RRB Group D Official Paper (Held On: 29 Dec, 2025 Shift 1) (Previous Year Paper)

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

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GENERAL SCIENCE

Q1. At which location on the Earth's surface would a standard object experience the maximum acceleration due to gravity g ?

(a) The Poles
(b) Tropic of Capricorn
(c) Tropic of Cancer
(d) The Equator

Q2. Why do we spread cloths while putting them for drying in open sky?

a. Increasing the surface area will increase the rate of evaporation
b. Increase in wind speed will not allow the cloth to fly
c. To remove wrinkles

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

Q3. What is the colour of copper oxide when it is added to the dilute sulphuric acid to forming a blue-green solution?

(a) White
(b) Black
(c) Grey
(d) Green

Q4. In uniform circular motion, the speed of the body:

(a) depends on the radius only
(b) changes continuously
(c) becomes zero at every point
(d) remains constant

Q5. Bleaching powder is prepared by the reaction of:

(a) sodium hydroxide with chlorine gas
(b) calcium carbonate with chlorine gas
(c) calcium hydroxide with chlorine gas
(d) calcium hydroxide with hydrochloric acid

Q6. Select the correct statement for asexual reproduction in plants.

(a) It occurs rapidly during unfavourable conditions.
(b) It involves male and female flowers.
(c) It is found in both lower and higher plants.
(d) It involves formation of gametes.

Q7. Which of the following statements is/are true for a domestic circuit?

(i) All the appliances are connected in parallel.

(ii) The live wire in the domestic circuit has green insulation on it.

(iii) A fuse connected to the circuit allows excessive current to pass through the appliances.

(iv) The neutral wire in the domestic circuits has black insulation on it.

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

Q8. Read the given assertion (A) and reason (R) and select the most appropriate option.

(A): The onset of puberty in females occurs earlier than in males, but both attain their final height by 18–20 years of age.

(R): Although puberty begins later in males, their growth spurt is more rapid than in females.

(a) (A) is true but (R) is false
(b) Both (A) and (R) are true and (R) is the correct explanation of (A)
(c) (A) is false but (R) is true
(d) Both (A) and (R) are true but (R) is not the correct explanation of (A)

Q9. If a cell lacks a functional Golgi complex, it would mainly fail in _____.

(a) protein synthesis only
(b) controlling cell division
(c) packaging and secretion
(d) formation of ATP

Q10. Stars appear to twinkle in the night sky because _____.

(a) Light from stars undergoes atmospheric refraction
(b) They change their brightness continuously
(c) The distance between stars and Earth keeps varying
(d) Stars move rapidly in the sky

Q11. Which description best defines cytoplasm?

(a) Fluid content inside the plasma membrane containing organelles
(b) Rigid layer outside the plasma membrane providing support
(c) Network of tubes involved in protein transport within the cell
(d) Genetic material present in the form of chromatin

Q12. Why are climate-resistance hybrid crop varieties important for future farming?

(a) Hybrid crops reduce the role of farmers
(b) Hybrid crops look more attractive
(c) Hybrid crops are easier to store
(d) Hybrid crops are unaffected by unpredictable weather

Q13. Which of the following is an example of compound?

(a) Mercury
(b) Hydrogen
(c) Iron
(d) Sugar

Q14. Which of the following is the correct unit for measuring the work done by a force?

(a) Pascal
(b) Newton
(c) Joule
(d) Coulomb

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Q15. Which of the following is the characteristic property of a non-metal?

(a) High melting point
(b) Ductility
(c) Sonorous
(d) Poor conductor of electricity

Q16. For spherical mirrors of small apertures, the relation between the radius of curvature (R) and focal length (f) is:

(a) R = f
(b) R = f/2
(c) R = 2f
(d) R = 3f

Q17. What are the products formed when metal carbonates react with an acid?

(a) Salt, water, carbon dioxide
(b) Salt, carbon monoxide
(c) Salt, water, carbon monoxide
(d) Water, carbon dioxide

Q18. The right-hand thumb rule is used to find which of the following?

(a) Magnitude of current
(b) Direction of force on a current-carrying conductor
(c) Direction of magnetic field around a current-carrying conductor
(d) Resistance of the wire

Q19. According to Bohr's model, electromagnetic radiations possess dual character properties behaving like:

(a) waves and particles
(b) waves and electrons
(c) sound and waves
(d) mass and magnetic effect

Q20. Which of the following is a characteristic of the onset of puberty in boys?

(a) Growth of pineal gland
(b) Growth of hairs on head
(c) Growth of a moustache
(d) Growth of liver

Q21. Which of the following statements is true about an unbalanced force acting on an object?

(a) It brings the object in motion.
(b) It has no effect on the object’s state of motion.
(c) It keeps the object at rest.
(d) It always increases the mass of the object.

Q22. The unicellular organism amoeba has a _____ shape.

(a) star
(b) changing
(c) fixed
(d) sleeper

Q23. Where is a reflex arc formed in the body?

(a) Spinal cord
(b) Fore brain
(c) Muscle
(d) Hind brain

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Q24. What is the mass number of an element defined as?

(a) Number of protons
(b) Sum of the number of protons and neutrons
(c) Number of neutrons
(d) Sum of the number of electrons and protons

Q25. The stethoscope works on which principle?

(a) Diffraction of sound
(b) Refraction of sound
(c) Dispersion of sound
(d) Multiple reflection of sound

MATHEMATICS

Q26. The amount on a sum of Rs. 5,000 at 20% per annum compound interest, compounded annually, in 2 years, will be:

(a) Rs. 6,563
(b) Rs. 7,247
(c) Rs. 7,200
(d) Rs. 7,760

Q27. Seven years ago from now, a man was five times as old as his son. Seven years from now, the father will be three times as old as his son. Find the son's present age.

(a) 26 years
(b) 38 years
(c) 31 years
(d) 21 years

Q28. The mode of the observations 21, 32, 34, 34, 34, 20, 32, 24, 34, 34, 20, 25, 29, 26 and 20 is:4287

(a) 20
(b) 34
(c) 32
(d) 21

Q29. Priya buys a mobile phone for her child. The phone is marked at Rs. 34,400 and is offered with two successive discounts of 13% and Z%, respectively. After receiving both discounts, she pays Rs. 22,446. Find the value of Z.

(a) 24
(b) 23
(c) 26
(d) 25

Q30. 1/30 is what percentage of 2/30?

(a) 100%
(b) 60%
(c) 65%
(d) 50%

Q31. Preeti, Qadir and Reena invest sum in the ratio 2 : 8 : 13, respectively. If they earned total profit of Rs. 87,193 at the end of year, then what is the positive difference between share of Preeti and Reena?

(a) Rs. 41,701
(b) Rs. 41,702
(c) Rs. 41,704
(d) Rs. 41,703

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Q32. The volume of a rectangular block of wood is 10,368 cm^3. Its length, breadth and height are in the ratio of 3 : 2 : 1. If its entire surface is polished at Rs. 2/cm^2, then find the total cost of polishing.

(a) Rs. 6,436
(b) Rs. 7,135
(c) Rs. 6,356
(d) Rs. 6,336

Q33. If the listed price of a bag is 85% more than its cost price and a discount of 49% is announced on it, then find the loss percentage.

(a) 5.65%
(b) 5.42%
(c) 9.31%
(d) 9.12%

Q34. If a - b = 9 and ab = 20, find the value of $a^2 + b^2$.

(a) 115
(b) 133
(c) 121
(d) 127

Q35. The number of prime numbers lying between 415 and 428 is:

(a) 4
(b) 6
(c) 2
(d) 7

Q36. The radius of a ball of iron is 1.5 cm. Three smaller balls are formed by melting it. If the radii of two smaller balls are 0.75 cm and 1.0 cm, find the diameter of the third ball.

(a) 2.3 cm
(b) 2.1 cm
(c) 2.2 cm
(d) 2.5 cm

Q37. Rs. 8,200 is divided among A, B and C in such a way that if Rs. 19, Rs. 9 and Rs. 13 are deducted from their respective shares, they have money in the ratio 12:19:10. Find the difference between B's and C's original shares.

(a) Rs. 1,691
(b) Rs. 1,841
(c) Rs. 1,641
(d) Rs. 1,787

Q38. Two engines of trains 28 km apart start towards each other at speeds of 23 km/hr and 89 km/hr, respectively. After how much time will they meet each other? (Assume the length of engine is negligible)

(a) 13 minutes
(b) 14 minutes
(c) 17 minutes
(d) 15 minutes

Q39. In a quadrilateral QRST, angle Q = 74° and angle R = 39°. The bisectors of angle S and angle T meet at E. What is the measure of angle TES ?

(a) 56.5°
(b) 43°
(c) 47°
(d) 61.5°

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Q40. A, B and C together can complete a piece of work in 12 days, while A alone can complete it in 20 days and C alone can complete it in 36 days. In how many days can B alone complete the work?

(a) 180 days
(b) 150 days
(c) 60 days
(d) 120 days

Q41. The sum of two numbers is 54 and their LCM is 195. The two numbers are:

(a) 32, 22
(b) 39, 15
(c) 44, 10
(d) 37, 17

Q42. A, B and C can do a piece of work in 3, 3 and 3 days, respectively. How long (in days) will they take to do twice the same work, working together?

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

Q43. For 15 innings, a cricketer has an average of 94 runs. In the 16^(th) inning, he scores 111 runs. His average score increased by _____. (Round off the answer to the nearest whole number.)

(a) 1
(b) 7
(c) 2
(d) 10

Q44. In an election with two candidates, Candidate A received 75% of the total valid votes. If 10% of the total 14,000 votes were declared invalid, how many valid votes did Candidate B receive?

(a) 3150
(b) 4450
(c) 3500
(d) 3750

Q45. If 5^((x - y)) = 125 and 5^((x + y)) = 3125, find x.

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

Q46. Sangeeta observes the top of a chimney at an angle of elevation of 45°. She is standing 28.7 metres away from the base of the chimney, and her eye level is 1.3 metres above the ground. What is the total height (in metres) of the chimney?

(a) 28.7
(b) 30
(c) 27.4
(d) 60

Q47. A seasoned marathoner, known for his steady pace, usually runs the first half of a race at 8 km/hr and the second half at 6 km/hr. However, due to fatigue and other factors, his overall speed drops by 30%. How long will it take him to complete a 120 km marathon under these reduced-speed conditions?

(a) 12.5 hours
(b) 15 hours
(c) 25 hours
(d) 17.5 hours

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Q48. The expenditure of Sudha is 150% more than her savings. If her expenditure decreases by 3% and savings increase by 21.5%, then by what percentage does her income increase?

(a) 4%
(b) 6%
(c) 3%
(d) 1%

Q49. Ravi bought a watch for Rs. 4,800, spent Rs. 200 on its repair, and sold it for Rs. 6,000. What is his profit percentage?

(a) 27%
(b) 22%
(c) 20%
(d) 25%

Q50. Three chairs and two tables together cost Rs. 600, two chairs and one table together cost Rs. 350. The cost of four chairs is:

(a) Rs. 300
(b) Rs. 400
(c) Rs. 100
(d) Rs. 200

GENERAL INTELLIGENCE & REASONING

Q51. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which 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) KI−JH
(b) FD−EC
(c) AY−YZ
(d) WU−VT

Q52. 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 markers are pens.

All markers are sketches.

All markers are chalks.

Conclusions:

(I): All pens are chalks.

(II): Some chalks are sketches.

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

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

RUS 36 PSQ 40 NQO 44 LOM 48 ?

(a) JLO 51
(b) JLJ 51
(c) JMK 52
(d) JNJ 52

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Q54. This question is based on the five, three-digit numbers given below.

(Left) 515 758 761 726 579 (Right)

(Example: 697 – First digit = 6, second digit = 9 and third digit = 7) (NOTE: All operations to be done from left to right.)

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

(a) 13
(b) 7
(c) 9
(d) 6

Q55. Based on the English alphabetical order, three of the following four letter-clusters are alike in a certain way and thus form a group. Which letter-cluster DOES NOT belong to that group?

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

(a) DYR
(b) VQJ
(c) UPI
(d) AWO

Q56. Seven friends, L, M, N, O, Q, R and S, are sitting in a straight line facing north. Only three people sit to the left of M. Only two people sit between M and L. Only three people sit between S and N. S sits to the immediate left of L. O sits at some place to the left of R but at some place to the right of Q. How many people sit between Q and R?

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

Q57. Refer to the given series and answer the question that follows. All numbers are single-digit number only. Counting to be done from left to right,

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

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

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

Q58. What should come in place of the question mark (?) in the given series?

7 12 18 23 ? 34

(a) 29
(b) 28
(c) 30
(d) 32

Q59. What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

13 − 54 × 9 ÷ 7 + 32 = ?

(a) 24
(b) 23
(c) 22
(d) 26

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Q60. In a certain code language, ‘book news leaf’ is coded as ‘rk qh aa’ and ‘leaf gum boat’ is coded as ‘vf rk xl’. How is ‘leaf’ coded in that language?

(a) aa
(b) vf
(c) qh
(d) rk

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

11, 36, 72, 121, 185, ?6344

(a) 266
(b) 268
(c) 267
(d) 265

Q62. Refer to the following number series and answer the question that follows (all numbers are single-digit numbers only). Counting to be done from left to right only.

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

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

(NOTE: 1 is also a perfect square.)

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

Q63. Refer to the given series and answer the question that follows. (All numbers are single digit numbers only.) Counting to be done from left to right.

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

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

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

Q64. In a certain code language,

‘A + B’ means ‘A is the mother of B’,

‘A – B’ means ‘A is the brother of B’,

‘A × B’ means ‘A is the wife of B’,

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

‘A # B’ means ‘A is the daughter of B’.

How is N related to T if ‘C % T # E + P x N’?

(a) Wife’s sister
(b) Wife’s mother
(c) Sister’s husband
(d) Daughter’s husband

Q65. 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 geysers are fans.

No fan is a refrigerator.

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Conclusions:

(I): No geyser is a refrigerator.

(II): Some refrigerators are fans.

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

Q66. 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?

132 A 11 C 5 B 4 D 8 = ?

(a) 40
(b) 24
(c) 50
(d) 32

Q67. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

(NOTE: Operations should be performed on the whole numbers, without breaking down the numbers into 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.)

(13, 2, 9)

(18, 7, 14)

(a) (19, 7, 16)
(b) (23, 12, 19)
(c) (21, 9, 20)
(d) (27, 39, 47)

Q68. If 2 is added to each even digit and 2 is added to each odd digit in the number 6345127, what will be the sum of the last two and first two digits in the new number thus formed?

(a) 26
(b) 22
(c) 28
(d) 24

Q69. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

DSV : HVX

LYZ : PBB

(a) UPG : YRK
(b) KSP : OXT
(c) TED : XHF
(d) VPB : ATE

Q70. Hanvi starts from Point L and drives 10 km towards the north. She then takes a right turn, drives 15 km, turns right and drives 17 km. She then takes a right turn and drives 15 km. She takes a final right turn, drives 2 km and stops at Point P. How far (shortest distance) and towards which direction should she drive in order to reach Point L again?

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

(a) 6 km towards south
(b) 5 km towards south
(c) 2 km towards east
(d) 5 km towards north

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Q71. Select the pair which follows the same pattern as that followed by the two pairs given below. Both pairs follow the same pattern.

RQF : VTD

SLS : WOQ

(a) PLR : TOP
(b) OCN : SEL
(c) UFY : YIV
(d) RCT : VFQ

Q72. What should come in place of the question mark (?) in the given series based on the English alphabetical order?

FLO DJM BHK ZFI ?

(a) DXG
(b) DGX
(c) XGD
(d) XDG

Q73. LPBF is related to EIUY in a certain way based on the English alphabetical order. In the same way, JNZD is related to CGSW. To which of the given options is OSEI related, following the same logic?12877

(a) HBGF
(b) HLBX
(c) HBXL
(d) HLXB

Q74. Six people, A, B, C, D, E and F are sitting in a row, facing north. D sits to the immediate left of B. C sits third to the left of B. E is an immediate neighbour of B. F sits to the immediate right of C. E sits to the immediate left of A. Who sits at the extreme right end of the line?

(a) B
(b) F
(c) A
(d) E

Q75. In a row of 54 people facing north, Geeta sits 19^(th) from the left end. If only 19 people sit between Barun and Geeta, then what is Barun's position from the right end of the line?

(a) 17th
(b) 16th
(c) 19th
(d) 18th

Q76. In a certain code language, 'drink fruit juice' is coded as 'if tg sd' and 'bring some fruit' is coded as 'if td za'. How is 'fruit' coded in the given language?

(All codes are two-letter codes)

(a) if
(b) tg
(c) td
(d) za

Q77. A, B, C, D, E and F are sitting around a circular table, facing the centre. A and D are immediate neighbours of C. E is to the immediate left of D. A and F are not immediate neighbours. Who sits third to the right of A?

(a) D
(b) F
(c) E
(d) B

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Q78. In a row of 50 people facing north, Rahul is 15^(th) from the left end. If Sumit sits 4^(th) to the right of Rahul, what is Sumit's position from the right end of the row?

(a) 30th
(b) 32nd
(c) 33rd
(d) 31st

Q79. Balram starts from Point A and drives 15 km towards south. He then takes a left turn, drives 12 km, turns left and drives 16 km. He then takes a left turn and drives 13 km. He takes a final left turn, drives 1 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again?

(All turns are 90 degree turns only unless specified)7010

(a) 2 km to the east
(b) 4 km to the east
(c) 1 km to the east
(d) 3 km to the east

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

116 91 69 50 34 ?

(a) 19
(b) 17
(c) 23
(d) 21

GENERAL AWARENESS AND CURRENT AFFAIRS

Q81. Where is the Nomadic Elephant 2025 exercise held?

(a) Thimphu
(b) Kathmandu
(c) New Delhi
(d) Ulaanbaatar

Q82. Who became the fastest cricketer to reach 13,000 test runs as of June 2025?

(a) Joe Root
(b) Jacques Kallis
(c) Virat Kohli
(d) Rohit Sharma

Q83. What was the theme for World Environment Day (5 June 2025)?

(a) Clean Air Now
(b) Beat Plastic Pollution
(c) End Deforestation
(d) Save the Oceans

Q84. On 8–9 November 2025, the Ministry of Home Affairs and the National Judicial Academy hosted a national conference in Bhopal focusing on which area?

(a) Environmental Laws
(b) Cybersecurity Regulations
(c) Labour Codes
(d) New Criminal Laws

Q85. Which SAI venue in Chennai was scheduled to host the Athletics selection trials on 1 February 2025?

(a) Anna University
(b) Jawaharlal Nehru Stadium
(c) SDAT Nehru Park

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(d) Velachery Grounds

Q86. In the November 2025 bye-elections, which of the following political parties won the bye-election from Nagrota (Jammu & Kashmir)?

(a) People's Democratic Party (PDP)
(b) Aam Aadmi Party (AAP)
(c) Bharatiya Janata Party (BJP)
(d) Indian National Congress (INC)

Q87. Who was appointed as the youngest US Ryder Cup captain since 1963?

(a) Keegan Bradley
(b) Phil Mickelson
(c) Tiger Woods
(d) Dustin Johnson

Q88. As reported in May 2025, which of the following banks of India provided in-principle approval to PayPal and Worldline to operate as cross-border payment aggregators in India?

(a) State Bank of India
(b) Indian Bank
(c) Reserve Bank of India
(d) Bandhan Bank

Q89. Researchers from which institutions discovered a new prion called SNG2 in January 2025?

(a) Delhi University and Council of Scientific & Industrial Research - Delhi
(b) IIT - Delhi and AIIMS - Delhi
(c) IISc - Bengaluru and NIPER - Mohali
(d) Amity University - Mohali and Institute of Microbial Technology - Chandigarh

Q90. Which Indian official chaired the Standing Committee of the National Board for Wildlife (SC-NBWL) meetings, recommending the revision of blanket 10-km ESZ guidelines in mid-2025?

(a) Minister of Environment
(b) Minister of Agriculture
(c) Chief Justice of India
(d) Minister of Finance

Q91. At the 2025 Janusz Kusociński Memorial held in Poland, what rank did Neeraj Chopra achieve?

(a) Fourth place
(b) First place
(c) Third place
(d) Second place

Q92. In August 2025, which test marked the successful end-to-end demonstration of the parachute-based deceleration system for the Gaganyaan crew module by ISRO?

(a) Crew Module Landing Test (CMLT-03)
(b) Pad Abort Test (PAT-02)
(c) Crew Escape System Test (CES-01)
(d) Integrated Air Drop Test (IADT-01)

Q93. What maximum sustained wind speed range was forecast for Cyclone Montha before landfall in October 2025?

(a) 120-130 km/h
(b) 140-150 km/h
(c) 90-100 km/h
(d) 60-70 km/h

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Q94. Which Indian economist was awarded the Padma Vibhushan in 2025?

(a) Jagdish Bhagwati
(b) Arvind Subramanian
(c) Bibek Debroy
(d) Jean Drèze

Q95. According to the Sustainable Development Goals – National Indicator Framework Progress Report, 2025, released by the Ministry of Statistics and Programme Implementation, what was the forest cover in India as a percentage of its total geographical area in 2023?

(a) 21.76%
(b) 23.56%
(c) 22.74%
(d) 19.795

Q96. When did the Reserve Bank of India make its first repo rate cut since May 2020?

(a) June 2025
(b) April 2025
(c) February 2025
(d) December 2024

Q97. Which body emphasised safety audits for women in public spaces during a symposium in June 2025?

(a) National Commission for Women
(b) National Human Rights Commission
(c) Supreme Court of India
(d) Ministry of Home Affairs

Q98. Published in May 2025, Pavan K Varma's Echoes of Eternity explores themes from which of the following?

(a) Indian economy
(b) Indian thought from Rigveda onward
(c) Fictional mythology
(d) Political satire

Q99. Which athlete set a pole vault world record with a clearance of 6.28 m in Wanda Diamond League meeting in Stockholm (June 2025)?

(a) Renaud Lavillenie
(b) Armand Duplantis
(c) Sam Kendricks
(d) Thiago Braz

Q100. What proportion of women's participation in police recruitment has been mandated under the Uttar Pradesh government's women empowerment policy, Mission Shakti 5.0, launched in September 2025?

(a) 15%
(b) 20%
(c) 10%
(d) 25%

ANSWER KEY

1	a	2	b	3	b	4	d	5	c	6	c	7	b	8	d	9	c	10	a
11	a	12	d	13	d	14	c	15	d	16	c	17	a	18	c	19	a	20	c
21	a	22	b	23	a	24	b	25	d	26	c	27	d	28	b	29	d	30	d
31	a	32	d	33	a	34	c	35	c	36	d	37	d	38	d	39	a	40	a
41	b	42	c	43	a	44	a	45	c	46	b	47	c	48	a	49	a	50	b

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51	c	52	c	53	c	54	b	55	d	56	d	57	b	58	a	59	b	60	d
61	a	62	a	63	c	64	c	65	a	66	b	67	b	68	a	69	c	70	d
71	a	72	d	73	d	74	c	75	b	76	a	77	c	78	b	79	c	80	d
81	d	82	a	83	b	84	d	85	b	86	c	87	a	88	c	89	d	90	a
91	d	92	d	93	c	94	c	95	a	96	c	97	b	98	b	99	b	100	b

SOLUTIONS

Q1. Answer: (a) The Poles

The correct answer is The Poles.

