of this bill is a critical step in the Budgetary Process, as it provides the legal authority to the Executive to spend the money allocated in the Union Budget.

Additional Information

• Article 118:

• This article empowers each House of Parliament to make rules for regulating its procedure and the conduct of its business.

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• It also provides for the President, after consultation with the Chairman of the Council of States and the Speaker of the House of the People, to make rules as to the procedure with respect to joint sittings.

• Article 117:

• It deals with Special Provisions as to Financial Bills. It stipulates that Financial Bills (Category I) cannot be introduced in the Rajya Sabha and require the recommendation of the President for introduction.

• It distinguishes between Money Bills (Article 110) and other Financial Bills.

• Article 119:

• This article allows Parliament to regulate by law the procedure in relation to financial business to ensure the timely completion of such business.

• If any provision of law made under this article is inconsistent with the rules made by a House of Parliament, the law prevails.

• Consolidated Fund of India:

• Established under Article 266(1), it is the fund into which all revenues received by the Government of India, all loans raised, and all moneys received in repayment of loans are credited.

• Expenditure from this fund requires Parliamentary authorization through an Appropriation Act.

Important Points

• The Appropriation Bill becomes the Appropriation Act after it receives the assent of the President of India.

• The Government cannot withdraw even a single rupee from the Consolidated Fund for its operational requirements without the enactment of this law.

• In the Indian Parliamentary system, the Appropriation Bill is classified as a Money Bill, meaning the Rajya Sabha has limited powers and can only recommend changes within 14 days, which the Lok Sabha may or may not accept.

• The Year 2025 marks the continuation of fiscal management where Appropriation (No. 2) usually follows the Vote on Account or acts as the main spending authorization for the Full Budget.

Q88. Answer: (b) Kochi, Kerala

The correct answer is Kochi, Kerala.

Key Points

• The 5th edition of the Lok Samvardhan Parv was organized by the Ministry of Minority Affairs, Government of India, in 2025.

• The event was hosted in the city of Kochi, Kerala, specifically held at the iconic Marine Drive Ground from February 14 to February 23, 2025.

• This initiative is designed to provide a national platform for artisans, craftsmen, and culinary experts belonging to minority communities to showcase and sell their traditional indigenous products.

• The 5th edition in Kochi emphasized the theme of “Vikas Bhi, Virasat Bhi” (Development along with Heritage), focusing on the preservation of India's rich cultural diversity while promoting economic growth.

• The fair featured over 300 artisans from more than 30 States and Union Territories, displaying a wide array of handicrafts, handlooms, and traditional heritage products.

Additional Information

• Ministry of Minority Affairs:

• The Ministry of Minority Affairs was carved out of the Ministry of Social Justice & Empowerment and created on January 29, 2006.

• It acts as the nodal agency for the overall policy, planning, coordination, evaluation, and review of the regulatory and development programs for minority communities including Muslims, Christians, Sikhs, Buddhists, Parsis, and Jains.

• As of 2025, the ministry is led by the Union Minister Kiren Rijiju, who has emphasized the socio-economic empowerment of these communities through skill development.

• PM VIKAS Scheme:

• The Lok Samvardhan Parv is an integral part of the Pradhan Mantri Virasat Ka Samvardhan (PM VIKAS) scheme.

• PM VIKAS is a central sector scheme that aims to improve the livelihoods of artisans and minority communities through skill development, education, and entrepreneurship.

• It converges five erstwhile schemes of the Ministry: Seekho aur Kamao, USTTAD, Hamari Dharohar, Nai Roshni, and Nai Manzil.

• Economic Impact and Digital Integration:

• The event significantly contributes to the employment generation of traditional craftsmen, providing them with direct access to urban markets without the interference of middlemen.

• To further enhance reach, many products displayed at Lok Samvardhan Parv are integrated with the GeM (Government e-Marketplace) portal, allowing artisans to sell their products to government departments and global audiences digitally.

• The fair also features “Bawarchikhana,” a dedicated section for traditional Indian cuisines, which promotes the culinary heritage

of different regions of India.

Important Points

• Host City Significance: Kochi, known as the “Queen of the Arabian Sea,” was chosen to highlight the cultural confluence of South India and to provide a gateway for artisans to tap into the thriving tourism and trade market of Kerala.

• Vocal for Local: The event is a practical implementation of the Hon'ble Prime Minister's vision of ‘Vocal for Local’ and ‘Aatmanirbhar Bharat’ (Self-reliant India).

