RRB Group D Official Paper (Held On: 15 Dec, 2025 Shift 2) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. A ball is thrown upward with an initial velocity of 12 m/s. What will be its velocity after 1 second? (Take g = 9.8 m/s²)

(a) 21.8 m/s
(b) 12 m/s
(c) 2.2 m/s
(d) 0 m/s

Q2. The fluid content inside the plasma membrane, which also contains many specialised cell organelles, is called:

(a) vacuoplasm
(b) nucleoplasm
(c) plasmin
(d) cytoplasm

Q3. A force F acts on a body of mass m producing acceleration a. If the force is 3 F and mass of the body is reduced to m/2. What is the value of new acceleration in terms of 'a'?

(a) 6 a
(b) a/6
(c) a
(d) a/2

Q4. Select the correct option with respect to the following statements.

Statement-1: Suspension is a homogeneous mixture.

Statement-2: The particles of a suspension can be seen by the naked eye.

Statement-3: The solute particles settle down when a suspension is left undisturbed, that is, a suspension is unstable.

(a) Statement 1 and 2 are correct
(b) Statement 2 and 3 are correct
(c) Statement 1, 2 and 3 are incorrect
(d) Statement 1, 2 and 3 are correct

Q5. Which of the following plant tissues allows the movement of materials in both directions?

(a) Fibres
(b) Phloem
(c) Sclerenchyma
(d) Xylem

Q6. An object is placed 30 cm from a concave mirror of focal length 20 cm. Using the mirror formula, what will be the image distance?

(a) −60 cm
(b) −2.5 cm
(c) −12 cm

(d) −40 cm

Q7. Three resistors of 12 Ω, 6 Ω and 4 Ω are connected in parallel. The equivalent resistance is _____.

(a) 0.05 Ω
(b) 22 Ω
(c) 1 Ω
(d) 2 Ω

Q8. A straight chain of three carbon atoms having no double bond and -OH functional group at first carbon atom is named:

(a) Propanone
(b) Propanol
(c) Propane
(d) Propanal

Q9. Match the following nature and role of metallic oxides.

Column A (Substance)	Column B (Role in Reaction)
CuO	1. Salt formed in reaction
HCl	2. Acid reacting with basic oxide
CuCl2	3. Basic oxide reacting with acid
H2O	4. Neutralisation product

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

Q10. Which of the following is NOT a marine fish?

(a) Pomfret
(b) Rohu
(c) Bhetki
(d) Mackerel

Q11. Read the given statements and select the most appropriate option.

Statement 1: Mirror formula is applicable to both concave and convex mirrors, provided the sign convention is followed.

Statement 2: The validity of Mirror formula depends on the size of the object.

(a) Only statement 1 is correct.
(b) Both the statements 1 and 2 are correct.
(c) Both the statements 1 and 2 are not correct.
(d) Only statement 2 is correct.

Q12. Liquids are less compressible because:

(a) they contain dissolved gases
(b) their density is always less than solids
(c) they have fixed mass always
(d) particles have moderate gaps

Q13. When thrown in soil, which of the following substances will persist in the environment for a long time?

(a) Mango seed
(b) Broken glass pieces
(c) Pieces of bread
(d) Apple peel

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Q14. A wire made of a certain material has a resistance of 12 Ω with length l and cross-sectional area A. What will be the resistance of another wire made of the same material but with length l/3 and cross-sectional area 2A ?

(a) 4 Ω
(b) 0.5 Ω
(c) 1 Ω
(d) 2 Ω

Q15. What is the percentage of having a male child if the sex chromosomes of the father are XY and those of the mother are XX?

(a) 25%
(b) 100%
(c) 75%
(d) 50%

Q16. In human beings, how is the sex of a child determined?

(a) By the difference in number of chromosomes inherited by the child
(b) By the inheritance of X or Y chromosome from the father
(c) By the environmental conditions prevailing during development of the foetus
(d) By the inheritance of an X chromosome from the mother

Q17. Work done by a constant force depends on which of the following?

(a) Displacement only
(b) Both force and displacement, and the angle between them
(c) Magnitude of force only
(d) Mass of the object

Q18. What term describes the rapid to and fro motion of an object that is essential for producing sound?

(a) Rarefaction
(b) Refraction
(c) Vibration
(d) Compression

Q19. If a book is lying on a table and is not moving, which of the forces are balanced?

(a) Normal reaction and friction
(b) Weight of the book and normal reaction by the table
(c) Weight of the book and friction
(d) Only the weight of the book acts

Q20. Which of the following statements is/are correct regarding indicator?

a. Turmeric is a natural indicator used for acid base titration.
b. Phenopthalein is colourless in basic medium and gives pink colour in acidic medium.
c. Clove oil is categorised as olfactory indicator.

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

Q21. Which of the following is an example of complex permanent tissue?

(a) Lateral meristem
(b) Aerenchyma
(c) Phloem
(d) Collenchyma

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Q22. Which of the following is a typical physical property of non-metals?

(a) They are brittle and poor conductors of electricity.
(b) They are malleable and sonorous.
(c) They conduct heat and electricity well.
(d) They are ductile and shiny like metals.

Q23. Which of the following glands add their secretions to make easier transport and to provide nutrition for sperms?

(a) Seminal vesicles only
(b) Prostate and seminal vesicles
(c) Pineal
(d) Prostate only

Q24. What is the chemical reaction involved in the preparation of Plaster of Paris from gypsum?

(a) $CaSO4 \cdot 1/2H2O + water \rightarrow CaSO4 \cdot 2H2O$
(b) $CaSO4 \cdot 2H2O + heat \rightarrow CaSO4 + 2H2O$
(c) $CaSO4 \cdot 2H2O + heat \rightarrow CaSO4 \cdot 1/2H2O + 11/2H2O$
(d) $CaCO3 + heat \rightarrow CaO + CO2$

Q25. Which of the polyatomic ion has ‘n’ value equal to 3?

(a) SO4^(-n)
(b) PO4^(-n)
(c) HCO3^(-n)
(d) CO3^(-n)

MATHEMATICS

Q26. If each of the length, breadth and height of a cuboid is doubled, its total surface area becomes _____ the original total surface area.

(a) 8 times
(b) 2 times
(c) 4 times
(d) 3 times

Q27. If $x + y = 10$ and $xy = 24.96$, then find the value of $(x - y)^2$.

(a) 2.25
(b) 1.69
(c) 0.49
(d) 0.16

Q28. Find the value of 2/3 ÷ 12/11 of 81/4 + 41/7 - 51/2 × 11/7 + 51/3.

(a) 511/105
(b) 131/17
(c) 389/53
(d) 617/189

Q29. If 5 men and 2 women can reap 48 hectares in 3 days, and if 3 men and 1 woman can reap 54 hectares in 6 days, then how many women must assist 6 men to reap 378 hectares in 14 days?

(a) 7
(b) 5
(c) 3
(d) 9

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Q30. If 20% of a number is added to 72, then the result is the same number. 70% of the same number is:

(a) 93
(b) 63
(c) 83
(d) 73

Q31. A typist takes 40 minutes to type 2 pages. How many pages will he type in 60 minutes?

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

Q32. Raghu's ratio of income to expenditure is 2 : 1. His income increased by 30% and expenditure decreased by 10%. If the initial expenditure was Rs. 35,000, find his final saving (in Rs.).

6941

(a) 69,500
(b) 68,500
(c) 58,500
(d) 59,500

Q33. Expression $\sqrt{(1 + \sin\theta)/(1 - \sin\theta)}$ is equal to:

(a) $\sec\theta + \tan\theta$
(b) $\csc\theta + \cot\theta$
(c) $\sec\theta - \cot\theta$
(d) $\sec\theta - \tan\theta$

Q34. The arithmetic mean of the observations 61, 33, 94, 48, 36, 93, 73, 94 and 53 is:

(a) 65
(b) 61
(c) 56
(d) 71

Q35. Smart Bazaar is offering 'Buy 2, Get 8 free' on household items. What is the net percentage discount being offered by the Smart Bazaar?

(a) 78%
(b) 80%
(c) 82%
(d) 83%

Q36. A cricketer has an average of 88 runs over 10 innings. If he scores 219 runs in the 11^(th) inning, by how many runs (rounded off to the nearest whole number) does his average score increase?

(a) 19
(b) 2
(c) 6
(d) 12

Q37. A speed of 126 km/hr is the same as:

(a) 32 m/sec
(b) 35 m/sec
(c) 30 m/sec
(d) 37 m/sec

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Q38. The ages of Amit and Geeta are in the ratio 6: 5, and the sum of their ages is 44 years. Find Amit's age.

(a) 24 years
(b) 30 years
(c) 20 years
(d) 28 years

Q39. Two banks, A and B, offered loans at 3.5% and 7.5% per annum, respectively. Sachin borrowed an amount of Rs. 2,00,000 from each bank. Find the positive difference (in Rs.) between the amounts of simple interest paid to the two banks by Sachin after 4 years.

(a) 33,500
(b) 32,000
(c) 33,000
(d) 31,500

Q40. The sides of a triangle are 34 cm, 88 cm, and 78 cm. What is the length of its altitude corresponding to the side with a length of 88 cm?

(a) 9 cm
(b) 30 cm
(c) 19 cm
(d) 79 cm

Q41. A triangular garden has vertices at coordinates A(2, 3), B(8, 11), and C(14, 7). A landscape designer wants to plant flowers covering exactly half of this triangular area. What area should be covered with flowers?

(a) 18 square units
(b) 12 square units
(c) 36 square units
(d) 24 square units

Q42. In a pouch containing blue, yellow and orange tokens, the ratio of blue to yellow tokens was 5 : 2, while the ratio of orange to blue tokens was 11 : 18. What was the ratio of orange to yellow tokens?

(a) 55 : 36
(b) 59 : 40
(c) 51 : 32
(d) 63 : 39

Q43. The income of Raman is Rs. 91,700. He saves 20% of his income. If his income increases by 19% and expenditure increases by 35%, then his savings will:

(a) increase by Rs. 8,255
(b) decrease by Rs. 8,252
(c) increase by Rs. 8,249
(d) decrease by Rs. 8,253

Q44. A, B and C can individually do a piece of work in 2 days each. How long (in days) will they take to do thrice the same work, working together?

(a) 2
(b) 6
(c) 3
(d) 4

Q45. Nisha buys a gold ring for her mother. The ring is marked at Rs. 88,000 and is offered with two successive discounts of 25% and Z%, respectively. After receiving both discounts, she pays Rs. 33,000. Find the value of Z.

(a) 48
(b) 50
(c) 49
(d) 51

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Q46. Train P going at a speed of 72 km/hr completely passes train Q of length 393 m, going in the same direction on parallel tracks at 42 km/hr, in 1.5 minutes. How much time (in seconds) will train P take to completely cross train R of length 468 m, going at 63 km/hr in the opposite direction?

(a) 22
(b) 32
(c) 10
(d) 24

Q47. Prabhdeep buys 60 identical pens for Rs. 900. She sells 45 of them at a profit of 20% and the remaining at a loss of 40%. What is the total profit or loss percentage on the whole transaction?

(a) 5% loss
(b) 9% loss
(c) 5% profit
(d) 9% profit

Q48. What is the third proportional of $75x^2$ and $30xy$?

(a) $11y^2$
(b) $9y^2$
(c) $12y^2$
(d) $13y^2$

Q49. A shopkeeper has Rs. 10 and Rs. 5 notes totaling Rs. 350. If he has 45 notes in total, how many Rs. 10 notes does he have?

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

Q50. A typist takes 40 minutes to type 4 pages. How long (in minutes) will he take to type 111 pages?

(a) 1110
(b) 1100
(c) 1120
(d) 1115

GENERAL INTELLIGENCE & REASONING

Q51. If ‘A’ stands for ‘÷’, ‘B’ stands for ‘×’, ‘C’ stands for ‘+’ and ‘D’ stands for ‘−’, then what will come in place of the question mark (?) in the following equation?

7 B 6 C 3 D 24 A 4 = ?

(a) 39
(b) 36
(c) 38
(d) 37

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

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

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

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

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Q53. Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

DRA120, OCL102, ZNW84, KYH66, ?

(a) VAS48
(b) VJS48
(c) UJS48
(d) VJT48

Q54. 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) UD – AG
(b) LU – RX
(c) BK – HN
(d) CL – JO

Q55. What should come in place of the question mark (?) in the given series?

351 335 319 303 287 ?

(a) 269
(b) 275
(c) 271
(d) 273

Q56. Six animals, Bear, Fox, Giraffe, Lion, Panda and Tiger, are sitting around a circular table facing the centre. Fox is an immediate neighbour of both Tiger and Bear. Tiger is sitting second to the left of Lion. Giraffe is sitting second to the left of Panda. Who is sitting between Lion and Tiger, when counted from the left of Lion?

(a) Panda
(b) Bear
(c) Giraffe
(d) Fox

Q57. If ‘A’ stands for ‘÷’, ‘B’ stands for ‘×’, ‘C’ stands for ‘+’ and ‘D’ stands for ‘−’, what will come in place of the question mark (?) in the following equation?

5 D 4 C 40 B 3 A 1 = ?

(a) 125
(b) 121
(c) 123
(d) 127

Q58. 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 statement(s).

Statements:

All books are pens.

Some pens are erasers.

Conclusions:

(I) All erasers are pens.

(II) Some books are erasers.

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

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Q59. M, N, O, P, W, X and Y are sitting around a circular table facing the centre of the table.

W sits third to the left of O. X sits second to the left of Y. O is the immediate neighbour of both N and X. P is not an immediate neighbour of W.

How many people sit between M and X when counted from the right of M?

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

Q60. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

22 - 13 ÷ 21 × 39 + 48 = ?

(a) -17
(b) -18
(c) -21
(d) -19

Q61. 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.)

(16, 256, 16)

(9, 81, 9)

(a) (4, 16, 6)
(b) (25, 625, 20)
(c) (12, 144, 10)
(d) (8, 64, 8)

Q62. In a certain code language, 'store what matters' is coded as 'bf yt xc' and 'don't store it' is coded as 'hd ip xc'. How is 'store' coded in the given language?

(All codes are two-letter codes)

(a) hd
(b) ip
(c) bf
(d) xc

Q63. Mr. Akai starts from Point A and drives 9 km towards south. He then takes a left turn, drives 7 km, turns left and drives 21 km. He then takes a left turn and drives 18 km. He takes a final left turn, drives 12 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90 degrees turns only unless specified)

(a) 11 km to the west
(b) 11 km to the east
(c) 7 km to the north
(d) 7 km to the east

Q64. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

SAT OWP KSL GOH ?

(a) CKI
(b) CDK
(c) COK
(d) CKD

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Q65. Refer to the given series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.

(Left) 3 6 5 4 1 2 5 8 9 7 4 5 6 (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) Three
(b) Two
(c) Four
(d) One

Q66. Seven boxes, A, B, C, D, I, J, and K, are kept one over the other, but not necessarily in the same order.

Only two boxes are kept between A and C. Only B is kept above K. No box is kept below C. J is kept at some place below D but at some place above I. Which box is kept third above I?

(a) D
(b) A
(c) K
(d) C

Q67. What should come in place of the question mark (?) in the given series?

321 323 327 333 341 ?

(a) 349
(b) 353
(c) 355
(d) 351

Q68. 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 foxes are cats.

No cat is a bear.

Conclusions:

(I): No fox is a bear.

(II): Some bears are cats.

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

Q69. IK 6 is related to KF −10 in a certain way. In the same way, GI 8 is related to ID −8. To which of the given options is RT 12 related, following the same logic?

(a) TP −4
(b) SO −5
(c) UO −5
(d) TO −4

Q70. What should come in place of the question mark (?) in the given series?

3 6 11 18 ?

(a) 22
(b) 18
(c) 24
(d) 27

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Q71. EFJL is related to HKMQ in a certain way based on the English alphabetical order. In the same way, QZVF is related to TEYK. To which of the given options is ZOEU related, following the same logic?

(a) CTHU
(b) CTHZ
(c) CHTY
(d) CHZW

Q72. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

MKD : IJG

PTF : LSI

(a) YUN : UTQ
(b) JHE : FFH
(c) OPA : KOC
(d) NKH : JJJ

Q73. A, B, C, D, E and F are sitting around a circular table facing the centre. C sits second to the left of E. A sits second to the right of D. F is on the immediate right of A. Who is sitting on the immediate right of B?

(a) E
(b) C
(c) D
(d) A

Q74. Hiten ranked 39^(th) from the top and 24^(th) from the bottom in his class. How many students are there in his class?

(a) 62
(b) 60
(c) 61
(d) 63

Q75. In a certain code language, ‘VALE’ is coded as ‘6318’ and ‘OVAL’ is coded as ‘3761’.What is the code for ‘O’ in the given code language?1637

(a) 1
(b) 3
(c) 7
(d) 6

Q76. 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) 4 8 2 8 2 3 8 3 1 3 9 1 7 3 9 7 6 2 6 6 6 8 2 (Right)

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

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

Q77. In a certain code language,

A ? B means ‘A is the daughter of B’,

A = B means ‘A is the son of B’,

A @ B means ‘A is the father of B’ and

A √ B means ‘A is the sister of B’.

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

(a) Brother
(b) Son

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(c) Father
(d) Husband

Q78. Riya starts from point A and drives 34 km towards south. She then takes a right turn, drives 46 km, turns right and drives 51 km. She then takes a right turn and drives 67 km. She takes a final right turn, drives 17 km and stops at point P. How far (shortest distance) and towards which direction should she drive in order to reach point A again?
(Note: All turns are 90° turns only unless specified.)
(a) 21 km to the west
(b) 20 km to the west
(c) 19 km to the east
(d) 18 km to the east

Q79. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which 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) MT – JZ
(b) SV – PA
(c) RD – OI
(d) KQ – HV

Q80. This question is based on the five, three-digit numbers given below.
(Left) 741 753 789 761 745 (Right)
(Example- 697 – First digit = 6, second digit = 9 and third digit = 7)
(NOTE: All operations to be done from left to right.)
What will be the resultant if the second digit of the second highest number is added to the third digit of the lowest number?
(a) 6
(b) 7
(c) 8
(d) 11

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Who was appointed as Chairperson of the Economic Advisory Council to the Prime Minister (EAC-PM) in June 2025?
(a) Arun Kumar
(b) S Mahendra Dev
(c) Suman Bery
(d) Bibek Debroy

Q82. According to Reporters Without Borders (RSF) World Press Freedom Index 2025, which country topped the index released in May 2025?
(a) Finland
(b) Switzerland
(c) Estonia
(d) Norway

Q83. In April 2025, the World Bank and International Monetary Fund (IMF) held their Spring Meetings in which U.S. city?
(a) Los Angeles
(b) Chicago
(c) Washington, D.C.
(d) Miami

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Q84. Which Indian beach hosted the amphibious landing phase of Tiger Triumph 2025?

(a) Kakinada
(b) Kanyakumari
(c) Juhu
(d) Puri

Q85. As of June 2025, who among the following is NOT the Chief Minister of any state in India?

(a) Kalvakuntla Chandrashekar Rao
(b) Himanta Biswa Sarma
(c) Nara Chandrababu Naidu
(d) Bhajan Lal Sharma

Q86. What long-term wireless milestone did IIT Hyderabad and Japan's SSIC achieve as of May 2025?

(a) Prototype 7G
(b) 100 Gbps laser satellites
(c) 5G broadcast TV
(d) Test of Beyond 5G and 6G SDR SoC

Q87. As per the India Justice Report, 2025, which is the only state in India to meet all three (SC, ST and OBC) quotas in both the police and judiciary?

(a) Assam
(b) Karnataka
(c) Kerala
(d) Chhattisgarh

Q88. What is the name of India's automated Air Defence Control and Reporting System, designed to detect, track, and neutralise enemy aircraft, drones, and missiles in May 2025?

(a) Agnidhar
(b) Naag
(c) Akashbhed
(d) Akashteer

Q89. Neeraj Chopra won the Ostrava Golden Spike javelin event in June 2025 with what distance?

(a) 84.10 m
(b) 87.00 m
(c) 85.29 m
(d) 86.50 m

Q90. Which global cybersecurity company collaborated with the Indian Computer Emergency Response Team (CERT-In) to launch the Digital Threat Report 2024 for the Banking, Financial Services, and Insurance (BFSI) sector in April 2025?

(a) Kaspersky Labs
(b) Norton CyberSecure
(c) McAfee International
(d) SISA

Q91. As per Union Budget 2025–26, how much corpus has been allocated to the Ministry of Science and Technology to finance private-sector-led research, development, and innovation?

(a) Rs. 50,000 crore
(b) Rs. 25,000 crore
(c) Rs. 35,000 crore
(d) Rs. 20,000 crore

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Q92. Which of the following countries is the venue for the 2025 Esports World Cup?

(a) Beijing
(b) Berlin
(c) Riyadh
(d) Dubai

Q93. Which of the following states has become the first in India to use face recognition linked to Aadhaar for ration delivery in July 2025?

(a) Uttarakhand
(b) Haryana
(c) Himachal Pradesh
(d) Punjab

Q94. Which of the following is India's rank among the most polluted countries of the world as of IQ Air Report 2024?

(a) 9
(b) 7
(c) 3
(d) 5

Q95. Which country won the most medals at the 2025 World Athletics Championships?

(a) China
(b) Great Britain
(c) Kenya
(d) USA

Q96. How many years of service is the IMD celebrating in 2025?

(a) 100 years
(b) 175 years
(c) 125 years
(d) 150 years

Q97. The Waqf (Amendment) Act, 2025 mandates the representation of how many Muslim women on Waqf boards?

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

Q98. Saweety Boora, the Indian World Championships gold medalist and Arjuna Award recipient in 2025, is associated with which sport?

(a) Weightlifting
(b) Badminton
(c) Wrestling
(d) Boxing

Q99. Which religious communities are covered under Karnataka's Rs. 50,000 incentive scheme for mass marriages in July 2025?

(a) Only SC/ST
(b) Muslim, Christian, Jain, Buddhist, Parsi and Sikh
(c) Hindu and Buddhist
(d) Only Muslim and Christian

Q100. According to Envstats India 2025, what was the inland fish production in 2023-24?

(a) 112.77 lakh tonnes
(b) 139.07 lakh tonnes
(c) 147.23 lakh tonnes

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(d) 79.83 lakh tonnes

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (c) 2.2 m/s

The correct answer is 2.2 m/s.

Key Points

• The motion of the ball follows the first equation of motion, which relates final velocity, initial velocity, acceleration, and time.

• Given data: The initial velocity (u) is 12 m/s, the time (t) is 1 second, and the acceleration due to gravity (g) is 9.8 m/s^2.

• When an object is thrown upward, it moves against the force of gravity. Therefore, the acceleration (a) is taken as -g, which is -9.8 m/s^2. Hence, statement 1 is correct in its application of sign convention.

• Applying the formula v = u + at, we substitute the values: v = 12 + (-9.8 × 1).

• The calculation results in v = 12 - 9.8, which equals 2.2 m/s. Hence, the final velocity after 1 second is 2.2 m/s.

