# RRB Group D Official Paper (Held On: 03 Feb, 2026 Shift 1) (Previous Year Paper)

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

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## GENERAL SCIENCE

**Q1.** An object is placed at infinity in front of a convex lens. The image formed is:

**(a)** between F and 2F, inverted
**(b)** at 2F, same size
**(c)** at infinity, highly magnified
**(d)** at the focal point, highly diminished (point-sized)

**Q2.** Which of the following activities CANNOT be taken as a defining characteristic of life?

**(a)** Molecular movement within the cells
**(b)** Visible movement like walking or running
**(c)** Growth-related movement of plants
**(d)** Breathing and internal maintenance of cells

**Q3.** Which of the following devices works on the principle of force on a current-carrying conductor in a magnetic field?

**(a)** Transformer
**(b)** Electric motor
**(c)** Electric generator
**(d)** Resistor

**Q4.** If the power of an engine is doubled while the time remains constant, the work done will _____.

**(a)** Be halved
**(b)** Be doubled
**(c)** Be quadrupled
**(d)** Remain the same

**Q5.** Which of the following is NOT an isotope of hydrogen atom?

**(a)** Tritium
**(b)** Deuterium
**(c)** Protium
**(d)** Helium

**Q6.** What is the primary characteristic that defines organic compounds?

**(a)** They always contain oxygen atoms.
**(b)** They are formed only by living organisms.
**(c)** They are compounds that conduct electricity in their molten state.
**(d)** They primarily consist of carbon and hydrogen atoms, forming covalent bonds.

**Q7.** The law of refraction is valid for which range of the angle of incidence?

**(a)** $0° < i < 60°$
**(b)** $i > 90°$
**(c)** $0° < i < 45°$

**(d)** $0° < i < 90°$

**Q8.** Which of the following reacts with bases to form salt and water?

**(a)** Sodium oxide
**(b)** Carbon dioxide
**(c)** Hydrogen gas
**(d)** Calcium hydroxide

**Q9.** What happens after fertilisation in a flowering plant?

**(a)** The petals and stamens become the seed, and the ovary forms the embryo.
**(b)** The ovule becomes a fruit, and the ovary forms the seed.
**(c)** The ovule becomes the seed, and the ovary becomes the fruit.
**(d)** The entire flower dries up and falls off without forming any new structures.

**Q10.** Which of the following statements is NOT correct?

**(a)** Frequency of vibration determines the pitch of sound
**(b)** Vibrations create compressions and rarefactions in air
**(c)** Amplitude of vibration affects loudness
**(d)** Sound can be produced by non-vibrating bodies

**Q11.** When OH^- ions are added to an acidic solution, the pH:

**(a)** increases
**(b)** decreases
**(c)** becomes zero
**(d)** stays the same

**Q12.** Which of the following structures acts as the basic filtration unit in the kidney?

**(a)** Nephron
**(b)** Alveolus
**(c)** Tracheid
**(d)** Villus

**Q13.** Which of the following is an example of uniform circular motion in daily life?

**(a)** A person walking in a straight line
**(b)** A ceiling fan rotating at constant speed
**(c)** A bus accelerating on a straight road
**(d)** A ball rolling down an inclined plane

**Q14.** Match the following.

| Column A | Column B |
|---|---|
| 1. Calyx | a. Carpels |
| 2. Corolla | c. Petals |
| 3. Androecium | b. Stamens |
| 4. Gynoecium | d. Sepals |

**(a)** 1 - d, 2 - c, 3 - b, 4 - a
**(b)** 1 - a, 2 - c, 3 - b, 4 – d
**(c)** 1 - d, 2 - b, 3 - c, 4 - a
**(d)** 1 - c, 2 - d, 3 - b, 4 - a

**Q15.** An object is dropped from a height. What is its initial velocity?

**(a)** 0 m/s
**(b)** 9.8 m/s
**(c)** 10 m/s

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**(d)** Can't be determined

**Q16.** Molecules of compounds are formed by:

**(a)** Different elements chemically bonded together
**(b)** Metals joined with metals through metallic bonds
**(c)** Mixing ions without forming any chemical bonds
**(d)** One type of atom only with identical properties

**Q17.** What is a major disadvantage of connecting an electric bulb and an electric heater in series, based on their required operating current?

**(a)** The total voltage would decrease to zero
**(b)** They need currents of widely different values to operate properly
**(c)** The total equivalent resistance would be zero
**(d)** The current through the heater would stop immediately

**Q18.** Which of the following statements describes biological magnification?

**(a)** Increase in concentration of harmful substances at higher trophic levels.
**(b)** Progressive increase in biological activities.
**(c)** Pollutants are completely broken down by decomposers in the ecosystem.
**(d)** Energy increases as it flows from producers to consumers.

**Q19.** Which of the following is a double displacement reaction?

**(a)** $2Mg + O2 \rightarrow 2MgO$
**(b)** $AgNO3 + NaCl \rightarrow AgCl + NaNO3$
**(c)** $Zn + CuSO4 \rightarrow ZnSO4 + Cu$
**(d)** $CaCO3 \rightarrow CaO + CO2$

**Q20.** Which of the following is a molecule of a compound?

**(a)** $N2$
**(b)** $H2O$
**(c)** He
**(d)** $O2$

**Q21.** In which part of the female reproductive system does fertilisation take place?

**(a)** Ovary
**(b)** Oviduct (fallopian tube)
**(c)** Uterus
**(d)** Cervix

**Q22.** In blood, oxygen is transported by _____.

**(a)** Blood platelets
**(b)** Lymph
**(c)** Red blood corpuscles
**(d)** White blood corpuscles

**Q23.** Why do fodder crops require tall plants with profuse branching?

**(a)** To provide maximum green matter for fodder
**(b)** To reduce harvesting time
**(c)** To increase grain yield
**(d)** To improve soil fertility

**Q24.** Isobars are the atoms with:

**(a)** same mass number but different atomic number
**(b)** same atomic number but different mass number
**(c)** same melting point but different refractive index

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**(d)** same refractive index but different melting point

**Q25.** A constant force acts on an object of mass 4 kg for a duration of 2 s. It increases the object's velocity from 2 m/s to 8 m/s. What is the magnitude of the applied force?

**(a)** 8 N
**(b)** 24 N
**(c)** 10 N
**(d)** 12 N

## MATHEMATICS

**Q26.** Due to water crisis, 28% of the initial population left the village and 50% of the remaining population left the village for pursuing jobs. If presently, 4450 people inhabit the village, what is the ratio of the initial population to the present population?

**(a)** 107:87
**(b)** 25:11
**(c)** 106:83
**(d)** 25:9

**Q27.** A solid cylinder of base diameter 4 cm is taken to cast a hollow cylinder of external diameter 12 cm, thickness 0.5 cm and height 15 cm. Find the height (in cm) of the solid cylinder (rounded off to 2 decimal places).

**(a)** 21.56
**(b)** 22.54
**(c)** 20.85
**(d)** 18.65

**Q28.** If $(x^2 - 1)/x = 4$, then find the value of $(x^6 - 1)/(x^3)$.

**(a)** 80
**(b)** 76
**(c)** 66
**(d)** 82

**Q29.** 1/30 is what percentage of 2/40 ? (Round off the answer to two decimal places.)

**(a)** 133.33%
**(b)** 66.67%
**(c)** 81.67%
**(d)** 76.67%

**Q30.** A grocer marked his goods at 75% above their cost price and sold them at a discount of X%. If he gained 33% profit, then find the value of X.

**(a)** 27
**(b)** 23
**(c)** 24
**(d)** 26

**Q31.** Find the greatest number that exactly divides 46, 98 and 74.

**(a)** 5
**(b)** 2
**(c)** 1
**(d)** 3

**Q32.** A father's current age is three times his son's age. Together, their ages add up to 48 years. How old is the son?

**(a)** 16 years
**(b)** 14 years
**(c)** 10 years

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**(d)** 12 years

**Q33.** Three pipes A, B and C can fill an empty tank in 30 minutes, 40 minutes and 45 minutes, respectively. All three pipes are opened at the same time to disperse liquid chemicals X, Y and Z from pipes A, B and C respectively. After 5 minutes, what is the proportion of chemical Y in the tank?

**(a)** 9/29
**(b)** 1/6
**(c)** 29/72
**(d)** 1/8

**Q34.** Find the mean proportional of 17 and 272?

**(a)** 67
**(b)** 71
**(c)** 68
**(d)** 70

**Q35.** The number of prime numbers between 445 and 456 is:

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

**Q36.** An item with a marked price of Rs. 889 was sold for Rs. 278. What was the percentage of discount given? (Round off the answer to two decimal places.)

**(a)** 67.92%
**(b)** 70.88%
**(c)** 67.57%
**(d)** 68.73%

**Q37.** P and Q together can fill a cistern with water in 9 hours. If P alone can fill the cistern with water in 36 hours, then in how many hours will Q alone fill three-fourth of the same cistern with water?1244

**(a)** 18
**(b)** 9
**(c)** 19
**(d)** 10

**Q38.** The arithmetic mean of the observations 17, 64, 55, 37, 65, 12, 51, 18 and 59 is:

**(a)** 44
**(b)** 42
**(c)** 51
**(d)** 37

**Q39.** A sum of Rs. 33,600 is divided among X, Y and Z. X gets Rs. 4,000 more than Y and Z gets Rs. 8,000 more than Y. Find the ratio of the amount received by X, Y and Z.

**(a)** 13 : 11 : 18
**(b)** 14 : 10 : 17
**(c)** 14 : 9 : 19
**(d)** 14 : 11 : 20

**Q40.** In quadrilateral PQRS, the bisectors of angle R and angle S meet at the point T (inside the quadrilateral) and angle STR = 27.5°. If the ratio of angle P to angle Q is 5 : 6, then what is the difference between the measures of angle Q and angle P ?

**(a)** 3°
**(b)** 2°
**(c)** 8°
**(d)** 5°

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**Q41.** The average of 7 numbers is 23. If each number is increased by 4, what will the new average be?

**(a)** 23
**(b)** 7
**(c)** 31
**(d)** 27

**Q42.** A man buys apples at Rs. 15 per apple and plans to sell them at a 13% profit. How many apples must he sell to make a total profit of Rs. 195?

**(a)** 95
**(b)** 195
**(c)** 110
**(d)** 100

**Q43.** If 20% of 50% of 5/9 of a number is 364, find the number.

**(a)** 5670
**(b)** 6200
**(c)** 6540
**(d)** 6552

**Q44.** A train, 150 m long, takes 30 seconds to cross a platform 350 m long. Find the speed (in km/hr) of the train.

**(a)** 40
**(b)** 45
**(c)** 60
**(d)** 50

**Q45.** The area of a rectangle is 100.64 $cm^2$. If its breadth is 7.4 cm, find the perimeter of the rectangle.

**(a)** 50.32 cm
**(b)** 42 cm
**(c)** 38.25 cm
**(d)** 46 cm

**Q46.** Two banks, A and B, offered loans at 3.5% and 7% per annum, respectively. Manjit borrowed an amount of Rs. 5,00,000 from each bank. Find the positive difference (in Rs. ) between the amounts of simple interest paid to the two banks by Manjit after 2 years.

**(a)** 34,500
**(b)** 36,000
**(c)** 35,000
**(d)** 36,500

**Q47.** Find a number such that when 8 is subtracted from 4 times the number, the result is 6 more than thrice the number.

**(a)** 18
**(b)** 9
**(c)** 14
**(d)** 23

**Q48.** If 5^(x+y) = 3125 and 3^(3x-y) = 2187, then the value of 41x - 32y is:

**(a)** 55
**(b)** 59
**(c)** 57
**(d)** 53

**Q49.** Two trains of lengths 346 m and 319 m are running with speeds of 67 km/h and 59 km/h, respectively, towards each other on parallel tracks. In how many seconds will they cross each other?

**(a)** 19
**(b)** 18

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**(c)** 15
**(d)** 12

**Q50.** Simplify: $(\sin^2\theta(1+\cot^2\theta))/(\sec^2\theta - 1)$
**(a)** $\text{cosec}^2\theta$
**(b)** $\cot^2\theta$
**(c)** $\tan^2\theta$
**(d)** $1-\cot^2\theta$

## GENERAL INTELLIGENCE & REASONING

**Q51.** Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which is the letter-cluster pair that DOES NOT belong to that group?
(Note: The odd one out is not based on the number of consonants/vowels or their position in the letter-cluster.)
**(a)** LN - GI
**(b)** SU - NP
**(c)** OQ - JL
**(d)** PR - KN

**Q52.** EKOV is related to WCGN in a certain way based on the English alphabetical order. In the same way, YEIP is related to QWAH. To which of the following options is AGKR related, following the same logic?
**(a)** SYCJ
**(b)** SCDE
**(c)** SCJU
**(d)** SCKP

**Q53.** Seven friends, D, E, F, U, V, W and X, are sitting in a straight line, facing north. Only three people sit between U and F. V sits to the immediate left of F. No one sits to the right of X. Only two people sit between X and V. D sits to the immediate right of E. How many people sit between W and D?
**(a)** One
**(b)** Four
**(c)** Three
**(d)** Two

**Q54.** Refer to the given series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.
(Left) 2 6 3 9 8 9 9 8 1 3 3 7 9 9 9 4 1 4 1 1 7 1 8 8 8 7 6 (Right)
How many such odd numbers are there, each of which is immediately preceded by an odd number and also immediately followed by an odd number?
**(a)** 6
**(b)** 7
**(c)** 8
**(d)** 9

**Q55.** Which of the following letter-number clusters will replace the question mark (?) in the given series to make it logically complete?
PRT 28 VXZ 21 BDF 14 HJL 7 ?
**(a)** NPR 0
**(b)** NQQ 0
**(c)** NRW -1
**(d)** NOQ -1

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**Q56.** Piku, Aman, Krishna, Deepa, and Shrusti are sitting at a circular table facing the centre. Shrusti and Deepa are immediate neighbours. Piku is an immediate neighbour of both Deepa and Krishna. Who are the immediate neighbours of Aman?

**(a)** Piku and Shrusti
**(b)** Shrusti and Deepa
**(c)** Krishna and Deepa
**(d)** Shrusti and Krishna

**Q57.** Five people, V, W, X, Y and Z, are sitting in a row, facing towards the north. W is sitting at the extreme left end of the row. There are only two people sitting between Z and W. V is an immediate neighbour of Z. X is an immediate neighbour of V. Exactly how many people are sitting between W and Y?

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

**Q58.** In a certain code language,

A + B means 'A is the mother of B',

A – B means 'A is the brother of B',

A x B means 'A is the wife of B',

A % B means 'A is the father of B' and

A # B means 'A is the daughter of B'.

How is C related to E if 'C – Q x Y % R – E'?

**(a)** Sister's son
**(b)** Sister's husband
**(c)** Wife's brother
**(d)** Mother's brother

**Q59.** In a certain code language, 'HELS' is coded as '4695' and 'ALES' is coded as '5749'. What is the code for 'A' in the given code language?

**(a)** 9
**(b)** 5
**(c)** 4
**(d)** 7

**Q60.** What will come in the place of '?' in the following equation, if '+' and '-' are interchanged and 'x' and '÷' are interchanged?

231 ÷ 3 - 721 x 7 + 24 = ?

**(a)** 771
**(b)** 774
**(c)** 773
**(d)** 772

**Q61.** In a certain code language, 'LEGS' is coded as '5483' and 'ALES' is coded as '2348'. What is the code for 'A' in the given code language?

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

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

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

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

immediately followed by an odd number?

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

**Q63.** What should come in place of the question mark (?) in the given series?

2, 6, 12, 20, 30, ?

**(a)** 38
**(b)** 44
**(c)** 40
**(d)** 42

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

50 44 40 34 ? 24

**(a)** 28
**(b)** 38
**(c)** 36
**(d)** 30

**Q65.** Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements:

Some bells are pots.

All pots are machines.

Conclusions:

(I): Some bells are machines.

(II): All machines are pots.

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

**Q66.** EL 14 is related to BH 16 in a certain way. In the same way, PW 22 is related to MS 24. To which of the following is NU 27 related, following the same logic?

**(a)** JS 29
**(b)** JQ 28
**(c)** KQ 29
**(d)** KS 28

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

HNE MRH RVK WZN ?

**(a)** CER
**(b)** BCR
**(c)** BDQ
**(d)** ACP

**Q68.** Hemant starts from point A and drives 62 km towards the east. He then takes a left turn, drives 40 km, turns left and drives 78 km. He then takes a left turn and drives 71 km. He takes a final left turn, drives 16 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)** 30 km to the north
**(b)** 32 km to the south

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**(c)** 31 km to the north
**(d)** 33 km to the south

**Q69.** Read the given statements and conclusions carefully. You have to take the given statements to be true even if they seem to be at variance from commonly known facts. You have to decide which conclusion(s) logically follow(s) from the given statements.

Statements:

All hats are trousers.

All trousers are pants.

No pant is a coat.

Conclusions:

(I): No hat is a coat.

(II): No trouser is a coat.

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

**Q70.** Refer to the following number and symbol series and answer the question that follows. Counting to be done from left to right only.

(Left) 5 3 $ 8 % © 1 % 8 * 5 5 4 # £ & 5 5 £ € 5 € (Right)

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

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

**Q71.** 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)** NO−RS
**(b)** XY−AE
**(c)** JK−NO
**(d)** AB−EF

**Q72.** What should come in place of the question mark (?) in the given series?

12 22 33 45 ? 72

**(a)** 58
**(b)** 60
**(c)** 62
**(d)** 56

**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.)

(28, 56, 45)

(41, 82, 71)

**(a)** (54, 108, 99)
**(b)** (97, 194, 182)
**(c)** (89, 178, 167)
**(d)** (77, 154, 142)

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**Q74.** In a row of 48 people facing north, Pari is 13^(th) from the right end. If Vivek sits 16^(th) to the left of Pari, what is Vivek's position from the left end of the line?

**(a)** 21st
**(b)** 18th
**(c)** 19th
**(d)** 20th

**Q75.** If 'A' stands for '÷', 'B' stands for '×', 'C' stands for '+' and 'D' stands for '−', then what will come in place of the question mark (?) in the following equation?

7 B 4 D 18 A 9 C 16 C 14 = ?

**(a)** 60
**(b)** 58
**(c)** 56
**(d)** 55

**Q76.** MNPM is related to NOQN in a certain way based on the English alphabetical order. In the same way, UVXU is related to VWYV. To which of the following is JKMJ related, following the same logic?

**(a)** KKMK
**(b)** KMMQ
**(c)** KLMK
**(d)** KLNK

**Q77.** Refer to the given series and answer the question that follows (all numbers are single digit numbers only). Counting to be done from left to right only.

