# RRB Group D Official Paper (Held On: 11 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.** What happens if one drop of acid rain water is put on blue litmus paper?

**(a)** Blue litmus paper will turn yellow.
**(b)** No colour changes in litmus paper.
**(c)** Blue litmus paper will turn red.
**(d)** Blue litmus paper will turn black.

**Q2.** In human female, when egg is not fertilised, which of the following process takes place?

**(a)** Parturition
**(b)** Zygote formation
**(c)** Menstruation
**(d)** Embryo development

**Q3.** Which of the following statements is NOT true according to the sign convention for spherical lenses?

**(a)** Object distance is negative.
**(b)** Object height is negative when the object is placed above the principal axis.
**(c)** The focal length of a convex lens is positive.
**(d)** The focal length of a concave lens is negative.

**Q4.** A student connects a voltmeter across the terminals of a glowing bulb. What does the voltmeter measure?

**(a)** Potential difference across the bulb
**(b)** Current through the bulb
**(c)** Heat produced by the bulb
**(d)** Resistance of the bulb

**Q5.** Which of the following is a molecule of a compound?

**(a)** H2
**(b)** H2O
**(c)** N2
**(d)** O2

**Q6.** The speed of sound (v) is calculated by multiplying which two wave properties?

**(a)** Amplitude and Frequency
**(b)** Wavelength and Frequency
**(c)** Amplitude and Time Period
**(d)** Wavelength and Amplitude

**Q7.** A particle's velocity-time graph is a straight line with a negative slope. What does this indicate about the particle's motion?

**(a)** The particle is at rest.
**(b)** The particle is speeding up in the positive direction.

**(c)** The particle is slowing down if moving in the positive direction.
**(d)** The particle is moving with increasing acceleration.

**Q8.** What are the main components of a neuron?
**(a)** Dendrites, cell body and nerve endings
**(b)** Dendrites, cell body and axon
**(c)** Cell body, dendrites, nerve endings and synapse
**(d)** Dendrites, cell body, axon and nerve endings

**Q9.** Where is the centre of curvature of a convex mirror located?
**(a)** At the principal focus of the mirror
**(b)** Behind the mirror
**(c)** In front of the mirror
**(d)** At the pole of the mirror

**Q10.** Which of the following reactions demonstrates the acidic nature of ethanoic acid?
**(a)** Ethanoic acid + Ethanol → Ester + Water
**(b)** Ethanoic acid + Sodium → Sodium ethanoate + Hydrogen gas
**(c)** Ethanoic acid + Sodium hydroxide → Sodium ethanoate + Water
**(d)** Ethanoic acid + Methanol → Methanoic acid + Ethane

**Q11.** Which of the following products is formed when carbon dioxide reacts with calcium hydroxide (lime water)?
**(a)** Calcium carbonate
**(b)** Sodium carbonate
**(c)** Calcium bicarbonate
**(d)** Calcium oxide

**Q12.** Which statement best describes a homologous series of organic compounds?
**(a)** A series of compounds having the same general formula, similar chemical properties, and consecutive members differing by a -CH2- group
**(b)** A series of compounds with different functional groups but the same molecular formula
**(c)** A series of elements with similar physical properties
**(d)** A series of compounds that all have branched chains

**Q13.** Two wires, A and B, of the same material, have the same length, but the cross-sectional area of wire A is twice that of wire B. The ratio of their resistances R_A : R_B is:
**(a)** 1 : 2
**(b)** 4 : 1
**(c)** 2 : 1
**(d)** 1 : 1

**Q14.** According to Newton’s second law of motion, what happens when an unbalanced force is applied to an object?
**(a)** The object moves in a circular path
**(b)** The object comes to rest immediately
**(c)** The object’s momentum remains unchanged
**(d)** The object’s momentum changes in the direction of the applied force

**Q15.** Select the correct statement from the following.
A) The large spaces between gas particles allow them to be easily squeezed into smaller volumes.
B) Gas particles have a high average kinetic energy.
**(a)** Only B
**(b)** Both A and B
**(c)** Neither A nor B
**(d)** Only A

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**Q16.** Which of the following human activities contributes to ozone layer depletion?

**(a)** Conserving water
**(b)** Composting organic waste
**(c)** Using CFC-based refrigerants and spray cans
**(d)** Using solar energy

**Q17.** What type of epithelial tissue is the outer skin made of?

**(a)** Cuboidal epithelium
**(b)** Stratified squamous epithelium
**(c)** Columnar epithelium
**(d)** Simple squamous epithelium

**Q18.** The expression for acceleration due to gravity on the surface of a planet of mass M and radius R is:

**(a)** g = R / GM2
**(b)** g = GR / M2
**(c)** g = GM2 / R
**(d)** g = GM / R2

**Q19.** From the given alternatives, which method of asexual reproduction involves the formation of a new plant from the broken portion of the parent plant?

**(a)** Spore formation
**(b)** Fertilisation
**(c)** Fragmentation
**(d)** Binary fission

**Q20.** The formula unit mass of a substance is the sum of the atomic masses of all atoms in a formula unit of a/an:

**(a)** atom
**(b)** mixture
**(c)** element
**(d)** compound

**Q21.** The distributions of electrons in the K, L, and M shell of the chlorine atom are:

**(a)** 2, 7, 8
**(b)** 2, 8, 7
**(c)** 2, 6, 5
**(d)** 2, 7, 7

**Q22.** What is the type of reproduction beginning from the fusion of male and female gametes called?

**(a)** Binary fission
**(b)** Cloning
**(c)** Budding
**(d)** Sexual reproduction

**Q23.** A particle has zero kinetic energy. What can be concluded about the particle's motion?

**(a)** Its momentum is maximum
**(b)** It is moving with high acceleration
**(c)** It must be at rest
**(d)** It is moving with uniform velocity

**Q24.** Which of the following statements is NOT correct regarding the nucleus?

**(a)** Nucleus plays a central role in cellular reproduction.
**(b)** Nucleus contains chromosomes.
**(c)** Nuclear membrane is a double-layered structure.
**(d)** Nuclear membrane is a non-porous and rigid structure.

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**Q25.** A farmer lives near a river, but the canal system in his area receives an irregular water supply from the reservoir. What should he ideally adopt for irrigation?

**(a)** Use of sprinklers only
**(b)** Wells
**(c)** Flood irrigation
**(d)** River lift system

## MATHEMATICS

**Q26.** A train of length 239 m takes 20 seconds to pass another train 161 m long coming from the opposite direction. If the speed of the first train is 43 km/hr, then find speed of the second train.

**(a)** 25 km/hr
**(b)** 38 km/hr
**(c)** 32 km/hr
**(d)** 29 km/hr

**Q27.** The amount on a sum of Rs. 4,400 at the rate of 20% per annum compound interest, compounded annually, in 2 years will be:

**(a)** Rs. 6,336
**(b)** Rs. 5,729
**(c)** Rs. 5,989
**(d)** Rs. 7,289

**Q28.** When x is added to each of 10, 14, 38 and 28, then the numbers so obtained, in this order, are in proportion. Then, if $3x : y :: y : (5x - 6)$, and $y > 0$, what is the value of y ?

**(a)** 79
**(b)** 65
**(c)** 72
**(d)** 78

**Q29.** The cost price of a box of notebooks is Rs. 7,400. The shopkeeper gave 28% discount on the cost price. What will be the selling price (in Rs. )?

**(a)** 5,406
**(b)** 5,377
**(c)** 5,348
**(d)** 5,328

**Q30.** From the top of a building 15 m high, the angle of depression to a point on the ground is 45 degrees. Find the horizontal distance from the building to the point.

**(a)** 7.5 m
**(b)** 45 m
**(c)** 30 m
**(d)** 15 m

**Q31.** A class of 75 students took a Physics test. 22 students had an average score of 85. The other students had an average score of 95. What is the average score (rounded off to one decimal place) of the whole class?

**(a)** 92.1
**(b)** 82.4
**(c)** 88.3
**(d)** 96.7

**Q32.** A trader buys an article and sells it at a profit of 25%. The buyer again sells it at a loss of 10%. If the final selling price is Rs. 9,900, then what was the cost price (in Rs. ) of the article for the first trader?

**(a)** 9,000
**(b)** 8,800

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**(c)** 8,000
**(d)** 8,400

**Q33.** The curved surface area and the volume of a cylindrical pipe is 565.2 $m^2$ and 1,695.6 $m^3$, respectively. Find the total surface area of the pipe.
(Use $\pi = 3.14$)
**(a)** 428.36 m2
**(b)** 548.29 m2
**(c)** 658.76 m2
**(d)** 791.28 m2

**Q34.** The monthly incomes of two friends, David and Ajay, are in the ratio 5 : 8, and each of them saves Rs. 72,000 every month. If the ratio of their monthly expenditure is 1 : 4, find the monthly income of David (in Rs. ).
**(a)** 91,000
**(b)** 1,26,000
**(c)** 89,000
**(d)** 90,000

**Q35.** Given that C is the third proportional of 59 and B. If B is the sum of the first three even natural numbers, then find the value of C. (Round off the answer to two decimal places.)
**(a)** 1.44
**(b)** 2.44
**(c)** 6.32
**(d)** 0.14

**Q36.** One pipe can fill a tank in 11 minutes, while another pipe can empty the completely filled tank in 22 minutes. If both the pipes are opened together when the tank is empty, how many minutes will it take to fill one-half of the tank?
**(a)** 23
**(b)** 22
**(c)** 12
**(d)** 11

**Q37.** In quadrilateral PQRS, the bisectors of angle R and angle S meet at the point T (inside the quadrilateral) and angle STR = 42.5°. If the ratio of angle P to angle Q is 8 : 9, then what is the difference between the measures of angle Q and angle P ?
**(a)** 7°
**(b)** 6°
**(c)** 2°
**(d)** 5°

**Q38.** If the radius of the base of a right circular cylinder is decreased by 15% and its height is increased by 149%, then what is the percentage increase (rounded to the nearest integer) in its volume?
**(a)** 53%
**(b)** 109%
**(c)** 73%
**(d)** 80%

**Q39.** X people were given a contract for doing a piece of work in 36 days. 3 people did not turn up to work due to sickness, and the rest of the people completed the work in 39 days. What is the value of X?
**(a)** 44
**(b)** 48
**(c)** 39
**(d)** 40

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**Q40.** The number of prime numbers lying between 309 and 320 is:

**(a)** 1
**(b)** 4
**(c)** 3
**(d)** 5

**Q41.** The average age of 43 students of a class is 13 years. If the age of the teacher is also included, the average age of the whole group becomes 14 years. The age (in years) of the teacher is:

**(a)** 54
**(b)** 56
**(c)** 58
**(d)** 57

**Q42.** Simplify the following.

$(a^3 - b^3)/(a^2 + ab + b^2) + (a^3 + b^3)/(a^2 - ab + b^2)$

**(a)** 2a2
**(b)** 2a
**(c)** 2b2
**(d)** 2b

**Q43.** The income of Raman is Rs. 43,800. He saves 20% of his income. If his income increases by 36% and expenditure increases by 40%, then his savings will:

**(a)** decrease by Rs. 1,753
**(b)** decrease by Rs. 1,748
**(c)** increase by Rs. 1,752
**(d)** increase by Rs. 1,757

**Q44.** Which of the following is NOT a prime number?

**(a)** 51
**(b)** 31
**(c)** 79
**(d)** 67

**Q45.** Two trains, 170 metres and 220 metres in length, are running in opposite directions. The first runs at the rate of 45 km/hr and the second at the rate of 63 km/hr. How long will they take to cross each other?

**(a)** 23 seconds
**(b)** 20 seconds
**(c)** 17 seconds
**(d)** 13 seconds

**Q46.** Simplify: $72 - [49 - (81 \div 9 - (14 - 24 \div 4) \div 8)]$

**(a)** 39
**(b)** 27
**(c)** 35
**(d)** 31

**Q47.** 3 cups and 4 glasses cost Rs. 270. If 2 more glasses are purchased, then the total amount becomes Rs. 330. Find the cost of a cup.

**(a)** Rs. 50
**(b)** Rs. 30
**(c)** Rs. 40
**(d)** Rs. 45

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**Q48.** R's age is twice the age of S and three times the age of T. S is 5 years older than T. What is the difference in ages (in years) between R and T?

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

**Q49.** If the expenditure of Company A in 2023 was Rs. 660 crore and the profit percentage was 35%, then what was its income in 2023?7052

**(a)** Rs. 891 crore
**(b)** Rs. 231 crore
**(c)** Rs. 435 crore
**(d)** Rs. 665 crore

**Q50.** Maya buys a mobile phone for her child. The phone is marked at Rs. 21,000 and is offered with two successive discounts of 5% and Z%, respectively. After receiving both discounts, she pays Rs. 11,172. Find the value of Z.

**(a)** 42
**(b)** 43
**(c)** 45
**(d)** 44

## GENERAL INTELLIGENCE & REASONING

**Q51.** Mr. Akai starts from Point A and drives 15 km towards the north. He then takes a right turn, drives 18 km, turns right and drives 23 km. He then takes a right turn and drives 26 km. He takes a final right turn, drives 8 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again? (All turns are 90-degree turns only unless specified.)

**(a)** 8 km to the west
**(b)** 8 km to the east
**(c)** 6 km to the north
**(d)** 6 km to the east

**Q52.** In the following triad, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one which follows the same logic.

DIVE - DEVI - EVID

BEAR - BRAE - RAEB

**(a)** COLD - CDLO - DLOC
**(b)** MUST - MUTS - USTM
**(c)** ICED - IECD - DECI
**(d)** SOUP - OSUP - POUS

**Q53.** Seven people B, C, D, I, J, K, and L are sitting around a circular table facing the centre of the table. Only three people sit between D and L, when counted from the right of L. Only three people sit between K and I, when counted from the left of K. B sits to the immediate right of D. J is an immediate neighbour of L as well as I. Who sits second to the left of C?

**(a)** J
**(b)** I
**(c)** K
**(d)** L

**Q54.** What should come in place of the question mark (?) in the given series?

12 28 45 63 ? 1023815

**(a)** 82
**(b)** 76
**(c)** 72

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**(d)** 88

**Q55.** Rakesh ranked 13^(th) from the top and 18^(th) from the bottom in his class. How many students are there in the class?

**(a)** 20
**(b)** 30
**(c)** 15
**(d)** 19

**Q56.** 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?2426

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

**Q57.** In a certain code language, ‘royal snow blue’ is coded as 'tl zw cr' and ‘blue two web’ is coded as ‘rg iq zw’. How is ‘blue’ coded in the given language?

**(a)** rg
**(b)** zw
**(c)** cr
**(d)** tl

**Q58.** 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) 2 6 9 1 2 5 7 2 5 2 2 4 7 9 3 2 5 4 1 4 9 9 1 8 9 (Right)

How many such even digits is/are there each of which is immediately preceded by an even digit and also immediately followed by an even digit?3345

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

**Q59.** Satish starts from Point A and drives 47 km towards south. He then takes a right turn, drives 65 km, turns right and drives 65 km. He then takes a right turn and drives 77 km. He takes a final right turn, drives 18 km and stops at Point P. How far (shortest distance) and towards which direction should he drive in order to reach Point A again?

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

**(a)** 12 km to the west
**(b)** 11 km to the west
**(c)** 13 km to the east
**(d)** 10 km to the west

**Q60.** 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) 1 2 8 4 6 9 5 8 8 7 9 2 6 6 5 8 6 3 1 1 4 4 6 (Right)

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

**(a)** Four
**(b)** One
**(c)** Two

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**(d)** Three

**Q61.** Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?

ZSL 18, VOH 29, RKD 40, NGZ 51, JCV 62, ?

**(a)** FOR 73
**(b)** FYR 73
**(c)** FYL 73
**(d)** FYI 73

**Q62.** 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)** BL-WR
**(b)** HR-CX
**(c)** QA-KG
**(d)** UE-PK

**Q63.** If + means -, - means x, x means ÷, ÷ means +, then what will come in place of the question mark (?) in the following equation?

21 - 4 ÷ 371 + 111 × 3 = ?

**(a)** 406
**(b)** 411
**(c)** 409
**(d)** 418

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

18, 22, 30, 42, 58, ?

**(a)** 79
**(b)** 76
**(c)** 77
**(d)** 78

**Q65.** 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)** WT-YU
**(b)** UR-WS
**(c)** SP-UQ
**(d)** QN-SP

**Q66.** 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:

Some samosas are burgers.

Some burgers are pizzas.

Conclusions:

(I): Some samosas are pizzas.

(II): All pizzas are burgers.

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

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**Q67.** What should come in place of the question mark (?) in the given series based on the English alphabetical order?

BMV, EOT, HQR, KSP, ?

**(a)** RUQ
**(b)** MUN
**(c)** QVM
**(d)** NUN

**Q68.** In the following triads, each group of letters is related to the subsequent one following a certain logic. Select from the given options, the one which follows the same logic.

RAMP - PRMA - RPAM

SEND - DSNE - SDEN

**(a)** CODE - OCDE - EODC
**(b)** KEPT - TKPE - KETP
**(c)** HALT - THAL - ALTH
**(d)** QUAD - DQAU - QDUA

**Q69.** CEID is related to JLPK in a certain way based on the English alphabetical order. In the same way, EGKF is related to LNRM. To which of the given options is GIMH related, following the same logic?9479

**(a)** PNOT
**(b)** PNTO
**(c)** NPOT
**(d)** NPTO

**Q70.** If 1 is added to each even digit and 2 is subtracted from each odd digit in the number 54286379, how many digits will appear more than once in the new number thus formed?

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

**Q71.** In a certain code language, ‘dirt is there’ is coded as ‘mp rc gp’ and ‘clean the dirt’ is coded as ‘hk mp bo’. How is ‘dirt’ coded in the given language?

**(a)** gp
**(b)** bo
**(c)** mp
**(d)** hk

**Q72.** Which of the following number will replace the question mark (?) in the given series?

1, 2, 6, 15, 31, 56, ?

**(a)** 92
**(b)** 80
**(c)** 72
**(d)** 86

**Q73.** 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.)

(12, 20, 45)

(18, 26, 57)

**(a)** (13, 21, 47)
**(b)** (15, 7, 19)
**(c)** (11, 20, 45)
**(d)** (9, 17, 29)

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**Q74.** A, B, C, D, E and F are sitting around a circular table facing the centre. E sits second to the left of B. C sits second to the right of F. D is on the immediate left of C. Who is sitting on the immediate right of A?

**(a)** F
**(b)** D
**(c)** C
**(d)** B

**Q75.** If 1 is added to each even digit and 1 is subtracted from each odd digit in the number 258671543, then what will be the value of middle digit in the new number thus formed?

**(a)** 3
**(b)** 5
**(c)** 6
**(d)** 4

**Q76.** In a certain code language,

P + Q means ‘P is the father of Q’,

P # Q means ‘P is the mother of Q’,

P & Q means ‘P is the wife of Q’,

and P % Q means ‘P is the sister of Q’.

How is V related to D if ‘V % L & C + B % D’?

**(a)** Wife's brother
**(b)** Husband's brother
**(c)** Mother’s mother
**(d)** Mother’s sister

**Q77.** 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:

Some erasers are pens.

Some pens are bags.

Conclusions:

(I) Some erasers are bags.

(II) All bags are pens.

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

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

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

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

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

**Q79.** Seven boxes, M, N, O, P, Q, R and S, are kept one over the other, but not necessarily in the same order. Only two boxes are kept between M and O. Only N is kept above S. No box is kept below O. R is kept at some place below P but at some place above Q. Which box is kept third above Q?

**(a)** P

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**(b)** M
**(c)** S
**(d)** N

**Q80.** Six people, A, B, C, D, E and F, are sitting in a row, facing north. A sits to the immediate left of B. C sits third to the left of B. D is an immediate neighbour of B. F sits to the immediate right of C. D sits to the immediate left of E. Who sits at the extreme right end of the line?

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

## GENERAL AWARENESS AND CURRENT AFFAIRS

**Q81.** Which of the following institutes conducted a PM2.5 air quality assessment in Indian cities in October 2025 and found that all ten of the most polluted cities were located within the National Capital Region (NCR)?

**(a)** Centre for Sustainable Urban Climate Research
**(b)** Centre for Research on Energy and Clean Air
**(c)** Indian Council for Environmental Data and Analysis
**(d)** National Institute for Atmospheric Studies and Policy

**Q82.** In December 2024, which foundation day was celebrated by the Border Security Force (BSF) of India?

**(a)** 20th
**(b)** 25th
**(c)** 50th
**(d)** 60th

**Q83.** Which of the following was the impact of the Election Commission of India Network (ECINET) on the publication of Index Cards during elections?

**(a)** Publication was delayed by several additional weeks.
**(b)** Cards were handwritten by officials at local polling stations.
**(c)** Cards were available within 72 hours of results.
**(d)** Cards were discontinued as part of new digital reforms.

**Q84.** What is the prize money for Bal Sahitya Puraskar winners?

**(a)** Rs. 50,000
**(b)** Rs. 25,000
**(c)** Rs. 1,00,000
**(d)** Rs. 75,000

**Q85.** The share of ULIPs in the total APE of which insurance company fell to 46.8% in Q1 FY26, compared to 51.4% in the same quarter last year?

**(a)** Life Insurance Corporation of India
**(b)** Bajaj Allianz Life Insurance Co. Ltd.
**(c)** Axis Max Life Insurance Co. Ltd.
**(d)** ICICI Prudential Life Insurance

**Q86.** What percentage did CPI inflation touch in April 2025 in India, marking a near six-year low?

**(a)** 3.16%
**(b)** 5.26%
**(c)** 4.2%
**(d)** 6.2%

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**Q87.** India submitted its 4^(th) Biennial Update Report to the UNFCCC in December 2024. What is the full form of UNFCCC?

**(a)** Union Network for Future Climate Control
**(b)** United Nations Framework Convention on Climate Change
**(c)** United Nations Foundation for Climate Cooperation
**(d)** United Nations Forum for Climate Coordination

**Q88.** Where was the VLSRSAM flight-test conducted by DRDO?

**(a)** Surya Lanka, Andhra Pradesh
**(b)** Pokhran Test Range, Rajasthan
**(c)** DRDO Missile Complex, Hyderabad
**(d)** Integrated Test Range, Odisha

**Q89.** The 2025 French Open, also known as Roland Garros, was played on which type of court surface?

**(a)** Grass
**(b)** Artificial Turf
**(c)** Hard Court
**(d)** Clay Court

**Q90.** Which of the following countries launched the world's first AI-based satellite In May 2025?

**(a)** Japan
**(b)** Russia
**(c)** USA
**(d)** China

**Q91.** How many gold medals did Suruchi Singh win in 10 m air pistol at ISSF World Cup in 2025?

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

**Q92.** Which team won the National Team of the Year award at the Sportstar Aces Awards 2025?

**(a)** Indian Men's Hockey Team
**(b)** Indian Women's Cricket Team
**(c)** Indian Men's Football Team
**(d)** Indian Chess Teams

**Q93.** Which organisation initiated a 12-day cybersecurity exercise called 'Cyber Suraksha', starting 16 June 2025?

**(a)** Indian Space Research Organisation
**(b)** Indian Air Force Cyber Agency
**(c)** Indian Defence Cyber Agency
**(d)** Cyber Security Association of India

**Q94.** Which of the following initiative was launched on 21 March 2025, by the Ministry of Science and Technology to offer structured biotech mentorship?