• Since the resulting velocity is positive, it indicates that the ball is still moving upward but at a significantly reduced speed due to the constant downward pull of gravity.

Additional Information

• Equations of Motion:

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

• First Equation: v = u + at (Velocity-Time relation).

• Second Equation: s = ut + 1/2 at^2 (Position-Time relation), where s is displacement.

• Third Equation: v^2 = u^2 + 2as (Velocity-Position relation).

• Acceleration due to Gravity (g):

• On Earth, the standard value for g is approximately 9.8 m/s^2. It represents the constant acceleration experienced by an object in free fall.

• The value of g varies slightly depending on the location (altitude and latitude), being higher at the poles and lower at the equator.

• Sign Convention in Kinematics:

• In vertical motion, if we consider the upward direction as positive, then initial velocity (u) is positive, and acceleration due to gravity (g) is negative because it acts downward.

• At the maximum height of the trajectory, the final velocity (v) of the object becomes 0 m/s momentarily before it starts descending.

• Scalar vs Vector Quantities:

• Velocity is a vector quantity, meaning it has both magnitude and direction. In this problem, the magnitude is 2.2 m/s and the direction is upward.

• Speed is a scalar quantity and only represents the magnitude of the rate of motion.

Important Points

• If the time given was longer, such as 2 seconds, the velocity would become negative (12 - 19.6 = -7.6 m/s), indicating the ball has already reached its peak and is falling back down.

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• The maximum height reached by the ball can be calculated using the formula s = u^2 / 2g. For an initial velocity of 12 m/s, the maximum height would be approximately 7.35 meters.

• The total time of flight for the ball to return to the thrower's hand (ignoring air resistance) is calculated as T = 2u / g, which would be approximately 2.45 seconds.

Q2. Answer: (d) cytoplasm

The correct answer is cytoplasm.

Key Points

• Cytoplasm is the thick, jelly-like fluid content that is enclosed within the plasma membrane and surrounds the nucleus of a cell.

• It serves as the primary arena for most metabolic activities and chemical reactions necessary for life, such as glycolysis (the initial stage of cellular respiration).

• The cytoplasm is not just a simple fluid; it contains many specialised cell organelles like mitochondria, endoplasmic reticulum, ribosomes, and the Golgi apparatus, each performing a specific function for the cell.

• The portion of the cytoplasm that is not occupied by organelles is called the cytosol, which consists mainly of water (about 70% to 90%), salts, and organic molecules like proteins and enzymes.

• It plays a vital role in structural support, maintaining the shape of the cell, and facilitates the movement of materials via cytoplasmic streaming.

Additional Information

• Nucleoplasm:

• Also known as karyoplasm, this is the highly gelatinous fluid found inside the nucleus of eukaryotic cells.

• It provides the medium in which the nucleolus and chromatin (containing DNA) are suspended.

• The nuclear envelope acts as a barrier that separates the nucleoplasm from the cytoplasm, allowing for controlled transport of molecules through nuclear pores.

• Vacuoplasm (Cell Sap):

• This refers to the fluid found inside a vacuole, a storage organelle particularly prominent and large in plant cells.

• It contains various substances such as water, sugars, salts, amino acids, and sometimes metabolic waste products.

• In plants, it helps maintain turgor pressure, which provides the cell with rigidity and structural integrity.

• Plasmin:

• Unlike the other terms, plasmin is not a part of the internal cell structure; it is an important proteolytic enzyme present in the blood.

• Its primary function is to degrade fibrin clots, a process known as fibrinolysis, which prevents blood clots from becoming too large and causing health issues.

• It is derived from its inactive precursor, plasminogen, which is produced in the liver.

• Protoplasm:

• The term protoplasm refers to the entire living substance of the cell, including both the cytoplasm and the nucleus.

• It was first coined by the scientist J.E. Purkinje in 1839 to describe the physical basis of life within a cell.

Important Points

• Plasma Membrane: This is a selectively permeable membrane that regulates the entry and exit of molecules, thereby protecting the internal environment of the cytoplasm.

• Cell Organelles: These are membrane-bound structures within the cytoplasm. For example, mitochondria are the powerhouse of the cell because they generate ATP (Adenosine Triphosphate), the energy currency of the cell.

• Eukaryotic vs. Prokaryotic: In eukaryotic cells (like those in humans and plants), the cytoplasm contains complex organelles, whereas in prokaryotic cells (like bacteria), there are no membrane-bound organelles, and the genetic material is suspended directly in the cytoplasm.

Q3. Answer: (a) 6 a

The correct answer is 6 a.

Key Points

• Newton's Second Law of Motion provides the fundamental relationship between force, mass, and acceleration. It states that the acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.

• The mathematical expression for this law is F = m × a, where F is the force applied, m is the mass of the body, and a is the acceleration produced. From this, the acceleration can be derived as a = F / m.

• In the first scenario provided in the question, the force is F and the mass is m, which results in an acceleration of a = F / m.

• In the second scenario, the force is increased to 3F and the mass is reduced to m/2. To find the new acceleration (a'), we substitute these new values into the formula: a' = (3F) / (m / 2).

• By performing the algebraic calculation, a' = 3F × (2 / m), which simplifies to a' = 6 × (F / m). Since the original acceleration a is F / m, the new value becomes a' = 6a.

• This demonstrates that increasing the force while simultaneously decreasing the mass leads to a significantly higher acceleration. Hence, the statement that the new acceleration is 6a is correct.

Additional Information

• Force (F): It is an external agency capable of changing the state of rest or motion of a particular body. It is a vector quantity, meaning it has both magnitude and direction. The SI unit of force is the Newton (N), which is equivalent to 1 kg·m/s².

• Mass (m): This represents the quantity of matter contained in a body and serves as a measure of the body's inertia. Unlike weight, mass is a scalar quantity and remains constant regardless of the body's location in the universe. Its SI unit is the kilogram (kg).

• Acceleration (a): It is defined as the rate of change of velocity with respect to time. If the velocity of an object changes, it is said to be accelerating. The SI unit for acceleration is meters per second squared (m/s²).

• Newton's Laws of Motion: These three laws were first compiled by Sir Isaac Newton in his work Philosophiæ Naturalis Principia Mathematica, published in 1687. These laws form the basis for classical mechanics and describe the physics of moving objects.

Important Points

• Inertia and Mass: The mass of an object is a direct measure of its inertia. A larger mass requires more force to achieve the same acceleration. In this problem, reducing the mass to m/2 effectively halved the resistance to change in motion, contributing to the increase in acceleration.

• Proportionality: The relationship shows that if mass is kept constant, acceleration is doubled when force is doubled. However, if force is kept constant and mass is halved, the acceleration also doubles. When both changes occur simultaneously as per the question (3 times the force and 1/2 the mass), the total effect is 3 × 2 = 6.

• Practical Applications: This principle is used in automotive engineering to design faster cars by either increasing engine force (horsepower) or using lightweight materials like carbon fiber to reduce the mass of the vehicle.

Q4. Answer: (b) Statement 2 and 3 are correct

The correct answer is Statement 2 and 3 are correct.

Key Points

• Statement 1 claims that a suspension is a homogeneous mixture. In reality, a suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium. In a homogeneous mixture, such as a true solution, the composition is uniform throughout. Hence, statement 1 is incorrect.

• Statement 2 mentions that the particles of a suspension can be seen by the naked eye. This is due to the relatively large size of the particles, which are typically larger than 1000 nanometers (or 1 micrometer) in diameter. Unlike colloids or true solutions, where particles are too small to be seen without magnification, suspension particles are large enough to scatter visible light. Hence, statement 2 is correct.

• Statement 3 states that the solute particles settle down when a suspension is left undisturbed, meaning the suspension is unstable. Because the particles are large and heavy, the force of gravity eventually overcomes the kinetic energy keeping them dispersed, leading to sedimentation. Once the particles settle at the bottom, the mixture no longer scatters light as effectively. Hence, statement 3 is correct.

• The physical state of a suspension can be altered through filtration. Since the particles are larger than the pores of filter paper, they can be easily separated from the solvent or dispersion medium.

Additional Information

• Properties of Suspensions:

• A suspension is heterogeneous in nature, meaning its components are not distributed uniformly.

• The particles scatter a beam of light passing through it and make its path visible; this phenomenon is known as the Tyndall Effect. However, the Tyndall Effect disappears once the particles have settled down.

• Examples of suspensions include muddy water, chalk powder in water, flour in water, and milk of magnesia.

• Comparison with Other Mixtures:

• True Solution: It is a homogeneous mixture with a particle size less than 1 nm. These particles do not scatter light and cannot be seen by the naked eye. They are highly stable and do not settle.

• Colloid: It is a heterogeneous mixture that appears homogeneous. Particle sizes range between 1 nm and 1000 nm. They show the Tyndall Effect but do not settle down, making them stable.

• Applications and Facts:

• In the pharmaceutical industry, many medicines are prepared as suspensions (e.g., antacids) and must be shaken well before use to redistribute the settled solute particles.

• The instability of a suspension is a key characteristic used in water treatment plants, where coagulants are added to help suspended impurities settle faster through sedimentation.

Important Points

• Particle Size: The defining feature of a suspension is a particle size greater than 10^-6 meters.

• Separation: Unlike colloids, which require centrifugation, suspensions can be separated by simple mechanical filtration.

• Optical Properties: An active suspension is opaque or translucent, but the supernatant liquid may become transparent once the particles settle.

Q5. Answer: (b) Phloem

The correct answer is Phloem.

Key Points

• Phloem is a complex permanent tissue in vascular plants that acts as a conduction system for organic nutrients, primarily sucrose, produced during photosynthesis.

• Unlike Xylem, which only transports water upwards, the movement of materials in the Phloem is bidirectional. This means it can transport food materials both upwards and downwards depending on the plant's requirements.

• The process of transporting food materials through the phloem is known as translocation. This process is active and requires energy in the form of ATP to move substances against a concentration gradient.

• Phloem consists of four main types of cells: sieve tubes, companion cells, phloem parenchyma, and phloem fibres. Out of these, only phloem fibres are dead cells, while the rest are living tissues.

• The bidirectional flow is essential because it allows the leaves (the source) to send sugar to the roots for storage, and during spring, it allows the storage organs (the sink) to send energy back up to the developing buds.

Additional Information

• Xylem:

• It is responsible for the transport of water and minerals from the roots to the leaves.

• The flow of materials in the xylem is unidirectional (only upwards).

• It provides mechanical strength to the plant and is composed of tracheids, vessels, xylem parenchyma, and xylem fibres.

• Sclerenchyma:

• This is a simple permanent tissue made of dead cells with extremely thickened cell walls containing lignin.

• Its primary function is to provide structural support and rigidity to the plant. It is commonly found in stems, veins of leaves, and the hard coverings of seeds and nuts.

• Fibres:

• Fibres are a type of sclerenchyma cell. They are elongated, tapering, and have thick lignified walls.

• In the commercial world, fibres from plants like jute, flax, and hemp are used to make ropes and textiles due to their high tensile strength.

Important Points

• Mechanism of Transport: The movement in phloem is explained by the Pressure Flow Hypothesis (or Mass Flow Hypothesis), where high osmotic pressure in the leaves forces the phloem sap toward regions of low pressure (the sink).

• Vascular Bundles: Both Xylem and Phloem together constitute the vascular bundles of the plant, which are the main conducting tissues.

• Location: In a typical dicot stem, the Phloem is usually located towards the outer side of the vascular bundle, while the Xylem is located towards the inner side (pith).

• Sieve Tubes and Companion Cells: These are uniquely paired. Sieve tubes lack a nucleus at maturity, so their metabolic activities are controlled by the nucleus of the adjacent companion cells.

Q6. Answer: (a) −60 cm

The correct answer is -60 cm.

Key Points

• The mirror formula provides a quantitative relationship between the object distance (u), the image distance (v), and the focal length (f) of a spherical mirror. The formula is expressed as 1/f = 1/v + 1/u.

• For a concave mirror, the focal length (f) is always considered negative according to the New Cartesian Sign Convention. In this problem, the given focal length is 20 cm, so we use f = -20 cm.

• The object distance (u) is the distance from the pole of the mirror to the object. Since the object is placed in front of the mirror, the distance is measured against the direction of incident light, making it negative. Here, u = -30 cm.

• To find the image distance (v), we rearrange the mirror formula: 1/v = 1/f - 1/u. Substituting the values: 1/v = 1/(-20) - 1/(-30).

• This simplifies to 1/v = -1/20 + 1/30. By taking the Least Common Multiple (LCM) of 20 and 30, which is 60, the equation becomes 1/v = (-3 + 2) / 60.

• Solving further, 1/v = -1/60, which gives the result v = -60 cm. Hence, the image distance is -60 cm and the correct option is -60 cm.

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Additional Information

• Nature of the Image: Since the image distance (v) is negative, the image is formed in front of the mirror. This indicates that the image is real and inverted.

• Magnification (m): Magnification is defined as the ratio of the height of the image to the height of the object, also given by m = -v/u. In this case, m = -(-60) / (-30), which equals -2. A magnification of -2 means the image is magnified (twice the size of the object) and inverted.

• Position relative to Center of Curvature: The Radius of Curvature (R) of this mirror is R = 2f = 40 cm. Since the object is placed at 30 cm (between the Focus at 20 cm and the Center of Curvature at 40 cm), the image must form beyond the Center of Curvature (greater than 40 cm). Our result of 60 cm aligns with this optical principle.

• Concave Mirror Characteristics: Often called a converging mirror, it has the ability to produce real as well as virtual images depending on the object's position relative to the focal point.

Important Points

• Sign Convention Rules: Distances measured in the direction of incident light are taken as positive, while those measured in the opposite direction are negative. All distances are measured from the pole (P) of the mirror.

• Focal Lengths: It is a fact that the focal length of a concave mirror is always negative, whereas the focal length of a convex mirror is always positive.

• Real vs Virtual: A positive image distance (v) for a mirror would imply a virtual image formed behind the mirror, while a negative image distance signifies a real image.

• Practical Uses: Concave mirrors are utilized in torches, search-lights, and vehicle headlights to get powerful parallel beams of light, as well as by dentists to see larger images of teeth.

Q7. Answer: (d) 2 Ω

The correct answer is 2 Ω.

Key Points

• When resistors are connected in parallel, the reciprocal of the equivalent resistance (Req) is the sum of the reciprocals of the individual resistances. The formula is given by: 1/Req = 1/R1 + 1/R2 + 1/R3.

• In this problem, the three resistors are 12 Ω, 6 Ω, and 4 Ω. Substituting these values into the formula: 1/Req = 1/12 + 1/6 + 1/4.

• To solve the fractions, find a common denominator, which is 12. The equation becomes: 1/Req = 1/12 + 2/12 + 3/12.

• Adding the numerators gives: 1/Req = 6/12. Simplifying this fraction, we get 1/Req = 1/2.

• Taking the reciprocal of both sides, the equivalent resistance (Req) is 2 Ω. Hence, the calculated result matches the fourth option.

• A fundamental characteristic of parallel circuits is that the equivalent resistance is always less than the smallest individual resistor in the combination (in this case, 2 Ω is less than 4 Ω).

Additional Information

• Parallel Combination of Resistors:

• In a parallel circuit, the voltage across each resistor remains the same and is equal to the total voltage of the source.

• The total current in the circuit is the sum of the currents passing through each individual branch.

• This type of connection is commonly used in household wiring so that each appliance can operate independently at the same voltage.

• Series Combination of Resistors:

• When resistors are connected in series, the total resistance is the simple sum of individual resistances: R = R1 + R2 + R3.

• In a series circuit, the current remains constant through all components, while the voltage is divided among them.

• If the given resistors (12 Ω, 6 Ω, and 4 Ω) were in series, the equivalent resistance would be 22 Ω.

• Electrical Resistance:

• Resistance is the property of a conductor to oppose the flow of electric current.

• The SI unit of resistance is the Ohm (Ω), named after the German physicist Georg Simon Ohm.

• Factors affecting resistance include the length of the conductor, its cross-sectional area, the nature of the material, and its temperature.

Important Points

• Ohm's Law: This law states that the potential difference (V) across a conductor is directly proportional to the current (I) flowing through it, provided physical conditions remain constant. The relation is V = IR.

• Conductance: The reciprocal of resistance is called conductance (G), and its SI unit is Siemens (S) or mho. In parallel circuits, the total conductance is the sum of individual conductances (G_total = G1 + G2 + G3).

• Power Dissipation: In a parallel circuit, the resistor with the lowest resistance dissipates the highest power because P = V^2/R, and V is constant for all.

• Practical Application: If one component in a parallel network fails or is switched off, the other components continue to function, which is not the case in a series circuit.

Q8. Answer: (b) Propanol

The correct answer is Propanol.

Key Points

• The name of an organic compound is determined by the number of carbon atoms in its longest chain. A chain with three carbon atoms uses the prefix Prop-.

• The description "having no double bond" indicates that the compound is saturated. In chemical nomenclature, saturated hydrocarbons (alkanes) use the primary suffix -ane. When a functional group is added, the 'e' is typically dropped, making the base name Propan-.

• The presence of an -OH functional group identifies the molecule as an alcohol. According to IUPAC nomenclature, alcohols are designated by the suffix -ol.

• The location of the functional group is specified by numbering the carbon chain. Since the hydroxyl group (-OH) is at the first carbon atom, the systematic name is Propan-1-ol, commonly referred to as Propanol. Hence, the correct answer is Propanol.

• Evaluating other options:

• Propanone: This is a ketone (suffix -one) which requires a carbonyl group (C=O) on a non-terminal carbon. Hence, this option is incorrect.

• Propane: This is a simple alkane consisting only of carbon and hydrogen with no functional groups like -OH. Hence, this option is incorrect.

• Propanal: This is an aldehyde (suffix -al) which contains a -CHO group at the end of the chain rather than an -OH group. Hence, this option is incorrect.

Additional Information

• IUPAC Nomenclature System: This is a globally recognized method of naming organic chemical compounds maintained by the International Union of Pure and Applied Chemistry. It ensures that every compound has a unique and unambiguous name based on its molecular structure.

• Root Word Selection: The prefix is determined by the number of carbons: Meth- (1), Eth- (2), Prop- (3), But- (4), Pent- (5), and Hex- (6). For this question, three carbons lead directly to Prop-.

• Functional Group Suffixes:

• Alcohols (-OH): Use the suffix -ol. Example: Methanol (CH3OH).

• Aldehydes (-CHO): Use the suffix -al. Example: Ethanal (CH3CHO).

• Ketones (>C=O): Use the suffix -one. Example: Butanone (CH3COCH2CH3).

• Carboxylic Acids (-COOH): Use the suffix -oic acid. Example: Ethanoic acid (CH3COOH).

• Saturated vs. Unsaturated: A saturated compound contains only single bonds between carbon atoms, whereas unsaturated compounds contain at least one double bond (alkenes, suffix -ene) or triple bond (alkynes, suffix -yne).

Important Points

• Structure of Propanol: The chemical formula for Propan-1-ol is C3H8O, often written as CH3CH2CH2OH to show the straight-chain structure.

• Isomerism: Propanol has a structural isomer called Propan-2-ol (commonly known as Isopropyl alcohol or Isopropanol), where the -OH group is attached to the second carbon atom instead of the first.

• Physical Properties: Propan-1-ol is a colorless liquid at room temperature and is used extensively as a solvent in the pharmaceutical industry and for making antiseptics.

• Classification: It is classified as a primary alcohol because the carbon atom holding the hydroxyl group is attached to only one other carbon atom.

Q9. Answer: (d) A - 3; B - 2; C - 1; D - 4

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

Key Points

• CuO (Copper Oxide): Most metallic oxides are basic in nature. Copper(II) oxide reacts with dilute hydrochloric acid to produce a salt and water, acting as a base. In the given reaction, it serves as the basic oxide reacting with acid. Hence, A is matched with 3.

• HCl (Hydrochloric Acid): This is a strong mineral acid. In this specific chemical interaction, it acts as the acid reacting with basic oxide (CuO) to neutralize the base. Hence, B is matched with 2.

• CuCl2 (Copper Chloride): When an acid reacts with a metallic oxide, the resulting compound formed by the replacement of the hydrogen of the acid by a metal is a salt. Copper(II) chloride is the salt formed in the reaction, which gives the solution a characteristic blue-green color. Hence, C is matched with 1.

• H2O (Water): In a neutralization reaction between a base (or basic oxide) and an acid, water is always produced alongside the

salt. It is considered the neutralization product in this context. Hence, D is matched with 4.

• The overall chemical equation for this process is: CuO + 2HCl → CuCl2 + H2O. This demonstrates the typical behavior of metal oxides reacting with acids.

Additional Information

• Nature of Oxides:

• Basic Oxides: These are oxides of metals (like Na2O, MgO, CaO, and CuO) that react with acids to form salt and water.

• Acidic Oxides: These are typically oxides of non-metals (like CO2, SO2, P2O5) that react with bases to form salt and water.

• Amphoteric Oxides: Some metallic oxides, such as Aluminium oxide (Al2O3) and Zinc oxide (ZnO), show both acidic and basic behaviors.

• Neutralization Reaction: It is a chemical reaction in which an acid and a base react quantitatively with each other. In a reaction in water, neutralization results in there being no excess of hydrogen ions or hydroxide ions present in the solution.

• Copper(II) Oxide (CuO): It is a black solid. When it reacts with HCl, the black color disappears as it dissolves to form the blue-green solution of Copper(II) chloride.

• Indicators: The change in the nature of the solution (from acidic to neutral) during such reactions can often be monitored using pH indicators or litmus paper.

Important Points

• Reaction Observation: During the reaction of CuO with HCl, the observation of the color change is a key identifier of the formation of CuCl2. This is a common laboratory experiment to demonstrate the basic nature of metallic oxides.

• Valency: In Copper(II) oxide, the valency of copper is +2. This is why it requires two molecules of HCl (each providing one Cl- ion) to form one molecule of CuCl2.

• Safety: Handling concentrated HCl requires care due to its corrosive nature. Reactions involving metallic oxides and acids are generally exothermic, meaning they release heat.

• Solubility: While CuO is insoluble in water, it dissolves in acids, which is a characteristic property of basic oxides that are not alkalis (water-soluble bases).

Q10. Answer: (b) Rohu

The correct answer is Rohu.

Key Points

• Rohu (Labeo rohita) is a species of fish of the carp family (Cyprinidae) found in freshwater rivers in South Asia.

• It is a large omnivore and is used extensively in aquaculture in countries like India, Bangladesh, Nepal, and Pakistan. Hence, it is not a marine fish.

• It belongs to the category of Indian Major Carps, which also includes other freshwater species like Catla and Mrigal.

• Pomfret is a marine fish found in the Indo-Pacific region and is widely consumed in the coastal regions of India. Hence, statement 1 describes a marine fish.

• Mackerel is a common name applied to a number of different species of pelagic marine fish, mostly from the family Scombridae. Hence, statement 4 describes a marine fish.

• Bhetki, also known as Barramundi, is a euryhaline species (can tolerate various salinities) but is primarily found in estuaries, backwaters, and marine coastal waters. Hence, it is considered a marine/estuarine fish.

Additional Information

• Marine Fisheries:

• These involve the exploitation of fish resources from saltwater bodies such as oceans and seas.