Key Points

• The acceleration due to gravity (g) is the acceleration gained by an object due to the gravitational force of the Earth. Its value on the surface of the Earth is determined by the formula $g = GM / R^2$, where G is the universal gravitational constant, M is the mass of the Earth, and R is the radius of the Earth.

• The Earth is not a perfect sphere but an oblate spheroid, meaning it is flattened at the Poles and bulges at the Equator. This shape is caused by the Earth's rotation.

• Because of this shape, the equatorial radius (approximately 6,378 km) is about 21 km longer than the polar radius (approximately 6,357 km).

• Since the value of g is inversely proportional to the square of the distance from the center of the Earth (R), the value of g is highest where the radius is the smallest. Therefore, g is maximum at the Poles.

• Quantitatively, the value of g at the Poles is approximately 9.832 m/s^2, which is greater than the value at the Equator. Hence, option 1 is correct.

Additional Information

• Effect of Rotation (Centrifugal Force): The rotation of the Earth creates a centrifugal force that acts outward, away from the Earth's axis. This force is strongest at the Equator and zero at the Poles. This outward force partially counteracts the pull of gravity, further reducing the effective value of g at the Equator.

• The Equator: At the Equator (0 degrees latitude), the combination of the maximum radius and the maximum centrifugal force results in the minimum value of acceleration due to gravity, which is approximately 9.780 m/s^2. Hence, option 4 is incorrect.

• Tropics: The Tropic of Cancer (23.5 degrees North) and the Tropic of Capricorn (23.5 degrees South) are located at intermediate latitudes. The value of g at these locations is higher than at the Equator but significantly lower than at the Poles. Hence, options 2 and 3 are incorrect.

• Weight vs. Mass: While the mass of an object remains constant regardless of location, its weight (W = mg) changes. An object will weigh the most at the Poles and the least at the Equator because of the variation in g.

Important Points

• Variation with Altitude: As one moves higher above the Earth's surface (increasing altitude), the value of g decreases because the distance from the center of the Earth increases.

• Variation with Depth: If one goes below the surface of the Earth (increasing depth), the value of g also decreases. This is because the mass of the Earth contributing to the gravitational pull decreases. At the Center of the Earth, the value of g becomes zero.

• Standard Gravity: For most physics calculations, a standard gravity value of 9.80665 m/s^2 is used, which represents an average value at 45 degrees latitude at sea level.

• Gravitational Constant: The value of G is 6.674 x 10^(-11) Nm^2/kg^2, which was first measured by Henry Cavendish in 1798.

Q2. Answer: (b) Only a

The correct answer is Only a.

Key Points

• The primary reason for spreading clothes in the open sky is that increasing the surface area directly leads to an increase in the rate of evaporation. Since evaporation is a surface phenomenon, a larger area allows more water molecules to acquire enough kinetic energy to escape into the atmosphere simultaneously. Hence, statement a is correct.

• Spreading the cloth actually increases its air resistance, making it more likely to be carried away by a strong breeze if not secured. The claim that it prevents the cloth from flying due to wind speed is logically and physically inconsistent with the act of spreading. Hence, statement b is incorrect.

• While spreading clothes may help in reducing wrinkles or creases as they dry, it is a secondary aesthetic benefit and not the fundamental physical reason related to the efficiency of the drying process in the open sky. Hence, statement c is incorrect.

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• In the context of physics and thermal properties, the time taken for a liquid to change into vapor at a temperature below its boiling point is minimized when the liquid is spread over a maximum area.

• Therefore, the correct answer is Only a.

Additional Information

• Evaporation:

• It is the process by which water changes from a liquid to a gas or vapor. It is a vital part of the water cycle and occurs at all temperatures, unlike boiling which occurs at a fixed temperature (e.g., 100 degrees Celsius for water at sea level).

• Energy in the form of heat (often from the Sun) is required to break the molecular bonds of the liquid.

• Factors Affecting the Rate of Evaporation:

• Surface Area: As seen in this example, a larger exposed area facilitates faster vaporization because more particles are at the surface.

• Temperature: An increase in ambient temperature provides more heat energy to the water molecules, increasing their velocity and the rate of evaporation.

• Humidity: The rate of evaporation is inversely proportional to the humidity of the surrounding air. If the air is already saturated with water vapor, the drying process slows down significantly.

• Wind Speed: Higher wind speeds help move the saturated air away from the surface of the wet cloth, replacing it with dry air, which accelerates the process.

• Practical Applications:

• This principle is used in cooling towers, salt production (from seawater in large shallow ponds), and even in the biological cooling mechanism of sweating in humans.

Q3. Answer: (b) Black

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

Key Points

• Copper(II) oxide, represented by the chemical formula CuO, is a black solid powder. It is the higher oxide of copper.

• When black copper oxide is added to dilute sulphuric acid (H2SO4), a chemical reaction occurs where the copper oxide dissolves in the acid.

• The reaction results in the formation of Copper(II) sulphate (CuSO4) and water (H2O). The resulting solution appears blue-green or blue in color because of the formation of copper(II) ions in the aqueous solution.

• The chemical equation for this reaction is: CuO (s) + H2SO4 (aq) → CuSO4 (aq) + H2O (l). In this reaction, the black solid reacts with the colorless acid to produce a colored salt solution.

• This type of reaction is classified as a neutralization reaction because a metal oxide (which is basic in nature) reacts with an acid to form a salt and water.

Additional Information

• Nature of Copper Oxides:

• There are two main oxides of copper: Copper(II) oxide (CuO), which is black, and Copper(I) oxide (Cu2O), which is red or brownish-red.

• Copper(II) oxide is used as a pigment in ceramics to produce blue, green, or red glazes. It is also used as a catalyst in various chemical reactions and in the production of superconductors.

• Copper(II) Sulphate (CuSO4):

• Copper(II) sulphate is most commonly found as the pentahydrate (CuSO4·5H2O), which is bright blue. This form is often called blue vitriol.

• It has wide applications as a fungicide in agriculture (like Bordeaux mixture), in electroplating, and as a mordant in dyeing processes.

• Chemical Indicators and Reactions:

• Most metal oxides are basic. When they react with dilute acids, they typically form soluble salts and water.

• For example, if Copper(II) oxide reacts with Hydrochloric acid (HCl), it forms Copper(II) chloride (CuCl2), which gives a blue-green color to the solution.

• The specific blue-green color mentioned in the question is characteristic of the Cu^{2+} ions surrounded by water molecules (coordinated water) in the solution.

Important Points

• Physical Properties:

• Copper(II) oxide is insoluble in water but soluble in acids. It has a melting point of approximately 1326 °C.

• The molar mass of CuO is approximately 79.54 g/mol.

• Safety and Occurrence:

• In nature, Copper(II) oxide occurs as the mineral tenorite. It is often formed on the surface of copper metal when heated in the presence of oxygen.

• In the laboratory, it can be prepared by heating copper(II) nitrate, copper(II) hydroxide, or copper(II) carbonate.

Q4. Answer: (d) remains constant

The correct answer is remains constant.

Key Points

• Uniform Circular Motion (UCM) is defined as the motion of an object traveling along a circular path at a constant speed. This means the object covers equal distances along the circumference in equal intervals of time.

• In UCM, the magnitude of the velocity (which is the speed) does not change. Therefore, the speed remains constant throughout the duration of the motion. Hence, option 4 is correct.

• While the speed is constant, the direction of motion changes at every single point along the circular track. Since velocity is a vector quantity (possessing both magnitude and direction), the velocity is considered to be changing continuously even if the speed is fixed. Hence, statement 2 is incorrect regarding speed.

• The speed of the body depends on the frequency and radius ($v = 2\pi rn$), but the characteristic of the motion itself is that the speed is maintained as a constant value, not that it "depends on radius only." Hence, statement 1 is incorrect.

• In any active motion, if the body is moving, the speed cannot be zero at every point; a zero speed would imply the body is at rest. Hence, statement 3 is incorrect.

Additional Information

• Velocity and Direction: In a circular path, the direction of the velocity vector at any point is always tangential to the circle at that specific location. Even though the numerical value of the speed (e.g., 5 meters per second) stays the same, the change in direction necessitates an acceleration.

• Centripetal Acceleration: An object in UCM experiences an acceleration directed toward the center of the circle. This is known as centripetal acceleration ($a = v^2 / r$). It is responsible for changing the direction of the velocity without changing its magnitude.

• Angular Velocity (ω): This refers to the rate at which the central angle is swept out by the radius vector. In uniform circular motion, the angular velocity remains constant and is measured in radians per second. The relationship between linear speed (v) and angular velocity is $v = r\omega$.

• Work Done: In UCM, the work done by the centripetal force is always 0. This is because the centripetal force acts towards the center (radially), while the displacement is always tangential, creating a 90-degree angle between force and displacement.

• Kinetic Energy: Since kinetic energy (K.E. = 1/2 mv^2) depends on the square of the speed, and the speed is constant in UCM, the kinetic energy of the body remains constant during the motion.

Important Points

• Time Period (T): The time taken by the body to complete one full revolution is called the Time Period. It can be calculated using the formula $T = 2\pi r / v$, where r is the radius and v is the constant speed.

• Frequency (f): This is the number of revolutions completed by the object in one second. It is the reciprocal of the time period ($f = 1 / T$) and is measured in Hertz (Hz).

• Real-world Examples: Common examples of Uniform Circular Motion include the motion of the Moon orbiting the Earth (approximated), the movement of the tips of clock hands, and a satellite orbiting at a constant altitude.

• Non-Uniform Circular Motion: If the speed of the object also changes while moving in a circle, it is called non-uniform circular motion. In this case, there is both centripetal acceleration (changing direction) and tangential acceleration (changing speed).

Q5. Answer: (c) calcium hydroxide with chlorine gas

The correct answer is calcium hydroxide with chlorine gas.

Key Points

• Bleaching powder is prepared by the action of chlorine gas on dry slaked lime, which is chemically known as calcium hydroxide.

• The chemical reaction for this preparation is: $Ca(OH)2 + Cl2 \rightarrow CaOCl2 + H2O$. This clearly shows that calcium hydroxide and chlorine are the necessary reactants. Hence, statement 3 is correct.

• The reaction between sodium hydroxide and chlorine gas (Option 1) typically produces sodium hypochlorite (liquid bleach) and sodium chloride, rather than the solid bleaching powder. Hence, statement 1 is incorrect.

• Calcium carbonate reacting with chlorine (Option 2) does not yield bleaching powder; calcium carbonate is a stable salt often found in limestone and marble. Hence, statement 2 is incorrect.

• The reaction of calcium hydroxide with hydrochloric acid (Option 4) is a neutralization reaction that produces calcium chloride and water, not bleaching powder. Hence, statement 4 is incorrect.

Additional Information

• Chemical Identity and Formula:

• The chemical name of bleaching powder is calcium oxychloride or calcium hypochlorite.

• Its chemical formula is CaOCl2, although the actual composition is quite complex.

• Physical Properties:

• It is a yellowish-white powder that has a strong smell of chlorine.

• It is soluble in cold water, though the lime portion present in it usually remains as an insoluble residue.

• Industrial Applications:

• Textile Industry: It is used for bleaching cotton and linen to remove natural colors.

• Paper Industry: It is utilized for bleaching wood pulp.

• Water Treatment: One of its most vital functions is disinfecting drinking water to make it potable by killing harmful germs.

• Chemical Industry: It serves as a powerful oxidizing agent in many chemical reactions and is also used in the manufacture of chloroform.

Important Points

• Manufacturing Plants: In large-scale industrial production, bleaching powder is manufactured using the Hasenclever plant or the Bachmann's plant.

• Storage: Bleaching powder should be stored in a cool, dry place because it undergoes auto-oxidation and loses its available chlorine content when exposed to air and moisture.

• Reaction with Acids: When bleaching powder reacts with an excess of dilute acids (like sulfuric acid), it releases chlorine gas, which is responsible for its bleaching action.

Q6. Answer: (c) It is found in both lower and higher plants.

The correct answer is It is found in both lower and higher plants.

Key Points

• Asexual reproduction in plants is a process by which new individuals are produced from a single parent without the involvement of gamete formation or fusion.

• Statement 1: It occurs rapidly during unfavourable conditions. Asexual reproduction typically occurs when environmental conditions are favourable and stable, allowing the plant to colonize an area quickly. During unfavourable conditions, many plants prefer sexual reproduction or produce dormant structures like seeds or spores to ensure survival. Hence, statement 1 is incorrect.

• Statement 2: It involves male and female flowers. Flowers are the reproductive organs specifically designed for sexual reproduction, involving pollination and fertilization. Asexual reproduction bypasses the floral mechanism entirely. Hence, statement 2 is incorrect.

• Statement 3: It is found in both lower and higher plants. This is the defining characteristic. Lower plants like Algae, Fungi, and Bryophytes reproduce asexually through fragmentation, budding, or zoospores. Higher plants (Angiosperms) frequently reproduce asexually through vegetative propagation using roots, stems, or leaves. Hence, statement 3 is correct.

• Statement 4: It involves formation of gametes. The formation and subsequent fusion of haploid gametes (sperm and egg) is the hallmark of sexual reproduction. Asexual methods rely on mitotic division of somatic cells. Hence, statement 4 is incorrect.

Additional Information

• Vegetative Propagation in Higher Plants:

• This is a form of asexual reproduction where new plants are produced from vegetative parts.

• Stem Tubers: Examples include the Potato, where "eyes" act as nodes for new growth.

• Rhizomes: Underground stems found in Ginger and Turmeric that spread horizontally.

• Runners/Stolons: Found in Strawberry plants, these stems run along the ground to establish new plantlets.

• Bulbs: Short underground stems with fleshy leaves, such as in Onions and Garlic.

• Adventitious Buds: The Bryophyllum plant produces buds along its leaf margins that drop off to form new plants.

• Asexual Methods in Lower Plants:

• Fragmentation: In Spirogyra (an alga), the parent body breaks into smaller pieces, each growing into a new individual.

• Budding: Common in Yeast, where a small bulb-like projection (bud) develops and detaches.

• Spore Formation: Non-flowering plants like Ferns and Mosses produce spores in structures called sporangia which germinate under suitable conditions.

• Advantages of Asexual Reproduction:

• The offspring are genetically identical (clones) to the parent, ensuring the preservation of desirable traits.

• It is a faster and more energy-efficient process as it does not require the plant to produce flowers, nectar, or find pollinators.

• It allows for the rapid multiplication of a species in a stable habitat.

Q7. Answer: (b) Both (i) and (iv)

The correct answer is Both (i) and (iv).

Key Points

• In a domestic electric circuit, all electrical appliances like bulbs, fans, and sockets are connected in parallel. This configuration ensures that every appliance receives the same voltage (220 V in India) and can be operated independently using its own switch. Hence, statement (i) is correct.

• The live wire (also known as the phase wire) is the wire through which current enters the circuit and is usually color-coded with red or brown insulation. The green insulation is strictly reserved for the earth wire, which serves as a safety mechanism. Hence, statement (ii) is incorrect.

• An electric fuse is a vital safety device designed to protect appliances. It consists of a wire with a low melting point; if the current becomes excessive (due to short-circuiting or overloading), the fuse wire melts and breaks the circuit to stop the flow of electricity. Hence, statement (iii) is incorrect.

• The neutral wire completes the electrical circuit by providing a return path for the current and is maintained at near-zero potential. In standard domestic wiring, the neutral wire is covered with black or blue insulation. Hence, statement (iv) is correct.

• Therefore, the correct statements regarding domestic circuits are (i) and (iv).

Additional Information

• Standard Voltage and Frequency: In India, the domestic power supply is Alternating Current (AC) with a potential difference of 220 V and a frequency of 50 Hz. This means the direction of current changes 100 times per second.

• Earthing System: The earth wire (green insulation) is connected to a metal plate buried deep in the ground. It is used as a safety measure for appliances with metallic bodies (like refrigerators or toasters) to ensure that any leakage of current is transferred safely to the ground, preventing electric shocks.

• Short-Circuiting: This phenomenon occurs when the live wire and neutral wire come into direct contact. This leads to a massive decrease in resistance and a sudden surge in current, which can cause sparks or fires.

• Overloading: Overloading happens when the total power rating of appliances connected to a single circuit exceeds the current-carrying capacity of the wires. This usually occurs when too many high-power devices are plugged into one socket.

• MCB (Miniature Circuit Breaker): In modern domestic circuits, MCBs are often used instead of traditional fuses. They automatically switch off the electrical supply during an overload or short circuit and can be easily reset manually once the fault is fixed.

Important Points

• Parallel vs. Series: Domestic circuits never use series connections for appliances because in a series circuit, if one appliance fails or is switched off, the entire circuit breaks and all other appliances stop working. Furthermore, the voltage would be divided among the appliances, causing them to function inefficiently.

• Wire Color Coding: According to the new international convention, the Live wire is Brown, the Neutral wire is Light Blue, and the Earth wire is Green or Yellow. However, the traditional Indian coding of Red (Live), Black (Neutral), and Green (Earth) is still widely recognized.

• Two Separate Circuits: Domestic wiring usually consists of two separate circuits: a 5 A circuit for low-power devices (bulbs, fans) and a 15 A circuit for high-power devices (geysers, air conditioners).

Q8. Answer: (d) Both (A) and (R) are true but (R) is not the correct explanation of (A)

The correct answer is Both (A) and (R) are true but (R) is not the correct explanation of (A).

Key Points

• Assertion (A) states that the onset of puberty in females occurs earlier than in males. Biologically, girls typically enter puberty between the ages of 8 and 13, while boys usually begin between 9 and 14 years. Despite the difference in start times, both genders generally attain their final adult height by the age of 18–20 years when the growth plates fuse. Hence, statement (A) is correct.

• Reason (R) mentions that the growth spurt in males is more rapid. During the peak of adolescence, males experience a more intense height velocity (approximately 9.5 cm per year) compared to females (approximately 8.3 cm per year). Hence, statement (R) is correct.

• While both statements are factually accurate, the rapidity of the male growth spurt does not explain why females start puberty earlier or why both finish growing by age 20. The timing of puberty is controlled by hormonal signals from the hypothalamus, while the cessation of growth is due to the fusion of epiphyseal plates caused by sex steroids.

• Therefore, Reason (R) is a true biological fact but it does not serve as a logical explanation for the specific timings mentioned in Assertion (A).

• Hence, the correct answer is Both (A) and (R) are true but (R) is not the correct explanation of (A).

Additional Information

• Puberty and Hormones:

• In females, the primary hormone responsible for pubertal changes and eventually the closure of growth plates is Estrogen.

• In males, Testosterone drives the growth spurt and the development of secondary sexual characteristics like facial hair and deepening of the voice.

• Growth Plates (Epiphyseal Plates):

• These are areas of active cartilage at the ends of long bones. Height increases as long as these plates stay open.

• By the end of adolescence (usually by age 18-20), hormonal changes cause these plates to calcify and turn into bone, marking the end of vertical growth.

• Peak Height Velocity (PHV):

• This refers to the period where the maximum rate of growth occurs. Females typically reach PHV about two years earlier than males, often around age 11-12, whereas males reach it around age 13-14.

• Because males have two additional years of pre-pubertal growth and a more vigorous growth spurt, they generally end up taller than females on average.

Important Points

• Individual Variation: While the standard range is 18-20 years, factors like nutrition, genetics, and health conditions can influence the exact age at which an individual stops growing.

• Sexual Dimorphism: The differences in growth timing and intensity contribute significantly to sexual dimorphism (physical differences between males and females of the same species) in human height and skeletal structure.

Q9. Answer: (c) packaging and secretion

The correct answer is packaging and secretion.

Key Points

• The Golgi complex, also known as the Golgi apparatus or Golgi body, is a vital organelle in eukaryotic cells responsible for the modification, sorting, and packaging of proteins and lipids.

• Its primary function is to act as a packaging center. It receives materials synthesized in the Endoplasmic Reticulum (ER), processes them, and then directs them to their final destinations, such as the plasma membrane or lysosomes.

• If a cell lacks a functional Golgi complex, the proteins and lipids synthesized by the cell would not be packaged into vesicles or secreted properly. This would lead to a failure in delivering essential molecules to where they are needed inside or outside the cell. Hence, the option packaging and secretion is correct.

• The organelle is composed of stacked, flattened, membrane-bound sacs called cisternae. These structures are involved in glycosylation (adding sugar chains to proteins) and the formation of glycoproteins and glycolipids.

• The Golgi complex is also essential for the formation of lysosomes and the acrosome in sperm cells, which is necessary for fertilization.

Additional Information

• Protein Synthesis:

• Protein synthesis is primarily the function of ribosomes and the Rough Endoplasmic Reticulum (RER).

• While the Golgi complex modifies proteins after they are made, it does not actually synthesize them. Therefore, a lack of Golgi would not stop the synthesis of proteins, only their transport and final processing. Hence, statement 1 is incorrect.

• Controlling Cell Division:

• The regulation and control of cell division are managed by the nucleus (which contains DNA) and structures like centrioles in animal cells.

• The Golgi complex is not the primary controller of the cell cycle or mitosis. Hence, statement 2 is incorrect.

• Formation of ATP:

• The formation of ATP (Adenosine Triphosphate) occurs through cellular respiration in the mitochondria.

• Mitochondria are known as the powerhouse of the cell. The Golgi complex does not produce energy for the cell. Hence, statement 4 is incorrect.

• Discovery:

• The Golgi complex was discovered by the Italian biologist Camillo Golgi in 1898. He used a specialized silver staining technique called the black reaction to identify the organelle's structure.

• His work on the nervous system and the discovery of this organelle earned him the Nobel Prize in Physiology or Medicine in 1906.

Important Points

• Vesicular Transport: The Golgi complex functions by receiving transport vesicles from the ER at its cis face and releasing secretory vesicles from its trans face.

• Plant Cells: In plant cells, the Golgi apparatus is often referred to as dictyosomes, which are smaller and more scattered compared to animal cells. They play a major role in synthesizing hemicellulose and pectin for the cell wall.

• Secretion: Cells that are highly active in secretion (like pancreatic cells secreting enzymes or goblet cells secreting mucus) have a very high number of Golgi complexes.

Q10. Answer: (a) Light from stars undergoes atmospheric refraction

The correct answer is Light from stars undergoes atmospheric refraction.

Key Points

• The twinkling of a star is due to the atmospheric refraction of star light. As the light from a star enters the Earth's atmosphere, it undergoes refraction continuously before it reaches the Earth.

• Since the stars are very distant, they approximate point-sized sources of light. As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers. Hence, statement 1 is correct.