• Cultural Programs: Apart from commerce, the Lok Samvardhan Parv in Kochi featured daily cultural performances by renowned artists, showcasing Ghazals, folk dances, and classical music, thereby fostering a spirit of ‘Ek Bharat Shreshtha Bharat’.

Q89. Answer: (a) Hindutva: Who is a Hindu?

The correct answer is Hindutva: Who is a Hindu?.

Key Points

• The book titled Hindutva: Who is a Hindu? was authored by Vinayak Damodar Savarkar (popularly known as Veer Savarkar) and was published in 1923.

• The book was written while Savarkar was imprisoned in Ratnagiri jail and under internment; it was initially published under the pseudonym 'A Maratha' to avoid British censorship.

• In this work, Savarkar systematically defined the concept of Hindutva as an all-encompassing political and cultural identity, distinct from the religious rituals of Hinduism.

• Savarkar's birth anniversary falls on 28th May; the year 2025 commemorates his 142nd birth anniversary, as he was born in 1883 in the village of Bhagur, Nashik district, Maharashtra.

• The core thesis of the book posits that a Hindu is anyone who considers India (Bharatvarsha) as their Pitribhu (Fatherland) and Punyabhu (Holy land). Hence, option 1 is the correct answer.

Additional Information

• My Experiments with Truth:

• This is the autobiography of Mohandas Karamchand Gandhi (Mahatma Gandhi).

• It was originally written in Gujarati and published as a series in his journal Navjivan between 1925 and 1929.

• The book covers Gandhi's life from his childhood in Porbandar to the year 1921, focusing on his spiritual and moral development.

• The Discovery of India:

• Written by Jawaharlal Nehru, the first Prime Minister of India.

• It was written during his imprisonment at Ahmednagar Fort between 1942 and 1945 following the Quit India Movement.

• The book provides a comprehensive analysis of Indian history, philosophy, and culture from the Indus Valley Civilization to the British Raj.

• India Wins Freedom:

• This is an autobiographical account by Maulana Abul Kalam Azad, a senior leader of the Indian National Congress and India's first Education Minister.

• The book offers an insider's view of the Indian Independence movement, the Partition of India, and Azad's personal views on the political leaders of that era.

Important Points

• Revolutionary Contributions: Veer Savarkar founded the secret society Abhinav Bharat Society in 1904 to promote armed rebellion against British rule.

• 1857 War of Independence: He authored another famous book, The Indian War of Independence 1857, in which he was among the first to describe the 1857 uprising as the "First War of Independence" rather than a mere sepoy mutiny.

• Cellular Jail: For his revolutionary activities, he was sentenced to two life terms (50 years) and sent to the Cellular Jail (Kala Pani) in the Andaman and Nicobar Islands in 1911.

• Political Leadership: He served as the President of the Hindu Mahasabha from 1937 to 1943, where he advocated for the rights of the Hindu community and a militarized India.

Q90. Answer: (a) Target Olympic Podium Scheme

The correct answer is Target Olympic Podium Scheme.

Key Points

• The Target Olympic Podium Scheme (TOPS) was launched in September 2014 by the Ministry of Youth Affairs and Sports (MYAS). Its primary objective is to identify and provide support to India’s elite athletes to help them achieve podium finishes at the Olympic Games and Paralympic Games. Hence, statement 1 is correct.

• The scheme was significantly revamped in April 2018 to establish a more robust technical support team and provide holistic assistance to athletes, including customized training programs and international exposure.

• It provides a monthly Out-of-Pocket Allowance (OPA) of Rs. 50,000 to athletes in the Core Group and Rs. 25,000 to those in the

Development Group to cover daily incidental expenses.

• As of 2025, the scheme continues to be the flagship initiative for high-performance sports in India, focusing on upcoming major events like the 2028 Los Angeles Olympics.

• The Mission Olympic Cell (MOC) is a dedicated body under this scheme that evaluates athlete performance and approves financial assistance for training, equipment, and travel.

Additional Information

• Come and Play Scheme:

• This initiative was launched by the Sports Authority of India (SAI) in 2011.

• Its main focus is on grassroots development and encouraging the general public and youth to utilize the various sports facilities available at SAI centers across the country.

• It is not specifically designed for elite-level Olympic or Paralympic podium training. Hence, statement 2 is incorrect.

• Go and Play Scheme:

• There is no official government-recognized initiative named the "Go and Play Scheme" for Olympic training; it is often used as a distractor for the "Come and Play Scheme." Hence, statement 3 is incorrect.