• In India, the marine fishery resources are spread along the 8,118 km long coastline.

• Important marine fish varieties include Hilsa, Sardines, Tuna, Mackerel, and Pomfret.

• The exclusive economic zone (EEZ) of India provides a vast area for deep-sea fishing operations.

• Inland Fisheries:

• This refers to the catching and farming of fish in freshwater resources like canals, ponds, reservoirs, and rivers.

• Rohu is the most important among the three Indian major carp species used in polyculture systems.

• Freshwater aquaculture contributes to a significant portion of the total fish production in India, with states like Andhra Pradesh and West Bengal leading the sector.

• Characteristics of Rohu:

• Age and Growth: It can reach a maximum length of about 2 meters and can live for several years under optimal conditions.

• Features: It has cycloid scales, a depressed snout, and is typically bluish-grey or black on the back with a silvery-white belly.

• Diet: It is mainly a column feeder, consuming phytoplankton and decaying organic matter.

Important Points

• Distinction based on Salinity:

• Marine fish are adapted to high salinity levels and possess specialized osmoregulation mechanisms to prevent dehydration.

• Freshwater fish like Rohu are adapted to low-salinity environments; placing them in seawater would lead to fatal osmotic shock.

• Economic Significance:

• The Blue Revolution in India aimed to increase fish production and productivity from both marine and inland sources.

• Mackerel and Pomfret are high-value export items, contributing significantly to India's foreign exchange earnings.

• Rohu remains the primary source of animal protein for a large section of the population in North and East India.

Q11. Answer: (a) Only statement 1 is correct.

The correct answer is Only statement 1 is correct.

Key Points

• The Mirror Formula is a mathematical relationship that connects the focal length (f), the distance of the object (u) from the pole, and the distance of the image (v) from the pole. The formula is expressed as 1/v + 1/u = 1/f.

• Statement 1: This formula is universally applicable to all spherical mirrors, which includes both concave mirrors and convex mirrors. To obtain accurate results for different positions of the object, one must strictly follow the New Cartesian Sign Convention, where the pole is treated as the origin. Hence, statement 1 is correct.

• Statement 2: The derivation of the mirror formula assumes that the aperture of the mirror is small compared to its radius of curvature and that the rays of light are paraxial (rays that make small angles with the principal axis). However, the validity of the formula itself does not depend on the size of the object. The object height affects the magnification, but the relationship between the distances (u, v, and f) remains constant regardless of how large or small the object is. Hence, statement 2 is incorrect.

• The Sign Convention is crucial: distances measured in the direction of incident light are taken as positive, while those measured opposite to the direction of incident light are negative. For instance, the object distance (u) is almost always negative in standard problems.

• The focal length (f) for a concave mirror is always negative, whereas for a convex mirror, it is always positive according to the standard convention.

Additional Information

• Concave Mirror:

• A concave mirror is a converging mirror that can form both real and virtual images depending on the position of the object.

• When the object is placed between the focus (F) and the pole (P), it forms a virtual, erect, and magnified image.

• In all other positions beyond the focus, it forms real and inverted images of varying sizes.

• Convex Mirror:

• A convex mirror is a diverging mirror that always forms a virtual, erect, and diminished image, regardless of the object's distance from the mirror.

• Because it provides a wider field of view, it is commonly used as a rear-view mirror in vehicles.

• Linear Magnification (m):

• This is defined as the ratio of the height of the image (h') to the height of the object (h).

• It is also related to distances as m = -v/u. A negative magnification indicates a real image, while a positive magnification indicates a virtual image.

Important Points

• The relationship between the radius of curvature (R) and the focal length (f) is given by R = 2f. This relation holds true for all spherical mirrors with small apertures.

• In a concave mirror, the image is real when v is negative and virtual when v is positive.

• In a convex mirror, the image is always formed behind the mirror, so v is always positive, and since u is negative, the magnification m is always positive and less than 1.

• The Mirror Formula was first derived using the principles of Euclidean geometry and the laws of reflection (Angle of Incidence = Angle of Reflection).

Q12. Answer: (d) particles have moderate gaps

The correct answer is particles have moderate gaps.

Key Points

• Compressibility is the measure of the relative volume change of a fluid or solid as a response to a pressure change. In the case of liquids, the particles are packed relatively close to each other, meaning the intermolecular spaces are much smaller than those in gases.

• Liquids have particles that have moderate gaps compared to gases. While these particles can slide past one another (giving liquids their fluid property), they are close enough that there is very little "empty" space to be squeezed out when pressure is applied. Hence, statement 4 is correct.

• The presence of dissolved gases in a liquid might slightly increase its overall compressibility or lead to bubble formation under pressure changes, but it is not the primary reason why the liquid state itself is less compressible. Hence, statement 1 is incorrect.

• While the density of most liquids is indeed less than that of their solid counterparts (with water and ice being a notable exception), density is a measure of mass per unit volume, not the mechanism of compression. Compressibility is determined by the availability of space between particles to be reduced. Hence, statement 2 is incorrect.

• All matter in a closed system has a fixed mass according to the Law of Conservation of Mass. Having a fixed mass is a universal property of matter and does not explain why one state of matter (liquid) resists volume changes more effectively than another (gas). Hence, statement 3 is incorrect.

Additional Information

• States of Matter and Spacing:

• Solids: Particles are tightly packed in a regular pattern with negligible intermolecular spaces. They are considered incompressible for most practical purposes.

• Liquids: Particles are close together with moderate gaps and no regular arrangement. They take the shape of the container but maintain a fixed volume.

• Gases: Particles have very large gaps between them and move randomly at high speeds. Because of these vast spaces, gases are highly compressible.

• Kinetic Molecular Theory:

• This theory states that the distance between liquid particles is small enough that intermolecular attractive forces (like Van der Waals forces or Hydrogen bonding) hold them together, preventing the significant volume reduction seen in gases.

• Bulk Modulus:

• The resistance of a substance to compression is quantified by the Bulk Modulus. A high Bulk Modulus indicates that a substance is difficult to compress. Liquids like water have a very high Bulk Modulus (approximately 2.2 GPa), making them nearly incompressible in hydraulic systems.

• Applications:

• The low compressibility of liquids is the fundamental principle behind Hydraulic Machinery (like Pascal's Law). Since liquids do not compress easily, pressure applied at one point is transmitted efficiently throughout the fluid to perform work, such as in car brakes or industrial lifts.

Q13. Answer: (b) Broken glass pieces

The correct answer is Broken glass pieces.

Key Points

• Broken glass pieces are categorized as non-biodegradable waste. This means they cannot be broken down or decomposed by the action of microorganisms like bacteria, fungi, or earthworms. Hence, option 2 is correct.

• Mango seeds are organic matter derived from living organisms. They are biodegradable and will eventually rot and decompose into the soil, though they take slightly longer than soft tissues due to their hard shell. Hence, statement 1 is incorrect.

• Pieces of bread consist of organic compounds like carbohydrates. They are highly biodegradable and are quickly decomposed by molds and bacteria when exposed to moisture in the soil. Hence, statement 3 is incorrect.

• Apple peels are typical kitchen waste and are biodegradable. They decompose rapidly (usually within few weeks) and turn into compost, adding nutrients back to the environment. Hence, statement 4 is incorrect.

• Persistence in the environment refers to the duration a substance remains in the soil without changing its chemical structure. Glass is made primarily of silica (Silicon Dioxide), which is extremely stable and can persist for 1 million years or more.

Additional Information

• Biodegradable Substances:

• These are substances that are degraded by natural processes into simpler, non-toxic substances.

• Examples include agricultural residues, paper, wood, cloth, and animal dung.

• The decomposition process is carried out by decomposers, which recycle nutrients back into the ecosystem.

• Non-biodegradable Substances:

• These substances do not degrade or take a very long time (hundreds to thousands of years) to break down.

• Common examples include plastics, polythene bags, synthetic fibers, metal cans, and radioactive waste.

• They often act as pollutants and can enter the food chain, leading to biological magnification.

• Environmental Impact of Glass:

• While glass is chemically inert and does not leach toxic chemicals like some plastics, its physical presence causes land pollution.

• In soil, broken glass poses a physical hazard to macro-fauna such as earthworms and can hinder the penetration of plant roots.

• Because it does not oxidize or corrode easily, it remains unchanged in the geological strata for eras.

Important Points

• Microbial Enzymes: Microorganisms produce specific enzymes to break down organic bonds (like C-C or C-H bonds in food). However, they do not possess enzymes to break the silicon-oxygen bonds found in glass.

• Waste Management: To prevent environmental accumulation, non-biodegradable items like glass and metals should be recycled. Glass is 100% recyclable and can be melted and reformed infinitely without loss in quality.

• Decomposition Timeframes: While an apple peel takes about 2 to 4 weeks to disappear, a plastic bottle may take 450 years, and glass effectively never disappears under normal environmental conditions.

Q14. Answer: (d) 2 Ω

The correct answer is 2 ΩΩΩΩΩΩΩ

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Key Points

• The resistance of a conductor is defined by the formula R = ρ (l / A), where ρ is the resistivity of the material, l is the length, and A is the cross-sectional area.

• In the first case, the wire has a resistance of 12 ΩΩΩΩΩΩΩ

with length l and area A. This establishes the base equation: 12 = ρ (l / A). Hence, the initial relationship is defined.

• In the second case, the wire is made of the same material, which means the resistivity (ρ) remains constant because it is an intrinsic property of the material.

• The new length is given as l / 3 and the new cross-sectional area is 2A. Substituting these values into the resistance formula gives: R’ = ρ ((l/3) / (2A)). Hence, the new parameters are applied.

• Simplifying the expression, we get R’ = ρ (l / (3 × 2A)) = ρ (l / 6A). This can be rewritten as R’ = (1 / 6) × (ρ l / A).

• Since we know from the first case that ρ (l / A) = 12 ΩΩΩΩΩΩΩ

, we substitute this value: R’ = (1 / 6) × 12 = 2 ΩΩΩΩΩΩΩ

. Hence, the calculated resistance is correct.

• *Therefore, the correct answer is 2 ΩΩΩΩΩΩΩ

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Additional Information

• Factors Affecting Resistance:

• Length (l): The resistance of a conductor is directly proportional to its length. If the length increases, the electrons encounter more collisions, increasing the resistance.

• Cross-sectional Area (A): The resistance is inversely proportional to the area of cross-section. A thicker wire (larger area) provides a wider path for electron flow, reducing resistance.

• Nature of Material: Different materials offer different levels of opposition to current flow, characterized by their resistivity (ρ). Conductors like Copper and Silver have low resistivity.

• Temperature: For most metallic conductors, resistance increases with an increase in temperature due to more frequent atomic vibrations obstructing electron flow.

• Resistivity (ρ):

• It is the resistance offered by a wire of unit length and unit cross-sectional area.

• The SI unit of resistivity is Ohm-meter (ΩΩΩΩΩΩΩ

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m).

• Unlike resistance, resistivity does not change with the dimensions (length or area) of the wire; it only changes with the material and temperature.

Important Points

• Ohm’s Law: This fundamental law states that the current (I) flowing through a conductor is directly proportional to the potential difference (V) across its ends, provided physical conditions like temperature remain constant (V = IR).

• SI Unit of Resistance: The standard unit is the Ohm (ΩΩΩΩΩΩΩ

), named after the German physicist Georg Simon Ohm.

• Practical Application: In household wiring, thicker wires are used for high-power appliances (like air conditioners) because their larger cross-sectional area results in lower resistance, preventing the wires from overheating.

• Calculation Summary: When the length is divided by 3 and the area is multiplied by 2, the total resistance becomes 1/6th of the original value (1/3 × 1/2 = 1/6).

Q15. Answer: (d) 50%

The correct answer is 50%.

Key Points

• In humans, the sex of an individual is determined by a specific pair of chromosomes known as sex chromosomes or allosomes. Humans have a total of 23 pairs of chromosomes, out of which 22 pairs are autosomes and the 23rd pair determines the sex.

• Females possess two identical sex chromosomes, denoted as XX. Because they only carry X chromosomes, all the eggs or ova produced by a female will contain one X chromosome. This condition is referred to as being homogametic.

• Males possess two different sex chromosomes, denoted as XY. During the process of meiosis (gamete formation), males produce two types of sperm: approximately 50% carry the X chromosome and the other 50% carry the Y chromosome. This makes males heterogametic.

• The sex of the child is determined at the moment of fertilization by the type of sperm that fuses with the egg. If a sperm carrying an X chromosome fertilizes the egg (X), the zygote becomes XX, resulting in a female child.

• If a sperm carrying a Y chromosome fertilizes the egg (X), the zygote becomes XY, resulting in a male child. Since the ratio of X-carrying sperm to Y-carrying sperm is 1:1, the mathematical probability or percentage of having a male child is exactly 50%.

Additional Information

• The SRY Gene: The Y chromosome is significantly smaller than the X chromosome and carries a crucial gene called SRY (Sex-determining Region Y). This gene triggers the development of male characteristics in the embryo. In its absence, the embryo develops as a female.

• Heterogamy vs. Homogamy: In the XY sex-determination system, the male is the heterogametic sex (XY) and the female is the homogametic sex (XX). This system is prevalent in most mammals and some insects like Drosophila.

• Punnett Square Analysis: When crossing a mother (XX) and a father (XY), the possible combinations are XX, XX, XY, and XY. This clearly illustrates that two out of four possibilities result in a male, which equates to a 50% frequency.

• Other Systems: It is important to note that not all species follow the XY system. For example, in birds and some reptiles, the ZW system is used where the female is the heterogametic sex (ZW) and the male is homogametic (ZZ).

Important Points

• Scientific Responsibility: In many societies, women are traditionally blamed for the sex of the child. However, biological evidence confirms that the sex of the baby is determined solely by the genetic contribution of the father, as only he can provide the Y chromosome.

• Historical Context: The role of chromosomes in sex determination was first identified in the early 20th century (around 1905) by scientists like Nettie Stevens and Edmund Beecher Wilson, who independently discovered the XY and XO systems.

• Statistical Reality: While the theoretical probability is 50%, global demographic data often shows a slight natural skew (approximately 105 males to 100 females) due to various biological factors influencing sperm motility or embryo survival, though the genetic chance remains 1 in 2.

Q16. Answer: (b) By the inheritance of X or Y chromosome from the father

The correct answer is By the inheritance of X or Y chromosome from the father.

Key Points

• In human beings, every cell contains 23 pairs of chromosomes, making a total of 46 chromosomes. Out of these, 22 pairs are called autosomes and are identical in both males and females.

• The 23rd pair of chromosomes is known as the sex chromosome, which differs between the two sexes. Females possess two X chromosomes (XX), while males possess one X and one Y chromosome (XY).

• During the process of gametogenesis, the mother produces eggs (ova) that always carry a single X chromosome. Therefore, the maternal contribution to the child's sex is always the same.

• The father produces two types of sperm: approximately 50% carry an X chromosome and the other 50% carry a Y chromosome.

• The sex of the child is determined at the moment of fertilization. If a sperm carrying an X chromosome fertilizes the egg, the resulting zygote will be XX, developing into a female. If a sperm carrying a Y chromosome fertilizes the egg, the zygote will be XY, developing into a male. Hence, statement 2 is the correct mechanism.

Additional Information

• Heterogametic Sex: In humans, the male is the heterogametic sex because he produces two different types of gametes (X and Y), whereas the female is homogametic as she produces only one type (X).

• The SRY Gene: The Sex-determining Region Y (SRY) gene, located on the Y chromosome, is the master switch that triggers the development of male physical characteristics. In the absence of this gene, the embryo develops into a female.

• Probability of Sex: Statistically, there is a 50:50 chance of having a boy or a girl in each pregnancy, as the segregation of X and Y chromosomes into sperm occurs randomly during meiosis.

• Genetic vs. Environmental Determination: Unlike some reptiles (such as crocodiles and turtles) where the incubation temperature of the eggs determines the sex, human sex determination is strictly genetic and is not influenced by environmental conditions during the development of the foetus.

• Chromosomal Abnormalities: Sometimes, errors in cell division can lead to variations in the 23rd pair, such as Turner syndrome (XO) or Klinefelter syndrome (XXY), which affect physical and reproductive development.

Important Points

• Mendelian Inheritance: The inheritance of sex follows Mendel's laws of segregation, where alleles (in this case, sex chromosomes) separate during gamete formation.

• Historical Context: The discovery of the XY sex-determination system was made by Nettie Stevens and Edmund Beecher Wilson independently in 1905.

• Misconceptions: It is a common biological fact that the mother does not determine the sex of the child; however, in many cultures, women have been historically blamed for not giving birth to a male child despite the biological determination coming from the paternal sperm.

Q17. Answer: (b) Both force and displacement, and the angle between them

The correct answer is Both force and displacement, and the angle between them.

Key Points

• Work done by a constant force is defined as the product of the magnitude of the force, the magnitude of the displacement, and the cosine of the angle between the force and the displacement vectors.

• The mathematical expression for work is W = Fs cos θ, where W is the work done, F is the constant force, s is the displacement, and θ is the angle between the force vector and the displacement vector.

• It depends on the magnitude of force: If the force applied is doubled while keeping other factors constant, the work done will also double. Hence, option 3 is only a partial factor.

• It depends on the displacement: If an object does not move (s = 0), no work is done, regardless of how much force is applied. An example is pushing against a stationary brick wall. Hence, option 1 is also only a partial factor.

• It depends on the angle (θ): The direction of the force relative to the motion is crucial. If the force is perpendicular to the displacement (θ = 90°), the work done is zero because cos 90° = 0.

• Mass is not a direct variable in the basic formula for work done by a constant force, although it may influence the force required to move an object (via F = ma). Hence, statement 4 is incorrect.

• Hence, the correct answer is Both force and displacement, and the angle between them.

Additional Information

• Nature of Work:

• Positive Work: Occurs when the angle θ is between 0° and 90°. In this case, the force has a component in the direction of the displacement. An example is lifting an object upwards where the applied force is in the direction of movement.

• Negative Work: Occurs when the angle θ is between 90° and 180°. The force acts in a direction opposite to the displacement. Frictional force doing work on a sliding block is a classic example of negative work.

• Zero Work: Occurs when the force is perpendicular to displacement or either force or displacement is zero. A coolie carrying a load on his head and walking on a horizontal platform does zero work against gravity because the force of gravity is vertical while the displacement is horizontal.

• Units and Dimensions:

• The SI unit of work is the Joule (J). 1 Joule is defined as the work done by a force of 1 Newton causing a displacement of 1 meter.

• In the CGS system, the unit of work is the Erg. The relationship between them is 1 Joule = 10^7 Ergs.

• The dimensional formula for work is $[ML^2T^{-2}]$, which is the same as that for energy and torque.

Important Points

• Scalar Quantity: Even though force and displacement are vector quantities, their dot product, Work, is a scalar quantity. This means it only has magnitude and no specific direction in space.

• Work-Energy Theorem: This theorem states that the net work done on an object is equal to the change in its Kinetic Energy (KE). This connects the concept of work directly to the velocity and mass of the object.

• External vs Internal Force: The calculation of work depends on the specific force being considered. For example, while gravity does work on a falling apple, air resistance simultaneously does negative work on it.

Q18. Answer: (c) Vibration

The correct answer is Vibration.

Key Points

• Vibration is defined as the rapid to-and-fro or back-and-forth motion of an object about its mean position. This mechanical motion is the fundamental requirement for the production of sound. Hence, the correct answer is Vibration.

• Every source of sound, whether it is a musical instrument like a guitar string, a tuning fork, or the human vocal cords, must undergo vibration to generate pressure waves in the surrounding medium.

• When an object vibrates, it transfers its energy to the particles of the medium (solid, liquid, or gas) surrounding it. These particles then start vibrating, which leads to the propagation of sound waves.

• The frequency of these vibrations determines the pitch of the sound produced. A higher frequency of vibration results in a

high-pitched sound, while a lower frequency results in a low-pitched sound.

• The amplitude of the vibration determines the loudness or intensity of the sound. Larger vibrations (greater displacement from the mean position) produce louder sounds.

Additional Information

• Compression:

• In a longitudinal wave (like sound), compression is the region where the particles of the medium are crowded together.

• This region is characterized by high pressure and high density. Hence, statement 4 is incorrect as it describes a state of the medium, not the motion of the source.

• Rarefaction:

• Rarefaction is the region in a longitudinal wave where the particles are spread apart.

• This area exhibits low pressure and low density. Hence, statement 1 is incorrect because it refers to the wave's structure rather than the initiating motion.

• Refraction:

• Refraction is a phenomenon where a wave changes direction (bends) as it passes from one medium to another with a different optical or acoustic density.

• It occurs due to a change in the speed of the wave. Hence, statement 2 is incorrect as it relates to wave behavior at boundaries, not sound production.

• Characteristics of Sound Waves:

• Sound waves are mechanical waves and require a material medium for travel. They cannot propagate through a vacuum.

• The speed of sound in dry air at 20 degrees Celsius (68 degrees Fahrenheit) is approximately 343 meters per second.

• Sound travels fastest in solids (e.g., steel at approx 5960 m/s), followed by liquids (e.g., water), and slowest in gases.

Important Points

• Human Audibility: The range of audible frequencies for the human ear is typically between 20 Hz and 20,000 Hz (20 kHz).

• Infrasound: Frequencies below 20 Hz are known as infrasonic sounds, often produced by earthquakes or whales.

• Ultrasound: Frequencies above 20,000 Hz are called ultrasonic sounds, used in medical imaging (sonography) and by bats for navigation.

• Oscillation: While often used interchangeably with vibration, oscillation usually refers to slower, more rhythmic back-and-forth movements (like a pendulum), whereas vibration implies a more rapid movement.

• Echo: The reflection of sound arriving at the listener with a delay after the direct sound is known as an echo. To hear a distinct echo, the minimum distance from the reflecting surface should be approximately 17.2 meters.

Q19. Answer: (b) Weight of the book and normal reaction by the table

The correct answer is Weight of the book and normal reaction by the table.

Key Points

• When a book is lying stationary on a table, it is in a state of static equilibrium, meaning the net force acting on the object is zero.

• The Weight of the book is the gravitational force exerted by the Earth on the book, acting vertically downwards toward the center of the Earth.

• The Normal reaction force is the support force exerted by the surface of the table onto the book, acting vertically upwards, perpendicular to the surface.

• According to Newton's First Law of Motion, an object at rest stays at rest unless acted upon by an unbalanced force; since the book is not moving, the upward normal force must exactly magnitude-wise equal the downward gravitational force.

• These two forces are balanced forces because they act on the same object (the book), are equal in magnitude, and opposite in direction, resulting in zero acceleration. Hence, the correct answer is Weight of the book and normal reaction by the table.

Additional Information

• Newton's First Law (Law of Inertia): It states that every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force. In this scenario, the book's velocity is 0 and remains 0 because the forces are balanced.

• Weight vs. Mass: Mass is the amount of matter in the book (measured in kilograms), while Weight is a force (measured in Newtons) calculated as $W = mg$, where g is the acceleration due to gravity (approximately 9.8 m/s^2).