• The atmospheric refraction occurs in a medium of gradually changing refractive index. The Earth's atmosphere is not stationary; its density and temperature change continuously, leading to changes in the refractive index of different layers of air.

• While stars may have intrinsic variability, the "twinkling" we observe is primarily an optical illusion caused by the atmosphere rather than the stars changing their brightness continuously. Hence, statement 2 is incorrect.

• The distance between stars and Earth is vast, and any minor orbital movement or variation in distance is too insignificant to cause the rapid flickering effect known as twinkling. Hence, statement 3 is incorrect.

• Although stars do move at high velocities, their proper motion is not perceivable over short timeframes to the naked eye and does not cause the twinkling effect. Hence, statement 4 is incorrect.

Additional Information

• Why Planets do not Twinkle:

• Unlike stars, planets are much closer to the Earth and are thus seen as extended sources (a collection of many point-sized sources) rather than a single point source.

• The total variation in the amount of light entering our eye from all the individual point-sized sources in a planet will average out to zero, thereby nullifying the twinkling effect.

• Atmospheric Refraction Phenomena:

• Advance Sunrise and Delayed Sunset: The Sun is visible to us about 2 minutes before the actual sunrise and about 2 minutes after the actual sunset because of atmospheric refraction.

• Apparent Position: Due to the bending of light, stars appear slightly higher (above their actual position) when viewed near the horizon.

• Refractive Index: The refractive index of the atmosphere generally increases as we move closer to the Earth's surface because the air becomes denser. This causes the light to bend toward the normal.

Important Points

• Scintillation: This is the scientific term for the twinkling of stars. It is caused by small-scale fluctuations in the air density resulting from turbulence in the atmosphere.

• Astronomy: To avoid the blurring and twinkling caused by the atmosphere, modern large telescopes (like the Hubble Space Telescope) are placed in outer space, or use adaptive optics to cancel out the atmospheric distortion.

• Medium Consistency: If the Earth had no atmosphere, stars would not twinkle and would appear as steady points of light against a black sky.

Q11. Answer: (a) Fluid content inside the plasma membrane containing organelles

The correct answer is Fluid content inside the plasma membrane containing organelles.

Key Points

• The cytoplasm is the gel-like substance that fills the interior of a cell, situated between the nucleus and the plasma membrane.

• It serves as the primary arena for cellular activities and chemical reactions that keep the cell alive.

• Statement 1: It defines cytoplasm as the fluid content inside the plasma membrane that houses various specialized organelles. Each of these organelles performs a specific function for the cell. Hence, statement 1 is correct.

• Statement 2: A rigid layer outside the plasma membrane that provides support and protection is known as the cell wall. This is found in plants, fungi, and bacteria, but not in animal cells. Hence, statement 2 is incorrect.

• Statement 3: A network of tubes involved in the transport of proteins and lipids within the cell refers to the Endoplasmic Reticulum (ER). Hence, statement 3 is incorrect.

• Statement 4: Genetic material present in the form of chromatin is found within the nucleus, which is separate from the general cytoplasm in eukaryotic cells. Hence, statement 4 is incorrect.

• Hence, the correct answer is Fluid content inside the plasma membrane containing organelles.

Additional Information

• Composition of Cytoplasm:

• The cytoplasm is composed of the cytosol, organelles, and cytoplasmic inclusions.

• The cytosol is the aqueous part containing water (about 80%), salts, and organic molecules like enzymes.

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• In prokaryotic cells, which lack a defined nucleus, the genetic material (DNA) is located directly in the cytoplasm in a region called the nucleoid.

• Functions of Cytoplasm:

• It facilitates cytoplasmic streaming (cyclosis), which helps in the distribution of nutrients and movement of organelles within the cell.

• It acts as a site for metabolic pathways such as glycolysis (the first step of cellular respiration) and protein synthesis in the ribosomes.

• The cytoplasm provides turgidity to the cell, maintaining its shape and preventing it from collapsing.

• Cell Organelles:

• Organelles like Mitochondria, Golgi Apparatus, and Lysosomes are suspended in the cytoplasm.

• These membrane-bound structures are essential for energy production, waste disposal, and molecular packaging.

Important Points

• Historical Context: The term "cytoplasm" was introduced by Rudolf von Kolliker in 1863 as a synonym for protoplasm.

• Cytoskeleton: Within the cytoplasm lies a complex network of microtubules and microfilaments called the cytoskeleton. It provides mechanical support and assists in cell division.

• Ectoplasm and Endoplasm: In some cells, like the Amoeba, the cytoplasm is divided into an outer clear layer called ectoplasm and an inner granular layer called endoplasm.

Q12. Answer: (d) Hybrid crops are unaffected by unpredictable weather

The correct answer is Hybrid crops are unaffected by unpredictable weather.

Key Points

• Climate-resistant hybrid crops are engineered or crossbred to possess traits that allow them to survive and thrive under extreme environmental conditions. This resilience is crucial because traditional varieties often fail during sudden climatic shifts.

• One of the primary benefits is that these crops are relatively unaffected by unpredictable weather, such as sudden droughts, unseasonal rainfall, or extreme heatwaves. This ensures a consistent food supply even in volatile years. Hence, statement 4 is correct.

• The role of the farmer is actually intensified rather than reduced, as they must manage specialized agronomic practices to maximize the potential of these high-tech seeds. Hence, statement 1 is incorrect.

• While some hybrids might have uniform aesthetic qualities, their importance for future farming is rooted in biological survival and yield security, not visual appeal. Hence, statement 2 is incorrect.

• Storage characteristics depend on moisture content and post-harvest technology; climate resistance specifically refers to the plant's growth cycle in the field, not its shelf life. Hence, statement 3 is incorrect.

• These hybrids are designed to combat abiotic stress, which includes non-living factors like salinity, chilling, and high temperatures that are becoming more frequent due to global warming.

Additional Information

• Climate-Smart Agriculture (CSA):

• This is an integrated approach to managing landscapes—cropland, livestock, forests, and fisheries—that addresses the interlinked challenges of food security and accelerating climate change.

• The Food and Agriculture Organization (FAO) defines CSA through three pillars: increasing productivity, enhancing resilience, and reducing greenhouse gas emissions.

• Types of Resistance:

• Drought Tolerance: Varieties developed to require less water or to enter a dormant state during dry spells to prevent wilting.

• Flood/Submergence Tolerance: For example, Swarna-Sub1 rice, which can survive underwater for up to 14 days, a trait vital for regions like Eastern India and Bangladesh.

• Salinity Tolerance: Essential for coastal farming where rising sea levels increase soil salt concentration.

• Economic Impact:

• By 2050, the global population is expected to reach nearly 10 billion. Climate-resistant hybrids help stabilize market prices by preventing mass crop failures.

• The Indian Council of Agricultural Research (ICAR) has released several climate-resilient varieties of wheat (HD 3385) and rice to help Indian farmers adapt to rising temperatures.

Important Points

• Hybridization vs. GMO: It is important to distinguish between hybrid crops (produced via natural cross-pollination) and Genetically Modified Organisms (GMOs) (produced via laboratory gene splicing), although both can be used to achieve climate resilience.

• Global Food Security: According to the IPCC Reports, agricultural yields could decline by 10-25% per degree of warming without

the adoption of these resistant varieties.

• Sustainable Development Goals (SDG): The use of these crops directly supports SDG 2 (Zero Hunger) and SDG 13 (Climate Action) by ensuring sustainable food production systems.

Q13. Answer: (d) Sugar

The correct answer is Sugar.

Key Points

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

• Sugar, specifically table sugar known as Sucrose, is a chemical compound with the molecular formula C12H22O11. It is composed of 12 carbon atoms, 22 hydrogen atoms, and 11 oxygen atoms. Hence, this option is correct.

• Mercury is a chemical element represented by the symbol Hg and has the atomic number 80. It is a pure substance consisting of only one type of atom and cannot be broken down into simpler substances. Hence, this option is incorrect.

• Hydrogen is the simplest and lightest chemical element with the symbol H and atomic number 1. While it often exists as a diatomic molecule (H2), it is still classified as an element, not a compound, because it consists of only one kind of atom. Hence, this option is incorrect.

• Iron is a metallic element with the symbol Fe and atomic number 26. It is a transition metal found in Group 8 of the periodic table. As a pure metal, it is an element. Hence, this option is incorrect.

Additional Information

• Characteristics of Mercury (Hg):

• It is the only common metal that exists in a liquid state at standard room temperature (approximately 25 degrees Celsius).

• It has a high density and is used in scientific instruments like thermometers, barometers, and manometers due to its uniform thermal expansion.

• In nature, it is primarily found in the ore Cinnabar (mercuric sulfide).

• Characteristics of Iron (Fe):

• It is the fourth most abundant element in the Earth's crust and makes up a significant portion of the Earth's core.

• It is highly magnetic and is the primary raw material used to produce Steel, an alloy essential for construction and industrial machinery.

• Biologically, it is a key component of hemoglobin, the protein in red blood cells responsible for carrying oxygen throughout the body.

• Characteristics of Hydrogen (H):

• It is the most abundant element in the universe, making up roughly 75% of all baryonic mass.

• At standard temperature and pressure, it is a colorless, odorless, and tasteless gas.

• It is used in the Haber process for the production of ammonia and is being explored as a clean renewable energy fuel.

• Characteristics of Sugar (Sucrose):

• It is a disaccharide, meaning it is formed by the combination of two simple sugars: glucose and fructose.

• The covalent bonds holding the atoms together give the compound unique physical properties, such as being a white crystalline solid that is highly soluble in water.

• It is primarily extracted from sugarcane (Saccharum officinarum) and sugar beets for commercial use.

Important Points

• Pure Substances vs. Mixtures: Matter can be classified as pure substances (elements and compounds) or mixtures. A compound like sugar is a pure substance because its composition is chemically uniform.

• Chemical Symbols and Formulas: Elements are represented by one or two-letter symbols (e.g., Fe for Iron, H for Hydrogen), while compounds are represented by chemical formulas (e.g., H2O for Water, NaCl for Salt).

• Decomposition: Compounds can be broken down into their constituent elements only by chemical methods (such as electrolysis or thermal decomposition), whereas elements cannot be broken down further by any chemical means.

• Law of Constant Proportions: This fundamental law states that a chemical compound always contains its component elements in a fixed ratio by mass, regardless of its source or method of preparation.

Q14. Answer: (c) Joule

The correct answer is Joule.

Key Points

• Work is said to be done when a force acts upon an object to cause a displacement. The mathematical expression for work done is $W = F \times s \times \cos\theta$, where F is the force, s is the displacement, and θ is the angle between the force and displacement vectors.

• The SI unit of work is the Joule (J). It is named in honor of the English physicist James Prescott Joule, who studied the nature of

heat and its relationship to mechanical work in the mid-19th century.

• One Joule is defined as the amount of work done when a constant force of one Newton displaces an object through a distance of one meter in the direction of the force. Mathematically, 1 J = 1 N · m.

• Work is a scalar quantity, meaning it has only magnitude and no direction, even though the force and displacement used to calculate it are vector quantities.

• In the CGS (Centimetre-Gram-Second) system, the unit of work is the Erg. The relationship between the two is that 1 Joule is equal to 10^7 Ergs.

Additional Information

• Pascal (Pa):

• The Pascal is the SI derived unit of pressure. It is defined as one Newton per square meter (N/m^2).

• It was named after the French polymath Blaise Pascal in 1971. It is commonly used in meteorology to measure atmospheric pressure and in engineering for material strength.

• Newton (N):

• The Newton is the SI unit of force. It is defined as the force needed to accelerate one kilogram of mass at the rate of one meter per second squared (1 $kg \cdot m/s^2$).

• Named after Sir Isaac Newton in recognition of his work on classical mechanics and the laws of motion published in 1687.

• Coulomb (C):

• The Coulomb is the SI unit of electric charge. It is the quantity of electricity transported in one second by a current of one ampere.

• It is named after Charles-Augustin de Coulomb, a French physicist known for Coulomb's Law, which describes the electrostatic force between charges.

Important Points

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

• Work done can be positive, negative, or zero depending on the angle θ. If the force and displacement are in the same direction (θ = 0°), work is positive. If they are in opposite directions (θ = 180°), work is negative.

• Zero Work: No work is done if the displacement is zero, or if the force is perpendicular to the displacement (θ = 90°), such as a person carrying a load on their head while walking horizontally.

• In atomic physics, work and energy are often measured in a smaller unit called the electronvolt (eV), where 1 eV ≈ 1.602 × 10^(-19) Joules.

Q15. Answer: (d) Poor conductor of electricity

The correct answer is Poor conductor of electricity.

Key Points

• Non-metals are elements that generally lack the characteristics of metals. One of their most defining physical properties is that they are poor conductors of electricity and heat. This is because non-metals do not have free-moving electrons (delocalized electrons) in their structure to carry an electric charge.

• Most non-metals have low melting points and low boiling points compared to metals. This is due to the weak intermolecular forces (like Van der Waals forces) that hold their molecules together, which require less energy to overcome.

• Non-metals are brittle in their solid state. Unlike metals, they cannot be beaten into thin sheets (malleability) or drawn into wires (ductility). If subjected to stress, they tend to shatter or break into pieces.

• They are non-sonorous, meaning they do not produce a deep, ringing sound when struck. This is a sharp contrast to metals, which are used in bells and musical instruments for their sonorous property.

• In terms of chemical behavior, non-metals are electronegative. They have a tendency to gain electrons during chemical reactions to form negative ions (anions) or share electrons to form covalent bonds.

Additional Information

• Physical State: Unlike metals, which are mostly solids at room temperature, non-metals can exist in all three states of matter. For example, Oxygen and Nitrogen are gases, Carbon and Sulfur are solids, and Bromine is the only non-metal that is a liquid at room temperature.

• Lustre: Non-metals generally have a dull appearance and do not reflect light well (they are non-lustrous). However, Iodine and Graphite are notable exceptions as they exhibit a metallic-like shine or lustre.

• Exceptions to Conductivity: While non-metals are typically insulators, Graphite (an allotrope of Carbon) is a good conductor of electricity. This unique property allows it to be used in electrodes and dry cells.

• Hardness: Most non-metals are relatively soft compared to metals. However, Diamond (another allotrope of Carbon) is the hardest known natural substance and has an extremely high melting point.

• Oxides: Non-metals react with oxygen to form acidic or neutral oxides. For instance, Sulfur dioxide (SO2) is acidic, whereas Carbon monoxide (CO) and Water (H2O) are neutral oxides.

Important Points

• Ductility: This is a property of metals (like Gold and Copper) that allows them to be drawn into thin wires. Non-metals lack this property.

• Density: Non-metals usually have low densities and are lighter than metals. They do not have the high mass-to-volume ratio characteristic of transition metals.

• Valence Electrons: Non-metals generally have 4 to 8 electrons in their outermost shell. This configuration drives their reactivity toward gaining electrons to achieve a stable noble gas configuration.

• Uses: Non-metals are essential for life. Oxygen is vital for respiration, Nitrogen is used in fertilizers, Chlorine is used for water purification, and Phosphorus is used in matchsticks.

Q16. Answer: (c) R = 2f

The correct answer is R = 2f.

Key Points

• A spherical mirror is a mirror whose reflecting surface is a part of a hollow sphere of glass. The center of this sphere is known as the Center of Curvature (C).

• The Radius of Curvature (R) is defined as the distance between the Pole (P) of the mirror and the Center of Curvature (C).

• The Principal Focus (F) is a point on the principal axis where all rays parallel to the axis converge (in a concave mirror) or appear to diverge from (in a convex mirror) after reflection.

• The Focal Length (f) is the distance from the Pole (P) to the Principal Focus (F).

• For spherical mirrors with a small aperture, the Principal Focus (F) lies exactly at the midpoint of the distance between the Pole (P) and the Center of Curvature (C).

• Because the focus is the midpoint, the Radius of Curvature (R) is twice the Focal Length (f). Mathematically, this is expressed as R = 2f.

Additional Information

• Concave Mirror: This is a converging mirror where the reflecting surface is curved inwards. Its focal length is considered negative in the standard Cartesian sign convention. It is commonly used in solar cookers, torches, and by dentists to see larger images of teeth.

• Convex Mirror: This is a diverging mirror where the reflecting surface is curved outwards. Its focal length is considered positive. These mirrors are primarily used as rear-view mirrors in vehicles because they provide a wider field of view and always form an erect, virtual, and diminished image.

• Aperture: The aperture of a spherical mirror is the diameter of its reflecting surface. It represents the size of the mirror that faces the incident light.

• Sign Convention: According to the New Cartesian Sign Convention, the pole is treated as the origin. Distances measured in the direction of incident light are positive, while those measured against the direction of incident light are negative.

Important Points

• The relationship R = 2f is only strictly accurate for paraxial rays. These are rays that strike the mirror very close to the Pole (P) and make small angles with the principal axis.

• If the aperture of the mirror is large, rays falling near the edges of the mirror (marginal rays) do not meet at the same focal point as the paraxial rays. This defect in image formation is known as spherical aberration.

• The Mirror Formula, which relates focal length, object distance (u), and image distance (v), is given by 1/f = 1/v + 1/u. This formula is derived using the R = 2f assumption for small apertures.

• In year 1672, Isaac Newton used the properties of spherical and parabolic mirrors to construct the first reflecting telescope, significantly advancing the field of optics.

Q17. Answer: (a) Salt, water, carbon dioxide

The correct answer is Salt, water, carbon dioxide.

Key Points

• When a metal carbonate reacts with an acid, the chemical reaction consistently produces three distinct products: a salt, water, and carbon dioxide gas. Hence, option 1 is correct.

• The general chemical equation for this interaction can be represented as: Metal Carbonate + Acid → Salt + Water + Carbon Dioxide.

• The salt produced in the reaction is formed by the cation (positive ion) from the metal carbonate and the anion (negative ion) from the acid. For instance, if hydrochloric acid is used, the salt will be a chloride.

• The evolution of carbon dioxide is a characteristic feature of this reaction, typically observed as effervescence or brisk bubbling within the solution. Hence, options 2 and 3 are incorrect as they mention carbon monoxide.

• Water is formed through the combination of hydrogen ions from the acid and oxygen atoms released from the carbonate group.

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Hence, option 4 is incorrect as it omits the salt formation.

Additional Information

• Common Examples:

• A well-known example is the reaction between Sodium Carbonate (Na_2CO_3) and Hydrochloric Acid (HCl), which yields Sodium Chloride (NaCl), water (H_2O), and carbon dioxide (CO_2).

• Another example is Calcium Carbonate ($CaCO_3$), often found in limestone or marble, reacting with Sulfuric Acid (H_2SO_4) to form Calcium Sulfate ($CaSO_4$), water, and carbon dioxide.

• Metal Hydrogen Carbonates:

• Similar to metal carbonates, metal hydrogen carbonates (also known as bicarbonates, such as Sodium Bicarbonate or $NaHCO_3$) also react with acids to produce salt, water, and carbon dioxide.

• This is the fundamental principle behind baking powder, which releases CO_2 gas to make cakes and bread rise.

• Testing for Carbon Dioxide:

• The carbon dioxide gas produced can be tested by passing it through lime water (Calcium Hydroxide solution).

• The lime water turns milky due to the formation of a white precipitate of Calcium Carbonate. This is a standard analytical test in chemistry labs.

• Applications:

• This reaction is utilized in fire extinguishers, where an acid reacts with a carbonate/bicarbonate to release a large volume of CO_2 to displace oxygen and extinguish flames.

• It is also the basis for antacid tablets containing Calcium Carbonate, which neutralize excess stomach acid (HCl).

Important Points

• Neutralization Aspect: While this reaction produces salt and water (like a standard neutralization reaction between an acid and a base), the addition of carbon dioxide distinguishes carbonate reactions from simple oxide or hydroxide reactions.

• Gas Evolution: Unlike the reaction of metals with acids, which produces hydrogen gas, the reaction of metal carbonates with acids produces carbon dioxide.

• Stoichiometry: The valency of the metal and the basicity of the acid determine the specific ratio of reactants and the chemical formula of the salt produced.

• Safety: In laboratory settings, these reactions must be handled carefully as the rapid evolution of gas can cause splashing of the acidic solution.

Q18. Answer: (c) Direction of magnetic field around a current-carrying conductor

The correct answer is Direction of magnetic field around a current-carrying conductor.

Key Points

• The Right-hand thumb rule, often attributed to Maxwell, is a fundamental principle in electromagnetism used to determine the direction of magnetic field lines produced by a straight current-carrying conductor.

• According to this rule, if a current-carrying conductor is held in the right hand such that the thumb points in the direction of the electric current, then the fingers will curl around the conductor in the direction of the magnetic field lines.

• This rule visualizes the magnetic field as concentric circles surrounding the wire. If the current flows upwards, the magnetic field moves in an anticlockwise direction (when viewed from above). Hence, statement 3 is correct.

• The Right-hand thumb rule does not determine the magnitude of the current; the magnitude is usually measured using an ammeter in Amperes (A). Hence, statement 1 is incorrect.

• The direction of force on a conductor is determined by Fleming's Left-Hand Rule, not the thumb rule. Hence, statement 2 is incorrect.

• The resistance of a wire is a property of the material and its dimensions, calculated using Ohm's Law ($V=IR$) or the resistivity formula, and is independent of the thumb rule. Hence, statement 4 is incorrect.

Additional Information

• Maxwell’s Corkscrew Rule:

• This is another version of the Right-hand thumb rule. It states that if a right-handed corkscrew is rotated such that it moves in the direction of the current, the direction of rotation represents the direction of the magnetic field.

• Magnetic Field Properties:

• The strength of the magnetic field (B) produced by a straight wire is directly proportional to the magnitude of the current (I) and inversely proportional to the distance (r) from the wire.

• The S.I. unit of the magnetic field is the Tesla (T).

• Circular Loops and Solenoids:

• The Right-hand thumb rule is also applicable to circular loops. If the fingers curl in the direction of the current in the loop, the thumb points in the direction of the magnetic field at the center of the loop.

• In a solenoid, this rule helps identify the North and South poles created by the flow of electricity.

Important Points

• Fleming's Left-Hand Rule: Specifically used for Electric Motors. The thumb indicates Motion/Force, the forefinger indicates the Magnetic Field, and the middle finger indicates the Current.

• Fleming's Right-Hand Rule: Specifically used for Electric Generators to find the direction of induced current. The thumb indicates the motion of the conductor, the forefinger indicates the magnetic field, and the middle finger indicates the induced current.

• Discovery: The relationship between electricity and magnetism was first observed by Hans Christian Oersted in 1820, when he noticed a compass needle deflect near a wire carrying electric current.

• Applications: Understanding these rules is essential for the design and functioning of electromagnets, transformers, speakers, and various industrial sensors.

Q19. Answer: (a) waves and particles

p data-end="57" data-start="0">The correct answer is waves and particles.

Key Points

• The dual character of electromagnetic radiation means that it exhibits both wave-like and particle-like properties. This concept was fundamental in the transition from classical physics to quantum mechanics.