**(a)** BioInnovate India
**(b)** BioNurture Mentorship Programme
**(c)** BioSaarthi Mentorship Initiative
**(d)** Biotech Startup Mission

**Q95.** The Mussalman Wakf (Repeal) Bill, 2025, seeks to remove the outdated Mussalman Wakf Act of _____.

**(a)** 1953
**(b)** 1933
**(c)** 1923
**(d)** 1943

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**Q96.** Which Indian state has announced plans to build a 'Great Green Wall' by 2030 to protect its coastline from cyclones and environmental degradation?

**(a)** Andhra Pradesh
**(b)** Tamil Nadu
**(c)** Odisha
**(d)** West Bengal

**Q97.** What was the theme of the International Day of Democracy, 2025, celebrated in September 2025?

**(a)** Strengthening Democracy, Inspiring Participation
**(b)** Voices for Change
**(c)** Democracy for Development
**(d)** Achieving Gender Equality, Action by Action

**Q98.** Who received the Lifetime Achievement Award at the Bengaluru International Film Festival, 2025?

**(a)** Anupam Kher
**(b)** Adoor Gopalakrishnan
**(c)** Shabana Azmi
**(d)** Manoj Bajpayee

**Q99.** In 2025, which authority raised serious objections to the Aparajita Bill 2024, calling its proposed punishments under BNS excessively harsh and disproportionate?

**(a)** Law Commission of India
**(b)** Central Government
**(c)** National Commission for Women
**(d)** Supreme Court

**Q100.** In 2025, which government's commitment was emphasised by the inauguration of the Khelo India multipurpose hall in Arunachal Pradesh?

**(a)** State Government
**(b)** Tribal Council
**(c)** Local Panchayat
**(d)** Union Government

## ANSWER KEY

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

## SOLUTIONS

**Q1. Answer: (c) Blue litmus paper will turn red.**

The correct answer is Blue litmus paper will turn red.

Key Points

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• Acid rain contains acids such as sulfuric acid ($H_2SO_4$) and nitric acid ($HNO_3$), formed when sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_x$) react with water vapor in the atmosphere.

• Blue litmus paper is an indicator used to test the acidity or basicity of a solution.

• When blue litmus paper comes in contact with an acidic substance (pH less than 7), it turns red, indicating the presence of an acid.

• Since acid rain water has a low pH (typically between 4-5), it is acidic in nature. Hence, when a drop of acid rain water is placed on blue litmus paper, the paper turns red.

• This reaction is due to the presence of hydrogen ions (H^+) in the acid rain water, which interact with the litmus indicator, causing the color change.

Additional Information

• Litmus Paper:

• Litmus paper is a natural indicator made from lichens. It is widely used to test the acidity or alkalinity of substances.

• Blue litmus paper turns red in the presence of an acid, while red litmus paper turns blue in the presence of a base.

• Neutral substances do not cause any color change in litmus paper.

• Acid Rain:

• Acid rain occurs due to the emission of sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_x$) from industrial processes, vehicular emissions, and burning of fossil fuels.

• These gases react with atmospheric water and oxygen to form acids such as sulfuric acid and nitric acid, which precipitate as acid rain.

• Acid rain has harmful effects on plants, aquatic life, buildings, and human health.

• pH Scale:

• The pH scale measures the acidity or alkalinity of a solution, ranging from 0 to 14.

• A pH value less than 7 indicates an acidic solution, while a value greater than 7 indicates a basic solution.

• A pH of 7 indicates a neutral solution, such as pure water.

• Environmental Impact of Acid Rain:

• Acid rain damages crops, forests, and aquatic ecosystems by lowering the pH of soil and water bodies.

• It corrodes buildings, monuments, and infrastructure, especially those made of limestone or marble.

• Efforts to reduce acid rain include minimizing $SO_2$ and $NO_x$ emissions through cleaner energy sources and stricter regulations.

Important Points

• Indicators: Indicators like litmus paper, phenolphthalein, and methyl orange help in identifying the nature of substances (acidic, basic, or neutral).

• Reducing Acid Rain: Adoption of renewable energy sources, installation of scrubbers in industries, and promoting afforestation are effective measures to mitigate acid rain.

• Global Efforts: International agreements like the Clean Air Act and protocols aim to reduce emissions causing acid rain.

**Q2. Answer: (c) Menstruation**

The correct answer is Menstruation.

Key Points

• Menstruation refers to the periodic shedding of the uterine lining (endometrium) in human females when fertilization of the egg does not occur.

• This process is part of the menstrual cycle, which typically lasts around 28 days, though it can range from 21 to 35 days in different individuals.

• Menstruation occurs due to a drop in the levels of the hormones estrogen and progesterone, leading to the breakdown and discharge of the endometrial lining.

• The discharge during menstruation consists of blood, mucus, and tissue from the uterine lining, and it typically lasts for 3-7 days.

• It is a natural and essential part of the female reproductive cycle, preparing the body for a potential pregnancy each month. If fertilization does not occur, the uterine lining is shed, and the cycle begins again.

Additional Information

• Parturition:

• Parturition refers to the process of giving birth to a baby. It typically occurs at the end of the gestation period (about 9 months in humans).

• This process involves uterine contractions, dilation of the cervix, and the delivery of the baby and placenta.

• Parturition is not related to the menstrual cycle but is a culmination of pregnancy.

• Zygote Formation:

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• A zygote is formed when a sperm cell fertilizes an egg cell. This marks the beginning of pregnancy in humans.
• The zygote undergoes multiple cell divisions and develops into an embryo, eventually implanting itself into the uterine lining.
• If fertilization does not occur, zygote formation does not take place, and menstruation begins.
• Embryo Development:
• Embryo development is the process by which a fertilized egg (zygote) grows and differentiates into a multicellular organism.
• This process includes stages like cleavage, blastocyst formation, implantation, and further differentiation.
• Embryo development occurs only when fertilization has taken place, making it irrelevant in the case of menstruation.
• Hormonal Regulation in Menstruation:
• The menstrual cycle is regulated by hormones such as estrogen, progesterone, luteinizing hormone (LH), and follicle-stimulating hormone (FSH).
• FSH stimulates the growth of ovarian follicles, while LH triggers ovulation. Estrogen and progesterone regulate the thickening of the uterine lining.
• When fertilization does not occur, the levels of estrogen and progesterone drop, leading to the shedding of the uterine lining (menstruation).

Important Points

• Duration of Menstrual Cycle: The average menstrual cycle is about 28 days, but it can vary from 21 to 35 days.
• Age of Onset: Menstruation typically begins during puberty, around the age of 11-14 years, and continues until menopause (around 45-55 years).
• Common Symptoms: Symptoms during menstruation can include cramps, mood swings, fatigue, bloating, and headaches.
• Significance: Menstruation is a natural biological process that prepares the body for pregnancy and reflects a healthy reproductive system.

**Q3. Answer: (b) Object height is negative when the object is placed above the principal axis.**

The correct answer is Object height is negative when the object is placed above the principal axis..

Key Points

• Statement 1: Object distance is negative.
• According to the standard sign convention for spherical lenses, distances measured against the direction of the incoming light are taken as negative. Since the object is usually placed to the left of the lens (against the direction of light), the object distance is always negative.
• Hence, this statement is correct.
• Statement 2: Object height is negative when the object is placed above the principal axis.
• In the sign convention for spherical lenses, heights measured above the principal axis are considered positive, while heights measured below are taken as negative. Thus, the object height cannot be negative if the object is placed above the principal axis.
• Hence, this statement is incorrect.
• Statement 3: The focal length of a convex lens is positive.
• A convex lens converges light rays, and its focal point lies on the side opposite to the object. Therefore, the focal length of a convex lens is taken as positive.
• Hence, this statement is correct.
• Statement 4: The focal length of a concave lens is negative.
• A concave lens diverges light rays, and its focal point lies on the same side as the object. Therefore, the focal length of a concave lens is taken as negative.
• Hence, this statement is correct.

Additional Information

• Sign Convention for Spherical Lenses:
• Distances are measured from the optical center of the lens.
• Distances measured in the direction of the incoming light are positive, while distances against the direction of light are negative.
• Heights above the principal axis are positive, and heights below the axis are negative.
• Convex Lens Characteristics:
• A convex lens is a converging lens that focuses light rays to a point on the other side of the lens.
• Focal length is positive, and the lens is used in applications like magnifying glasses, cameras, and telescopes.
• Concave Lens Characteristics:
• A concave lens is a diverging lens that spreads out light rays, appearing to come from a focal point on the same side as the object.
• Focal length is negative, and the lens is used in applications like eyeglasses for myopia (short-sightedness) and peepholes.

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• Applications of Spherical Lenses:
• Convex lenses are used in devices like projectors, microscopes, and cameras due to their converging properties.
• Concave lenses are used in optical instruments like binoculars and corrective glasses for certain vision impairments.

Important Points

• Lens Formula:
• The lens formula is given by 1/f = 1/v - 1/u, where:
• f: Focal length of the lens
• v: Image distance
• u: Object distance
• This formula applies to both convex and concave lenses, with the sign convention dictating the values of v, u, and f.
• Magnification:
• The magnification (M) of a lens is given by M = h'/h = -v/u, where:
• h': Height of the image
• h: Height of the object
• A positive magnification indicates an erect image, while a negative magnification indicates an inverted image.

**Q4. Answer: (a) Potential difference across the bulb**

The correct answer is Potential difference across the bulb.

Key Points

• A voltmeter is an instrument specifically designed to measure the potential difference (voltage) between two points in an electrical circuit.
• When connected across the terminals of a glowing bulb, the voltmeter measures the voltage drop across the bulb. This drop indicates the amount of electrical energy being consumed by the bulb per unit charge.
• The voltmeter operates by having a high internal resistance, which ensures that it does not significantly affect the circuit or draw current during measurement. Hence, the voltmeter measures the potential difference across the bulb.
• The voltmeter does not measure the current through the bulb, as current measurement requires an ammeter connected in series with the circuit. Hence, option 2 is incorrect.
• The voltmeter does not directly measure the heat produced by the bulb, as heat is a secondary effect of electrical power dissipation. Power can be calculated using the potential difference and current. Hence, option 3 is incorrect.
• The voltmeter cannot measure the resistance of the bulb. Resistance is calculated indirectly using Ohm's law (R=V/IR=V/IR=V/IR=V/IR=V/IR=V/IR=V/IR=V/I
). Hence, option 4 is incorrect.

Additional Information

• Voltmeter:
• A voltmeter is connected in parallel to the component whose voltage is to be measured.
• It has a high internal resistance to prevent current from flowing through it, ensuring accurate voltage measurements.
• Modern voltmeters are often digital, providing precise readings of potential difference.
• Example: Multimeters can function as voltmeters to measure voltage in circuits.
• Ohm’s Law:
• This fundamental law states that the current (IIIIIIII
) through a conductor is directly proportional to the voltage (VVVVVVVV
) across it, provided the temperature remains constant: V=IRV=IRV=IRV=IRV=IR.
• Using Ohm's Law, we can calculate the resistance of the bulb if both the voltage (VVVVVV) and current (II) are known.
• Applications: Used in designing circuits, calculating power, and determining electrical parameters.
• Electrical Power:
• Power consumed by the bulb (PP) is calculated using the formula: P=VIP=VI, where VVVVVV is voltage and II is current.
• Heat produced by the bulb is a result of electrical power dissipation in the filament.
• Example: For a bulb with a voltage of 12V and current of 2A, the power is P=12×2=24WattsP=12×2=24Watts.
• Resistance of Bulb:
• The resistance (RR) of the bulb is related to its material and design, and it affects the current flow and brightness.
• It can be calculated indirectly using R=V/IR=V/IR=V/IR=V/IR=V/IR=V/I, where VV is potential difference and II is current.
• Example: A bulb with a voltage of 12V and current of 2A has a resistance of R=12/2=6ΩR=12/2=6ΩR=12/2=6ΩR=12/2=6ΩR=12/2=6ΩR=12/2=6Ω.

Important Points

• Measurement Devices:

• Ammeter: Used to measure current, connected in series in the circuit.

• Voltmeter: Used to measure voltage, connected in parallel.

• Multimeter: A versatile device that measures voltage, current, and resistance.

• Wattmeter: Used to measure electrical power.

• Power and Energy:

• Power indicates the rate at which energy is consumed by the bulb.

• Energy consumption is measured in kilowatt-hours (kWhkWh ), commonly used in electricity bills.

• Example: A 100W bulb used for 10 hours consumes 100×10=1,000Wh=1kWh100×10=1,000Wh=1kWh.

• Applications in Daily Life:

• Voltage measurement is essential in household appliances to ensure safety and functionality.

• Understanding resistance and power helps in choosing energy-efficient devices.

• Electrical measurements are vital in industries, laboratories, and renewable energy systems.

**Q5. Answer: (b) H2O**

The correct answer is H2O.

Key Points

• H2O, commonly known as water, is a molecule of a compound. It is composed of two hydrogen atoms covalently bonded to one oxygen atom.

• A compound is defined as a substance that consists of atoms of two or more different elements chemically bonded together in a fixed ratio. H2O fits this definition as it contains hydrogen and oxygen atoms.

• Other options like H2, N2, and O2 are molecules of elements, not compounds, as they consist of only one type of element (hydrogen, nitrogen, or oxygen respectively).

• Water is an essential compound in nature, serving as a solvent in various biological and chemical processes. Its molecular structure contributes to its unique properties like high boiling and melting points, surface tension, and ability to dissolve many substances.

• H2O is formed through chemical reactions such as the combination of hydrogen gas and oxygen gas in the presence of energy (e.g., combustion reaction).

Additional Information

• H2:

• H2 is a molecule of the element hydrogen. It consists of two hydrogen atoms bonded covalently.

• It is not a compound because it contains only one type of element.

• Hydrogen gas is commonly used in industries, such as in fuel cells and as a reducing agent in chemical reactions.

• N2:

• N2 is a molecule of the element nitrogen. It is composed of two nitrogen atoms bonded by a triple covalent bond, making it highly stable.

• It is not a compound as it contains only one type of element.

• Nitrogen gas makes up about 78% of Earth's atmosphere and is essential for life, especially in the nitrogen cycle.

• O2:

• O2 is a molecule of the element oxygen, consisting of two oxygen atoms bonded by a double covalent bond.

• It is not a compound as it contains only oxygen atoms.

• Oxygen gas is crucial for respiration in most living organisms and is vital for combustion processes.

• H2O:

• H2O is a compound because it contains two different elements: hydrogen and oxygen.

• Its molecular shape is bent due to the lone pairs on the oxygen atom, resulting in a polar molecule.

• It exhibits unique properties like being a universal solvent, having high specific heat capacity, and supporting life on Earth.

• Examples of its use include drinking water, agriculture, and as a solvent in laboratories.

Important Points

• Difference Between Molecules of Elements and Compounds:

• A molecule of an element contains atoms of only one type of element (e.g., H2, O2, N2).

• A molecule of a compound contains atoms of two or more different elements chemically bonded (e.g., H2O, CO2, NaCl).

• Examples of Compounds:

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• Water ($H_2O$): Composed of hydrogen and oxygen.
• Carbon Dioxide ($CO_2$): Composed of carbon and oxygen.
• Sodium Chloride (NaCl): Composed of sodium and chlorine.
• Properties of Water:
• High boiling point (100°C) and freezing point (0°C) due to hydrogen bonding.
• Excellent solvent for ionic and polar substances.
• Essential for biological processes like photosynthesis and cellular respiration.

**Q6. Answer: (b) Wavelength and Frequency**

The correct answer is Wavelength and Frequency.

Key Points

• The speed of sound (v) is calculated using the formula: $v = \lambda \times f$, where $\lambda$ (wavelength) is the distance between two consecutive crests or troughs of a wave, and f (frequency) is the number of vibrations or oscillations per second.
• The wavelength ($\lambda$) is typically measured in meters (m), while the frequency (f) is measured in hertz (Hz). Multiplying these two properties gives the speed of sound in meters per second (m/s).
• Sound waves are longitudinal waves, meaning that the particles of the medium through which the sound travels oscillate parallel to the direction of wave propagation.
• The speed of sound depends on the properties of the medium, such as density and elasticity, but the relationship between wavelength and frequency remains constant for a given medium.
• The formula $v = \lambda \times f$ is fundamental in wave mechanics and applies to both sound and electromagnetic waves.

Additional Information

• Amplitude and Frequency: Amplitude refers to the maximum displacement of particles from their mean position in a wave, and frequency is the number of oscillations per second. While both are important wave properties, they do not determine the speed of sound. Instead, amplitude is related to the energy of the wave, and frequency is related to pitch.
• Wavelength and Amplitude: Wavelength is the distance between two consecutive points of similar phase (like crests), while amplitude determines the wave's intensity or loudness. Their product does not give the speed of sound.
• Amplitude and Time Period: Time period (T) is the reciprocal of frequency ($T = 1/f$). While both amplitude and time period are critical in describing wave behavior, their product does not relate to the speed of sound.
• Physical Factors Affecting Sound Speed: The speed of sound varies with the medium's properties, such as temperature, density, and elasticity. For example:
• In air at 20°C, the speed of sound is approximately 343 m/s.
• In water, the speed of sound is significantly higher, around 1482 m/s, due to the medium's higher density and elasticity.
• Practical Applications:
• In sonar technology, the relationship between wavelength, frequency, and speed is used to detect objects underwater.
• In musical instruments, tuning is based on frequency, which affects the speed and wavelength of sound waves in air.

Important Points

• Frequency (f): It is measured in hertz (Hz) and represents the number of wave cycles per second. For example, a sound wave with a frequency of 100 Hz completes 100 oscillations per second.
• Wavelength ($\lambda$): It is the distance between two consecutive crests or troughs of a wave, measured in meters (m). A longer wavelength corresponds to a lower frequency for a given speed of sound.
• Relationship Between Speed, Wavelength, and Frequency: For a wave propagating through a medium, the speed remains constant unless the medium's properties change. Thus, if the wavelength increases, the frequency decreases proportionally, and vice versa.
• Medium Dependency: In gases, the speed of sound is slower compared to liquids and solids, as the intermolecular forces and density differ across these states of matter.

**Q7. Answer: (c) The particle is slowing down if moving in the positive direction.**

The correct answer is The particle is slowing down if moving in the positive direction..

Key Points

• A velocity-time graph with a negative slope indicates that the velocity of the particle is decreasing over time.
• This decrease in velocity implies that the particle is slowing down, provided it is moving in the positive direction.
• The slope of the velocity-time graph represents the acceleration. A negative slope corresponds to a negative acceleration (deceleration).
• If the particle is initially moving in the positive direction and the velocity magnitude reduces, it signifies that the particle is slowing down. Hence, the correct option is identified.

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• Other options such as the particle being at rest or moving with increasing acceleration are incorrect, as these scenarios would result in different graph characteristics.

Additional Information

• Velocity-Time Graph:

• The velocity-time graph provides insights into how the velocity of a particle changes with time.

• A straight line on the graph indicates uniform acceleration or deceleration.

• If the slope of the line is negative, the particle is decelerating or slowing down.

• If the slope is positive, the particle is accelerating in the direction of motion.

• Acceleration:

• Acceleration is the rate of change of velocity with respect to time.

• A negative acceleration (also called deceleration) implies that the velocity of the particle is decreasing.

• In the context of the graph, the slope of the velocity-time curve directly represents the acceleration.

• Incorrect Options Explanation:

• Option 1: "The particle is at rest." - This would be represented by a horizontal line on the velocity-time graph at velocity = 0.

• Option 2: "The particle is speeding up in the positive direction." - This would require a positive slope on the graph, not a negative one.

• Option 4: "The particle is moving with increasing acceleration." - This would result in a curved line on the velocity-time graph, not a straight line with a negative slope.

• Real-Life Example:

• A car moving forward and applying brakes experiences deceleration, which is depicted as a negative slope on the velocity-time graph.

• Similarly, a ball rolling uphill slows down due to gravity, resulting in a similar graph pattern.

Important Points

• Negative Acceleration (Deceleration):

• When a particle experiences a force opposite to its motion, it undergoes negative acceleration.

• Examples include braking vehicles, friction acting on a sliding object, or an object moving against an inclined plane.

• Analysis of Graphs:

• The slope of a velocity-time graph is a fundamental tool in understanding motion.

• Positive slope = acceleration, negative slope = deceleration, horizontal line = constant velocity, and vertical line = instantaneous change (not physically possible).

• Practical Application:

• Velocity-time graphs are widely used in fields like transportation engineering, physics simulations, and sports analytics to study motion and predict outcomes.

**Q8. Answer: (d) Dendrites, cell body, axon and nerve endings**

The correct answer is Dendrites, cell body, axon and nerve endings.

Key Points

• Neurons, also called nerve cells, are the fundamental units of the nervous system responsible for transmitting information throughout the body.

• A typical neuron consists of four main components: dendrites, cell body (soma), axon, and nerve endings.

• Dendrites: These are branched projections that receive electrical signals from other neurons and convey them to the cell body.

• Cell Body (Soma): This is the central part of the neuron, containing the nucleus and cytoplasm. It processes incoming signals and generates outgoing signals.

• Axon: A long, thread-like projection that transmits signals away from the cell body to other neurons, muscles, or glands.

• Nerve Endings (Axon Terminals): These are the endpoints of the axon, where the neuron communicates with other cells via neurotransmitter release at synapses.

Additional Information

• Types of Neurons:

• Sensory Neurons: Transmit sensory information (e.g., touch, light, sound) from sensory receptors to the central nervous system (CNS).

• Motor Neurons: Send signals from the CNS to muscles or glands, enabling movement or secretion.

• Interneurons: Connect sensory and motor neurons within the CNS for processing and integration of information.

• Function of Dendrites: Dendrites increase the surface area of neurons for receiving signals and play a crucial role in integrating incoming information.

• Structure of the Axon: Axons are often covered by a myelin sheath, which is made up of glial cells. This sheath increases the speed of electrical signal transmission.

• Synapse: The junction between a nerve ending and another cell (e.g., neuron, muscle cell) where neurotransmitters facilitate communication.

• Neurotransmitters: Chemicals like dopamine, serotonin, and acetylcholine released at synapses to transmit signals between neurons.

Important Points

• Neuron Communication: Neurons transmit signals via electrical impulses (action potentials) and chemical signals (neurotransmitters).

• Myelination: Myelin sheaths are formed by Schwann cells in the peripheral nervous system (PNS) and oligodendrocytes in the central nervous system (CNS).

• Diseases Related to Neurons: Disorders like Alzheimer's disease, Parkinson's disease, and multiple sclerosis involve damage to neurons or their connections.

• Neuroplasticity: The ability of neurons to adapt, reorganize, and form new connections in response to learning or injury.

**Q9. Answer: (b) Behind the mirror**

The correct answer is Behind the mirror.

Key Points

• The centre of curvature of a convex mirror is the center of the sphere from which the mirror is a part.