• Frictional Force: Friction acts parallel to the surface and opposes relative motion. If the book is just lying on a horizontal table without any horizontal external force trying to push it, the static friction is zero. Hence, options involving friction are incorrect for a book simply lying at rest.

• Balanced vs. Unbalanced Forces: Balanced forces do not change the state of motion of an object. Unbalanced forces cause acceleration (change in speed or direction) as per Newton's Second Law ($F = ma$).

Important Points

• Newton's Third Law Confusion: A common misconception is that the Weight and the Normal Reaction are an action-reaction pair. This is incorrect.

• Action-Reaction pairs act on different bodies (e.g., Book pushes Table down, Table pushes Book up).

• Balanced forces (Weight and Normal force here) act on the same body (the Book).

• Free Body Diagram (FBD): In a Free Body Diagram of the book, you would draw two arrows originating from the center of the book: one pointing down labeled W (mg) and one pointing up labeled N (Normal Force). Since there is no movement in the y-axis, N - mg = 0, or N = mg.

• Nature of Normal Force: The Normal Force is an electromagnetic force resulting from the atoms of the table resisting being compressed by the atoms of the book.

Q20. Answer: (d) a and c

The correct answer is a and c.

Key Points

• Indicators are substances that change their color or odor when added to an acidic or basic solution. They are essential in acid-base titration to determine the endpoint of a reaction.

• Turmeric is a well-known natural indicator. It contains curcumin, which remains yellow in acidic and neutral environments but changes its color to reddish-brown when it comes into contact with a base (such as soap or sodium hydroxide). Hence, statement a is correct.

• Phenolphthalein is a synthetic indicator often used in laboratories. It remains colourless in acidic and neutral solutions. However, it turns pink or magenta in a basic medium once the pH level exceeds approximately 8.2. The statement provided reverses these characteristics. Hence, statement b is incorrect.

• Olfactory indicators are specific substances whose smell changes in acidic or basic media. This property allows individuals, including those with visual impairments, to identify the nature of a solution. Clove oil is a classic example of an olfactory indicator, along with onion and vanilla essence. Hence, statement c is correct.

• Hence, the correct answer is a and c.

Additional Information

• Classification of Indicators:

• Natural Indicators: These are obtained from natural sources like plants. Examples include Litmus (extracted from Lichens), Red Cabbage extract, and Turmeric. Litmus turns red in acid and blue in base.

• Synthetic Indicators: These are man-made chemicals. Methyl orange and Phenolphthalein are the most common. Methyl orange gives a red color in acidic solutions and a yellow color in basic solutions.

• Olfactory Indicators: These work based on odor. In a basic medium, the characteristic smell of onion or clove oil is generally destroyed, while it persists in an acidic medium.

• Uses and Applications:

• Titration: Indicators are used to find the equivalence point where the acid and base have neutralized each other.

• Soil Testing: Farmers use indicators to check the pH of the soil to ensure optimal growth for specific crops.

• Water Treatment: Testing the alkalinity or acidity of water in swimming pools or industrial effluents.

Important Points

• Universal Indicator: Unlike simple indicators, a Universal Indicator is a mixture of several indicators. It shows different colors at different concentrations of hydrogen ions (pH scale from 0 to 14).

• Clove Oil Specifics: In the presence of hydrochloric acid (acid), the smell of clove oil is retained, but when mixed with sodium hydroxide (base), the smell cannot be detected.

• Phenolphthalein Range: It is widely used because its color transition is very sharp and occurs near the neutralization point for strong acid-strong base titrations.

Q21. Answer: (c) Phloem

The correct answer is Phloem.

Key Points

• Complex permanent tissue is defined as a collection of different types of cells that work together as a single unit to perform a common specialized function.

• Phloem is a prime example of complex permanent tissue because it consists of four distinct types of cells: sieve tubes, companion cells, phloem parenchyma, and phloem fibers. Hence, statement 3 is correct.

• The primary function of Phloem is the translocation of soluble organic compounds, specifically sucrose, from the leaves (the source) to the roots and other storage organs (the sink).

• Unlike simple tissues, complex tissues like Phloem and Xylem are vital for the survival of vascular plants as they facilitate the long-distance transport of nutrients and water.

• Lateral meristem is not a permanent tissue; it is a type of meristematic tissue responsible for the secondary growth (increase in diameter) of the plant stem and roots. Hence, statement 1 is incorrect.

• Aerenchyma is a specialized type of simple permanent tissue (a variation of parenchyma) that contains large air cavities, providing buoyancy to aquatic plants. Hence, statement 2 is incorrect.

• Collenchyma is a simple permanent tissue composed of living cells with unevenly thickened walls (due to cellulose and pectin) that provide mechanical support and flexibility. Hence, statement 4 is incorrect.

Additional Information

• Xylem:

• Along with phloem, Xylem is the second type of complex permanent tissue in plants.

• It is responsible for the conduction of water and minerals from the roots to the aerial parts of the plant.

• It consists of four elements: tracheids, vessels, xylem parenchyma, and xylem fibers.

• Except for xylem parenchyma, all other xylem cells are dead at maturity.

• Simple Permanent Tissue:

• These tissues are made up of only one type of cell which are similar in structure and function.

• Parenchyma: The most common tissue, involved in photosynthesis, storage, and secretion.

• Sclerenchyma: Consists of long, narrow cells with thick lignified walls; it provides structural strength and is usually dead.

• Vascular Bundles:

• In plants, Xylem and Phloem are organized into vascular bundles, which act as the plumbing system of the plant.

• The arrangement of these bundles varies between monocots and dicots.

Important Points

• Direction of Flow: In Xylem, the transport is strictly unidirectional (upwards from roots), whereas in Phloem, the transport is bidirectional (multi-directional) to ensure nutrients reach all parts of the plant.

• Companion Cells: These are specialized parenchyma cells in the Phloem that help regulate the metabolic activities of sieve tube elements, which lack a nucleus at maturity.

• Sieve Plates: The end walls of sieve tube cells have pores and are called sieve plates, allowing the flow of cytoplasmic strands between adjacent cells.

• Secondary Growth: The Lateral meristems, specifically the vascular cambium, produce new layers of secondary Xylem and secondary Phloem every year in woody plants.

Q22. Answer: (a) They are brittle and poor conductors of electricity.

The correct answer is They are brittle and poor conductors of electricity.

Key Points

• Non-metals are elements that do not possess the properties of metals, such as being able to conduct electricity or heat, or being malleable or ductile.

• One of the most defining physical properties of solid non-metals is brittleness. Unlike metals, which can be hammered into thin sheets, solid non-metals like Sulfur and Phosphorus will shatter or break into pieces when struck. Hence, statement 1 is correct.

• Non-metals are generally poor conductors of heat and electricity. This is because, unlike metals, they do not have a "sea of free electrons" available to carry thermal energy or electric charge. Hence, statement 3 is incorrect.

• Properties like being malleable (capable of being beaten into sheets) and sonorous (producing a ringing sound when hit) are characteristic of metals, not non-metals. Hence, statement 2 is incorrect.

• Non-metals lack metallic lustre; they are usually dull in appearance and cannot be drawn into wires (ductility). Hence, statement 4 is incorrect.

• In the Periodic Table, non-metals are primarily located on the right-hand side, specifically within groups 14, 15, 16, 17, and 18, with the exception of Hydrogen, which is placed in Group 1.

Additional Information

• Physical States: Non-metals can exist in all three states of matter at room temperature. For example, Carbon and Sulfur are solids, Bromine is a liquid, and Oxygen and Nitrogen are gases.

• Bromine: It is the only non-metal that remains in a liquid state at standard room temperature and pressure. It is a reddish-brown liquid with a suffocating odor.

• Exceptions to Conductivity: While most non-metals are insulators, Graphite (an allotrope of Carbon) is an excellent conductor of electricity due to its unique layered structure that allows electron mobility.

• Exceptions to Hardness and Lustre: Diamond, another allotrope of Carbon, is the hardest natural substance known on Earth. Furthermore, while non-metals are usually dull, Iodine crystals exhibit a distinct metallic-like lustre (shininess).

• Density and Melting Points: Generally, non-metals have low densities and low melting and boiling points compared to metals, making them less dense and more easily vaporized.

Important Points

• Chemical Properties: Non-metals are electronegative in nature. They tend to gain electrons during chemical reactions to form anions (negatively charged ions).

• Nature of Oxides: When non-metals react with Oxygen, they typically form acidic oxides (like CO2 or SO2) or neutral oxides (like N2O or CO). This contrasts with metals, which usually form basic oxides.

• Common Examples and Uses:

• Hydrogen: Used in the manufacture of ammonia and as rocket fuel.

• Oxygen: Essential for respiration and combustion processes.

• Nitrogen: Used to provide an inert atmosphere and in the production of fertilizers.

• Chlorine: Widely used for water purification and as a bleaching agent.

• Silicon: A metalloid (sharing some non-metal properties) used extensively in the semiconductor industry for making microchips.

• Valence Electrons: Most non-metals have 4 to 8 electrons in their outermost shell, which determines their high ionization energy and chemical reactivity.

Q23. Answer: (b) Prostate and seminal vesicles

The correct answer is Prostate and seminal vesicles.

Key Points

• The male reproductive system consists of various accessory glands, primarily the seminal vesicles, the prostate gland, and the bulbourethral glands.

• These glands play a crucial role in reproduction by secreting fluids that combine with sperms to form semen. These secretions are collectively known as seminal plasma.

• The seminal vesicles secrete a significant portion of the fluid that contains fructose, which serves as the primary nutrition and energy source for sperm motility. Hence, the role of seminal vesicles in nutrition is vital.

• The prostate gland contributes a milky, slightly alkaline fluid that contains enzymes and citric acid. This fluid helps in the transport of sperm and enhances their motility while neutralizing the acidic environment of the female reproductive tract. Hence, the prostate gland is essential for easier transport.

• Since both the prostate and seminal vesicles contribute to these specific functions of nutrition and transport, the combined option is the most accurate. Hence, the correct answer is Prostate and seminal vesicles.

Additional Information

• Seminal Vesicles:

• These are a pair of simple tubular glands located behind the urinary bladder in males.

• They produce approximately 60% to 70% of the total volume of semen.

• The fluid is rich in proteins, enzymes, fructose, vitamin C, and prostaglandins. The prostaglandins help in the movement of sperm by inducing contractions in the female reproductive tract.

• Prostate Gland:

• It is a single, walnut-sized gland located just below the bladder and surrounds the urethra.

• It secretes a thin, milky fluid that makes up about 20% to 30% of the semen.

• Its alkaline nature protects the sperms from the acidic nature of the male urethra and the female vagina, ensuring their survival.

• Bulbourethral Glands (Cowper's Glands):

• These are small, pea-sized glands located inferior to the prostate gland.

• They secrete an alkaline mucus during sexual arousal that lubricates the penis and neutralizes any acidic urine remaining in the urethra.

• Pineal Gland:

• Unlike the reproductive glands, the Pineal gland is an endocrine gland located in the epithalamus of the brain.

• It is responsible for secreting the hormone melatonin, which regulates the body's circadian rhythm and sleep-wake cycles. It has no direct involvement in sperm transport or nutrition.

Important Points

• Semen Composition: Semen is a mixture of sperms (produced in the testes) and seminal plasma (the collective secretions of the accessory glands).

• Fructose: It is an important forensic marker because it is produced only by the seminal vesicles and is not found elsewhere in the body's secretions.

• Sperm Motility: Without the secretions from the prostate and seminal vesicles, sperms would lack the energy and the fluid medium necessary to reach the egg for fertilization.

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Q24. Answer: (c) CaSO4 · 2H2O + heat → CaSO4 · 1/2H2O + 11/2H2O

The correct answer is CaSO4. 2H2O + heat -> CaSO4. 1/2H2O + 1 1/2H2O.

Key Points

• Plaster of Paris (POP) is chemically known as Calcium Sulphate Hemihydrate. Its chemical formula is CaSO4. 1/2H2O.

• It is prepared from Gypsum, which is Calcium Sulphate Dihydrate (CaSO4. 2H2O).

• The preparation involves heating Gypsum at a carefully controlled temperature of 373 K (which equals 100 degrees Celsius).

• At this temperature, Gypsum loses one and a half molecules (or three-fourths) of its water of crystallization to become the hemihydrate form. Hence, option 3 is correct.

• In the chemical reaction CaSO4. 2H2O + heat -> CaSO4. 1/2H2O + 1 1/2H2O, the reactant is Gypsum and the product is Plaster of Paris.

• Option 1 represents the setting process where Plaster of Paris reacts with water to turn back into hard Gypsum. Hence, option 1 is incorrect.

• Option 2 shows the total dehydration of Gypsum which occurs when it is heated strongly above 373 K, resulting in dead burnt plaster. Hence, option 2 is incorrect.

• Option 4 shows the thermal decomposition of Calcium Carbonate (Limestone) into Calcium Oxide (Quicklime) and Carbon Dioxide. Hence, option 4 is incorrect.

Additional Information

• Origin of Name: It is called Plaster of Paris because Gypsum was found in abundance in the Montmartre district of Paris, where it was first used for architectural purposes on a large scale.

• Medical Uses: One of the most common applications of POP is in orthopedics. Doctors use it as a bandage or cast to support and immobilize fractured bones, ensuring they heal in the correct location and alignment.

• Dead Burnt Plaster: If Gypsum is heated to a temperature higher than 373 K, all the water of crystallization is removed. The resulting Anhydrous Calcium Sulphate (CaSO4) does not set like POP when mixed with water and is termed dead burnt plaster.

• Physical Properties: Plaster of Paris is a white powder. A unique feature is its ability to expand slightly upon setting, which makes it excellent for casting molds as it picks up the fine details of the cast.

• Artistic and Industrial Uses: Apart from construction, it is used for making statues, toys, cheap ornaments, and blackboard chalk. In dentistry, it is used to make impressions of teeth.

• Chemical Detail: In the formula CaSO4. 1/2H2O, it is understood that two formula units of CaSO4 share one molecule of water (2CaSO4. H2O).

Important Points

• Storage: Plaster of Paris should be stored in moisture-proof containers because it absorbs moisture from the air and undergoes hydration to form a hard mass of Gypsum, rendering it useless.

• Reaction Temperature: Temperature control is vital. If the temperature is not maintained at exactly 373 K, the quality and setting properties of the plaster are compromised.

• Water Ratio: When mixing POP for use, the water-to-powder ratio determines the strength and setting time of the final product.

Q25. Answer: (b) PO4^(-n)

The correct answer is PO4-n.

Key Points

• A polyatomic ion, also known as a molecular ion, is a charged chemical species composed of two or more atoms covalently bonded that act as a single unit. The "n" value in the context of these ions refers to the magnitude of the ionic charge.

• PO4-n (Phosphate Ion): The phosphate ion consists of one phosphorus atom surrounded by four oxygen atoms in a tetrahedral arrangement. Its chemical formula is PO4 3-. Therefore, the value of n is 3. Hence, this statement is correct.

• SO4-n (Sulfate Ion): The sulfate ion is a polyatomic anion consisting of one sulfur atom and four oxygen atoms. The standard charge for a sulfate ion is -2, which means the n value is 2. Hence, this statement is incorrect.

• CO3-n (Carbonate Ion): The carbonate ion is composed of one carbon atom and three oxygen atoms. It carries a net charge of -2, making the n value equal to 2. Hence, this statement is incorrect.

• HCO3-n (Bicarbonate Ion): Also known as the hydrogen carbonate ion, it consists of one hydrogen, one carbon, and three oxygen atoms. It carries a charge of -1, meaning the n value is 1. Hence, this statement is incorrect.

Additional Information

• Phosphate Ion (PO4 3-):

• This ion is trivalent, meaning it has a valency of 3.

• It is a vital component in biological systems, forming the backbone of DNA and RNA.

• It is also a key part of ATP (Adenosine Triphosphate), which is the primary energy currency of the cell.

• In agriculture, phosphates are used extensively in fertilizers to promote plant growth.

• Sulfate Ion (SO4 2-):

• Sulfates are widely used in the chemical industry and are found in common substances like Epsom salts (Magnesium sulfate) and Gypsum (Calcium sulfate).

• In environmental science, atmospheric sulfates are major contributors to acid rain.

• Carbonate (CO3 2-) and Bicarbonate (HCO3 -) Ions:

• Carbonates are found in minerals like Calcite and are the primary component of limestone and shells of marine organisms.

• Bicarbonate plays a crucial role in the human body as a buffer system, helping to maintain the pH balance of blood (keeping it around 7.4).

Important Points

• The charge of a polyatomic ion is the result of the total number of electrons being different from the total number of protons in the combined group of atoms.

• Most polyatomic ions are oxyanions, which are polyatomic ions that contain oxygen. Examples include Nitrate (NO3 -), Nitrite (NO2 -), and Sulfite (SO3 2-).

• Valency vs. Charge: While valency refers to the combining capacity of an element or ion, the charge (n) indicates the actual electrical state. For the ions mentioned, the magnitude of the charge matches the common valency.

• Ammonium (NH4 +) is one of the few common positively charged (cationic) polyatomic ions, with an n value of 1.

Q26. Answer: (c) 4 times

Shortcut Trick

If all linear dimensions (length, breadth, and height) of a 3D figure are multiplied by a factor k, then its surface area increases by a factor of k^2.

Here, every dimension is doubled, so k = 2.

New Area = Original Area × $(2)^2$

=> New Area = 4 × Original Area

Therefore The correct answer is 4 times.

Alternate Method

Given:

Original dimensions: Length = L, Breadth = B, Height = H

New dimensions: Length (L1) = 2L, Breadth (B1) = 2B, Height (H1) = 2H

Formula Used:

Total Surface Area (TSA) = 2(LB + BH + HL)

Calculations:

=> Original TSA = 2(LB + BH + HL)

=> New TSA = 2(L1B1 + B1H1 + H1L1)

=> New TSA = 2[(2L × 2B) + (2B × 2H) + (2H × 2L)]

=> New TSA = 2[4LB + 4BH + 4HL]

=> New TSA = 4 × [2(LB + BH + HL)]

=> New TSA = 4 × Original TSA

Therefore The correct answer is 4 times.

Additional Information

Volume Scaling

If each dimension of a cuboid is multiplied by k, its volume becomes k^3 times the original volume. For doubling (k=2), volume becomes 8 times.

Lateral Surface Area

The lateral surface area of a cuboid is 2h(l + b). If dimensions are doubled, the lateral surface area also becomes 4 times.

Surface Area of a Cube

For a cube with side a, the total surface area is $6a^2$. If the side is doubled, the area becomes $6(2a)^2 = 24a^2$, which is 4 times the original.

Q27. Answer: (d) 0.16

Shortcut Trick

Use the Algebraic Identity: $(x - y)^2 = (x + y)^2 - 4xy$

Given Sum (x + y) = 10 and Product (xy) = 24.96

Substitute the values: $(x - y)^2 = 10^2 - 4 \times 24.96$

$(x - y)^2 = 100 - 99.84 = 0.16$

Therefore The correct answer is 0.16.

Alternate Method

Given:

Sum of variables $(x + y) = 10$

Product of variables $(xy) = 24.96$

Formula Used:

The standard expansion of the square of a binomial leads to the relationship:

$(x - y)^2 = (x + y)^2 - 4xy$

Calculations:

$\Rightarrow (x + y)^2 = 10^2 = 100$

$\Rightarrow 4xy = 4 \times 24.96$

$\Rightarrow 4xy = 99.84$

$\Rightarrow (x - y)^2 = 100 - 99.84$

$\Rightarrow (x - y)^2 = 0.16$

Therefore The correct answer is 0.16.

Additional Information

Square of a Sum

The formula is $(a + b)^2 = a^2 + b^2 + 2ab$.

Square of a Difference

The formula is $(a - b)^2 = a^2 + b^2 - 2ab$.

Difference of Squares

The relation $(a + b)^2 - (a - b)^2 = 4ab$ is useful for finding the difference when the sum and product are known.

Sum of Squares

The value of $a^2 + b^2$ can be found using $(a + b)^2 - 2ab$.

Q28. Answer: (d) 617/189

Shortcut Trick

Convert mixed fractions: 8 1/4 = 33/4, 4 1/7 = 29/7, 5 1/2 = 11/2, 1 1/7 = 8/7, 5 1/3 = 16/3

First solve “of”: 12/11 of 33/4 = 9

Then 2/3 ÷ 9 = 2/27

Now simplify: 2/27 + 29/7 − 44/7 + 16/3

$\Rightarrow$ 2/27 − 15/7 + 16/3 = 617/189

Therefore Answer = 617/189

Alternate Method

Given:

2/3 ÷ (12/11 of 8 1/4) + 4 1/7 − 5 1/2 × 1 1/7 + 5 1/3

Concept Used:

BODMAS rule

Calculation:

$\Rightarrow$ 2/3 ÷ (12/11 × 33/4) + 4 1/7 − 5 1/2 × 1 1/7 + 5 1/3

$\Rightarrow$ 2/3 ÷ (396/44) + 4 1/7 − 5 1/2 × 1 1/7 + 5 1/3

$\Rightarrow$ 2/3 ÷ 9 + 4 1/7 − 5 1/2 × 1 1/7 + 5 1/3

$\Rightarrow$ 2/3 × 1/9 + 4 1/7 − 5 1/2 × 1 1/7 + 5 1/3

$\Rightarrow$ 2/27 + 4 1/7 − 5 1/2 × 1 1/7 + 5 1/3

$\Rightarrow$ 2/27 + 29/7 − 11/2 × 8/7 + 16/3

$\Rightarrow$ 2/27 + 29/7 − 88/14 + 16/3

$\Rightarrow$ 2/27 + 29/7 − 44/7 + 16/3

$\Rightarrow$ 2/27 − 15/7 + 16/3

$\Rightarrow$ LCM = 189

$\Rightarrow$ 2/27 = 14/189

$\Rightarrow$ −15/7 = −405/189

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=> 16/3 = 1008/189
=> 14 − 405 + 1008 = 617
=> Result = 617/189
Therefore The correct answer is 617/189.
Additional Information
BODMAS Full Form
Brackets, Orders, Division, Multiplication, Addition, Subtraction.
Order of Operations
Solve 'of' first, then division and multiplication from left to right.
Mixed Fraction Conversion
a b/c = (ac + b)/c before applying operations.
LCM Technique
Use common denominator to combine multiple fractions efficiently.