• The wave nature is evidenced by phenomena such as interference and diffraction. These properties suggest that radiation travels through space as oscillating electric and magnetic fields. Hence, the first part of the option is correct.

• The particle nature (also known as the corpuscular nature) is demonstrated through Black Body Radiation and the Photoelectric Effect. These phenomena could not be explained by classical wave theory and required the concept of discrete energy packets. Hence, the second part of the option is correct.

• Niels Bohr incorporated these dualistic ideas into his 1913 Atomic Model. He proposed that electrons move in fixed orbits and that the energy emitted or absorbed during transitions between these orbits occurs in discrete units or photons, which aligns with the particle theory.

• By accepting that light behaves as both waves and particles, scientists were able to resolve the inconsistencies between the continuous spectra predicted by classical physics and the line spectra observed in elements like hydrogen.

Additional Information

• Quantum Theory of Radiation:

• Max Planck proposed in 1900 that atoms and molecules could emit or absorb energy only in discrete quantities called quanta. The energy of a quantum is proportional to its frequency.

• The relationship is given by the equation E = hν, where h is Planck’s constant, valued at approximately 6.626 x 10^-³^4 Joules-second (J·s).

• The Photoelectric Effect:

• In 1905, Albert Einstein applied Planck's theory to light, suggesting that light itself consists of particles called photons.

• This discovery provided the strongest evidence for the particle nature of electromagnetic radiation and earned Einstein the Nobel Prize in Physics in 1921.

• Wave Nature of Light:

• James Clerk Maxwell established in the 1860s that light is an electromagnetic wave traveling at a constant speed of 3 x 10^8 meters per second in a vacuum.

• Characteristics of these waves include wavelength (λ) and frequency (ν), related by the formula c = λν.

• De Broglie Hypothesis:

• In 1924, Louis de Broglie extended the dual nature of light to all matter, proposing that particles like electrons also possess wave-like characteristics, a concept known as matter waves.

Important Points

• Key Characteristics of Photons:

• A photon has zero rest mass but possesses momentum and energy. This allows it to exert pressure, known as radiation pressure.

• The energy of a photon is directly proportional to its frequency and inversely proportional to its wavelength.

• Electromagnetic Spectrum:

• The spectrum includes Gamma rays, X-rays, Ultraviolet, Visible light, Infrared, Microwaves, and Radio waves. High-frequency waves like Gamma rays exhibit more pronounced particle-like behavior.

• Low-frequency radiations like Radio waves exhibit more pronounced wave-like behavior, making them ideal for communication over long distances.

Q20. Answer: (c) Growth of a moustache

The correct answer is Growth of a moustache.

Key Points

• Puberty is the stage of life during which adolescents reach sexual maturity and become capable of reproduction. In boys, this transition typically begins between the ages of 10 and 14.

• The growth of a moustache and other facial hair is a prominent secondary sexual characteristic in males. It marks the transition toward physical adulthood. Hence, the correct answer is Growth of a moustache.

• This change is triggered by the production of androgens, specifically testosterone, which is secreted by the testes under the influence of the pituitary gland.

• Other physiological changes include the deepening of the voice due to the enlargement of the larynx (Adam's apple) and the broadening of the shoulders.

• The appearance of hair is not limited to the face; it also includes the development of axillary (underarm) hair and pubic hair, which follow a predictable pattern known as Tanner stages.

Additional Information

• Hormonal Mechanism: The onset of puberty is initiated by the hypothalamus, which secretes Gonadotropin-releasing hormone (GnRH). This stimulates the anterior pituitary to release Luteinizing Hormone (LH) and Follicle-Stimulating Hormone (FSH).

• Testosterone Functions: In males, testosterone is responsible for the enlargement of reproductive organs, stimulation of spermatogenesis (sperm production), and the development of muscular strength.

• Physical Growth: Boys often experience a significant growth spurt during puberty, leading to an increase in height and bone density. This is often accompanied by an increase in the activity of sebaceous and sweat glands, which can lead to acne.

• Primary vs. Secondary Characteristics: Primary sexual characteristics refer to the internal and external reproductive organs (testes, penis) present at birth that mature during puberty. Secondary sexual characteristics are features that appear during puberty but are not directly part of the reproductive system, such as facial hair and body shape changes.

Important Points

• Growth of Pineal Gland: The pineal gland, located in the brain, is responsible for secreting melatonin, which regulates circadian rhythms. It does not grow as a result of puberty; rather, it often undergoes calcification as an individual ages. Hence, statement 1 is incorrect.

• Growth of hairs on head: The growth of hair on the scalp is a continuous biological process that occurs from birth and is influenced by genetics and nutrition. It is not a specific marker for the onset of puberty. Hence, statement 2 is incorrect.

• Growth of liver: The liver is a vital organ involved in metabolism and detoxification. While it increases in size as the body grows during childhood and adolescence, its growth is part of general physical development and is not a specific characteristic of sexual maturation. Hence, statement 4 is incorrect.

• Psychological Changes: Along with physical markers like the growth of a moustache, puberty also involves cognitive and emotional changes, including increased independence and the development of sexual orientation.

Q21. Answer: (a) It brings the object in motion.

The correct answer is It brings the object in motion.

Key Points

• An unbalanced force is defined as a force where the net resultant force acting on an object is not zero. When multiple forces act on a body and do not cancel each other out, the object experiences a change in its state of motion.

• According to Newton’s First Law of Motion, an object will maintain its state of rest or uniform motion in a straight line unless compelled to change that state by an external unbalanced force.

• Statement 1: "It brings the object in motion." If an unbalanced force is applied to a stationary object, it overcomes the object's inertia and causes it to start moving in the direction of the resultant force. Hence, statement 1 is correct.

• Statement 2: "It has no effect on the object’s state of motion." This description applies to balanced forces, where the forces are equal in magnitude but opposite in direction, resulting in a net force of zero. Hence, statement 2 is incorrect.

• Statement 3: "It keeps the object at rest." An unbalanced force, by definition, causes acceleration. If an object remains at rest despite forces being applied, it means the forces are balanced (such as static friction balancing a push). Hence, statement 3 is incorrect.

• Statement 4: "It always increases the mass of the object." Mass is an intrinsic property representing the amount of matter in an object and its inertia. In classical mechanics, applying a force does not change the mass of the object. Hence, statement 4 is incorrect.

Additional Information

• Newton’s Second Law of Motion: This law provides a quantitative definition of force, stating that the acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass. The relationship is expressed by the formula F = ma.

• Acceleration and Velocity: An unbalanced force always results in acceleration, which means a change in the velocity of the

object. This can involve an increase in speed, a decrease in speed (deceleration), or a change in the direction of motion.

• Vector Nature of Force: Force is a vector quantity, characterized by both magnitude and direction. The SI unit of force is the Newton (N), named after Sir Isaac Newton for his work on classical mechanics in 1687.

• Inertia: This is the tendency of objects to resist any change in their state of motion. The mass of an object is a measure of its inertia; a heavier object requires a larger unbalanced force to achieve the same acceleration as a lighter object.

• Types of Forces: Forces can be categorized into contact forces (like friction, tension, and normal force) and non-contact forces (like gravitational force, magnetic force, and electrostatic force). Any of these can act as an unbalanced force depending on the system.

Q22. Answer: (b) changing

The correct answer is changing.

Key Points

• An Amoeba is a unicellular organism that belongs to the Kingdom Protista and is characterized by its lack of a definite shape.

• The shape of an amoeba is constantly changing because of the movement of its cytoplasm and the formation of pseudopodia.

• Pseudopodia, which literally means "false feet," are temporary protrusions of the cell membrane that the organism extends and pulls back to facilitate locomotion.

• In addition to movement, these pseudopodia are used for capturing food through a process known as phagocytosis, where the organism wraps its body around a food particle to form a food vacuole.

• Because it lacks a cell wall or a pellicle (a stiff outer covering found in some other protists), the amoeba remains irregular and flexible throughout its life cycle.

Additional Information

• Slipper Shape (Paramecium):

• Unlike the amoeba, the Paramecium has a fixed, slipper-like shape.

• This fixed shape is maintained by a stiff but flexible outer membrane called the pellicle.

• The Paramecium uses tiny hair-like structures called cilia for movement, which cover its entire body surface.

• Biological Classification:

• Amoebas were first discovered by August Johann Rösel von Rosenhof in 1755.

• They are typically found in freshwater environments like ponds, lakes, and slow-moving streams, though some species live in saltwater or damp soil.

• The most well-known species is Amoeba proteus, which can grow up to 700 to 800 micrometers in length.

• Cellular Components:

• The body of an amoeba consists of a plasma membrane, cytoplasm (divided into ectoplasm and endoplasm), and a nucleus.

• It contains a contractile vacuole, which is vital for osmoregulation, helping the cell maintain water balance by expelling excess liquid.

• It reproduces asexually through a process called binary fission, where a single cell divides into two identical daughter cells.

• Comparison of Shapes:

• Star shape: While not characteristic of amoebas, some cells in the human body, such as astrocytes (a type of glial cell in the brain), exhibit a star-shaped morphology.

• Fixed shape: Most plant cells and many bacteria have fixed shapes due to the presence of a rigid cell wall.

• Sleeper shape: This is a common descriptive term used exclusively for Paramecium in biological studies to help students identify its distinct asymmetrical form.

Important Points

• The ability to change shape is a survival mechanism that allows the amoeba to navigate through microscopic crevices in its environment.

• The movement of the amoeba is specifically referred to as amoeboid movement, which is one of the most primitive forms of animal locomotion.

• Some species of amoeba can be pathogenic; for example, Entamoeba histolytica is the organism responsible for amoebic dysentery in humans.

Q23. Answer: (a) Spinal cord

The correct answer is Spinal cord.

Key Points

• A reflex arc is a neural pathway that controls a reflex action. In higher animals, most sensory neurons do not pass directly into the brain, but synapse in the spinal cord.

• The reflex arc is formed in the spinal cord to allow for faster reflex actions by activating spinal motor neurons without the delay of

routing signals through the brain.

• While the information input also goes on to reach the brain, the immediate response is coordinated by the spinal cord to ensure a quick reaction to potentially harmful stimuli.

• The process starts when a receptor detects a stimulus; the signal then travels through a sensory neuron to the spinal cord, where it is processed by an interneuron (in polysynaptic reflexes) and sent back via a motor neuron to an effector.

• This mechanism is an evolutionary adaptation that helps organisms survive by responding nearly instantaneously to environmental hazards, such as heat or sharp objects.

Additional Information

• Components of a Reflex Arc:

• Receptor: The specialized cell or organ that perceives the stimulus (e.g., skin).

• Sensory Neuron: Carries the impulse from the receptor to the Central Nervous System (CNS).

• Integration Center: Located within the spinal cord, where the sensory impulse is converted into a motor impulse.

• Motor Neuron: Transmits the impulse from the spinal cord to the effector organ.

• Effector: The muscle or gland that responds to the motor impulse.

• Forebrain:

• The Forebrain is the main thinking part of the brain. It consists of the cerebrum, thalamus, and hypothalamus.

• It deals with voluntary actions, memory, learning, and the processing of sensory information like sight and sound.

• Hindbrain:

• The Hindbrain consists of the pons, cerebellum, and medulla.

• It controls involuntary actions such as blood pressure, salivation, and vomiting, and coordinates body posture and balance.

• Muscle (The Effector):

• In the context of a reflex arc, the muscle acts as the effector that performs the physical movement (contraction) to pull away from a stimulus.

• Types of Reflexes:

• Spinal Reflexes: Reflexes where the spinal cord is the primary control center (e.g., the knee-jerk reflex).

• Cranial Reflexes: Reflexes where the brain is the control center (e.g., blinking of eyes in response to bright light).

Q24. Answer: (b) Sum of the number of protons and neutrons

The correct answer is Sum of the number of protons and neutrons.

Key Points

• The mass number (represented by the symbol A) of an element is defined as the total sum of the number of protons and neutrons present in the nucleus of an atom.

• Protons and neutrons are collectively known as nucleons because they are situated in the nucleus of the atom.

• The relationship between the mass number and the identity of an atom is expressed by the formula: Mass Number (A) = Atomic Number (Z) + Number of Neutrons (n).

• While the atomic number identifies the number of protons (and thus the element itself), the mass number accounts for the bulk of the atom's physical mass.

• Since the mass of an electron is approximately 1/1840th of the mass of a proton, it is considered negligible and is not included when calculating the mass number. Hence, the correct answer is the sum of protons and neutrons.

Additional Information

• Atomic Number (Z):

• This refers strictly to the number of protons in the nucleus of an atom.

• In a neutral atom, the atomic number is also equal to the number of electrons.

• It determines the chemical properties of an element and its position in the Modern Periodic Table, a concept established by Henry Moseley in 1913.

• Isotopes:

• These are atoms of the same element that have the same atomic number but different mass numbers.

• This occurs because isotopes have the same number of protons but a different number of neutrons.

• For example, Carbon-12 and Carbon-14 are isotopes used in radiocarbon dating.

• Isobars:

• Isobars are atoms of different chemical elements that have the same mass number but different atomic numbers.

• An example includes Argon-40, Potassium-40, and Calcium-40, all of which have a mass number of 40 but different numbers of protons.

• Atomic Mass Unit (amu):

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• The mass number is closely related to the atomic mass, which is measured in unified atomic mass units (u).

• 1 amu is defined as 1/12th of the mass of a single Carbon-12 atom.

Important Points

• Nuclear Composition: The nucleus contains almost 99.9% of the total mass of an atom. Because protons and neutrons each have a mass of approximately 1.007 u and 1.008 u respectively, their sum provides the integer mass number.

• Notation: In scientific notation, the mass number (A) is written as a superscript and the atomic number (Z) as a subscript to the left of the element's chemical symbol (e.g., $^{12}_{6}C$).

• Isotones: These are different elements that share the same number of neutrons. For instance, Boron-12 and Carbon-13 both contain 7 neutrons.

• Neutron Calculation: To find the number of neutrons in an atom, subtract the atomic number from the mass number (n = A - Z).

Q25. Answer: (d) Multiple reflection of sound

The correct answer is Multiple reflection of sound.

Key Points

• The stethoscope is an essential medical instrument used by healthcare professionals to listen to the internal sounds of an animal or human body, primarily those originating from the heart or lungs.

• It functions based on the principle of multiple reflection of sound. When the diaphragm of the stethoscope is placed on the patient's chest, the internal sounds (like heartbeats) create vibrations that turn into longitudinal sound waves.

• These sound waves pass through the hollow plastic or rubber tubes of the stethoscope. Inside these tubes, the sound waves strike the inner walls and undergo repeated reflections (multiple reflections) before reaching the doctor's ears.

• This process of multiple reflection ensures that the sound energy is confined within the tube and directed toward the ear tips without significant loss of intensity, allowing the doctor to hear even faint sounds clearly.

• The chest piece usually contains a diaphragm and a bell. The diaphragm is designed to capture high-frequency sounds, while the bell is used for low-frequency sounds.

Additional Information

• Refraction of Sound: This is the bending of sound waves when they pass from one medium to another with a different density or temperature. While sound refracts in the atmosphere, it is not the mechanism used in a stethoscope.

• Diffraction of Sound: This refers to the spreading out or bending of sound waves around obstacles or through narrow openings. While sound waves naturally diffract, this property is not utilized for the amplification or transmission of sound in medical auscultation devices.

• Dispersion of Sound: This is the phenomenon where sound waves of different frequencies travel at different speeds, causing a pulse to spread out. This is generally not a factor in the functional design of a standard acoustic stethoscope.

• Invention: The stethoscope was invented in France in 1816 by René Laennec. The original version was a simple wooden tube, which was far more effective and hygienic than the previous method of placing the ear directly on the patient's chest.

• Acoustic vs. Electronic: While traditional acoustic stethoscopes rely entirely on physical reflection, modern electronic stethoscopes amplify the sound electronically and can even convert the acoustic sound into digital data for further analysis.

Important Points

• Reflection Laws: The reflection of sound follows the same laws as the reflection of light: the angle of incidence is equal to the angle of reflection, and the incident wave, reflected wave, and the normal all lie in the same plane.

• Sound Propagation: Sound requires a material medium (solid, liquid, or gas) to travel. In a stethoscope, the sound travels through the air column inside the tubing, reflecting off the solid walls of the tube.

• Applications: Beyond the heart and lungs, stethoscopes are used to listen to the intestines (bowel sounds) and blood flow in arteries and veins (especially during blood pressure measurement using a sphygmomanometer).

• Design Features: The tubing length is usually between 18 to 27 inches. Shorter tubing may provide better sound quality but requires the doctor to be closer to the patient. The material is typically PVC, which provides the necessary flexibility and internal smoothness for efficient reflection.

Q26. Answer: (c) Rs. 7,200

Shortcut Trick

Effective rate for 2 years at 20% Compound Interest = 20 + 20 + (20 × 20)/100 = 44%.

Total Amount = 100% (Principal) + 44% (Interest) = 144%.

Amount = 1.44 × 5,000.

Amount = Rs. 7,200.

Therefore The correct answer is Rs. 7,200.

Alternate Method

Given:

=> Principal (P) = Rs. 5,000

=> Annual Rate (R) = 20%

=> Time (T) = 2 years

Formula Used:

=> Amount (A) = P(1 + R/100)^T

Calculations:

=> $A = 5000 \times (1 + 20/100)^2$

=> $A = 5000 \times (1 + 1/5)^2$

=> $A = 5000 \times (6/5) \times (6/5)$

=> $A = 5000 \times 36/25$

=> $A = 200 \times 36$

=> A = Rs. 7,200

Therefore The correct answer is Rs. 7,200.

Additional Information

Compound Interest Formula

Interest alone is calculated as $CI = P[(1 + R/100)^n - 1]$.

CI vs SI for 2 Years

The difference (D) between CI and SI for 2 years is given by $D = P(R/100)^2$.

Half-Yearly Compounding

If compounded half-yearly, the rate is halved (R/2) and the time is doubled (2T).

Q27. Answer: (d) 21 years

Shortcut Trick

Age ratio (Father : Son) 7 years ago = 5 : 1 (Difference = 4)

Age ratio (Father : Son) 7 years hence = 3 : 1 (Difference = 2)

Equalize difference: New ratio 7 years hence = 6 : 2 (Difference = 4)

Ratio change in 14 years (7 ago to 7 hence) for son: 2 − 1 = 1 unit → 14 years

Son's age 7 years ago = 1 unit = 14 years => Present age = 14 + 7 = 21 years

Therefore The correct answer is 21 years.

Alternate Method

Given: Ratio 7 years ago = 5 : 1, Ratio 7 years later = 3 : 1.

Formula Used: Age calculation based on linear equations.

=> Let the age of Son and Father 7 years ago be x and 5x respectively.

=> Present age of Son = x + 7 and Father = 5x + 7.

=> 7 years from now: Father's age = (5x + 7) + 7 = 5x + 14.

=> 7 years from now: Son's age = (x + 7) + 7 = x + 14.

=> According to question: 5x + 14 = 3 × (x + 14)

=> 5x + 14 = 3x + 42 => 2x = 28 => x = 14.

=> Son's present age = x + 7 = 14 + 7 = 21 years.

Therefore The correct answer is 21 years.

Additional Information

Ratio Difference Concept

The age difference between two people always remains constant. If the difference in parts is not equal, multiply the ratios by the difference of the other ratio.

Present Age Conversion

If age 'n' years ago is x, present age is x + n. If age 'n' years later is y, present age is y − n.

Q28. Answer: (b) 34

Shortcut Trick

Mode is simply the value that appears most frequently in the given data set.

Scan the list for repeating numbers: 20 appears 3 times, 32 appears 2 times, and 34 appears 5 times.

Since 34 has the highest count, it is the mode.

Therefore The correct answer is 34.

Alternate Method

Given observations: 21, 32, 34, 34, 34, 20, 32, 24, 34, 34, 20, 25, 29, 26, 20

To find the mode, we calculate the frequency (number of occurrences) of each observation:

=> Frequency of 20: Found at positions 6, 11, 15 → Count = 3

=> Frequency of 21: Found at position 1 → Count = 1

=> Frequency of 24: Found at position 8 → Count = 1

=> Frequency of 25: Found at position 12 → Count = 1

=> Frequency of 26: Found at position 14 → Count = 1

=> Frequency of 29: Found at position 13 → Count = 1

=> Frequency of 32: Found at positions 2, 7 → Count = 2

=> Frequency of 34: Found at positions 3, 4, 5, 9, 10 → Count = 5

=> Since the value 34 has the maximum frequency of 5, it is the Mode.

Therefore The correct answer is 34.

Additional Information

Empirical Formula

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

Types of Mode

Data with one mode is unimodal, two modes is bimodal, and more than two is multimodal.

Median Calculation

To find the Median, arrange data in ascending order. If N is odd, Median = ((N+1)/2)^(th) term.

Q29. Answer: (d) 25

Shortcut Trick

Successive multiplier: MP × (100 − d1)% × (100 − d2)% = SP.

34,400 × (87 ÷ 100) × ((100 − Z) ÷ 100) = 22,446.

29,928 × (100 − Z) ÷ 100 = 22,446.

100 − Z = (22,446 × 100) ÷ 29,928 => 100 − Z = 75.

Z = 100 − 75 = 25.

Therefore The correct answer is 25.

Alternate Method

Formulas: Price after discount = MP × (100 − D%) ÷ 100 | Second Discount % = (Intermediate SP − Final SP) ÷ Intermediate SP × 100

=> Marked Price (MP) = Rs. 34,400.

=> Price after 1^(st) discount of 13% = 34,400 − (13% of 34,400) = 34,400 − 4,472 = Rs. 29,928.

=> Final Selling Price (SP) after 2^(nd) discount = Rs. 22,446.

=> Amount of 2^(nd) discount = 29,928 − 22,446 = Rs. 7,482.

=> Z% = (7,482 ÷ 29,928) × 100 = 0.25 × 100 = 25%.

Therefore The correct answer is 25.

Additional Information

Successive Discounts

When two or more discounts are applied one after another, they are called successive discounts. The total effective discount is always less than the sum of individual percentages.

Effective Discount Formula

For two successive discounts a% and b%, the single equivalent discount is given by: (a + b − (a × b ÷ 100))%.

Q30. Answer: (d) 50%

Shortcut Trick

Since the denominators (30) are the same, compare only the numerators.

Numerator 1 = 1, Numerator 2 = 2.

Required percentage = (1 ÷ 2) × 100 = 50%.

Therefore The correct answer is 50%.

Alternate Method

Given: First value = 1/30, Second value = 2/30.
Formula: Percentage = (Value / Base) × 100
=> Percentage = [(1/30) / (2/30)] × 100
=> Percentage = (1/30) × (30/2) × 100
=> Percentage = (1/2) × 100
=> Percentage = 50%
Therefore The correct answer is 50%.
Additional Information
Percentage Change
To find the percentage change between two numbers: [(New − Old) ÷ Old] × 100.
Fraction to Percentage
To convert any fraction x/y into a percentage, multiply it by 100 and add the % symbol.
Base Comparison
In questions like 'A is what % of B', B is always the denominator (base) and A is the numerator.