• In the case of a convex mirror, the reflective surface bulges outward, and the center of the sphere lies behind the mirror.

• The centre of curvature is not located on the reflective side of the convex mirror but rather on the side opposite to the reflection.

• This is because all the normals to the surface of a convex mirror point away from the center of curvature.

• In a convex mirror, the focal point and the center of curvature are both virtual, meaning they cannot be physically located in front of the mirror but are positioned behind it.

Additional Information

• Convex Mirror:

• A convex mirror, also known as a diverging mirror, has a reflective surface that curves outward.

• It always forms virtual, erect, and diminished images, irrespective of the object's position.

• Convex mirrors are widely used in applications like vehicle rearview mirrors due to their ability to provide a wide field of view.

• Centre of Curvature:

• The centre of curvature of a mirror is the center of the sphere of which the mirror surface is a part.

• For a convex mirror, this point lies behind the mirror, making it a virtual point.

• Principal Focus:

• The principal focus of a convex mirror is the point where light rays initially parallel to the principal axis appear to diverge from after reflection.

• It is always located behind the mirror, making it a virtual focus.

• Difference Between Convex and Concave Mirrors:

• While a convex mirror has its center of curvature and focus behind the mirror, a concave mirror has these points located in front of the mirror.

• Convex mirrors always form virtual images, while concave mirrors can form both real and virtual images depending on the object's position.

• Applications of Convex Mirrors:

• Used in vehicle rearview mirrors for a wider field of vision.

• Employed in security mirrors in shopping malls and stores to monitor a larger area.

• Used in automated teller machines (ATMs) to ensure security by providing a broader view of the surroundings.

Important Points

• The focal length of a convex mirror is always positive since the focus lies behind the mirror.

• The mirror formula, given as (1/f = 1/v + 1/u), is applicable for both convex and concave mirrors, where f is the focal length, v is the image distance, and u is the object distance.

• The magnification produced by a convex mirror is always less than 1 because the image is always diminished.

• Convex mirrors are preferred in daily applications requiring a wide field of view because of their unique reflective properties.

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**Q10. Answer: (c) Ethanoic acid + Sodium hydroxide → Sodium ethanoate + Water**

The correct answer is Ethanoic acid + Sodium hydroxide → Sodium ethanoate + Water.

Key Points

• Acidic Nature of Ethanoic Acid: The reaction of ethanoic acid with a base (like sodium hydroxide) demonstrates its acidic nature. This is because an acid reacts with a base to form a salt and water, a process known as neutralization.

• Reaction Equation: The reaction is represented as: CH3COOH + NaOH → CH3COONa + H2O. Here, ethanoic acid (CH3COOH) reacts with sodium hydroxide (NaOH) to produce sodium ethanoate (CH3COONa) and water (H2O).

• Acid-Base Neutralization: Ethanoic acid donates a proton (H^+), and sodium hydroxide provides hydroxide ions (OH^-), which combine to form water, leaving sodium ethanoate as the salt.

• Significance of the Reaction: This reaction is a direct demonstration of the acidic property of ethanoic acid, as acids are characterized by their ability to neutralize bases.

• Why Other Options Are Incorrect: While some other reactions involve ethanoic acid, they do not directly demonstrate its acidic nature. For example, esterification reactions do not involve neutralization with a base.

Additional Information

• Reaction of Ethanoic Acid with Sodium: In this reaction, ethanoic acid reacts with sodium metal to produce sodium ethanoate and hydrogen gas: CH3COOH + Na → CH3COONa + H2. Although this reaction shows the reactivity of ethanoic acid, it is not a direct demonstration of its acidic nature.

• Esterification Reaction: Ethanoic acid reacts with alcohols (e.g., ethanol) in the presence of an acid catalyst to form esters and water. For example, CH3COOH + C2H5OH → CH3COOC2H5 + H2O. This reaction highlights its chemical versatility but does not emphasize its acidity.

• Reaction with Metals: Ethanoic acid reacts with active metals (like sodium) to release hydrogen gas, a property that confirms it is an acid. However, this reaction is more indicative of general acid behavior rather than a specific demonstration of acidic neutralization.

• Uses of Sodium Ethanoate: Sodium ethanoate, the product of the reaction with sodium hydroxide, is widely used in industries for applications such as food preservation, buffering solutions, and dye production.

• Acidic Properties of Ethanoic Acid: Ethanoic acid is a weak acid, as it partially dissociates in water to release H^+ ions: CH3COOH <=> CH3COO^- + H^+. This property is responsible for its ability to participate in acid-base reactions.

Important Points

• Definition of Acids and Bases: According to the Bronsted-Lowry theory, acids are substances that donate protons (H^+), while bases accept protons. Ethanoic acid acts as an acid in reactions with bases like sodium hydroxide.

• Neutralization Reaction: This is a chemical reaction in which an acid and a base react quantitatively with each other. In the case of ethanoic acid and sodium hydroxide, the products are sodium ethanoate and water.

• pH of Ethanoic Acid: A dilute solution of ethanoic acid has a pH of around 4-5, indicating its weak acidic nature. It does not fully ionize in water, unlike strong acids such as hydrochloric acid.

• Industrial Applications: Ethanoic acid is used in the production of synthetic fibers, plastics, and food additives. Its reactions with bases and alcohols are foundational in industrial chemistry.

• Distinction Between Weak and Strong Acids: Ethanoic acid is a weak acid because it only partially dissociates in water. Strong acids, like sulfuric acid, fully dissociate and have a much lower pH.

**Q11. Answer: (a) Calcium carbonate**

The correct answer is Calcium carbonate.

Key Points

• When carbon dioxide (CO2) reacts with calcium hydroxide (Ca(OH)2), the product formed is calcium carbonate (CaCO3).

• Calcium hydroxide is commonly referred to as lime water, and when CO2 gas is passed through it, a white precipitate of calcium carbonate is formed.

• The chemical reaction for this process is:

Ca(OH)2 + CO2 → CaCO3 + H2O.

• This reaction is used as a qualitative test for the presence of carbon dioxide gas. The formation of a white precipitate indicates the presence of CO2.

• If excess CO2 is passed through lime water, the calcium carbonate reacts further to form calcium bicarbonate (Ca(HCO3)2), which is soluble in water.

Additional Information

• Calcium carbonate (CaCO3):

• It is a naturally occurring substance found in rocks such as limestone, marble, and chalk.

• It is widely used in various industries, including construction (cement production), agriculture (soil pH adjustment), and medicine (antacids).

• It is insoluble in water but reacts with acids to produce carbon dioxide gas.
• Sodium carbonate (Na2CO3):
• Also known as washing soda, it is a completely different compound and is not formed in this reaction.
• It is used in cleaning agents, glass manufacturing, and water softening processes.
• Calcium bicarbonate (Ca(HCO3)2):
• It forms when excess CO2 is bubbled through lime water, causing the initial calcium carbonate precipitate to dissolve.
• It is soluble in water and contributes to the hardness of water.
• Calcium oxide (CaO):
• Also known as quicklime, it is formed by heating calcium carbonate (CaCO3) strongly.
• This compound is not formed in the reaction between CO2 and lime water.
• It is used in cement production, steel manufacturing, and as a reagent for chemical processes.

Important Points

• Qualitative Test for CO2:
• The reaction between CO2 and lime water is a common laboratory experiment to test for the presence of carbon dioxide gas.
• The appearance of a white precipitate (CaCO3) confirms the presence of CO2.
• Reactions of CO2 with Bases:
• Carbon dioxide reacts with bases like calcium hydroxide to form carbonate or bicarbonate compounds.
• This is an example of an acid-base reaction where CO2 acts as an acidic oxide.
• Applications of Calcium Carbonate:
• Used in the production of chalk, lime, and cement.
• Acts as a filler in paper, rubber, and plastics industries.
• Used in water treatment to neutralize acidic water and adjust pH levels.

**Q12. Answer: (a) A series of compounds having the same general formula, similar chemical properties, and consecutive members...**

The correct answer is A series of compounds having the same general formula, similar chemical properties, and consecutive members differing by a -CH2- group..

Key Points

• Definition of Homologous Series: A homologous series is a group of organic compounds that follow a particular pattern, having the same general formula, similar chemical properties, and a regular difference in their molecular structures by a -CH2- group.
• Consecutive Members Differ by -CH2-: Each member in the homologous series differs from the next by a -CH2- unit. For example, in the alkane series, methane (CH4) and ethane (C2H6) differ by one -CH2- group.
• Similar Chemical Properties: Compounds in a homologous series exhibit similar chemical behavior because they have the same functional group. For instance, all alcohols (R-OH) show similar reactivity due to the hydroxyl group.
• Physical Properties Show Gradation: The physical properties, such as boiling points, melting points, and density, show a gradual change as the molecular size increases.
• Examples of Homologous Series: Common examples include the alkane series (CnH2n+2), alkene series (CnH2n), and alcohol series (CnH2n+1OH).

Additional Information

• Key Characteristics of Homologous Series:
• General Formula: All members of a homologous series can be represented by a single general formula. For example, alkanes can be represented as CnH2n+2.
• Functional Group: The chemical properties of the members are dictated by the presence of a functional group, such as -OH in alcohols or -COOH in carboxylic acids.
• Gradation in Physical Properties: The gradual change in physical properties is due to the increasing molecular mass or size. For instance, boiling points increase in the alkane series as more -CH2- groups are added.
• Option-wise Analysis:
• Option 1: Correct. It accurately describes the characteristics of a homologous series.
• Option 2: Incorrect. A homologous series cannot have different functional groups; this would lead to entirely different chemical properties.
• Option 3: Incorrect. This describes elements with similar physical properties, not a homologous series.
• Option 4: Incorrect. Homologous series can include both straight-chain and branched compounds, but the statement that all members have branched chains is not true.
• Examples of Homologous Series:

• Alkanes: Methane (CH4), ethane (C2H6), propane (C3H8).

• Alkenes: Ethene (C2H4), propene (C3H6), butene (C4H8).

• Alcohols: Methanol (CH3OH), ethanol (C2H5OH), propanol (C3H7OH).

Important Points

• Functional Group: The functional group determines the chemical reactivity of the compounds in the series. For example, -OH in alcohols makes them soluble in water and reactive towards acids.

• Applications: Homologous series help in the systematic study of organic compounds, prediction of properties, and identification of unknown compounds.

• Industrial Relevance: Many homologous series, such as alkanes and alcohols, are crucial in industries, including fuels, pharmaceuticals, and polymers.

• Nomenclature: Compounds in a homologous series follow the IUPAC nomenclature system, ensuring uniform naming.

**Q13. Answer: (a) 1 : 2**

The correct answer is 1 : 2.

Key Points

• Resistance and its formula: The resistance (R) of a wire is given by the formula: R = ρ × (L / A), where:

• ρ (rho): Resistivity of the material (same for both wires, as they are of the same material).

• L: Length of the wire (same for both wires).

• A: Cross-sectional area of the wire.

• Given condition: Wire A has twice the cross-sectional area of wire B. Let the cross-sectional area of wire B be A, then the cross-sectional area of wire A will be 2A.

• Relation between resistances: Since L and ρ are the same for both wires, the resistance ratio depends only on their cross-sectional areas. Using the formula R prop. to 1/A:

• Resistance of wire A, R_A = ρ × (L / 2A).

• Resistance of wire B, R_B = ρ × (L / A).

• Taking the ratio, R_A : R_B = (L / 2A) : (L / A) = 1 : 2.

• Final result: The ratio of their resistances is 1 : 2.

Additional Information

• Factors affecting resistance: The resistance of a wire depends on:

• Length (L): Resistance increases with an increase in length.

• Cross-sectional area (A): Resistance decreases with an increase in area.

• Material: The resistivity (ρ) of the material determines how much resistance it offers.

• Temperature: For most materials, resistance increases with an increase in temperature.

• Applications of resistance:

• Resistors are used in electrical circuits to control the flow of current.

• High-resistance materials are used as heating elements in devices like toasters and electric heaters.

• Understanding resistivity:

• Resistivity (ρ) is a material property that quantifies how strongly a material opposes the flow of electric current.

• It is measured in ohm-meters (Ω·m).

• Materials with low resistivity (like copper and silver) are good conductors, while materials with high resistivity (like rubber and glass) are insulators.

• Practical implications:

• Thicker wires (larger cross-sectional area) have lower resistance and are used in high-current applications.

• Longer wires have higher resistance, so they are avoided in designs where minimal energy loss is required.

**Q14. Answer: (d) The object’s momentum changes in the direction of the applied force**

The correct answer is The object’s momentum changes in the direction of the applied force..

Key Points

• Newton’s Second Law of Motion states that the rate of change of momentum of an object is directly proportional to the unbalanced force applied to it and occurs in the direction of the force.

• Momentum is defined as the product of the mass and velocity of an object. It is a vector quantity, meaning it has both magnitude and direction.

• When an unbalanced force is applied to an object, it creates an acceleration according to the equation F = ma (Force = Mass × Acceleration). This acceleration causes a change in the object’s velocity, and since momentum depends on velocity, the

momentum of the object also changes.

• The change in momentum occurs in the direction of the applied force, which is why the object's momentum changes in that specific direction.

• The other options are incorrect because:

• The object does not necessarily move in a circular path unless the force is centripetal (Option 1).

• The object does not come to rest immediately unless the force is applied in the opposite direction and is strong enough to stop the motion (Option 2).

• The momentum cannot remain unchanged when an unbalanced force is applied, as per Newton's Second Law (Option 3).

Additional Information

• Newton's Laws of Motion:

• First Law: States that an object will remain at rest or in uniform motion in a straight line unless acted upon by an external force (Law of Inertia).

• Second Law: Explains how the velocity of an object changes when it is subjected to an external force, mathematically expressed as F = ma.

• Third Law: States that for every action, there is an equal and opposite reaction.

• Momentum:

• It is a measure of the motion of an object and is calculated as p = mv, where p is momentum, m is mass, and v is velocity.

• Momentum is conserved in an isolated system where no external forces act.

• Unbalanced Force:

• An unbalanced force occurs when the forces acting on an object are not equal in magnitude and direction, causing the object to accelerate.

• Example: A car accelerating forward when the engine applies a forward force greater than the resistive forces (friction and air resistance).

• Applications of Newton's Second Law:

• It is used in designing vehicles to ensure proper acceleration and braking systems.

• It helps in understanding the motion of celestial bodies under gravitational forces.

• Engineers use it to calculate the forces acting on structures and machines.

Important Points

• SI Unit: The SI unit of momentum is kg·m/s, and force is measured in Newtons (N).

• Real-life Example: In sports, such as cricket, a fielder reduces the impact of catching a fast-moving ball by moving their hands backward to increase the time of impact, thereby reducing the force.

• Impulse: The change in momentum of an object is known as impulse, which is equal to the product of force and the time duration of the force applied.

• Rocket Propulsion: Newton's Second Law is key to explaining how rockets launch, as the expulsion of gas creates a force that changes the rocket's momentum.

**Q15. Answer: (b) Both A and B**

The correct answer is Both A and B.

Key Points

• Statement A: The large spaces between gas particles allow them to be easily squeezed into smaller volumes.

• This statement is correct. Gases have a unique property where their particles are widely spaced compared to solids and liquids. These large intermolecular spaces allow gases to be compressed easily under pressure.

• For example, gases like oxygen and nitrogen can be compressed into cylinders for medical or industrial purposes.

• Statement B: Gas particles have a high average kinetic energy.

• This statement is also correct. The kinetic energy of gas particles is directly proportional to the temperature of the gas (measured in Kelvin). As temperature increases, the particles move faster, indicating higher kinetic energy.

• The kinetic energy of gas particles is a fundamental concept in the kinetic molecular theory of gases.

• Both A and B are correct:

• Both statements align with the properties of gases. Statement A explains why gases are compressible, while statement B explains the relationship between temperature and particle motion in gases.

• These properties are crucial for understanding gas behavior in various applications, such as industrial gas storage, thermodynamics, and fluid dynamics.

Additional Information

• Kinetic Molecular Theory of Gases:

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• The theory describes the behavior of gas particles, assuming they are in constant random motion.

• The average kinetic energy of gas particles depends only on the temperature of the gas.

• Gases are assumed to have negligible intermolecular forces, and collisions between particles are perfectly elastic.

• Compressibility of Gases:

• Gases can be compressed due to the large spaces between their particles, as opposed to solids and liquids, where particles are closely packed.

• This property is utilized in various applications, such as compressed natural gas (CNG) and liquefied petroleum gas (LPG) storage.

• Relationship Between Temperature and Kinetic Energy:

• The kinetic energy of gas particles is proportional to the absolute temperature (Kelvin scale).

• For example, doubling the temperature of a gas doubles the average kinetic energy of its particles.

• Applications of Gas Properties:

• Compressibility is crucial for gas storage in industries and medical applications.

• The relationship between temperature and kinetic energy is used in thermodynamics and heat engines.

Important Points

• Boyle's Law: At constant temperature, the pressure of a gas is inversely proportional to its volume, which explains the compressibility of gases.

• Charles's Law: At constant pressure, the volume of a gas is directly proportional to its absolute temperature, linking temperature and particle motion.

• Real vs. Ideal Gases: While the above properties apply to ideal gases, real gases deviate under high pressure and low temperature due to intermolecular forces.

• Practical Uses: Understanding gas behavior is essential in fields like meteorology, aviation, and chemical engineering.

**Q16. Answer: (c) Using CFC-based refrigerants and spray cans**

The correct answer is Using CFC-based refrigerants and spray cans.

Key Points

• Chlorofluorocarbons (CFCs), used in refrigeration, air conditioning, and aerosol spray cans, are one of the primary contributors to ozone layer depletion. These compounds release chlorine atoms upon exposure to ultraviolet (UV) radiation, which then react with ozone (O3) molecules, breaking them apart.

• The ozone layer is crucial for shielding the Earth from harmful UV-B radiation. Depletion of the ozone layer increases the risk of skin cancer, cataracts, and other health issues, as well as negatively impacting ecosystems and wildlife.

• CFCs were widely used in the 20th century due to their stability, non-flammability, and low toxicity. However, their negative impact on the ozone layer was discovered in the 1970s, leading to global efforts to phase them out.

• The 1987 Montreal Protocol was a landmark international treaty aimed at reducing the production and consumption of ozone-depleting substances, including CFCs. It has been highly effective in curbing ozone depletion.

• Alternative substances, such as hydrofluorocarbons (HFCs), have been developed to replace CFCs. However, HFCs are potent greenhouse gases and contribute to global warming, necessitating further innovation in sustainable refrigerants.

Additional Information

• Ozone Layer:

• The ozone layer is a region in the Earth's stratosphere that contains a high concentration of ozone (O3) molecules. It absorbs most of the Sun's harmful ultraviolet radiation, particularly UV-B and UV-C rays.

• The majority of ozone is found between 15 and 35 kilometers above the Earth's surface in a region called the stratosphere.

• Ozone depletion results in the formation of the "ozone hole," primarily observed over Antarctica during the spring (September to November).

• Other Ozone-Depleting Substances (ODS):

• In addition to CFCs, other ODS include halons (used in fire extinguishers), carbon tetrachloride, methyl chloroform, and methyl bromide (used in pesticides).

• These substances release halogen atoms (chlorine or bromine) when exposed to UV radiation, which then catalyze ozone destruction.

• Global Efforts to Protect the Ozone Layer:

• The Montreal Protocol (1987) is a legally binding international treaty that has been ratified by 198 countries. It has successfully phased out 99% of ozone-depleting substances globally.

• The Kigali Amendment (2016) to the Montreal Protocol focuses on phasing down hydrofluorocarbons (HFCs), which are potent greenhouse gases.

• Impact of Ozone Depletion:

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• Increased exposure to UV radiation can lead to skin cancer, cataracts, and weakened immune systems in humans.

• UV radiation can also harm phytoplankton, the base of marine food chains, and damage crops, leading to reduced agricultural productivity.

• Options Analysis:

• Conserving water: Water conservation does not contribute to ozone depletion. It is an environmentally beneficial practice aimed at reducing water wastage. (Incorrect)

• Composting organic waste: Composting organic waste reduces landfill emissions and promotes soil fertility but has no impact on the ozone layer. (Incorrect)

• Using CFC-based refrigerants and spray cans: This is the primary human activity responsible for ozone layer depletion due to the release of chlorine atoms. (Correct)

• Using solar energy: Solar energy is a clean and renewable energy source that does not contribute to ozone depletion. (Incorrect)

**Q17. Answer: (b) Stratified squamous epithelium**

The correct answer is Stratified squamous epithelium.

Key Points

• The outer layer of the skin, also known as the epidermis, is primarily composed of stratified squamous epithelium. This tissue type is specialized to provide protection against mechanical stress, pathogens, and dehydration.

• Stratified squamous epithelium consists of multiple layers of cells, with the outermost layer being keratinized (hardened) to form a tough, protective barrier.

• This tissue type is particularly suited for areas exposed to friction and wear, such as the surface of the skin, due to its ability to regenerate quickly through mitotic activity in the basal layers.

• The keratinized layer of the epidermis is made up of dead cells filled with the protein keratin, which is essential for waterproofing and enhancing the skin's mechanical strength.

• The basal layer of the stratified squamous epithelium contains melanocytes, which produce melanin, contributing to skin pigmentation and protection against ultraviolet (UV) radiation.

Additional Information

• Other Types of Epithelial Tissues:

• Cuboidal epithelium: Composed of cube-shaped cells, this tissue is found in glands, kidney tubules, and the thyroid gland. It is involved in secretion and absorption.

• Columnar epithelium: Made up of tall, column-like cells, it lines the stomach, intestines, and respiratory tract, aiding in absorption and secretion. Some columnar cells may have cilia to move substances.

• Simple squamous epithelium: Consists of a single thin layer of flat cells, enabling easy diffusion of gases and nutrients. It is found in the lungs (alveoli), blood vessels, and glomeruli of kidneys.

• Skin Structure:

• The skin comprises three main layers: the epidermis (outermost), dermis (middle), and hypodermis (innermost).

• The dermis contains connective tissue, blood vessels, sweat glands, and nerve endings.

• The hypodermis, or subcutaneous layer, is primarily made of fat and connective tissue, providing insulation and cushioning.

• Functions of the Skin:

• Protection from environmental damage, including microorganisms, UV radiation, and physical injuries.

• Regulation of body temperature through sweat glands and blood vessel dilation or constriction.

• Sensation of touch, pressure, pain, and temperature through embedded sensory receptors.

• Prevention of water loss through the keratinized layer.

• Keratinization:

• The process by which cells in the epidermis produce keratin, a structural protein, and eventually die to form the tough outer layer of the skin.

• This process is crucial for creating a barrier that is both waterproof and resistant to physical damage.

Important Points

• Melanocytes and Melanin:

• Melanocytes are specialized cells found in the basal layer of the epidermis that produce the pigment melanin.

• Melanin provides skin pigmentation and protects against UV radiation by absorbing harmful rays.

• Skin Disorders:

• Conditions like psoriasis and eczema involve the abnormal functioning of epidermal cells.

• Skin cancer, such as melanoma, arises from uncontrolled growth of melanocytes.