• National Sports Fund (National Sports Development Fund - NSDF):

• The NSDF was established in 1998 under the Charitable Endowments Act, 1890.

• Its purpose is to mobilize resources from government, non-government, and private sectors for the promotion of sports in India.

• While the NSDF provides the financial backing for various programs including TOPS, it is a funding mechanism rather than the specific training initiative for elite athletes. Hence, statement 4 is incorrect.

Important Points

• Mission Olympic Cell (MOC): A specialized committee chaired by the Director General of SAI that meets frequently to clear proposals for foreign training, procurement of high-end equipment, and hiring of personal coaches or physiotherapists.

• Khelo India Programme: Launched in 2018, this program works alongside TOPS to identify talent at a young age and provide a scholarship of Rs. 5 lakh per annum for eight years to talented players.

• Elite Athlete Support: Under TOPS, the government bears the entire cost of international competitions, sports science support, and medical insurance for the selected athletes.

• Focus Areas: The scheme prioritizes sports where India has a high potential for medals, such as Wrestling, Boxing, Shooting, Archery, Badminton, and Athletics.

Q91. Answer: (b) Rs. 2,000 crores

The correct answer is Rs. 2,000 crores.

Key Points

• The Comptroller and Auditor General (CAG) of India, in its 2025 report, estimated a significant revenue loss of Rs. 2,000 crores to the Delhi Government due to irregularities in the Excise Policy 2021-22.

• The report detailed that the loss was a direct result of improper implementation, including the waiver of license fees and the lack of competitive bidding in several zones.

• According to the CAG, the policy, which was intended to increase revenue by 9,500 crores annually, failed to meet its targets due to administrative lapses and procedural violations.

• The 2025 audit specifically highlighted that the decision to provide relief to liquor licensees during the COVID-19 pandemic was done without the necessary statutory approvals, contributing to the Rs. 2,000 crore shortfall.

• The findings of the CAG serve as a primary document for the Public Accounts Committee (PAC) to review the financial conduct of the National Capital Territory (NCT) of Delhi.

Additional Information

• Delhi Excise Policy 2021-22:

• The policy was introduced in November 2021 with the aim of ending the government liquor trade and handing over the entire retail sector to private players.

• It divided Delhi into 32 zones, where each zone was auctioned to private bidders for a high license fee.

• The policy was eventually withdrawn by the Delhi Cabinet in July 2022 after the Lieutenant Governor (LG) recommended a CBI investigation into its formulation and execution.

• The Role of CAG:

• The Comptroller and Auditor General is a constitutional authority established under Article 148 of the Constitution of India.

• The CAG is responsible for auditing all receipts and expenditures of the Union and State Governments, including those with Legislative Assemblies like Delhi.

• The reports of the CAG are submitted to the President or Governor (or LG in case of UTs) to be laid before the Parliament or State Legislature.

• Agencies Involved in Investigation:

• The Central Bureau of Investigation (CBI) filed the initial FIR regarding the scam, focusing on corruption and undue favors to licensees.

• The Enforcement Directorate (ED) investigated the money laundering aspect, alleging that a "South Group" provided kickbacks worth Rs. 100 crores to political leaders.

Important Points

• Statutory Framework: The liquor trade in the capital is governed by the Delhi Excise Act, 2009 and the Delhi Excise Rules, 2010. Any deviation from these rules constitutes a legal violation.

• Revenue Components: The government revenue from liquor primarily comes from Excise Duty, Value Added Tax (VAT), and License Fees. The 2021-22 policy attempted to shift the bulk of revenue to upfront license fees.

• Impact of the Scam: The controversy led to the arrest of high-ranking officials and politicians in 2023 and 2024, making it one of the most high-profile financial scams in recent Indian history.

• The 2025 Report Significance: The CAG report mentioned in the question provides the final audited figure of the financial damage, distinguishing it from the initial estimates provided by the Chief Secretary of Delhi in 2022.

Q92. Answer: (a) Approval to commence reinsurance business

The correct answer is Approval to commence reinsurance business.

Key Points

• The Insurance Regulatory and Development Authority of India (IRDAI) granted the R2 License to Valueattics Reinsurance in March 2025, marking a significant milestone for the entity in the Indian insurance sector.

• An R2 License serves as the second and final stage of the registration process for reinsurance companies in India, effectively acting as the Certificate of Registration that allows the company to commence reinsurance business operations. Hence, the correct answer is Approval to commence reinsurance business.

• The granting of this license implies that Valueattics Reinsurance has met the rigorous regulatory requirements regarding capital adequacy, business plan viability, and management expertise as mandated by the IRDAI.