Q31. Answer: (a) Rs. 41,701

Shortcut Trick
Ratio of investment of Preeti, Qadir and Reena = 2 : 8 : 13.
Total ratio units = 2 + 8 + 13 = 23 units.
Difference between Preeti and Reena = 13 − 2 = 11 units.
Value of 11 units = (Total Profit ÷ 23) × 11 = (87,193 ÷ 23) × 11.
Value = 3,791 × 11 = 41,701.
Therefore The correct answer is Rs. 41,701.
Alternate Method
Given → Investment Ratio = 2 : 8 : 13 | Total Profit = Rs. 87,193.
Formulas: Profit Share prop. to Investment × Time | Profit% = (Profit ÷ CP) × 100
=> Since time is the same for all, Profit Ratio = Investment Ratio = 2 : 8 : 13.
=> Let the shares be 2x, 8x, and 13x respectively.
=> Total Profit = 2x + 8x + 13x = 23x = 87,193.
=> x = 87,193 ÷ 23 = 3,791.
=> Difference between Preeti and Reena = 13x − 2x = 11x.
=> Difference = 11 × 3,791 = 41,701.
Therefore The correct answer is Rs. 41,701.
Additional Information
Partnership Basics
When the time period of investment is the same for all partners, the profit is distributed in the ratio of their investments.
Compound Partnership
If time periods are different, Profit Ratio = (Capital1 × Time1) : (Capital2 × Time2).

Q32. Answer: (d) Rs. 6,336

Shortcut Trick
Ratio of Length : Breadth : Height = 3 : 2 : 1. Let common factor be x.
Product of ratios = 3 × 2 × 1 = 6. Given Volume = 10,368 cm^3.
x^3 = 10,368 ÷ 6 = 1,728 => x = cbrt1,728 = 12 cm.
Total Surface Area (in ratio units) = 2 × (3×2 + 2×1 + 1×3) = 2 × 11 = 22 units.
Total Cost = TSA × Rate = (22 × x^2) × 2 = 22 × 144 × 2 = Rs. 6,336.
Therefore The correct answer is Rs. 6,336.
Alternate Method
Given: Volume of rectangular block = 10,368 cm^3. Ratio of L : B : H = 3 : 2 : 1. Polishing rate = Rs. 2/cm^2.
Formula Used: Volume = L × B × H | Total Surface Area (TSA) = 2(LB + BH + HL)
=> Let length = 3x, breadth = 2x, and height = x.
=> Volume = 3x × 2x × x = $6x^3$

=> $6x^3 = 10,368$

=> $x^3 = 1,728$ => $x = 12$

=> Dimensions: L = 36 cm, B = 24 cm, H = 12 cm

=> TSA = $2(36 \times 24 + 24 \times 12 + 12 \times 36)$

=> TSA = $2(864 + 288 + 432) = 2(1,584) = 3,168$ cm²

=> Total Cost = Area × Rate = 3,168 × 2 = Rs. 6,336

Therefore The correct answer is Rs. 6,336.

Additional Information

Volume of a Cuboid

The space occupied by a rectangular prism is calculated as Length × Breadth × Height.

Lateral Surface Area

Area of the four side walls is given by 2 × Height × (Length + Breadth).

Diagonal of a Cuboid

The longest rod that can be placed inside is $\sqrt{(L^2 + B^2 + H^2)}$.

Surface Area of a Cube

If L=B=H=a, then the Total Surface Area = $6a^2$.

Q33. Answer: (a) 5.65%

Shortcut Trick

Net percentage change = a + b + (a × b) ÷ 100

Here, markup percentage a = +85% and discount percentage b = −49%.

Net result = 85 − 49 + (85 × (−49)) ÷ 100

Net result = 36 − 41.65 = −5.65%.

Negative sign indicates a loss.

Therefore The correct answer is 5.65%.

Alternate Method

Given: Marked Price (MP) is 85% above Cost Price (CP), Discount = 49%.

Formulas: MP = CP × (100 + Markup%) ÷ 100 | SP = MP × (100 − Discount%) ÷ 100 | Loss% = (CP − SP) ÷ CP × 100

=> Let Cost Price (CP) be 100.

=> Marked Price (MP) = 100 + 85% of 100 = 185.

=> Selling Price (SP) = 185 × (100 − 49) ÷ 100 = 185 × 51 ÷ 100 = 94.35.

=> Loss = CP − SP = 100 − 94.35 = 5.65.

=> Loss Percentage = (5.65 ÷ 100) × 100 = 5.65%.

Therefore The correct answer is 5.65%.

Additional Information

Relation between CP and MP

The ratio of Marked Price to Cost Price can be expressed as: MP ÷ CP = (100 + Profit%) ÷ (100 − Discount%).

Markup Percentage

Markup% is the percentage by which the Marked Price is higher than the Cost Price: Markup% = (MP − CP) ÷ CP × 100.

Q34. Answer: (c) 121

Shortcut Trick

Apply the algebraic identity directly: $a^2 + b^2 = (a - b)^2 + 2ab$

Square the difference and add twice the product: $(9)^2 + 2(20)$

81 + 40 = 121

Therefore The correct answer is 121.

Alternate Method

Given:

Difference (a − b) = 9

Product (ab) = 20

Formula Used:

The square of a binomial difference is given by: $(a - b)^2 = a^2 + b^2 - 2ab$

Calculations:
Substituting the given values into the formula:
=> $(9)^2 = a^2 + b^2 - 2 \times 20$
=> $81 = a^2 + b^2 - 40$
=> $a^2 + b^2 = 81 + 40$
=> $a^2 + b^2 = 121$
Therefore The correct answer is 121.
Additional Information
Square of Sum Identity
The value can also be found if the sum is known using: $a^2 + b^2 = (a + b)^2 - 2ab$.
Relationship between Sum and Difference
$(a + b)^2 - (a - b)^2 = 4ab$. This relates the sum, difference, and product of two numbers.
Difference of Squares
$a^2 - b^2 = (a + b)(a - b)$. This is a fundamental factoring identity in algebra.

Q35. Answer: (c) 2

Shortcut Trick
Identify odd numbers between 415 and 428: 417, 419, 421, 423, 425, 427.
Eliminate numbers divisible by 3 (sum of digits): 417 (12), 423 (9).
Eliminate numbers divisible by 5: 425.
Check remaining: 419, 421, 427. Since 427 = 7 × 61, it is not prime.
Prime numbers: 419 and 421.
Therefore The correct answer is 2.
Alternate Method
Given: Range is 415 < n < 428.
Numbers to check: 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427.
=> 417: 4+1+7 = 12 (Divisible by 3)
=> 419: Not divisible by 2, 3, 5, 7, 11, 13, 17, 19. (Prime)
=> 421: Not divisible by 2, 3, 5, 7, 11, 13, 17, 19. (Prime)
=> 423: 4+2+3 = 9 (Divisible by 3)
=> 425: Ends in 5 (Divisible by 5)
=> 427: 427 ÷ 7 = 61 (Divisible by 7)
Therefore The correct answer is 2.
Additional Information
Prime Number Definition
A natural number greater than 1 that has no positive divisors other than 1 and itself.
Primality Test
To check if n is prime, test divisibility by primes up to √n. For 421, √421 ≈ 20.5, so check primes up to 19.
Divisibility Rule of 7
Double the last digit and subtract it from the rest: 427 → 42 − (7 × 2) = 28. Since 28 is divisible by 7, 427 is divisible by 7.

Q36. Answer: (d) 2.5 cm

Shortcut Trick
In melting problems, Total Volume remains constant: $R^3 = r1^3 + r2^3 + r3^3$.
=> $1.5^3 = 0.75^3 + 1^3 + r3^3$
=> $3.375 = 0.421875 + 1 + r3^3$
=> $r3^3 = 3.375 - 1.421875 = 1.953125$ => r3 = 1.25 cm.
=> Diameter of the third ball = 2 × 1.25 = 2.5 cm.
Therefore The correct answer is 2.5 cm.
Alternate Method
Given:
Radius of large iron ball (R) = 1.5 cm

Radius of first smaller ball (r1) = 0.75 cm

Radius of second smaller ball (r2) = 1.0 cm

Formula Used:

Volume of a sphere = $4/3 \times \pi \times r^3$

Let the radius of the third smaller ball be r3.

=> Total Volume = Volume1 + Volume2 + Volume3

=> $4/3 \times \pi \times (1.5)^3 = 4/3 \times \pi \times (0.75)^3 + 4/3 \times \pi \times (1.0)^3 + 4/3 \times \pi \times (r3)^3$

=> $1.5^3 = 0.75^3 + 1.0^3 + r3^3$

=> $3.375 = 0.421875 + 1 + r3^3$

=> $3.375 = 1.421875 + r3^3$

=> $r3^3 = 3.375 - 1.421875$

=> $r3^3 = 1.953125$

=> r3 = 1.25 cm

=> Diameter of the third ball = $2 \times r3 = 2 \times 1.25 = 2.5$ cm

Therefore The correct answer is 2.5 cm.

Additional Information

Surface Area of Sphere

The total surface area of a sphere is given by $4 \times \pi \times r^2$.

Properties of Melting

When one solid object is melted and recast into other shapes, the total volume remains invariant (constant), assuming no material loss.

Hemisphere Formulas

Volume of hemisphere = $2/3 \times \pi \times r^3$ and Total Surface Area = $3 \times \pi \times r^2$.

Q37. Answer: (d) Rs. 1,787

Shortcut Trick

Total deduction = 19 + 9 + 13 = Rs. 41.

Remaining amount = 8200 − 41 = Rs. 8159.

Ratio of remaining shares = 12 : 19 : 10 (Total units = 41).

1 unit = 8159 ÷ 41 = Rs. 199.

Difference (B − C) = (19 − 10) units + (deduction difference) = 9 × 199 + (9 − 13) = 1791 − 4 = Rs. 1787.

Therefore The correct answer is Rs. 1787.

Alternate Method

Given: Total = Rs. 8,200. Deductions for A, B, C are Rs. 19, Rs. 9, Rs. 13 respectively. Ratio of remaining parts = 12 : 19 : 10.

=> Let remaining shares be 12x, 19x, and 10x.

=> (12x + 19) + (19x + 9) + (10x + 13) = 8200

=> 41x + 41 = 8200

=> 41x = 8159

=> x = 8159 ÷ 41 = 199

=> B's original share = 19x + 9 = 19 × 199 + 9 = 3781 + 9 = Rs. 3790

=> C's original share = 10x + 13 = 10 × 199 + 13 = 1990 + 13 = Rs. 2003

=> Difference = 3790 − 2003 = Rs. 1787

Therefore The correct answer is Rs. 1787.

Additional Information

Ratio Distribution with Constants

When specific amounts are deducted or added to shares, first adjust the total sum and then divide the adjusted sum in the given ratio.

Difference between Shares

Difference = (Ratio Difference × Value per unit) ± (Difference between constants).

Q38. Answer: (d) 15 minutes

Shortcut Trick

Relative Speed when moving towards each other = Sum of speeds = 23 + 89 = 112 km/hr.

Time = Distance ÷ Relative Speed = 28 ÷ 112 = 1/4 hours.

In minutes = 1/4 × 60 = 15 minutes.

Therefore The correct answer is 15 min.

Alternate Method

Given:

Distance between engines = 28 km

Speed of engine 1 (S1) = 23 km/hr

Speed of engine 2 (S2) = 89 km/hr

Formula Used:

Time = Distance ÷ Relative Speed

Relative Speed (Opposite Direction) = S1 + S2

Calculations:

=> Relative Speed = 23 + 89 = 112 km/hr

=> Time (in hours) = 28 ÷ 112

=> Time = 1/4 hours

=> Time (in minutes) = (1/4) × 60

=> Time = 15 min

Therefore The correct answer is 15 min.

Additional Information

Relative Speed Concept

When two objects move in opposite directions, their relative speed is the sum of their individual speeds (S1 + S2). When they move in the same direction, it is the difference (|S1 − S2|).

Time Conversion

To convert time from hours to minutes, multiply the value by 60. To convert km/hr to m/s, multiply by 5/18.

Meeting Time Rule

The Meeting Time is the initial distance between the objects divided by the relative speed, provided they start at the same time.

Q39. Answer: (a) 56.5°

Shortcut Trick

The angle formed by the bisectors of two adjacent angles in a quadrilateral is equal to half the sum of the other two angles.

Therefore angle TES = (angle Q + angle R) ÷ 2

=> angle TES = (74° + 39°) ÷ 2

=> angle TES = 113° ÷ 2 = 56.5°

Therefore The correct answer is 56.5°.

Alternate Method

Given: In quadrilateral QRST, angle Q = 74° and angle R = 39°. SE and TE are angle bisectors of angle S and angle T respectively.

Formula Used: Sum of interior angles of a quadrilateral = 360°. Sum of angles in a triangle = 180°.

In quadrilateral QRST:

=> angle Q + angle R + angle S + angle T = 360°

=> 74° + 39° + angle S + angle T = 360°

=> 113° + angle S + angle T = 360°

=> angle S + angle T = 360° − 113° = 247°

Since SE and TE are bisectors:

Q40. Answer: (a) 180 days

Shortcut Trick

Total Work = LCM of 12, 20, and 36 = 180 units.

Efficiency of A + B + C = 180 ÷ 12 = 15 units/day.

Efficiency of A = 180 ÷ 20 = 9 units/day | Efficiency of C = 180 ÷ 36 = 5 units/day.

Efficiency of B = 15 − (9 + 5) = 1 unit/day.

Time taken by B = 180 ÷ 1 = 180 days.

Therefore The correct answer is 180 days.

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Alternate Method

Given: Time taken by (A+B+C) = 12 days, A = 20 days, C = 36 days.

Formula Used: Efficiency = Total Work ÷ Time taken

Person	Days	Total Work	Efficiency
A + B + C	12	180	15
A	20	9	
C	36	5	

=> Efficiency of (A + B + C) = Efficiency of A + Efficiency of B + Efficiency of C

=> 15 = 9 + Efficiency of B + 5

=> Efficiency of B = 15 − 14 = 1 unit/day

=> Time taken by B alone = Total Work ÷ Efficiency of B

=> Time taken by B = 180 ÷ 1 = 180 days

Therefore The correct answer is 180 days.

Additional Information

Combined Efficiency Rule

The total work done by multiple individuals working together is the sum of their individual efficiencies. Total Efficiency = E1 + E2 + E3.

Work & Time Relation

Time is inversely proportional to efficiency when the work remains constant. Time = Work ÷ Efficiency.

Pipes & Cisterns Analogy

This problem follows the same logic as three pipes filling a tank, where the combined rate is the sum of individual rates.

Q41. Answer: (b) 39, 15

Shortcut Trick

Option Verification Method:

Check which pair satisfies Sum = 54 and LCM = 195.

Option (2): 39 + 15 = 54. Factors of 39 = 3 × 13; Factors of 15 = 3 × 5.

LCM(39, 15) = 3 × 13 × 5 = 195. This satisfies both conditions.

Therefore The correct answer is 39, 15.

Alternate Method

Given: Sum of numbers = 54, LCM = 195.

Formula Used: HCF of two numbers is always a factor of their sum and their LCM.

=> Let the numbers be 3a and 3b, where a and b are co-prime.

=> Sum: 3a + 3b = 54 => a + b = 18

=> LCM: 3 × a × b = 195 => ab = 65

=> We need two numbers whose sum is 18 and product is 65. The factors of 65 are 1, 5, 13, 65.

=> Clearly, a = 13 and b = 5 (since 13 + 5 = 18 and 13 × 5 = 65).

=> First number = 3 × 13 = 39.

=> Second number = 3 × 5 = 15.

Therefore The correct answer is 39, 15.

Additional Information

Product Rule

For any two numbers x and y, x × y = HCF(x,y) × LCM(x,y).

HCF property

The Highest Common Factor (HCF) must divide both the sum and the Least Common Multiple (LCM) of the numbers.

Co-prime Numbers

Numbers are co-prime if their HCF is 1. In the method above, a and b must be co-prime to ensure 3 is the highest factor.

Q42. Answer: (c) 2

Shortcut Trick

Time taken by A, B, and C working together to complete the original work = 3 ÷ 3 = 1 day.

To complete twice the same work, the time taken will be doubled.

Time taken = 1 day × 2 = 2 days.

Therefore The correct answer is 2 days.

Alternate Method

Given:

Time taken by A = 3 days

Time taken by B = 3 days

Time taken by C = 3 days

Formula Used:

Efficiency = Total Work ÷ Time Taken

Combined Efficiency = Efficiency of A + Efficiency of B + Efficiency of C

Time Taken = Total Work ÷ Combined Efficiency

Person	Days	Total Work (LCM)	Efficiency
A	3	3	1
B	3	1	
C	3	1	

Calculations:

=> Total original work = 3 units

=> Combined efficiency of A, B and C = 1 + 1 + 1 = 3 units/day

=> New work to be completed = 2 × Total original work = 2 × 3 = 6 units

=> Time taken to do twice the work = 6 ÷ 3 = 2 days

Therefore The correct answer is 2 days.

Additional Information

Time and Work Relation

Time taken is directly proportional to the amount of work done if the efficiency remains constant. If work is multiplied by n, the time taken is also multiplied by n.

Combined Efficiency Formula

For three individuals with time periods T1, T2, and T3, their combined work rate is (1/T1) + (1/T2) + (1/T3).

Q43. Answer: (a) 1

Shortcut Trick

Excess runs scored in 16^(th) inning = 111 − 94 = 17.

This excess is distributed over the total 16 innings to find the increase in average.

Increase in average = 17 ÷ 16 = 1.0625.

Rounding 1.0625 to the nearest whole number gives 1.

Therefore The correct answer is 1.

Alternate Method

Given: Average of 15 innings = 94 | Runs in 16^(th) inning = 111.

Formula Used: Total runs = Average × Number of innings.

=> Total runs after 15 innings = 15 × 94 = 1410.

=> Total runs after 16 innings = 1410 + 111 = 1521.

=> New average for 16 innings = 1521 ÷ 16 = 95.0625.

=> Increase in average = New average − Old average

=> Increase in average = 95.0625 − 94 = 1.0625.

=> Rounded to nearest whole number = 1.

Therefore The correct answer is 1.

Additional Information

Net Deviation Method

Increase in average = (New value − Old average) ÷ Total number of items including the new one.

Weighted Average

The combined average of two groups with n1 and n2 items and averages a1 and a2 is (n1a1 + n2a2) ÷ (n1 + n2).

Batting Average Formula

Batting Average = (Total runs scored) ÷ (Number of times the batsman got out/Total innings played).

Q44. Answer: (a) 3150

Shortcut Trick

Total votes = 14,000

Valid votes = 90% of 14,000 = 12,600

Candidate A got 75% of valid votes → Candidate B got 25% of valid votes

Votes for Candidate B = 12,600 × 1/4 = 3,150

Therefore The correct answer is 3150.

Alternate Method

Given:

Total votes = 14,000

Invalid percentage = 10%

Candidate A valid vote share = 75%

Calculations:

=> Total Valid Votes = 14,000 − (10% of 14,000)

=> Total Valid Votes = 14,000 − 1,400 = 12,600

=> Candidate B share % = 100% − 75% = 25%

=> Candidate B votes = 25% of 12,600

=> Candidate B votes = 12,600 ÷ 4 = 3,150

Therefore The correct answer is 3150.

Additional Information

Valid vs Invalid Votes

In election problems, winners and losers are always calculated based on Valid Votes unless stated otherwise. Valid = Total − Invalid.

Successive Percentage Method

Votes for B = Total × (Valid% / 100) × (B% / 100). Here, 14,000 × 0.90 × 0.25 = 3,150.

Voter Turnout

If 'voters who did not cast vote' is mentioned, subtract them first from the Total Registered Voters to find total votes polled.

Q45. Answer: (c) 4

Shortcut Trick

Express given values as powers of 5: 125 = 5^3 and 3125 = 5^5.

By equating the exponents, we get: x − y = 3 and x + y = 5.

Add the two equations directly: (x − y) + (x + y) = 3 + 5.

=> 2x = 8 => x = 4.

Therefore The correct answer is 4.

Alternate Method

Given:

5^((x − y)) = 125

5^((x + y)) = 3125

Concept Used:

If a^m = a^n, then m = n.

Calculations:

=> 125 = 5 × 5 × 5 = 5^3

=> 3125 = 5 × 5 × 5 × 5 × 5 = 5^5

=> 5^((x − y)) = 5^3

=> x − y = 3 ---- (1)

=> 5^((x + y)) = 5^5

=> x + y = 5 ---- (2)

=> Adding equation (1) and (2):

=> (x − y) + (x + y) = 3 + 5

=> 2x = 8

=> x = 8 ÷ 2

=> x = 4

Therefore The correct answer is 4.

Additional Information

Product Rule of Exponents

When multiplying terms with the same base, you add their exponents: a^m × aⁿ = a^(m+n)

Quotient Rule of Exponents

When dividing terms with the same base, you subtract their exponents: a^m ÷ aⁿ = a^(m−n)

Power of a Power Rule

When raising a power to another power, you multiply the exponents: (a^m)ⁿ = a^(m×n)

Zero Exponent Rule

Any non-zero base raised to the power of zero is equal to one: a^0 = 1

Q46. Answer: (b) 30

Shortcut Trick

For an angle of elevation of 45°, the horizontal distance (Base) is always equal to the perpendicular height above eye level.

Height above eye level = Distance from base = 28.7 m.

Total Height of Chimney = Height above eye level + Eye level height = 28.7 + 1.3 = 30 m.

Therefore The correct answer is 30 m.

Alternate Method

Given:

Distance from base (D) = 28.7 m

Angle of elevation (θ) = 45°

Height of observer (h) = 1.3 m

Formula Used:

tan(θ) = Perpendicular / Base

Total Height = Perpendicular + height of observer

Calculations:

=> tan(45°) = (Height of chimney − 1.3) / 28.7

=> 1 = (Height − 1.3) / 28.7

=> Height − 1.3 = 28.7

=> Height = 28.7 + 1.3

=> Height = 30 m

Therefore The correct answer is 30 m.

Additional Information

Angle of Elevation

The angle formed by the line of sight with the horizontal when looking up at an object.

Trigonometric Ratios for Standard Angles

tan 30° = 1/√3, tan 45° = 1, and tan 60° = √3 are frequently used in height and distance problems.

Observer Height Rule

If the observer has a significant height, it must be added to the calculated vertical distance from the eye level to find the total height from the ground.

Q47. Answer: (c) 25 hours

Shortcut Trick

Average speed for equal distances = 2uv ÷ (u + v)

Original Avg Speed = (2 × 8 × 6) ÷ (8 + 6) = 96 ÷ 14 = 48/7 km/hr

New Speed = (48/7) × 70% = (48/7) × 0.7 = 4.8 km/hr

Time = Distance ÷ New Speed = 120 ÷ 4.8 = 25 hr

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Therefore The correct answer is 25 hr.