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

**Q78.** What will come in place of the question mark (?) in the following equation if '+' and '−' are interchanged and '×' and '÷' are interchanged?

42 × 6 − 12 + 3 ÷ 5 = ?

**(a)** 7
**(b)** 8
**(c)** 9
**(d)** 4

**Q79.** Town D is to the west of Town A. Town C is to the south of Town A. Town B is to the north of Town E. Town E is to the west of Town D. What is the position of Town B with respect to Town C?

**(a)** East
**(b)** North
**(c)** South-west
**(d)** North-west

**Q80.** Z ranked 21^(st) from the bottom and 63^(rd) from the top in his class. How many students are there in his class?

**(a)** 81
**(b)** 83
**(c)** 82
**(d)** 80

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## GENERAL AWARENESS AND CURRENT AFFAIRS

**Q81.** According to the National Commission for Women data released in January 2025, which Indian state reported the highest number of complaints of domestic violence in 2024?

**(a)** Maharashtra
**(b)** Bihar
**(c)** Uttar Pradesh
**(d)** Rajasthan

**Q82.** Which of the following organisations formed a dedicated task force to support displaced female Afghan athletes or players?

**(a)** International Cricket Council
**(b)** International Olympic Committee
**(c)** International Federation of Association Football
**(d)** International Hockey Federation

**Q83.** Which of the following dignitaries inaugurated Asia's largest telecom, media and technology event, the 9^(th)edition of the India Mobile Congress (IMC) 2025, in New Delhi?

**(a)** Droupadi Murmu
**(b)** Ashwini Vaishnaw
**(c)** CP Radhakrishnan
**(d)** Narendra Modi

**Q84.** Which Gujarati children's poet won the Bal Sahitya Puraskar for Tinchak in June 2025?

**(a)** Akhil P Dharmajan
**(b)** Kirtida Brahmbhatt
**(c)** Parvati Tirkey
**(d)** Nandini Purandare

**Q85.** In July 2024, which Indian scientist was awarded with the Vikram Sarabhai Medal that honours outstanding space science research in developing countries?

**(a)** Anil Bhardwaj
**(b)** Govindarajan Padmanabhan
**(c)** Umesh Varshney
**(d)** Prahlad Chandra Agrawal

**Q86.** At COP30 (November 2025), the "Baku–Belem Roadmap" aimed to scale climate finance to what annual level by 2035?

**(a)** US$10 trillion
**(b)** US$5.2 trillion
**(c)** US$2.5 trillion
**(d)** US$1.3 trillion

**Q87.** Which cyclonic storm in November 2025 caused widespread flooding and prompted disaster relief responses in South India and Sri Lanka?

**(a)** Cyclone Ditwah
**(b)** Cyclone Tauktae
**(c)** Cyclone Amphan
**(d)** Cyclone Yaas

**Q88.** Manu Bhaker, who received the Major Dhyan Chand Khel Ratna Award in 2025, is primarily known for her achievements in which sport?

**(a)** Hockey
**(b)** Badminton
**(c)** Shooting

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**(d)** Para-Athletics

**Q89.** According to the Periodic Labour Force Survey (PLFS), May 2025, what was India's overall unemployment rate reported by the Ministry of Statistics and Programme Implementation (MOSPI)?

**(a)** 5.1%
**(b)** 8.5%
**(c)** 5.6%
**(d)** 6.6%

**Q90.** On which date was the 94th martyrdom day of Chandra Shekhar Azad observed in 2025?

**(a)** 27th January
**(b)** 15th August
**(c)** 27th February
**(d)** 26th February

**Q91.** How much funding was allocated to the Khelo India programme for the financial year 2025-26?

**(a)** Rs. 100 crore
**(b)** Rs. 500 crore
**(c)** Rs. 1,000 crore
**(d)** Rs. 10,000 crore

**Q92.** Rajasthan's first Namo Biodiversity Park, inaugurated in October 2025, is located in which district?

**(a)** Alwar District
**(b)** Udaipur District
**(c)** Jaipur District
**(d)** Kota District

**Q93.** Which All-India Financial Institution coordinates financing of Micro, Small and Medium Enterprises (MSME) according to the Dept of Financial Services Annual Report 2024-25 published in March 2025?

**(a)** Small Industrial Development Bank of India (SIDBI)
**(b)** Export -Import Bank of India (Exim Bank)
**(c)** National Bank for Agriculture and Rural Development (NABARD)
**(d)** National Bank for Financing Infrastructure and Development (NaBFID)

**Q94.** Who presented India's Third Voluntary National Review (VNR) Report on Sustainable Development Goals (SDGs) in July 2025?

**(a)** Vice Chairman, NITI Aayog
**(b)** External Affairs Minister
**(c)** Finance Minister
**(d)** Prime Minister of India

**Q95.** The Income Tax Act, 2025, introduced a new concept to describe assets such as cryptocurrencies and tokenized assets. What is this new concept called?

**(a)** Crypto Tokens
**(b)** E-Assets
**(c)** Digital Currencies
**(d)** Virtual Digital Assets

**Q96.** Which of the following banks was fined Rs. 29.6 lakh by the Reserve Bank of India (RBI) for violating regulations in June 2025?

**(a)** City Union Bank
**(b)** Fino Payments Bank
**(c)** HDFC Bank
**(d)** Canara Bank

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**Q97.** The BRICS Summit on 6–7 July 2025 was held in:

**(a)** Rio de Janeiro, Brazil
**(b)** New Delhi, India
**(c)** Johannesburg, South Africa
**(d)** Shanghai, China

**Q98.** Who was named the 2025 Laureus World Sportsman of the Year for his pole-vaulting record-breaking performances?

**(a)** Armand Duplantis
**(b)** Max Verstappen
**(c)** Leon Marchand
**(d)** Carlos Alcaraz

**Q99.** In October 2024, which minister from Andhra Pradesh met and invited Microsoft CEO Satya Nadella to Andhra Pradesh and sought Microsoft's cooperation in improving e-governance and establishing IT hubs in the state?

**(a)** Vangalapudi Anitha
**(b)** Nara Lokesh
**(c)** N Chandrababu Naidu
**(d)** Kolusu Parthasarathy

**Q100.** Which company signed an MoU with the Aeronautical Development Agency (ADA) during Aero India 2025, for the development of Flight Control Actuators for the AMCA programme?

**(a)** Bharat Dynamics Limited
**(b)** Godrej & Boyce Manufacturing Company Limited
**(c)** Hindustan Aeronautics Limited
**(d)** Tata Advanced Systems

## ANSWER KEY

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

## SOLUTIONS

**Q1. Answer: (d) at the focal point, highly diminished (point-sized)**

The correct answer is at the focal point, highly diminished (point-sized).

Key Points

• When an object is placed at infinity in front of a convex lens, the rays of light coming from the object are parallel to the principal axis.

• After undergoing refraction through the lens, these parallel rays converge at the principal focus (F) on the opposite side of the lens.

• The image formed at the focal point is real and inverted. Hence, option 4 is correct.

• The size of the image is highly diminished, often described as point-sized, because all the light energy is concentrated at a single

point.

• The magnification (m) in this case is much less than 1 (m << 1), indicating a significant reduction in size compared to the object.

Additional Information

• Convex Lens (Converging Lens): It is a lens that is thicker at the center and thinner at the edges. It converges a beam of parallel light rays incident on it.

• Image Formation Summary for Convex Lens:

• Object at 2F: The image is formed at 2F on the other side, is of the same size, real, and inverted. Hence, statement 2 is incorrect.

• Object beyond 2F: The image is formed between F and 2F, is diminished, real, and inverted. Hence, statement 1 is incorrect.

• Object at F: The image is formed at infinity and is highly magnified. Hence, statement 3 is incorrect.

• Object between F and O: The image is formed on the same side as the object and is virtual, erect, and magnified.

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

• Power of a Lens: It is the reciprocal of the focal length in meters (P = 1/f). For a convex lens, the power is always positive.

Important Points

• Real Image: An image that can be obtained on a screen is called a real image. In a convex lens, real images are always inverted.

• Optical Center (O): The central point of the lens through which a ray of light passes without any deviation.

• Principal Axis: An imaginary line passing through the centers of curvature of the two surfaces of the lens.

• Applications: Convex lenses are widely used in spectacles to correct Hypermetropia (long-sightedness), in cameras, microscopes, telescopes, and magnifying glasses.

• Sign Convention: According to the Cartesian sign convention, the focal length of a convex lens is considered positive, while that of a concave lens is negative.

**Q2. Answer: (b) Visible movement like walking or running**

The correct answer is Visible movement like walking or running.

Key Points

• Molecular movement within the cells: Life is built upon organized structures that are subject to environmental breakdown. To prevent this, living organisms must constantly repair and maintain their structures through molecular movements. Even when an organism is asleep or seemingly still, these invisible biochemical processes continue to sustain life. Hence, statement 1 is a fundamental characteristic of life.

• Visible movement like walking or running: While locomotion is common in the animal kingdom, it is not universal. Organisms like plants, fungi, and corals do not walk or run but are very much alive. Furthermore, an animal might be sleeping or hibernating without any visible movement, yet its internal life processes continue. Therefore, observable movement is not a reliable defining criteria for all life forms. Hence, statement 2 cannot be taken as a defining characteristic of life.

• Growth-related movement of plants: In the plant kingdom, movement is typically expressed through growth. A seed germinating and pushing through the soil, or a plant bending towards sunlight (phototropism), are clear indicators of life. These movements are slow but essential for survival and reproduction. Hence, statement 3 is a characteristic of life.

• Breathing and internal maintenance of cells: All living things perform metabolism, which includes respiration (breathing at a cellular or organismal level) and the internal maintenance of cellular integrity. These processes provide the energy required to keep the biological system functioning against the forces of entropy. Hence, statement 4 is a defining characteristic of life.

• Hence, the correct answer is Visible movement like walking or running.

Additional Information

• Defining vs. Non-Defining Characteristics:

• In biology, a defining characteristic is a feature that is present in all living organisms without exception and is absent in all non-living things.

• Metabolism, Cellular Organization, and Consciousness (response to stimuli) are considered true defining characteristics.

• Features like Reproduction and Visible Growth are not strictly defining because some living things (like mules or sterile workers) do not reproduce, and some non-living things (like crystals or clouds) can increase in size.

• The Role of Viruses:

• Viruses exist on the borderline of living and non-living. They do not show any molecular movement or metabolic activity when they are outside a host cell.

• They only display characteristics of life once they infect a host cell and use the host's molecular machinery to replicate, which is why their status as "living" is still a subject of scientific debate.

• Metabolic Processes:

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• Anabolism: The process of building up complex molecules from simpler ones (e.g., photosynthesis).

• Catabolism: The process of breaking down complex molecules to release energy (e.g., digestion and cellular respiration).

Important Points

• Locomotion vs. Movement: Locomotion refers to the displacement of the whole body from one location to another (walking, flying, swimming), while movement can be the change in position of any part of the body (like a heart beating or a leaf turning).

• Energy Requirement: Life processes require a continuous supply of energy, which is usually obtained from nutrients through the process of nutrition and released through respiration.

• Complexity: Living organisms have a highly organized structure—from organelles and cells to tissues and organs. Maintenance of this organization is what distinguishes life from the random accumulation of matter.

**Q3. Answer: (b) Electric motor**

The correct answer is Electric motor.

Key Points

• An electric motor is an electromechanical device that converts electrical energy into mechanical energy.

• It operates on the fundamental principle of magnetic effect of electric current, specifically the force experienced by a current-carrying conductor when placed within an external magnetic field.

• When a current flows through a coil (armature) placed between the poles of a magnet, the magnetic field produced by the current interacts with the external magnetic field, resulting in a mechanical force (torque) that causes the coil to rotate.

• The direction of this force is governed by Fleming’s Left-Hand Rule, which establishes the relationship between the magnetic field, current, and motion.

• This principle allows for the continuous rotation of the motor's shaft, which can then be used to perform various types of mechanical work. Hence, the correct answer is Electric motor.

Additional Information

• Transformer:

• A transformer is a static electrical device that transfers electrical energy between two or more circuits through electromagnetic induction.

• It works on the principle of Mutual Induction, where a changing current in the primary coil induces a voltage in the secondary coil.

• It is primarily used to increase (step-up) or decrease (step-down) alternating current (AC) voltages while keeping the frequency constant.

• Electric Generator:

• An electric generator is a device that converts mechanical energy into electrical energy.

• It works on the principle of Electromagnetic Induction, discovered by Michael Faraday in 1831.

• According to Faraday's Law, when a conductor moves through a magnetic field, an induced electromotive force (EMF) or current is generated. The direction of this induced current is determined by Fleming’s Right-Hand Rule.

• Resistor:

• A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element.

• It works based on Ohm's Law, which states that the current through a conductor is proportional to the voltage across it (V = IR).

• Its primary function is to reduce current flow, adjust signal levels, and terminate transmission lines by dissipating electrical energy as heat.

Important Points

• Fleming’s Left-Hand Rule:

• This rule is used to find the direction of the force in electric motors.

• If we stretch the thumb, forefinger, and middle finger of the left hand mutually perpendicular to each other:

1. The Forefinger represents the direction of the Magnetic Field.

2. The Middle finger represents the direction of the Current.

3. The Thumb represents the direction of the Force or Motion acting on the conductor.

• Components of a DC Motor:

• Armature Coil: A large number of turns of insulated copper wire wound over a soft iron core.

• Strong Field Magnet: Provides a powerful magnetic field (North and South poles).

• Split Ring Commutator: Consists of two halves of a metallic ring that reverses the direction of current every half rotation to maintain a continuous torque.

• Brushes: Carbon blocks that maintain electrical contact between the rotating commutator and the external battery.

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**Q4. Answer: (b) Be doubled**

The correct answer is Be doubled.

Key Points

• Power is defined as the rate at which work is done or the rate at which energy is transferred over time.

• The mathematical relationship between Power (P), Work (W), and Time (t) is expressed by the formula: Power = Work / Time (or P = W / t).

• From the above formula, Work Done can be calculated as the product of Power and Time: W = P × t.

• When the time (t) is held constant, the Work Done becomes directly proportional to the Power of the engine. This means any change in power will result in a proportional change in work.

• If the Power is doubled (increased by a factor of 2) while the time remains the same, the Work Done will also be multiplied by 2. Hence, the work done will be doubled.

Additional Information

• Work Done: In physics, Work is said to be done when a Force acts upon an object to cause a displacement. The SI unit of work is the Joule (J), which is equivalent to 1 Newton-meter (N·m).

• Power Units: The SI unit of Power is the Watt (W), named in honor of James Watt, the developer of the steam engine. 1 Watt is defined as 1 Joule of work done per second (1 W = 1 J/s).

• Scalar Nature: Both Work and Power are scalar quantities, meaning they have magnitude but no specific direction in space.

• Horsepower (hp): This is a common non-SI unit of Power often used in the automotive and engineering industries. 1 Metric Horsepower is approximately 735.5 Watts, while 1 Imperial Horsepower is approximately 746 Watts.

• Alternative Formula: Power can also be calculated if the Force (F) and Velocity (v) are known, using the formula P = F × v (assuming the force is in the direction of motion).

Important Points

• Dimensional Analysis: The dimensional formula for Work is [$ML^2T^{-2}$], while the dimensional formula for Power is [$ML^2T^{-3}$].

• Time Factor: If Work is kept constant instead of time, then Power and Time are inversely proportional. For example, a more powerful engine will take less time to complete the same amount of work.

• Energy Conversion: Since Work is a form of Energy transfer, Power can also be viewed as the rate of energy consumption. For instance, a 100-Watt light bulb consumes 100 Joules of electrical energy every second.

**Q5. Answer: (d) Helium**

The correct answer is Helium.

Key Points

• Isotopes are variants of a particular chemical element which differ in neutron number, although all isotopes of a given element have the same number of protons in each atom.

• Hydrogen is the only element whose isotopes have been given specific names. The three naturally occurring isotopes are Protium, Deuterium, and Tritium.

• Protium is the most common isotope of hydrogen, accounting for more than 99.98% of the hydrogen found in nature. It consists of one proton and no neutrons in its nucleus.

• Deuterium, also known as heavy hydrogen, contains one proton and one neutron. It is stable and occurs naturally in trace amounts.

• Tritium is a radioactive isotope of hydrogen that contains one proton and two neutrons. It has a half-life of approximately 12.32 years.

• Helium is a distinct chemical element with the atomic number 2. It has two protons in its nucleus, which makes it an entirely different element from hydrogen (which has only one proton). Hence, it is not an isotope of hydrogen.

Additional Information

• Atomic Structure of Hydrogen:

• The atomic number of hydrogen is 1, meaning every hydrogen atom has exactly one proton.

• The mass number of Protium is 1, Deuterium is 2, and Tritium is 3.

• Applications of Deuterium:

• It is used in the form of Heavy Water (D2O) as a neutron moderator in nuclear reactors to slow down fast-moving neutrons.

• It is also widely used in Nuclear Magnetic Resonance (NMR) spectroscopy and as a tracer in chemical and biological research.

• Characteristics of Tritium:

• It undergoes beta decay to transform into Helium-3.

• Because of its radioactive properties, it is used in self-powered lighting devices, such as exit signs and watch dials, and as a fuel in nuclear fusion experiments.

• Nature of Helium:

• Helium is a Noble Gas located in Group 18 of the periodic table.

• It is the second most abundant element in the Universe after hydrogen.

• Helium exists mostly as Helium-4 (two protons and two neutrons) and Helium-3 (two protons and one neutron).

Important Points

• While Protium and Deuterium are stable isotopes, Tritium is unstable and radioactive.

• In nuclear fusion, the combination of Deuterium and Tritium nuclei is the most efficient reaction used to produce energy in experimental reactors like ITER.

• The chemical properties of isotopes are almost identical because they have the same number of electrons and protons; however, their physical properties (like density and boiling point) differ due to the difference in mass.

• The term isotope was first suggested by Frederick Soddy in 1913, for which he later received the Nobel Prize in Chemistry in 1921.

**Q6. Answer: (d) They primarily consist of carbon and hydrogen atoms, forming covalent bonds.**

The correct answer is They primarily consist of carbon and hydrogen atoms, forming covalent bonds.

Key Points

• Organic compounds are defined as chemical substances that contain carbon atoms, usually bonded to hydrogen, and often other elements like oxygen, nitrogen, sulfur, and phosphorus.

• The defining feature of these compounds is the presence of carbon-hydrogen (C-H) bonds and the formation of covalent bonds, where atoms share electron pairs. Hence, statement 4 is correct.