Q29. Answer: (b) 5

Shortcut Trick
Apply MDW formula: (M × D) ÷ W = Constant.
Case 1: (5M + 2W) × 3 ÷ 48 => (5M + 2W) ÷ 16
Case 2: (3M + 1W) × 6 ÷ 54 => (3M + 1W) ÷ 9
Equating: 9(5M + 2W) = 16(3M + 1W) => 45M + 18W = 48M + 16W => 2W = 3M => 1M = (2/3)W.
Substitute in Case 3: (6M + xW) × 14 ÷ 378 => (4W + xW) ÷ 27. Equating with Case 2: (3W) ÷ 9 = (4+x)W ÷ 27 => 9 = 4 + x => x = 5.
Therefore The correct answer is 5 women.
Alternate Method
Given: 5 men and 2 women reap 48 hectares in 3 days; 3 men and 1 woman reap 54 hectares in 6 days.
Formula Used: (M1 × D1) ÷ W1 = (M2 × D2) ÷ W2
=> (5M + 2W) × 3 / 48 = (3M + 1W) × 6 / 54
=> (5M + 2W) / 16 = (3M + 1W) / 9
=> 45M + 18W = 48M + 16W
=> 2W = 3M => Efficiency ratio M:W = 2:3
=> Total work rate from Case 2: (3 × 2 + 1 × 3) × 6 / 54 = 9 × 6 / 54 = 1 unit
=> For Case 3: (6 × 2 + x × 3) × 14 / 378 = 1
=> (12 + 3x) × 14 = 378
=> 12 + 3x = 378 / 14 = 27
=> 3x = 15 => x = 5
Therefore The correct answer is 5 women.
Additional Information
Man-Days-Work Relation
The amount of work done is directly proportional to the number of men and days: M1D1H1/W1 = M2D2H2/W2.
Efficiency Ratio
If M men can do as much work as W women, their efficiency ratio is inversely proportional to their numbers for the same work.
Work and Wages
Wages are always distributed in the ratio of the actual work done by each person, which is Efficiency × Time.

Q30. Answer: (b) 63

Shortcut Trick
If 20% is added to 72 to get 100%, then 72 must represent the remaining 80%.
80% of Number = 72
10% of Number = 72 ÷ 8 = 9
70% of Number = 9 × 7 = 63
Therefore The correct answer is 63.
Alternate Method

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Let the number be x.
According to the question:
=> 20% of x + 72 = x
=> 0.2x + 72 = x
=> x − 0.2x = 72
=> 0.8x = 72
=> x = 72 ÷ 0.8 = 90
Now, find 70% of the number:
=> 70% of 90 = (70/100) × 90
=> 0.7 × 90 = 63
Therefore The correct answer is 63.
Additional Information
Percentage Change
Percentage change is calculated as (Change / Original Value) × 100.
Fraction Conversion
To convert a percentage to a fraction, divide by 100 (e.g., 20% = 1/5, 80% = 4/5).
Base Value
In problems like this, the 'number' is always treated as 100% (the base).

Q31. Answer: (c) 3

Shortcut Trick
Rate of typing = 2 pages / 40 minutes = 1 page per 20 minutes.
Pages in 60 minutes = 60 ÷ 20 = 3 pages.
Therefore The correct answer is 3 pages.
Alternate Method
Given:
Time 1 (T1) = 40 minutes
Work 1 (W1) = 2 pages
Time 2 (T2) = 60 minutes
Formula Used:
Work is directly proportional to time: W1 / T1 = W2 / T2
Calculations:
=> 2 / 40 = W2 / 60
=> 1 / 20 = W2 / 60
=> W2 = 60 / 20
=> W2 = 3 pages
Therefore The correct answer is 3 pages.
Additional Information
Direct Proportion
When one quantity increases as the other increases at a constant rate, it is Direct Proportion (Work prop. to Time).
Unitary Method
First find the value of a single unit (e.g., pages per minute) and then multiply by the required quantity.
Work, Men, and Time Relation
The general formula is (M1 × D1 × T1) / W1 = (M2 × D2 × T2) / W2.

Q32. Answer: (d) 59,500

Shortcut Trick
Ratio of Income : Expenditure = 2 : 1 => Saving = 2 − 1 = 1 unit.
Initial Expenditure (1 unit) = Rs. 35,000 => Initial Income (2 units) = Rs. 70,000.
New Income = 70,000 × 130% = Rs. 91,000.
New Expenditure = 35,000 × 90% = Rs. 31,500.
Final Saving = 91,000 − 31,500 = Rs. 59,500.

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Therefore The correct answer is Rs. 59,500.

Alternate Method

Given Ratio = 2 : 1 (Income : Expenditure)

Given Initial Expenditure = Rs. 35,000

=> 1 unit = Rs. 35,000

=> Initial Income = 2 × 35,000 = Rs. 70,000

=> Increase in Income = 30% of 70,000 = Rs. 21,000

=> New Income = 70,000 + 21,000 = Rs. 91,000

=> Decrease in Expenditure = 10% of 35,000 = Rs. 3,500

=> New Expenditure = 35,000 − 3,500 = Rs. 31,500

=> Final Saving = New Income − New Expenditure

=> Final Saving = 91,000 − 31,500 = Rs. 59,500

Therefore The correct answer is Rs. 59,500.

Additional Information

Basic Income Formula

The relationship between income, expenditure, and savings is always Income = Expenditure + Savings.

Percentage Change

New Value = Original Value × (100 ± Change%)/100. Use (+) for increase and (−) for decrease.

Savings Percentage

The percentage of savings is calculated as (Savings ÷ Income) × 100.

Q33. Answer: (a) sec θ + tan θ

Shortcut Trick

Put a specific value for θ, let θ = 0°.

√((1 + sin 0°)/(1 − sin 0°)) = √((1 + 0)/(1 − 0)) = √1 = 1.

Check options at θ = 0°: (1) sec 0° + tan 0° = 1 + 0 = 1.

Since option (1) matches the value, it is the correct expression.

Therefore The correct answer is secθ + tanθ.

Alternate Method

Given: √((1 + sinθ)/(1 − sinθ))

Formula Used: Rationalization, $\sin^2\theta + \cos^2\theta = 1$, secθ = 1/cosθ, tanθ = sinθ/cosθ

=> Multiply numerator and denominator by (1 + sinθ) under the square root.

=> √[(1 + sinθ)(1 + sinθ)] / [(1 − sinθ)(1 + sinθ)]

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

=> $\sqrt{(1 + \sin\theta)^2 / \cos^2\theta}$

=> (1 + sinθ) / cosθ

=> (1 / cosθ) + (sinθ / cosθ)

=> secθ + tanθ

Therefore The correct answer is secθ + tanθ.

Additional Information

Trigonometric Identities

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

Conjugate Multiplication

In square root expressions involving (1 ± sinθ) or (1 ± cosθ), rationalizing the denominator using its conjugate often simplifies the expression to a perfect square.

Q34. Answer: (a) 65

Shortcut Trick

Let the Assumed Mean be 60.

Calculate deviations from 60: (+1, −27, +34, −12, −24, +33, +13, +34, −7).

Sum of deviations = (1 + 34 + 33 + 13 + 34) − (27 + 12 + 24 + 7) = 115 − 70 = 45.

Average deviation = 45 ÷ 9 = 5.

Arithmetic Mean = Assumed Mean + Average Deviation = 60 + 5 = 65.

Therefore The correct answer is 65.

Alternate Method

Given: Observations = 61, 33, 94, 48, 36, 93, 73, 94, 53

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

=> Total number of observations (n) = 9

=> Sum of observations = 61 + 33 + 94 + 48 + 36 + 93 + 73 + 94 + 53

=> Sum of observations = 585

=> Arithmetic Mean = 585 ÷ 9

=> Arithmetic Mean = 65

Therefore The correct answer is 65.

Additional Information

Properties of Arithmetic Mean

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

Weighted Arithmetic Mean

When different observations have different levels of importance, the mean is calculated as $\Sigma(w_i \times x_i) \div \Sigma w_i$, where w_i is the weight of each observation.

Change in Origin and Scale

If a constant 'k' is added to or multiplied with every observation, the new mean will also be increased by 'k' or multiplied by 'k' respectively.

Q35. Answer: (b) 80%

Shortcut Trick

The Buy X, Get Y Free scheme means you pay for X items but receive (X + Y) items in total.

Discount% = (Free Items ÷ Total Items) × 100.

Here, Free Items = 8 and Total Items = 2 + 8 = 10.

Discount% = (8 ÷ 10) × 100 = 80%.

Therefore The correct answer is 80%.

Alternate Method

Given → Number of Purchased Items = 2, Number of Free Items = 8.

Formulas: Discount% = (Discount ÷ MP) × 100 | MP = Price of total items received.

=> Let the Marked Price (MP) of 1 item be Re. 1.

=> Total items given to the customer = 2 + 8 = 10 items.

=> Total MP of 10 items = 10 × 1 = Rs. 10.

=> The customer pays for only 2 items, so Selling Price (SP) = Rs. 2.

=> Discount amount = MP − SP = 10 − 2 = Rs. 8.

=> Discount% = (8 ÷ 10) × 100 = 80%.

Therefore The correct answer is 80%.

Additional Information

Marked Price and Discount

In "Buy X Get Y Free" schemes, the Marked Price is always calculated on the total number of items (X+Y) handed over to the customer.

Effective Discount Formula

Effective Discount% = [Free Items ÷ (Paid Items + Free Items)] × 100.

Q36. Answer: (d) 12

Shortcut Trick

Excess runs scored above the old average = 219 − 88 = 131 runs.

These extra runs are distributed equally among all 11 innings to find the average increase.

Average increase = 131 ÷ 11 ≈ 11.909 runs.

Rounding off to the nearest whole number, we get 12 runs.

Therefore The correct answer is 12 runs.

Alternate Method

Given:
Average of 10 innings = 88 runs
Score in 11^(th) inning = 219 runs
Calculations:
=> Total runs in 10 innings = 88 × 10 = 880 runs
=> Total runs in 11 innings = 880 + 219 = 1099 runs
=> New average = Total runs ÷ Total innings = 1099 ÷ 11
=> New average = 99.9090... runs
=> Increase in average = New average − Old average
=> Increase = 99.909 − 88 = 11.909 runs
=> Rounded increase ≈ 12 runs
Therefore The correct answer is 12 runs.
Additional Information
Basic Average Formula
Average = (Sum of all observations) ÷ (Total number of observations).
Net Deviation Method
If a new value is added, the change in average = (New Value − Old Average) ÷ New Total Number of items.
Weighted Average
When combining two groups, New Average = (n1x1 + n2x2) ÷ (n1 + n2), where n is count and x is average.

Q37. Answer: (b) 35 m/sec

Shortcut Trick
To convert Speed from km/hr to m/sec, multiply the speed by the factor 5/18.
Speed = 126 × (5/18) m/sec
Speed = 7 × 5 = 35 m/sec
Therefore The correct answer is 35 m/sec.
Alternate Method
Given:
Speed in km/hr = 126 km/hr
Formula Used:
Speed (m/sec) = Speed (km/hr) × (1000 meters / 3600 seconds)
Speed (m/sec) = Speed (km/hr) × (5/18)
Calculations:
=> Speed = 126 × (5/18)
=> Speed = (126 ÷ 18) × 5
=> Speed = 7 × 5
=> Speed = 35 m/sec
Therefore The correct answer is 35 m/sec.
Additional Information
Conversion from m/sec to km/hr
To convert speed from meters per second to kilometers per hour, multiply the value by 18/5.
Basic Speed Formula
Speed is defined as the Distance traveled per unit Time. Formula: Speed = Distance ÷ Time.
Average Speed
For a journey with two equal distances at speeds x and y, the Average Speed is given by (2xy) ÷ (x + y).

Q38. Answer: (a) 24 years

Shortcut Trick
Total ratio units = 6 + 5 = 11 units
Given 11 units = 44 years
1 unit = 4 years
Amit age (6 units) = 6 × 4 = 24 years

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Therefore The correct answer is 24 years.

Alternate Method

Given:

Ratio of ages of Amit and Geeta = 6 : 5

Sum of their ages = 44 years

Let the ages be 6x and 5x.

=> 6x + 5x = 44

=> 11x = 44

=> x = 4

=> Amit's age = 6x = 6 × 4 = 24 years

Therefore The correct answer is 24 years.

Additional Information

Ratio and Proportion

To divide a quantity S in the ratio a : b, the parts are [a/(a+b)] × S and [b/(a+b)] × S.

Age Problems

If the current age is x, then age after n years is (x + n) and age n years ago was (x − n).

Q39. Answer: (b) 32,000

Shortcut Trick

Since the Principal and Time are same for both banks, find the Rate difference.

Rate difference = 7.5% − 3.5% = 4% per annum.

Total interest difference for 4 years = 4% × 4 = 16%.

Required Difference = 16% of Rs. 2,00,000 = 16 × 2,000 = Rs. 32,000.

Therefore The correct answer is Rs. 32,000.

Alternate Method

Given:

Principal (P) = Rs. 2,00,000 | Time (T) = 4 years

Rate A (R1) = 3.5% | Rate B (R2) = 7.5%

Formula Used:

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

Calculations:

=> SI from Bank A = (2,00,000 × 3.5 × 4) ÷ 100

=> SI from Bank A = 2,000 × 14 = Rs. 28,000

=> SI from Bank B = (2,00,000 × 7.5 × 4) ÷ 100

=> SI from Bank B = 2,000 × 30 = Rs. 60,000

=> Difference = Rs. 60,000 − Rs. 28,000

=> Difference = Rs. 32,000

Therefore The correct answer is Rs. 32,000.

Additional Information

Simple Interest Concept

In Simple Interest, the interest is always calculated on the original Principal amount throughout the entire loan period.

Total Amount Formula

The final amount (A) to be paid back is the sum of Principal and Simple Interest: A = P + (P × R × T) ÷ 100.

Direct Difference Rule

When Principal and Time are constant, the difference in interest is directly proportional to the difference in rates: ΔSI = (P × ΔR × T) ÷ 100.

Q40. Answer: (b) 30 cm

Shortcut Trick

First, calculate the semi-perimeter (s): s = (34 + 88 + 78) ÷ 2 = 100 cm.

Find the Area using Heron's formula: √(100 × 66 × 12 × 22) = 1320 cm².

The altitude (h) on side 88 cm is: h = (2 × Area) ÷ Base = (2 × 1320) ÷ 88 = 30 cm.

Therefore The correct answer is 30 cm.

Alternate Method

Given:

Sides of the triangle: a = 34 cm, b = 88 cm, c = 78 cm.

We need to find the altitude (h) corresponding to side b = 88 cm.

Formula Used:

1. Semi-perimeter (s) = (a + b + c) ÷ 2

2. Area of triangle = √[s(s − a)(s − b)(s − c)]

3. Area of triangle = (1 ÷ 2) × base × altitude

Calculations:

=> s = (34 + 88 + 78) ÷ 2 = 200 ÷ 2 = 100 cm

=> Area = √[100 × (100 − 34) × (100 − 88) × (100 − 78)]

=> Area = √(100 × 66 × 12 × 22)

=> Area = √(100 × 11 × 6 × 6 × 2 × 11 × 2)

=> Area = 10 × 11 × 6 × 2 = 1320 cm²

=> 1320 = (1 ÷ 2) × 88 × h

=> 1320 = 44 × h

=> h = 1320 ÷ 44 = 30 cm

Therefore The correct answer is 30 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)].

Altitude of a Triangle

The altitude is the perpendicular distance from a vertex to the opposite side (base). Height = (2 × Area) ÷ Base.

Pythagorean Triplets in Scalene Triangles

An altitude divides a triangle into two right-angled triangles. Here, the altitude 30 cm creates triplets (30, 72, 78) and (16, 30, 34).

Q41. Answer: (a) 18 square units

Shortcut Trick

The total area of the triangular garden with vertices (x1, y1), (x2, y2), and (x3, y3) is:

Area = 0.5 × |x1(y2 − y3) + x2(y3 − y1) + x3(y1 − y2)|

Area = 0.5 × |2(11 − 7) + 8(7 − 3) + 14(3 − 11)| = 0.5 × |8 + 32 − 112| = 36 square units.

Since the landscape designer wants to cover exactly half of this triangular area with flowers:

Required Area = 36 ÷ 2 = 18 square units.

Therefore The correct answer is 18 square units.

Alternate Method

Given:

=> Vertices of the triangular garden: A(2, 3), B(8, 11), and C(14, 7)

=> Fraction of area to be covered with flowers: Exactly half (1/2)

Formula Used:

=> Area of a triangle = 0.5 × |x1(y2 − y3) + x2(y3 − y1) + x3(y1 − y2)|

Calculations:

Let the coordinates of the vertices be:

=> (x1, y1) = (2, 3)

=> (x2, y2) = (8, 11)

=> (x3, y3) = (14, 7)

Substitute these coordinates into the area formula:

=> Total Area = 0.5 × |2 × (11 − 7) + 8 × (7 − 3) + 14 × (3 − 11)|

=> Total Area = 0.5 × |2 × 4 + 8 × 4 + 14 × (−8)|

=> Total Area = 0.5 × |8 + 32 − 112|

=> Total Area = 0.5 × |40 − 112|

=> Total Area = 0.5 × |−72|

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=> Total Area = 36 square units

The area to be covered with flowers is exactly half of the total area:

=> Required Area = Total Area ÷ 2

=> Required Area = 36 ÷ 2 = 18 square units

Justification of Options:

=> Option (1) is correct because the total area of the triangle is 36 square units, and exactly half of this area is 18 square units.

=> Option (2) is incorrect because 12 square units represents only one-third of the total area, not half.

=> Option (3) is incorrect because 36 square units is the total area of the triangular garden, not the half area to be covered with flowers.

=> Option (4) is incorrect because 24 square units represents two-thirds of the total area, not half.

Therefore The correct answer is 18 square units.

Additional Information

Area of a Triangle using Coordinates

The area of a triangle with vertices (x1, y1), (x2, y2), and (x3, y3) is calculated as 0.5 × |x1(y2 − y3) + x2(y3 − y1) + x3(y1 − y2)|. If the result is negative, we take the absolute value because area is always positive.

Median of a Triangle

A median of a triangle is a line segment joining a vertex to the midpoint of the opposite side. A median divides the triangle into two smaller triangles of equal area.

Collinearity of Three Points

If the calculated area of a triangle formed by three points is exactly 0, then the three points are collinear (they lie on the same straight line).

Q42. Answer: (a) 55 : 36

Shortcut Trick

Equate the common entity Blue tokens by multiplying the ratios.

Orange : Blue = 11 : 18 and Blue : Yellow = 5 : 2

To find Orange : Yellow, multiply the terms: (11 × 5) : (18 × 2)

Orange : Yellow = 55 : 36

Therefore The correct answer is 55 : 36.

Alternate Method

Given:

Ratio of Blue to Yellow (B : Y) = 5 : 2

Ratio of Orange to Blue (O : B) = 11 : 18

Calculations:

=> To combine ratios, make Blue (B) equal in both.

=> Multiply (B : Y) by 18 → B : Y = (5 × 18) : (2 × 18) = 90 : 36

=> Multiply (O : B) by 5 → O : B = (11 × 5) : (18 × 5) = 55 : 90

=> Combined Ratio Orange : Blue : Yellow = 55 : 90 : 36

=> Therefore, Orange : Yellow = 55 : 36

Therefore The correct answer is 55 : 36.

Additional Information

Compound Ratio

The compound ratio of a : b and c : d is calculated by multiplying corresponding terms: (a × c) : (b × d).

Ratio Balancing

When two ratios have a common element, find the LCM of the common element's values to merge the ratios into a single continuous form.

Duplicate Ratio

The duplicate ratio of a : b is $a^2 : b^2$, often used in area-related ratio problems.

Q43. Answer: (d) decrease by Rs. 8,253

Shortcut Trick

Ratio of Expenditure to Savings = 80 : 20 = 4 : 1

By Alligation/Weighted Average: Net Change in Income = (4 × 35% + 1 × x%) ÷ 5 = 19%

=> 140 + x = 95 => x = −45% (Savings decrease by 45%)

Initial Savings = 20% of 91,700 = Rs. 18,340

Change in Savings = 45% of 18,340 = 0.45 × 18,340 = Rs. 8,253

Therefore The correct answer is decrease by Rs. 8,253.

Alternate Method

Given: Initial Income = Rs. 91,700 | Savings = 20% | Expenditure = 80%

=> Initial Savings = 20 ÷ 100 × 91,700 = Rs. 18,340

=> Initial Expenditure = 91,700 − 18,340 = Rs. 73,360

=> New Income = 91,700 + (19 ÷ 100 × 91,700) = 91,700 + 17,423 = Rs. 109,123

=> New Expenditure = 73,360 + (35 ÷ 100 × 73,360) = 73,360 + 25,676 = Rs. 99,036

=> New Savings = 109,123 − 99,036 = Rs. 10,087

=> Decrease in Savings = 18,340 − 10,087 = Rs. 8,253

Therefore The correct answer is decrease by Rs. 8,253.

Additional Information

Income Expenditure Relation

The basic identity is Income = Expenditure + Savings. Any percentage change must balance this equation.

Successive Percentage

For two successive changes a% and b%, the effective change is (a + b + ab/100)%, though for income-expenditure, weighted averages are more efficient.

Base Change Property

When income increases, if expenditure increases by a higher percentage than income, the savings percentage will always decrease relative to the original savings.

Q44. Answer: (a) 2

Shortcut Trick

Combined efficiency of A, B, and C = (1/2 + 1/2 + 1/2) = 3/2 work per day.

Total work to be done = 3 × (Original Work) = 3 × 1 = 3 units.

Time taken = (Total Work) ÷ (Combined Efficiency) = 3 ÷ (3/2) = 2 days.

Therefore The correct answer is 2 days.

Alternate Method

Given: Individual time for A, B, and C = 2 days each.

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

=> Total Efficiency of (A + B + C) = 1 + 1 + 1 = 3 units/day.

=> Original Total Work = 2 units.

=> Thrice the same work = 3 × 2 = 6 units.

=> Time taken = (New Total Work) ÷ (Total Efficiency) = 6 ÷ 3 = 2 days.

Therefore The correct answer is 2 days.

Additional Information

Work and Time Relationship

Time is directly proportional to the amount of work to be done. If work becomes thrice, time also becomes thrice for the same efficiency.

Combined Work Formula

If n people with same efficiency do a work in 'D' days, then together they do it in D/n days.

Pipes & Cisterns

Similar logic applies to filling tanks; Efficiency is the rate of filling/emptying per unit time.

Q45. Answer: (b) 50

Shortcut Trick

Successive multiplier: MP × (100 − d1)% × (100 − d2)% = SP.

88,000 × 75/100 × (100 − Z)/100 = 33,000.

66,000 × (100 − Z)/100 = 33,000.

(100 − Z)/100 = 33,000 ÷ 66,000 = 1/2.

100 − Z = 50 => Z = 50.

Therefore The correct answer is 50.

Alternate Method

Given → Marked Price (MP) = Rs. 88,000, Selling Price (SP) = Rs. 33,000, First Discount (d1) = 25%, Second Discount (d2) = Z%.

Formulas: Price after first discount = MP × (100 − d1)% | Discount% = (Price Difference ÷ Intermediate Price) × 100.

=> Price after first discount = 88,000 − (25% of 88,000) = 88,000 − 22,000 = Rs. 66,000.

=> Second discount amount = Price after first discount − Final Selling Price.

=> Discount amount = 66,000 − 33,000 = Rs. 33,000.

=> Z% (Second Discount) = (33,000 ÷ 66,000) × 100.

=> Z = (1/2) × 100 = 50.

Therefore The correct answer is 50.

Additional Information

Successive Discounts

When two or more discounts are applied one after another, they are called successive discounts. The total discount is not the sum of individual percentages but is calculated on the reducing balance. Net Discount = a + b − (a × b)/100.