Alternate Method

Given: Total Distance = 120 km, Speed1 = 8 km/hr, Speed2 = 6 km/hr, Speed Reduction = 30%

Formula: Average Speed = Total Distance ÷ Total Time

=> Time for 1^(st) half = 60 ÷ 8 = 7.5 hr

=> Time for 2^(nd) half = 60 ÷ 6 = 10 hr

=> Original Average Speed = 120 ÷ (7.5 + 10) = 120 ÷ 17.5 = 1200 ÷ 175 = 48/7 km/hr

=> Reduced overall speed = (48/7) × (100 − 30)/100 = (48/7) × 0.7 = 4.8 km/hr

=> Required Time = 120 ÷ 4.8 = 25 hr

Therefore The correct answer is 25 hr.

Additional Information

Average Speed (Equal Distances)

When a journey is divided into two equal distances with speeds u and v, the average speed is given by (2uv) / (u + v).

Percentage Speed Change

If speed decreases by x%, the new speed is (100 − x)% of the original speed. Time taken is inversely proportional to speed for a fixed distance.

General Average Speed Formula

Average Speed = (Total Distance) ÷ (Total Time taken), regardless of the number of segments or distances involved.

Q48. Answer: (a) 4%

Shortcut Trick

Using the Alligation or Weighted Average method for Income (I), Expenditure (E), and Savings (S).

Ratio of E : S = 250 : 100 = 5 : 2.

Net change in Income = [(Expenditure % change × E ratio) + (Savings % change × S ratio)] ÷ Total ratio

Net change = [(−3 × 5) + (21.5 × 2)] ÷ 7 = [−15 + 43] ÷ 7 = 28 ÷ 7 = 4%.

Therefore The correct answer is 4%.

Alternate Method

Given:

Let Savings = 100

Expenditure = 100 + 150% of 100 = 250

Income = Expenditure + Savings = 250 + 100 = 350

Calculations:

=> New Expenditure = 250 − (3% of 250) = 250 − 7.5 = 242.5

=> New Savings = 100 + (21.5% of 100) = 100 + 21.5 = 121.5

=> New Income = 242.5 + 121.5 = 364

=> Increase in Income = 364 − 350 = 14

=> % Increase = (14 ÷ 350) × 100

=> % Increase = (1 ÷ 25) × 100 = 4%

Therefore The correct answer is 4%.

Additional Information

Income Equation

The fundamental relation in financial arithmetic is Income = Expenditure + Savings.

Percentage Change in Sum

If Z = X + Y, the % change in Z is given by (ΔX + ΔY)/Z_(initial) × 100, which is the weighted average of individual changes.

Base Change Property

When a value is increased by x%, it becomes (100+x)/100 times its original value.

Q50. Answer: (b) Rs. 400

Shortcut Trick

2 Chairs + 1 Table = Rs. 350

Multiplying by 2: 4 Chairs + 2 Tables = Rs. 700

Given: 3 Chairs + 2 Tables = Rs. 600

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Difference (1 Chair) = Rs. 700 − Rs. 600 = Rs. 100

Cost of 4 Chairs = 4 × 100 = Rs. 400

Therefore The correct answer is Rs. 400.

Alternate Method

Given:

Cost of 3 chairs and 2 tables = Rs. 600

Cost of 2 chairs and 1 table = Rs. 350

Formula Used:

Linear equations in two variables: ax + by = c

Calculations:

Let the cost of one chair be C and one table be T.

=> 3C + 2T = 600 --- (i)

=> 2C + T = 350 --- (ii)

=> From (ii), T = 350 − 2C

=> Substitute T in (i): 3C + 2(350 − 2C) = 600

=> 3C + 700 − 4C = 600

=> −C = 600 − 700

=> C = 100

=> Cost of 4 chairs = 4 × 100 = 400

Therefore The correct answer is Rs. 400.

Additional Information

Elimination Method

A process of solving simultaneous equations by multiplying equations by suitable constants so that adding or subtracting them eliminates one variable.

Substitution Method

Solving for one variable in terms of the other from one equation and substituting it into the second equation.

Unitary Method

Finding the value of a single unit first (1 Chair) and then multiplying by the required number of units (4 Chairs).

Q51. Answer: (c) AY−YZ

Logic followed here is:

In each pair, the first letter of the second cluster is obtained by subtracting 1 from the first letter of the first cluster, and the second letter of the second cluster is obtained by subtracting 1 from the second letter of the first cluster.

Option (1) KI − JH

Option (2) FD − EC

Option (3) AY − YZ

Option (4) WU − VT

In options (1), (2), and (4), the pattern followed is (Cluster 1) → (-1, -1) → (Cluster 2). However, in option (3), this pattern is not followed.

Therefore, the letter-cluster pair that does not belong to the group is AY − YZ.

Hence, the correct answer is "Option 3".

Q52. Answer: (c) Only conclusion (II) follows

Statements:

All markers are pens.

All markers are sketches.

All markers are chalks.

Venn Diagram Logic:

Conclusions:

(I) All pens are chalks → Does not follows (Because only markers are common to both pens and chalks. It is not given that all pens are chalks.)

(II) Some chalks are sketches → Follows (Because all markers are chalks and all markers are sketches, therefore some chalks are definitely sketches.)

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Therefore, only conclusion (II) follows.

Hence, the correct answer is "Option 3".

Q53. Answer: (c) JMK 52

Logic followed here is: Each cluster in the series follows a specific pattern for its letters and its number. Each letter decreases by 2 in positional value, and the number increases by 4.

Therefore, the code that replaces the question mark is JMK 52.

Hence, the correct answer is "Option 3".

Q54. Answer: (b) 7

Logic followed here is:(Second digit of Highest Number) + (Second digit of Lowest Number).

The given numbers are:

515, 758, 761, 726, 579

Highest number is 761 →

The second digit of the highest number (761) is 6.

Lowest number is 515 →

The second digit of the lowest number (515) is 1.

Similarly, let's find the resultant:

Resultant = 6 + 1 = 7

Therefore, the resultant is 7.

Hence, the correct answer is "Option 2".

Q55. Answer: (d) AWO

Logic followed here is: The difference between the positional values of consecutive letters in each cluster follows a specific pattern of -5 and -7.

1) DYR:

2) VQJ:

3) UPI:

4) AWO:

The pattern observed in DYR, VQJ, and UPI is a consistent decrease of -5 and -7. However, 'AWO' follows a different pattern of -4 and -8.

Therefore, the letter-cluster that does not belong to the group is AWO.

Hence, the correct answer is "Option 4".

Q56. Answer: (d) Three

Question:

Seven friends, L, M, N, O, Q, R and S, are sitting in a straight line facing north.

→ Only three people sit to the left of M.

→ Only two people sit between M and L.

→ Only three people sit between S and N.

→ S sits to the immediate left of L.

→ O sits somewhere to the left of R but somewhere to the right of Q.

Q is at position 1.

R is at position 5.

People between them are:

→ N

→ O

→ M

Total people between Q and R = 3

Hence, the correct answer is "Option 4 — Three".

Q57. Answer: (b) Three

Given:

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

Logic followed here is: We need to find odd digits that are immediately preceded by an odd digit and immediately followed by an even digit.

Pattern: Odd Number → Odd Number → Even Number

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

The required odd digits are:

→ 9 in (5 9 2)

→ 5 in (9 5 2)

→ 5 in (1 5 2)

Therefore, there are 3 such odd digits.

Hence, the correct answer is "Option 2".

Q58. Answer: (a) 29

Logic followed here is: The series follows an alternating addition pattern where consecutive terms are obtained by adding 5 and 6 alternately.

Therefore, the number that should come in place of the question mark is 29.

Hence, the correct answer is "Option 1".

Q59. Answer: (b) 23

Signs interchange:

•	−	×	÷
↓	↓	↓	↓
−	•	÷	×

Given equation:

13 − 54 × 9 ÷ 7 + 32 = ?

After interchanging the signs:

=> 13 + 54 ÷ 9 × 7 − 32

=> 13 + 6 × 7 − 32

=> 13 + 42 − 32

=> 55 − 32

=> 23

Therefore, the value in place of the question mark is 23.

Hence, the correct answer is "Option 2".

Q60. Answer: (d) rk

Given:

‘book news leaf’ is coded as ‘rk qh aa’

‘leaf gum boat’ is coded as ‘vf rk xl’

Therefore:

→ leaf = rk

Hence, the correct answer is "Option 4".

Q61. Answer: (a) 266

Logic followed here is:

The series is formed by adding the squares of consecutive natural numbers, starting from 5^2, to the previous term to obtain the next number.

Therefore, the number that should come in place of the question mark is 266.

Hence, the correct answer is "Option 1".

Q62. Answer: (a) More than three

Given:

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

Logic followed here is: We need to find even numbers that are immediately preceded by a perfect square and immediately followed by an odd number.

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Perfect square single-digit numbers are:

→ 1

→ 4

→ 9

Pattern: Perfect Square → Even Number → Odd Number

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

The required even numbers are:

→ 8 in (9 8 5)

→ 6 in (4 6 7)

→ 8 in (4 8 3)

→ 6 in (9 6 5)

Therefore, there are 4 such even numbers.

Hence, the correct answer is "Option 1 — More than three".

Q63. Answer: (c) 2

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

Logic followed here is: We need to find even digits that are immediately preceded by an odd digit and also immediately followed by an even digit.

Pattern: Odd Number → Even Number → Even Number

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

The required even digits are:

→ 6 in (3 6 4)

→ 8 in (3 8 4)

Therefore, there are 2 such even digits.

Hence, the correct answer is "Option 3".

Q64. Answer: (c) Sister’s husband

Given:

A is					
Symbol	**•**	**•**	**×**	**%**	**#**
Meaning	mother	brother	wife	father	daughter

to B

Expression:

C % T # E + P × N

Step-by-step relation:

Family structure:

N ← husband of P

P ← daughter of E

T ← daughter of E

So, T and P are sisters.

Since P is wife of N, therefore N is husband of T’s sister.

Therefore, N is related to T as Sister’s husband.

Hence, the correct answer is "Option 3".

Q65. Answer: (a) Only conclusion (I) follows

Statements:

All geysers are fans.

No fan is a refrigerator.

Venn Diagram Logic:

Conclusions:

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(I) No geyser is a refrigerator → Follows (Because all geysers are fans and no fan is a refrigerator.)
(II) Some refrigerators are fans → Does not follows (Because it is clearly given that no fan is a refrigerator.)
Therefore, only conclusion (I) follows.
Hence, the correct answer is "Only conclusion (I) follows."

Q66. Answer: (b) 24

Given:

Letter	Symbol
A	÷
B	×
C	•
D	•

Given equation:
132 A 11 C 5 B 4 D 8
Replace the symbols:
= 132 ÷ 11 + 5 × 4 – 8
= 12 + 5 × 4 - 8
= 12 + 20 - 8
= 32 - 8
= 24
Therefore, the value in place of the question mark is 24.
Hence, the correct answer is "Option 2".

Q67. Answer: (b) (23, 12, 19)

Logic followed here is: (1st Number - 11 = 2nd Number) and (1st Number - 4 = 3rd Number).
For
(13, 2, 9) →
2nd Number = 13 - 11 = 2
3rd Number = 13 - 4 = 9
(18, 7, 14) →
2nd Number = 18 - 11 = 7
3rd Number = 18 - 4 = 14
Similarly, lOption 2) (23, 12, 19):
2nd Number = 23 - 11 = 12
3rd Number = 23 - 4 = 19
Therefore, the set (23, 12, 19) is related in the same way.
Hence, the correct answer is "Option 2".

Q68. Answer: (a) 26

Shortcut Trick
Identify the four target digits: first two (6, 3) and last two (2, 7).
Original sum of these four digits = 6 + 3 + 2 + 7 = 18.
Since 2 is added to every digit (even and odd), total increase for 4 digits = 4 × 2 = 8.
New sum = Original sum + Total increase = 18 + 8 = 26.
Therefore The correct answer is 26.
Alternate Method
Given Number: 6345127
Operation: Add 2 to each even digit and add 2 to each odd digit (effectively adding 2 to every digit).
=> New first digit: 6 + 2 = 8
=> New second digit: 3 + 2 = 5
=> New sixth digit: 2 + 2 = 4

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=> New seventh digit: 7 + 2 = 9

=> New first two digits: 8, 5

=> New last two digits: 4, 9

=> Required Sum = (8 + 5) + (4 + 9)

=> Required Sum = 13 + 13 = 26

Therefore The correct answer is 26.

Additional Information

Digit Manipulation Property

When a constant k is added to n specific digits of a number, the total sum of those digits increases by exactly n × k.

Parity Preservation

Adding an even number (like 2) to any digit preserves its parity (even remains even, odd remains odd).

Sum of Digits (Digital Root)

Changing individual digits affects the total sum of digits directly; this is often used in divisibility tests for 3 and 9.

Q69. Answer: (c) TED : XHF

Logic followed here is: +4, +3, +2 shift in the alphabetical order.

For

DSV : HVX →

LYZ : PBB →

Similarly, Option 3) TED : XHF:

Therefore, the pair 'TED : XHF' follows the same pattern.

Hence, the correct answer is "Option 3".

Q70. Answer: (d) 5 km towards north

Given:

Hanvi starts from Point L.

→ Drives 10 km towards North

→ Takes a right turn and drives 15 km

→ Takes a right turn and drives 17 km

→ Takes a right turn and drives 15 km

→ Takes a final right turn and drives 2 km to reach Point P

Final Position:

Point P is 5 km south of Point L.

So, to reach Point L again, Hanvi must travel:

→ 5 km towards North

Therefore, the shortest distance is 5 km towards north.

Hence, the correct answer is "Option 4".

Q71. Answer: (a) PLR : TOP

Logic followed here is: (Letter 1 + 4), (Letter 2 + 3), (Letter 3 - 2).

For RQF : VTD →

For SLS : WOQ →

Similarly,

Checking option (1) PLR : TOP →

Therefore, the pair 'PLR : TOP' follows the same pattern.

Hence, the correct answer is "Option 1".

Q72. Answer: (d) XDG

Logic followed here is.

Logic: Each letter in the word is shifted backward by 2 positions in the English alphabetical order to obtain the corresponding letter of the next word in the series.

Therefore, the term that should come in place of the question mark is XDG.

Hence, the correct answer is "Option 2".

Q73. Answer: (d) HLXB

Logic followed here is:

The letters in the first word are shifted backward by 7 positions in the English alphabetical order to obtain the letters of the second word.

For

LPBF is related to EIUY →

JNZD is related to CGSW →

Similarly, Option 4) OSEI:

Therefore, the word related to 'OSEI' is HLXB.

Hence, the correct answer is "Option 4".

Q74. Answer: (c) A

Given:

D sits to the immediate left of B.

C sits third to the left of B.

E is an immediate neighbour of B.

F sits to the immediate right of C.

E sits to the immediate left of A

The person sitting at the extreme right end is A.

Hence, the correct answer is "Option 3".

Q75. Answer: (b) 16th

Given:

Total people in the row = 54

Geeta sits 19^(th) from the left end.

There are 19 people between Barun and Geeta.

Step 1:

Geeta is at the 19^(th) position from the left.

If 19 people sit between Geeta and Barun, then:

Barun's position from the left = 19 + 19 + 1

→ 39

Step 2:

Now find Barun’s position from the right end.

Formula:

Position from right = Total people − Position from left + 1

→ 54 − 39 + 1

→ 16

Therefore, Barun is 16^(th) from the right end.

Hence, the correct answer is "Option 2".

Q76. Answer: (a) if

Given:

‘drink fruit juice’ is coded as ‘if tg sd’

‘bring some fruit’ is coded as ‘if td za’

Therefore, “fruit” is coded as “if”.

Hence, the correct answer is "Option 1".

Q77. Answer: (c) E

Given:

A, B, C, D, E and F are sitting around a circular table facing the centre.

→ A and D are immediate neighbours of C.

→ E is to the immediate left of D.

→ A and F are not immediate neighbours.

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From A, moving three places to the right:

A → B → F → E

Therefore, E sits third to the right of A.

Hence, the correct answer is "Option 3".

Q78. Answer: (b) 32nd

Given:

Total people in the row = 50

Rahul is 15^(th) from the left end.

Sumit sits 4^(th) to the right of Rahul.

Step 1:

Rahul's position from the left = 15

Sumit sits 4 places to the right of Rahul.

So, Sumit's position from the left:

→ 15 + 4 = 19

Step 2:

Now find Sumit's position from the right end.

Formula:

→ Position from right = Total people − Position from left + 1

→ 50 − 19 + 1

→ 32

Therefore, Sumit is 32^(nd) from the right end.

Hence, the correct answer is "Option 2".

Q79. Answer: (c) 1 km to the east

Given:

Balram starts from Point A.

→ Drives 15 km towards south

→ Takes a left turn and drives 12 km

→ Takes a left turn and drives 16 km

→ Takes a left turn and drives 13 km

→ Takes a final left turn and drives 1 km to reach Point P

Point P is 1 km west of Point A.

So, to reach Point A again, Balram must move:

→ 1 km towards east

Hence, the correct answer is "Option 3".

Q80. Answer: (d) 21

Logic followed here is: The difference between consecutive terms in the series decreases by a constant value of 3 in each step.

Therefore, the value that should come in place of the question mark (?) is 21.

Hence, the correct answer is "Option 4".

Q81. Answer: (d) Ulaanbaatar

The correct answer is Ulaanbaatar.

Key Points

• Nomadic Elephant is a specialized joint military exercise conducted annually between the Indian Army and the Mongolian Armed Forces.

• The 2025 edition of the exercise is scheduled to be held in Ulaanbaatar, which is the capital city of Mongolia. This follows the traditional rotation of venues between the two nations to foster mutual military understanding.

• The primary focus of this exercise is to enhance interoperability and synergy between the two armies while performing Counter-Terrorism and Peacekeeping operations under a United Nations mandate.

• During the exercise, troops engage in tactical-level drills, including room intervention, reflex shooting, and survival techniques in mountainous or semi-urban environments.

• The training program is designed to share best practices and combat experiences, strengthening the Strategic Partnership that

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was established between India and Mongolia in May 2015.

Additional Information

• Ulaanbaatar:

• It is the largest city and the economic, cultural, and political center of Mongolia.

• Located in north-central Mongolia, the city lies at an elevation of about 1,300 meters in the valley of the Tuul River.

• It is frequently cited as the coldest national capital in the world due to its high altitude and distance from the sea.

• Exercise History:

• The Nomadic Elephant series commenced in 2004 and has evolved into a cornerstone of bilateral defense cooperation.

• The 16th edition (2024) was held at the Foreign Training Node in Umroi, Meghalaya, showcasing the continuous commitment of both nations to defense diplomacy.

• Participating Units:

• The Indian Army is typically represented by a contingent from an infantry regiment, often the JAMMU & KASHMIR LIGHT INFANTRY or Gorkha Rifles, whereas the Mongolian Armed Forces deploy personnel from the 011 Special Forces Battalion or similar elite units.

Important Points

• Defense Diplomacy: The exercise plays a vital role in India's "Act East Policy" and its "Spiritual Neighbor" outreach to Mongolia, emphasizing regional security and Indo-Pacific stability.

• Scope of Training: Beyond combat drills, the exercise includes humanitarian assistance and disaster relief (HADR) modules, preparing both forces for non-combat emergencies.

• Bilateral Relations: India was the first country outside the Soviet bloc to establish diplomatic relations with Mongolia in 1955, and military exercises like Nomadic Elephant remain a key pillar of this long-standing 69-year-old relationship.

• Operational Environment: Training in Ulaanbaatar provides Indian troops with exposure to extreme weather conditions and rugged terrains, which is essential for global peacekeeping readiness.

Q82. Answer: (a) Joe Root

The correct answer is Joe Root.

Key Points

• As of June 2025, the England batter Joe Root became the fastest cricketer to reach the monumental milestone of 13,000 runs in Test cricket.

• Root achieved this feat during a Test match against India, surpassing previous timing and innings records set by legendary players like Sachin Tendulkar and Sir Alastair Cook.

• By reaching this landmark, Joe Root solidified his position as one of the greatest modern-day red-ball cricketers, being a prominent member of the prestigious "Fab Four" group of batsmen.

• Since making his debut in 2012 at Nagpur, Root has been a cornerstone of the England cricket team, known for his technical proficiency and ability to score across different conditions globally.

• His rapid ascent to 13,000 runs was bolstered by an extraordinary run of form between 2021 and 2024, during which he scored several double centuries and consistently maintained a high average.

Additional Information

• Jacques Kallis:

• The South African legend is widely considered the greatest all-rounder in the history of the game.

• He finished his career with 13,289 Test runs in 166 matches and also claimed 292 wickets in the longest format.

• Kallis held the record for the most Player of the Match awards in Test cricket for a significant period.

• Virat Kohli:

• A prolific Indian batter and former captain, Virat Kohli is known for his aggressive style and unmatched consistency across formats.

• As of early 2025, he remains one of the highest run-getters for India, chasing numerous milestones in Test cricket and having already crossed the 8,800-run mark.

• He led India to several historic Test series wins, most notably in Australia in 2018-19.

• Rohit Sharma:

• The current captain of the Indian cricket team, Rohit Sharma is famous for his elegant stroke-play and his record of three double centuries in ODIs.

• In Test cricket, he successfully transitioned into an opening batter in 2019, significantly improving his statistical output in the red-ball format.

Important Points

• The 13,000 Run Club: Only a handful of players in the history of cricket have reached this milestone, including Sachin Tendulkar

(15,921 runs), Ricky Ponting (13,378 runs), Jacques Kallis (13,289 runs), and Rahul Dravid (13,288 runs).

• Age Factor: Achieving this milestone in June 2025 at the age of 34 makes Joe Root one of the youngest players to reach the 13,000-run mark, giving him a realistic chance to challenge the all-time record held by Sachin Tendulkar.

• Bazball Era: The aggressive batting philosophy adopted by England under coach Brendon McCullum and captain Ben Stokes helped accelerate Root's scoring rate, contributing to him reaching the milestone faster in terms of calendar days and matches.

Q83. Answer: (b) Beat Plastic Pollution

The correct answer is Beat Plastic Pollution.

Key Points

• World Environment Day 2025 is centered around the theme "Beat Plastic Pollution" (often associated with the global effort to "End Plastic Pollution"), highlighting the urgent need for global cooperation to eliminate plastic waste. Hence, the correct answer is Beat Plastic Pollution.

• The Republic of Korea has been announced as the global host for World Environment Day on 5 June 2025. This event is particularly significant as it precedes the finalization of a legally binding international instrument on plastic pollution.

• The 2025 campaign focuses on accelerating the transition to a circular economy, where plastic is redesigned, reused, and recycled rather than discarded into the environment.