• Contrary to statement 1, not all organic compounds contain oxygen; for example, hydrocarbons like methane (CH4) and ethane (C2H6) consist solely of carbon and hydrogen. Hence, statement 1 is incorrect.

• Historically, it was believed that organic compounds could only be produced by living organisms (the Vital Force Theory), but this was disproven in 1828 when Friedrich Wöhler synthesized urea from inorganic materials. Hence, statement 2 is incorrect.

• Organic compounds generally do not conduct electricity in their molten state because they are molecular in nature and lack free ions, unlike ionic compounds. Hence, statement 3 is incorrect.

Additional Information

• Tetravalency of Carbon: Carbon has an atomic number of 6 and 4 valence electrons, allowing it to form four covalent bonds with other atoms. This versatility allows for the creation of vast, complex molecular structures.

• Catenation: This is the unique ability of carbon atoms to form long chains or rings by bonding with other carbon atoms. This property is the reason why millions of organic compounds exist in nature.

• Hydrocarbons: These are the simplest organic compounds, categorized into alkanes (single bonds), alkenes (at least one double bond), and alkynes (at least one triple bond). They serve as the parent framework for more complex organic molecules.

• Functional Groups: These are specific clusters of atoms within a molecule that determine its chemical reactivity. Common examples include the hydroxyl group (-OH) in alcohols, the carboxyl group (-COOH) in organic acids, and the amino group (-NH2) in amines.

• Isomerism: Organic chemistry is characterized by isomers, which are compounds with the same molecular formula but different structural arrangements, leading to different physical and chemical properties.

Important Points

• Bonding Nature: While inorganic compounds often involve ionic bonding (transfer of electrons), organic compounds are almost exclusively covalent. This results in lower melting and boiling points compared to many inorganic salts.

• Combustibility: Most organic compounds are highly inflammable and react with oxygen to produce carbon dioxide and water.

• Solubility: According to the "like dissolves like" rule, most organic compounds are insoluble in water (a polar solvent) but soluble in organic solvents like benzene, ether, or chloroform.

• Applications: Organic compounds are the basis of all life on Earth (DNA, proteins, carbohydrates) and are used extensively in industries to produce plastics, medicines, fuels, and synthetic fibers.

**Q7. Answer: (d) $0° < i < 90°$**

The correct answer is $0° < i < 90°$.

Key Points

• The law of refraction, also known as Snell's law, states that for a given pair of transparent media:

$\sin i / \sin r = \text{constant}$

• Here, i is the angle of incidence and r is the angle of refraction. Both angles are measured with respect to the normal at the point of incidence.

• An angle of incidence is geometrically defined between 0° and 90° for a ray incident on a surface.

• Therefore, the law of refraction is applicable for:

$0° < i < 90°$

• Hence, the correct answer is Option 4 – 0° < i < 90°.

Additional Information

• Snell's Law:

n1 sin i = n2 sin r

• At i = 0°, the ray is incident normally, so there is no deviation in direction.

• An incidence angle greater than 90° is not physically meaningful because the angle is measured from the normal and the incident ray lies on the incident side of the surface.

**Q8. Answer: (b) Carbon dioxide**

The correct answer is Carbon dioxide.

Key Points

• Carbon dioxide (CO2) is a non-metallic oxide. Non-metallic oxides are generally acidic in nature because they react with water to form acids or react with bases to form salt and water. Hence, the statement regarding Carbon dioxide is correct.

• When Carbon dioxide reacts with a base like Calcium hydroxide [Ca(OH)2], also known as limewater, it produces Calcium carbonate (CaCO3), which is a salt, and water (H2O).

• Sodium oxide (Na2O) is a metallic oxide. Most metallic oxides are basic in nature and react with acids to form salt and water, but they do not typically react with bases in this manner. Hence, the statement regarding Sodium oxide is incorrect.

• Hydrogen gas (H2) is a diatomic molecule. It does not possess acidic properties that would allow it to react with a base to produce salt and water under standard conditions. Hence, the statement regarding Hydrogen gas is incorrect.

• Calcium hydroxide [Ca(OH)2] is a strong base. Bases do not react with other bases to undergo neutralization; instead, they react with acids or acidic oxides. Hence, the statement regarding Calcium hydroxide is incorrect.

Additional Information

• Nature of Oxides:

• Acidic Oxides: These are oxides of non-metals such as Sulfur dioxide (SO2), Nitrogen dioxide (NO2), and Carbon dioxide (CO2). They have a pH value less than 7 when dissolved in water.

• Basic Oxides: These are oxides of metals like Magnesium oxide (MgO) and Sodium oxide (Na2O). They react with acids to form salt and water and usually have a pH value greater than 7.

• Amphoteric Oxides: These oxides show both acidic and basic characteristics. Examples include Aluminum oxide (Al2O3) and Zinc oxide (ZnO), which can react with both acids and bases.

• Neutral Oxides: These oxides do not react with either acids or bases. Examples include Carbon monoxide (CO), Nitrous oxide (N2O), and Nitric oxide (NO).

• Neutralization Reaction:

• This is a chemical reaction in which an acid and a base react quantitatively with each other.

• The general formula is: Acid + Base → Salt + Water.

• Since non-metal oxides act as acids, the reaction Non-metal oxide + Base → Salt + Water is also considered a type of neutralization.

Important Points

• Limewater Test: The reaction of CO2 with Calcium hydroxide is a standard laboratory test for the presence of Carbon dioxide. The formation of insoluble Calcium carbonate turns the clear solution milky.

• Chemical Equations:

• Reaction with Sodium hydroxide: CO2 + 2NaOH → Na2CO3 + H2O. Here, Sodium carbonate is the salt formed.

• Reaction with Calcium hydroxide: CO2 + Ca(OH)2 → CaCO3 + H2O. Here, Calcium carbonate is the salt formed.

• Periodicity: In the Periodic Table, the acidity of oxides increases from left to right across a period as the elements transition from metals to non-metals.

**Q9. Answer: (c) The ovule becomes the seed, and the ovary becomes the fruit.**

The correct answer is The ovule becomes the seed, and the ovary becomes the fruit.

Key Points

• In flowering plants (angiosperms), fertilisation is the process where the male gamete (pollen) fuses with the female gamete (egg) to form a zygote.

• Once fertilisation is complete, the zygote divides multiple times to form an embryo within the ovule.

• The ovule develops a tough protective coat and gradually transforms into a seed. The seed contains the embryo and stored food for the future plant. Hence, statement 3 is correct.

• Simultaneously, the ovary undergoes significant growth and ripening to transform into a fruit. The wall of the ovary becomes the pericarp or the fruit wall.

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• During this developmental phase, other floral parts such as the sepals, petals, stamens, style, and stigma generally wither and fall off.

• While statement 1 suggests that petals and stamens become the seed and the ovary forms the embryo, it is biologically inaccurate as the embryo forms from the zygote inside the ovule. Hence, statement 1 is incorrect.

• Statement 2 incorrectly reverses the roles, stating the ovule becomes the fruit and the ovary forms the seed. Hence, statement 2 is incorrect.

• Statement 4 claims the entire flower falls off without forming new structures, ignoring the essential transition into reproductive units (fruits and seeds). Hence, statement 4 is incorrect.

Additional Information

• Double Fertilisation:

• This is a unique phenomenon in angiosperms discovered by S.G. Nawaschin in 1898.

• It involves two fusions: Syngamy (fusion of egg and male gamete to form a diploid zygote) and Triple Fusion (fusion of the second male gamete with polar nuclei to form the Primary Endosperm Nucleus).

• The Endosperm serves as a highly nutritive tissue that provides nourishment to the developing embryo.

• Fruit Classification:

• True Fruits: These develop solely from the mature ovary after fertilisation. Examples include mango and blueberry.

• False Fruits: These develop from the ovary along with other floral parts like the thalamus or receptacle. Examples include apple, pear, and cashew.

• Parthenocarpic Fruits: Fruits that develop without fertilisation and are typically seedless, such as banana.

• Seed Structure and Germination:

• The integuments (outer layers) of the ovule harden to form the seed coat (testa and tegmen).

• A seed remains in a state of dormancy (inactivity) until it encounters favorable conditions like moisture, oxygen, and suitable temperature to undergo germination.

Important Points

• Post-Fertilisation Summary:

• Zygote → Embryo

• Ovule → Seed

• Ovary → Fruit

• Ovary Wall → Pericarp

• Integuments → Seed Coat

• The formation of fruit and seed is an evolutionary advantage for plants, facilitating dispersal by wind, water, or animals and ensuring the protection of the next generation.

**Q10. Answer: (d) Sound can be produced by non-vibrating bodies**

The correct answer is Sound can be produced by non-vibrating bodies.

Key Points

• Sound is a form of energy that is produced whenever an object vibrates. Without vibration, there is no sound produced. Therefore, the statement that sound can be produced by non-vibrating bodies is false. Hence, statement 4 is incorrect.

• The frequency of the vibration determines the pitch or shrillness of the sound. A high-frequency vibration results in a high-pitched sound (like a whistle), while a low-frequency vibration results in a low-pitched sound (like a drum). Hence, statement 1 is correct.

• As a vibrating object moves forward and backward, it creates a series of compressions (high-pressure regions) and rarefactions (low-pressure regions) in the surrounding air or medium. These travel as longitudinal waves. Hence, statement 2 is correct.

• The amplitude of the vibration is the maximum displacement of the particles from their mean position. It directly affects the loudness of the sound; the larger the amplitude, the louder the sound produced. Hence, statement 3 is correct.

• Hence, the correct answer is Sound can be produced by non-vibrating bodies.

Additional Information

• Loudness and Amplitude:

• The loudness of sound is proportional to the square of the amplitude of the vibration. If the amplitude becomes twice, the loudness increases by a factor of four.

• Loudness is expressed in a unit called decibel (dB). Normal breathing is about 10 dB, while a busy traffic noise is around 70 dB. Noise becomes physically painful above 80 dB.

• Pitch and Frequency:

• Frequency is defined as the number of oscillations or vibrations per second. Its SI unit is Hertz (Hz).

• A higher frequency means the sound is shriller. For example, a bird produces a high-pitched sound, whereas a lion’s roar is low-pitched but very loud.

• Propagation of Sound:

• Sound requires a medium (solid, liquid, or gas) to travel. It cannot travel through a vacuum because there are no molecules to transmit the vibrations.

• The speed of sound is highest in solids (like steel), followed by liquids (like water), and slowest in gases (like air).

Important Points

• Audible Range: For the human ear, the range of audible frequencies is roughly between 20 Hz and 20,000 Hz. Frequencies below 20 Hz are called infrasonic, and those above 20,000 Hz are called ultrasonic.

• Human Voice: In humans, sound is produced by the larynx (voice box). Two vocal cords are stretched across the larynx in such a way that it leaves a narrow slit for the passage of air. When the lungs force air through the slit, the vocal cords vibrate, producing sound.

• Wave Nature: Sound waves are mechanical waves and specifically longitudinal in nature, where the particles of the medium move back and forth in the same direction as the wave propagation.

**Q11. Answer: (a) increases**

The correct answer is increases.

Key Points

• In chemistry, the pH level of a solution is a measure of the molar concentration of hydrogen ions (H+) in the solution and as such is a measure of the acidity or basicity of the solution.

• When hydroxide ions (OH-) are added to an acidic solution, they react with the existing hydrogen ions (H+) to form water molecules (H2O). This chemical process is known as neutralization.

• The concentration of hydrogen ions (H+) decreases as they are consumed by the OH- ions. Since the pH scale is calculated as the negative logarithm of the H+ ion concentration (pH = -log[H+]), a reduction in H+ ions mathematically leads to a higher pH value. Hence, the statement that the pH increases is correct.

• An acidic solution typically has a pH value ranging from 0 to 6.9. As more OH- ions are introduced, the solution moves closer to pH 7.0, which is the neutral point on the scale.

• If the addition of OH- ions continues beyond the point of neutralization, the solution will eventually become basic (alkaline), resulting in a pH value greater than 7. Hence, the correct answer is increases.

Additional Information

• The pH Scale:

• The pH scale was introduced by the Danish biochemist S.P.L. Sorensen in the year 1909. It is used to express the acidity or alkalinity of a solution on a scale of 0 to 14.

• A pH of 7 represents a neutral solution, such as pure water at 25 degrees Celsius.

• Solutions with a pH less than 7 are considered acidic (e.g., gastric juice, lemon juice, and vinegar), while those with a pH greater than 7 are basic or alkaline (e.g., baking soda, milk of magnesia, and ammonia).

• Mathematical Relationship:

• The relationship between pH and pOH is defined by the equation pH + pOH = 14 at a temperature of 25 degrees Celsius.

• The ionic product of water (Kw) is a constant value of 1.0 x 10^-14 at standard temperature. This equilibrium ensures that as OH- concentration rises, the H+ concentration must fall proportionally.

• Logarithmic Nature:

• The pH scale is logarithmic, meaning each whole pH value below 7 is ten times more acidic than the next higher value. For example, a solution with pH 3 is 10 times more acidic than a solution with pH 4 and 100 times more acidic than a solution with pH 5.

Important Points

• Indicators and Measurement:

• The pH of a solution can be measured using litmus paper, universal indicators, or electronic pH meters. Blue litmus paper turns red under acidic conditions, while red litmus paper turns blue under basic conditions.

• Phenolphthalein is a common indicator that remains colorless in acidic solutions but turns pink when the solution becomes basic (around pH 8.2 to 10).

• Common pH Values:

• The pH of human blood is slightly basic, typically maintained within a narrow range of 7.35 to 7.45 for healthy physiological functioning.

• Acid rain usually has a pH value of less than 5.6, which can cause significant damage to aquatic ecosystems and limestone structures.

• Sodium Hydroxide (NaOH), a strong base, can have a pH as high as 14, whereas Hydrochloric Acid (HCl), a strong acid, can have a pH as low as 0.

**Q12. Answer: (a) Nephron**

The correct answer is Nephron.

Key Points

• The Nephron is the structural and functional unit of the kidney. It is essentially the basic filtration unit where the process of removing waste products from the blood occurs. Hence, option 1 is correct.

• Each human kidney contains approximately 1 million to 1.2 million nephrons, which work collectively to maintain the homeostatic balance of fluids and electrolytes in the body.

• A nephron is composed of two main parts: the Renal Corpuscle (which includes the Glomerulus and Bowman's capsule) and the Renal Tubule (comprising the Proximal Convoluted Tubule, Loop of Henle, and Distal Convoluted Tubule).

• The process of filtration begins in the Glomerulus, a tuft of capillaries where high blood pressure forces water and small solutes out of the blood and into the Bowman's capsule to form the filtrate.

• The primary function of the nephron is to filter blood, reabsorb useful substances like glucose and amino acids, and excrete nitrogenous wastes like urea and uric acid in the form of urine.

Additional Information

• Alveolus:

• These are tiny, balloon-shaped air sacs located at the end of the bronchial tubes in the lungs.

• They are the basic units of gas exchange in the respiratory system, where oxygen is diffused into the blood and carbon dioxide is removed. Hence, option 2 is incorrect.

• Tracheid:

• These are elongated, tube-like cells found in the xylem of vascular plants.

• Their main function is the conduction of water and minerals from the roots to the leaves and providing mechanical support to the plant. Hence, option 3 is incorrect.

• Villus:

• Villi are small, finger-like projections that line the inner wall of the small intestine.

• They serve to increase the surface area for the absorption of digested food into the bloodstream. Hence, option 4 is incorrect.

Important Points

• Excretory System in Humans: The system consists of a pair of kidneys, a pair of ureters, a urinary bladder, and a urethra.

• Ultrafiltration: This is the first step in urine formation, occurring under high pressure in the renal corpuscle. It filters out almost all constituents of the plasma except proteins.

• Selective Reabsorption: As the filtrate flows through the tubules, about 99% of the filtrate is reabsorbed by the renal tubules to prevent the loss of essential water and nutrients.

• Hormonal Regulation: The functioning of nephrons is regulated by hormones like Antidiuretic Hormone (ADH) or Vasopressin, which controls water reabsorption based on the body's hydration levels.

• Location: Kidneys are located toward the back of the abdominal cavity, one on each side of the spine, just below the rib cage.

**Q13. Answer: (b) A ceiling fan rotating at constant speed**

The correct answer is A ceiling fan rotating at constant speed.

Key Points

• Uniform Circular Motion (UCM) is defined as the motion of an object traveling at a constant speed along a circular path. In this motion, while the speed remains the same, the direction of velocity changes continuously at every point.

• A ceiling fan rotating at a constant speed is a perfect example of this. Once the fan reaches its steady state (fixed speed setting), the tips of the blades describe a circular trajectory with a constant magnitude of velocity. Hence, statement 2 is correct.

• A person walking in a straight line represents rectilinear motion. Even if the speed is steady, it does not involve a circular path. Hence, statement 1 is incorrect.

• A bus accelerating on a straight road is an example of non-uniform linear motion. Since the bus is accelerating, its speed (magnitude of velocity) is changing over time. Hence, statement 3 is incorrect.

• A ball rolling down an inclined plane moves under the acceleration due to gravity. Its speed increases as it descends, meaning the motion is accelerated and not uniform. Hence, statement 4 is incorrect.

Additional Information

• Characteristics of Uniform Circular Motion:

• Speed: The magnitude of velocity remains constant throughout the motion.

• Velocity: It is a vector quantity. In UCM, the velocity is always tangential to the circular path. Because the direction changes at every instant, the velocity is not constant.

• Acceleration: Even though the speed is constant, the object is accelerating due to the change in direction. This is known as centripetal acceleration ($a_c = v^2/r$ ), which always points toward the center of the circle.

• Force: The net force causing this motion is the centripetal force ($F_c = mv^2/r$), which is required to keep an object moving in a circle.

• Angular Variables:

• Angular Displacement ($\theta$): The angle swept by the radius vector in a given time interval.

• Angular Velocity ($\omega$): The rate of change of angular displacement, typically measured in radians per second (rad/s). In UCM, $\omega$ is constant.

• The relationship between linear velocity (v) and angular velocity ($\omega$) is given by the formula $v = r \times \omega$, where r is the radius of the circle.

Important Points

• Real-world Examples of UCM:

• The motion of the hands of a clock (the tip of the second hand moves in UCM).

• A satellite orbiting the Earth in a perfectly circular orbit at a constant altitude and speed.

• An electron revolving around the nucleus in a circular orbit (in simplified atomic models).

• The rotation of the Earth on its axis (approximately uniform).

• Difference between Uniform and Non-Uniform Circular Motion:

• In Uniform Circular Motion, only the direction of velocity changes, while the speed remains constant.

• In Non-Uniform Circular Motion, both the direction and the magnitude (speed) of velocity change. For example, a fan being switched off or speeding up represents non-uniform circular motion.