**Q18. Answer: (d) g = GM / R2**

The correct answer is g = GM / R².

Key Points

• Acceleration due to gravity is the force experienced by an object of unit mass due to the gravitational pull of a celestial body (planet, star, etc.). It is denoted by g.

• The formula for calculating acceleration due to gravity on the surface of a planet is derived from Newton's Law of Gravitation.

• The gravitational force is given by the formula: F = GMm / R², where:

• G: Universal gravitational constant (6.674 × 10^-11 N·m²/kg²).

• M: Mass of the planet.

• m: Mass of the object experiencing the force.

• R: Radius of the planet.

• The acceleration due to gravity, g, is derived by dividing the gravitational force by the mass of the object:

• g = F/m = GM/R².

• Therefore, the correct expression for acceleration due to gravity is g = GM / R².

Additional Information

• Universal Gravitational Constant (G):

• The value of G is constant throughout the universe.

• Its value is 6.674 × 10^-11 N·m²/kg².

• G was first measured by Henry Cavendish in the late 18th century using the torsion balance experiment.

• Factors Affecting Acceleration Due to Gravity:

• Mass of the planet (M): Higher the mass, greater the gravitational pull and hence the higher the value of g.

• Radius of the planet (R): Larger the radius, lower the value of g due to the inverse square relationship.

• Altitude: As the altitude increases, the value of g decreases because the distance from the center of the planet increases.

• Latitude: Due to the planet's rotation, the value of g is slightly lower at the equator and higher at the poles.

• Applications of Acceleration Due to Gravity:

• Used in calculating the weight of an object (Weight = mass × g).

• Essential in physics experiments such as free-fall and projectile motion.

• Helps in determining escape velocity (velocity required to escape the gravitational field of a planet).

• Variation of g with Depth:

• The value of g decreases as one moves towards the center of the planet.

• At the center of the planet, g = 0 because the gravitational forces cancel out.

Important Points

• Weight vs. Mass:

• Mass is a scalar quantity and remains constant irrespective of location.

• Weight is a vector quantity and depends on the value of g.

• Moon's Gravity:

• The value of g on the Moon is approximately 1/6th of that on Earth.

• It is due to the Moon's smaller mass and radius compared to Earth.

• Gravitational Anomalies:

• Local variations in g may occur due to differences in the Earth's crust density or topographical features.

**Q19. Answer: (c) Fragmentation**

The correct answer is Fragmentation.

Key Points

• Fragmentation is a type of asexual reproduction in which a new organism develops from a fragment or broken portion of the parent organism.

• This process is commonly observed in certain plants and organisms such as algae, fungi, and some animals like sponges and flatworms.

• The broken fragment of the parent plant has the ability to regenerate and grow into a complete, independent organism under suitable environmental conditions.

• Fragmentation is different from other methods of asexual reproduction like binary fission and spore formation, as it specifically involves the physical splitting of the parent organism.

• Examples of plants that reproduce through fragmentation include hydra, moss, and liverwort. Certain algae, such as Spirogyra,

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also exhibit this form of reproduction.

Additional Information

• Spore Formation:

• Spore formation is another type of asexual reproduction where organisms produce spores that can grow into new individuals.

• It is common in fungi, bacteria, and certain plants like ferns and mosses.

• Spores are microscopic structures that are resistant to harsh conditions and can remain dormant until favorable conditions arise.

• Fertilization:

• Fertilization is a process of sexual reproduction where the male and female gametes fuse to form a zygote.

• This process is not related to asexual reproduction and involves genetic mixing of two parents.

• Examples include reproduction in humans, animals, and flowering plants.

• Binary Fission:

• Binary fission is a method of asexual reproduction in unicellular organisms like bacteria and amoeba.

• The parent organism splits into two identical daughter organisms, each inheriting the genetic material of the parent.

• This process is faster and commonly observed in prokaryotic organisms.

• Applications of Fragmentation:

• Fragmentation is widely utilized in horticulture and agriculture to propagate plants.

• It ensures genetic uniformity, which is useful for maintaining desired traits in crops or ornamental plants.

• This method is particularly beneficial for reproducing species that do not produce viable seeds.

Important Points

• Comparison of Asexual Reproduction Methods:

• Fragmentation: Involves physical splitting; requires regeneration capabilities.

• Spore Formation: Involves production of spores; resistant to extreme conditions.

• Binary Fission: Quick division of unicellular organisms into two identical cells.

• Budding: Formation of a new organism from a small outgrowth (bud) on the parent.

• Advantages of Fragmentation:

• Allows for rapid reproduction and colonization.

• Ensures genetic uniformity, which is beneficial for stable environments.

• Does not require pollinators or external reproductive agents.

• Environmental Requirements:

• Fragmentation requires adequate moisture, nutrients, and temperature for successful regeneration.

• In aquatic environments, fragmentation is highly efficient due to water's ability to carry fragments to new locations.

**Q20. Answer: (d) compound**

The correct answer is compound.

Key Points

• The formula unit mass of a substance is the sum of the atomic masses of all the atoms present in its formula unit. For compounds, the formula unit represents the simplest ratio of the ions or atoms in the compound.

• This concept is applicable to both ionic compounds and molecular compounds. For example, the formula unit mass of sodium chloride (NaCl) is calculated by adding the atomic masses of sodium (Na) and chlorine (Cl).

• In the case of a compound, the formula unit is representative of the smallest repeating unit that retains the compound's chemical identity.

• The formula unit mass is expressed in atomic mass units (amu) or unified mass units (u), where 1 amu is defined as one-twelfth of the mass of a carbon-12 atom.

• Hence, the formula unit mass is directly relevant to compounds and not to atoms, mixtures, or individual elements.

Additional Information

• Atomic Mass:

• The mass of a single atom is called its atomic mass. It is measured in atomic mass units (amu).

• For example, the atomic mass of hydrogen is approximately 1 amu, and that of oxygen is approximately 16 amu.

• Molecular Mass:

• The molecular mass of a substance is the sum of the atomic masses of all the atoms in a molecule of the substance.

• For example, the molecular mass of water ($H_2O$) is calculated as: (2 × atomic mass of H) + (1 × atomic mass of O) = (2 × 1) + (1 × 16) = 18 amu.

• Difference Between a Compound and a Mixture:

• A compound is a pure substance composed of two or more elements chemically combined in a fixed proportion, e.g., sodium chloride (NaCl).

• A mixture is a combination of two or more substances that are not chemically combined, e.g., air or salt water.

• Examples of Formula Unit Mass:

• The formula unit mass of sodium chloride (NaCl): (atomic mass of Na) + (atomic mass of Cl) = 23 + 35.5 = 58.5 amu.

• The formula unit mass of calcium chloride (CaCl2): (atomic mass of Ca) + 2 × (atomic mass of Cl) = 40 + 2 × 35.5 = 111 amu.

Important Points

• Atoms: Atoms are the smallest units of an element that retain its chemical properties. The concept of formula unit mass does not apply to individual atoms.

• Elements: Elements are pure substances consisting of only one type of atom. The formula unit mass is not relevant to elements as they are not made of multiple atoms in a fixed ratio.

• Mixtures: Mixtures are physical combinations of substances that do not have a definite composition or formula unit. Hence, formula unit mass is not applicable to mixtures.

• Compounds: Compounds are substances formed by the chemical combination of two or more elements in a fixed ratio. The formula unit mass is specifically used for compounds, especially ionic compounds.

**Q21. Answer: (b) 2, 8, 7**

The correct answer is 2.

Key Points

• The distributions of electrons in the K, L, and M shells of the chlorine atom are 2, 8, and 7 respectively.

• The chlorine atom has an atomic number of 17, which determines the number of electrons present in a neutral atom.

• Electrons are distributed across shells based on the $2n^2$ rule, where "n" represents the shell number.

• The K shell (n=1) can hold up to 2 electrons, the L shell (n=2) can hold up to 8 electrons, and the M shell (n=3) can hold up to 18 electrons. However, chlorine only needs 7 electrons in the M shell to complete its configuration.

• Thus, the electron configuration for chlorine is 2, 8, 7, aligning with option 2.

Additional Information

• Electron Shell Distribution:

• Electrons are arranged in shells around the nucleus of an atom. The shells are labeled as K, L, M, N, etc., starting from the innermost shell.

• The capacity of each shell is determined by the formula $2n^2$, where "n" represents the shell number.

• For chlorine, the atomic number 17 means it has 17 electrons distributed as 2 in K shell, 8 in L shell, and 7 in M shell.

• Valence Electrons:

• Chlorine has 7 valence electrons in its outermost shell (M shell).

• Valence electrons determine an atom's chemical properties, including its ability to bond with other atoms.

• Chlorine is highly reactive due to its tendency to gain 1 electron to complete its octet.

• Chlorine Atom:

• Chlorine is a chemical element with the symbol Cl and atomic number 17.

• It is a halogen and belongs to Group 17 of the periodic table.

• Chlorine is widely used in industry for water purification, chemical synthesis, and disinfection.

• Electronic Configuration:

• The electronic configuration of chlorine is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$, representing the distribution of electrons in its orbitals.

• This configuration highlights chlorine's tendency to form ionic bonds by gaining an electron, resulting in a stable chloride ion ($Cl^-$).

• Periodic Table Context:

• Chlorine belongs to the halogen family, which includes elements like fluorine, bromine, iodine, and astatine.

• Halogens are known for their high reactivity due to their need to gain one electron to complete their octet.

• Chlorine's position in the periodic table helps predict its chemical behavior and interactions.

**Q22. Answer: (d) Sexual reproduction**

The correct answer is Sexual reproduction.

Key Points

• Sexual reproduction is a biological process in which the fusion of male and female gametes occurs, resulting in the formation of a zygote that develops into a new organism.

• It involves two parent organisms contributing genetic material, ensuring genetic diversity in the offspring.

• This method of reproduction is prevalent in higher plants, animals, and humans.

• Key stages of sexual reproduction include: gamete formation (through meiosis), fertilization (fusion of gametes), and development of the zygote into a new organism.

• Sexual reproduction plays a crucial role in evolution, as it allows for the mixing of genetic material, leading to better adaptability and survival of species.

Additional Information

• Binary fission:

• This is an asexual reproduction method in which a single organism divides into two identical daughter cells.

• It occurs in prokaryotes such as bacteria and some unicellular eukaryotes like amoeba.

• Binary fission does not involve gametes or genetic recombination, resulting in genetically identical offspring.

• Cloning:

• Cloning is an artificial asexual reproduction technique where an exact genetic copy of an organism is created.

• Examples include Dolly the sheep, the first mammal cloned using somatic cell nuclear transfer.

• Clones lack genetic diversity, making them prone to diseases and less adaptable to environmental changes.

• Budding:

• Budding is a form of asexual reproduction where a new organism develops as an outgrowth, or bud, from the parent body.

• It occurs in organisms like yeast, hydra, and some plants.

• The bud eventually detaches and grows into a new individual, genetically identical to the parent.

• Sexual reproduction in detail:

• It involves meiosis, a type of cell division that reduces the chromosome number by half, producing haploid gametes.

• Fertilization restores the diploid chromosome number, forming a zygote.

• Examples include flowering plants (pollination) and humans (internal fertilization).

• Advantages include genetic variation, adaptability, and resilience to environmental changes.

Important Points

• Fertilization in sexual reproduction:

• It can be internal (as in mammals) or external (as in amphibians and fish).

• In internal fertilization, the fusion of gametes takes place inside the female body, ensuring better protection of the zygote.

• Applications of sexual reproduction:

• It is crucial in agriculture for breeding new plant varieties with desirable traits.

• In medical science, understanding sexual reproduction aids in fertility treatments and addressing genetic disorders.

• Evolutionary significance:

• Sexual reproduction fosters natural selection by allowing beneficial traits to spread in a population.

• It helps species adapt to changing environments and increases their chances of survival.

**Q23. Answer: (c) It must be at rest**

The correct answer is It must be at rest.

Key Points

• Kinetic Energy (KE) of a particle is given by the formula: $KE = (1/2)mv^2$, where m is the mass of the particle and v is its velocity. If kinetic energy is zero, the velocity must also be zero.

• A particle with zero velocity implies that it is not in motion. Hence, the particle must be at rest.

• Momentum of a particle is given by the formula: $p = mv$. Since velocity (v) is zero, the momentum of the particle is also zero.

• The particle cannot have maximum momentum (as suggested in Option 1) or any motion-related property like acceleration (as suggested in Option 2) because both require movement.

• If the particle is at rest, it cannot move with a uniform velocity (as suggested in Option 4) or any velocity other than zero.

• Conclusion: A particle with zero kinetic energy is necessarily at rest.

Additional Information

• Kinetic Energy (KE):

• Kinetic energy is a type of mechanical energy associated with the motion of an object.

• It depends on two factors: the mass of the object and the square of its velocity. Hence, even a small velocity contributes significantly to the particle's kinetic energy.

• Units: The SI unit of kinetic energy is the joule (J).

• Momentum:

• Momentum is a vector quantity defined as the product of an object's mass and velocity.

• If the velocity is zero, the momentum of the particle is also zero, irrespective of its mass.
• Units: The SI unit of momentum is kilogram meter per second (kg·m/s).
• Rest and Motion:
• An object is said to be at rest when its position does not change with respect to a reference point over time.
• An object is in motion when its position changes with respect to a reference point over time.
• Applications of Kinetic Energy:
• Kinetic energy plays a crucial role in various fields such as transportation, sports, and mechanical systems.
• Examples: Moving vehicles, flying aircraft, spinning turbines, and flowing rivers all possess kinetic energy.

Important Points

• Relation Between Kinetic Energy and Momentum:
• Kinetic energy and momentum are related by the equation: $KE = p^2 / 2m$, where p is momentum and m is mass.
• If kinetic energy is zero, momentum must also be zero.
• Zero Kinetic Energy:
• An object with zero kinetic energy cannot move until acted upon by an external force, as per Newton's First Law of Motion.
• It signifies the absence of motion in the reference frame being observed.
• Conservation of Energy:
• In an isolated system, the total energy (potential + kinetic) remains constant. If kinetic energy is zero, the energy might be in another form, like potential energy.

**Q24. Answer: (d) Nuclear membrane is a non-porous and rigid structure.**

The correct answer is Nuclear membrane is a non-porous and rigid structure..

Key Points

• The nucleus plays a central role in cellular reproduction: The nucleus is responsible for regulating the cell cycle, mitosis, and meiosis. It contains genetic information essential for cell division, ensuring the accurate transmission of DNA to daughter cells. Hence, this statement is correct.
• The nucleus contains chromosomes: Chromosomes are thread-like structures made of DNA and proteins found within the nucleus. They carry genetic information required for cellular functions and reproduction. Hence, this statement is correct.
• The nuclear membrane is a double-layered structure: The nuclear envelope consists of two lipid bilayers—an inner membrane and an outer membrane. This structure separates the nucleus from the cytoplasm. Hence, this statement is correct.
• Nuclear membrane is a non-porous and rigid structure: This is incorrect because the nuclear membrane is porous, allowing the exchange of materials like RNA and proteins between the nucleus and cytoplasm. The pores are part of the nuclear pore complex, which facilitates selective transport. The membrane is also flexible, adapting to changes during cell division. Hence, this statement is incorrect.

Additional Information

• Nuclear Membrane:
• The nuclear membrane, also known as the nuclear envelope, is a double-layered structure that separates the nucleus from the cytoplasm.
• It contains nuclear pores, which are complexes facilitating selective transport of molecules like RNA and proteins.
• The nuclear envelope disassembles during cell division (mitosis) and reassembles afterward.
• Chromosomes:
• Chromosomes are composed of DNA and histone proteins, forming a structure called chromatin.
• In humans, there are 46 chromosomes (23 pairs), which include autosomes and sex chromosomes.
• They are essential for carrying genetic information and guiding protein synthesis through gene expression.
• Role of Nucleus in Cellular Reproduction:
• The nucleus orchestrates both mitosis (cell division for growth and repair) and meiosis (cell division for reproduction).
• It ensures the accurate replication and distribution of genetic material through processes like DNA replication and chromosome segregation.
• Nuclear Pore Complex:
• The nuclear pores are large protein complexes embedded within the nuclear envelope.
• They regulate the selective transport of molecules between the nucleus and the cytoplasm, allowing the exchange of RNA, ribosomal subunits, and proteins.
• These pores play a crucial role in maintaining nuclear-cytoplasmic communication.

Important Points

• Nuclear Membrane Dynamics:

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• The nuclear membrane breaks down during mitosis to allow chromosome segregation.

• It reforms after mitosis to encapsulate the genetic material within the daughter nuclei.

• Nucleus as the Control Center:

• The nucleus regulates gene expression by controlling transcription (RNA synthesis).

• It stores genetic material in the form of DNA, which directs all cellular activities.

**Q25. Answer: (d) River lift system**

The correct answer is River lift system.

Key Points

• The River lift system is ideal for areas with irregular water supply from reservoirs or canals, as it utilizes available water from nearby rivers by pumping it to the fields for irrigation.

• This system ensures a consistent water supply for irrigation, making it suitable for regions where the canal system is unreliable or intermittent.

• The system involves lifting water from rivers to higher elevations using pumps and supplying it to agricultural lands, ensuring proper irrigation during dry spells.

• It helps in achieving better water management and is particularly effective in areas where farmers live near rivers but face challenges with reservoir-fed canal systems.

• The Government of India promotes such systems under various agricultural and irrigation schemes to enhance productivity and water efficiency.

Additional Information

• Sprinklers:

• Sprinkler irrigation involves spraying water uniformly across the field, mimicking rainfall.

• It is suitable for areas with adequate water pressure but not ideal for regions with irregular water supply as it requires consistent water flow.

• Sprinklers are commonly used for crops like vegetables, fruits, and flowers where water conservation is essential.

• Wells:

• Wells are a traditional source of irrigation, drawing groundwater for agricultural use.

• They are beneficial in areas with significant groundwater reserves but may not be sustainable in regions with low water tables.

• Excessive reliance on wells can lead to groundwater depletion, making them unsuitable for areas with irregular water supply.

• Flood irrigation:

• Flood irrigation involves directly flooding the fields with water, which is less efficient and results in water wastage.

• It is suitable for regions with abundant water resources but not ideal for areas with irregular reservoir-fed canal systems.

• This method can lead to soil erosion and nutrient leaching, reducing agricultural productivity.

• River lift system:

• The system is particularly effective in areas near rivers where farmers face challenges in accessing regular canal water supply.

• It ensures equitable water distribution, supports irrigation during dry periods, and minimizes dependency on reservoirs.

• It is an important tool for regions with inconsistent canal water supply, enhancing agricultural output and reducing water scarcity issues.

Important Points

• Government Initiatives:

• The Pradhan Mantri Krishi Sinchai Yojana (PMKSY) promotes efficient water management systems like river lift irrigation to ensure "Har Khet Ko Pani" (Water for Every Field).

• Under PMKSY, financial assistance is provided to implement sustainable irrigation systems, including pumps and lift irrigation setups.

• Examples:

• In states like Maharashtra and Andhra Pradesh, river lift systems have been successfully implemented to address water scarcity and improve agricultural productivity.

• Such systems help farmers achieve better yields even in regions with unpredictable water supply from reservoirs.

**Q26. Answer: (d) 29 km/hr**

Shortcut Trick

Relative Speed in opposite direction = (Sum of lengths) ÷ Time

Relative Speed = (239 + 161) ÷ 20 = 400 ÷ 20 = 20 m/s

Convert m/s to km/hr: 20 × (18/5) = 72 km/hr

Speed of second train = Relative Speed − Speed of first train = 72 − 43 = 29 km/hr

Therefore The correct answer is 29 km/hr.

Alternate Method

Given:

Length of first train (L1) = 239 m

Length of second train (L2) = 161 m

Speed of first train (S1) = 43 km/hr

Time taken to cross each other = 20 seconds

Formula Used:

Relative Speed (Opposite Direction) = S1 + S2

Distance = Relative Speed × Time

Conversion: 1 m/s = 18/5 km/hr

Calculations:

Let the speed of the second train be S2 km/hr.

=> Total distance to be covered = L1 + L2

=> Distance = 239 + 161 = 400 m

=> Relative Speed in m/s = Total Distance ÷ Time

=> Relative Speed = 400 ÷ 20 = 20 m/s

=> Relative Speed in km/hr = 20 × (18/5)

=> Relative Speed = 4 × 18 = 72 km/hr

=> Since they are moving in opposite directions, Relative Speed = S1 + S2

=> 72 = 43 + S2

=> S2 = 72 − 43

=> S2 = 29 km/hr

Therefore The correct answer is 29 km/hr.

Additional Information

Relative Speed Concept

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

Crossing Distance

To cross each other completely, the total distance covered is always the sum of the lengths of both trains (L1 + L2), regardless of direction.

Unit Conversion

To convert speed from km/hr to m/s, multiply by 5/18. To convert from m/s to km/hr, multiply by 18/5.

**Q27. Answer: (a) Rs. 6,336**

Shortcut Trick

Net percentage change for 2 years at 20% = 20 + 20 + (20 × 20) ÷ 100 = 44%

Total amount percentage = 100% (Principal) + 44% (Interest) = 144%

Required Amount = 4400 × 144%

Amount = 44 × 144 = 6336

Therefore The correct answer is Rs. 6,336.

Alternate Method

Given:

Principal (P) = Rs. 4,400

Rate (R) = 20% per annum

Time (n) = 2 years

Formula Used:

Amount (A) = $P(1 + R \div 100)^n$

Calculations:

=> $A = 4400 \times (1 + 20 \div 100)^2$

=> $A = 4400 \times (1 + 1 \div 5)^2$

=> A = 4400 × (6 ÷ 5)²
=> A = 4400 × (36 ÷ 25)
=> A = 176 × 36
=> A = 6336
Therefore The correct answer is Rs. 6,336.
Additional Information
Effective Interest Rate
For a rate of r% for 2 years, the effective compound interest rate is calculated as r + r + (r × r) ÷ 100.
CI vs SI Difference
The difference between Compound Interest and Simple Interest for 2 years is given by P × (R ÷ 100)².
Compounding Periods
If interest is compounded half-yearly, the rate becomes R ÷ 2 and the time period becomes 2n in the formula A = P(1 + R ÷ 100)ⁿ.