• The year 2025 marks a critical juncture for environmental policy, coinciding with the fifth session of the Intergovernmental Negotiating Committee (INC-5), which aims to develop an international treaty to end plastic pollution.

• This theme serves as a reminder that more than 400 million tonnes of plastic are produced every year, half of which is designed to be used only once, and less than 10% is recycled.

Additional Information

• History and Origin:

• World Environment Day was established by the United Nations General Assembly in 1972 during the Stockholm Conference on the Human Environment.

• The first celebration took place in 1973 with the iconic slogan "Only One Earth".

• Lead Organization:

• The United Nations Environment Programme (UNEP), headquartered in Nairobi, Kenya, is the primary agency responsible for coordinating the activities and themes of this global day.

• Recent Themes and Hosts:

• 2024: The theme was "Land restoration, desertification and drought resilience", hosted by the Kingdom of Saudi Arabia.

• 2023: The theme was also "Beat Plastic Pollution", hosted by Côte d'Ivoire in partnership with the Netherlands, emphasizing that the fight against plastic is a multi-year priority.

• Global Impact:

• It has grown to be the largest global platform for environmental public outreach, celebrated by millions of people across more than 150 countries.

• The day encourages individual and collective action to protect ecosystems and supports Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production) and SDG 14 (Life Below Water).

Important Points

• Plastic Waste Statistics: It is estimated that 19 to 23 million tonnes of plastic leak into aquatic ecosystems annually, polluting lakes, rivers, and seas.

• Microplastics: Tiny plastic particles up to 5mm in diameter, known as microplastics, find their way into food, water, and even the air, posing significant health risks to humans and wildlife.

• Legislative Action: Many countries, including India, have implemented bans on Single-Use Plastics (SUP). In India, a ban on identified single-use plastic items came into effect on 1 July 2022 to curb pollution.

• Republic of Korea's Role: By hosting the 2025 event, South Korea aims to showcase its commitment to carbon neutrality and innovative waste management systems.

Q84. Answer: (d) New Criminal Laws

The correct answer is New Criminal Laws.

Key Points

• On 8–9 November, the Ministry of Home Affairs (MHA) and the National Judicial Academy (NJA) organized a national conference in Bhopal, Madhya Pradesh, dedicated to the implementation and nuances of the New Criminal Laws.

• The conference served as a critical platform for members of the judiciary, legal experts, and administrative officials to discuss the transition from colonial-era statutes to a more modern, citizen-centric legal framework.

• The primary focus was on the three transformative acts: the Bharatiya Nyaya Sanhita (BNS), the Bharatiya Nagarik Suraksha Sanhita (BNSS), and the Bharatiya Sakshya Adhiniyam (BSA).

• Discussions highlighted the shift from a "punishment-based" system to a "justice-based" system, emphasizing the decolonization of the Indian criminal justice system.

• The event underscored the importance of technological integration, such as the mandatory videography of crime scenes and the use of digital evidence, which are core components of the new legal reforms.

Additional Information

• Bharatiya Nyaya Sanhita (BNS), 2023:

• It replaces the Indian Penal Code (IPC) of 1860.

• It introduces community service as a form of punishment for specific petty offenses and defines terrorism and organized crime for the first time within a general criminal code.

• Bharatiya Nagarik Suraksha Sanhita (BNSS), 2023:

• It replaces the Code of Criminal Procedure (CrPC) of 1973.

• It mandates strict timelines for investigations, trials, and the delivery of judgments, aiming to reduce the massive backlog of cases in Indian courts.

• Bharatiya Sakshya Adhiniyam (BSA), 2023:

• It replaces the Indian Evidence Act of 1872.

• It expands the definition of documentary evidence to include electronic or digital records, giving them the same legal standing as paper documents.

• The implementation of these laws officially began on July 1, 2024, marking a significant milestone in India's legislative history.

Important Points

• National Judicial Academy (NJA): Located in Bhopal, it is a premier institute for the training and capacity building of judges across India. Its role in this conference was to ensure the judiciary is well-equipped to interpret the new statutes correctly.

• Decolonization Objective: A major theme of the conference was removing the colonial mindset embedded in the old laws (which were drafted by the British) and replacing them with laws that reflect contemporary Indian values.

• Victim Rights: The new laws grant more rights to victims, including the right to be informed about the progress of an investigation within 90 days.

• Zero FIR: The BNSS formally institutionalizes the concept of Zero FIR, allowing any person to file a First Information Report at any police station, regardless of the jurisdiction where the crime occurred.

Q85. Answer: (b) Jawaharlal Nehru Stadium

The correct answer is Jawaharlal Nehru Stadium.

Key Points

• The Jawaharlal Nehru Stadium in Chennai was the designated venue for the Athletics selection trials conducted by the Sports Authority of India (SAI) on 1 February 2025.

• These trials are primarily conducted to identify and induct talented young sportspersons into the SAI Training Centre (STC) scheme for the academic session 2025-26.

• The Jawaharlal Nehru Stadium, also known as the JLN Stadium, is a premier multi-purpose sports facility in Tamil Nadu, featuring a high-quality 8-lane synthetic athletics track that meets international standards.

• The selection process is typically aimed at athletes in the age group of 12 to 18 years, evaluating their performance across various disciplines such as sprints, middle-distance running, jumps, and throws.

• The Sports Authority of India (SAI) utilizes such iconic venues to ensure that aspiring athletes have access to the best infrastructure and scientific testing equipment during the evaluation phase.

Additional Information

• Sports Authority of India (SAI):

• Established in 1984, SAI is the apex national sports body in India, functioning under the Ministry of Youth Affairs and Sports.

• It was created to promote sports excellence and manage the stadiums that were constructed or renovated for the 1982 Asian Games held in New Delhi.

• SAI operates several regional centers across the country, including the one overseeing sports development in Southern India.

• Jawaharlal Nehru Stadium (Chennai):

• Constructed in 1993, this stadium has a seating capacity of approximately 40,000 and is a hub for football and athletics in Chennai.

• It was built in a record time of 234 days and has hosted major events like the South Asian Games and National Inter-State Athletics Championships.

• The complex also houses an indoor stadium with a capacity of 8,000 for sports like badminton, volleyball, and basketball.

• SAI Training Centre (STC) Scheme:

• The STC Scheme aims at grooming junior athletes by providing residential and non-residential training facilities.

• Selected trainees receive benefits such as a nutritious diet, sports kit, insurance cover, and stipend to support their education and training expenses.

Important Points

• Selection Criteria: For the February 2025 trials, candidates were required to demonstrate their potential through a Battery of Tests (physical fitness tests) and specific skill-based performance in their respective athletic events.

• Documentation: Aspiring athletes attending the trials at JLN Stadium were mandated to produce original documents including Aadhar Card, Date of Birth Certificate, and Sports Achievement Certificates (State or National level) from the preceding three years.

• Collaborative Management: While the Jawaharlal Nehru Stadium is owned by the Sports Development Authority of Tamil Nadu (SDAT), it is frequently utilized by SAI for national-level talent scouting and high-performance training camps.

Q86. Answer: (c) Bharatiya Janata Party (BJP)

The correct answer is Bharatiya Janata Party (BJP).

Key Points

• The Bharatiya Janata Party (BJP) secured a significant victory in the Nagrota Assembly constituency during the bye-elections held in November 2025.

• The Nagrota seat, located in the Jammu district of the Union Territory of Jammu & Kashmir, is considered a high-profile constituency due to its strategic and political importance in the Jammu region.

• Bye-elections are conducted by the Election Commission of India (ECI) to fill a vacancy that arises before the expiration of the full term of the legislative body, often due to the death, resignation, or disqualification of the sitting representative.

• In this specific contest, the BJP candidate managed to consolidate a majority of the votes, defeating rivals from the Indian National Congress (INC) and regional parties like the People's Democratic Party (PDP).

• The victory in Nagrota further strengthened the BJP's position in the Jammu and Kashmir Legislative Assembly, reflecting the party's continued influence in the Jammu division. Hence, the correct answer is the Bharatiya Janata Party (BJP).

Additional Information

• Political Landscape of Jammu & Kashmir:

• Since the abrogation of Article 370 in August 2019, Jammu & Kashmir was reorganized into a Union Territory with a Legislative Assembly.

• The political arena is characterized by a mix of national parties like the BJP and INC, and regional parties such as the National Conference (NC) and the People's Democratic Party (PDP).

• Nagrota Constituency:

• Nagrota is a key town and a tehsil in the Jammu district. It is also home to a major Indian Army corps headquarters, making it a sensitive and prominent location.

• The constituency has historically seen intense competition between the BJP and the National Conference.

• Election Commission of India (ECI):

• The ECI is an autonomous constitutional authority responsible for administering election processes in India at the national, state, and district levels.

• Under Article 324 of the Constitution of India, the ECI has the power of superintendence, direction, and control of elections.

• Significance of Bye-elections:

• Bye-elections, or By-polls, serve as a barometer for the popularity of the ruling party and the opposition between general elections.

• They are mandated by the Representation of the People Act, 1951, which stipulates that a bye-election must be held within six months of the occurrence of the vacancy, provided the remainder of the term is not less than one year.

Important Points

• The Representation of the People Act, 1951: This act contains provisions for the conduct of elections, the qualifications and disqualifications for membership of the Houses, and the procedure for settling doubts and disputes arising out of elections.

• Voter Turnout: Bye-elections in Jammu & Kashmir often witness varying levels of voter participation, influenced by the prevailing security situation and socio-political climate of the region.

• Electoral Rolls: The update of electoral rolls is a crucial step taken by the ECI before any election to ensure all eligible citizens can exercise their franchise.

Q87. Answer: (a) Keegan Bradley

p- The correct answer is Keegan Bradley.

Key Points

• On July 8, 2024, the PGA of America officially announced the appointment of Keegan Bradley as the captain for the U.S. Team in the 2025 Ryder Cup.

• At the age of 38, Bradley is the youngest person to lead the United States team since Arnold Palmer, who served as a playing captain at the age of 34 in 1963.

• The 2025 Ryder Cup is scheduled to be held at the iconic Bethpage Black Course in Farmingdale, New York.

• Keegan Bradley is a well-known American professional golfer who won the 2011 PGA Championship in his major debut and has represented the U.S. in two previous Ryder Cups (2012 and 2014).

• His appointment marks a significant shift toward a younger generation of leadership for the U.S. Team following their defeat at the 2023 event in Italy.

Additional Information

• Selection Process: The captaincy was initially offered to Tiger Woods, a 15-time major champion. However, Woods declined the role due to his extensive responsibilities regarding the PGA Tour's ongoing negotiations with the Public Investment Fund (PIF) of Saudi Arabia and his focus on his health.

• The Ryder Cup: This is a biennial men's golf competition contested between teams from Europe and the United States. The venue alternates between courses in the USA and Europe every two years.

• Predecessor: Bradley takes over the mantle from Zach Johnson, who was the captain during the 44th Ryder Cup held at Marco Simone Golf and Country Club in 2023.

• Captain's Role: The captain is responsible for selecting vice-captains, determining the captain's picks (players who do not qualify automatically via points), and deciding the daily player pairings during the tournament.

• Playing Captain Potential: Given his current form on the PGA Tour, there is speculation that Keegan Bradley could become a playing captain if he manages to qualify for the team through his ranking or self-selection, a feat not seen in the Ryder Cup since Arnold Palmer in 1963.

Important Points

• Keegan Bradley's Career: Born in 1986 in Woodstock, Vermont, Bradley has secured six PGA Tour victories as of 2024. He was the PGA Tour Rookie of the Year in 2011.

• Bethpage Black: This venue is famous for its difficulty and the passionate New York crowd. It previously hosted the U.S. Open in 2002 and 2009, as well as the PGA Championship in 2019.

• Historical Context: Since 1963, most U.S. captains have been in their late 40s or 50s. Bradley's youth is intended to bring fresh energy and a closer connection to the current active players on the Tour.

• Match Play Format: The Ryder Cup consists of 28 matches played over three days, utilizing foursomes (alternate shot), fourballs (best ball), and singles formats.

Q88. Answer: (c) Reserve Bank of India

The correct answer is Reserve Bank of India.

Key Points

• The Reserve Bank of India (RBI), as the primary regulator of the Indian financial system, granted in-principle approval to global payment leaders PayPal and Worldline to operate as Cross-Border Payment Aggregators (PA-CB) in May 2025.

• This approval allows these entities to facilitate cross-border transactions for import and export of goods and services, bringing them under the direct regulatory purview of the central bank.

• The PA-CB license is a specialized category introduced by the RBI to regulate intermediaries that handle online international payments, ensuring better transparency and security in foreign exchange flows. Hence, the correct answer is Reserve Bank of India.

• By obtaining this in-principle approval, PayPal and Worldline can now move toward full authorization, provided they meet the compliance and net worth criteria specified by the RBI.

• The move is part of the RBI's broader framework, originally released in October 2023, aimed at bringing all cross-border payment intermediaries under a formal regulatory structure to prevent money laundering and ensure consumer protection.

Additional Information

• Payment Aggregator-Cross Border (PA-CB):

• There are three categories of PA-CB licenses: Export-only (PA-CB-E), Import-only (PA-CB-I), and Combined (PA-CB-E&I).

• Entities applying for this license must maintain a minimum net worth of INR 15 crore at the time of application, which must be increased to INR 25 crore by a specified deadline (usually within March 2026 for existing entities).

• This framework applies to all non-bank entities providing PA-CB services, including those facilitating e-commerce transactions for Indian merchants selling abroad or Indian customers buying from foreign merchants.

• Regulatory Framework:

• The Reserve Bank of India exercises its power under Section 18 read with Section 10(2) of the Payment and Settlement Systems Act, 2007 to regulate these aggregators.

• Before this framework, many fintech companies operated in a regulatory "grey area" regarding cross-border settlements; the new guidelines mandate KYC (Know Your Customer) compliance for all parties involved.

• Other Options:

• State Bank of India (SBI) and Indian Bank are Public Sector Banks (PSBs). While they facilitate payments, they do not grant regulatory approvals to other fintech companies; they are themselves regulated by the RBI.

• Bandhan Bank is a Private Sector Bank that primarily focuses on micro-banking and general retail banking services and lacks the authority to issue payment aggregator licenses.

Important Points

• Impact on Fintech: The inclusion of PayPal and Worldline in the PA-CB ecosystem strengthens India's position in the global digital economy and provides MSMEs (Micro, Small, and Medium Enterprises) with more secure channels for international trade.

• Compliance Norms: Authorized PA-CBs are required to maintain Escrow accounts with scheduled commercial banks in India for their operations to ensure that funds belonging to merchants and customers are protected.

• Date and Context: While the regulatory circular was issued in late 2023, the RBI processed multiple applications throughout 2024 and 2025, granting approvals in phases to ensure companies met the rigorous data localization and security standards of India.

Q89. Answer: (d) Amity University - Mohali and Institute of Microbial Technology - Chandigarh

The correct answer is Amity University - Mohali and Institute of Microbial Technology - Chandigarh.

Key Points

• In January 2025, a team of researchers from Amity University, Mohali and the Council of Scientific & Industrial Research - Institute of Microbial Technology (CSIR-IMTECH), Chandigarh, announced the discovery of a novel prion.

• The newly identified prion has been named SNG2, an acronym for Supersaturating Non-Amyloidogenic Globular 2.

• This discovery is a landmark in the field of molecular biology as it identifies a prion that behaves differently from traditional disease-causing proteins.

• The SNG2 prion was discovered in the yeast species Saccharomyces cerevisiae, which is a common model organism used for studying cellular processes.

• Unlike pathological prions that form toxic amyloid fibrils, SNG2 forms globular structures that are non-amyloidogenic, meaning they do not aggregate into the stiff fibers typical of neurodegenerative diseases.

• The researchers found that SNG2 acts as a functional switch, helping the organism survive and adapt under environmental stress, such as nutrient deprivation or temperature changes.

Additional Information

• Prions and Proteostasis:

• Prions are misfolded proteins that can induce normal versions of the same protein to also misfold. This chain reaction usually leads to protein aggregation.

• In humans, prions are notorious for causing fatal conditions like Creutzfeldt-Jakob Disease (CJD) and Kuru, as well as Mad Cow Disease in cattle.

• Functional Prions:

• While many prions are harmful, "functional prions" are those that provide a biological benefit. SNG2 is a prime example of a functional prion that assists in cellular memory and stress response.

• This discovery suggests that protein-based epigenetic inheritance is more diverse and common than previously understood.

• The Role of SNG2:

• The SNG2 protein remains in a supersaturated state within the cell until triggered by stress.

• Its non-amyloidogenic nature is crucial because it allows the cell to utilize the protein's aggregated form without suffering the cellular toxicity that usually leads to cell death in amyloid-related diseases.

• Institutions Involved:

• Amity University, Mohali is a leading private research university in Punjab, known for its focus on biotechnology.

• CSIR-IMTECH, located in Chandigarh, is a premier national laboratory under the Ministry of Science and Technology, specializing in microbial engineering and protein science.

Important Points

• The discovery of SNG2 in 2025 provides new insights into how proteins can store information and help organisms adapt to their surroundings without changing their DNA.

• The study utilized advanced biophysical techniques and fluorescence microscopy to observe the transition of the protein into its globular prion state.

• Understanding the mechanism of non-amyloidogenic prions like SNG2 could eventually lead to new therapeutic strategies for human diseases like Alzheimer’s and Parkinson’s, by teaching scientists how to prevent proteins from forming toxic amyloid clumps.

• This research underscores the importance of inter-institutional collaboration in India for achieving breakthroughs in fundamental biological sciences.

Q90. Answer: (a) Minister of Environment

The correct answer is Minister of Environment.

Key Points

• The Standing Committee of the National Board for Wildlife (SC-NBWL) is a high-level statutory body chaired by the Union Minister of Environment, Forest and Climate Change. While the full National Board for Wildlife (NBWL) is chaired by the Prime Minister, the Standing Committee handles the routine and technical approvals for projects.

• In recent deliberations aimed for completion by mid-2025, the Minister of Environment has overseen the recommendation to revise the traditional blanket 10-km Eco-Sensitive Zone (ESZ) guidelines.

• The 10-km radius guideline was originally part of the Wildlife Conservation Strategy adopted in 2002, which suggested that lands within 10 kilometres of the boundaries of National Parks and Wildlife Sanctuaries should be notified as eco-fragile zones.

• The proposed revision led by the Minister of Environment aims to make these zones more site-specific rather than adhering to a uniform distance, acknowledging that geographical and biological requirements vary across different Protected Areas in India.

• The SC-NBWL plays a critical role under the Wild Life (Protection) Act, 1972, as it is the body that examines the impact of developmental activities on wildlife habitats before granting clearances. Hence, the correct answer is the Minister of Environment.

Additional Information

• Eco-Sensitive Zones (ESZ):

• These zones are notified by the Ministry of Environment, Forest and Climate Change (MoEFCC) under the Environment (Protection) Act, 1986.

• The primary function of an ESZ is to act as a "shock absorber" for Protected Areas by regulating activities around them to minimize negative impacts on the ecosystem.

• Activities in these zones are classified into three categories: Prohibited (e.g., commercial mining, sawmills), Regulated (e.g., felling of trees, hotels/resorts), and Permitted (e.g., ongoing agricultural practices, rainwater harvesting).

• Legal Precedents:

• In June 2022, the Supreme Court of India directed that every National Park and Wildlife Sanctuary in the country must have a mandatory ESZ of at least 1 kilometre.

• However, in April 2023, the Supreme Court modified this judgement, clarifying that the 1-km rule would not be applicable where a specific ESZ notification had already been issued or where the Protected Area was located along interstate boundaries.

• National Board for Wildlife (NBWL):

• It is a statutory organization constituted under Section 5A of the Wild Life (Protection) Act, 1972.

• It serves as an apex body to review all wildlife-related matters and approve projects in and around National Parks and Wildlife Sanctuaries.

• The NBWL consists of 47 members, including the Prime Minister as Chairperson and the Minister of Environment as the Vice-Chairperson.

Important Points

• Role of the Standing Committee: The SC-NBWL consists of the Minister of Environment, the Member Secretary, and other members nominated by the Vice-Chairperson. It exercises the powers delegated to it by the full board, making it the most active regulatory body for wildlife clearances in India.

• Revision Rationale: The move to revise the 10-km blanket guideline is intended to address the administrative and socio-economic challenges faced by local communities living near Protected Areas while ensuring that conservation is not compromised.

• Timeline: The target date of mid-2025 reflects the government's policy cycle to streamline environmental clearances and update aging conservation frameworks to align with modern data and ecological mapping.

• Jurisdiction: No alteration of the boundaries of a National Park or a Wildlife Sanctuary can be made except on a recommendation of the National Board for Wildlife, highlighting the legal authority of the committee chaired by the Minister of Environment.

Q91. Answer: (d) Second place

The correct answer is Second place.

Key Points

• In the year 2025, India’s premier javelin thrower Neeraj Chopra participated in the prestigious Janusz Kusociński Memorial and achieved the Second place on the podium.

• The competition was held at the Silesian Stadium located in Chorzów, Poland, which is a renowned venue for international track and field events.

• The Janusz Kusociński Memorial is a top-tier athletics meeting categorized under the World Athletics Continental Tour Gold, attracting the highest caliber of global athletes.

• Neeraj Chopra, representing India, competed against a world-class field of throwers to secure his rank, further cementing his reputation for consistency in the Javelin Throw discipline.

• This achievement in 2025 serves as a vital part of his preparation for the major athletic cycles, maintaining his World Ranking among the top three javelin throwers globally.

Additional Information

• Neeraj Chopra's Career Profile:

• Born in 1997 in Khandra, Haryana, Neeraj Chopra is an Indian Army officer (Subedar) and the first Indian to win an Olympic Gold medal in athletics during the Tokyo 2020 Olympics.

• He holds a National Record of 89.94 meters, set at the Stockholm Diamond League in 2022.

• His trophy cabinet includes Gold medals from the World Championships (2023), Asian Games (2018, 2022), and Commonwealth Games (2018).

• Janusz Kusociński Memorial History:

• This event was established in 1954 to honor the memory of the legendary Polish athlete Janusz Kusociński.

• Janusz Kusociński was the Olympic champion in the 10,000m run at the 1932 Los Angeles Games and a hero of the Polish resistance during World War II.

• The meet is one of the oldest in Europe and has been the site of numerous world records over the decades, particularly in throwing and jumping events.

• Significance of the Venue:

• The Silesian Stadium (Stadion Śląski) in Poland has a seating capacity of over 54,000 and is a specialized venue for Diamond League and Continental Tour meetings.

• The stadium is often referred to as the "Witch's Cauldron" due to its intense atmosphere during international sports competitions.

Important Points

• Technical Aspects of Javelin:

• The men's javelin used in professional competitions like the 2025 Memorial weighs exactly 800 grams and measures between 2.6 and 2.7 meters in length.

• Success in this sport depends on the velocity of the run-up, the angle of release (typically around 32 to 36 degrees), and the aerodynamic stability of the spear.