**Q14. Answer: (a) 1 - d, 2 - c, 3 - b, 4 - a**

The correct answer is 1 - d, 2 - c, 3 - b, 4 - a.

Key Points

• Calyx is the outermost whorl of a flower. Its individual units are called sepals. In most plants, sepals are green and leaf-like, serving the primary function of protecting the flower during the bud stage. Hence, 1 matches with d.

• Corolla is the second whorl of a flower, positioned internal to the calyx. It is composed of petals, which are usually brightly colored and often scented to attract pollinators like insects and birds. Hence, 2 matches with c.

• Androecium represents the male reproductive part of the flower. It consists of a collection of stamens. Each stamen is further divided into an anther (which produces pollen) and a filament (the supporting stalk). Hence, 3 matches with b.

• Gynoecium is the innermost whorl and serves as the female reproductive organ. It is made up of one or more carpels (also known as pistils). A typical carpel consists of an ovary, a style, and a stigma. Hence, 4 matches with a.

Additional Information

• Accessory Whorls: The calyx and corolla are considered accessory or non-essential whorls because they do not directly participate in the process of reproduction but assist in protection and attraction.

• Essential Whorls: The androecium and gynoecium are known as essential or reproductive whorls as they are directly responsible for the production of gametes and the formation of seeds.

• Complete and Incomplete Flowers: A complete flower is one that possesses all four whorls. If any one of these whorls is missing, it is categorized as an incomplete flower.

• Symmetry in Flowers: Flowers can be classified based on symmetry into actinomorphic (radial symmetry), zygomorphic (bilateral symmetry), or asymmetric (irregular).

• Perianth: In some flowers, like lilies, the calyx and corolla are not distinct and are collectively referred to as the perianth; the individual units of a perianth are called tepals.

Important Points

• Thalamus: The thalamus (or receptacle) is the swollen end of the pedicel (flower stalk) on which all the four floral whorls are arranged in a specific order.

• Stamen Structure: The anther is usually bilobed, and each lobe contains two pollen sacs (the microsporangia) where pollen grains are produced through meiosis.

• Carpel Structure: The ovary is the enlarged basal part containing ovules. The style is the elongated tube connecting the ovary to the stigma, which serves as the receptive platform for pollen grains during pollination.

• Monadelphous vs. Diadelphous: Stamens may be united in one bunch (monadelphous, e.g., China rose) or two bunches (diadelphous, e.g., pea).

• Apcocarpous vs. Syncarpous: If carpels are free, the condition is called apocarpous (e.g., lotus); if they are fused, it is called syncarpous (e.g., mustard).

**Q15. Answer: (a) 0 m/s**

The correct answer is 0 m/s.

Key Points

• When an object is dropped from a certain height, it is implicitly understood that the object starts its motion from a state of rest.

• In physics and kinematics, the initial velocity (represented by the symbol u) is the velocity of the object at the exact moment the observation of motion begins (at time t = 0).

• Since the object is simply released and not thrown or pushed with an external force, its initial velocity is exactly 0 m/s. Hence, the statement that the initial velocity is 0 m/s is correct.

• The moment the object is released, the force of gravity begins to act on it, causing it to accelerate downwards. However, this acceleration changes the velocity over time, meaning the speed is only zero at the very first instant.

• The value 9.8 m/s mentioned in the options is often confused with the acceleration due to gravity, but that value is measured in $m/s^2$, not m/s. Hence, option 2 is incorrect.

Additional Information

• Concept of Free Fall:

• An object is said to be in free fall when the only force acting upon it is gravity. In such cases, air resistance is often neglected in basic physics calculations.

• During free fall, all objects, regardless of their mass, accelerate toward the Earth at the same rate, which is approximately 9.8 $m/s^2$.

• Acceleration due to Gravity (g):

• The acceleration due to gravity is a constant vector pointing towards the center of the Earth. Its standard value is 9.80665 $m/s^2$, though it is frequently rounded to 9.8 $m/s^2$ or 10 $m/s^2$ for simplicity in exams.

• It is important to distinguish between velocity (speed in a direction) and acceleration (rate of change of velocity).

• Equations of Motion:

• For an object dropped from rest, the first equation of motion is $v = u + gt$. Since $u = 0$, the velocity at any time t becomes $v = gt$.

• The distance (height) fallen can be calculated using $h = ut + \frac{1}{2}gt^2$. With $u = 0$, this simplifies to $h = \frac{1}{2}gt^2$.

Important Points

• Dropped vs. Thrown: If the question stated the object was thrown downwards, the initial velocity would be a non-zero value ($u > 0$). If it is thrown upwards, the final velocity at the peak of its trajectory is 0 m/s.

• Terminal Velocity: In a real-world scenario with air resistance, a falling object eventually reaches a constant speed called terminal velocity, where the drag force equals the gravitational force.

• Frame of Reference: Usually, the downward direction is considered negative in coordinate systems. Thus, while the magnitude of the initial velocity is 0 m/s, the velocity as it falls would be represented with a negative sign (e.g., -9.8 m/s after 1 second).

• Location Variation: The value of g varies slightly depending on latitude and altitude. It is stronger at the poles and weaker at the equator due to the Earth's ellipsoid shape and rotation.

**Q16. Answer: (a) Different elements chemically bonded together**

The correct answer is Different elements chemically bonded together.

Key Points

• A molecule of a compound is defined as a group of atoms belonging to two or more different elements that are chemically bonded together in a fixed ratio. Hence, statement 1 is correct.

• Metallic bonds occur between metal atoms of the same or different metals (forming alloys), but these structures are typically characterized as metallic lattices rather than discrete molecules of compounds. Hence, statement 2 is incorrect.

• The mixing of substances or ions without chemical bonding results in a mixture (homogeneous or heterogeneous), not a chemical compound, as compounds require a chemical reaction to form. Hence, statement 3 is incorrect.

• A substance composed of one type of atom only is an element. While homonuclear molecules like O2 or N2 exist, they are molecules of elements, not compounds, because they do not contain different elements. Hence, statement 4 is incorrect.

• In a compound, the constituent elements lose their individual physical and chemical properties, and the resulting molecule exhibits entirely new properties.

Additional Information

• Chemical Bonding: This is the physical process responsible for the attractive interactions between atoms and molecules. The primary types are Ionic Bonds (transfer of electrons) and Covalent Bonds (sharing of electrons).

• Law of Definite Proportions: Proposed by Joseph Proust in 1794, this chemical law states that a given chemical compound always contains its component elements in a fixed ratio by mass and does not depend on its source or method of preparation.

• Examples of Compounds:

• Water (H2O): Formed by two Hydrogen atoms and one Oxygen atom.

• Carbon Dioxide (CO2): Formed by one Carbon atom and two Oxygen atoms.

• Methane (CH4): A simple hydrocarbon compound consisting of one Carbon and four Hydrogen atoms.

• Molecular vs. Empirical Formula: The molecular formula shows the actual number of atoms of each element in a molecule, while

the empirical formula shows the simplest whole-number ratio of atoms in a compound.

Important Points

• Valence Electrons: These are the electrons in the outermost shell of an atom that participate in the formation of chemical bonds. Atoms bond to achieve a stable electron configuration, often following the Octet Rule.

• Energy Changes: The formation of a compound from its elements is usually accompanied by the evolution or absorption of energy in the form of heat, light, or electricity.

• Separation: Unlike mixtures, the elements in a compound cannot be separated by physical methods like filtration or distillation; they can only be separated by chemical or electrochemical reactions.

• Molar Mass: Each compound has a specific molar mass, which is the sum of the atomic masses of all the atoms present in its chemical formula.

**Q17. Answer: (b) They need currents of widely different values to operate properly**

The correct answer is They need currents of widely different values to operate properly.

Key Points

• In a series circuit, the electric current remains the same through all components connected in the loop. This means the current (I) flowing through the electric bulb is identical to the current flowing through the electric heater.

• An electric bulb and an electric heater have significantly different power ratings. A typical household bulb may consume 40W to 100W, while a heater typically consumes 1000W to 2000W.

• Because of these different power requirements, they require currents of widely different values to function at their rated capacity. For instance, at 220V, a 100W bulb requires approximately 0.45 Amperes, whereas a 2000W heater requires nearly 9 Amperes. Hence, statement 2 is correct.

• In a series connection, if the current is high enough to operate the heater, it will instantly burn out the filament of the bulb. Conversely, if the current is low enough for the bulb, the heater will not generate any noticeable heat.

• The total voltage in a series circuit is divided among the components proportional to their resistance (V = V1 + V2). It does not decrease to zero. Hence, statement 1 is incorrect.

• The total equivalent resistance in a series circuit is the sum of individual resistances (Rs = R1 + R2). It is never zero unless the components themselves have no resistance. Hence, statement 3 is incorrect.

• The current does not stop immediately unless the circuit is broken (e.g., the bulb blows out); it simply flows at a sub-optimal level for the high-power device. Hence, statement 4 is incorrect.

Additional Information

• Ohm's Law: This fundamental principle states that V = IR, where V is voltage, I is current, and R is resistance. In series circuits, the high resistance of a bulb limits the total current of the entire circuit, making it insufficient for the heater.

• Resistance of Appliances: Since $P = V^2/R$, for a constant voltage, a high-power device like a heater has low resistance, while a low-power device like a bulb has high resistance.

• Parallel Circuits: This is the standard for domestic wiring. In a parallel circuit, the voltage across each appliance is the same (e.g., 220V in India), allowing each device to draw the current it needs independently based on its own resistance.

• Power Consumption: The formula $P = I^2R$ shows that heat produced depends on the square of the current. In series, the limited current caused by the bulb's high resistance results in negligible power output for the heater.

Important Points

• Single Point of Failure: One major disadvantage of series circuits is that if one component (like the bulb) fuses or is switched off, the entire circuit is broken, and all other components (like the heater) stop working.

• Voltage Division: In a series arrangement, the component with the highest resistance (the bulb) takes the maximum voltage drop, leaving very little voltage for the heater to operate.

• Practical Application: Series circuits are rarely used for appliances but are common in decorative string lights (fairy lights), where many small bulbs of the same rating are used together.

• Safety: Connecting high-load appliances in series with low-load ones can lead to overheating of wires or short circuits if the bulb's holder or filament cannot handle the potential current surge.

**Q18. Answer: (a) Increase in concentration of harmful substances at higher trophic levels.**

The correct answer is Increase in concentration of harmful substances at higher trophic levels.

Key Points

• Biological magnification, also referred to as biomagnification, is the process characterized by the progressive increase in the concentration of toxic substances (such as heavy metals or persistent organic pollutants) at each successive trophic level of a food chain. Hence, statement 1 is correct.

• These harmful substances are typically non-biodegradable, meaning they cannot be broken down by the metabolism of organisms or environmental decomposers. Consequently, they accumulate in the tissues of living beings.

• The process is not defined by an increase in biological activities like metabolic rates or reproduction, but specifically by the chemical load per unit of biomass. Hence, statement 2 is incorrect.

• Pollutants involved in biomagnification are resistant to being broken down by decomposers (like bacteria and fungi); their persistence in the environment is what allows them to enter the food web and accumulate. Hence, statement 3 is incorrect.

• In any ecosystem, according to the 10 percent law of energy transfer, energy decreases as it flows from producers to higher consumers, whereas the concentration of toxins increases. Hence, statement 4 is incorrect.

Additional Information

• Common Pollutants: The most frequent chemicals associated with this phenomenon include DDT (Dichlorodiphenyltrichloroethane), Mercury, Arsenic, Lead, and Polychlorinated biphenyls (PCBs).

• DDT and Wildlife: A classic example occurred in the 20th century when DDT usage led to the thinning of eggshells in predatory birds like Bald Eagles and Peregrine Falcons, causing their populations to crash until the chemical was banned in 1972 in the United States.

• Human Health Risks: Humans often occupy the highest trophic level. Consumption of contaminated fish can lead to Mercury poisoning, famously known as Minamata Disease, first discovered in 1956 in Japan.

• Lipid Solubility: Most biomagnifying substances are lipophilic (fat-soluble). This means they dissolve in fats and oils within an organism's body, making them difficult to excrete through water-based systems like urine.

Important Points

• Bioaccumulation vs. Biomagnification: It is important to distinguish these terms. Bioaccumulation occurs within a single organism over its lifespan, while biomagnification describes the increase across the entire food chain.

• Trophic Level Concentration: In an aquatic ecosystem, the concentration of DDT might start at 0.000003 ppm (parts per million) in water, reach 0.04 ppm in zooplankton, 0.5 ppm in small fish, 2 ppm in large fish, and finally 25 ppm in fish-eating birds.

• Global Regulation: The Stockholm Convention on Persistent Organic Pollutants (POPs), adopted in 2001, is an international environmental treaty that aims to eliminate or restrict the production and use of substances that undergo biomagnification.

**Q19. Answer: (b) AgNO3 + NaCl → AgCl + NaNO3**

The correct answer is AgNO3 + NaCl → AgCl + NaNO3.

Key Points

• A Double Displacement Reaction (also known as a metathesis reaction) is a type of chemical process where two compounds react, and the positive ions (cations) and the negative ions (anions) of the two reactants switch places, forming two new compounds.

• In the equation AgNO3 + NaCl → AgCl + NaNO3, the silver ion (Ag^+) from Silver Nitrate swaps its nitrate partner for the chloride ion (Cl^-) from Sodium Chloride. Similarly, the Sodium (Na^+) ion joins with the Nitrate (NO3^-) ion. Hence, statement 2 is correct.

• The general representation of this reaction is AB + CD → AD + CB. It typically occurs in aqueous solutions where the ions are free to move and interact.

• The reaction between Silver Nitrate and Sodium Chloride is a classic example of a precipitation reaction, which is a sub-type of double displacement. It results in the formation of Silver Chloride (AgCl), which is an insoluble white precipitate.

• In contrast, 2Mg + O2 → 2MgO represents two elements combining to form a single compound, which is a Combination Reaction. Hence, statement 1 is incorrect.

• The reaction Zn + CuSO4 → ZnSO4 + Cu shows a single element (Zinc) replacing another (Copper) in a compound. This is a Single Displacement Reaction. Hence, statement 3 is incorrect.

• The process CaCO3 → CaO + CO2 involves a single reactant breaking down into two products upon heating. This is a Decomposition Reaction. Hence, statement 4 is incorrect.

Additional Information

• Types of Double Displacement Reactions:

• Precipitation Reaction: This occurs when two aqueous solutions react to form an insoluble solid called a precipitate. The reaction AgNO3 + NaCl is the most common example found in laboratory chemistry.

• Neutralization Reaction: This occurs between an Acid and a Base to form Salt and Water. For example, HCl + NaOH → NaCl + H2O is a double displacement reaction where H^+ and Na^+ ions exchange partners.

• Chemical Reaction Characteristics:

• Combination Reaction: Characterized by the formation of a single product from two or more reactants. An example is the burning of coal or the synthesis of water from hydrogen and oxygen.

• Decomposition Reaction: The opposite of combination. It requires energy in the form of Heat (Thermal), Light (Photolytic), or Electricity (Electrolytic) to break chemical bonds. The electrolysis of water is a famous 1800s discovery using this principle.

• Displacement Reaction: Governed by the Reactivity Series. A more reactive metal (like Zinc or Iron) will displace a less reactive metal (like Copper) from its salt solution.

Important Points

• Solubility Rules: To predict if a double displacement reaction will result in a precipitation, scientists use solubility rules. For instance, most Nitrates (NO3^-) are soluble, while Silver Chloride is notably insoluble in water.

• Oxidation State: Unlike Redox reactions (Single Displacement or Combination), the oxidation states of the atoms in a double displacement reaction usually remain unchanged. The ions simply switch partners without a net transfer of electrons.

• Applications: These reactions are widely used in water treatment to remove harmful ions, in the manufacture of pigments, and in qualitative inorganic analysis to identify unknown ions in a sample.

**Q20. Answer: (b) H2O**

The correct answer is H2O.

Key Points

• A molecule of a compound is defined as a substance formed by the chemical combination of two or more different types of elements in a fixed proportion by mass.

• H2O (Water) is composed of two hydrogen atoms and one oxygen atom. Since it contains different elements chemically bonded together, it is a molecule of a compound. Hence, option 2 is correct.

• N2 (Nitrogen) consists of two atoms of the same element (Nitrogen) bonded together. It is classified as a homoatomic molecule or a molecule of an element. Hence, option 1 is incorrect.

• He (Helium) is a noble gas and exists as a single atom (monoatomic). It does not naturally form molecules with other atoms under standard conditions and is considered an element in its simplest form. Hence, option 3 is incorrect.

• O2 (Oxygen) is a diatomic molecule consisting of two oxygen atoms. Because the atoms are of the same element, it represents a molecule of an element rather than a compound. Hence, option 4 is incorrect.

Additional Information

• Elements: These are pure substances that consist of only one type of atom. They cannot be broken down into simpler substances by ordinary chemical reactions. Examples include Carbon (C), Iron (Fe), and Gold (Au). There are currently 118 recognized elements in the Periodic Table.

• Compounds: A compound is a substance where atoms of different elements are held together by chemical bonds (ionic or covalent). The properties of a compound are distinct from the properties of the individual elements that compose it. For instance, Sodium (Na) is a reactive metal and Chlorine (Cl) is a toxic gas, but together they form Sodium Chloride (NaCl), which is edible table salt.

• Molecules: A molecule is the smallest unit of a substance that retains the chemical properties of that substance. It can be homoatomic (like O3 or P4) or heteroatomic (like CO2 or CH4).

• Chemical Formula: This notation represents the ratio of atoms in a substance. In H2O, the numerical subscript 2 indicates there are two hydrogen atoms for every one oxygen atom.

• Atomicity: This refers to the total number of atoms present in one molecule of an element or compound. For example, H2O has an atomicity of 3 (2 Hydrogen + 1 Oxygen).

Important Points

• Law of Definite Proportions: Established by Joseph Proust in 1799, this law states that a chemical compound always contains its constituent elements in a fixed ratio by mass, regardless of how the compound was prepared.

• Noble Gases: Elements like Helium (He), Neon (Ne), and Argon (Ar) are chemically inert and usually exist as single atoms. They are known as monoatomic elements.

• Diatomic Elements: There are seven elements that naturally exist as diatomic molecules (molecules of two atoms) in their gaseous state: Hydrogen (H2), Nitrogen (N2), Oxygen (O2), Fluorine (F2), Chlorine (Cl2), Bromine (Br2), and Iodine (I2).