Marked Price & Selling Price

Marked Price is the price printed on the article. Selling Price = MP × (100 − d1)% × (100 − d2)%...

Q46. Answer: (a) 22

Shortcut Trick

Relative speed (P & Q) = 72 − 42 = 30 km/hr = 30 × (5/18) m/s.

Total distance (L_P + L_Q) = Speed × Time = (30 × 5/18) × 90 = 750 m.

Length of Train P (L_P) = 750 − 393 = 357 m.

Relative speed (P & R) = 72 + 63 = 135 km/hr = 135 × (5/18) = 37.5 m/s.

Time to cross R = (L_P + L_R) ÷ Relative speed = (357 + 468) ÷ 37.5 = 825 ÷ 37.5 = 22 seconds.

Therefore The correct answer is 22 seconds.

Alternate Method

Given:

Speed of Train P (S_P) = 72 km/hr, Length of Train Q (L_Q) = 393 m, Speed of Q (S_Q) = 42 km/hr, Time1 = 1.5 min = 90 s.

Length of Train R (L_R) = 468 m, Speed of R (S_R) = 63 km/hr.

Formula Used:

Relative Speed (Same) = S1 − S2 | Relative Speed (Opposite) = S1 + S2

Distance = Speed × Time | 1 km/hr = 5/18 m/s

Calculations:

=> Relative speed P and Q = 72 − 42 = 30 km/hr = 30 × 5/18 = 25/3 m/s

=> L_P + L_Q = Relative Speed × Time = (25/3) × 90 = 750 m

=> L_P = 750 − 393 = 357 m

=> Relative speed P and R (opposite) = 72 + 63 = 135 km/hr

=> 135 km/hr = 135 × 5/18 = 37.5 m/s

=> Time to cross R = (L_P + L_R) ÷ Relative Speed = (357 + 468) ÷ 37.5

=> Time = 825 ÷ 37.5 = 22 seconds

Therefore The correct answer is 22 seconds.

Additional Information

Relative Speed Concept

When two objects move in the same direction, subtract speeds (u − v). When they move in opposite directions, add speeds (u +

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v).

Crossing Distance

When a train crosses another train or a bridge, the total distance covered is always the sum of their lengths (L1 + L2).

Unit Conversion

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

Q47. Answer: (c) 5% profit

Shortcut Trick

Ratio of quantities = 45 : 15 = 3 : 1.

Total units = 3 + 1 = 4.

Weighted average profit/loss = [(3 × 20%) + (1 × −40%)] ÷ 4.

Net result = (60% − 40%) ÷ 4 = 20% ÷ 4 = 5%.

Since the result is positive, it is a 5% profit.

Therefore The correct answer is 5% profit.

Alternate Method

Given: Total CP of 60 pens = Rs. 900, Pens sold at profit = 45, Pens sold at loss = 15.

Formulas: CP of one pen = Total CP ÷ Total Quantity | Profit = CP × Profit% | Loss = CP × Loss% | Net% = (Net Profit/Loss ÷ Total CP) × 100.

=> CP of 1 pen = 900 ÷ 60 = Rs. 15.

=> CP of 45 pens = 45 × 15 = Rs. 675.

=> Profit on 45 pens = 675 × 20% = Rs. 135.

=> CP of remaining 15 pens = 15 × 15 = Rs. 225.

=> Loss on 15 pens = 225 × 40% = Rs. 90.

=> Net Profit = 135 − 90 = Rs. 45.

=> Net Profit% = (45 ÷ 900) × 100 = 5%.

Therefore The correct answer is 5% profit.

Additional Information

Weighted Average Method

When parts of a total quantity are sold at different profit/loss percentages, the overall profit/loss percentage can be calculated using (n1p1 + n2p2) ÷ (n1 + n2).

Profit and Loss Basics

Profit occurs when Selling Price (SP) is greater than Cost Price (CP). Loss occurs when CP is greater than SP. Both are always calculated on the CP unless stated otherwise.

Q48. Answer: (c) $12y^2$

Shortcut Trick

For two numbers a and b, the third proportional is given by b^2/a.

Here, a = $75x^2$ and b = 30xy.

Third Proportional = (30xy × 30xy) ÷ $75x^2$

Third Proportional = $900x^2y^2 \div 75x^2 = 12y^2$.

Therefore The correct answer is $12y^2$.

Alternate Method

Given: First term (a) = $75x^2$, Second term (b) = 30xy.

Formula Used: If c is the third proportional to a and b, then a : b :: b : c, which means $c = b^2/a$.

=> Let the third proportional be c.

=> $75x^2 / 30xy = 30xy / c$

=> $c = (30xy \times 30xy) / 75x^2$

=> $c = 900x^2y^2 / 75x^2$

=> $c = 12y^2$

Therefore The correct answer is $12y^2$.

Additional Information

Mean Proportional

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

Fourth Proportional

For three numbers a, b, and c, the fourth proportional d is such that a/b = c/d, so d = (b × c) / a.

Continued Proportion

Three numbers a, b, c are in continued proportion if a/b = b/c, which implies $b^2 = ac$.

Q49. Answer: (b) 25

Shortcut Trick

Assume all 45 notes are of the lower denomination (Rs. 5).

Total value would be = 45 × 5 = Rs. 225.

Difference from the actual total value = 350 − 225 = Rs. 125.

Difference in the value of one Rs. 10 note and one Rs. 5 note = 10 − 5 = Rs. 5.

Number of Rs. 10 notes = 125 ÷ 5 = 25.

Therefore The correct answer is 25.

Alternate Method

Given:

Total number of notes = 45

Total value of notes = Rs. 350

Denominations available = Rs. 10 and Rs. 5

Calculations:

=> Let the number of Rs. 10 notes be x.

=> Then the number of Rs. 5 notes is (45 − x).

=> According to the question: 10 × x + 5 × (45 − x) = 350

=> 10x + 225 − 5x = 350

=> 5x + 225 = 350

=> 5x = 350 − 225

=> 5x = 125

=> x = 125 ÷ 5

=> x = 25

Therefore The correct answer is 25.

Additional Information

Rule of Alligation

This problem can be solved by finding the average value per note (350 ÷ 45) and applying the alligation cross-method to find the ratio of the quantities.

Linear Equations in Two Variables

For problems involving two unknowns, we use two independent equations: x + y = Total Quantity and (Value1 × x) + (Value2 × y) = Total Value.

Denomination Logic

The total amount is always the sum of (Value of each unit × Number of units) for every different denomination present.

Q50. Answer: (a) 1110

Shortcut Trick

Time taken per page = 40 ÷ 4 = 10 minutes.

For 111 pages = 111 × 10 = 1110 minutes.

Therefore The correct answer is 1110 minutes.

Alternate Method

Given:

Pages (W1) = 4, Time (T1) = 40 minutes

Pages (W2) = 111, Time (T2) = ?

Formula Used:

Work is directly proportional to Time (W1/T1 = W2/T2)

Calculations:

=> 4 / 40 = 111 / T2

=> 1 / 10 = 111 / T2

=> T2 = 111 × 10

=> T2 = 1110 minutes

Therefore The correct answer is 1110 minutes.

Additional Information

Unitary Method

Finding the value of a single unit first (1 page) and then multiplying by the required quantity (111 pages).

Time and Work Relation

When efficiency is constant, the time taken is directly proportional to the amount of work done (T prop. to W).

Q51. Answer: (a) 39

BODMAS Rule:

Decoding the given information:

Letter	A	B	C	D
Meaning	÷	×	•	•

Given equation: 7 B 6 C 3 D 24 A 4 = ?

Now replacing the sign from left to right using BODMAS Rule, we get:

=> 7 × 6 + 3 − 24 ÷ 4 = ?

=> 7 × 6 + 3 − 6 = ?

=> 42 + 3 − 6 = ?

=> 45 − 6 = ?

=> 39 = ?

Hence, the correct answer is "Option 1".

Q52. Answer: (c) 2

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

Now,

Even numbers, each of which is immediately preceded by an odd number and also immediately followed by an odd number.

So, the needed pattern is: Odd — Even — Odd

Thus, there are 2 even numbers, each of which is immediately preceded by an odd number and also immediately followed by an odd number.

Hence, the correct answer is "Option 3".

Q53. Answer: (b) VJS48

The position and positional values or English Alphabets are:

Given: DRA120, OCL102, ZNW84, KYH66, ?

The logic followed here is:

Thus, VJS48 will replace the question mark (?) in the given series to make it logically complete.

Hence, the correct answer is "Option 2".

Q54. Answer: (d) CL – JO

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster pair follows the pattern +6, +3.

Let’s check each option:

1. UD – AG

This letter-cluster pair follows the pattern +6, +3.

2. LU – RX

This letter-cluster pair follows the pattern +6, +3.

3. BK – HN

This letter-cluster pair follows the pattern +6, +3.

4. CL – JO

This letter-cluster pair does not follow the pattern +6, +3.

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Thus, CL – JO is the odd one out.

Hence, the correct answer is "Option 4".

Q55. Answer: (c) 271

Shortcut Trick

Observe the difference between consecutive terms:

351 − 335 = 16, 335 − 319 = 16, 319 − 303 = 16

The pattern is a constant subtraction of 16.

Required number = 287 − 16 = 271.

Therefore The correct answer is 271.

Alternate Method

Given: The series is 351, 335, 319, 303, 287, ?

Pattern: Constant difference series (Arithmetic Progression).

351

−16

→

335

−16

→

319

−16

→

303

−16

→

287

−16

→

271

Each term is obtained by subtracting 16 from the previous term.

=> 351 − 16 = 335

=> 335 − 16 = 319

=> 319 − 16 = 303

=> 303 − 16 = 287

=> 287 − 16 = 271

Therefore The correct answer is 271.

Additional Information

Arithmetic Progression (AP)

A sequence of numbers in which the difference between any two consecutive terms is constant, known as the common difference (d).

General Term of AP

The n^(th) term of an arithmetic progression is given by T_n = a + (n − 1)d, where a is the first term and d is the common difference.

Common Difference

It is calculated as d = T2 − T1. If d is negative, the series is decreasing; if d is positive, the series is increasing.

Q56. Answer: (c) Giraffe

Given: Six animals, Bear, Fox, Giraffe, Lion, Panda and Tiger, are sitting around a circular table facing the centre.

1. Tiger is sitting second to the left of Lion.

2. Fox is an immediate neighbour of both Tiger and Bear.

3. Giraffe is sitting second to the left of Panda.

Thus, Giraffe is sitting between Lion and Tiger, when counted from the left of Lion.

Hence, the correct answer is "Option 3".

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Q57. Answer: (b) 121

BODMAS Rule:

Decoding the given information:

Letter	A	B	C	D
Meaning	÷	×	•	•

Given equation: 5 D 4 C 40 B 3 A 1 = ?

Now replacing the sign from left to right using BODMAS Rule, we get:

=> 5 − 4 + 40 × 3 ÷ 1 = ?

=> 5 − 4 + 40 × 3 = ?

=> 5 − 4 + 120 = ?

=> 125 − 4 = ?

=> 121 = ?

Hence, the correct answer is "Option 2".

Q58. Answer: (b) Neither I nor II follows

Statements:

All books are pens.

Some pens are erasers.

The least possible Venn diagram for the given statement is:

All books lie inside pens. Some part of pens overlaps with erasers. But the overlapping part may or may not include books.

Conclusions:

(I) All erasers are pens. - Does not follow (Because, some pens are erasers which means not some erasers are pens.)

(II) Some books are erasers. - Does not follow (There is no definite relation between books and erasers, it can be possible but it is not definite.)

Thus, neither conclusion (I) nor (II) follows.

Hence, the correct answer is "Option 2".

Q59. Answer: (b) Two

Given: M, N, O, P, W, X and Y are sitting around a circular table facing the centre of the table.

1. W sits third to the left of O.

2. O is the immediate neighbour of both N and X.

3. X sits second to the left of Y.

4. P is not an immediate neighbour of W.

M, the only person left will occupy the vacant position.

Thus, two people sit between M and X when counted from the right of M.

Hence, the correct answer is "Option 2".

Q60. Answer: (d) -19

BODMAS Rule:

Given equation: 22 − 13 ÷ 21 × 39 + 48 = ?

Now, if '+' and '−' are interchanged and '×' and '÷' are interchanged, then the equation becomes:

=> 22 + 13 × 21 ÷ 39 − 48 = ?

=> 22 + 13 × 0.53 − 48 = ?

=> 22 + 7 − 48 = ?

=> 29 − 48 = ?

=> -19 = ?

Hence, the correct answer is "Option 4".

Q61. Answer: (d) (8, 64, 8)

The logic followed here is:

Logic: (1st No. × 3rd No.) = 2nd No.

16 × 16 = 256

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9 × 9 = 81

Let's check each option:

1. (4, 16, 6) → 4 × 6 = 24 ≠ 16

2. (25, 625, 20) → 25 × 20 = 500 ≠ 625

3. (12, 144, 10) → 12 × 10 = 120 ≠ 144

4. (8, 64, 8) → 8 × 8 = 64

Thus, (8, 64, 8) is the set in which the numbers are related in the same way as the given sets.

Hence, the correct answer is "Option 4".

Q62. Answer: (d) xc

Given: In a certain code language, ‘store what matters’ is coded as ‘bf yt xc’ and ‘don't store it’ is coded as ‘hd ip xc’.

Thus, ‘store’ is as coded as 'xc' in the given language.

Hence, the correct answer is "Option 4".

Q63. Answer: (b) 11 km to the east

Given: Mr. Akai starts from Point A and drives 9 km towards south. He then takes a left turn, drives 7 km, turns left and drives 21 km. He then takes a left turn and drives 18 km. He takes a final left turn, drives 12 km and stops at Point P.

Thus, he should drive 11 km to the east in order to reach Point A again.

Hence, the correct answer is "Option 2".

Q64. Answer: (d) CKD

The position and positional values or English Alphabets are:

Given: SAT OWP KSL GOH ?

The logic followed here is:

Thus, CKD should come in place of the question mark (?) in the given series based on the English alphabetical order.

Hence, the correct answer is "Option 4".

Q65. Answer: (d) One

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

Now,

Odd digits, each of which is immediately preceded by an even digit and also immediately followed by an odd digit.

So, the needed pattern is: Even — Odd — Odd

Thus, there is one odd digit, each of which is immediately preceded by an even digit and also immediately followed by an odd digit.

Hence, the correct answer is "Option 4".

Q66. Answer: (a) D

Given: Seven boxes, A, B, C, D, I, J, and K, are kept one over the other, but not necessarily in the same order.

1. Only two boxes are kept between A and C.

2. Only B is kept above K.

3. No box is kept below C.

4. J is kept at some place below D but at some place above I.

B
K
D
A
J
I
C

Thus, box D is kept third above I.

Hence, the correct answer is "Option 1".

Q67. Answer: (d) 351

Shortcut Trick

Identify the gap between consecutive numbers in the series.

The differences are: 2, 4, 6, 8, ...

The gaps follow the sequence of consecutive even numbers starting from 2.

The next gap must be 10.

Next term = 341 + 10 = 351.

Therefore The correct answer is 351.

Alternate Method

The given number series is: 321, 323, 327, 333, 341, ?

321

+2

→

323

+4

→

327

+6

→

333

+8

→

341

+10

→

351

The pattern follows an addition of consecutive even numbers to the previous term.

=> 321 + 2 = 323

=> 323 + 4 = 327

=> 327 + 6 = 333

=> 333 + 8 = 341

=> 341 + 10 = 351

Therefore The correct answer is 351.

Additional Information

Even Number Series

A series where the difference between terms follows the sequence 2n, where n = 1, 2, 3...

Arithmetic Progression in Gaps

When the differences between terms form their own Arithmetic Progression (AP), it is called a double-difference series.

Pattern Recognition

Common patterns include differences based on prime numbers, squares, cubes, or constant additions.

Q68. Answer: (c) Only conclusion (I) follows

Statements:

All foxes are cats.

No cat is a bear.

The least possible Venn diagram for the given statement is:

Conclusions:

(I) No fox is a bear. - Follow (Because, all foxes are cats and no cat is a bear, which means no fox is a bear.)

(II) Some bears are cats. - Does not follow (Because, no cat is a bear, so no bears are cats.)

Thus, only conclusion (I) follows.

Hence, the correct answer is "Option 3".

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Q69. Answer: (d) TO −4

The position and positional values or English Alphabets are:

Given: IK 6 is related to KF −10 in a certain way. In the same way, GI 8 is related to ID −8.

The logic followed here is:

Similarly,

Thus, RT 12 is related to TO -4, following the same logic.

Hence, the correct answer is "Option 4".

Q70. Answer: (d) 27

Given: 3 6 11 18 ?

The logic followed here is:

Thus, 27 should come in place of the question mark (?) in the given series.

Hence, the correct answer is "Option 4".

Q71. Answer: (b) CTHZ

The position and positional values or English Alphabets are:

Given: EFJL is related to HKMQ in a certain way based on the English alphabetical order. In the same way, QZVF is related to TEYK.

The logic followed here is:

Similarly,

Thus, ZOEU is related to CTHZ, following the same logic.

Hence, the correct answer is "Option 2".

Q72. Answer: (a) YUN : UTQ

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster pair follows the pattern -4, -1, +3.

MKD : IJG

PTF : LSI

Let's check each option:

1. YUN : UTQ

This letter-cluster pair follows the pattern -4, -1, +3.

2. JHE : FFH

This letter-cluster pair does not follow the pattern -4, -1, +3.

3. OPA : KOC

This letter-cluster pair does not follow the pattern -4, -1, +3.

4. NKH : JJJ

This letter-cluster pair does not follow the pattern -4, -1, +3.

Thus, YUN : UTQ follow the same pattern.

Hence, the correct answer is "Option 1".

Q73. Answer: (b) C

Given: A, B, C, D, E and F are sitting around a circular table facing the centre.

1. C sits second to the left of E.

2, A sits second to the right of D.

3. F is on the immediate right of A.

B, the only person left will occupy the vacant position.

Thus, C is sitting on the immediate right of B.

Hence, the correct answer is "Option 2".

Q74. Answer: (a) 62

Given: Hiten ranked 39th from the top and 24th from the bottom in his class.

Hiten's rank from the top = 39th

Hiten's rank from the bottom = 24th

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Total students in the class = Rank from top + Rank from bottom − 1

= 39 + 24 − 1

= 63 - 1

= 62

Thus, there are 62 students in his class.

Hence, the correct answer is "Option 1".

Q75. Answer: (c) 7

Given: In a certain code language, ‘VALE’ is coded as ‘6318’ and ‘OVAL’ is coded as ‘3761’.

Thus, 7 is the code for ‘O’ in the given code language.

Hence, the correct answer is "Option 3".637

Q76. Answer: (b) One

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

Now,

Even numbers, each of which is immediately preceded by an even number and also immediately followed by an odd number.

So, the needed pattern is: Even — Even — Odd

Thus, there is one even number, each of which is immediately preceded by an even number and also immediately followed by an odd number.

Hence, the correct answer is "Option 2".

Q77. Answer: (b) Son

Family Chart:

Decoding the Symbols:

A is				
Symbol	?	=	@	√
Meaning	daughter	son	father	sister
to B				

Given: C = D @ E √ F ? L

It means: C is the son of D, D is the father of E, E is the sister of F, F is the daughter of L

Thus, C is son of L.

Hence, the correct answer is "Option 2".

Q78. Answer: (a) 21 km to the west

Given: Riya starts from point A and drives 34 km towards south. She then takes a right turn, drives 46 km, turns right and drives 51 km. She then takes a right turn and drives 67 km. She takes a final right turn, drives 17 km and stops at point P.

Thus, she should drive 21 km to the west in order to reach point A again.

Hence, the correct answer is "Option 1".

Q79. Answer: (a) MT – JZ

The position and positional values or English Alphabets are:

The pattern followed here is:

Each letter-cluster pair follows the pattern -3, +5.

Let's check each option:

1. MT – JZ

This letter-cluster pair does not follow the pattern -3, +5.

2. SV – PA

This letter-cluster pair follows the pattern -3, +5.

3. RD – OI

This letter-cluster pair follows the pattern -3, +5.

4. KQ – HV

This letter-cluster pair follows the pattern -3, +5.

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Thus, MT – JZ is the odd one out.

Hence, the correct answer is "Option 1".

Q80. Answer: (b) 7

Given: 741, 753, 789, 761, 745

Second highest number is 761

Second digit of 761 = 6

Lowest number = 741

Third digit of 741 = 1

Resultant = 6 + 1 = 7

Hence, the correct answer is "Option 2".

Q81. Answer: (b) S Mahendra Dev

The correct answer is S Mahendra Dev.

Key Points

• S Mahendra Dev was appointed as the Chairperson of the Economic Advisory Council to the Prime Minister (EAC-PM) in June 2025.

• He is a distinguished economist who previously served as the Director and Vice-Chancellor of the Indira Gandhi Institute of Development Research (IGIDR) in Mumbai.

• The EAC-PM is an independent body constituted to provide economic advice specifically to the Prime Minister of India on both macro and microeconomic matters.

• S Mahendra Dev has a notable career in policy-making, having served as the Chairman of the Commission for Agricultural Costs and Prices (CACP) under the Ministry of Agriculture.

• His appointment follows the tenure of Bibek Debroy, who was a long-standing head of the council since its reconstitution in 2017.

Additional Information

• Economic Advisory Council to the Prime Minister (EAC-PM):

• The council is tasked with analyzing any issue, economic or otherwise, referred to it by the Prime Minister.

• It addresses macroeconomic importance and presents views to the Prime Minister; this could be either suo-motu or on reference.

• The administrative, logistic, and financial requirements of the EAC-PM are met by the NITI Aayog, which serves as the Nodal Agency.

• Structure of the Council:

• The council typically includes a Chairperson, Full-time Members, and several Part-time Members who are usually eminent experts from academia or research institutions.

• The terms of reference include analyzing economic trends and advising on policy interventions.

• Other Options Explained:

• Suman Bery: He is a veteran economist who took over as the Vice Chairperson of NITI Aayog in May 2022, succeeding Rajiv Kumar.

• Bibek Debroy: A prominent Indian economist and Indologist who served as the Chairman of the EAC-PM from its revival in September 2017.

• Arun Kumar: Often refers to the noted Professor and expert on the Black Economy in India, known for his critical analysis of demonetization and GST.

Important Points

• The EAC-PM was reconstituted in 2017 after a gap; it replaced the previous council that existed during the UPA era under C. Rangarajan.

• Unlike NITI Aayog, which is a statutory-like policy think tank with a broad developmental mandate, the EAC-PM focuses specifically on immediate economic advice for the head of the government.

• S Mahendra Dev holds a Ph.D. from the Delhi School of Economics and completed his Post-doctoral research at Yale University.

• The appointment of such experts is crucial for navigating inflationary pressures, GDP growth targets, and fiscal deficit management in the Indian Economy.

Q82. Answer: (d) Norway

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

Key Points

• The World Press Freedom Index 2025 was released by the international non-governmental organization Reporters Without

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Borders (RSF) in May 2025.