**Q28. Answer: (c) 72**

Shortcut Trick
For numbers a, b, c, d to be in proportion by adding x, x = (ad − bc) / ((b + c) − (a + d))
x = (10 × 28 − 14 × 38) / ((14 + 38) − (10 + 28)) = (280 − 532) / (52 − 38) = −252 / 14 = −18
Given 3x : y :: y : (5x − 6) => y² = 3x(5x − 6)
y² = 3(−18) × [5(−18) − 6] = −54 × (−90 − 6) = −54 × −96 = 5184
y = √5184 = 72
Therefore The correct answer is 72.
Alternate Method
Given numbers: 10, 14, 38, 28
Condition: (10 + x), (14 + x), (38 + x), (28 + x) are in proportion.
From the proportion:
=> (10 + x) / (14 + x) = (38 + x) / (28 + x)
=> (10 + x)(28 + x) = (14 + x)(38 + x)
=> 280 + 10x + 28x + x² = 532 + 14x + 38x + x²
=> 280 + 38x = 532 + 52x
=> 52x − 38x = 280 − 532
=> 14x = −252
=> x = −18
Now, given 3x : y :: y : (5x − 6):
=> y² = 3x × (5x − 6)
=> y² = 3(−18) × [5(−18) − 6]
=> y² = −54 × (−90 − 6)
=> y² = −54 × −96
=> y² = 5184
=> y = √5184
=> y = 72 (Since y > 0)
Therefore The correct answer is 72.
Additional Information
Mean Proportional
If a, b, c are in continued proportion, then b is the mean proportional where b² = ac or b = √ac.
Fourth Proportional
If a, b, c, d are in proportion, then d is called the fourth proportional, and a/b = c/d or ad = bc.
Third Proportional
In the continued proportion a : b :: b : c, c is the third proportional to a and b, given by c = b² / a.

**Q29. Answer: (d) 5,328**

Shortcut Trick
Cost Price (CP) is taken as 100%.

Discount = 28% of CP.

Selling Price (SP) = CP − Discount% = 100% − 28% = 72%.

SP = 7,400 × 72/100 = 74 × 72 = 5,328.

Therefore The correct answer is Rs. 5,328.

Alternate Method

Given: Cost Price (CP) = Rs. 7,400 and Discount% = 28%.

Formula Used: Selling Price = Cost Price − (Discount% × Cost Price)

=> Discount Amount = 28% of 7,400

=> Discount Amount = (28 ÷ 100) × 7,400

=> Discount Amount = 28 × 74 = 2,072

=> Selling Price = 7,400 − 2,072

=> Selling Price = 5,328

Therefore The correct answer is Rs. 5,328.

Additional Information

Standard Discount Formula

Generally, discount is offered on the Marked Price (MP). SP = MP − Discount.

Successive Discounts

If two discounts d1% and d2% are given, effective discount = (d1 + d2 − (d1 × d2)/100)%.

Profit and Loss Percentage

Profit % = (Profit/CP) × 100 and Loss % = (Loss/CP) × 100.

**Q30. Answer: (d) 15 m**

Shortcut Trick

In a right-angled triangle, if the angle of elevation/depression is 45°, then the Perpendicular and Base are always equal (Ratio 1 : 1).

Height of building (Perpendicular) = 15 m

Horizontal distance (Base) = Height of building

Therefore Horizontal distance = 15 m

Therefore The correct answer is 15 m.

Given:

Height of the building (AB) = 15 m

Angle of depression from top A to point C = 45°

Angle of elevation from point C to top A = 45° (Alternate interior angles)

Formula Used:

tan θ = Perpendicular / Base

In right-angled triangle ABC:

=> tan 45° = AB / BC

=> 1 = 15 / BC

=> BC = 15 m

Therefore The correct answer is 15 m.

Standard Trigonometric Ratios

For 30°, tan 30° = 1/√3; For 60°, tan 60° = √3. These are commonly used to find heights and distances.

Angle of Depression vs Elevation

The angle of depression from an observer to an object is numerically equal to the angle of elevation from the object to the observer due to parallel horizontal lines.

Pythagoras Theorem

In any right-angled triangle, Hypotenuse² = Perpendicular² + Base². In this case, AC = √(15² + 15²) = 15√2 m.

**Q31. Answer: (a) 92.1**

Shortcut Trick

Assume the base average for all students is 95.

Group 1 (22 students) has an average of 85, which is 10 less than 95.

Total deviation = 22 × (−10) = −220.

Average deviation for the whole class = −220 ÷ 75 ≈ −2.93.

Whole class average = 95 − 2.93 = 92.066... ≈ 92.1.

Therefore The correct answer is 92.1.

Alternate Method

Given: Total students = 75 | Group 1 = 22 students | Average 1 = 85 | Average 2 = 95

Formula: Combined Average = (n1 × x1 + n2 × x2) ÷ (n1 + n2)

=> Number of students in Group 2 = 75 − 22 = 53 => Sum of scores for Group 1 = 22 × 85 = 1870 => Sum of scores for Group 2 = 53 × 95 = 5035 => Total sum of scores = 1870 + 5035 = 6905 => Combined Average = 6905 ÷ 75 => Combined Average = 92.0666... => Rounded Average ≈ 92.1

Therefore The correct answer is 92.1.

Additional Information

Weighted Average

When groups have different sizes, the combined average is the sum of products of group sizes and their averages, divided by the total count.

Deviation Method

Assume a temporary mean to simplify calculations. The true mean = Assumed Mean + (Sum of deviations ÷ Total count).

Rounding Rule

To round to one decimal place, look at the second decimal digit; if it is 5 or more, increase the first decimal digit by 1.

**Q32. Answer: (b) 8,800**

Shortcut Trick

Net ratio: Profit 25% (4 → 5) and Loss 10% (10 → 9)

Combined multiplier = (5/4) × (9/10) = 45/40 = 9/8

Final Selling Price = Rs. 9,900 => 9 units = 9,900

1 unit = 1,100

Initial CP = 8 units = 8 × 1,100 = Rs. 8,800

Therefore The correct answer is Rs. 8,800.

Alternate Method

Given: Profit% = 25%, Loss% = 10%, Final Selling Price = Rs. 9,900

Formula: Final SP = CP × (100 + Gain%)/100 × (100 − Loss%)/100

=> Let the cost price for the first trader be Rs. x.

=> First selling price = x × (125/100) = 1.25x

=> Final selling price = 1.25x × (90/100)

=> 1.25x × 0.9 = 9,900

=> 1.125x = 9,900

=> x = 9,900 / 1.125

=> x = 9,900 ÷ (9/8)

=> x = 1,100 × 8

=> x = 8,800

Therefore The correct answer is Rs. 8,800.

Additional Information

Successive Percentage Change

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

Effective Multiplying Factor

For chain transactions, the final value = Initial Value × mf1 × mf2 × ... × mf_n, where mf is the multiplying factor (1 ± r/100).

Profit and Loss Basics

Profit = SP − CP; Loss = CP − SP; SP = CP × (100 + P%)/100 or CP × (100 − L%)/100.

**Q33. Answer: (d) 791.28 m2**

Shortcut Trick

Ratio of Volume to CSA = ($\pi r^2 h$) / ($2\pi rh$) = r/2

=> r/2 = 1695.6 ÷ 565.2 = 3

=> Radius (r) = 6 m

=> TSA = CSA + 2 × π × r²

=> TSA = 565.2 + 2 × 3.14 × 36 = 565.2 + 226.08 = 791.28 m²

Therefore The correct answer is 791.28 m².

Alternate Method

Given: Curved Surface Area (CSA) = 565.2 m², Volume (V) = 1695.6 m³, π = 3.14

Formulae: Volume = πr²h | CSA = 2πrh | TSA = CSA + 2πr²

=> Volume / CSA = (πr²h) / (2πrh) = 1695.6 / 565.2

=> r / 2 = 3

=> r = 6 m

=> TSA = CSA + 2 × π × r²

=> TSA = 565.2 + 2 × 3.14 × (6)²

=> TSA = 565.2 + 6.28 × 36

=> TSA = 565.2 + 226.08

=> TSA = 791.28 m²

Therefore The correct answer is 791.28 m².

Additional Information

Total Surface Area of Cylinder

The sum of the area of the curved surface and the two circular bases: TSA = 2πrh + 2πr² = 2πr(h + r).

Volume and Radius Relationship

For any cylinder, the radius can be directly found if Volume (V) and Curved Surface Area (CSA) are known: r = 2V ÷ CSA.

Hollow Cylinder Volume

If the pipe has thickness, the volume of material is given by V = πh(R² − r²), where R is outer and r is inner radius.

**Q34. Answer: (d) 90,000**

Shortcut Trick

Cross Product Method:

Units difference = (5 × 4) − (8 × 1) = 20 − 8 = 12 units

Value difference = Rs. 72,000 × (4 − 1) = Rs. 2,16,000

12 units = Rs. 2,16,000 => 1 unit = Rs. 18,000

David's Income = 5 units × 18,000 = Rs. 90,000

Therefore The correct answer is Rs. 90,000.

Alternate Method

Given:

Income ratio (David : Ajay) = 5 : 8

Expenditure ratio (David : Ajay) = 1 : 4

Savings for each = Rs. 72,000

Formula Used:

Income − Savings = Expenditure

Let David's income be 5x and Ajay's income be 8x.

=> (5x − 72000) / (8x − 72000) = 1 / 4

=> 4 × (5x − 72000) = 1 × (8x − 72000)

=> 20x − 288000 = 8x − 72000

=> 20x − 8x = 288000 − 72000

=> 12x = 216000

=> x = 216000 ÷ 12 = 18000

=> David's monthly income = 5x = 5 × 18000 = 90000

Therefore The correct answer is Rs. 90,000.

Additional Information

Income, Expenditure & Savings Relation

The fundamental relation is Income = Expenditure + Savings. If savings are constant, the difference in income units corresponds to the difference in expenditure units after scaling.

Cross-Multiplication Method

For two ratios a:b and c:d where a fixed value k is added/subtracted: 1 unit = |(b×c − a×d)| / |k×(c − d)|.

Equating Ratio Differences

When savings are equal, ensure the difference between income and expenditure units is the same for both persons by multiplying the ratios with suitable constants.

**Q35. Answer: (b) 2.44**

Shortcut Trick

B = Sum of first three even natural numbers = 2 + 4 + 6 = 12.

Third Proportional C = $B^2$ ÷ First Term.

C = $12^2$ ÷ 59 = 144 ÷ 59.

C ≈ 2.44.

Therefore The correct answer is 2.44.

Alternate Method

Given: First term (a) = 59, Second term (b) = B.

B = First three even natural numbers (2, 4, 6).

Formula: If a, b, and C are in continued proportion, then a : b :: b : C.

=> B = 2 + 4 + 6 = 12

=> For third proportional: 59 ÷ 12 = 12 ÷ C

=> 59 × C = 12 × 12

=> C = 144 ÷ 59

=> C = 2.44067...

=> C ≈ 2.44 (rounded to two decimal places)

Therefore The correct answer is 2.44.

Additional Information

Mean Proportional

The mean proportional between two numbers a and b is given by √(a × b).

Fourth Proportional

If four numbers a, b, c, and d are in proportion (a : b :: c : d), then the fourth proportional d = (b × c) ÷ a.

Sum of First n Even Numbers

The sum of the first n even natural numbers is calculated using the formula n × (n + 1).

Continued Proportion

If a, b, c are in continued proportion, then a/b = b/c, which implies $b^2$ = ac.

**Q36. Answer: (d) 11**

Shortcut Trick

Rate of filling pipe = 1/11 per minute.

Rate of emptying pipe = 1/22 per minute.

Net rate of both pipes = 1/11 − 1/22 = 1/22 per minute.

Time for full tank = 22 minutes.

Time for half tank = 22 ÷ 2 = 11 minutes.

Therefore The correct answer is 11.

Alternate Method

Given: Fill time = 11 min, Empty time = 22 min.

Let the total capacity of the tank be the LCM of 11 and 22.

=> Total capacity = 22 units.

| Pipes | Time | Capacity | Efficiency |
|---|---|---|---|
| Pipe A | 11 | 22 | +2 |
| Pipe B | 22 | −1 | |

Combined efficiency of (A + B) = 2 − 1 = 1 unit/min.

=> Target to fill = 1/2 × Total Capacity

=> Work = 1/2 × 22 = 11 units.

=> Time required = Work ÷ Combined Efficiency

=> Time = 11 ÷ 1 = 11 minutes.

Therefore The correct answer is 11.

Additional Information

Negative Work Concept

In pipes and cisterns, a filling pipe has positive efficiency, while an outlet or emptying pipe has negative efficiency.

Total Work Formula

Time required = Total Work ÷ Net Efficiency. Total work is usually taken as the LCM of time taken by individual pipes.

Partial Filling

If only a fraction of the tank needs to be filled, multiply the total capacity by that fraction before dividing by efficiency.

**Q37. Answer: (d) 5°**

Shortcut Trick

Property: In quadrilateral PQRS, the angle between bisectors of angle R and angle S is angle STR = (angle P + angle Q) / 2.

angle P + angle Q = 2 × 42.5° = 85°.

Ratio P : Q = 8 : 9, Sum of ratios = 8 + 9 = 17 units.

17 units = 85° → 1 unit = 5°.

Difference between angle Q and angle P = (9 − 8) units = 1 unit = 5°.

Therefore The correct answer is 5°.

Alternate Method

Given: angle STR = 42.5°, Ratio angle P : angle Q = 8 : 9.

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

=> In ΔSTR, angle STR + angle TSR + angle TRS = 180°

=> 42.5° + angle S/2 + angle R/2 = 180°

=> (angle S + angle R)/2 = 180° − 42.5° = 137.5°

=> angle S + angle R = 137.5° × 2 = 275°

=> In quadrilateral PQRS, angle P + angle Q + angle R + angle S = 360°

=> angle P + angle Q + 275° = 360°

=> angle P + angle Q = 85°

=> Let angle P = 8x and angle Q = 9x

=> 8x + 9x = 85° => 17x = 85° => x = 5°

=> Difference = angle Q − angle P = 9x − 8x = x = 5°

Therefore The correct answer is 5°.

Additional Information

Angle Sum Property

The sum of all interior angles of any quadrilateral is always 360°.

Adjacent Angle Bisectors

The angle formed by the bisectors of two adjacent angles of a quadrilateral is equal to half the sum of the other two angles: angle T = (angle P + angle Q)/2.

Opposite Angle Bisectors

The acute angle formed by the intersection of bisectors of two opposite angles is equal to half the difference of the other two angles.

**Q38. Answer: (d) 80%**

Shortcut Trick

Volume of Cylinder (V) prop. to $r^2 \times h$

Radius decrease factor = 1 − 0.15 = 0.85

Height increase factor = 1 + 1.49 = 2.49

New Volume Factor = $(0.85)^2 \times 2.49 = 0.7225 \times 2.49$

New Volume Factor = 1.799025

Percentage increase = (1.799025 − 1) × 100 ≈ 80%

Therefore The correct answer is 80%.

Alternate Method

Given:
Decrease in radius (r) = 15%
Increase in height (h) = 149%
Formula Used:
Volume of cylinder = $\pi r^2 h$
Let initial radius (r1) = 100 units and initial height (h1) = 100 units
=> Initial Volume (V1) = $\pi \times (100)^2 \times 100 = 1,000,000\pi$ cubic units
=> New radius (r2) = 100 − 15% of 100 = 85 units
=> New height (h2) = 100 + 149% of 100 = 249 units
=> New Volume (V2) = $\pi \times (85)^2 \times 249$
=> V2 = $\pi \times 7225 \times 249 = 1,799,025\pi$ cubic units
=> Increase in Volume = $1,799,025\pi - 1,000,000\pi = 799,025\pi$
=> Percentage Increase = $(799,025\pi / 1,000,000\pi) \times 100$
=> Percentage Increase = 79.9025% ≈ 80%
Therefore The correct answer is 80%.
Additional Information
Curved Surface Area (CSA) of Cylinder
The area of the side surface of the cylinder is given by $2 \times \pi \times r \times h$.
Total Surface Area (TSA) of Cylinder
The sum of the CSA and the area of the two circular bases: $2\pi r(h + r)$.
Successive Percentage Formula
For two successive changes x% and y%, the net change is [x + y + (xy/100)]%.
Volume proportionality
If radius changes by factor 'a' and height by factor 'b', volume changes by factor $a^2 \times b$.

**Q39. Answer: (c) 39**

Shortcut Trick
Time Ratio = 36 : 39 → 12 : 13
Since work is constant, Men Ratio is inverse of Time Ratio = 13 : 12
Difference in ratio parts = 13 − 12 = 1 unit
Given, 1 unit = 3 people
Value of X (Original Men) = 13 units = 13 × 3 = 39
Therefore The correct answer is 39.
Alternate Method
Given:
Initial number of people = X
Initial time taken = 36 days
Number of people after 3 people didn't turn up = X − 3
Actual time taken = 39 days
Formula Used: M1 × D1 = M2 × D2
Calculations:
=> X × 36 = (X − 3) × 39
=> 36X = 39X − 117
=> 39X − 36X = 117
=> 3X = 117
=> X = 117 ÷ 3
=> X = 39
Therefore The correct answer is 39.
Additional Information
Chain Rule Formula
For work problems involving men (M), days (D), and hours (H), the formula is (M1 × D1 × H1) / W1 = (M2 × D2 × H2) / W2.
Inverse Proportion in Work

The number of people is inversely proportional to the time taken to complete a constant amount of work (M prop. to 1/D).

Unitary Method for Time & Work

If one person can do a job in 'n' days, then their work rate is 1/n per day.

**Q40. Answer: (c) 3**

Shortcut Trick

Numbers between 309 and 320 are 310, 311, 312, 313, 314, 315, 316, 317, 318, 319.

Exclude evens (310, 312, 314, 316, 318) and multiples of 5 (315).

Check remaining: 311 (Prime), 313 (Prime), 317 (Prime), 319 (11 × 29).

Total prime numbers = 3.

Therefore The correct answer is 3.

Alternate Method

Given: Range of numbers between 309 and 320.

Method Used: Primality testing of numbers within the specified interval.

=> Numbers to check: {310, 311, 312, 313, 314, 315, 316, 317, 318, 319}

=> For a number n to be prime, it must not be divisible by any prime number ≤ √n.

=> √320 ≈ 17.88. Check divisibility by 2, 3, 5, 7, 11, 13, 17.

=> 311: Not div. by 2, 3 (sum=5), 5, 7, 11, 13, 17 → Prime

=> 313: Not div. by 2, 3 (sum=7), 5, 7, 11, 13, 17 → Prime

=> 315: Divisible by 5 (ends in 5) → Composite

=> 317: Not div. by 2, 3 (sum=11), 5, 7, 11, 13, 17 → Prime

=> 319: Divisible by 11 (3 − 1 + 9 = 11) → Composite (11 × 29)

=> Total Primes = 3

Therefore The correct answer is 3.

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 its divisibility by all prime numbers up to √N.

Divisibility Rule for 11

A number is divisible by 11 if the difference between the sum of digits at odd positions and the sum of digits at even positions is 0 or a multiple of 11.

**Q41. Answer: (d) 57**

Shortcut Trick

Teacher’s age = New Average + (Initial number of students × Increase in average)

Increase in average = 14 − 13 = 1 year

Teacher’s age = 14 + (43 × 1)

Teacher’s age = 14 + 43 = 57 years

Therefore The correct answer is 57.

Alternate Method

Given:

Number of students = 43 | Initial Average = 13 years | New Average (with teacher) = 14 years

Formula Used:

Total Age = Average × Number of People

=> Total age of 43 students = 43 × 13

=> Total age of 43 students = 559 years

=> Total people including teacher = 43 + 1 = 44

=> Total age of 44 people = 44 × 14

=> Total age of 44 people = 616 years

=> Age of teacher = Total age of group − Total age of students

=> Age of teacher = 616 − 559 = 57 years

Therefore The correct answer is 57.

Additional Information

Average Formula

Average = (Sum of all observations) ÷ (Total number of observations).

Inclusion Shortcut

When one person joins and average increases: New person age = Old Average + [New total members × Increase in Avg].

Exclusion Shortcut

When one person leaves and average changes: Age of person who left = Old Average ± [New total members × Change in Avg].

Weighted Average

Combined Average = (n1A1 + n2A2) ÷ (n1 + n2), where n is count and A is average.

**Q42. Answer: (b) 2a**

Shortcut Trick

Using algebraic identities, identify the standard reduction forms.

$(a^3 - b^3) / (a^2 + ab + b^2) = a - b$

$(a^3 + b^3) / (a^2 - ab + b^2) = a + b$

The expression simplifies to: $(a - b) + (a + b) = 2a$

Therefore The correct answer is 2a.

Alternate Method

Given:

Expression: $[(a^3 - b^3) / (a^2 + ab + b^2)] + [(a^3 + b^3) / (a^2 - ab + b^2)]$

Formula Used:

1. $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
2. $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

Calculation:

$\Rightarrow [(a - b)(a^2 + ab + b^2) / (a^2 + ab + b^2)] + [(a + b)(a^2 - ab + b^2) / (a^2 - ab + b^2)]$

$\Rightarrow (a - b) + (a + b)$

$\Rightarrow a - b + a + b$

$\Rightarrow 2a$

Therefore The correct answer is 2a.

Additional Information

Sum of Cubes Identity

The sum of cubes can be factored as $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$.

Difference of Cubes Identity

The difference of cubes can be factored as $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$.

Difference of Squares

One of the most used identities is $a^2 - b^2 = (a + b)(a - b)$.

BODMAS rule

Always solve expressions in the order: Brackets, Orders, Division/Multiplication, and Addition/Subtraction.

**Q43. Answer: (c) increase by Rs. 1,752**

Shortcut Trick

Let initial Income = 100, then Savings = 20 and Expenditure = 80.

Change in Income (ΔI) = 100 × 36% = 36 units.

Change in Expenditure (ΔE) = 80 × 40% = 32 units.

Change in Savings (ΔS) = ΔI − ΔE = 36 − 32 = 4 units.

Value of 100 units = Rs. 43,800 => Value of 1 unit = Rs. 438.

Savings increase = 4 units × Rs. 438 = Rs. 1,752.

Therefore The correct answer is increase by Rs. 1,752.

Alternate Method

Given: Initial Income = Rs. 43,800 | Savings % = 20% | Income increase = 36% | Expenditure increase = 40%

Formula: Income = Expenditure + Savings

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=> Initial Savings = 20% of 43,800 = 0.20 × 43,800 = Rs. 8,760

=> Initial Expenditure = 43,800 − 8,760 = Rs. 35,040

=> Increase in Income = 36% of 43,800 = 0.36 × 43,800 = Rs. 15,768

=> Increase in Expenditure = 40% of 35,040 = 0.40 × 35,040 = Rs. 14,016

=> Change in Savings = Increase in Income − Increase in Expenditure

=> Change in Savings = 15,768 − 14,016 = Rs. 1,752

=> Since the result is positive, savings increase by Rs. 1,752.

Therefore The correct answer is increase by Rs. 1,752.

Additional Information

Income-Expenditure Relationship

The fundamental relation is Income = Expenditure + Savings. Any change in two components directly determines the change in the third.

Percentage Change Formula

Percentage change = (Final Value − Initial Value) ÷ Initial Value × 100. This is useful when the question asks for the percentage increase or decrease of savings.

Alligation Method for Income-Expenditure

This topic can also be solved using alligation where the ratio of Expenditure to Savings (80:20 or 4:1) is placed at the bottom, and the growth rates are placed at the top.

**Q44. Answer: (a) 51**

Shortcut Trick

Check the sum of digits for divisibility by 3.

Sum of digits of 51 = 5 + 1 = 6.

Since 6 is divisible by 3, 51 is also divisible by 3 (51 = 3 × 17).

Numbers 31, 67, and 79 cannot be divided by any number other than 1 and themselves.

Therefore The correct answer is 51.

Alternate Method

Given: Numbers provided are 51, 31, 79, and 67.