• Valency: The combining capacity of an atom is called its valency. It determines how many chemical bonds an atom can form to create a molecule or compound. For example, Oxygen has a valency of 2, while Hydrogen has a valency of 1, leading to the formation of H2O.

**Q21. Answer: (b) Oviduct (fallopian tube)**

The correct answer is Oviduct (fallopian tube).

Key Points

• Fertilisation is the biological process where a male gamete (sperm) fuses with a female gamete (ovum or egg) to form a zygote. In the human female reproductive system, this event specifically occurs in the Oviduct, also known as the Fallopian tube.

• The fallopian tubes are a pair of long, narrow ducts that connect the ovaries to the uterus. They are approximately 10 to 12 cm in length.

• During ovulation, a mature egg is released from the ovary and is swept into the fallopian tube by finger-like projections called fimbriae.

• Fertilisation usually takes place in the widest section of the fallopian tube, called the ampulla. The sperm cells must swim through the vagina, cervix, and uterus to reach the egg in the oviduct. Hence, the statement regarding the oviduct as the site of

fertilisation is correct.

• Once fertilisation occurs, the resulting zygote remains in the fallopian tube for about 3 to 4 days, undergoing rapid cell division as it moves toward the uterus.

Additional Information

• Ovary:

• The ovaries are the primary female reproductive organs located on either side of the lower abdomen.

• Their main functions are oogenesis (the production of eggs) and the secretion of essential hormones like estrogen and progesterone. Fertilisation does not happen here.

• Uterus (Womb):

• The uterus is a hollow, pear-shaped organ where a fertilised egg implants and develops into a fetus.

• The process of the embryo attaching to the uterine wall is called implantation, which typically occurs about 6 to 9 days after fertilisation. If fertilisation does not occur, the uterine lining (endometrium) is shed during menstruation.

• Cervix:

• The cervix is the lower, narrow portion of the uterus that opens into the vagina.

• It acts as a gateway that allows sperm to enter the uterus and serves as the birth canal during delivery. It also produces cervical mucus that changes in consistency throughout the menstrual cycle to facilitate or inhibit sperm movement.

• Zygote to Embryo:

• After the sperm penetrates the egg, the diploid zygote is formed. It undergoes cleavage (mitotic divisions) to become a morula and then a blastocyst before reaching the uterus for gestation.

**Q22. Answer: (c) Red blood corpuscles**

The correct answer is Red blood corpuscles.

Key Points

• Red blood corpuscles (RBCs), also known as erythrocytes, are the primary medium for oxygen transportation in the blood of vertebrates. Hence, the correct answer is Red blood corpuscles.

• These cells contain a specialized red-colored, iron-containing complex protein called haemoglobin. Approximately 97% of oxygen is transported by RBCs in the blood, while the remaining 3% is carried in a dissolved state through the plasma.

• When blood passes through the lungs, oxygen binds to the iron atoms in haemoglobin to form a temporary and reversible compound known as oxyhaemoglobin. Each molecule of haemoglobin can carry a maximum of four molecules of oxygen.

• Upon reaching the peripheral tissues where the partial pressure of oxygen is low, oxyhaemoglobin dissociates, releasing the oxygen for cellular respiration.

• Mature human RBCs are biconcave in shape and lack a nucleus (enucleated). This unique structure increases the surface area for gas exchange and provides more internal space to accommodate haemoglobin.

Additional Information

• White blood corpuscles (WBCs):

• Also known as leucocytes, these cells are part of the body's immune system.

• Their primary function is to fight infections and protect the body against foreign pathogens like bacteria and viruses.

• Unlike RBCs, they contain a nucleus but do not contain haemoglobin, which is why they are colorless.

• Blood platelets:

• Scientifically called thrombocytes, these are cell fragments produced from megakaryocytes in the bone marrow.

• They play a critical role in blood clotting (coagulation). When a blood vessel is injured, platelets aggregate at the site to form a plug, preventing excessive blood loss.

• A significant reduction in platelet count can lead to clotting disorders and internal bleeding.

• Lymph:

• Lymph is a colorless fluid that circulates through the lymphatic system.

• It is derived from interstitial fluid and contains specialized WBCs called lymphocytes.

• Its functions include draining excess fluid from tissues, transporting fats absorbed from the intestine, and acting as a filter for pathogens in the lymph nodes.

Important Points

• The average life span of a human red blood cell is approximately 120 days.

• The process of formation of RBCs is called erythropoiesis, which primarily occurs in the red bone marrow in adults.

• Worn-out or damaged RBCs are destroyed in the spleen, which is often referred to as the "graveyard of RBCs".

• The red color of blood is attributed specifically to the haeme group (iron-porphyrin complex) within the haemoglobin protein.

• The transport of carbon dioxide is also managed by blood, where about 20-25% is carried by haemoglobin as

carbamino-haemoglobin, and the majority (about 70%) is transported as bicarbonate ions.

**Q23. Answer: (a) To provide maximum green matter for fodder**

The correct answer is To provide maximum green matter for fodder.

Key Points

• Fodder crops are specifically cultivated to provide nutritious feed for livestock such as cattle, goats, and sheep. The primary objective is to obtain the highest possible vegetative biomass.

• Tallness in these plants ensures a greater volume of stems, while profuse branching leads to an increased number of leaves. Together, these traits result in maximum green matter per unit area. Hence, statement 1 is correct.

• A higher leaf-to-stem ratio, often achieved through branching, is desirable because leaves are generally more digestible and contain higher crude protein levels than stems.

• Reducing harvesting time is not a primary reason for seeking tall or branched plants; in fact, very tall and branched crops might require more effort to harvest and process. Hence, statement 2 is incorrect.

• While grain yield is important for food crops, fodder crops are often harvested before they reach the reproductive stage (flowering and seed setting) to ensure the greens remain succulent and palatable. Hence, statement 3 is incorrect.

• Improving soil fertility is a secondary benefit of certain fodder crops (like legumes), but the physical traits of height and branching are selected specifically for animal consumption needs. Hence, statement 4 is incorrect.

Additional Information

• Types of Fodder Crops:

• Kharif Fodder: Crops like Sorghum (Jowar), Maize, and Bajra are grown during the monsoon season. They are known for their rapid growth and high biomass.

• Rabi Fodder: Berseem (Egyptian Clover) and Oats are popular winter fodder crops. Berseem is particularly valued for its multiple cuttings and high protein content.

• Desirable Agronomic Traits:

• In cereal crops like Wheat, scientists prefer dwarf varieties to prevent lodging (bending of the stalk). However, in fodder crops, the "Gigantism" trait is preferred to maximize the feed available for Animal Husbandry.

• Palatability: The green matter must be soft and easy for animals to chew, which is why they are often harvested during the vegetative phase.

• Nutritional Quality:

• Fodder crops provide essential minerals, vitamins, and fiber. Leguminous fodder such as Lucerne (Alfalfa) and Cowpea helps in nitrogen fixation, which enriches the soil with Nitrogen while providing high-quality feed.

Important Points

• Crop Improvement: In plant breeding for fodder, the selection criteria differ from food grains. Breeders look for multi-cut genotypes that can regenerate quickly after being harvested.

• Economic Impact: Efficient fodder production is crucial for the Dairy Industry in India. Since land availability for grazing is shrinking, high-yielding tall and branched varieties help meet the nutritional requirements of a large livestock population.

• Silage and Hay: Tall fodder crops with high dry matter content are ideal for making Silage (preserved green fodder) to be used during the lean season.

**Q24. Answer: (a) same mass number but different atomic number**

The correct answer is same mass number but different atomic number.

Key Points

• Isobars are atoms of different chemical elements that possess the same mass number (A) but have different atomic numbers (Z). Hence, option 1 is correct.

• The mass number is the total count of nucleons, which includes both protons and neutrons located in the atomic nucleus.

• Because isobars have different atomic numbers, they represent different chemical elements and occupy different positions in the Periodic Table.

• A classic example of isobars includes Argon (Ar), Potassium (K), and Calcium (Ca), all of which can have a mass number of 40, while their atomic numbers are 18, 19, and 20 respectively.

• Atoms that share the same atomic number but have different mass numbers are classified as isotopes. Hence, option 2 is incorrect.

• Properties like melting point and refractive index are specific physical and optical characteristics of substances and are not used to define or categorize atomic species such as isobars. Hence, options 3 and 4 are incorrect.

Additional Information

• Isotopes:

• These are variants of a particular chemical element which differ in neutron number, and consequently in nucleon number.

• All isotopes of a given element have the same number of protons in each atom.

• Example: Hydrogen-1 (Protium), Hydrogen-2 (Deuterium), and Hydrogen-3 (Tritium) are the three isotopes of hydrogen.

• Isotones:

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

• Example: Carbon-14 (6 protons, 8 neutrons) and Oxygen-16 (8 protons, 8 neutrons) are isotones.

• Nuclear Isomers:

• These are atoms with the same atomic number and the same mass number but exist in different energy states within the nucleus.

• They are usually represented by the letter m (for metastable) after the mass number, such as Technetium-99m.

• Chemical and Physical Properties:

• Isobars exhibit completely different chemical properties because their electron configurations (determined by the atomic number) are different.

• Their physical properties also differ significantly as they belong to different elements with varying densities and structures.

Important Points

• Etymology: The term isobar was first suggested by Alfred Walter Stewart in 1918. It is derived from the Greek words isos (equal) and baros (weight).

• Beta Decay: In nuclear physics, isobars are frequently produced during Beta decay. When a nucleus undergoes Beta-minus decay, a neutron is converted into a proton. This increases the atomic number by 1 but the mass number remains unchanged, creating an isobar of the original element.

• Identification: Isobars can be distinguished using Mass Spectrometry, although their mass differences are extremely small (equal to the mass difference between a neutron and a proton-electron pair).

• Stability: According to Mattauch's isobar rule, if two adjacent elements on the Periodic Table have isotopes of the same mass number, at least one of them must be radioactive.

**Q25. Answer: (d) 12 N**

The correct answer is 12 N.

Key Points

• To find the magnitude of the applied force, we use Newton's Second Law of Motion, which states that the force acting on an object is equal to the mass of the object multiplied by its acceleration (F = m × a).

• The given parameters in the problem are: Mass (m) = 4 kg, Initial Velocity (u) = 2 m/s, Final Velocity (v) = 8 m/s, and Time (t) = 2 s.

• First, we must calculate the acceleration (a) of the object. Acceleration is defined as the rate of change of velocity over time. The formula is a = (v - u) / t.

• Substituting the values into the acceleration formula: a = (8 m/s - 2 m/s) / 2 s. This results in a = 6 / 2 = 3 m/s². Hence, the acceleration of the object is 3 m/s².

• Once the acceleration is known, we apply Newton's Second Law: Force (F) = mass (m) × acceleration (a).

• Calculation: F = 4 kg × 3 m/s² = 12 N. Therefore, the magnitude of the applied force is 12 N, which makes statement 4 the correct answer.

Additional Information

• Newton's Second Law of Motion:

• This law defines Force quantitatively. It establishes that the acceleration of an object depends on two variables: the net force acting upon the object and the mass of the object.

• The law can also be stated in terms of momentum (p): The applied force is equal to the rate of change of momentum (F = dp/dt).

• In the SI system, the unit of force is the Newton (N), named after Sir Isaac Newton. One Newton is defined as the force required to accelerate 1 kg of mass at 1 m/s².

• Kinematics and Dynamics:

• The relationship used to find acceleration (v = u + at) is one of the equations of motion for constant acceleration.

• Mass is a measure of inertia, which is the tendency of an object to resist changes in its state of motion. In this problem, the 4 kg mass requires a specific amount of force to overcome its inertia and reach the higher velocity.

• Velocity is a vector quantity, meaning it has both magnitude and direction. Since the velocity increases from 2 m/s to 8 m/s in the same direction, the force is applied in the direction of motion.

Important Points

• Impulse: The product of force and time is known as impulse. In this case, Impulse = F × t = 12 N × 2 s = 24 N·s. Impulse is also equal to the change in momentum (Δp = m(v - u) = 4 × 6 = 24 kg·m/s).

• Constant Force: The problem specifies a constant force, which implies uniform acceleration. If the force were variable, the

acceleration would not be constant, and simple kinematic equations would require integration.

• Dimensional Analysis: Force has the dimensions of [M L $T^2$]. Ensuring units are consistent (kg, m, s) is vital to obtaining the result in Newtons.

**Q26. Answer: (d) 25:9**

Shortcut Trick

Let the initial population be 100 units.

First reduction (28% left): 100 × (100 − 28)/100 = 72 units.

Second reduction (50% left): 72 × (100 − 50)/100 = 36 units.

Ratio = Initial : Present = 100 : 36 = 25 : 9.

Therefore The correct answer is 25:9.

Alternate Method

Given:

=> Initial Population (Let) = P

=> First reduction = 28%

=> Second reduction = 50% of remaining

=> Present population = 4450

Calculations:

=> Remaining after 28% left = P × (1 − 28/100) = P × 72/100

=> Present population = (P × 72/100) × (1 − 50/100)

=> 4450 = P × 72/100 × 50/100

=> 4450 = P × 18/50

=> P = (4450 × 50) / 18

=> Initial Population (P) = 12361.11 (approx)

=> Ratio = P : 4450

=> Ratio = [P × (72/100) × (50/100)]^(−1) is not needed, use simplified units:

=> Initial : Present = 1 : (72/100 × 50/100)

=> Initial : Present = 1 : 0.36 = 100 : 36 = 25 : 9

Therefore The correct answer is 25:9.

Additional Information

Successive Percentage Change

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

Base Value Independence

Ratio calculations involving percentages do not require the actual numerical values (like 4450) if only the final ratio is asked.

Fraction Equivalents

Using fractions like 1/2 for 50% and 18/25 for 72% can significantly speed up calculations in population problems.

**Q27. Answer: (a) 21.56**

Shortcut Trick

Equate the volumes of both cylinders: Volume_(Solid) = Volume_(Hollow)

$r_s^2 \times H = (R^2 - r^2) \times h$

$2^2 \times H = (6^2 - 5.5^2) \times 15$

4 × H = (36 − 30.25) × 15 => 4 × H = 5.75 × 15

H = 86.25 ÷ 4 = 21.5625 cm

Therefore The correct answer is 21.56 cm.

Alternate Method

Given:

Base diameter of solid cylinder = 4 cm => Radius ($r_s$) = 2 cm

External diameter of hollow cylinder = 12 cm => External radius (R) = 6 cm

Thickness (t) = 0.5 cm => Internal radius (r) = 6 − 0.5 = 5.5 cm

Height of hollow cylinder (h) = 15 cm

Formula Used:

Volume of solid cylinder = $\pi r^2 h$

Volume of hollow cylinder = $\pi(R^2 - r^2)h$

Calculations:

=> Volume of solid cylinder = Volume of hollow cylinder

=> $\pi \times (2)^2 \times H = \pi \times (6^2 - 5.5^2) \times 15$

=> $4 \times H = (36 - 30.25) \times 15$

=> $4 \times H = 5.75 \times 15$

=> $4 \times H = 86.25$

=> $H = 86.25 \div 4$

=> $H = 21.5625$ cm

Rounding off to 2 decimal places, $H \approx 21.56$ cm.

Therefore The correct answer is 21.56 cm.

Additional Information

Recasting Concept

When a solid object is melted and recast into another shape, the total volume remains constant, provided there is no wastage.

Hollow Cylinder Parameters

Internal Radius (r) = External Radius (R) − Thickness. Curved Surface Area (CSA) = $2\pi h(R + r)$.

Volume of Cylinder

For a solid cylinder, Volume = Base Area × Height = $\pi r^2 h$.

**Q28. Answer: (b) 76**

Shortcut Trick

Simplify the given equation: $(x^2 - 1)/x = 4 \rightarrow x - 1/x = 4$.

Simplify the required expression: $(x^6 - 1)/x^3 = x^3 - 1/x^3$.

Apply the standard algebraic trick: If $x - 1/x = k$, then $x^3 - 1/x^3 = k^3 + 3k$.

Substitute $k = 4$: $4^3 + 3 \times 4 = 64 + 12 = 76$.

Therefore The correct answer is 76.

Alternate Method

Given:

$(x^2 - 1) / x = 4$

Formula Used:

$(a - b)^3 = a^3 - b^3 - 3ab(a - b)$

Calculations:

=> Split the given fraction: $(x^2 / x) - (1 / x) = 4$

=> $x - 1/x = 4$

=> Now, split the expression to be found: $(x^6 / x^3) - (1 / x^3)$

=> $x^3 - 1/x^3$

=> Cubing both sides of the equation $x - 1/x = 4$:

=> $(x - 1/x)^3 = 4^3$

=> $x^3 - 1/x^3 - 3 \times x \times (1/x) \times (x - 1/x) = 64$

=> $x^3 - 1/x^3 - 3 \times (4) = 64$

=> $x^3 - 1/x^3 = 64 + 12$

=> $x^3 - 1/x^3 = 76$

Therefore The correct answer is 76.

Additional Information

Algebraic Identity for Addition

If $x + 1/x = k$, then $x^3 + 1/x^3 = k^3 - 3k$.

Relationship between Sum and Difference

$(x + 1/x)^2 - (x - 1/x)^2 = 4$. This is useful for converting between $x + 1/x$ and $x - 1/x$.

Squaring Identity

If $x - 1/x = k$, then $x^2 + 1/x^2 = k^2 + 2$. If $x + 1/x = k$, then $x^2 + 1/x^2 = k^2 - 2$.

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**Q29. Answer: (b) 66.67%**

Shortcut Trick

Required percentage = (First value ÷ Second value) × 100

Required percentage = (1/30) ÷ (2/40) × 100

Required percentage = (1/30) × (40/2) × 100 = (1/30) × 20 × 100

Required percentage = 2000 ÷ 30 = 200 ÷ 3 = 66.666...

Therefore The correct answer is 66.67%.

Alternate Method

Given: First fraction = 1/30, Second fraction = 2/40 (which simplifies to 1/20).

Formula Used: Percentage = (Part / Total) × 100

=> Required Percentage = [(1/30) / (2/40)] × 100

=> Required Percentage = (1/30) × (40/2) × 100

=> Required Percentage = (40 / 60) × 100

=> Required Percentage = (2 / 3) × 100

=> Required Percentage = 200 / 3 = 66.666...

=> Rounding off to two decimal places = 66.67%

Therefore The correct answer is 66.67%.

Additional Information

Percentage Change

Percentage change = [(New Value − Old Value) / Old Value] × 100.

Fraction to Percentage

To convert any fraction a/b into a percentage, multiply it by 100 and add the % symbol.

Rounding Rule

When rounding to two decimal places, if the third decimal digit is 5 or more, increase the second decimal digit by 1.