• With this approval, the company is authorized to accept risks from direct insurers (primary insurance companies), helping them manage their solvency margins and risk exposure.

• The entry of new players like Valueattics Reinsurance into the reinsurance market is intended to increase the reinsurance capacity within India, reducing the dependence on foreign reinsurers and curbing capital outflow from the country.

Additional Information

• IRDAI (Insurance Regulatory and Development Authority of India):

• It is a statutory body formed under the IRDA Act, 1999, following the recommendations of the Malhotra Committee.

• Headquartered in Hyderabad (shifted from Delhi in 2001), its primary mission is to protect the interests of policyholders and regulate the orderly growth of the insurance industry.

• Understanding Reinsurance:

• Reinsurance is often described as "insurance for insurance companies." It allows primary insurers to transfer a portion of their risk portfolio to a reinsurer to protect against catastrophic losses.

• Key functions of reinsurance include risk distribution, taxation benefits, stabilizing loss experience, and increasing the underwriting capacity of the primary insurer.

• The Registration Process (R1 to R3):

• The IRDAI follows a phased licensing approach: R1 is the preliminary "In-principle" approval, and R2 is the formal registration for business commencement.

• For foreign reinsurance branches (FRBs), there may be additional stages or specific classifications like R3 depending on the operational scope and retrocession permissions.

• Regulatory Framework:

• All reinsurance operations in India are governed by the Insurance Act, 1938 and various IRDAI (Reinsurance) Regulations issued periodically.

• Companies must maintain a solvency ratio of at least 1.5 to ensure they have enough capital to pay out claims even during financial distress.

Important Points

• Valueattics Reinsurance is expected to contribute to the Indian government's vision of making India a global reinsurance hub, similar to London or Singapore.

• The minimum paid-up equity capital for a reinsurer in India is typically Rs. 200 Crore, significantly higher than the Rs. 100 Crore required for life or general insurance companies.

• In the Indian market, GIC Re (General Insurance Corporation of India) remains the largest player and holds the "Right of First Refusal" on certain reinsurance business, though the market is becoming increasingly competitive with private and foreign

entrants.

Q93. Answer: (a) Japan

The correct answer is Japan.

Key Points

• Max Verstappen, representing Oracle Red Bull Racing, secured a dominant victory at the 2025 Japanese Grand Prix. This win was a pivotal moment in the 2025 Formula 1 season, reinforcing his status as a leading contender for the World Drivers' Championship.

• The race took place at the Suzuka International Racing Course, which is the only "figure-eight" layout on the FIA calendar. Verstappen's mastery of the high-speed S-Curves and the 130R corner was instrumental in his success.

• The 2025 victory showcased the continued technical synergy between Red Bull Racing and Honda RBPT (Red Bull Powertrains). The car's aerodynamic efficiency allowed Verstappen to maintain a significant lead over rivals from Ferrari and Mercedes throughout the 53 laps.

• Strategic excellence from the pit wall, led by Team Principal Christian Horner, ensured that Verstappen executed a flawless two-stop strategy, adapting perfectly to the track temperatures in Japan during the April race window.

• With this win, Max Verstappen added another trophy to his extensive collection, marking one of his most convincing performances of the 2025 calendar year.

Additional Information

• The Japanese Grand Prix History:

• The event first appeared on the Formula 1 schedule in 1976 at Fuji Speedway.

• Since 1987, the Suzuka Circuit has been the primary home for the race, known for its intense technical difficulty and passionate local fanbase.

• Historically, Japan has been the site where many World Championships have been decided due to its traditional slot late in the October season, though it was moved to April starting in 2024 to promote sustainability through regional "clustering" of races.

• Max Verstappen's Profile:

• Born in Hasselt, Belgium, on September 30, 1997, Verstappen competes under the Dutch flag.

• He made his Formula 1 debut in 2015 with Toro Rosso at just 17 years old, becoming the youngest driver in the history of the sport.

• By 2025, he had already secured multiple World Drivers' Titles (consecutively from 2021 to 2024), placing him among the all-time greats like Michael Schumacher and Lewis Hamilton.

• Other 2025 Grand Prix Locations:

• Bahrain: Usually hosts the season opener at the Sakhir circuit, characterized by night racing and desert conditions.

• Spain: Held at the Circuit de Barcelona-Catalunya, a track frequently used for testing due to its mix of high and low-speed sectors.

• China: The Shanghai International Circuit returned to prominence in the mid-2020s, featuring one of the longest straights on the F1 calendar.