Rule: A prime number is a natural number greater than 1 that has exactly two factors: 1 and the number itself.

=> For 31: Factors are 1 and 31 (Prime).

=> For 67: Factors are 1 and 67 (Prime).

=> For 79: Factors are 1 and 79 (Prime).

=> For 51: Divisors are 1, 3, 17, and 51.

=> Since 51 has more than two factors, it is a composite number.

Therefore The correct answer is 51.

Additional Information

Prime Numbers

A number that has only two factors, 1 and itself. Examples: 2, 3, 5, 7, 11, 13, etc.

Composite Numbers

A number that has more than two factors. The number 1 is neither prime nor composite.

Divisibility Rule of 3

A number is divisible by 3 if the sum of its digits is a multiple of 3.

Smallest Prime Number

The number 2 is the smallest prime number and the only even prime number.

**Q45. Answer: (d) 13 seconds**

Relative Speed (Opposite Direction) = 45 + 63 = 108 km/hr

Convert to m/s: 108 × (5/18) = 30 m/s

Total distance to cover = Sum of train lengths = 170 + 220 = 390 m

Time = Distance ÷ Speed = 390 ÷ 30 = 13 seconds

Therefore The correct answer is 13 seconds.

Alternate Method

Given:

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Length of first train (L1) = 170 m
Length of second train (L2) = 220 m
Speed of first train (S1) = 45 km/hr
Speed of second train (S2) = 63 km/hr
Formula Used:
Relative Speed (Opposite) = S1 + S2
Time = (L1 + L2) ÷ (Relative Speed)
Calculations:
=> Total distance to be covered = 170 + 220 = 390 m
=> Relative speed = 45 + 63 = 108 km/hr
=> Speed in m/s = 108 × (5/18) m/s
=> Speed in m/s = 6 × 5 = 30 m/s
=> Time taken to cross each other = 390 ÷ 30
=> Time = 13 seconds
Therefore The correct answer is 13 seconds.
Additional Information
Relative Speed in Same Direction
When two objects move in the same direction, Relative Speed = |S1 − S2|.
Unit Conversion
To convert Speed from km/hr to m/s, multiply by 5/18. To convert m/s to km/hr, multiply by 18/5.
Crossing a Stationary Object
When a train crosses a pole or a person, the distance covered is equal to the length of the train itself.

**Q46. Answer: (d) 31**

Shortcut Trick
Solve inner small bracket: (14 − 24 ÷ 4) = 14 − 6 = 8
Solve nested parenthesis: (81 ÷ 9 − 8 ÷ 8) = 9 − 1 = 8
Solve square bracket: [49 − 8] = 41
Final calculation: 72 − 41 = 31
Therefore The correct answer is 31.
Alternate Method
Given: 72 − [49 − (81 ÷ 9 − (14 − 24 ÷ 4) ÷ 8)]
Formula Used: VBODMAS rule (Vinculum, Bracket, Of, Division, Multiplication, Addition, Subtraction)
=> 72 − [49 − (81 ÷ 9 − (14 − 6) ÷ 8)]
=> 72 − [49 − (81 ÷ 9 − 8 ÷ 8)]
=> 72 − [49 − (9 − 1)]
=> 72 − [49 − 8]
=> 72 − 41
=> 31
Therefore The correct answer is 31.
Additional Information
VBODMAS Rule
Simplification must follow the sequence: Vinculum, Brackets, Of, Division, Multiplication, Addition, and finally Subtraction.
Priority of Brackets
Solve internal expressions in the specific order: Parentheses (), then Curly Braces { }, and lastly Square Brackets [].
Sign Rules
Multiplying two negative signs yields a positive result (− × − = +), while a negative outside a bracket reverses the signs of all terms inside.

**Q47. Answer: (a) Rs. 50**

Shortcut Trick
Extra cost for 2 more glasses = 330 − 270 = Rs. 60.

Cost of 1 glass = 60 ÷ 2 = Rs. 30.

Cost of 4 glasses = 4 × 30 = Rs. 120.

Cost of 3 cups = 270 − 120 = Rs. 150.

Cost of 1 cup = 150 ÷ 3 = Rs. 50.

Therefore The correct answer is Rs. 50.

Alternate Method

Given:

3 cups + 4 glasses = Rs. 270

3 cups + 6 glasses = Rs. 330

Formula Used:

Method of Elimination for Linear Equations in two variables.

Let the cost of one cup be C and the cost of one glass be G.

=> 3C + 4G = 270 → (1)

=> 3C + 6G = 330 → (2)

=> Subtracting equation (1) from equation (2):

=> (3C + 6G) − (3C + 4G) = 330 − 270

=> 2G = 60

=> G = 60 ÷ 2 = 30

=> Substituting G = 30 in equation (1):

=> 3C + 4 × 30 = 270

=> 3C + 120 = 270

=> 3C = 270 − 120

=> 3C = 150

=> C = 150 ÷ 3 = 50

Therefore The correct answer is Rs. 50.

Additional Information

Linear Equations in Two Variables

Equations of the form ax + by = c represent a relationship between two quantities. They are solved using substitution or elimination methods.

Elimination Method

In this method, one variable is eliminated by adding or subtracting the equations after making the coefficients of that variable equal.

Unitary Method

Finding the value of a single unit (item) first to calculate the total value of multiple units or vice versa. For example, Cost of 1 unit = Total Cost ÷ Total Quantity.

**Q48. Answer: (a) 20**

Shortcut Trick

Ratio of Ages R : S : T based on given conditions (LCM of 2 and 3 = 6):

R : S = 2 : 1 → 6 : 3

R : T = 3 : 1 → 6 : 2

Combined Ratio R : S : T = 6 : 3 : 2

Difference between S and T = 3 − 2 = 1 unit = 5 years.

Required difference between R and T = 6 − 2 = 4 units = 4 × 5 = 20 years.

Therefore The correct answer is 20.

Alternate Method

Given:

R = 2 × S => S = R/2

R = 3 × T => T = R/3

S − T = 5 years

Substituting the values of S and T in the difference equation:

=> R/2 − R/3 = 5

=> (3R − 2R) / 6 = 5

=> R / 6 = 5

=> R = 30 years

=> T = 30 / 3 = 10 years

=> Difference R − T = 30 − 10 = 20 years

Therefore The correct answer is 20.

Additional Information

Ratio of Ages

When comparing three or more quantities, find a common base (LCM) to create a single ratio chain (A:B:C).

Constant Difference Property

The numerical difference between the ages of two people always remains constant regardless of the number of years passed or future time.

Average Age

Average age = (Sum of ages of all persons) ÷ (Total number of persons).

**Q49. Answer: (a) Rs. 891 crore**

Shortcut Trick

Profit % = 35% → Multiplying Factor = 1 + 35/100 = 1.35

Income = Expenditure × 1.35

Income = 660 × 1.35 = 891

Therefore The correct answer is Rs. 891 crore.

Alternate Method

Given: Expenditure = Rs. 660 crore, Profit % = 35%

Formula: Income = Expenditure × (100 + Profit %)/100

=> Profit = 35% of Rs. 660 crore

=> Profit = (35 ÷ 100) × 660

=> Profit = 0.35 × 660 = 231

=> Income = Expenditure + Profit

=> Income = 660 + 231

=> Income = 891

Therefore The correct answer is Rs. 891 crore.

Additional Information

Profit Percentage Formula

Profit % = [(Income − Expenditure) ÷ Expenditure] × 100. This is the standard formula used for company financial performance.

Loss Percentage Formula

Loss % = [(Expenditure − Income) ÷ Expenditure] × 100. It occurs when expenditure exceeds total income.

Direct Income Relation

Income = Expenditure × [(100 + Profit %) ÷ 100]. This shortcut avoids calculating profit separately.

**Q50. Answer: (d) 44**

Shortcut Trick

Price after 1st discount of 5% = 21000 × 0.95 = Rs. 19950

Total discount amount required from this price = 19950 − 11172 = Rs. 8778

Second discount percentage Z = (8778 ÷ 19950) × 100

Z = 44%

Therefore The correct answer is 44.

Alternate Method

Given: Marked Price (MP) = Rs. 21,000, Final Selling Price (SP) = Rs. 11,172, Discount 1 = 5%, Discount 2 = Z%.

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

=> 11172 = 21000 × (100 − 5)/100 × (100 − Z)/100

=> 11172 = 21000 × (95/100) × (100 − Z)/100

=> 11172 = 210 × 95 × (100 − Z)/100

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=> 11172 = 19950 × (100 − Z)/100

=> 11172 ÷ 199.5 = 100 − Z

=> 56 = 100 − Z

=> Z = 100 − 56

=> Z = 44

Therefore The correct answer is 44.

Additional Information

Successive Discount Formula

When two discounts a% and b% are given successively, the equivalent single discount is given by [a + b − (ab/100)]%.

Effective Price Calculation

The selling price after multiple discounts can be found using the multiplying factor method: SP = MP × (1 − d1) × (1 − d2) × ... × (1 − d_n).

Discount Percentage

Discount % is always calculated on the Marked Price (MP) unless specified otherwise. Formula: Discount % = (MP − SP)/MP × 100.

**Q51. Answer: (b) 8 km to the east**

According to the given information,

To reach point A again, he should drive 26 - 18 = 8 km in East direction.

Hence, the correct answer is “Option 2”.

**Q52. Answer: (a) COLD - CDLO - DLOC**

Pattern followed here is,

Set 1: DIVE - DEVI - EVID

Set 2: BEAR - BRAE - RAEB

Similarly,

Option (1): COLD - CDLO - DLOC

Hence, the correct answer is “Option 1”.

**Q53. Answer: (a) J**

Seven people B, C, D, I, J, K, and L are sitting around a circular table facing the centre of the table.

1. Only three people sit between D and L, when counted from the right of L.

2. Only three people sit between K and I, when counted from the left of K.

3. B sits to the immediate right of D.

4. J is an immediate neighbour of L as well as I.

J sits second to the left of C.

Hence, the correct answer is “Option 1”.

**Q54. Answer: (a) 82**

Logic followed here is,

12 + 16 = 28

28 + 17 = 45

45 + 18 = 63

63 + 19 = 82

82 + 20 = 102

Hence, the correct answer is “Option 1”.

**Q55. Answer: (b) 30**

Given:

Rakesh is 13th from the top.

Rakesh is 18th from the bottom.

Total = Rank from Top + Rank from Bottom - 1

Number of students = 13 + 18 - 1

= 31 - 1

= 30 students.
Hence, the correct answer is "Option 2".

**Q56. Answer: (d) 7**

Given: (Left) 515 758 761 726 579 (Right)
Highest number = 761
Second digit of the highest number = 6
Lowest number = 515
Second digit of the lowest number = 1
Now, 6 + 1 = 7
Hence, the correct answer is “Option 4”.

**Q57. Answer: (b) zw**

‘royal snow blue’ is coded as 'tl zw cr'
And ‘
blue two web’ is coded as ‘rg iq zw’.
‘blue’ coded in the given language as "zw".
Hence, the correct answer is “Option 2”.

**Q58. Answer: (d) One**

Given series:
(Left) 2 6 9 1 2 5 7 2 5 2 2 4 7 9 3 2 5 4 1 4 9 9 1 8 9 (Right)
Condition to be checked:
Even digit ← Even digit → Even digit
Checking the series:
(Left) 2 6 9 1 2 5 7 2 5 2 2 4 7 9 3 2 5 4 1 4 9 9 1 8 9 (Right)
There is only one such digit that satisfies the given condition.
Hence, the correct answer is "Option 4".

**Q59. Answer: (a) 12 km to the west**

According to the given information,
To reach point A again, he should drive 77 - 65 = 12 km in West direction.
Hence, the correct answer is “Option 1”.

**Q60. Answer: (a) Four**

Given series:
(Left) 1 2 8 4 6 9 5 8 8 7 9 2 6 6 5 8 6 3 1 1 4 4 6 (Right)
Condition to be checked:
Even digit ← Even digit → Even digit
Checking the series:
(Left) 1 2 8 4 6 9 5 8 8 7 9 2 6 6 5 8 6 3 1 1 4 4 6 (Right)
There are four such digits that satisfy the given condition.
Hence, the correct answer is "Option 1".

**Q61. Answer: (b) FYR 73**

Pattern followed here is,
Hence, the correct answer is “Option 2”.

**Q62. Answer: (c) QA-KG**

(1) BL-WR
(2) HR-CX
(3) QA-KG
(4) UE-PK
Hence, the correct answer is “Option 3”.

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**Q63. Answer: (d) 418**

BODMAS Table:

Given equation: 21 − 4 ÷ 371 + 111 × 3 = ?

| | | | |
|---|---|---|---|
| • | • | × | ÷ |
| • | × | ÷ | • |

Now, replacing the symbols:

=> 21 × 4 + 371 − 111 ÷ 3 = ?

=> 21 × 4 + 371 − 111 ÷ 3 = ?

=> 84 + 371 − 37 = ?

=> 84 + 371 − 37 = ?

=> 455 − 37 = ?

=> 418.

Hence, the correct answer is "Option 4".

**Q64. Answer: (d) 78**

Logic followed here is,\

18 + 4 = 22

22 + 8 = 30

30 + 12 = 42

42 + 16 = 58

58 + 20 = 78

Hence, the correct answer is “Option 4”.

**Q65. Answer: (d) QN-SP**

(1) WT-YU

(2) UR-WS

(3) SP-UQ

(4) QN-SP

Hence, the correct answer is “Option 4”.

**Q66. Answer: (d) Neither conclusion (I) nor (II) follows**

Least possible Venn diagram,

Conclusions:

(I) Some samosas are pizzas → Does not follow (There is no direct relation given between samosas and pizzas. so, it is possible not definite).

(II) All pizzas are burgers → Does not follow (As some burgers are pizzas. so, All pizzas are burger is not true).

Neither conclusion (I) nor (II) follows.

Hence, the correct answer is “Option 4”.

**Q67. Answer: (d) NUN**

Pattern followed here is,

Hence, the correct answer is “Option 4”.

**Q68. Answer: (d) QUAD - DQAU - QDUA**

Pattern followed here is,

Set 1: RAMP - PRMA - RPAM

Set 2: SEND - DSNE - SDEN

Similarly,

Option (4): QUAD - DQAU - QDUA

Hence, the correct answer is “Option 4”.

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**Q69. Answer: (d) NPTO**

CEID is related to JLPK,

EGKF is related to LNRM,

Similarly,

GIMH related to,

Hence, the correct answer is “Option 4”.

**Q70. Answer: (d) Three**

Given:

1 is added to each even digit and 2 is subtracted from each odd digit in the number 54286379.

| Given | 5 | 4 | 2 | 8 | 6 | 3 | 7 | 9 |
|---|---|---|---|---|---|---|---|---|
| Operation | -2 | +1 | +1 | +1 | +1 | -2 | -2 | -2 |
| New number | 3 | 5 | 3 | 9 | 7 | 1 | 5 | 7 |

The new number formed is 35397157.

Now, counting digits that appear more than once:

• 3 appears 2 times

• 5 appears 2 times

• 7 appears 2 times

Total digits repeated = 3

Hence, the correct answer is "Option 4".

**Q71. Answer: (c) mp**

‘dirt is there’ is coded as ‘mp rc gp’ And ‘

‘clean the dirt’ is coded as ‘hk mp bo’.

‘dirt’ coded in the given language as "mp".

Hence, the correct answer is “Option 3”.

**Q72. Answer: (a) 92**

Logic followed here is,

Hence, the correct answer is “Option 1”.

**Q73. Answer: (a) (13, 21, 47)**

The logic followed here is:

Logic: 1st number + 8 = 2nd number

2nd number × 2 + 5 = 3rd number.

Now,

For, (12, 20, 45)

=> 12 + 8 = 20

=> (20 × 2) + 5 = 40 + 5 = 45.

For, (18, 26, 57)

=> 18 + 8 = 26

=> (26 × 2) + 5 = 52 + 5 = 57.

Similarly, for (13, 21, 47)

=> 13 + 8 = 21

=> (21 × 2) + 5 = 42 + 5 = 47.

Hence, the correct answer is "Option 1".

**Q74. Answer: (d) B**

A, B, C, D, E and F are sitting around a circular table facing the centre.

1. E sits second to the left of B.

2. C sits second to the right of F.

3. D is on the immediate left of C.

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B sitting on the immediate right of A.

Hence, the correct answer is “Option 4”.

**Q75. Answer: (c) 6**

Given:

1 is added to each even digit and 1 is subtracted from each odd digit in the number 258671543.

| Given | 2 | 5 | 8 | 6 | 7 | 1 | 5 | 4 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| Operation | +1 | -1 | +1 | +1 | -1 | -1 | -1 | +1 | -1 |
| New number | 3 | 4 | 9 | 7 | 6 | 0 | 4 | 5 | 2 |

The new number formed is 349760452.

The middle digit (5th digit from the left) is 6.

Hence, the correct answer is "Option 3".

**Q76. Answer: (d) Mother’s sister**

We draw the following table from given conditions:

| P is | | | |
|---|---|---|---|
| • | # | & | % |
| Father | Mother | Wife | Sister |
| of Q | | | |

V % L & C + B % D → V is Sister of L, L is wife of C, C is father of B and B is sister of D.

V is D's mother's Sister.

Hence, the correct answer is “Option 4”.

**Q77. Answer: (c) Neither conclusion (I) nor (II) follows.**

Least possible Venn diagram,

Conclusions:

(I) Some erasers are bags → Does not follow (There is no direct relation given between erasers and bags. so, it is possible not definite).

(II) All bags are pens → Does not follow (As some pen are bags. so, all bags are pens is not true).

Neither conclusion (I) nor (II) follows.

Hence, the correct answer is “Option 3”.

**Q78. Answer: (d) 3**

Given series:

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

Condition to be checked:

Odd digit ← Odd digit → Even digit

Checking the series:

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

There are three such digits that satisfy the given condition.

Hence, the correct answer is "Option 4".

**Q79. Answer: (a) P**

Seven boxes, M, N, O, P, Q, R and S, are kept one over the other, but not necessarily in the same order.

1. Only two boxes are kept between M and O.
2. Only N is kept above S.
3. No box is kept below O.
4. R is kept at some place below P but at some place above Q.

| N |
|---|

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| |
|---|
| S |
| P |
| M |
| R |
| Q |
| O |

P box is kept third above Q.

Hence, the correct answer is “Option 1”.

**Q80. Answer: (a) E**

Six people, A, B, C, D, E and F, are sitting in a row, facing north.

1. A sits to the immediate left of B.
2. C sits third to the left of B.
3. D is an immediate neighbour of B.
4. F sits to the immediate right of C.
5. D sits to the immediate left of E.

E sits at the extreme right end of the line.

Hence, the correct answer is “Option 1”.

**Q81. Answer: (b) Centre for Research on Energy and Clean Air**

The correct answer is Centre for Research on Energy and Clean Air.

Key Points

• The Centre for Research on Energy and Clean Air (CREA) released an air quality assessment in October 2025, focusing on the concentration of PM2.5 (Particulate Matter 2.5) across major urban centers in India.

• The assessment revealed a critical environmental situation where all ten of the most polluted cities in the country were located within the National Capital Region (NCR).

• This concentration of high pollution levels in a single geographic belt underscores the regional nature of air quality crises in North India, especially during the onset of the winter season.

• The data for this study was compiled using readings from the Continuous Ambient Air Quality Monitoring Stations (CAAQMS), which provide real-time updates on various pollutants. Hence, the correct answer is Centre for Research on Energy and Clean Air.

• Cities such as Delhi, Noida, Ghaziabad, and Faridabad recorded PM2.5 levels significantly higher than the National Ambient Air Quality Standards (NAAQS) and World Health Organization (WHO) guidelines.

Additional Information

• Understanding PM2.5:

• PM2.5 refers to atmospheric particulate matter that has a diameter of less than 2.5 micrometers, which is about 3% the diameter of a human hair.

• Because they are so small and light, these particles tend to stay longer in the air than heavier particles and can penetrate deep into the human respiratory system and bloodstream.

• The National Capital Region (NCR):

• The NCR is a coordinated planning region centered around Delhi, encompassing districts from three neighboring states: Haryana, Uttar Pradesh, and Rajasthan.

• The region faces severe air quality challenges due to a combination of industrial emissions, vehicular exhaust, construction dust, and seasonal factors like stubble burning in nearby agrarian states.

• Centre for Research on Energy and Clean Air (CREA):

• CREA is an independent research organization established in 2019 and headquartered in Helsinki, Finland.

• It specializes in identifying the trends, causes, and health impacts of air pollution to support the transition toward clean energy.

• The organization frequently publishes reports on fossil fuel consumption and its direct correlation with global and regional air quality degradation.

• National Clean Air Programme (NCAP):

• Launched in January 2019 by the Ministry of Environment, Forest and Climate Change (MoEFCC), it is a long-term, time-bound national strategy.

• The program aims to achieve a 20% to 30% reduction in Particulate Matter concentrations by 2024 (base year 2017), which was

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later revised to a 40% reduction by 2026.

Important Points

• Graded Response Action Plan (GRAP): This is a set of emergency measures that kick in depending on the Air Quality Index (AQI) in Delhi-NCR. It was first implemented in 2017.

• Winter Inversion: During October and November, colder temperatures and lower wind speeds lead to a phenomenon called temperature inversion, where a layer of warm air traps cooler air (and pollutants) near the ground.

• CPCB Role: The Central Pollution Control Board (CPCB) of India is the statutory organization under the Ministry of Environment, Forest and Climate Change that monitors the official AQI across the country.

**Q82. Answer: (d) 60th**

The correct answer is 60th.

Key Points

• The Border Security Force (BSF), India's premier border-guarding agency, celebrated its 60th Raising Day on December 1, 2024.

• Established on December 1, 1965, the force was created in the wake of the Indo-Pakistani War of 1965 to ensure the security of India's borders and for matters connected therewith.

• The 60th anniversary marks six decades of the force's dedicated service as the "First Line of Defence" of the Indian territories, particularly along the borders with Pakistan and Bangladesh.

• The BSF is one of the seven Central Armed Police Forces (CAPF) of India and is currently the world's largest border-guarding force, with a strength of approximately 2.65 lakh personnel across 193 battalions.

• The primary objective of the foundation day celebrations is to honor the bravery and sacrifices of the BSF personnel who protect the nation's sovereignty in diverse terrains, from the Thar Desert to the Rann of Kutch and the Sunderbans.

Additional Information

• Mandate and Jurisdiction: The BSF is charged with guarding the 3,323 km long India-Pakistan border and the 4,096 km long India-Bangladesh border. It operates under the administrative control of the Ministry of Home Affairs (MHA), Government of India.

• Motto: The official motto of the force is "Jeevan Paryant Kartavya" (Duty Unto Death), reflecting the unwavering commitment of the jawans to national security.

• Internal Security Roles: Beyond border guarding, the BSF plays a significant role in internal security duties, including anti-Naxal operations in states like Chhattisgarh and Odisha, and assisting in the conduct of free and fair elections across the country.

• Specialized Wings: The BSF is the only CAPF to have its own Air Wing, Water Wing, and an Artillery Regiment. It also maintains a unique Camel Contingent, which is a major attraction during the Republic Day Parade.