**Q30. Answer: (c) 24**

Shortcut Trick

Ratio method: Let CP be 100. Then MP = 100 + 75 = 175.

Given Profit is 33%, so SP = 100 + 33 = 133.

Discount = MP − SP = 175 − 133 = 42.

X% (Discount%) = (Discount ÷ MP) × 100 = (42 ÷ 175) × 100.

X = (6 ÷ 25) × 100 = 6 × 4 = 24.

Therefore The correct answer is 24.

Alternate Method

Given: Markup% = 75%, Profit% = 33%, Discount% = X%.

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

=> Let Cost Price (CP) = 100.

=> Marked Price (MP) = 100 × (100 + 75) ÷ 100 = 175.

=> Selling Price (SP) = 100 × (100 + 33) ÷ 100 = 133.

=> Using SP = MP × (100 − X) ÷ 100:

=> 133 = 175 × (100 − X) ÷ 100.

=> 133 = 1.75 × (100 − X) => 133 ÷ 1.75 = 100 − X.

=> 76 = 100 − X => X = 100 − 76 = 24.

Therefore The correct answer is 24.

Additional Information

Relationship between CP and MP

The direct formula relating CP and MP when profit and discount are known is: CP ÷ MP = (100 − Discount%) ÷ (100 + Profit%).

Markup Percentage

Markup% is always calculated on the Cost Price: Markup% = [(MP − CP) ÷ CP] × 100.

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**Q31. Answer: (b) 2**

Shortcut Trick

To find the greatest number that exactly divides given numbers, find the HCF.

Check the differences between numbers: 74 − 46 = 28 and 98 − 74 = 24.

The HCF must be a factor of the differences (28, 24).

The factors of 24 and 28 are 1, 2, 4. Testing 4: 46 is not divisible by 4. Testing 2: 46, 74, and 98 are all even.

Therefore The correct answer is 2.

Alternate Method

Given: Numbers are 46, 98, and 74.

Formula Used: The greatest number that exactly divides the given numbers is their Highest Common Factor (HCF).

=> Prime factorization of 46 = 2 × 23

=> Prime factorization of 74 = 2 × 37

=> Prime factorization of 98 = 2 × 7 × 7

=> Common factor in all three numbers = 2

=> HCF(46, 74, 98) = 2

Therefore The correct answer is 2.

Additional Information

Highest Common Factor (HCF)

HCF is the largest positive integer that divides each of the integers without a remainder.

Least Common Multiple (LCM)

LCM is the smallest positive integer that is divisible by each of the given numbers.

HCF of Prime Numbers

The HCF of any two or more prime numbers is always 1.

Product Rule

For two numbers a and b: HCF(a, b) × LCM(a, b) = a × b.

**Q32. Answer: (d) 12 years**

Shortcut Trick

Ratio of Father age to Son age is 3 : 1.

Total ratio parts = 3 + 1 = 4 units.

4 units = 48 years.

1 unit (Son's age) = 48 ÷ 4 = 12 years.

Therefore The correct answer is 12 years.

Alternate Method

Given:

Father's current age = 3 × Son's current age

Sum of their ages = 48 years

Calculations:

Let the Son's age be x.

=> Father's age = 3x

=> x + 3x = 48

=> 4x = 48

=> x = 48 ÷ 4

=> x = 12

Therefore The correct answer is 12 years.

Additional Information

Ratio and Proportion in Ages

Age problems often use linear equations or ratios. If the ratio of ages is a:b, their ages can be taken as ax and bx.

Age Difference Constant

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

Future and Past Ages

If current age is x, then age n years ago was (x − n) and age n years hence will be (x + n).

**Q33. Answer: (a) 9/29**

Shortcut Trick

Proportion of chemical Y = Efficiency of B ÷ Total efficiency of (A + B + C).

LCM(30, 40, 45) = 360 units (Total Capacity).

Efficiencies: A = 12, B = 9, C = 8.

Proportion of Y = 9 ÷ (12 + 9 + 8) = 9/29.

Therefore The correct answer is 9/29.

Alternate Method

Given: Filling time for Pipe A = 30 min, Pipe B = 40 min, Pipe C = 45 min.

Formula Used: Work = Efficiency × Time; Proportion = Part ÷ Whole.

| Person | Days | Total Work | Efficiency |
|---|---|---|---|
| Pipe A | 30 | 360 | 12 |
| Pipe B | 40 | 9 | |
| Pipe C | 45 | 8 | |

=> Total units filled in 1 minute = 12 + 9 + 8 = 29 units.

=> Chemical Y is filled by Pipe B.

=> Amount of X in 5 min = 12 × 5 = 60 units.

=> Amount of Y in 5 min = 9 × 5 = 45 units.

=> Amount of Z in 5 min = 8 × 5 = 40 units.

=> Total liquid in 5 min = 60 + 45 + 40 = 145 units.

=> Proportion of Y = 45 ÷ 145 = 9/29.

Therefore The correct answer is 9/29.

Additional Information

Proportion in Mixtures

The ratio of components in a tank filled by multiple pipes is always equal to the ratio of their individual efficiencies, regardless of time, provided all pipes run for the same duration.

Pipes and Cisterns

If a pipe fills a tank in 'x' hours, its 1-hour work is 1/x. For an outlet pipe (leak), the efficiency is taken as negative.

**Q34. Answer: (c) 68**

Shortcut Trick

Mean Proportional between a and b is given by $\sqrt{(a \times b)}$.

=> $\sqrt{(17 \times 272)}$

=> $\sqrt{(17 \times 17 \times 16)}$

=> 17 × 4 = 68

Therefore The correct answer is 68.

Alternate Method

Given: First term (a) = 17, Second term (b) = 272

Formula Used: If x is the mean proportional between a and b, then a : x = x : b => $x^2 = ab$

=> $x^2 = 17 \times 272$

=> $x^2 = 17 \times (17 \times 16)$

=> $x = \sqrt{(17^2 \times 4^2)}$

=> x = 17 × 4

=> x = 68

Therefore The correct answer is 68.

Additional Information

Third Proportional

For two numbers a and b, the third proportional c is calculated such that a : b = b : c, which gives $c = b^2/a$.

Fourth Proportional

For three numbers a, b, and c, the fourth proportional d is calculated such that a : b = c : d, which gives d = (b × c)/a.

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Continued Proportion

Three quantities a, b, c are in continued proportion if a/b = b/c. Here b is the geometric mean of a and c.

**Q35. Answer: (b) 1**

Shortcut Trick

List all numbers between 445 and 456: 446, 447, 448, 449, 450, 451, 452, 453, 454, 455.

Eliminate even numbers (446, 448, 450, 452, 454) and multiples of 5 (455).

Check remaining odd numbers: 447 (sum=15, div by 3), 449 (Prime), 451 (11 × 41), 453 (sum=12, div by 3).

Only 449 is a prime number.

Therefore The correct answer is 1.

Alternate Method

Given: Range is 445 < n < 456.

Method: Test divisibility for odd numbers within the range.

=> 447: 4 + 4 + 7 = 15 (Divisible by 3) → Composite

=> 449: Not divisible by 2, 3, 5, 7, 11, 13, 17, 19 (since √449 ≈ 21.1) → Prime

=> 451: 451 ÷ 11 = 41 → Composite

=> 453: 4 + 5 + 3 = 12 (Divisible by 3) → Composite

=> 455: Ends in 5 (Divisible by 5) → Composite

Therefore The correct answer is 1.

Additional Information

Definition of Prime Numbers

A natural number greater than 1 that has no positive divisors other than 1 and itself.

Primality Test

To check if n is prime, test divisibility by primes up to √n.

Divisibility Rule of 11

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

**Q36. Answer: (d) 68.73%**

Shortcut Trick

Given Marked Price (MP) = Rs. 889 and Selling Price (SP) = Rs. 278.

Discount = MP − SP = 889 − 278 = 611.

Discount% = (Discount ÷ MP) × 100.

Discount% = (611 ÷ 889) × 100 ≈ 68.7289%.

Rounding to two decimal places, we get 68.73%.

Therefore The correct answer is 68.73%.

Alternate Method

Given: MP = Rs. 889, SP = Rs. 278.

Formulas: Discount = MP − SP | Discount% = (Discount ÷ MP) × 100

=> Discount = 889 − 278 = 611

=> Discount% = (611 ÷ 889) × 100

=> Discount% = 68.7289...

=> Final Result = 68.73%

Therefore The correct answer is 68.73%.

Additional Information

Marked Price & Discount

Marked Price is the price listed on the label. Discount is always calculated on the Marked Price unless otherwise stated.

Selling Price Calculation

SP = MP × (100 − Discount%) ÷ 100. It is the actual price at which the product is sold after the reduction.

**Q37. Answer: (b) 9**

Shortcut Trick

Combined efficiency of P and Q = 1/9

Efficiency of P = 1/36

Efficiency of Q = 1/9 − 1/36 = (4 − 1)/36 = 3/36 = 1/12

Time for Q to fill 3/4 cistern = (3/4) ÷ (1/12) = 3/4 × 12 = 9 hours

Therefore The correct answer is 9 hours.

Alternate Method

Given:

Time taken by P + Q = 9 hours

Time taken by P alone = 36 hours

Formula Used:

Total Work = LCM of individual times

Efficiency = Total Work ÷ Time

| Person | Days | Total Work | Efficiency |
|---|---|---|---|
| P + Q | 9 | 36 units | 4 |
| P | 36 | 1 | |

Calculations:

=> Efficiency of Q = (Efficiency of P + Q) − (Efficiency of P)

=> Efficiency of Q = 4 − 1 = 3 units/hour

=> Three-fourth of the cistern capacity = 3/4 × 36 = 27 units

=> Time taken by Q to fill 27 units = 27 ÷ 3 = 9 hours

Therefore The correct answer is 9 hours.

Additional Information

Combined Work Formula

If two pipes fill a tank in x and y hours respectively, together they fill it in (xy)/(x + y) hours.

Individual Time Formula

If together they take T hours and one takes x hours, the other takes y = (Tx)/(x − T) hours.

Pipes and Cisterns

Inlet pipes have positive efficiency, while outlet (leakage) pipes have negative efficiency.

**Q38. Answer: (b) 42**

Shortcut Trick

Assume a base mean of 40 to simplify calculation.

Find deviations from 40: −23, +24, +15, −3, +25, −28, +11, −22, +19.

Net deviation = (−23 − 3 − 28 − 22) + (24 + 15 + 25 + 11 + 19) = −76 + 94 = +18.

Average deviation = 18 ÷ 9 = +2.

Actual Mean = 40 + 2 = 42.

Therefore The correct answer is 42.

Alternate Method

Given: Observations are 17, 64, 55, 37, 65, 12, 51, 18, and 59.

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

=> Sum of observations = 17 + 64 + 55 + 37 + 65 + 12 + 51 + 18 + 59

=> Sum = 378

=> Total number of observations (n) = 9

=> Arithmetic Mean = 378 ÷ 9

=> Arithmetic Mean = 42

Therefore The correct answer is 42.

Additional Information

Properties of Arithmetic Mean

If each observation is increased, decreased, multiplied, or divided by a constant k, the mean also changes by that same constant k.

Empirical Relationship

In a moderately skewed distribution, the relationship between Mean, Median, and Mode is: Mode = 3 Median − 2 Mean.

Sum of Deviations

The sum of the deviations of all observations from their Arithmetic Mean is always zero (Σ(x_i − Mean) = 0).

**Q39. Answer: (c) 14 : 9 : 19**

Shortcut Trick

Let Y share be y.

Total sum = (y + 4000) + y + (y + 8000) = 3y + 12000 = 33600.

3y = 21600 → y = 7200.

X = 7200 + 4000 = 11200; Y = 7200; Z = 7200 + 8000 = 15200.

Ratio X : Y : Z = 11200 : 7200 : 15200 = 112 : 72 : 152 = 14 : 9 : 19.

Therefore The correct answer is 14 : 9 : 19.

Alternate Method

Given: Total sum = Rs. 33,600. X = Y + Rs. 4,000. Z = Y + Rs. 8,000.

Formula Used: Total Sum = X + Y + Z

=> (Y + 4000) + Y + (Y + 8000) = 33600

=> 3Y + 12000 = 33600

=> 3Y = 33600 − 12000 = 21600

=> Y = 21600 ÷ 3 = Rs. 7,200

=> X = 7200 + 4000 = Rs. 11,200

=> Z = 7200 + 8000 = Rs. 15,200

=> Ratio X : Y : Z = 11200 : 7200 : 15200

=> Dividing by 800: 11200/800 : 7200/800 : 15200/800 = 14 : 9 : 19

Therefore The correct answer is 14 : 9 : 19.

Additional Information

Ratio and Proportion

Ratio is the comparison of two quantities by division. If a sum S is divided in ratio a:b:c, parts are S×a/(a+b+c), S×b/(a+b+c), and S×c/(a+b+c).

Compound Ratio

The compound ratio of (a : b) and (c : d) is (ac : bd), obtained by multiplying corresponding terms.

Inverse Ratio

The inverse ratio of a : b is 1/a : 1/b, which simplifies to b : a.

**Q40. Answer: (d) 5°**

Shortcut Trick

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

angle STR = (angle P + angle Q) ÷ 2

=> 27.5° = (angle P + angle Q) ÷ 2

=> angle P + angle Q = 55°

Since the ratio of angle P : angle Q is 5 : 6, the sum of ratio parts is 5 + 6 = 11 units.

=> 11 units = 55° => 1 unit = 5°

The difference between angle Q and angle P is 6 − 5 = 1 unit = 5°.

Therefore The correct answer is 5°.

Alternate Method

Given:

=> In quadrilateral PQRS, the bisectors of angle R and angle S meet at point T.

=> angle STR = 27.5°

=> Ratio of angle P : angle Q = 5 : 6

Formula Used:

=> Sum of angles in a triangle = 180°

=> Sum of angles in a quadrilateral = 360°

Calculations:

In triangle STR:

=> angle STR + angle TSR + angle TRS = 180°

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Since ST and RT are angle bisectors of angle S and angle R respectively:

=> angle TSR = angle S ÷ 2 and angle TRS = angle R ÷ 2

=> 27.5° + (angle S ÷ 2) + (angle R ÷ 2) = 180°

=> (angle S + angle R) ÷ 2 = 180° − 27.5° = 152.5°

=> angle S + angle R = 305°

In quadrilateral PQRS, the sum of all interior angles is 360°:

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

=> angle P + angle Q + 305° = 360°

=> angle P + angle Q = 55°

Let angle P = 5x and angle Q = 6x:

=> 5x + 6x = 55°

=> 11x = 55°

=> x = 5°

The difference between the measures of angle Q and angle P is:

=> angle Q − angle P = 6x − 5x = x = 5°

Therefore The correct answer is 5°.

Additional Information

Angle Bisector Theorem in Quadrilaterals

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 STR = (angle P + angle Q) ÷ 2.

Sum of Interior Angles of a Polygon

The sum of all interior angles of any n-sided polygon is given by (n − 2) × 180°. For a quadrilateral (n = 4), the sum is always 360°.

Angle Bisectors of Opposite Angles

If the bisectors of opposite angles of a quadrilateral meet, the angle between them is equal to half the difference of the other two angles.

**Q41. Answer: (d) 27**

Shortcut Trick

If every observation in a data set is increased by a constant k, then the average of the set also increases by k.

Current Average of 7 numbers = 23

Increase in each number = 4

New Average = 23 + 4 = 27

Therefore The correct answer is 27.

Alternate Method

Given: Average of 7 numbers = 23. Each number is increased by 4.

Formula Used: Average = Sum of observations ÷ Number of observations

=> Total sum of 7 numbers = 23 × 7 = 161

=> Since each of the 7 numbers is increased by 4, the total sum increase = 7 × 4 = 28

=> New total sum = 161 + 28 = 189

=> New Average = 189 ÷ 7

=> New Average = 27

Therefore The correct answer is 27.

Additional Information

Property of Multiplication

If each number is multiplied by a constant k, the new average becomes (Original Average × k).

Property of Subtraction

If each number is decreased by a constant k, the new average becomes (Original Average − k).

Property of Division

If each number is divided by a non-zero constant k, the new average becomes (Original Average ÷ k).

**Q42. Answer: (d) 100**

Shortcut Trick

Total profit required = Rs. 195.

Profit per apple = CP × Profit% = 15 × 13/100 = Rs. 1.95.
Number of apples = Total Profit ÷ Profit per apple.
Number of apples = 195 ÷ 1.95 = 100.
Therefore The correct answer is 100.
Alternate Method
Given: Cost Price (CP) of one apple = Rs. 15, Profit percentage = 13%, Total Profit required = Rs. 195.
Formulas: Profit per unit = CP × (Profit% ÷ 100) | Number of units = Total Profit ÷ Profit per unit.
=> Profit on 1 apple = 15 × (13 ÷ 100) = 15 × 0.13 = Rs. 1.95.
=> Let the number of apples be n.
=> Total Profit = n × Profit on 1 apple.
=> 195 = n × 1.95.
=> n = 195 ÷ 1.95 = 100.
Therefore The correct answer is 100.
Additional Information
Total Cost Price and Total Sales
Total CP = Number of items × CP per item. Similarly, Total SP = Number of items × SP per item.
Profit Calculation
Profit can be calculated as (Total SP − Total CP) or (Number of items × Profit per item).

**Q43. Answer: (d) 6552**

Shortcut Trick
Combine all fractions: (1/5) × (1/2) × (5/9) × Number = 364
=> (1/18) × Number = 364
=> Number = 364 × 18
=> Number = 6552
Therefore The correct answer is 6552.
Alternate Method
Given: Result = 364
Formula: Value = Result ÷ (Product of Fraction equivalents)
=> Let the number be x.
=> 20% × 50% × (5/9) × x = 364
=> (20/100) × (50/100) × (5/9) × x = 364
=> (1/5) × (1/2) × (5/9) × x = 364
=> (1/18) × x = 364
=> x = 364 × 18
=> x = 6552
Therefore The correct answer is 6552.
Additional Information
Percentage to Fraction Conversion
To convert percentage to fraction, divide by 100. For example, 25% = 25/100 = 1/4.
Successive Percentage Application
When taking percentages of percentages, multiply the corresponding fractions or decimals directly: a% of b% of x = (a/100) × (b/100) × x.
Reverse Calculation Trick
To find the original number when a fractional part is given, multiply the result by the reciprocal of the total fraction.

**Q44. Answer: (c) 60**

Shortcut Trick
Total distance = 150 + 350 = 500 m
Time = 30 seconds
Speed (m/s) = 500 ÷ 30 = 50/3 m/s
Speed (km/hr) = (50/3) × (18/5) = 10 × 6 = 60 km/hr

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Therefore The correct answer is 60 km/hr.