• Technical Regulations: The 2025 season represented the final year of the current ground-effect aerodynamic regulations before the major 2026 engine and chassis rule changes, allowing teams like Red Bull to reach the peak of their development cycle.

Q94. Answer: (a) Assam

The correct answer is Assam.

Key Points

• The state of Assam launched a revised and comprehensive Flood Hazard Zonation Atlas in mid-June 2025 to strengthen its disaster management capabilities.

• This atlas was primarily developed by the Assam State Disaster Management Authority (ASDMA) in collaboration with the National Remote Sensing Centre (NRSC) under the Indian Space Research Organisation (ISRO).

• The primary objective of this tool is to provide a detailed spatial analysis of areas that are chronically affected by floods, utilizing satellite imagery and historical data spanning several decades.

• It serves as a decision-support system for government departments to plan infrastructure, such as embankments, roads, and bridges, in a manner that accounts for periodic inundation risks.

• By identifying high-risk zones, the state aims to improve the efficiency of rescue operations and the distribution of relief materials during the monsoon season.

Additional Information

• Geographical Vulnerability:

• Assam is located in the Brahmaputra and Barak river valleys, making it one of the most flood-prone regions in India.

• The Brahmaputra River is known for its high sediment load and tendency to change course, leading to severe riverbank erosion

and annual flooding.

• Role of Technology in Disaster Management:

• Modern tools include Geographic Information Systems (GIS) and Remote Sensing, which allow for real-time monitoring of water levels and catchment area precipitation.

• The Flood Hazard Zonation Atlas categorizes regions into different hazard levels, ranging from very high to low, based on the frequency of flooding.

• Comparison with Other States:

• Bihar: Highly vulnerable to floods due to the Kosi River, often referred to as the "Sorrow of Bihar." The state also utilizes satellite-based mapping for the Gangetic plains.

• Kerala: Faced catastrophic floods in 2018 and 2019, leading to the adoption of advanced Inundation Modeling and early warning systems for its 44 rivers.

• Karnataka: Experiences riverine floods in the Krishna and Cauvery basins and urban flooding in cities like Bengaluru.

Important Points

• Legal and Institutional Framework:

• The Disaster Management Act, 2005 mandates the creation of state and district-level authorities to mitigate the impact of natural calamities.

• The State Disaster Response Fund (SDRF) and National Disaster Response Fund (NDRF) provide the necessary financial backing for rehabilitation and reconstruction.

• Significance for Agriculture:

• The atlas is vital for the Agriculture Department to advise farmers on crop cycles and to promote the use of submergence-tolerant rice varieties in flood-prone areas of Assam.

• It helps in assessing crop damage accurately for insurance claims under schemes like the Pradhan Mantri Fasal Bima Yojana (PMFBY).

Q95. Answer: (d) 74%

The correct answer is 74%.

Key Points

• As of May 2025, the Government of India permits Foreign Direct Investment (FDI) in the defense sector up to 74% through the Automatic Route for companies seeking new industrial licenses.

• This significant policy shift was formalized through Press Note 4 (2020 Series) issued by the Department for Promotion of Industry and Internal Trade (DPIIT) in September 2020, aimed at boosting local manufacturing.

• For investments exceeding 74%, the Government Route is applicable, allowing up to 100% FDI where it is likely to result in access to modern technology or for other reasons to be recorded by the government.

• The policy stipulates that any foreign investment in the defense sector is subject to Security Clearance by the Ministry of Home Affairs and as per the guidelines of the Ministry of Defence.

• The liberalization of FDI limits is a core component of the Atmanirbhar Bharat Abhiyan (Self-Reliant India Mission), designed to encourage Original Equipment Manufacturers (OEMs) to set up production facilities within India.

Additional Information

• Evolution of FDI in Defense:

• In 2001, the defense sector was first opened to private participation with an FDI cap of 26%.

• The limit was increased to 49% under the Automatic Route in 2014 to stimulate the Make in India initiative.

• The current 74% limit serves to provide foreign investors with management control, thereby incentivizing the transfer of high-end technology to Indian subsidiaries.

• Automatic vs. Government Route:

• The Automatic Route signifies that the foreign investor or the Indian company does not require any prior approval from the Reserve Bank of India (RBI) or the Government of India for the investment.

• The Government Route (or Approval Route) requires prior clearance from the concerned administrative ministry, which in this case is the Ministry of Defence.

• Regulatory Framework:

• Defense manufacturing is primarily regulated under the Industries (Development and Regulation) Act, 1951 and the Arms Act, 1959.