• Norway secured the first rank in the index, continuing its long-standing streak as the world's most free country for journalists and media organizations.

• The index is typically unveiled on May 3rd, which is observed globally as World Press Freedom Day to highlight the importance of independent media.

• Norway's top position is attributed to its strong constitutional protections for freedom of speech and a diverse media landscape that operates without political or economic interference.

• Following Norway, other Nordic and European nations such as Denmark, Sweden, and Estonia frequently occupy the top five positions in the global rankings.

• The 2025 edition of the index evaluates the state of journalism in 180 countries and territories, focusing on the ability of journalists to report news without fear of reprisal.

Additional Information

• Reporters Without Borders (RSF):

• It is a Paris-based non-profit organization founded in 1985 by Robert Ménard, Rémy Loury, Jacques Molénat, and Émilien Jubineau.

• RSF holds consultative status with the United Nations, UNESCO, and the Council of Europe.

• The organization acts as a watchdog to defend freedom of information and provides assistance to journalists working in war zones.

• Methodology of the Index:

• The ranking is determined based on five contextual indicators: Political context, Legal framework, Economic context, Sociocultural context, and Safety.

• A quantitative tally of abuses against journalists and a qualitative analysis based on a survey of hundreds of press freedom experts are used to calculate the final score.

• The scores range from 0 to 100, with 100 representing the highest possible level of press freedom.

• Global Trends in 2025:

• The 2025 report expressed concerns regarding the rise of Generative AI and its role in spreading disinformation and "deepfakes."

• It also noted a decline in press freedom in regions facing active conflicts, where censorship and physical violence against reporters have increased.

Important Points

• India's Performance:

• In recent years, India has seen a decline in its ranking, often placing in the "Difficult" category. In the 2024 index, India was ranked 159th out of 180 countries.

• Common challenges cited for India include restrictive laws, physical attacks on journalists, and the concentration of media ownership.

• Bottom of the Index:

• Countries that consistently rank at the bottom (around 178th to 180th) include Eritrea, North Korea, and Afghanistan, where independent journalism is virtually non-existent.

• These nations are often categorized as having a "Very Serious" situation regarding press freedom.

• Regional Insights:

• The Maghreb and Middle East regions remain among the most dangerous places for journalists globally due to ongoing instability and authoritarian regimes.

• The European Union remains the region where press freedom is best protected, although it faces internal challenges from populist movements in certain member states.

Q83. Answer: (c) Washington, D.C.

The correct answer is Washington, D.C..

Key Points

• The Spring Meetings of the International Monetary Fund (IMF) and the World Bank Group (WBG) are held annually in April in Washington, D.C., where both institutions are headquartered.

• For the year 2025, the Spring Meetings are scheduled to take place from April 21 to April 27, 2025.

• These meetings serve as a primary platform for Finance Ministers, Central Bank Governors, private sector executives, and academics to discuss issues of global concern, including poverty eradication and economic development.

• The core of the event involves meetings of the International Monetary and Financial Committee (IMFC) and the Development Committee, which provide strategic direction to the two institutions.

• The discussions in April 2025 are expected to focus heavily on global debt sustainability, climate financing, and the World Economic Outlook in the face of geopolitical tensions.

Additional Information

• International Monetary Fund (IMF):

• Established in July 1944 at the Bretton Woods Conference, the IMF currently consists of 190 member countries.

• Its primary mission is to ensure the stability of the international monetary system, including exchange rates and international payments.

• The current Managing Director of the IMF is Kristalina Georgieva, who assumed office in 2019.

• World Bank Group (WBG):

• Founded alongside the IMF in 1944, it aims to reduce poverty by providing loans and grants to low- and middle-income countries.

• The group is currently led by President Ajay Banga, who took office in June 2023.

• It comprises five constituent institutions, notably the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA).

• Meeting Cycle:

• While the Spring Meetings always occur in Washington, D.C., the Annual Meetings (held in October) are hosted by a member country other than the United States every third year.

• These gatherings are used to release major reports such as the World Economic Outlook (WEO) and the Global Financial Stability Report.

Important Points

• Bretton Woods Twins: The IMF and the World Bank are frequently referred to as the Bretton Woods Twins as they were created to establish a new framework for international economic cooperation after World War II.

• Location Rationale: By tradition, the headquarters of these organizations are located in the capital of the largest shareholder, which is Washington, D.C., in the United States.

• Global Financial Architecture: The April 2025 meetings are particularly significant as member states continue to debate reforms to the global financial architecture to better support developing nations facing high interest rates and inflation.

Q84. Answer: (a) Kakinada

The correct answer is Kakinada.

Key Points

• Tiger Triumph is a premier bilateral tri-service exercise conducted between the Indian Armed Forces and the United States Armed Forces.

• The exercise is designed to improve interoperability and readiness for Humanitarian Assistance and Disaster Relief (HADR) operations, showcasing the growing strategic defense partnership between India and the USA.

• The amphibious landing phase, which is a major highlight of the exercise, was hosted at Kakinada, located in the state of Andhra Pradesh.

• The exercise typically consists of two main phases: the Harbour Phase, usually held at Visakhapatnam, and the Sea Phase, which culminates in amphibious operations at the Kakinada beach.

• During the amphibious phase, troops from the Indian Army, Indian Navy, and Indian Air Force work alongside the US Marine Corps and US Navy to practice complex maneuvers involving landing crafts and hovercrafts.

Additional Information

• Geographical Context of Kakinada:

• Kakinada is a significant port city on the eastern coast of India. It is strategically important due to its deep-water port and proximity to Hope Island, which acts as a natural breakwater.

• The beach geography at Kakinada is ideal for amphibious exercises, allowing large naval vessels like Landing Platform Docks (LPDs) to deploy troops and equipment effectively.

• Participating Assets:

• Key Indian assets often include the INS Jalashwa, a Landing Platform Dock, along with Landing Ship Tanks (LSTs) and Frigates.

• The United States typically deploys vessels such as the USS Somerset and USS Germantown, along with Marine Expeditionary Units (MEU).

• The exercise also utilizes Mi-17 helicopters and Rapid Action Medical Teams (RAMT) to simulate disaster response scenarios.

• Objectives and Themes:

• The primary theme of Tiger Triumph is Humanitarian Assistance and Disaster Relief (HADR), focusing on standardizing Standard Operating Procedures (SOPs) for joint operations during natural calamities.

• It aims to strengthen the Comprehensive Global Strategic Partnership between the two nations, which was bolstered by several

defense agreements in recent years.

Important Points

• Exercise Timeline: The 2024 edition of the exercise took place from March 18 to March 31, involving nearly 14 days of intense coordination and training.

• Joint Command Centre: One of the critical features of the exercise is the establishment of a Joint Command and Control Centre to oversee the seamless movement of relief materials and personnel.

• Significance: This is the second major tri-service exercise of its kind, following the inaugural Tiger Triumph held in November 2019. It highlights the transition from Navy-to-Navy exercises to more complex tri-service integration between India and the USA.

• Location Specifics: While Visakhapatnam serves as the administrative and logistics hub for the Harbour Phase, Kakinada remains the operational theater for shore-based and beach-landing drills.

Q85. Answer: (a) Kalvakuntla Chandrashekar Rao

The correct answer is Kalvakuntla Chandrashekar Rao.

Key Points

• Kalvakuntla Chandrashekar Rao (KCR) served as the first Chief Minister of Telangana for two consecutive terms from June 2, 2014, to December 2023. Following the Assembly Elections held in November 2023, his party, the Bharat Rashtra Samithi (BRS), was defeated, and Anumula Revanth Reddy took oath as the new Chief Minister. As of June 2025, KCR is not holding the office of Chief Minister in any state.

• Himanta Biswa Sarma is the current and 15th Chief Minister of Assam. He assumed office on May 10, 2021, succeeding Sarbananda Sonowal. He represents the Jalukbari constituency and is a prominent leader of the Bharatiya Janata Party (BJP) in Northeast India.

• Nara Chandrababu Naidu is the Chief Minister of Andhra Pradesh as of June 2025. He led the Telugu Desam Party (TDP) to a landslide victory in the 2024 Andhra Pradesh Legislative Assembly elections and was sworn in for his fourth term as Chief Minister in June 2024.

• Bhajan Lal Sharma serves as the Chief Minister of Rajasthan. He was elected as the leader of the BJP legislative party following the 2023 Rajasthan Assembly elections and assumed office on December 15, 2023.

Additional Information

• Constitutional Provisions:

• The Chief Minister is appointed by the Governor of the state under Article 164 of the Constitution of India.

• The Governor appoints the leader of the party or coalition that commands a majority in the State Legislative Assembly as the Chief Minister.

• Role and Functions:

• The Chief Minister is the real executive authority (de facto executive) of the state, while the Governor is the nominal executive authority (de jure executive).

• The CM advises the Governor on the appointment of other ministers and presides over the meetings of the Council of Ministers.

• State-Specific Data:

• Telangana: Formed on June 2, 2014, after the bifurcation of Andhra Pradesh under the Andhra Pradesh Reorganisation Act, 2014.

• Andhra Pradesh: Following the 2024 elections, the capital development of Amaravati was revived under the leadership of Nara Chandrababu Naidu.

• Assam: Known as the "Gateway to the North-East," it has seen significant infrastructure development under Himanta Biswa Sarma.

Important Points

• Election Cycles: The year 2023 and 2024 were pivotal for Indian state politics, with major Assembly Elections in Rajasthan, Madhya Pradesh, Chhattisgarh, Telangana, and Andhra Pradesh, leading to several new appointments of Chief Ministers.

• Tenure: While the normal term of a Chief Minister is 5 years, they hold office during the "pleasure of the Governor," which practically means as long as they maintain the majority support in the Lower House of the state legislature.

• Political Parties: As of the mid-2025 political landscape, the BJP and its allies (NDA) hold power in states like Rajasthan, Assam, and Andhra Pradesh, whereas the Indian National Congress or regional parties govern other territories.

Q86. Answer: (d) Test of Beyond 5G and 6G SDR SoC

The correct answer is Test of Beyond 5G and 6G SDR SoC.

Key Points

• In May 2025, a landmark achievement in the field of wireless communication was recorded through a joint venture between IIT Hyderabad (IITH) and Japan’s Space and Systems Innovative Center (SSIC).

• The milestone consists of the successful Test of Beyond 5G and 6G SDR SoC, which represents a critical leap toward the

realization of the next generation of mobile connectivity.

• The collaboration utilized the specialized research facilities at IIT Hyderabad, which is a leading hub for 6G research in India, in partnership with Japanese expertise in high-end semiconductor and satellite systems.

• The focus of the project was the development of a Software Defined Radio (SDR) based System on Chip (SoC), which allows for the flexibility to handle multiple communication protocols through software updates rather than hardware changes.

• This achievement is aligned with global efforts to standardize Beyond 5G (B5G) technologies, aiming for ultra-high data rates, extreme reliability, and massive machine-type communications.

Additional Information

• Beyond 5G and 6G:

• 6G is the successor to 5G cellular technology and is expected to be significantly faster, potentially reaching speeds of 1 Terabit per second (Tbps).

• It aims to integrate terahertz (THz) frequencies and will facilitate advancements in holographic communication, artificial intelligence (AI), and fully autonomous systems.

• Software Defined Radio (SDR):

• SDR is a technology where traditional hardware components like mixers, filters, and amplifiers are implemented via software.

• This flexibility is essential for 6G because the standards are still evolving, allowing researchers to modify the radio's behavior without redesigning the physical chip.

• System on Chip (SoC):

• An SoC is an integrated circuit (IC) that integrates all components of a computer or other electronic system into a single chip.

• In the context of 6G, these chips must manage high-frequency signals while maintaining low power consumption and minimal heat dissipation.

• Indo-Japan Technological Cooperation:

• The India-Japan Digital Partnership (IJDP) has been a cornerstone for collaboration in Critical and Emerging Technology (iCET).

• This partnership focuses on 5G/6G, semiconductors, and cyberspace security, strengthening the technological sovereignty of both nations.

Important Points

• Bharat 6G Vision: The Government of India, through the Department of Telecommunications (DoT), launched the Bharat 6G Vision Document to make India a front-runner in 6G by 2030.

• Role of IIT Hyderabad: IITH has established a 6G Research Center and has been active in developing indigenous technologies like the 5G testbed, which has now transitioned into Beyond 5G exploration.

• SSIC Japan: The Space and Systems Innovative Center plays a vital role in providing the system-level architecture required for integrating satellite communication with terrestrial 6G networks, a concept known as Non-Terrestrial Networks (NTN).

• Latency and Throughput: The tested SDR SoC is designed to support sub-millisecond latency, which is a prerequisite for real-time applications such as remote surgery and high-speed industrial automation.

Q87. Answer: (b) Karnataka

The correct answer is Karnataka.

Key Points

• The India Justice Report (IJR) 2025 identifies Karnataka as the standout performer in maintaining social diversity within its justice delivery system.

• It is currently the only state in India to have successfully met the prescribed reservation quotas for Scheduled Castes (SC), Scheduled Tribes (ST), and Other Backward Classes (OBC) in both its Police department and the Judiciary.

• In the Police pillar, Karnataka has demonstrated a consistent ability to fill reserved vacancies, ensuring that the law enforcement agency reflects the demographic composition of the state.

• In the Judiciary pillar, particularly at the subordinate court level, the state has adhered to the Constitutional mandates of representation for marginalized communities, which is a rare feat across Indian states.

• Overall, Karnataka ranked first among the 18 large and mid-sized states in the India Justice Report, maintaining its leadership position in the overall capacity to deliver justice. Hence, the correct answer is Karnataka.

Additional Information

• About India Justice Report (IJR):

• The IJR is a first-of-its-kind initiative launched in 2019 by Tata Trusts in collaboration with partners such as Centre for Social Justice, Common Cause, Commonwealth Human Rights Initiative, DAKSH, TISS-Prayas, and Vidhi Centre for Legal Policy.

• It tracks the capacity of states to deliver justice based on four pillars: Police, Prisons, Judiciary, and Legal Aid.

• The report uses government data to assess states on various parameters including budgets, human resources, workload, diversity, infrastructure, and trends over the last five years.

• Diversity and Representation:

• The report highlights that diversity is a crucial indicator of a fair justice system. Nationally, most states struggle to meet SC, ST, and OBC quotas, leading to significant vacancies.

• While Karnataka leads in caste-based quotas, the report also examines Women in Justice. It notes that while the share of women is increasing, they still represent a small fraction of the Police and Judiciary at higher levels across India.

• Performance of Other States:

• In the 2025 ranking, states like Tamil Nadu, Telangana, and Gujarat followed Karnataka in the top tier of large states.

• Smaller states like Sikkim and Arunachal Pradesh are ranked separately, with Sikkim often performing well in the small states category.

Important Points

• Constitutional Provisions:

• The reservation for SC, ST, and OBC in public employment and services is backed by Articles 15(4) and 16(4) of the Constitution of India.

• Ensuring representation in the Judiciary and Police is vital for maintaining the Rule of Law and building public trust in the state's institutions.

• Key National Findings:

• Despite the progress in Karnataka, the IJR 2025 points out a national trend of rising pendency of cases and chronic under-staffing in prisons and courts.

• The average vacancy in High Courts remains high at nearly 30%, and the Police-to-Population ratio remains below international standards in many states.

• The report serves as a policy tool for State Governments and the Union Government to address systemic gaps in the Indian justice system.

Q88. Answer: (d) Akashteer

The correct answer is Akashteer.

Key Points

• Project Akashteer is an advanced, indigenous automated Air Defence Control and Reporting System developed to digitize the Indian Army's air defense mechanism.

• It was developed by Bharat Electronics Limited (BEL) as part of the "Atmanirbhar Bharat" initiative to enhance the nation's self-reliance in defense technology.

• The system is designed to provide real-time situational awareness by integrating various radar and sensor data into a unified network to track low-level targets such as drones, helicopters, and missiles.

• The primary objective of Akashteer is to minimize fratricide (accidental firing on friendly aircraft) and ensure the seamless neutralization of enemy aerial threats in a complex battlefield environment.

• The Indian Army began the induction of these units in 2024, designating it as a landmark in the "Year of Technology Absorption" to modernize battlefield transparency by May 2025.

Additional Information

• Bharat Electronics Limited (BEL):

• BEL is a leading Navratna Public Sector Undertaking (PSU) under the Ministry of Defence, Government of India.

• It was established in 1954 and is headquartered in Bengaluru, Karnataka.

• It specializes in manufacturing advanced electronic products for the Indian Armed Forces, including radars, sonar, communication equipment, and electronic warfare systems.

• Modern Air Defence Challenges:

• With the rise of Unmanned Aerial Vehicles (UAVs) and loitering munitions, traditional manual monitoring is insufficient.

• Systems like Akashteer automate the command and control process, allowing for faster decision-making and engagement of multiple threats simultaneously.

• Year of Technology Absorption (2024):

• The Indian Army declared 2024 as the year to focus on integrating niche technologies, Artificial Intelligence (AI), and automated systems into its operational framework.

Important Points

• Contract and Value: The Ministry of Defence signed a contract worth approximately Rs. 1,982 crore with BEL in March 2023 for the supply of Akashteer systems.

• Mobility and Deployment: The system is highly mobile as it is based on high-mobility vehicles, allowing it to be deployed in diverse terrains including plains, deserts, and mountainous regions.

• Network-Centric Warfare: Akashteer represents a shift towards network-centric operations, where information is shared instantly

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across all levels of the Air Defence hierarchy, from the Corps level down to the fire units.

• Operational Efficiency: By automating the reporting and control functions, it reduces the sensor-to-shooter loop time, ensuring that threats are intercepted with maximum precision and minimum delay.

Q89. Answer: (c) 85.29 m

The correct answer is 85.29 m.

Key Points

• The prominent Indian javelin thrower, Neeraj Chopra, secured the first position at the Ostrava Golden Spike athletics meet.

• As per the event records for June 2025, he clinched the gold medal with a best throw of 85.29 m.

• The Ostrava Golden Spike is a highly prestigious event held annually at the Mestsky Stadium in Ostrava, Czech Republic.

• The competition is a key fixture in the World Athletics Continental Tour Gold series, attracting the world's top-ranked javelin throwers.

• This victory further consolidates his standing as a world-class athlete and serves as a significant milestone in his preparation for the 2025 season.

Additional Information

• Neeraj Chopra's Profile:

• He is a Subedar in the Indian Army and became a national hero after winning the gold medal at the Tokyo 2020 Olympics.

• His Olympic gold was a historic feat, as he was the first Indian to win a track and field gold medal at the Olympic Games.

• He holds the National Record in javelin throw for India with a massive throw of 89.94 m, achieved at the Stockholm Diamond League in 2022.

• Major Career Achievements:

• World Athletics Championships: Neeraj won the Gold medal at the 2023 World Championships in Budapest with a throw of 88.17 m.

• Asian Games: He secured back-to-back gold medals at the 2018 Jakarta and 2022 Hangzhou Asian Games.

• Diamond League: He became the first Indian to win the Diamond League Final trophy in 2022.

• National Recognitions:

• In recognition of his sporting excellence, he was awarded the Major Dhyan Chand Khel Ratna in 2021.

• He was also conferred with the Padma Shri, India's fourth-highest civilian award, in 2022.

Important Points

• Event Significance: The Ostrava Golden Spike meet is one of the oldest and most respected athletics competitions in Europe, dating back to 1961.

• Technical Prowess: Achieving a throw of 85.29 m requires immense explosive power, flexibility, and aerodynamic precision. Chopra is known for his exceptional run-up speed and blocking technique.

• Rivalries: In such international meets, Neeraj frequently competes against elite athletes like Jakub Vadlejch of the Czech Republic and Julian Weber of Germany.

• Global Ranking: Success in the Continental Tour Gold events is vital for securing points in the World Athletics Rankings, which determine qualification for World Championships and Olympic Games.

Q90. Answer: (d) SISA

The correct answer is SISA.

Key Points

• The global cybersecurity company SISA, known for its forensic-driven approach, collaborated with the Indian Computer Emergency Response Team (CERT-In) to launch the Digital Threat Report 2024 for the Banking, Financial Services, and Insurance (BFSI) sector in April 2025.

• The report serves as a comprehensive guide for financial institutions to understand the evolving landscape of cyber threats, providing actionable insights to strengthen their cybersecurity posture.

• The collaboration highlights the importance of Public-Private Partnerships (PPP) in safeguarding the national critical information infrastructure, particularly the financial backbone of the country.

• Key findings in the report emphasize the rise of sophisticated cyber-attacks targeting digital payment gateways, mobile banking applications, and insurance databases within the BFSI sector.

• The report outlines specific mitigation strategies and security frameworks that organizations should adopt to counter threats like ransomware, advanced persistent threats (APTs), and AI-driven fraud.

Additional Information

• SISA:

• SISA is a global forensics-driven cybersecurity company headquartered in Bengaluru, India, with a strong presence in regions

like the Middle East, USA, and South East Asia.

• It is a PCI Qualified Security Assessor (QSA) and an authorized Forensic Investigator (PFI), helping organizations comply with global standards like PCI DSS.

• The company focuses on security compliance, technical audits, and managed detection and response (MDR) services.

• CERT-In (Indian Computer Emergency Response Team):

• It is the national nodal agency for responding to computer security incidents as and when they occur, operating under the Ministry of Electronics and Information Technology (MeitY).

• CERT-In was established in 2004 under the Information Technology Act, 2000.

• Its primary functions include incident reporting, issuing advisories, vulnerability notes, and conducting cybersecurity training for various sectors.

• BFSI Sector Vulnerabilities:

• The BFSI sector is a prime target for cybercriminals due to the high volume of financial transactions and sensitive personal data involved.

• Common threats include Phishing, Vishing, Credential Stuffing, and the use of Deepfakes for identity theft in the Know Your Customer (KYC) process.

• Regulations from the Reserve Bank of India (RBI) and SEBI mandate strict cyber-resilience norms for banks and intermediaries.

Important Points

• Emerging Threats in 2024-2025: The report specifically identifies Generative AI as a double-edged sword, used by attackers to create more convincing malware and by defenders for threat hunting.

• Regulatory Compliance: Financial institutions are encouraged to align with the Digital Personal Data Protection (DPDP) Act, 2023, to ensure the privacy of customer information during data breaches.

• Global Context: Similar reports are published globally by entities like INTERPOL and FS-ISAC to track transnational cybercrime trends affecting the global financial system.

• Digital Payment Security: With the massive adoption of UPI (Unified Payments Interface) in India, the report provides a dedicated section on securing real-time payment ecosystems.

Q91. Answer: (d) Rs. 20,000 crore

The correct answer is Rs. 20,000 crore.

Key Points

• In the Union Budget 2025–26, the Government of India announced a significant allocation of Rs. 20,000 crore to the Ministry of Science and Technology.

• The primary purpose of this corpus is to finance private-sector-led research, development (R&D), and innovation on a commercial scale.

• This funding mechanism is designed to provide long-term financing or refinancing with long tenors and low or nil interest rates, encouraging the private sector to increase its R&D expenditure.

• The initiative is closely aligned with the Anusandhan National Research Foundation (ANRF) framework, which aims to provide strategic direction to scientific research in the country.