• Peace-time vs. War-time: During peace times, its role is to prevent trans-border crimes, smuggling, and infiltrations. During hostilities, it acts as a force to defend the borders and assist the Indian Army.

Important Points

• Founding Figure: K.F. Rustamji, an Indian Police Service (IPS) officer, was the founding Director General (DG) of the BSF and is often referred to as the architect of the force.

• 1971 Liberation War: The BSF played a pivotal and heroic role in the Liberation War of Bangladesh in 1971, operating deep within enemy territory even before the formal declaration of war by the Indian Army.

• International Recognition: BSF personnel regularly participate in United Nations Peacekeeping Missions across various countries, showcasing India's commitment to global peace and security.

• Border Management Initiatives: In recent years, the force has implemented CIBMS (Comprehensive Integrated Border Management System), utilizing drones, thermal imagers, and smart fencing to enhance surveillance capabilities.

• Headquarters: The force is headquartered in New Delhi, with various Frontier Headquarters and Sector Headquarters spread across the border states of India.

**Q83. Answer: (c) Cards were available within 72 hours of results.**

The correct answer is Cards were available within 72 hours of results.

Key Points

• The Election Commission of India Network (ECINET) is a specialized Wide Area Network (WAN) designed to facilitate seamless communication and data transfer between the Election Commission of India (ECI), Chief Electoral Officers (CEOs) at the state level, and District Election Officers (DEOs).

• Historically, the publication of Index Cards, which contain vital statistical data of each constituency, was a manual and time-consuming process that took several weeks or even months to complete after the declaration of results.

• The implementation of ECINET enabled the electronic transmission of election data from the counting centers directly to the central database, significantly reducing the turnaround time for data processing.

• As a result of this digital integration, the Index Cards became available for public and official use within 72 hours of the

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announcement of election results. Hence, statement 3 is correct.

• This technological leap eliminated the possibility of delays associated with physical transport of documents and manual entry errors. Hence, statement 1 is incorrect.

• The digitization ensured that cards were no longer handwritten but generated through a standardized automated system. Hence, statement 2 is incorrect.

• Far from being discontinued, the Index Cards were modernized and made more accessible through digital reforms to ensure transparency in electoral statistics. Hence, statement 4 is incorrect.

Additional Information

• Election Commission of India (ECI): Established on January 25, 1950, the ECI is an autonomous constitutional authority responsible for administering election processes in India. It operates under Article 324 of the Constitution of India.

• National Informatics Centre (NIC): The NIC plays a crucial role in providing the technical backbone for ECINET. It helps in the development of ICT (Information and Communication Technology) tools that assist in voter registration, polling station mapping, and real-time result dissemination.

• Index Cards: In the context of Indian elections, an Index Card is a detailed record for each constituency that captures voter turnout, valid votes, rejected votes, and the performance of various political parties and candidates.

• GENESYS: This is the General Election Management System used by the ECI for the compilation and analysis of election results, working in tandem with ECINET to provide instantaneous updates.

• Digital Transformation: The ECI has introduced various digital initiatives like ENCORE (Enabling Communications on Real-time Environment), the Suvidha portal for candidate permissions, and the cVIGIL app for reporting Model Code of Conduct violations.

Important Points

• Data Accuracy: The use of ECINET ensures that the data reflected in the Index Cards is 100% authentic and synchronized with the Form 20 (Final Result Sheet) filled at the counting tables.

• Connectivity: ECINET connects all 36 States and Union Territories with the Nirvachan Sadan (ECI Headquarters) in New Delhi, ensuring a unified flow of information during the General Elections.

• Public Access: The rapid publication of these cards within 72 hours allows researchers, political analysts, and the media to perform deep-dive analytics on voting patterns almost immediately after the government formation process begins.

• Transparency: By reducing the time lag, the ECI strengthens the democratic framework, as stakeholders can verify the electoral data before the official Statistical Reports are formally printed.

**Q84. Answer: (a) Rs. 50,000**

The correct answer is Rs. 50,000.

Key Points

• The Bal Sahitya Puraskar is a prestigious literary honor in India, instituted by the Sahitya Akademi, which is the National Academy of Letters.

• The prize money for the Bal Sahitya Puraskar winners consists of a casket containing an engraved copper-plaque and a cheque of Rs. 50,000. Hence, the correct answer is Rs. 50,000.

• This award was established in the year 2010 to recognize and promote excellence in children's literature across various Indian languages.

• The awards are presented annually for the most outstanding books by Indian authors, first published during the five years immediately preceding the year of the award.

• The selection of the awardees is made on the basis of recommendations made by Juries comprising three members in the respective languages, following the procedure laid down for the purpose.

Additional Information

• Sahitya Akademi Main Award:

• The main Sahitya Akademi Award is given to the most outstanding books of literary merit published in any of the major Indian languages.

• The prize money for the main award was initially Rs. 5,000 in 1954, which was later increased to Rs. 1,00,000 from the year 2009 onwards.

• Yuva Puraskar:

• The Yuva Puraskar was instituted in 2011 to encourage young writers under the age of 35.

• Similar to the Bal Sahitya Puraskar, the prize money for the Yuva Puraskar is also Rs. 50,000 and an engraved copper-plaque.

• Languages Recognized:

• The Sahitya Akademi recognizes 24 languages for its awards.

• These include the 22 languages listed in the Eighth Schedule of the Constitution of India, along with English and Rajasthani.

• Translation Prize:

• The Sahitya Akademi Translation Prize is given to outstanding translations of creative and critical works.

• The amount of this prize is also Rs. 50,000, aimed at facilitating cross-cultural literary exchange within India.

Important Points

• Establishment of Sahitya Akademi: The Sahitya Akademi was formally inaugurated by the Government of India on 12 March 1954. It functions as an autonomous organization under the Ministry of Culture.

• Headquarters: The headquarters of the Akademi is located in Rabindra Bhavan, New Delhi, which also houses other national academies like Sangeet Natak Akademi and Lalit Kala Akademi.

• Bhasha Samman: Apart from the regular annual awards, the Akademi gives Bhasha Samman to writers/scholars for significant contribution to classical and medieval literature and languages not formally recognized by the Akademi. The prize money for Bhasha Samman is Rs. 1,00,000.

• Eligibility of Books: To be eligible for the Bal Sahitya Puraskar, the book must be a work of original writing for children and not a translation or an edited work.

**Q85. Answer: (d) ICICI Prudential Life Insurance**

The correct answer is ICICI Prudential Life Insurance.

Key Points

• The share of Unit Linked Insurance Plans (ULIPs) in the total Annualized Premium Equivalent (APE) for ICICI Prudential Life Insurance witnessed a decrease to 46.8% during the first quarter (Q1) of FY26.

• This is a notable decline from the 51.4% share recorded in the same quarter of the previous financial year (Q1 FY25), indicating a shift in the company's product distribution strategy. Hence, the correct answer is ICICI Prudential Life Insurance.

• The reduction in ULIP concentration suggests a strategic move by the insurer to diversify its portfolio by increasing the focus on non-linked savings and protection products.

• ICICI Prudential has been actively rebalancing its mix to mitigate risks associated with equity market volatility, which directly impacts the demand and performance of market-linked products like ULIPs.

• Despite the lower share of ULIPs, the company continues to maintain a strong market position by leveraging its multi-channel distribution network, including bancassurance and agency channels.

Additional Information

• Annualized Premium Equivalent (APE):

• APE is a standardized measure used by the insurance industry to compare sales across different periods. It is calculated as the sum of 100% of regular premiums and 10% of single premiums received during the year.

• It helps analysts and investors understand the growth trajectory of an insurance firm regardless of the premium payment frequency chosen by customers.

• Unit Linked Insurance Plans (ULIPs):

• A ULIP is a financial product that offers a combination of insurance and investment. A portion of the premium is used for life cover, while the remainder is invested in equity, debt, or hybrid funds.

• These plans are subject to market risks, and the Net Asset Value (NAV) fluctuates based on the performance of the underlying assets.

• ICICI Prudential Life Insurance Company Limited:

• It is a joint venture between ICICI Bank Limited and Prudential Corporation Holdings Limited.

• The company commenced its operations in 2001 and was the first private sector life insurer in India to be listed on the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) in 2016.

• It is headquartered in Mumbai, Maharashtra.

• Regulatory Oversight:

• The insurance sector in India is regulated by the Insurance Regulatory and Development Authority of India (IRDAI), which was established under the IRDA Act, 1999.

• IRDAI ensures the protection of policyholders' interests and regulates the solvency margins and investment norms for insurance companies.

Important Points

• Leadership: As of recent filings, Anup Bagchi serves as the Managing Director & CEO of ICICI Prudential Life Insurance.

• Value of New Business (VNB): This is a key metric for life insurers that represents the present value of future profits expected from the new business written during a specific period. A diversified product mix often aims to improve the VNB margin.

• Solvency Ratio: It is a measure of an insurance company's ability to meet its long-term claims. IRDAI mandates a minimum solvency ratio of 150% to ensure financial stability.

• Market Trends: The shift away from ULIPs toward guaranteed return plans often occurs when interest rates are favorable or when investors seek capital protection over high-risk market returns.

**Q86. Answer: (a) 3.16%**

The correct answer is 3.16%.

Key Points

• The Consumer Price Index (CPI) based retail inflation in India touched a significant low of 3.16% in April 2025.

• This level represents a near six-year low for the country, indicating a substantial easing of price pressures on essential goods and services for the common consumer.

• The data is compiled and released monthly by the National Statistical Office (NSO), which functions under the Ministry of Statistics and Programme Implementation (MoSPI).

• The drop to 3.16% was primarily driven by a decline in food inflation and a favorable base effect from the previous year.

• Such a low inflation rate provides the Reserve Bank of India (RBI) with more flexibility in its Monetary Policy, potentially allowing for a reduction in the Repo Rate to encourage investment and economic consumption.

Additional Information

• Consumer Price Index (CPI):

• It is a comprehensive measure used to estimate the price changes in a basket of goods and services representative of consumption expenditure in an economy.

• In India, the CPI is the primary tool used by the central bank to monitor inflation and set interest rates.

• The current Base Year for calculating CPI in India is 2012, which assigned a value of 100 to the price levels of that period.

• Inflation Targeting Framework:

• Under the RBI Act, 1934, the Government of India, in consultation with the Reserve Bank, sets an inflation target every five years.

• The current target is 4%, with an upper tolerance limit of 6% and a lower tolerance limit of 2%.

• The April 2025 figure of 3.16% is well within this mandatory 2% to 6% range, reflecting successful price stability management.

• Monetary Policy Committee (MPC):

• The MPC consists of six members and is responsible for deciding the policy repo rate to achieve the inflation target.

• It meets at least four times a year to review the macroeconomic situation and adjust liquidity in the banking system.

Important Points

• Headline vs. Core Inflation: While the headline inflation (which includes food and fuel) dropped to 3.16%, economists also track Core Inflation, which excludes the volatile food and energy sectors to understand the underlying long-term trend.

• Rural and Urban Indices: The NSO releases separate indices for CPI (Rural), CPI (Urban), and CPI (Combined). The 3.16% figure refers to the Combined index, which represents the national average.

• Weightage: In the Indian CPI basket, Food and Beverages carry the highest weightage at approximately 45.86%, making retail inflation highly sensitive to changes in agricultural output and monsoon patterns.

• WPI Comparison: Unlike the Wholesale Price Index (WPI), which tracks prices at the factory gate or wholesale level, the CPI reflects the actual cost of living for the end-user, including taxes and retail margins.

**Q87. Answer: (b) United Nations Framework Convention on Climate Change**

p data-end="57" data-start="0">The correct answer is United Nations Framework Convention on Climate Change.

Key Points

• UNFCCC stands for the United Nations Framework Convention on Climate Change, which is the primary international treaty aimed at addressing climate change.

• The convention was adopted on 9 May 1992 and opened for signature at the Rio Earth Summit (United Nations Conference on Environment and Development) in June 1992.

• Its ultimate objective is to achieve the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

• India, as a party to the convention, submitted its 4th Biennial Update Report (BUR) in December 2024. This report provides updates on the national greenhouse gas (GHG) inventory, mitigation actions, and the support needed and received.

• The UNFCCC Secretariat is located in Bonn, Germany, and it supports the global response to the threat of climate change.

Additional Information

• Structure and Membership:

• The UNFCCC has near-universal membership, with 198 Parties having ratified the convention.

• The Conference of the Parties (COP) is the supreme decision-making body of the Convention, meeting annually to assess progress in dealing with climate change.

• Parties are classified into Annex I (industrialized countries), Annex II (developed countries that provide financial resources), and Non-Annex I (mostly developing countries, including India).

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• Key International Agreements:

• The Kyoto Protocol, adopted in 1997, was the first major extension of the UNFCCC, setting legally binding emission reduction targets for developed countries.

• The Paris Agreement, adopted in 2015 at COP21, aims to limit global warming to well below 2 degrees Celsius, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.

• Reporting Mechanisms:

• Biennial Update Reports (BURs) are submitted by Non-Annex I parties every two years to maintain transparency regarding their climate actions and carbon footprint.

• Under the Enhanced Transparency Framework (ETF) of the Paris Agreement, these reports are transitioning into Biennial Transparency Reports (BTRs) to ensure more rigorous tracking of Nationally Determined Contributions (NDCs).

Important Points

• India's Climate Commitments:

• India has pledged to achieve Net Zero emissions by the year 2070, as announced at COP26 in Glasgow.

• In its updated NDCs, India aims to reduce the emission intensity of its GDP by 45% by 2030 from 2005 levels.

• India is also working toward achieving 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030.

• Significance of the 4th BUR (2024):

• The 4th BUR submitted in December 2024 highlights India's progress in decoupling its economic growth from greenhouse gas emissions.

• The report includes data on sectors such as Energy, Industrial Processes and Product Use (IPPU), Agriculture, Waste, and Land Use, Land-Use Change, and Forestry (LULUCF).

**Q88. Answer: (d) Integrated Test Range, Odisha**

The correct answer is Integrated Test Range, Odisha.

Key Points

• The Vertical Launch Short Range Surface-to-Air Missile (VL-SRSAM) was successfully flight-tested by the Defence Research and Development Organisation (DRDO) and the Indian Navy.

• The test was conducted from the Integrated Test Range (ITR), Chandipur, off the coast of Odisha. Hence, option 4 is correct.

• The VL-SRSAM is an indigenous weapon system designed to neutralize various aerial threats at close ranges, including sea-skimming targets.

• During the test, the missile was launched from a naval ship against a high-speed unmanned aerial target to demonstrate its vertical launch capability.

• The system has been developed by DRDO facilities, primarily the Defence Research and Development Laboratory (DRDL) and Research Centre Imarat (RCI) based in Hyderabad, but the physical testing occurred at the Odisha range.

Additional Information

• Integrated Test Range (ITR), Odisha:

• Located at Chandipur in the Balasore district of Odisha, it serves as the primary missile testing facility for India.

• It provides the necessary infrastructure for the performance evaluation of rockets, missiles, and airborne weapon systems.

• Most of India's major missiles, including the Agni, Prithvi, and Akash series, have been tested here.

• DRDO (Defence Research and Development Organisation):

• It was established in 1958 by merging the Technical Development Establishment of the Indian Army and the Directorate of Technical Development and Production.

• It functions under the Ministry of Defence, Government of India, and is headquartered in New Delhi.

• The current Chairman of DRDO (as of 2024) is Dr. Samir V Kamat.

• VL-SRSAM Technical Specifications:

• It is a canisterized system, which means it is stored and operated from specially designed compartments.

• The missile has a strike range of approximately 40 to 50 km and can hit targets at an altitude of around 15 km.

• It features cruciform wings that provide aerodynamic stability and thrust vector control for high maneuverability.

Important Points

• Other Options Overview:

• Pokhran Test Range, Rajasthan: This site is primarily used for testing artillery guns and was the location for India's nuclear tests in 1974 and 1998.

• Surya Lanka, Andhra Pradesh: This is a station for the Indian Air Force located in Bapatla, often used for live-fire exercises of Surface-to-Air Missiles like Akash.

• DRDO Missile Complex, Hyderabad: This is a major research hub comprising DRDL, RCI, and Advanced Systems Laboratory (ASL) where missiles are designed and developed, rather than being the primary site for long-range flight testing.

• Strategic Significance: The successful development of VL-SRSAM enhances the Indian Navy's defensive capabilities against supersonic anti-ship missiles. It replaces the older Barak-1 surface-to-air missile systems on Indian warships.

**Q89. Answer: (d) Clay Court**

The correct answer is Clay Court.

Key Points

• The French Open, also popularly known as Roland Garros, is unique among the four Grand Slam tennis tournaments as it is the only one played on Clay Courts.

• The 2025 edition of the tournament is scheduled to be held in Paris, France, at the iconic Stade Roland Garros, maintaining its long-standing tradition of using "Terre Battue" (red clay).

• The surface is characterized by its slow speed and high bounce, which significantly alters the dynamics of the game compared to other surfaces. It rewards players with great stamina, patience, and the ability to slide into shots. Hence, the option Clay Court is correct.

• Historically, the tournament transitioned to its current location in 1928, and the 2025 event continues to be managed by the French Tennis Federation (FFT).

• Because the surface slows down the ball and makes it harder to hit unreturnable serves (aces), the French Open is often considered the most physically demanding tennis tournament in the world.

Additional Information

• Surface Composition:

• A French Open clay court is not made of pure clay; it is actually a five-layer structure. The top layer consists of 1-2 mm of crushed red brick, followed by crushed limestone, clinker (coal residue), crushed gravel, and finally a drainage system.

• Comparison with Other Surfaces:

• Grass Courts: These are used at Wimbledon in the United Kingdom. It is the fastest surface with a low bounce. Hence, the option Grass is incorrect.

• Hard Courts: Used at the Australian Open and the US Open. These are made of synthetic/acrylic layers over concrete or asphalt, providing a medium-fast pace. Hence, the option Hard Court is incorrect.

• Artificial Turf: While used in some local or recreational clubs, it is never used for professional Grand Slam level events. Hence, the option Artificial Turf is incorrect.

• Historical Context:

• The tournament was first held in 1891 as a national championship. It opened to international players in 1925. It is named after the French aviator Roland Garros, who was the first person to fly across the Mediterranean Sea.

Important Points

• The King of Clay: Rafael Nadal of Spain holds the record for the most men's singles titles at the French Open, having won 14 titles as of recent years. His dominance on this surface is unprecedented in sports history.

• Championship Format: The tournament features Men’s Singles (best of five sets), Women’s Singles (best of three sets), as well as Doubles and Mixed Doubles.

• Prize Money and Ranking: As a Grand Slam, the event offers the highest possible ATP and WTA ranking points (2000 points for the winner) and multi-million Euro prize purses.

• Environmental Factors: Because it is an outdoor tournament played on a natural surface, weather conditions like humidity and wind play a significant role. Damp weather makes the clay heavier and slower, while hot, dry weather makes it faster and the bounce higher.

**Q90. Answer: (d) China**

The correct answer is China.

Key Points

• In May 2025, China successfully launched the world’s first AI-based satellite, marking a significant milestone in the integration of artificial intelligence with aerospace technology.

• The satellite is equipped with an on-board AI processing system that allows it to analyze data in real-time while in orbit, rather than sending vast amounts of raw data back to Earth for processing.

• This launch was part of China's broader initiative to enhance its space-based computing capabilities, significantly reducing the latency involved in satellite communications and remote sensing analysis.

• The AI-based satellite is designed for high-efficiency autonomous operations, enabling it to detect and identify specific targets or environmental changes without human intervention from ground control.

• The development of this technology solidifies China's position as a leader in the global space race, particularly in the domain of

"Smart Satellites" and edge computing in space.

Additional Information

• Edge Computing in Space:

• Traditional satellites act as mere relays, but AI satellites utilize Edge Computing to process data locally. This minimizes the bandwidth required to transmit results back to ground stations.

• By using Neural Processing Units (NPUs), these satellites can handle complex tasks such as image recognition and data filtering at extreme speeds.

• Applications of AI Satellites:

• These satellites are highly effective in disaster management, where they can autonomously identify forest fires or flood zones within seconds and alert relevant authorities.

• In urban planning, they provide real-time updates on traffic density and infrastructure development by analyzing high-resolution imagery on the fly.

• They also support environmental monitoring by tracking carbon emissions and illegal deforestation activities across the globe.

• Technological Specifications:

• The satellite launched in 2025 features a high-capacity AI brain capable of performing trillions of operations per second.

• It operates in Low Earth Orbit (LEO), which is the preferred altitude for high-speed data acquisition and real-time observation missions.

Important Points

• Global Context: While countries like the USA and Japan have been experimenting with AI components, China's May 2025 mission is recognized as the first fully integrated AI-centric satellite platform.

• Data Efficiency: The AI algorithms on board can compress and prioritize data, ensuring that only the most critical information is transmitted, which is vital for military and emergency response applications.

• Future Prospects: The success of this mission paves the way for future constellations of smart satellites that can communicate with each other to form a decentralized AI network in space.

• Collaborating Entities: The project involved major Chinese aerospace firms and AI research institutes, reflecting a synergy between commercial space interests and national strategic goals.

**Q91. Answer: (b) Three**

The correct answer is Three.

Key Points

• Indian shooter Suruchi Singh delivered an extraordinary performance at the ISSF World Cup 2025, which was held in New Delhi, India.

• She successfully won a total of three gold medals specifically in the 10 m air pistol discipline, marking one of the most successful individual runs in the tournament's history. Hence, the statement regarding three medals is correct.

• Her first gold medal was secured in the 10m Air Pistol Women's Individual event, where she outscored competitors from across the globe in the final round at the Dr. Karni Singh Shooting Range.

• The second gold medal was earned in the 10m Air Pistol Mixed Team event, where she displayed exceptional coordination with her partner to clinch the top spot on the podium.

• She completed her hat-trick of golds by winning the third gold medal in the 10m Air Pistol Women's Team event, contributing to India's dominance in the overall medal tally of the 2025 season.

Additional Information

• ISSF World Cup:

• The International Shooting Sport Federation (ISSF) governs the World Cup series, which serves as a premier platform for shooters to earn ranking points and Olympic quotas.

• The 2025 edition held in India saw a massive participation of over 400 shooters from more than 50 countries.

• 10m Air Pistol Event:

• This is a standard Olympic shooting event where participants use a 4.5 mm (.177 cal) caliber air pistol to fire at a target placed at a distance of 10 meters.

• In the qualification round, shooters must fire 60 shots within a time limit of 75 minutes.

• The final round follows an elimination format where the scores are reset, and shots are scored in decimal values to determine the winner.

• Significance of the Achievement:

• Winning three gold medals in a single World Cup edition is a rare feat in the shooting circuit, highlighting Suruchi Singh's technical precision and mental fortitude.

• This performance solidified India's reputation as a global powerhouse in pistol shooting, following the footsteps of legendary

shooters like Manu Bhaker and Jaspal Rana.

Important Points

• Venue Details: The ISSF World Cup 2025 was hosted at the Dr. Karni Singh Shooting Range, which is one of the world's most advanced shooting facilities located in the capital city of India.