• All foreign investments are subject to National Security clauses, allowing the government to review any investment that may affect the sovereignty and integrity of the nation.

• Sectoral Impact:

• The increase to 74% has facilitated major global firms like Safran, Lockheed Martin, and Boeing to explore deeper collaborations

with Indian partners.

• It aims to reduce the Defense Import Bill, as India has historically been one of the world's largest importers of major arms.

Important Points

• Fresh Industrial Licenses: The 74% automatic limit is specifically applicable to companies seeking New Industrial Licenses. Existing licensees seeking to infuse fresh foreign investment up to 49% must follow specific declaration protocols.

• Review Authority: The Department of Defence Production (DDP) functions as the nodal agency for processing cases under the Government Route and monitors the Indigenization progress.

• Equity Cap: While the 74% route is automatic, the government maintains the right to scrutinize any investment on the grounds of Security, ensuring that the control of critical defense infrastructure remains transparent.

Q96. Answer: (b) Gulmarg, Jammu and Kashmir

The correct answer is Gulmarg, Jammu and Kashmir.

Key Points

• The second phase of the Khelo India Winter Games 2025 was officially held in the world-famous ski resort of Gulmarg, located in the Baramulla district of Jammu and Kashmir.

• This phase of the multi-sport event took place in February 2025, following the successful completion of the first phase held earlier in the year.

• The competition in Gulmarg featured high-intensity winter sports disciplines, including Alpine Skiing, Snowboarding, Nordic Skiing, and Ski Mountaineering, attracting top athletes from across the country.

• The Jammu and Kashmir Sports Council, in collaboration with the Ministry of Youth Affairs and Sports, spearheaded the organization to promote winter tourism and professional sports in the region.

• The games serve as a platform to identify talent for representing India in international arenas like the Asian Winter Games and the Winter Olympics.

• Hence, the correct answer is Gulmarg, Jammu and Kashmir.

Additional Information

• Phase 1 of KIWG 2025:

• The first phase of the 2025 edition was conducted in Leh, Ladakh.

• It primarily focused on ice-based sports such as Ice Hockey, Figure Skating, and Speed Skating.

• Mascot of the Games:

• The official mascot for the Khelo India Winter Games 2025 is 'Sheen-e-She' (or Shan), which is a Snow Leopard.

• This mascot symbolizes the biodiversity of the Himalayas and the resilience required for winter sports.

• Infrastructure and Location:

• Gulmarg is situated at an altitude of approximately 2,650 meters and is home to the Gulmarg Gondola, one of the highest cable cars in the world.

• The region provides ideal conditions for winter sports due to its heavy snowfall and naturally groomed slopes like the Kongdoori and Apharwat peaks.

• Participating Entities:

• Athletes representing various States, Union Territories, and organizations like the Indian Army (HAWS - High Altitude Warfare School) and ITBP participate in these games.

Important Points

• Growth of Winter Sports: Since the inaugural edition in 2020, the Khelo India Winter Games have significantly increased the popularity of niche sports like Curling and Ice Skating in India.

• Economic Impact: Hosting these games helps boost the economy of Jammu and Kashmir and Ladakh by promoting sports tourism during the peak winter months.

• Youth Engagement: Under the Khelo India initiative, the government provides financial assistance and world-class coaching to selected athletes through Khelo India State Centres of Excellence (KISCE).

• Historical Context: Gulmarg has hosted the majority of the KIWG editions (including 2020, 2021, 2023, and 2024), establishing itself as the winter sports capital of India.

Q97. Answer: (d) Dhanush

The correct answer is Dhanush.

Key Points

• The Agnibaan - SOrTeD (Sub-Orbital Technological Demonstrator) mission was successfully launched on 30 May 2024.

• It was launched from Dhanush, which is India's first private launchpad, established by the space startup Agnikul Cosmos.

• The Dhanush launchpad is located within the premises of the Satish Dhawan Space Centre (SDSC SHAR) in Sriharikota,

Andhra Pradesh.

• This mission marked a significant milestone as it was the first-ever launch from a private launchpad in India and featured the world's first single-piece 3D-printed semi-cryogenic engine, named Agnilet.

• The flight was a sub-orbital mission, designed to test the flight systems and the 3D-printed engine technology before full-scale orbital launches.

Additional Information

• Agnikul Cosmos:

• It is an IIT Madras-incubated space startup founded in 2017 by Srinath Ravichandran and Moin SPM.

• The company focuses on developing cost-effective and customizable launch vehicles for small satellites.