• Global Competition Context:

• In the 2025 season, Neeraj Chopra continued his rivalry with top athletes such as Jakub Vadlejch of the Czech Republic and Anderson Peters of Grenada.

• Securing the Second place in Poland earned him significant points in the World Athletics Ranking system, which determines qualification for seasonal finales like the Diamond League Final.

• The consistency shown by Chopra is a testament to his training under experts like Dr. Klaus Bartonietz, focusing on biomechanics and injury prevention.

Q92. Answer: (d) Integrated Air Drop Test (IADT-01)

The correct answer is Integrated Air Drop Test (IADT-01).

Key Points

• The Integrated Air Drop Test (IADT-01), conducted in August 2025, represented a critical milestone for ISRO (Indian Space Research Organisation) by demonstrating the full parachute-based deceleration system for the Gaganyaan crew module.

• This test involved the use of a Crew Module (CM) mockup, which was dropped from an altitude of approximately 5 kilometers using an Indian Air Force C-130J transport aircraft.

• The primary objective of IADT-01 was to validate the complex sequence of ten parachutes that are essential for slowing down the crew module from high-speed atmospheric re-entry to a safe touchdown speed.

• During the test, the sequence began with the deployment of Apex Cover Separation parachutes, followed by Drogue parachutes to stabilize the module, and finally the Main parachutes to ensure a soft landing. Hence, the correct answer is Integrated Air Drop Test (IADT-01).

Additional Information

• Gaganyaan Mission Overview:

• The Gaganyaan project aims to demonstrate India's human spaceflight capability by launching a crew of three members to an orbit of 400 km for a 3-day mission and bringing them back safely to Earth.

• The mission utilizes the LVM3 (Launch Vehicle Mark-3), which is ISRO's heaviest and most reliable rocket, re-configured to meet human-rating requirements.

• The spacecraft consists of two main parts: the Crew Module (CM), where the astronauts reside, and the Service Module (SM), which contains the propulsion and power systems.

• Parachute System Details:

• The deceleration system is incredibly complex, featuring 2 ACS (Apex Cover Separation) parachutes, 2 Pilot parachutes, 2

Drogue parachutes, and 3 Main parachutes.

• The Main parachutes are designed to reduce the landing velocity to less than 8.5 meters per second, ensuring the safety of the astronauts during a splashdown in the Indian Ocean.

• The Aerial Delivery Research and Development Establishment (ADRDE), a lab under DRDO, played a vital role in designing and developing these specialized parachutes.

Important Points

• Other Related Tests:

• Pad Abort Test (PAT): This test evaluates the Crew Escape System (CES)'s ability to quickly move the crew module away from the launch vehicle in case of an emergency while still on the launch pad.

• Test Vehicle Abort Mission (TV-D1): Conducted prior to IADT, this involved a high-altitude abort demonstration to check the escape system's performance during transonic flight conditions.

• Crew Module Landing Test (CMLT): Focuses specifically on the impact dynamics and flotation systems of the module after it hits the water surface.

• Significance of the 2025 Timeline:

• By August 2025, ISRO successfully completed several uncrewed flight tests to qualify all systems before the first crewed mission, which marks India as the fourth nation to independently send humans into space after the USA, Russia, and China.

Q93. Answer: (c) 90-100 km/h

p data-end="57" data-start="0">The correct answer is 90-100 km/h.

Key Points

• Cyclone Montha was a tropical cyclone that developed in the North Indian Ocean basin, specifically in the Bay of Bengal, during October 2025.

• The India Meteorological Department (IMD) issued bulletins forecasting that the system would maintain a maximum sustained wind speed in the range of 90-100 km/h just before making landfall.

• With wind speeds reaching 90-100 km/h, the system was classified as a Severe Cyclonic Storm. This category typically involves wind speeds between 89 km/h and 117 km/h. Hence, the statement regarding the 90-100 km/h range is correct.

• The forecast also indicated gusting speeds reaching up to 110 km/h, which posed a significant threat to temporary structures and agricultural crops in the coastal districts.

• The landfall was projected to impact the eastern coast of India, specifically affecting the states of Odisha and West Bengal, leading to the mobilization of NDRF (National Disaster Response Force) teams.

Additional Information

• Classification of Cyclones:

• The IMD classifies cyclonic disturbances based on their maximum sustained surface wind speed (MSW). A Cyclonic Storm has speeds of 62-88 km/h, while a Severe Cyclonic Storm ranges from 89-117 km/h.

• If the winds exceed 118-165 km/h, it is termed a Very Severe Cyclonic Storm, and anything above 221 km/h is a Super Cyclonic Storm.

• Sustained Wind Speed:

• In the context of Indian meteorology, sustained wind speed is usually measured as a 3-minute average or a 10-minute average at a height of 10 meters.

• This metric is crucial for determining the potential damage to infrastructure and the height of the storm surge expected during landfall.

• Cyclone Naming:

• The name Montha was contributed by Myanmar as part of the naming protocol established by the WMO/ESCAP Panel on Tropical Cyclones.

• Naming helps in disaster risk communication and avoids confusion when multiple systems are active simultaneously in the same geographical region.

• Impact and Mitigation:

• A wind range of 90-100 km/h is strong enough to cause the uprooting of trees, damage to power lines, and significant storm surges of about 0.5 to 1.0 meter above the astronomical tide.

• The Integrated Cyclone Adventure System and satellite imagery (such as INSAT-3DR) are used to track the latitude and longitude of the eye of the storm.

Important Points

• Historical Context: October and November are considered the peak post-monsoon cyclone season for the Bay of Bengal due to high sea surface temperatures.

• Landfall Characteristics: The landfall process involves the center of the cyclone eye moving over the coast, where the highest wind pressure is often felt in the right forward quadrant of the storm.

• Warning Protocols: The IMD uses a four-stage warning system: Pre-Cyclone Watch, Cyclone Alert (Yellow), Cyclone Warning (Orange), and Post-Landfall Outlook (Red).

Q94. Answer: (c) Bibek Debroy

The correct answer is Bibek Debroy.

Key Points

• Bibek Debroy was posthumously awarded the Padma Vibhushan, India's second-highest civilian honor, in January 2025.

• He was a distinguished Indian economist, scholar, and author who significantly influenced India's economic policy and academic landscape.

• He served as the Chairman of the Economic Advisory Council to the Prime Minister (EAC-PM) until his passing in late 2024.

• The award was conferred in the field of Literature and Education, reflecting his vast contributions to scholarship beyond just Economics. Hence, the correct answer is Bibek Debroy.

• He was also a former Member of NITI Aayog, where he played a crucial role in shaping developmental strategies for the Government of India.

Additional Information

• Academic and Professional Career:

• Born on January 25, 1955, he was educated at Ramakrishna Mission School, Presidency College (Kolkata), Delhi School of Economics, and Trinity College (Cambridge).

• He worked with various prestigious institutions, including the Indian Institute of Foreign Trade (IIFT) and the Legal Reforms Project of the Ministry of Finance.

• He was also the Director of the Rajiv Gandhi Institute for Contemporary Studies and a Professor at the Centre for Policy Research (CPR).

• Contributions to Literature:

• He is widely acclaimed for his unabridged English translation of the Mahabharata in 10 volumes.

• His scholarly work includes translations of the Bhagavad Gita, the Ramayana, and several Puranas, making ancient Indian texts accessible to a global audience.

• He authored and edited numerous books on Economics, Governance, and Indian heritage throughout his career.

• Economic Reforms:

• He chaired the Debroy Committee (High-level Committee for Reorganization of the Railway Board) in 2015, which recommended structural changes in Indian Railways.

• His work often focused on legal reforms, infrastructure, and poverty estimation in the Indian context.

Important Points

• Padma Awards 2025:

• The Padma Awards are announced annually on the eve of Republic Day (January 25).

• In 2025, the list included several posthumous awardees, highlighting the enduring impact of their work.

• The Padma Vibhushan is awarded for "exceptional and distinguished service" and is only preceded by the Bharat Ratna.

• Other Options Context:

• Jagdish Bhagwati: A world-renowned Indian-American economist known for his work on international trade, though he was not the recipient of the Padma Vibhushan in 2025.

• Arvind Subramanian: Former Chief Economic Adviser to the Government of India (2014-2018), recognized for his insights into the Indian economy.

• Jean Drèze: A prominent development economist known for his work on famine, hunger, and the MNREGA in India.

• Legacy: Bibek Debroy passed away on November 1, 2024, at the All India Institute of Medical Sciences (AIIMS), New Delhi, at the age of 69.

Q95. Answer: (a) 21.76%

The correct answer is 21.76%.

Key Points

The Sustainable Development Goals – National Indicator Framework (NIF) Progress Report, 2025 was released by the Ministry of Statistics and Programme Implementation (MoSPI), Government of India.

According to the report, the forest cover in India as a percentage of its total geographical area for the year 2023 was recorded as 21.76%.

This indicator is part of the monitoring mechanism for SDG Goal 15, which focuses on "Life on Land" and aims to protect, restore, and promote the sustainable use of terrestrial ecosystems.

The data utilized in the NIF Progress Report is primarily derived from the assessments conducted by the Forest Survey of India

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(FSI) and is mapped to the progress of the United Nations' 2030 Agenda.

Maintaining and increasing the forest cover is essential for biodiversity conservation, carbon sequestration, and ensuring ecological balance in the country.

Additional Information

India State of Forest Report (ISFR):

The Forest Survey of India (FSI), an organization under the Ministry of Environment, Forest and Climate Change (MoEFCC), publishes this biennial report.

The ISFR 2021 assessment (the 17th cycle) reported the total forest cover of India to be 7,13,789 sq km.

This figure represented 21.71% of the total geographical area of India (3,287,469 sq km). The 21.76% figure in the 2025 Progress Report reflects the updated indicators within the National Indicator Framework.

Classification of Forest Cover:

Forest cover is classified into three categories based on canopy density: Very Dense Forest (density > 70%), Moderately Dense Forest (density 40%–70%), and Open Forest (density 10%–40%).

Any land with a tree canopy density of more than 10% and an area of more than 1 hectare is considered forest cover, regardless of land ownership or legal status.

State-wise Data:

Madhya Pradesh has the largest forest cover in terms of area in the country.

In terms of percentage of geographical area, Mizoram ranks highest at approximately 84.53%, followed by Arunachal Pradesh.

Sustainable Development Goal 15 (SDG 15):

This goal targets the sustainable management of forests, combating desertification, and halting land degradation and biodiversity loss.

India's National Indicator Framework tracks 12 indicators specifically under SDG 15 to monitor domestic progress.

Important Points

National Forest Policy, 1988: The government aims to bring 33% of the total geographical area under forest and tree cover to ensure environmental stability and ecological security.

Tree Cover: Unlike forest cover, tree cover refers to isolated or small patches of trees (less than 1 hectare) found outside the recorded forest area. When combined, the Total Forest and Tree Cover in India is approximately 24.62% of the total area.

Carbon Stock: The total carbon stock in the country's forests is estimated to be around 7,204 million tonnes, showing an increase compared to previous assessments, which is a key metric for climate change mitigation.

NIF Progress Report 2025: This report serves as a critical document for policymakers to understand the gap between current achievements and the 2030 targets set by the United Nations.

Q96. Answer: (c) February 2025

The correct answer is February 2025.

Key Points

• The Reserve Bank of India (RBI), in its Monetary Policy Committee (MPC) meeting held in February 2025, announced a reduction in the policy repo rate by 25 basis points (bps).

• This policy move brought the repo rate down to 6.25% from the previous level of 6.50%, which had been maintained since February 2023.

• This was the first repo rate cut implemented by the central bank since May 2020, when the rate was slashed to support the economy during the COVID-19 pandemic.

• Along with the rate cut, the MPC also shifted the monetary policy stance from 'withdrawal of accommodation' to 'neutral', providing more flexibility for future actions based on economic data.

• The decision was primarily driven by a visible moderation in inflation and the need to support economic growth as domestic demand showed signs of stabilizing.

Additional Information

• Repo Rate: The Repurchase Rate is the interest rate at which the Reserve Bank of India lends money to commercial banks in the event of any shortfall of funds. It is a vital tool used by the RBI to control the money supply and inflation in the Indian economy.

• Monetary Policy Committee (MPC): It is a six-member committee constituted by the Central Government under Section 45ZB of the amended RBI Act, 1934. The committee is chaired by the Governor of the RBI, currently Shaktikanta Das.

• Inflation Targeting: The RBI follows a flexible inflation targeting framework with a target for Consumer Price Index (CPI) inflation at 4%, with a tolerance band of +/- 2% (i.e., within the range of 2% to 6%).

• Standing Deposit Facility (SDF) and Marginal Standing Facility (MSF): Following the February 2025 cut, the SDF rate was adjusted to 6.00% and the MSF rate (along with the Bank Rate) was adjusted to 6.50% to maintain the policy corridor.

Important Points

• Historical Context: In May 2020, the repo rate was reduced to a record low of 4.00%. To combat rising inflation post-pandemic, the RBI increased the rate by a cumulative 250 basis points between May 2022 and February 2023.

• Impact of the Cut: A reduction in the repo rate typically leads to a decrease in borrowing costs for consumers and businesses, potentially lowering interest rates on home loans, car loans, and business credits.

• Economic Growth: The RBI projected Real GDP growth for the Financial Year 2025-26 to remain robust, citing that the February 2025 rate cut would provide the necessary stimulus to sustain investment and consumption.

Q97. Answer: (b) National Human Rights Commission

The correct answer is National Human Rights Commission.

Key Points

• In June 2025, the National Human Rights Commission (NHRC) convened a significant national symposium specifically addressing the safety and security of women in public and semi-public spaces across India.

• The commission strongly advocated for the institutionalization of safety audits, which are systematic evaluations of the physical and social environment of urban spaces to identify factors that contribute to a lack of safety for women.

• The NHRC highlighted that these audits should focus on infrastructure gaps such as poor street lighting, lack of CCTV coverage, and inadequate public transport facilities that hinder women's mobility. Hence, the correct answer is the National Human Rights Commission.

• The body emphasized that urban local bodies (ULBs) and police departments must collaborate with civil society organizations to conduct these audits periodically to ensure gender-responsive urban planning.

• During the symposium, the NHRC also pointed out the necessity of technological integration, such as mobile-based panic buttons and real-time tracking systems, as a follow-up to the findings of the safety audits.

Additional Information

• National Human Rights Commission (NHRC):

• It is a Statutory public body established on 12 October 1993 under the Protection of Human Rights Act (PHRA), 1993.

• The commission is headquartered in New Delhi and serves as the watchdog of human rights in the country, relating to life, liberty, equality, and dignity of the individual as guaranteed by the Constitution of India.

• The Chairperson and members are appointed by the President of India on the recommendations of a high-powered committee headed by the Prime Minister.

• Safety Audits and Urban Design:

• A safety audit is a participatory tool developed originally in Canada in the 1980s to involve women in the assessment of their own safety in the urban environment.

• In India, various NGOs like Jagori and Safetipin have pioneered the use of safety audits to map safety scores for different areas in cities like Delhi, Mumbai, and Bengaluru.

• Key parameters of these audits include lighting, openness, visibility, crowd, security, and walkpath availability.

• Safe City Project:

• The Ministry of Home Affairs has implemented the Safe City Project under the Nirbhaya Fund in 8 major cities: Ahmedabad, Bengaluru, Chennai, Delhi, Hyderabad, Kolkata, Lucknow, and Mumbai.

• This project aligns with the NHRC's recommendations by focusing on smart policing, emergency response systems, and gender-sensitization of the police force.

• It also aims at improving forensic facilities and establishing One Stop Centres (OSC) for women in distress.

Important Points

• Article 21 of the Indian Constitution guarantees the Right to Life and Personal Liberty, which the NHRC interprets to include the right to move freely and safely in public spaces without fear of gender-based violence.

• The United Nations Sustainable Development Goal (SDG) 11 specifically targets making cities and human settlements inclusive, safe, resilient, and sustainable, with a focus on providing universal access to safe, inclusive, and accessible green and public spaces, especially for women.

• Section 12 of the PHRA, 1993, empowers the NHRC to review the factors that inhibit the enjoyment of human rights and recommend appropriate remedial measures to the government.

Q98. Answer: (b) Indian thought from Rigveda onward

The correct answer is Indian thought from Rigveda onward.

Key Points

• Echoes of Eternity is a significant literary work authored by Pavan K Varma, a renowned diplomat and writer, published in May 2025.

• The book serves as an extensive exploration of Indian thought, beginning with the Rigveda, which is considered the oldest of the four Vedas and a foundational text of Indian philosophy.

• The narrative traces the evolution of philosophical concepts over thousands of years, examining how ancient wisdom remains relevant in the 21st century.

• The work focuses on the spiritual and metaphysical foundations of India, touching upon themes such as Sanatana Dharma, the nature of consciousness, and the continuity of the Indian civilization.

• Through this book, Pavan K Varma aims to make complex intellectual traditions accessible to a modern audience, bridging the gap between ancient texts and contemporary societal values.

Additional Information

• Author Profile: Pavan K Varma is a former officer of the Indian Foreign Service (IFS) and has served as the Ambassador of India to several countries, including Bhutan and Cyprus. He has also been a member of the Rajya Sabha.

• Literary Contributions: He is well-known for his insightful books on Indian culture and history, such as The Great Hindu Civilisation, Being Indian, and The Great Indian Middle Class.

• Significance of the Rigveda: The Rigveda consists of 1,028 hymns organized into 10 Mandalas. It represents the earliest recorded form of Indo-Aryan thought and contains the Gayatri Mantra, which is central to Hindu tradition.

• Context of the Book: Echoes of Eternity emphasizes that Indian thought is not a static relic of the past but a living, breathing intellectual heritage that continues to influence global spirituality and ethics.

• Theme of Continuity: The book highlights the resilient nature of Indian philosophical inquiry, which has survived centuries of foreign invasions and colonial rule to remain a vital part of the nation's identity.

Important Points

• The book is released at a time when there is a growing global interest in Indic knowledge systems and Vedic philosophy.

• Pavan K Varma frequently utilizes his diplomatic background to provide a comparative perspective on how Indian thought differs from and complements Western philosophical traditions.

• The publication of Echoes of Eternity in 2025 marks another milestone in the author's career as a public intellectual and cultural commentator.

• Major themes in the book also include the concept of Dharma, the cycle of Samsara, and the pursuit of Moksha, which are core to the Upanishadic and Vedic eras.

Q99. Answer: (b) Armand Duplantis

The correct answer is Armand Duplantis.

Key Points

• The Swedish pole vaulter Armand "Mondo" Duplantis set a new world record by clearing a height of 6.28 m.

• This record-breaking performance occurred during the Wanda Diamond League meeting held in Stockholm, Sweden, in June 2025.

• By clearing 6.28 m, Duplantis once again improved upon his own previous global mark, cementing his status as the greatest pole vaulter in history.

• The event, known as the Bauhaus-Galan, saw Duplantis compete in front of a home crowd at the historic Stockholm Olympic Stadium.

• The 6.28 m clearance was achieved on his first attempt (or as specified in the meet details), demonstrating his unmatched consistency at extreme heights. Hence, the correct answer is Armand Duplantis.

Additional Information

• Armand Duplantis:

• Born on November 10, 1999, in Lafayette, Louisiana, USA, he holds dual citizenship but represents Sweden in international competitions.

• He won the Gold Medal at the Tokyo 2020 Olympics and the Paris 2024 Olympics, establishing a legacy of dominance.

• He was awarded the World Athlete of the Year title multiple times by World Athletics.

• Renaud Lavillenie:

• A French pole vaulter who held the world record of 6.16 m from 2014 to 2020.

• He won the Olympic Gold at the 2012 London Games and remains one of the most decorated athletes in the sport's history.

• Sam Kendricks:

• An American pole vaulter and a two-time World Champion (2017 and 2019).

• He is known for his consistent podium finishes and for winning the Bronze Medal at the 2016 Rio Olympics.

• Thiago Braz:

• A Brazilian athlete who rose to fame by winning the Olympic Gold Medal at the 2016 Rio Olympics with a then-Olympic record of 6.03 m.

• He also secured a Bronze Medal at the Tokyo 2020 Olympics.

Important Points

• Wanda Diamond League: This is an annual series of elite track and field athletic competitions, comprising 15 of the best invitational athletics meetings in the world. It was established in 2010 to replace the IAAF Golden League.

• World Athletics: The international governing body for the sport of athletics, which officially ratifies world records such as the 6.28 m mark set by Duplantis.

• Pole Vault Dynamics: The sport involves using a flexible pole made of carbon fiber or fiberglass. World records can be set both indoors and outdoors, and since 2000, World Athletics rules do not distinguish between the two for the overall world record.

Q100. Answer: (b) 20%

The correct answer is 20%.

Key Points

• The Uttar Pradesh government, under the leadership of Chief Minister Yogi Adityanath, launched the fifth phase of its flagship women empowerment initiative, Mission Shakti 5.0, in September 2025.

• Under this new policy phase, the state government has officially mandated 20% participation of women in police recruitment to bolster the presence of female personnel in the UP Police force.

• The primary objective of this mandate is to ensure that more women are represented in law enforcement, which in turn facilitates a more supportive environment for women reporting crimes and seeking justice.

• This reservation is a strategic move to promote gender diversity and empower women to take active roles in the state's security apparatus.

• The policy aligns with the broader goals of Mission Shakti, which focuses on providing security, dignity, and self-reliance to the women of Uttar Pradesh.

Additional Information

• Evolution of Mission Shakti:

• The mission was originally launched in October 2020 following the need for a comprehensive campaign to address issues related to women's safety and empowerment in the state.

• It operates on three core pillars: Suraksha (Safety), Samman (Respect), and Swavlamban (Self-reliance).

• Infrastructure and Outreach:

• Under previous phases of the mission, Women Help Desks were established in all 1,585 police stations across Uttar Pradesh.

• The government also introduced Pink Booths and deployed Mahila Beat Officers to reach women at the grassroots level in both rural and urban areas.

• Holistic Empowerment:

• Apart from police recruitment, Mission Shakti 5.0 emphasizes social security schemes such as the Mukhya Mantri Kanya Sumangala Yojana, which provides financial assistance to girl children.

• The mission also integrates with national programs like Beti Bachao Beti Padhao to improve the sex ratio and educational outcomes for girls in the state.

• Administrative Monitoring:

• The progress of the mission is monitored at the highest levels of the Home Department and the Department of Women and Child Development to ensure effective implementation of the 20% recruitment quota and other safety protocols.

Important Points

• Impact on Law Enforcement: Increasing women's participation to 20% is expected to improve the handling of cases related to domestic violence, sexual harassment, and child protection.

• Date of Launch: September 2025 marks the transition to Phase 5.0, showing the long-term commitment of the state government toward women-centric governance.

• Nodal Agencies: Various departments, including Education, Health, and Rural Development, collaborate under the Mission Shakti umbrella to provide vocational training and legal awareness to women.

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