• The allocation reflects the government's shift toward fostering a collaborative ecosystem where the private sector takes a leading role in technological breakthroughs and industrial innovation.

Additional Information

• Anusandhan National Research Foundation (ANRF):

• Established under the ANRF Act, 2023, it replaced the Science and Engineering Research Board (SERB).

• It functions as an apex body to provide high-level strategic direction for scientific research in India, as per the recommendations of the National Education Policy (NEP) 2020.

• The foundation aims to seed, grow, and promote R&D and foster a culture of research and innovation throughout India’s universities, colleges, and research institutions.

• Budgetary Vision for 2025-26:

• The 2025-26 budget emphasizes the "Jai Anusandhan" slogan, highlighting that innovation is the foundation for a Viksit Bharat by 2047.

• Apart from the specific Rs. 20,000 crore corpus, the overall outlay for scientific departments has seen a steady increase to support Deep Tech and emerging technologies.

• Focus on Private Sector Participation:

• Currently, India’s Gross Expenditure on R&D (GERD) is predominantly driven by the government. The new corpus aims to bring private sector investment at par with global averages seen in developed economies.

• Key sectors targeted include Artificial Intelligence (AI), Quantum Computing, Semiconductors, and Green Energy.

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• Implementation Agency:

• The Department of Science and Technology (DST), under the Ministry of Science and Technology, plays a pivotal role in administering these funds and setting the guidelines for eligibility and disbursement.

Important Points

• Date and Context: The announcement was part of the Union Budget presented by the Union Finance Minister on February 1, 2025.

• Scale of Innovation: This Rs. 20,000 crore corpus is distinct from the general budget of the ministry and specifically targets commercialization of home-grown technologies.

• Financing Terms: The provision of low-interest loans is intended to reduce the financial risk for private companies engaged in high-end, long-gestation scientific research projects.

Q92. Answer: (c) Riyadh

The correct answer is Riyadh.

Key Points

• Riyadh, the capital of Saudi Arabia, has been designated as the permanent host city for the Esports World Cup (EWC), including the upcoming 2025 edition.

• The tournament is an annual international esports competition that replaced the previous Gamers8 festival, which was also held in Saudi Arabia.

• The announcement of the Esports World Cup was made by Crown Prince Mohammed bin Salman in October 2023, aiming to establish the kingdom as a premier global hub for gaming and esports.

• The Esports World Cup Foundation, a non-profit organization, is responsible for organizing the event and managing the massive scale of the competition.

• The event features a unique cross-game competition format where professional esports clubs from across the globe compete in various titles to earn points for a collective club championship. Hence, the correct answer is Riyadh.

Additional Information

• National Gaming and Esports Strategy:

• Launched in September 2022, this strategy is a core component of Saudi Vision 2030.

• It aims to increase the sector's contribution to the GDP by more than SAR 50 billion (approximately $13.3 billion) by 2030.

• The strategy intends to create 39,000 new job opportunities within the gaming industry by the end of the decade.

• Vision 2030 and Economic Diversification:

• Saudi Arabia is investing heavily in the entertainment and sports sectors to reduce its economic reliance on oil.

• The Public Investment Fund (PIF) has established Savvy Games Group, which has spent billions of dollars acquiring major gaming entities like ESL FaceIt Group and Scopely.

• Prize Pool and Global Impact:

• The 2024 inaugural edition set a record for the largest prize pool in esports history, exceeding $60 million.

• The event attracts millions of viewers globally and brings together elite athletes from games such as League of Legends, Dota 2, Counter-Strike 2, StarCraft II, and Mobile Legends: Bang Bang.

Important Points

• Tournament Structure:

• Unlike traditional single-title tournaments, the Esports World Cup focuses on Club Excellence. This means organizations like Team Liquid, FaZe Clan, or G2 Esports compete across multiple games to be crowned the ultimate champion club.

• The 2025 edition is expected to expand even further with more game titles and a larger qualifying structure involving regional qualifiers in Europe, Asia, and the Americas.

• Infrastructure:

• The venue in Riyadh features state-of-the-art facilities at Boulevard City, including specialized arenas for different game genres (FPS, MOBA, Battle Royale).

• This infrastructure is designed to accommodate the summer season peak, making Riyadh a major tourist destination during the tournament months.

Q93. Answer: (c) Himachal Pradesh

The correct answer is Himachal Pradesh.

Key Points

• Himachal Pradesh has achieved a significant milestone by becoming the first state in India to implement Aadhaar-linked face recognition for the delivery of rations under the Public Distribution System (PDS) in July 2025.

• The initiative utilizes the Aadhaar FaceRD (Face Recognition Device) technology, which was developed by the Unique

Identification Authority of India (UIDAI) to provide a secure and contactless authentication method.

• This system is specifically designed to assist beneficiaries such as the elderly and manual laborers whose fingerprints may have faded or become difficult to scan due to age or physical work.

• By integrating this technology into Electronic Point of Sale (ePoS) machines at Fair Price Shops (FPS), the state government aims to eliminate leakages, reduce fraudulent transactions, and ensure that food grains reach the rightful owners.

• The rollout was spearheaded by the Department of Food, Civil Supplies and Consumer Affairs of Himachal Pradesh, making the state a leader in digital governance within the food security sector.

Additional Information

• Aadhaar-Enabled Public Distribution System (AePDS):

• This is a technology-driven reform to modernize the PDS by linking Aadhaar numbers with Ration Cards to authenticate beneficiaries in real-time.

• It helps in the de-duplication of Ration Cards and ensures that the subsidy is targeted effectively toward the Below Poverty Line (BPL) and Antyodaya Anna Yojana (AAY) families.

• One Nation One Ration Card (ONORC):

• The introduction of face recognition further strengthens the ONORC scheme, which allows migrant workers to claim their rations from any Fair Price Shop across India.

• The FaceRD app ensures that even if a worker is in a different state, their identity can be verified seamlessly without relying on physical biometric touchpoints.

• Digital India Mission:

• This technological advancement in Himachal Pradesh aligns with the Government of India's Digital India vision, promoting transparency and accountability in welfare schemes.

• The use of Artificial Intelligence (AI) and machine learning in face matching is a step toward contactless governance.

Important Points

• National Food Security Act (NFSA), 2013: The legal framework that mandates the central and state governments to provide subsidized food grains to nearly two-thirds of India's population.

• UIDAI Role: The Unique Identification Authority of India provides the necessary API and security protocols to ensure that the biometric data of citizens is encrypted and protected during the authentication process.

• Operational Efficiency: Before the implementation of face recognition, a significant percentage of authentication failures occurred due to technical issues with iris or fingerprint scanners; this new method has shown a higher success rate in diverse climatic conditions like those found in the hilly regions of Himachal Pradesh.

Q94. Answer: (d) 5

The correct answer is 3.

Key Points

• According to the IQAir World Air Quality Report 2023, which was released in March 2024, India has been ranked as the 3rd most polluted country in the world.

• The report analyzed data from 134 countries, regions, and territories, focusing on PM2.5 concentrations, which are fine particulate matter particles that pose the greatest risk to human health.

• India's average annual PM2.5 concentration was recorded at 54.4 micrograms per cubic meter (µg/m³), which is more than 10 times higher than the WHO (World Health Organization) annual air quality guideline.

• In the previous year's report (data for 2022), India was ranked 8th, indicating a significant deterioration in air quality as it jumped to the 3rd position in the 2024 report.

• The top two most polluted countries ahead of India are Bangladesh (ranked 1st with 79.9 µg/m³) and Pakistan (ranked 2nd with 73.7 µg/m³).

Additional Information

• IQAir is a Swiss air quality technology company that prepares this annual report by aggregating data from over 30,000 air quality monitoring stations globally.

• Begusarai, a city in Bihar, India, emerged as the world's most polluted metropolitan area in the 2024 report, with an average annual PM2.5 concentration of 118.9 µg/m³.

• Delhi has once again been identified as the most polluted capital city in the world. It has held this undesirable title four times since 2018.

• The WHO air quality guidelines recommend that annual average levels of PM2.5 should not exceed 5 µg/m³. Approximately 92.5% of the countries and regions reporting data exceeded this value.

• Air pollution remains a critical health crisis in South Asia, with 9 out of the 10 most polluted cities in the world being located in this region, primarily across India and Pakistan.

Important Points

• The PM2.5 particles are so small (less than 2.5 micrometers in diameter) that they can enter the bloodstream and cause various respiratory and cardiovascular diseases.

• In India, about 1.3 billion people, or 96% of the population, live with air quality that is seven times higher than the WHO guideline.

• Factors contributing to high pollution in India include vehicle emissions, coal burning for power generation, industrial waste, biomass burning for cooking, and construction dust.

Q95. Answer: (d) USA

The correct answer is USA.

Key Points

• The 20th edition of the World Athletics Championships is scheduled to be held in 2025.

• The United States of America (USA) is historically the most dominant nation in track and field, consistently topping the medal table in almost every iteration of the event.

• The 2025 Championships are set to take place in Tokyo, Japan. The events will primarily be hosted at the Japan National Stadium, which was also the centerpiece for the Tokyo 2020 Olympic Games.

• The scheduled dates for this global sporting event are from September 13 to September 21, 2025.

• The USA track and field team typically excels in sprints, hurdles, and relay events, which significantly contributes to their high medal count. In the preceding 2023 Budapest Championships, the USA finished first with a total of 29 medals, including 12 Gold.

Additional Information

• Host Selection:

• Tokyo was selected as the host city by the World Athletics Council during their meeting in Oregon in July 2022.

• Tokyo outperformed other competing bids from cities such as Nairobi (Kenya), Silesia (Poland), and Singapore to secure the 2025 event.

• World Athletics:

• The event is organized by World Athletics, the international governing body for the sport of athletics, founded in 1912 and currently headed by President Sebastian Coe.

• The championships were held every four years initially but moved to a biennial (every two years) cycle starting in 1991.

• Previous and Future Venues:

• The 19th edition was held in Budapest, Hungary, in August 2023.

• The 21st edition of the championships in 2027 has been awarded to Beijing, China, marking a return to the Bird's Nest stadium.

Important Points

• Performance Trends: While the USA leads in total counts, countries like Kenya and Ethiopia are traditionally dominant in long-distance running and marathons.

• Economic Impact: Hosting the World Athletics Championships is expected to bring significant tourism and infrastructure benefits to Tokyo, utilizing the facilities upgraded for the 2020 Olympics.

• Participation: More than 2,000 athletes from over 200 nations are expected to compete across 49 different athletic disciplines during the nine-day event in 2025.

Q96. Answer: (d) 150 years

The correct answer is 150 years.

Key Points

• The India Meteorological Department (IMD) is celebrating its sesquicentennial year (150 years) of service to the nation in 2025.

• Established in 1875, the IMD is one of the oldest scientific institutions in India, and it will complete 150 years of its existence on January 15, 2025.

• The year-long celebrations for this milestone were officially inaugurated by the Vice President of India, Jagdeep Dhankhar, on January 15, 2024, at Vigyan Bhawan, New Delhi.

• The IMD functions under the Ministry of Earth Sciences (MoES) of the Government of India and is the principal agency responsible for meteorological observations, weather forecasting, and seismology.

• Throughout its history, the department has evolved from basic weather reporting to using advanced technologies like Doppler Weather Radars and Satellite imagery. Hence, the correct answer is 150 years.

Additional Information

• Historical Background:

• Before the formal establishment of IMD, individual meteorological observatories were established by the East India Company in Calcutta (1785), Madras (1796), and Bombay (1826).

• In 1875, the Government of India centralized all meteorological work under one umbrella, appointing H.F. Blanford as the first Meteorological Reporter.

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• Headquarters Evolution:

• The headquarters of IMD was initially located in Calcutta. It was later shifted to Shimla in 1905, then to Pune in 1928, and finally to New Delhi in 1944, where it remains today.

• Technological Milestones:

• IMD utilizes a vast network of surface observatories, upper air stations, and Automatic Weather Stations (AWS).

• It has significantly improved Cyclone Warning systems, reducing casualty rates during extreme weather events through the use of INSAT series satellites and ocean buoys.

• International Collaboration:

• IMD is a member of the World Meteorological Organization (WMO) and acts as a Regional Specialized Meteorological Centre for providing tropical cyclone advisories to 13 countries in the Bay of Bengal and Arabian Sea region.

Important Points

• New Initiatives for 150th Year:

• Panchayat Mausam Seva: A portal launched to provide localized weather forecasts to every panchayat in India, helping farmers with Agromet advisories.

• Mausam App: An integrated mobile application providing real-time weather updates, warnings, and radar maps to the general public.

• Decision Support System (DSS): Advanced tools for specialized sectors like Aviation, Power, and Water Management were introduced during the anniversary celebrations.

• Regional Infrastructure:

• The IMD operates through 6 Regional Meteorological Centres (RMCs) located in Mumbai, Chennai, New Delhi, Kolkata, Nagpur, and Guwahati to ensure geographical coverage across the subcontinent.

Q97. Answer: (b) Two

The correct answer is Two.

Key Points

• The Waqf (Amendment) Bill, introduced in August 2024 (often discussed in context of its upcoming implementation in 2025), proposes a mandatory representation of two Muslim women on both the Central Waqf Council and the State Waqf Boards.

• This provision is aimed at ensuring gender diversity and empowering women in the administrative decision-making processes of Waqf properties, which was previously dominated by male representation.

• Under the proposed amendments to the Waqf Act, 1995, the composition of the State Waqf Boards will be expanded to include not only Muslim women but also two non-Muslim members, ensuring a more inclusive governance structure.

• The Union Minister of Minority Affairs, Shri Kiren Rijiju, introduced the bill to bring transparency and efficiency, noting that the inclusion of two Muslim women is a historic step toward reform within the community's socio-religious institutions.

• The bill also mandates that the Central Waqf Council must include two Muslim women among its members, who are appointed by the Central Government.

Additional Information

• The Waqf Act, 1995:

• This is the primary legislation governing Waqf institutions in India. A Waqf is a permanent dedication of property for religious, pious, or charitable purposes under Muslim Law.

• The 1995 Act replaced the earlier Waqf Act of 1954 and was significantly amended in 2013 to provide more powers to the Waqf Boards.

• Proposed Changes in the 2024/2025 Amendment:

• The new bill seeks to rename the Waqf Act, 1995 as the Unified Waqf Management, Empowerment, Efficiency and Development Act.

• It proposes that any property identified as Waqf property must undergo a mandatory verification process through the District Collector to prevent disputes.

• The amendment also states that only a person who has been practicing Islam for at least five years can donate property as Waqf (Waqif).

• Central Waqf Council:

• Established in 1964, it is an Indian statutory body that advises the Central Government on matters concerning the working of State Waqf Boards.

• The Council is headed by the Union Minister in charge of Minority Affairs, who acts as the Ex-officio Chairperson.

• Joint Parliamentary Committee (JPC):

• Following its introduction in the Lok Sabha in 2024, the Waqf (Amendment) Bill was referred to a Joint Parliamentary Committee for detailed scrutiny due to its complex socio-legal implications.

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• The committee consists of members from both the Lok Sabha and the Rajya Sabha to review the clauses concerning women's representation and the Collector's powers.

Q98. Answer: (d) Boxing

The correct answer is Boxing.

Key Points

• Saweety Boora is a distinguished Indian boxer who competes in the 81 kg (light heavyweight) category. Her career is marked by several international accolades, making her one of the most successful female boxers in India.

• In March 2023, she achieved a significant career milestone by winning the Gold Medal at the IBA Women's World Boxing Championships held in New Delhi. She defeated China's Wang Lina in the final to secure the top spot on the podium.

• Recognizing her consistent performance and contribution to Indian sports, the Government of India conferred upon her the Arjuna Award in January 2025. This award is one of the highest honors for sportspersons in the country.

• Hailing from Hisar, Haryana, she initially started as a kabaddi player before transitioning to boxing at the suggestion of her father, a former national-level basketball player.

• Her success in 2023 was a momentous occasion as she became only the seventh Indian boxer (male or female) to win a World Championship Gold, joining the ranks of legends like Mary Kom and Nikhat Zareen.

Additional Information

• Arjuna Award for Outstanding Performance in Sports and Games:

• Instituted in 1961, the Arjuna Award is given by the Ministry of Youth Affairs and Sports, Government of India.

• It recognizes outstanding achievement in National sports. The award carries a cash prize of Rs. 15 lakh, a bronze statue of Arjuna, and a scroll of honor.

• Recipients are selected based on their performance over the preceding four years at the international level and for showing qualities of leadership, sportsmanship, and a sense of discipline.

• IBA Women's World Boxing Championships:

• The IBA (International Boxing Association) organizes these championships biennially. The 2023 edition was hosted by India at the Indira Gandhi Sports Complex in New Delhi.

• India finished at the top of the medal tally in the 2023 edition, with four gold medals won by Nitu Ghanghas, Nikhat Zareen, Lovlina Borgohain, and Saweety Boora.

• Boxing Federation of India (BFI):

• The BFI is the governing body for Olympic boxing in India. It is responsible for organizing national championships and managing the training and selection of the Indian national teams for international events like the Olympics and Asian Games.

Important Points

• Historical Achievements: Long before her 2023 glory, Saweety Boora won a Silver Medal at the 2014 AIBA Women's World Boxing Championships in Jeju City, South Korea.

• Asian Dominance: She also secured a Gold Medal at the 2022 Asian Amateur Boxing Championships held in Amman, Jordan, further cementing her status as a powerhouse in the 81 kg division.

• Significance of the 2025 Award: The National Sports Awards 2024 (presented in early 2025) highlighted the growth of women's combat sports in India, with Saweety Boora being a key figure among the awardees.

• Training and Support: Like many elite athletes from Haryana, she has benefited from the robust sports infrastructure in the state, which has produced a high percentage of India's international medalists in wrestling and boxing.

Q99. Answer: (b) Muslim, Christian, Jain, Buddhist, Parsi and Sikh

The correct answer is Muslim, Christian, Jain, Buddhist, Parsi and Sikh.

Key Points

• The Karnataka Government, through its Minority Welfare Department, provides financial incentives to encourage mass marriages among minority communities to reduce the financial burden on poor families.

• As per the latest directives and scheme updates for July 2025, the incentive amount for couples participating in these mass marriages has been set at Rs. 50,000.

• The scheme specifically covers the six notified minority communities in the state: Muslim, Christian, Jain, Buddhist, Parsi, and Sikh. Hence, the correct answer is Muslim, Christian, Jain, Buddhist, Parsi and Sikh.

• The primary objective of this initiative is to prevent Below Poverty Line (BPL) families from falling into debt traps due to high wedding expenses and to promote the concept of simple, community-led weddings.

• To avail of this benefit, the combined annual income of the couple’s parents or the couple themselves must typically fall below a specified threshold, often Rs. 2 lakh or less, depending on the latest department guidelines.

Additional Information

• Eligibility Criteria:

• Applicants must be permanent residents of Karnataka.

• The bride must have attained the age of 18 years and the groom must be at least 21 years old, adhering to the Prohibition of Child Marriage Act.

• The beneficiaries must belong to the Minority Community as defined by the National Commission for Minorities Act, 1992.

• Required Documentation:

• Valid Aadhar Card of both the bride and the groom for identity verification.

• BPL (Below Poverty Line) Card or an Income Certificate issued by the Tahsildar.

• Caste/Minority Certificate to prove eligibility under the specific religious categories.

• Bank Account details linked with Aadhar (Direct Benefit Transfer - DBT) for the disbursement of the Rs. 50,000 incentive.

• Scheme Administration:

• The scheme is implemented by the Directorate of Minorities in Karnataka.

• Applications are usually processed through the Seva Sindhu portal or directly through the District Minority Welfare Offices.

Important Points

• Evolution of Welfare Schemes: This incentive is often compared to the "Shadi Bhagya" (also known as the Bidai Scheme) launched in 2013, which initially provided Rs. 50,000 for the marriage of poor minority women.

• Mass Marriage Focus: Unlike individual grants, the mass marriage incentive specifically rewards participation in organized group ceremonies to foster social harmony and communal cooperation.

• Saptapadi Scheme: For the Hindu community, the Karnataka Government runs a parallel program called the Saptapadi scheme under the Muzrai Department, which provides gold mangalsutras and cash incentives for mass marriages held in selected temples.

• Social Impact: By providing Rs. 50,000, the state aims to empower marginalized religious groups and ensure that social ceremonies do not lead to economic distress or bonded labor due to private loans.

Q100. Answer: (b) 139.07 lakh tonnes

The correct answer is 139.07 lakh tonnes.

Key Points

• According to the Envstats India 2025 report (and recent data from the Ministry of Fisheries, Animal Husbandry and Dairying), India's total fish production has shown a consistent upward trajectory, with the inland fish production specifically reaching 139.07 lakh tonnes during the 2023-24 financial year.

• Inland fisheries have become the primary driver of the sector's growth, contributing significantly more than the marine sector. The production has increased from 131.13 lakh tonnes in 2022-23 to the current figure, reflecting a steady growth rate. Hence, the correct answer is 139.07 lakh tonnes.

• The inland sector now accounts for approximately 79% of the total fish production in the country, showcasing a shift from traditional marine fishing to aquaculture and fresh-water resources.

• The Department of Fisheries has highlighted that the consistent rise is due to improved infrastructure, better seeds, and the adoption of modern technology like Recirculatory Aquaculture Systems (RAS) and Biofloc.

• This growth is pivotal for food security and providing livelihood to over 30 million people, particularly those in the marginalized and unorganized sectors.

Additional Information

• Pradhan Mantri Matsya Sampada Yojana (PMMSY):

• Launched in May 2020, this flagship scheme aims to bring about the Blue Revolution through sustainable and responsible development of the fisheries sector.

• It has an estimated investment of Rs. 20,050 crores for a period of 5 years (FY 2020-21 to FY 2024-25).

• The scheme focuses on enhancing fish production to 22 million metric tonnes by 2024-25 and doubling the incomes of fishers and fish farmers.

• India's Global Standing:

• India is currently the third-largest fish-producing country in the world.

• It occupies the second position in aquaculture production globally.

• The fisheries sector contributes about 1.09% to the total National GVA and over 6.72% to the Agricultural GVA.

• Marine Fish Production:

• While inland fish production reached 139.07 lakh tonnes, marine fish production for 2023-24 stood at approximately 36.38 lakh tonnes.

• The total fish production (Inland + Marine) for the year 2023-24 is estimated at 175.45 lakh tonnes.

Important Points

• Fisheries and Aquaculture Infrastructure Development Fund (FIDF):

• Created in 2018-19 with a corpus of Rs. 7,522.48 crore to provide concessional finance to State Governments and private entities for fisheries infrastructure.

• It supports the creation of fishing harbours, fish landing centres, and cold storage facilities.

• Blue Economy 2.0:

• The Interim Budget 2024-25 emphasized the Blue Economy 2.0 to promote climate-resilient activities and restoration/adaptation measures along the coastline.

• Five integrated aqua parks are being set up to bolster value chain efficiencies and exports.

• State-wise Production:

• Andhra Pradesh continues to be the leading producer of inland fish in India, followed by states like West Bengal and Uttar Pradesh.

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