• In 2022, Agnikul inaugurated India's first private launchpad and mission control center at Sriharikota.

• Agnilet Engine:

• The Agnilet is a semi-cryogenic engine that uses Liquid Oxygen (LOX) and Kerosene as propellants.

• It is unique because it is entirely 3D-printed as a single piece of hardware, significantly reducing the number of components and assembly time.

• Regulatory Framework:

• The launch was supported by IN-SPACe (Indian National Space Promotion and Authorization Centre) and ISRO (Indian Space Research Organisation).

• IN-SPACe acts as a single-window nodal agency to promote and authorize private sector participation in the Indian space sector.

• Significance for the Indian Space Sector:

• Following the success of Skyroot Aerospace's Vikram-S in November 2022, the Agnibaan mission further cements India’s position in the global private space industry.

• The use of additive manufacturing (3D printing) in rocket engines showcases India's technological advancements in deep-tech sectors.

Important Points

• The Agnibaan rocket is a customizable, two-stage launch vehicle capable of carrying a payload of up to 100 kg to a Low Earth Orbit (LEO) of about 700 km.

• The SOrTeD mission specifically utilized a single-stage version of the rocket to demonstrate vertical ascent and controlled flight.

• The establishment of private launchpads like Dhanush is part of the Indian Space Policy 2023, which encourages Non-Government Entities (NGEs) to own and operate space infrastructure.

Q98. Answer: (d) 3.8%

The correct answer is 3.8%.

Key Points

• The Economic Survey 2024-25, tabled in Parliament in January 2025, projected the growth rate for the Agriculture and Allied Sectors to be 3.8% for the financial year FY 2025.

• This forecast indicates a significant recovery and expansion compared to the previous financial year, FY 2024, where the growth rate was estimated at a lower 1.4% due to erratic weather patterns. Hence, the correct answer is 3.8%.

• The survey attributes this optimistic growth projection to the expectation of a normal monsoon and favorable reservoir levels across the country, which are critical for the Kharif and Rabi sowing seasons.

• The agriculture sector remains a vital pillar of the Indian economy, contributing approximately 18-19% to the Gross Value Added (GVA) and providing a livelihood for nearly 45% of the population.

• The improvement in agricultural output is expected to boost rural demand, which in turn supports the broader recovery of the Fast-Moving Consumer Goods (FMCG) and automobile sectors.

Additional Information

• Overall GDP Growth Forecast:

• The Economic Survey 2024-25 has projected India’s real GDP growth to be in the range of 6.5% to 7% for FY 2025.

• This growth trajectory maintains India's position as the fastest-growing major economy in the world, supported by strong domestic investment and private consumption.

• Role of the Economic Survey:

• The Economic Survey is a flagship document prepared by the Department of Economic Affairs under the Ministry of Finance.

• It is authored by the Chief Economic Advisor (CEA) of India, a position currently held by Dr. V. Anantha Nageswaran.

• The document provides a detailed report card of the economy for the closing financial year and offers insights and outlooks for the upcoming year.

• Focus on Food Inflation:

• The survey highlighted that while headline inflation is moderating, food inflation remains a key area of concern for policymakers.

• Supply-side measures and the expected 3.8% growth in agriculture are seen as essential tools to stabilize the prices of essential commodities like cereals and vegetables.

Important Points

• Structural Reforms in Agriculture:

• The 2024-25 survey emphasizes the need for digitalization in the farming sector through the Digital Public Infrastructure (DPI) for agriculture.

• It highlights the success of the PM-KISAN scheme, which provides direct income support to 11 crore farmers, ensuring financial stability.

• Credit Growth:

• The Institutional Credit to the agriculture sector has seen a steady rise, with the government setting high targets for Agricultural Credit to ensure farmers have access to affordable loans.

• Capital Expenditure (CapEx):

• A major theme of the January 2025 release is the continuation of high Capital Expenditure by the government, which includes building irrigation facilities, cold chains, and rural roads to support the 3.8% growth target.

Q99. Answer: (d) Singapore Convention Week 2025

The correct answer is Singapore Convention Week 2025.

Key Points

• The Indian Council of Arbitration (ICA), in collaboration with FICCI, organized a significant Symposium-cum-Roundtable titled 'Bridging Markets, Resolving Disputes via ADR in the India–Singapore Corridor'.

• This event was held on the sidelines of the Singapore Convention Week 2025, which is a premier global event dedicated to dispute resolution. Hence, the correct answer is Singapore Convention Week 2025.