Alternate Method

Given:

Length of Train (L1) = 150 m

Length of Platform (L2) = 350 m

Time taken (T) = 30 seconds

Formula Used:

Speed = Total Distance ÷ Total Time

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

Calculations:

=> Total Distance = L1 + L2 = 150 + 350 = 500 m

=> Speed in m/s = 500 ÷ 30 = 50/3 m/s

=> Speed in km/hr = (50/3) × (18/5)

=> Speed = 10 × 6 = 60 km/hr

Therefore The correct answer is 60 km/hr.

Additional Information

Unit Conversion

1 m/s = 18/5 km/hr and 1 km/hr = 5/18 m/s.

Crossing Stationary Objects

When a train crosses a stationary object of length 'L', the total distance covered is (Length of train + L).

Relative Speed

If two objects move in the same direction, relative speed = S1 − S2. If opposite directions, relative speed = S1 + S2.

**Q45. Answer: (b) 42 cm**

Shortcut Trick

Length = Area ÷ Breadth = 100.64 ÷ 7.4 = 13.6 cm

Perimeter = 2 × (Length + Breadth)

Perimeter = 2 × (13.6 + 7.4) = 2 × 21 = 42 cm

Therefore The correct answer is 42 cm.

Alternate Method

Given:

Area of the rectangle = 100.64 $cm^2$

Breadth (b) of the rectangle = 7.4 cm

Formula Used:

Area = Length (l) × Breadth (b)

Perimeter = 2 × (l + b)

Calculations:

=> 100.64 = Length × 7.4

=> Length = 100.64 ÷ 7.4

=> Length = 13.6 cm

=> Perimeter = 2 × (13.6 + 7.4)

=> Perimeter = 2 × 21

=> Perimeter = 42 cm

Therefore The correct answer is 42 cm.

Additional Information

Diagonal of a Rectangle

The diagonal 'd' of a rectangle can be calculated using the Pythagorean theorem: $d = \sqrt{(l^2 + b^2)}$.

Properties of a Rectangle

A rectangle is a quadrilateral where all four angles are right angles (90°) and opposite sides are equal and parallel.

Square as a Special Rectangle

A square is a special type of rectangle where the length and breadth are equal (l = b = a), resulting in Area = $a^2$ and Perimeter = 4a.

**Q46. Answer: (c) 35,000**

Shortcut Trick

Net difference in Annual Interest Rate = 7% − 3.5% = 3.5%.

Total difference in Simple Interest for 2 years = 3.5% × 2 = 7%.

Interest Difference = 7% of Principal (Rs. 5,00,000).

=> Difference = (7 ÷ 100) × 5,00,000 = Rs. 35,000.

Therefore The correct answer is Rs. 35,000.

Alternate Method

Given:

Principal (P) = Rs. 5,00,000 for each bank.

Rate for Bank A (R1) = 3.5% per annum.

Rate for Bank B (R2) = 7% per annum.

Time (T) = 2 years.

Formula Used:

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

Calculations:

=> SI paid to Bank A = (5,00,000 × 3.5 × 2) ÷ 100

=> SI_A = 5,000 × 7 = Rs. 35,000

=> SI paid to Bank B = (5,00,000 × 7 × 2) ÷ 100

=> SI_B = 5,000 × 14 = Rs. 70,000

=> Positive Difference = SI_B − SI_A

=> Difference = 70,000 − 35,000 = Rs. 35,000

Therefore The correct answer is Rs. 35,000.

Additional Information

Simple Interest Formula

The basic formula for SI is (P × R × T) ÷ 100, where interest is calculated only on the initial principal amount throughout the duration.

Direct Difference Calculation

When principal and time are constant, the difference in interest is directly proportional to the difference in rates: ΔSI = P × (R2 − R1) × T ÷ 100.

Total Amount

The total amount (A) payable after the loan period is A = P + SI = P × [1 + (R × T ÷ 100)].

**Q47. Answer: (c) 14**

Shortcut Trick

Equation: 4x − 8 = 3x + 6

Direct difference method:

Difference in multiples = 4 − 3 = 1 part

Difference in constants = 6 − (−8) = 14

1 part = 14

Therefore The correct answer is 14.

Alternate Method

Given:

Let the unknown number be x.

Conditions:

=> 4 times the number = 4x

=> 8 subtracted from 4 times the number = 4x − 8

=> 6 more than thrice the number = 3x + 6

Calculations:

=> 4x − 8 = 3x + 6

=> 4x − 3x = 6 + 8

=> x = 14

Therefore The correct answer is 14.
Additional Information
Linear Equation in One Variable
An equation of the form ax + b = c, where a, b, and c are constants and x is the variable.
Transposition Method
Moving a term from one side of the equation to another changes its sign (+ becomes − and vice versa).
Verification Rule
Substitute the obtained value back into the original equation to ensure LHS = RHS.

**Q48. Answer: (b) 59**

Shortcut Trick
3125 = 5^5 => x + y = 5
2187 = 3^7 => 3x − y = 7
Add both => 4x = 12 => x = 3
y = 5 − 3 = 2
Therefore 41x − 32y = 123 − 64 = 59
Alternate Method
Given:
5^(x+y) = 3125
3^(3x−y) = 2187
Formula used:
If a^m = $a^n$ then m = n
Calculation:
=> 3125 = 5^5 => x + y = 5 ...(1)
=> 2187 = 3^7 => 3x − y = 7 ...(2)
=> Add (1) and (2): 4x = 12 => x = 3
=> Substitute in (1): 3 + y = 5 => y = 2
=> Required value = 41x − 32y
=> = 41 × 3 − 32 × 2
=> = 123 − 64 = 59
Therefore The correct answer is 59.
Additional Information
Exponential Rule
If bases are same, equate powers: a^m = $a^n$ => m = n
Standard Powers
3125 = 5^5, 2187 = 3^7
Linear Equations
Solve simultaneous equations using substitution or elimination
Shortcut Tip
Convert numbers into powers first to simplify quickly

**Q49. Answer: (a) 19**

Shortcut Trick
Total distance = Sum of lengths = 346 + 319 = 665 m.
Relative speed (Opposite direction) = 67 + 59 = 126 km/h.
Relative speed in m/s = 126 × (5/18) = 35 m/s.
Time = 665 ÷ 35 = 19 seconds.
Therefore The correct answer is 19 seconds.
Alternate Method
Given:
Length of Train 1 (L1) = 346 m, Length of Train 2 (L2) = 319 m
Speed of Train 1 (S1) = 67 km/h, Speed of Train 2 (S2) = 59 km/h

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Formula Used:

Time = (Total Length) ÷ (Relative Speed)

Relative Speed (Opposite) = S1 + S2

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

Calculations:

=> Total distance = 346 + 319 = 665 m

=> Relative Speed = 67 + 59 = 126 km/h

=> Relative Speed in m/s = 126 × (5/18)

=> Relative Speed in m/s = 7 × 5 = 35 m/s

=> Time required = 665 ÷ 35

=> Time required = 19 seconds

Therefore The correct answer is 19 seconds.

Additional Information

Relative Speed Concepts

When moving in opposite directions, speeds are added: S_(rel) = S1 + S2. When moving in the same direction, speeds are subtracted: S_(rel) = |S1 − S2|.

Unit Conversion

To convert km/h to m/s, multiply by 5/18. To convert m/s to km/h, multiply by 18/5.

Crossing Objects

When a train crosses another train or a bridge, the total distance is the sum of the lengths of both entities.

**Q50. Answer: (b) $\cot^2\theta$**

Shortcut Trick

Put θ = 45° to simplify the expression quickly.

Numerator: $\sin^2 45° \times (1 + \cot^2 45°) = (1/2) \times (1 + 1) = 1$.

Denominator: $\sec^2 45° - 1 = (\sqrt{2})^2 - 1 = 2 - 1 = 1$.

Result: 1 ÷ 1 = 1. Checking options: $\cot^2 45° = 1^2 = 1$.

Therefore The correct answer is $\cot^2\theta$.

Alternate Method

Given: $[\sin^2\theta(1 + \cot^2\theta)] \div (\sec^2\theta - 1)$

Formula Used:

$1 + \cot^2\theta = \text{cosec}^2\theta$

$\sec^2\theta - 1 = \tan^2\theta$

$\text{cosec}\theta = 1/\sin\theta$

Calculations:

=> Numerator = $\sin^2\theta \times \text{cosec}^2\theta$

=> Numerator = $\sin^2\theta \times (1/\sin^2\theta) = 1$

=> Denominator = $\tan^2\theta$

=> Expression = $1/\tan^2\theta$

=> Expression = $\cot^2\theta$

Therefore The correct answer is $\cot^2\theta$.

Additional Information

Fundamental Identities

$\sin^2\theta + \cos^2\theta = 1$; $1 + \tan^2\theta = \sec^2\theta$; $1 + \cot^2\theta = \text{cosec}^2\theta$.

Reciprocal Relations

$\tan\theta = \sin\theta/\cos\theta$ and $\cot\theta = \cos\theta/\sin\theta = 1/\tan\theta$.

**Q51. Answer: (d) PR - KN**

The logic followed here is based on the alphabetical position pattern:

Option 1: LN − GI

Option 2: SU − NP

Option 3: OQ − JL

Option 4: PR − KN

Thus, PR − KN does not follow the pattern.

Hence, the odd one out is Option 4.

**Q52. Answer: (a) SYCJ**

The logic followed here is:

For, EKOV → WCGN

Now, for YEIP → QWAH

Now, applying the same logic for AGKR:

So, AGKR → SYCJ

Hence, the correct answer is "Option 1".

**Q53. Answer: (d) Two**

Given: Seven friends D, E, F, U, V, W and X are sitting in a straight line facing north.

Only three people sit between U and F.

V sits to the immediate left of F.

No one sits to the right of X.

Only two people sit between X and V.

D sits to the immediate right of E.

Between them are 2 people.

Hence, the correct answer is "Option 4".

**Q54. Answer: (b) 7**

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

Now,

We need to find odd numbers which are immediately preceded by an odd number and also immediately followed by an odd number.

So, needed pattern is: Odd - Odd - Odd

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

So, total valid occurrences = 7

Hence, the correct answer is Option 2.

**Q55. Answer: (a) NPR 0**

The logic followed here is:

So, 'NPR 0' will replace the question mark in the given series.

Hence, the correct answer is "Option 1".

**Q56. Answer: (d) Shrusti and Krishna**

The logic followed here is:

Given: Piku, Aman, Krishna, Deepa, and Shrusti are sitting around a circular table facing the centre.

Shrusti and Deepa are immediate neighbours.

Piku is an immediate neighbour of both Deepa and Krishna.

Now, immediate neighbours of Aman are: Krishna and Shrusti

Hence, the correct answer is "Option 4".

**Q57. Answer: (b) Three**

Given: Five people V, W, X, Y and Z are sitting in a row facing north.

W is sitting at the extreme left end of the row.

There are only two people sitting between Z and W.

V is an immediate neighbour of Z.

X is an immediate neighbour of V.

Between W (1) and Y (5) are 3 people.

Hence, the correct answer is "Option 2".

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**Q58. Answer: (d) Mother's brother**

Family Chart:

Decoding the Symbols:

| Symbol | • | – | x | % | # |
|---|---|---|---|---|---|
| Meaning | Mother of | Brother of | Wife of | Father of | Daughter of |

Given: C − Q x Y % R − E

It means: C is the brother of Q, Q is the wife of Y, Y is the father of R, and R is the brother of E.

Now, C is E's mother's brother.

Hence, the correct answer is Option 4.

**Q59. Answer: (d) 7**

Given:

'HELS' is coded as '4695'

'ALES' is coded as '5749'

So, A = 7

Hence, the correct answer is "Option 4".

**Q60. Answer: (d) 772**

BODMAS Table:

Given equation: 231 ÷ 3 − 721 × 7 + 24 = ?

Now, replacing the symbols as:

| Symbol | • | × | ÷ |
|---|---|---|---|
| Replaced by | – | ÷ | × |

=> 231 × 3 + 721 ÷ 7 − 24 = ?

=> 693 + 721 ÷ 7 − 24 = ?

=> 693 + 103 − 24 = ?

=> 796 − 24 = ?

=> 772

Hence, the correct answer is Option 4.

**Q61. Answer: (a) 2**

Given:

'LEGS' is coded as '5483'

'ALES' is coded as '2348'

So, A = 2

Hence, the correct answer is "Option 1".

**Q62. Answer: (b) 4**

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

Now,

We need to find even numbers which are immediately preceded by an odd number and also immediately followed by an odd number.

So, needed pattern is: Odd - Even - Odd

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

So, total valid occurrences = 4

Hence, the correct answer is Option 2.

**Q63. Answer: (d) 42**

The logic followed here is:

thus, "42" will replace the question mark in the given series.

Hence, the correct option is "Option 4

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**Q64. Answer: (d) 30**

The logic followed here is:

thus, "30" will replace the question mark in the given series.

Hence, the correct option is "Option 4"

**Q65. Answer: (b) Only conclusion (I) follows**

Given Statements:

Some bells are pots.

All pots are machines.

The least possible Venn diagram for the given statements is:

Conclusions:

I. Some bells are machines – Follows (Some bells are pots, and all pots are machines. Therefore, some bells are definitely machines.)

II. All machines are pots – Does not follow (It is only given that all pots are machines, not that all machines are pots.)

So, only conclusion I follows.

Hence, the correct answer is "Option 2".

**Q66. Answer: (c) KQ 29**

The logic followed here is:

For, EL 14 → BH 16

Now, for PW 22 → MS 24

Now, applying the same logic for NU 27:

So, NU 27 → KR 29

Hence, the correct answer is "Option 3".

**Q67. Answer: (c) BDQ**

The logic followed here is:

So, 'BDQ' will replace the question mark in the given series.

Hence, the correct answer is "Option 3".

**Q68. Answer: (c) 31 km to the north**

Given:

Hemant drives 62 km East.

He turns left → 40 km North.

He turns left → 78 km West.

He turns left → 71 km South.

He turns left → 16 km East and reaches point P.

Therefore, to reach Point A again, Hemant must travel 31 km towards the North.

Hence, the correct answer is "Option 3".

**Q69. Answer: (c) Both conclusions (I) and (II) follow**

Given Statements:

All hats are trousers.

All trousers are pants.

No pant is a coat.

The least possible Venn diagram for the given statements is:

Conclusions:

I. No hat is a coat – Follows (All hats are trousers, all trousers are pants, and no pant is a coat. Therefore, no hat can be a coat.)

II. No trouser is a coat – Follows (All trousers are pants, and no pant is a coat. Therefore, no trouser can be a coat.)

So, both conclusions I and II follow.

Hence, the correct answer is "Option 3".

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**Q70. Answer: (a) 4**

Given: (Left) 5 3 $ 8 % © 1 % 8 * 5 5 4 # £ & 5 5 £ € 5 € (Right)

Now,

Numbers, which are immediately preceded by a symbol and also immediately followed by a symbol.

So, Needed pattern is: Symbol - Number - Symbol

(Left) 5 3 $ 8 % © 1 % 8 * 5 5 4 # £ & 5 5 £ € 5 € (Right)

So, Only four numbers satisfy the condition.

Hence, the correct answer is Option 1.

**Q71. Answer: (b) XY−AE**

The logic followed here is based on the alphabetical position pattern:

Option 1: NO−RS

Option 2: XY−AE

Option 3: JK−NO

Option 4: AB−EF

Thus, XY−AE does not follow the pattern.

Hence, the odd one out is Option 2.

**Q72. Answer: (a) 58**

The logic followed here is:

thus, "58" will replace the question mark in the given series.

Hence, the correct option is "Option 1

**Q73. Answer: (c) (89, 178, 167)**

The logic followed here is:

Logic:

=> First Number × 2 = Second Number

=> Second Number − 11 = Third Number

For, (28, 56, 45)

=> 28 × 2 = 56

=> 56 − 11 = 45

For, (41, 82, 71)

=> 41 × 2 = 82

=> 82 − 11 = 71

Now, checking the options using the same pattern:

Option 1) (54, 108, 99)

=> 54 × 2 = 108

=> 108 − 11 = 97 ≠ 99

Option 2) (97, 194, 182)

=> 97 × 2 = 194

=> 194 − 11 = 183 ≠ 182

Option 3) (89, 178, 167)

=> 89 × 2 = 178

=> 178 − 11 = 167

Option 4) (77, 154, 142)

=> 77 × 2 = 154

=> 154 − 11 = 143 ≠ 142

Hence, the correct answer is Option 3.

**Q74. Answer: (d) 20th**

Given:

Pari is 13th from the right end

Vivek is 16 places to the left of Pari

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Total number of people = 48

Vivek's position from right = Pari's position from right + 16

= 13 + 16

= 29th from the right

Position from left = (Total − Position from right) + 1

= (48 − 29) + 1

= 19 + 1

= 20th

Therefore, Vivek's position from the left end is 20th.

Hence, the correct answer is Option 4.

**Q75. Answer: (c) 56**

BODMAS Table:

Given equation: 7 B 4 D 18 A 9 C 16 C 14 = ?

Now, replacing the symbols as:

| Symbol | A | B | C | D |
|---|---|---|---|---|
| Replaced by | ÷ | × | • | − |

=> 7 × 4 − 18 ÷ 9 + 16 + 14 = ?

=> 28 − 18 ÷ 9 + 16 + 14 = ?

=> 28 − 2 + 16 + 14 = ?

=> 26 + 16 + 14 = ?

=> 42 + 14 = ?

=> 56

Hence, the correct answer is Option 3.

**Q76. Answer: (d) KLNK**

The logic followed here is:

For, MNPM → NOQN

Now, for UVXU → VWYV

Now, applying the same logic for JKMJ:

So, JKMJ → KLNK

Hence, the correct answer is "Option 4".

**Q77. Answer: (a) 2**

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

Now,

We need to find odd numbers which are immediately preceded by an odd number and also immediately followed by an even number.

So, needed pattern is: Odd - Odd - Even

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

So, total valid occurrences = 2

Hence, the correct answer is Option 1.

**Q78. Answer: (d) 4**

BODMAS Table:

Given equation: 42 × 6 − 12 + 3 ÷ 5 = ?

Now, replacing the symbols as:

| Symbol | • | − | × | ÷ |
|---|---|---|---|---|
| Replaced by | − | • | ÷ | × |

=> 42 ÷ 6 + 12 − 3 × 5 = ?

=> 7 + 12 − 3 × 5 = ?

=> 7 + 12 − 15 = ?

=> 19 − 15 = ?

=> 4

Hence, the correct answer is Option 4.

**Q79. Answer: (d) North-west**

Given:

Town D is to the West of Town A.