• Historical Context: India has consistently topped the ISSF medal tables between 2019 and 2025, showing a massive growth in the sport's infrastructure and talent pool.

• Equipment: The air pistols used in the 10m event are powered by compressed air or carbon dioxide and must adhere to strict weight and dimension regulations set by the ISSF.

**Q92. Answer: (d) Indian Chess Teams**

The correct answer is Indian Chess Teams.

Key Points

• The Indian Chess Teams (both Men and Women) were crowned the National Team of the Year at the prestigious Sportstar Aces Awards 2025 held in Mumbai.

• This recognition was primarily due to their historic "Double Gold" achievement at the 45th FIDE Chess Olympiad held in Budapest, Hungary, in September 2024.

• The Men's team, comprising Gukesh D, R Praggnanandhaa, Arjun Erigaisi, Vidit Gujrathi, and Pentala Harikrishna, finished at the top of the open section with an almost perfect score.

• The Women's team, consisting of Harika Dronavalli, R Vaishali, Divya Deshmukh, Vantika Agrawal, and Tania Sachdev, also secured the Gold Medal, marking the first time India won both categories simultaneously.

• The performance solidified India's position as a global superpower in chess, with players like Gukesh D and Arjun Erigaisi also winning individual gold medals for their respective boards. Hence, the correct answer is Indian Chess Teams.

Additional Information

• Sportstar Aces Awards:

• It is an annual awards ceremony organized by The Hindu Group through its sports magazine, Sportstar.

• The 2025 edition celebrated the sporting achievements of Indian athletes throughout the calendar year 2024, which included the Paris Olympics and Paralympics.

• Other Major Winners in 2025:

• Sportstar of the Year (Male): Gukesh D was honored for his stellar year, which included winning the Candidates Tournament and leading the Olympiad team.

• Sportstar of the Year (Female): Manu Bhaker received this award after becoming the first Indian in the post-Independence era to win two medals in a single edition of the Olympics (Paris 2024).

• Sportsman of the Year (Track and Field): Neeraj Chopra was recognized for his Silver Medal at the Paris 2024 Olympics.

• Significance of the 45th Chess Olympiad:

• India joined an elite group of nations (including the former USSR and China) to have won the Double Gold at a single Olympiad.

• The event saw Gukesh D achieve a staggering rating performance, further cementing his status as the youngest-ever challenger for the World Chess Championship.

Important Points

• Jaspal Rana, the personal coach of Manu Bhaker, was awarded the Coach of the Year for his contribution to India's success in Shooting.

• The Indian Men's Hockey Team (Option 1) was also a strong contender after winning the Bronze Medal at the Paris 2024 Olympics, but the unprecedented double gold in chess gave the Indian Chess Teams the edge.

• The Lifetime Achievement Award at the 2025 ceremony was presented to shooting legend Abhinav Bindra, India's first individual Olympic gold medalist.

• These awards use a combination of jury votes (led by legends like Sunil Gavaskar) and public voting to determine winners across various categories.

**Q93. Answer: (c) Indian Defence Cyber Agency**

The correct answer is Indian Defence Cyber Agency.

Key Points

• The Indian Defence Cyber Agency (DCyA) initiated a comprehensive 12-day cybersecurity exercise titled ‘Cyber Suraksha’, which commenced on 16 June 2025.

• The exercise is designed to evaluate and enhance the cyber-defence readiness and operational capabilities of the Indian Armed Forces in the face of evolving digital threats.

• The ‘Cyber Suraksha’ exercise serves as a collaborative platform for the Indian Army, Indian Navy, and Indian Air Force to develop jointness and synergy in their cyber operations.

• A primary objective of this drill is to test the robustness of the military's information technology infrastructure and ensure the security of strategic communication networks against potential cyber-espionage and state-sponsored attacks.

• By conducting this exercise, the DCyA aims to refine Standard Operating Procedures (SOPs) and strengthen the nation's cyber-resilience within the framework of the Ministry of Defence.

Additional Information

• Defence Cyber Agency (DCyA):

• The DCyA is a tri-service command of the Indian Armed Forces, established in 2019 to handle cyber warfare and digital security.

• It is headquartered in New Delhi and operates under the administrative and operational control of the Chief of Defence Staff (CDS).

• The agency was formed based on the recommendations of the Naresh Chandra Task Force to integrate the disparate cyber capabilities of the three services into a single unified command.

• It plays a vital role in protecting critical information infrastructure (CII) and conducting both offensive and defensive cyber operations to safeguard national interests.

• Significance of Cyber Exercises:

• In the modern era of Hybrid Warfare, the cyber domain is recognized as the fifth dimension of warfare, alongside land, air, sea, and space.

• Exercises like 'Cyber Suraksha' are crucial for identifying vulnerabilities in military hardware and software systems, including Satellite-based communication and C4I systems.

• These drills ensure that the defence personnel are well-trained in the latest encryption techniques and threat-hunting methodologies.

Important Points

• Inter-Agency Cooperation: The Indian Defence Cyber Agency works in close coordination with national bodies such as CERT-In (Indian Computer Emergency Response Team) and the National Critical Information Infrastructure Protection Centre (NCIIPC).

• Technological Focus: The exercise focuses on emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), and Quantum Computing to stay ahead of sophisticated malware and ransomware attacks.

• Strategic Policy: Such initiatives are aligned with India's National Cyber Security Strategy, which emphasizes atmanirbharta (self-reliance) in developing indigenous cyber-security tools and software.

• Historical Context: Since its inception in 2019, the DCyA has significantly expanded its footprint, conducting multiple training programs and drills to secure the digital ecosystem of the Indian Ministry of Defence.

**Q94. Answer: (c) BioSaarthi Mentorship Initiative**

The correct answer is BioSaarthi Mentorship Initiative.

Key Points

• The BioSaarthi Mentorship Initiative was officially launched on 21 March 2025 by the Union Ministry of Science and Technology. It is designed to act as a catalyst for the burgeoning biotechnology ecosystem in India.

• The primary objective of this initiative is to provide structured mentorship to biotech startups, early-stage researchers, and students, ensuring they receive professional guidance from established industry veterans and renowned academicians.

• By creating a bridge between academia and industry, the program seeks to facilitate the transition of innovative lab-scale research into commercialized products and scalable business models.

• The initiative emphasizes inclusive growth, specifically targeting innovators in Tier-II and Tier-III cities who often lack access to high-level strategic and technical networks found in major metropolitan hubs.

• The BioSaarthi platform offers guidance on several critical aspects, including Intellectual Property Rights (IPR) management, regulatory compliance, and clinical trial strategies. Hence, the correct answer is the BioSaarthi Mentorship Initiative.

Additional Information

• Biotechnology Industry Research Assistance Council (BIRAC):

• BIRAC is a Section 8, Not-for-Profit Public Sector Enterprise, set up by the Department of Biotechnology (DBT) to empower the emerging biotech enterprise.

• It plays a pivotal role in implementing schemes like BioSaarthi to bridge the gap between industry and academia.

• The organization provides funding, infrastructure, and incubation support to startups through various programs like the Biotechnology Ignition Grant (BIG).

• India's Bioeconomy Goals:

• India aims to reach a Bioeconomy valuation of $300 billion by the year 2030, contributing significantly to the $5 trillion economy vision.

• The Department of Biotechnology focuses on sectors such as Biopharma, Bio-agriculture, and Bio-industrial applications to drive this growth.

• In 2024-25, the focus intensified on Deep Tech and Synthetic Biology to ensure global competitiveness.

Important Points

• Department of Biotechnology (DBT): Established in 1986, it is the nodal agency under the Ministry of Science and Technology responsible for the development of modern biology and biotechnology in India.

• Global Standing: India is currently ranked among the top 12 biotechnology destinations in the world and holds the 3rd position in the Asia-Pacific region.

• Focus on Startups: The number of biotech startups in India has grown from a few hundred in 2014 to over 6,000 by 2024, necessitating initiatives like BioSaarthi for high-quality technical mentorship.

• Sectors Covered: The mentorship covers diverse fields including Genomics, Vaccine Development, Bio-informatics, and Precision Medicine.

**Q95. Answer: (c) 1923**

The correct answer is 1923.

Key Points

• The Mussalman Wakf (Repeal) Bill, 2025, has been proposed to officially remove the Mussalman Wakf Act, 1923 (Act No. 42 of 1923), from the Indian legal system.

• The Mussalman Wakf Act, 1923, was a colonial-era legislation enacted during the British Raj with the primary objective of ensuring better management of Wakf properties and mandatory auditing of their accounts.

• The 1923 Act required Mutawallis (managers of Waqf) to furnish statements of particulars and annual accounts to the District Court, ensuring a degree of financial transparency.

• The repeal of this 102-year-old law is part of the Government of India's broader legislative cleanup drive to abolish obsolete and redundant laws that have lost their relevance due to subsequent modern enactments.

• The provisions of the 1923 Act have been effectively superseded by more comprehensive legislations, such as the Waqf Act, 1954, and the currently prevailing Waqf Act, 1995.

Additional Information

• Waqf Act, 1995:

• This is the primary legislation currently governing the administration and supervision of Waqf properties in India.

• It established State Waqf Boards and the Central Waqf Council to oversee the protection and proper utilization of dedicated properties.

• The 1995 Act was significantly amended in 2013 to provide more powers to the Waqf Boards and to make encroachment on Waqf property a cognizable offense.

• Waqf (Amendment) Bill, 2024/2025:

• The Union Government introduced a new amendment bill in the Lok Sabha in August 2024, which seeks to rename the 1995 Act to the Unified Waqf Management, Empowerment, Efficiency and Development Act.

• One of the major proposed changes is the mandatory representation of women and non-Muslims in the Central Waqf Council and State Boards to ensure diversity.

• The bill also proposes the creation of a centralized portal and database for the registration of all Waqf properties in the country.

• Definition of Waqf:

• A Waqf is a permanent dedication of movable or immovable property for any purpose recognized by the Muslim Law as religious, pious, or charitable.

• Once a property is declared as Waqf, its ownership is believed to be transferred to Almighty Allah, and it cannot be sold or transferred.

Important Points

• Central Waqf Council: It is a statutory body established in 1964 under the Ministry of Minority Affairs. It advises the Union Government on matters concerning the working of the State Waqf Boards.

• Mutawalli: This term refers to the manager or custodian of a Waqf property. While the property belongs to God, the Mutawalli is responsible for its day-to-day administration and ensuring the income is used for intended charitable purposes.

• Historical Context: Before the 1923 Act, the Mussalman Wakf Validating Act, 1913, was passed to restore the validity of Waqf-alal-aulad (private family trusts), which had been challenged by British courts in the 1894 Abul Fata Mahomed Ishak v. Russomoy Dhur Chowdry case.

• Role of the Collector: In the latest proposed amendments, the District Collector is designated as the authority to determine if a property is Waqf land or Government land in case of disputes, shifting certain powers away from the Waqf Tribunals.

**Q96. Answer: (a) Andhra Pradesh**

The correct answer is Andhra Pradesh.

Key Points

• The government of Andhra Pradesh has proposed the development of a 'Great Green Wall' along its coastline, aimed for

completion by the year 2030.

• The initiative is designed to act as a natural biological shield to protect the state's coastal districts from the devastating impacts of cyclones, high-tide surges, and tsunamis.

• The project focuses on the extensive planting of mangroves and shelterbelt plantations (such as casuarina trees) along the 974 km long coastline, which is the second-longest in mainland India.

• This green belt is expected to prevent coastal erosion and mitigate environmental degradation caused by climate change and industrial activities near the shore. Hence, the correct answer is Andhra Pradesh.

• The project also aims to enhance biodiversity by restoring degraded coastal ecosystems, thereby supporting the local fishing communities and marine life.

Additional Information

• The Great Green Wall Concept:

• The original Great Green Wall initiative was launched by the African Union in 2007 to combat desertification in the Sahel region.

• In the Indian context, besides Andhra Pradesh, there are discussions regarding a Green Wall of India extending from Gujarat to Delhi along the Aravalli Range to stop the eastward expansion of the Thar Desert.

• Coastal Vulnerability of Andhra Pradesh:

• The state is frequently hit by severe cyclonic storms originating in the Bay of Bengal. Historical examples include Cyclone Hudhud (2014) and Cyclone Michaung (2023).

• The Coringa Wildlife Sanctuary in Andhra Pradesh is one of the largest stretches of mangrove forests in India and serves as a primary template for this green wall project.

• Role of Mangroves:

• Mangroves are salt-tolerant trees that act as carbon sinks, sequestering up to four times more carbon than terrestrial forests.

• They provide a critical breeding ground for various fish species and protect the inland areas by breaking the force of storm waves.

Important Points

• Climate Targets: The 2030 deadline aligns with India’s Sustainable Development Goals (SDG 13 - Climate Action) and the United Nations Decade on Ecosystem Restoration.

• Institutional Support: The project involves collaboration between the Forest Department, Environment Ministry, and Coastal Zone Management authorities to ensure compliance with CRZ (Coastal Regulation Zone) guidelines.

• Economic Benefits: By stabilizing the coastline, the Great Green Wall protects port infrastructure in cities like Visakhapatnam and Kakinada, which are vital for the state's Blue Economy.

• Species Selection: Specifically selected species like Avicennia marina and Rhizophora are utilized for their high survival rates in saline environments and their ability to form dense barriers.

**Q97. Answer: (d) Achieving Gender Equality, Action by Action**

The correct answer is Achieving Gender Equality, Action by Action.

Key Points

• The International Day of Democracy is celebrated annually on September 15 across the globe to promote and uphold the principles of democracy.

• For the year 2025, the designated theme is Achieving Gender Equality, Action by Action, focusing on the critical role that gender parity plays in the sustainability of democratic institutions.

• The day was established by a resolution passed by the United Nations General Assembly in 2007, with the aim of encouraging governments to strengthen their national programs devoted to the promotion and consolidation of democracy.

• The theme Achieving Gender Equality, Action by Action highlights that a democracy is truly representative only when women have equal access to political leadership and decision-making processes. Hence, the correct answer is option 4.

• This theme emphasizes concrete actions and policy reforms rather than just rhetoric, aiming to eliminate the systemic barriers that prevent marginalized genders from participating in civic life.

Additional Information

• Historical Context:

• The idea for the day originated from the Inter-Parliamentary Union (IPU), which adopted the Universal Declaration on Democracy in September 1997.

• This declaration affirmed that democracy is an international standard and a fundamental right for all citizens of the world.

• Sustainable Development Goals (SDGs):

• The 2025 theme is closely linked to SDG 5 (Gender Equality) and SDG 16 (Peace, Justice, and Strong Institutions).

• The United Nations recognizes that inclusive governance is essential for achieving the 2030 Agenda for Sustainable Development.

• Legal Foundations:

• The principles of democracy are enshrined in the Universal Declaration of Human Rights, specifically under Article 21, which states that the will of the people shall be the basis of the authority of government.

• This is expressed through periodic and genuine elections by universal and equal suffrage.

• Global Participation:

• Various non-governmental organizations (NGOs), parliaments, and civil society groups hold events on September 15 to discuss transparency, accountability, and human rights.

Important Points

• Gender and Democracy: Research by the UN Women and the IPU consistently shows that countries with higher female representation in legislatures tend to pass more laws related to social welfare, education, and healthcare.

• Challenges in 2025: The theme addresses the global decline in democratic freedoms in some regions and the gender-based violence that often targets women in public office.

• Implementation: "Action by Action" refers to localized efforts such as legislative quotas, funding for women candidates, and combating online harassment to ensure a safe democratic space for all.

• Institutional Role: The United Nations Department of Global Communications works alongside the IPU to disseminate educational materials about the rule of law and voter education on this day.

**Q98. Answer: (c) Shabana Azmi**

The correct answer is Shabana Azmi.

Key Points

• Renowned veteran actress Shabana Azmi was honored with the prestigious Lifetime Achievement Award at the 16th Bengaluru International Film Festival (BIFFes) in 2025.

• The award was presented to her in recognition of her monumental contribution to Indian cinema over a career spanning more than 50 years.

• The 16th edition of the festival was scheduled from February 27 to March 6, 2025, in Bengaluru, the capital of Karnataka.

• The announcement was made by the Karnataka Chalanachitra Academy, which organizes the event under the aegis of the Government of Karnataka.

• Shabana Azmi is celebrated for her versatility and her role in the Parallel Cinema movement in India, which brought realistic and socially relevant themes to the forefront.

Additional Information

• Career Highlights of Shabana Azmi:

• She made her acting debut in 1974 with the film Ankur, directed by Shyam Benegal, which earned her the first of several National Film Awards.

• She holds the record for the most wins in the National Film Award for Best Actress category, having won the title five times for films like Arth, Khandhar, and Paar.

• The Government of India honored her with the Padma Shri in 1988 and the Padma Bhushan in 2012 for her excellence in the arts.

• Bengaluru International Film Festival (BIFFes):

• It is a premier film festival in India that showcases world cinema to the local audience and provides a platform for Asian and Indian filmmakers.

• The festival includes various competition sections, such as the Chitrapura Asian Cinema Competition and the Indian Cinema Competition.

• The 2025 edition focused on diverse storytelling, featuring over 200 films from across the globe.

• Social Contributions:

• Beyond her cinematic achievements, Shabana Azmi is a dedicated social activist, focusing on child survival, fighting AIDS, and advocating for the rights of slum dwellers and women.

• She has also served as a nominated member of the Rajya Sabha, the upper house of the Parliament of India, from 1997 to 2003.

Important Points

• The Lifetime Achievement Award at BIFFes is one of the highest honors bestowed by the state of Karnataka in the field of cinema.

• Previous recipients of such prestigious honors at film festivals include legends like Adoor Gopalakrishnan and Amitabh Bachchan, highlighting the caliber of the award.

• The festival also plays a crucial role in promoting the Kannada film industry (Sandalwood) by hosting a dedicated Kannada Cinema Competition section.

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• In 2025, the festival venue spread across multiple screens at Orion Mall and other cultural hubs in Bengaluru to ensure wide public accessibility.

**Q99. Answer: (b) Central Government**

The correct answer is Central Government.

Key Points

• The Central Government of India, primarily through the Union Ministry of Home Affairs (MHA), raised serious objections in early 2025 regarding the Aparajita Woman and Child (West Bengal Criminal Laws Amendment) Bill, 2024.

• The Aparajita Bill was passed by the West Bengal Legislative Assembly on September 3, 2024, in the aftermath of the RG Kar Medical College incident to strengthen laws against sexual violence.

• The Central Government argued that the proposed punishments under the bill were excessively harsh and disproportionate compared to the provisions laid out in the Bharatiya Nyaya Sanhita (BNS), which replaced the Indian Penal Code. Hence, the statement is correct.

• A major point of contention was the bill's provision for a mandatory death penalty in cases of rape where the victim dies or is left in a vegetative state, which the Central Government noted deviates from the discretionary power given to judges under the BNS 2023.

• The Central Government emphasized that since "Criminal Law" falls under the Concurrent List of the Seventh Schedule of the Constitution of India, any state amendment that is repugnant to a Central law requires Presidential assent under Article 254(2).

Additional Information

• The Aparajita Bill, 2024:

• The bill officially titled the Aparajita Woman and Child (West Bengal Criminal Laws Amendment) Bill, 2024, seeks to amend the Bharatiya Nyaya Sanhita (BNS), Bharatiya Nagarik Suraksha Sanhita (BNSS), and the POCSO Act in their application to West Bengal.

• Key features include a 10-day investigation limit for rape cases from the date of the preliminary report and the creation of a specialized Aparajita Task Force at the district level.

• The bill proposes rigorous imprisonment for life for the remainder of the convict's natural life without parole for various categories of sexual assault.

• Bharatiya Nyaya Sanhita (BNS):

• The BNS is the official criminal code of India, which came into effect on July 1, 2024, replacing the Indian Penal Code (IPC) of 1860.

• It contains 358 sections and introduces new offenses like terrorism, organized crime, and mob lynching, while enhancing punishments for crimes against women and children.

Important Points

• Constitutional Repugnancy: Under Article 254, if any provision of a law made by the Legislature of a State is repugnant to any provision of a law made by Parliament, the Central law prevails unless the State law has received the assent of the President.

• Procedural Hurdles: The West Bengal Governor referred the Aparajita Bill to the President of India for consideration, leading to the Ministry of Home Affairs scrutinizing it for legal and procedural consistency with existing national frameworks.

• Legal Criticism: Legal experts have noted that mandatory capital punishment has been previously struck down by the Supreme Court in cases like Mithu vs. State of Punjab (1983), as it violates Articles 14 and 21 of the Constitution by removing judicial discretion.

**Q100. Answer: (d) Union Government**

The correct answer is Union Government.

Key Points

• The inauguration of the Khelo India multipurpose hall in Arunachal Pradesh in 2025 stands as a clear reflection of the Union Government's unwavering commitment to the development of the North Eastern Region (NER).

• This infrastructure project was executed under the Khelo India Scheme, which is a flagship national program spearheaded by the Ministry of Youth Affairs and Sports, Government of India.

• The Union Minister of Youth Affairs and Sports, during the visit to Arunachal Pradesh, emphasized that the Union Government aims to bridge the geographical and infrastructural gap between the North East and the rest of the country through high-quality sports facilities.

• The multipurpose hall is equipped to host various indoor disciplines such as Badminton, Table Tennis, Boxing, and Wrestling, providing a platform for local youth to train under international standards.

• By funding and overseeing such projects, the Union Government ensures that talented athletes from border states like Arunachal Pradesh are integrated into the national sports mainstream, aligning with the vision of "Viksit Bharat".

Additional Information

• Khelo India Programme:

• Launched in 2018, the Khelo India (Play India) curriculum was introduced to revive the sports culture in India at the grass-root level by building a strong framework for all sports played in the country.

• It is categorized as a Central Sector Scheme, which means the Union Government provides 100% funding for its implementation across various states and Union Territories.

• The program has several components, including Play Field Development, Community Coaching Development, and the establishment of State Level Khelo India Centres.

• Focus on Arunachal Pradesh and North East:

• Under the "Act East Policy", the Union Government has prioritized the Eight North Eastern States for sports excellence, recognizing their natural talent in athletics and combat sports.

• In Arunachal Pradesh, specific Khelo India State Centres of Excellence (KISCE) have been established to focus on sports like Archery, Weightlifting, and Taekwondo.

• The Union Government has allocated specialized budgets under the North Eastern Region (NER) head to ensure that funds are specifically utilized for sports infrastructure in these hilly terrains.

Important Points

• Talent Identification and Support:

• One of the most significant features of the Union Government's initiative is the Long Term Athlete Development program, where 1,000 talented athletes are identified annually.

• Each identified athlete is provided with an annual financial assistance of Rs. 5,00,000 for a period of 8 years to cover their training, equipment, and nutritional needs.

• Administrative Integration:

• The Sports Authority of India (SAI), which functions under the Union Government, works in coordination with the State Government of Arunachal Pradesh to manage these newly inaugurated facilities.

• The multipurpose hall in 2025 is part of a larger plan to host regional and national level competitions in Arunachal Pradesh, boosting local economy and sports tourism.

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