• The primary objective of the symposium was to discuss and enhance the use of Alternative Dispute Resolution (ADR) mechanisms to facilitate smoother trade and investment between India and Singapore.

• The event highlighted the growing importance of the Singapore Convention on Mediation and how it provides a robust framework for enforcing international settlement agreements.

• The roundtable brought together legal experts, arbitrators, and corporate leaders to address challenges and opportunities in the India-Singapore economic corridor.

Additional Information

• Indian Council of Arbitration (ICA):

• Established in 1965, the ICA is the apex arbitral institution in India.

• It is headquartered in New Delhi and functions as an autonomous body under the Ministry of Commerce and Industry, Government of India.

• The ICA provides institutional arbitration services and promotes the use of ADR to settle commercial disputes efficiently.

• Singapore Convention Week (SCW):

• Organized annually by the Singapore Ministry of Law, the SCW is a signature event for the international dispute resolution community.

• It serves as a platform for thought leadership and networking among practitioners, government officials, and business executives.

• The week features various sessions on Arbitration, Mediation, and the evolving legal landscape of international commerce.

• The Singapore Convention on Mediation:

• Formally known as the United Nations Convention on International Settlement Agreements Resulting from Mediation.

• It was adopted on December 20, 2018, and opened for signature in Singapore on August 7, 2019.

• India was among the first group of 46 countries to sign the convention, reflecting its commitment to becoming a global hub for commercial dispute resolution.

• ADR Mechanisms:

• Alternative Dispute Resolution refers to methods like Arbitration, Mediation, and Conciliation used to resolve disputes outside the traditional courtroom.

• These methods are preferred in international trade because they are faster, confidential, and allow parties to choose experts as neutrals.

• Effective ADR is a key component of Ease of Doing Business indices, where India and Singapore have consistently worked to improve their rankings.

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Q100. Answer: (b) Manoj Kumar

The correct answer is Manoj Kumar.

Key Points

• Manoj Kumar is a legendary Indian actor, director, and screenwriter who became an iconic figure in Bollywood during the 1960s and 1970s.

• He earned the popular moniker "Bharat Kumar" due to his penchant for acting in and directing films with strong patriotic themes, where his character was often named Bharat.

• The veteran actor-director passed away on 4 April 2025 (as per the provided data), marking the end of a cinematic era dedicated to nationalism and Indian values.

• His significant contribution to cinema was recognized by the Government of India with the Dadasaheb Phalke Award in 2015, which is the highest honor in Indian cinema.

• He is best remembered for his "patriotic trilogy" of films: Shaheed (1965), Upkar (1967), and Purab Aur Paschim (1970).

• Hence, the correct answer is Manoj Kumar.

Additional Information

• Early Life and Background:

• Born as Harikishan Giri Goswami on July 24, 1937, in Abbottabad (then part of British India, now in Pakistan).

• His family migrated to Delhi during the Partition of India in 1947.

• He adopted the screen name Manoj Kumar after being inspired by Dilip Kumar's character in the 1949 film Shabnam.

• Directorial Milestones:

• His directorial debut, Upkar (1967), was produced at the request of Prime Minister Lal Bahadur Shastri to promote the slogan "Jai Jawan Jai Kisan" following the Indo-Pakistani War of 1965.

• In 1974, he directed Roti Kapada Aur Makaan, a massive hit that addressed social issues like unemployment and poverty in India.

• His 1981 film Kranti was another major success that focused on the Indian Independence Movement.

• Awards and Honors:

• He received the Padma Shri, India's fourth-highest civilian award, in the year 1992.

• Over his career, he won multiple Filmfare Awards, including Best Actor for Be-Imaan (1972) and Best Director for Upkar.

Important Points

• Analysis of Other Options:

• Amitabh Bachchan: Known as the "Angry Young Man" and "Shahenshah," he was born in 1942 and remains active in the film industry. While he has played patriotic roles, he is not referred to as "Bharat Kumar."

• Dilip Kumar: Often called the "Tragedy King," he was one of the greatest actors in Indian history. He passed away on July 7, 2021, at the age of 98.

• Rajesh Khanna: Recognized as the first "Superstar" of Indian cinema, he was famous for his romantic roles and massive fan following in the late 1960s and early 1970s. He passed away on July 18, 2012.

• Cinematic Style:

• Manoj Kumar's films were unique for blending entertainment with socio-political messages, often contrasting Western materialism with Indian spiritualism and culture.

• His portrayal of Bhagat Singh in Shaheed remains one of the most authentic depictions of the freedom fighter in Indian film history.

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