Town C is to the South of Town A.

Town E is to the West of Town D.

Town B is to the North of Town E.

So, relative to C, B is towards North-West.

Hence, the correct answer is "Option 4".

**Q80. Answer: (b) 83**

Given: Z's position in the class is

Rank from Top = 63

Rank from Bottom = 21

Now, Sum = 63 + 21 = 84

Total number of students = (Rank from Top + Rank from Bottom) − 1

= 84 − 1

= 83

Therefore, the total number of students in the class is 83.

Hence, the correct answer is Option 2.

**Q81. Answer: (c) Uttar Pradesh**

The correct answer is Uttar Pradesh.

Key Points

• The National Commission for Women (NCW) released its annual statistical report in January 2025, highlighting that Uttar Pradesh continues to record the highest number of complaints regarding crimes against women, including domestic violence.

• According to the data for the year 2024, the NCW received a total of 24,535 complaints from across the country, out of which Uttar Pradesh alone accounted for nearly 50.6% of the total grievances.

• Of the total complaints originating from Uttar Pradesh, a significant volume (approximately 12,410 cases) was related to the "Right to Dignity" and domestic violence, maintaining the state's position at the top of the list for the consecutive year.

• Following Uttar Pradesh, the National Capital Territory of Delhi recorded the second-highest number of complaints with 2,330, while Maharashtra stood third with 1,326 complaints registered in 2024.

• The data indicates that the "Right to Dignity" category, which includes harassment other than domestic violence, saw the highest number of overall filings, followed closely by specific complaints of domestic abuse and dowry harassment. Hence, the correct answer is Uttar Pradesh.

Additional Information

• National Commission for Women (NCW):

• The NCW is a statutory body of the Government of India, established on 31 January 1992.

• It was formed under the National Commission for Women Act, 1990, with the mandate to review constitutional and legal safeguards for women and recommend remedial legislative measures.

• The NCW consists of a Chairperson, five members, and a Member-Secretary, all nominated by the Central Government.

• As of January 2025, the Chairperson of the commission is Vijaya Rahatkar, who took charge in October 2024, succeeding Rekha Sharma.

• Legislative Framework for Protection:

• The Protection of Women from Domestic Violence Act, 2005 (PWDVA) is a key civil law that provides protection and support to women facing abuse within a domestic relationship.

• Criminal provisions such as Section 498A of the Indian Penal Code (IPC) (now integrated into the Bharatiya Nyaya Sanhita) deal specifically with cruelty by the husband or his relatives.

• The NCW facilitates the registration of these complaints and monitors the action taken by the respective state police departments.

Important Points

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• Reporting Mechanisms:

• The NCW launched a 24/7 Helpline Number (7827170170) to provide online support to women in distress, which has seen a surge in usage in states like Uttar Pradesh and Delhi.

• The high volume of complaints in Uttar Pradesh is often attributed to the state's massive population (approx 240 million) and intensified awareness campaigns like "Mission Shakti" launched by the state government.

• Nature of Complaints in 2024:

• Nationwide, 8,115 complaints were classified under "Right to Dignity", while 6,150 were specifically related to domestic violence.

• Complaints regarding molestation stood at 1,820, and cases of rape or attempt to rape accounted for 1,200 filings in the 2024 calendar year.

• The NCW also possesses suo motu powers to take cognizance of incidents reported in the media and initiate independent investigations.

**Q82. Answer: (a) International Cricket Council**

The correct answer is International Cricket Council.

Key Points

• The International Cricket Council (ICC) constituted a dedicated task force in November 2021 to review the status of cricket in Afghanistan and the Afghanistan Cricket Board (ACB) following the Taliban takeover.

• The primary objective of this task force was to monitor the situation on the ground and support the continued development of the game, with a specific focus on the future of female Afghan athletes and the women's national cricket team.

• The task force was led by Imran Khwaja (the ICC Deputy Chairman) and included prominent members such as Ross McCollum, Ramiz Raja, and Lawson Naidoo.

• The ICC mandates that all Full Members must have a functional women's cricket program; the task force was designed to engage with the ACB to ensure these requirements are met despite the political shifts.

• This initiative was a response to the humanitarian crisis and the subsequent displacement of many players, aiming to provide a pathway for displaced female cricketers to continue their professional journeys.

Additional Information

• International Cricket Council (ICC):

• The ICC is the global governing body for cricket, originally founded as the Imperial Cricket Conference in 1909.

• It is headquartered in Dubai, United Arab Emirates, having moved its base from London in 2005.

• The ICC currently has 108 member nations, comprising 12 Full Members and 96 Associate Members.

• Cricket in Afghanistan:

• The Afghanistan Cricket Board (ACB) became a Full Member of the ICC in June 2017, alongside Ireland, allowing the nation to play Test cricket.

• Despite the rapid growth of the men's team, women's cricket has faced severe restrictions since August 2021, leading many players to seek refuge in countries like Australia.

• Role of Other Global Bodies:

• The International Olympic Committee (IOC) and FIFA (football) have also been active in evacuating and supporting displaced Afghan athletes through Olympic Solidarity funds and special visas.

• However, the ICC's task force is unique in its administrative focus on maintaining the Full Member status of a country while demanding progress on gender inclusivity.

• ICC Governance:

• The current Chairman of the ICC is Greg Barclay, and the CEO is Geoff Allardice.

• The organization is responsible for major global events like the ICC Men's and Women's Cricket World Cups and the World Test Championship.

**Q83. Answer: (d) Narendra Modi**

The correct answer is Narendra Modi.

Key Points

• The 9th edition of the India Mobile Congress (IMC) 2025 is scheduled to be inaugurated by Prime Minister Narendra Modi in New Delhi.

• Recognized as Asia's largest telecom, media, and technology forum, the IMC serves as a premier platform for showcasing the latest innovations in the digital landscape.

• The event is expected to focus on the evolution of 6G technology, the expansion of 5G use cases, and the integration of Artificial Intelligence (AI) across various sectors.

• It is traditionally organized at iconic venues in the capital, such as Bharat Mandapam or Pragati Maidan, attracting global tech leaders, startups, and policymakers.

• The inauguration by Narendra Modi underscores the government's commitment to the Digital India vision and making the country a global hub for telecom manufacturing and technology exports.

Additional Information

• India Mobile Congress (IMC):

• Launched in 2017, IMC has grown to become the largest technology event in South Asia, co-hosted by the Department of Telecommunications (DoT) and the Cellular Operators Association of India (COAI).

• The forum facilitates discussions on Cybersecurity, Semiconductors, Green Technology, and Quantum Computing.

• The 8th edition of the event, held in October 2024, saw the Prime Minister highlight India's record-breaking 5G rollout and the goal of leading the global 6G standard-setting process.

• Organizational Roles:

• The Department of Telecommunications (DoT), under the Ministry of Communications, provides the regulatory framework and policy support for the event.

• The Cellular Operators Association of India (COAI) represents major industry players like Reliance Jio, Bharti Airtel, and Vodafone Idea.

Important Points

• Global Participation: The IMC typically hosts over 400 exhibitors and 2,500 delegates from more than 60 countries, making it a significant event for international diplomatic and commercial collaborations.

• Innovation Hub: The event features the "Aspire" program, which is a dedicated startup initiative aimed at fostering entrepreneurship in the deep-tech and telecom sectors.

• Technological Milestones: Under the leadership of Narendra Modi, India has successfully launched 5G services in over 400,000 sites across the country in a remarkably short span, a feat often showcased during these congresses.

• Venue Significance: Bharat Mandapam, where recent editions have been held, was the venue for the G20 Summit in 2023, reflecting the world-class infrastructure provided for IMC.

**Q84. Answer: (b) Kirtida Brahmbhatt**

The correct answer is Kirtida Brahmbhatt.

Key Points

• Kirtida Brahmbhatt, a noted Gujarati author and poet, was selected for the prestigious Sahitya Akademi Bal Sahitya Puraskar.

• The award was conferred for her outstanding poetry collection titled Tinchak, which is specifically written for children.

• The announcement of the winners for the Bal Sahitya Puraskar usually occurs in June, as part of the Sahitya Akademi's annual recognition of excellence in children's literature.

• For the Gujarati language category, the selection was made based on the recommendations of a three-member jury that evaluates the literary merit and creative contribution of works published in the preceding years.

• This recognition highlights Kirtida Brahmbhatt's significant role in enriching Gujarati children's literature and fostering a love for poetry among young readers.

Additional Information

• Sahitya Akademi Bal Sahitya Puraskar:

• This award was instituted in the year 2010 to promote and recognize high-quality literature written for children.

• It covers 24 Indian languages, including those listed in the Eighth Schedule of the Indian Constitution, as well as English and Rajasthani.

• The award consists of a copper plaque and a cash prize of Rs. 50,000.

• Other Notable Recipients (2024 Context):

• Nandini Purandare: Won the award in the English category for her biography titled 'Mountain Fairies: The Inspiring Life of Tenzing Norgay'.

• Akhil P Dharmajan: Recognized in the Malayalam category for his novel 'Ramante Kayyum Thozuthu Pookkalum'.

• Parvati Tirkey: While mentioned in literary awards circles, she is the recipient of the Sahitya Akademi Yuva Puraskar for Santali poetry, rather than the Bal Sahitya Puraskar.

• Sahitya Akademi:

• Founded on 12 March 1954, it is India's National Academy of Letters.

• It functions as an autonomous organization under the Ministry of Culture, Government of India, to promote literary dialogue and publication across various regional languages.

Important Points

• The Bal Sahitya Puraskar is one of the twin honors announced mid-year, the other being the Yuva Puraskar, which is awarded to young authors under the age of 35.

• The selection criteria for the Bal Sahitya Puraskar require that the author must be an Indian national and the work must be an

original contribution to the genre of children's books.

• The Sahitya Akademi also publishes translated versions of award-winning books to ensure that children across India can enjoy the diverse literary heritage of different states.

**Q85. Answer: (a) Anil Bhardwaj**

The correct answer is Anil Bhardwaj.

Key Points

• In July 2024, prominent Indian planetary scientist Anil Bhardwaj was honored with the Vikram Sarabhai Medal.

• The award was presented during the 45th Scientific Assembly of the Committee on Space Research (COSPAR) held in Busan, South Korea.

• The Vikram Sarabhai Medal is a prestigious international recognition jointly established by COSPAR and the Indian Space Research Organisation (ISRO).

• It is awarded to scientists who have made outstanding contributions to space research in developing countries, specifically promoting the legacy of Dr. Vikram Sarabhai.

• Anil Bhardwaj is currently the Director of the Physical Research Laboratory (PRL) in Ahmedabad, an institution founded by Sarabhai himself.

• His selection for this medal underscores India's growing influence and excellence in planetary sciences and space exploration on the global stage.

Additional Information

• Anil Bhardwaj's Contributions:

• He has played a pivotal role in several Indian space missions, including Chandrayaan-1, Mangalyaan (Mars Orbiter Mission), Chandrayaan-2, and Aditya-L1.

• His research primarily focuses on planetary atmospheres, ionospheres, and the interaction of solar wind with planetary bodies and comets.

• He is a recipient of numerous awards, including the Shanti Swarup Bhatnagar Prize in 2007 and the Infosys Prize in 2016.

• Committee on Space Research (COSPAR):

• Established in 1958 by the International Council of Scientific Unions (ICSU), it aims to promote scientific research in space at an international level.

• COSPAR provides a forum for scientists to discuss results and coordinate space research efforts across the globe.

• Vikram Sarabhai (1919–1971):

• He is widely recognized as the Father of the Indian Space Programme and was instrumental in the establishment of ISRO in 1969.

• Apart from PRL, he founded several other institutions like the Indian Institute of Management (IIM) Ahmedabad.

• Physical Research Laboratory (PRL):

• Known as the "cradle of space sciences" in India, PRL was founded in 1947.

• It functions under the Department of Space, Government of India, and conducts fundamental research in astronomy, astrophysics, solar physics, and planetary sciences.

Important Points

• The Vikram Sarabhai Medal is awarded biennially (every two years) to encourage scientific excellence in developing nations.

• The 45th COSPAR Scientific Assembly in Busan (July 13-21, 2024) saw the participation of thousands of scientists, where India’s progress in lunar and solar missions was a major highlight.

• Other notable Indian space scientists who have received international recognition recently include S. Somanath (ISRO Chairman), who has led the successful Chandrayaan-3 and Aditya-L1 missions.

• The award serves as a bridge between the global scientific community and emerging space-faring nations.

**Q86. Answer: (d) US$1.3 trillion**

The correct answer is US$1.3 trillion.

Key Points

• The Baku–Belem Roadmap was established to ensure a seamless transition and continuity between the COP29 presidency in Azerbaijan and the COP30 presidency in Brazil.

• A primary objective of this roadmap is to finalize and scale the New Collective Quantified Goal (NCQG), which is the successor to the previous US$100 billion annual climate finance target.

• At the conclusion of the negotiations leading toward COP30 in November 2025, the global community aimed to set a target for climate finance to reach an annual level of US$1.3 trillion by the year 2035.

• This US$1.3 trillion figure represents the total "global goal" for climate finance intended for developing nations to support their

mitigation and adaptation efforts. Hence, the target of US$1.3 trillion is the correct annual level.

• The roadmap emphasizes the "Mission 1.5°C" initiative, which focuses on keeping the global temperature rise within the limits set by the Paris Agreement through enhanced Nationally Determined Contributions (NDCs).

Additional Information

• The COP Presidencies Troika:

• The Troika is a collaborative partnership consisting of three consecutive presidencies: COP28 (UAE), COP29 (Azerbaijan), and COP30 (Brazil).

• Its purpose is to maintain momentum in international climate negotiations and provide a clear pathway toward the Belem summit in 2025.

• Structure of the Finance Goal:

• While the overarching goal is US$1.3 trillion annually by 2035, a specific "core" mobilization goal of US$300 billion per year was designated for developed countries to lead by 2035.

• This includes funds from public, private, bilateral, and multilateral sources, including Multilateral Development Banks (MDBs).

• Significance of COP30:

• COP30, scheduled for November 2025 in Belem, Brazil, is considered a landmark event as it marks the 10th anniversary of the Paris Agreement.

• It is the deadline for countries to submit their updated and more ambitious NDCs for the 2030-2035 period.

Important Points

• Climate Justice and Equity: Many developing nations and groups like the G77 + China argued that the US$1.3 trillion should primarily come from public grants rather than loans to avoid increasing the debt burden on vulnerable economies.

• Historical Context: The US$100 billion goal was originally set at COP15 in Copenhagen in 2009, but developed nations faced criticism for delays in meeting this target, which was finally achieved only in 2022.

• NCQG Purpose: The New Collective Quantified Goal is designed to reflect the evolving financial needs of Global South countries to combat climate change impacts like sea-level rise, extreme weather, and biodiversity loss.

**Q87. Answer: (a) Cyclone Ditwah**

p>The correct answer is Cyclone Ditwah.

Key Points

• Cyclone Ditwah is identified as the cyclonic storm that occurred in November 2025, leading to intense precipitation and severe flooding across South India and Sri Lanka.

• The storm originated in the Bay of Bengal as a low-pressure system and rapidly intensified into a Very Severe Cyclonic Storm with wind speeds ranging between 120 and 150 km/h.

• It made landfall near the coastal regions of Tamil Nadu and the northern provinces of Sri Lanka, causing significant damage to infrastructure, power grids, and agricultural land.

• The National Disaster Response Force (NDRF) in India and the Disaster Management Centre (DMC) in Sri Lanka spearheaded the disaster relief efforts, evacuating over 200,000 people to relief camps.

• Urban areas such as Chennai and Colombo experienced unprecedented waterlogging, which prompted the suspension of railway and aviation services for several days.

Additional Information

• Cyclone Tauktae:

• This was a powerful Extremely Severe Cyclonic Storm that developed in the Arabian Sea in May 2021.

• It primarily affected the Western coast of India, including the states of Gujarat, Maharashtra, Goa, and Karnataka.

• It was the strongest cyclone to strike Gujarat since the 1998 Kandla cyclone, leading to substantial industrial disruptions.

• Cyclone Amphan:

• Occurring in May 2020, Amphan was the first Super Cyclonic Storm to form in the Bay of Bengal since 1999.

• It caused catastrophic destruction in West Bengal and Bangladesh, with damages estimated at over $13 billion USD.

• The storm was characterized by a massive storm surge that inundated the Sundarbans delta.

• Cyclone Yaas:

• This Very Severe Cyclonic Storm formed in the Bay of Bengal in May 2021, shortly after Tauktae.

• It made landfall in the Balasore district of Odisha, causing widespread damage to kucha houses and saline water flooding in coastal villages.

• The storm's impact was felt as far as West Bengal and Jharkhand.

Important Points

• Naming of Cyclones: Tropical cyclones in the North Indian Ocean are named by the WMO/ESCAP Panel on Tropical Cyclones, which consists of 13 member countries including India, Sri Lanka, and Thailand.

• Role of IMD: The India Meteorological Department (IMD) serves as the Regional Specialized Meteorological Centre (RSMC) for providing tropical cyclone advisories to the region.

• Classification: Cyclones are categorized based on their Maximum Sustained Surface Wind Speed (MSW). A "Severe Cyclonic Storm" typically features wind speeds of 89–117 km/h (48–63 knots).

• Mitigation Tools: Modern technologies such as Doppler Weather Radars (DWR) and Ocean-buoys help in the early detection and tracking of these systems to minimize the loss of human life and livestock.

**Q88. Answer: (c) Shooting**

The correct answer is Shooting.

Key Points

• Manu Bhaker is a renowned Indian sport shooter who has represented the country in various international platforms, specializing in the 10m Air Pistol and 25m Pistol events.

• She achieved monumental success at the 2024 Paris Olympics, where she won two bronze medals. This feat made her the first Indian athlete since Independence to win two medals in a single edition of the Olympic Games.

• One of her medals was won in the Women's 10m Air Pistol event, and the second was a Mixed Team 10m Air Pistol bronze, which she won alongside partner Sarabjot Singh.

• In recognition of her extraordinary contribution to Indian sports and her historic performance at the Olympics, she was conferred with the Major Dhyan Chand Khel Ratna Award in 2025.

• Hailing from Goria village in the Jhajjar district of Haryana, she started her shooting career at a very young age and quickly rose to prominence by winning gold at the 2018 Commonwealth Games at just 16 years old.

• Hence, the correct answer is Shooting.

Additional Information

• Major Dhyan Chand Khel Ratna Award:

• This is the highest sporting honor in India, awarded annually by the Ministry of Youth Affairs and Sports.

• The award was formerly known as the Rajiv Gandhi Khel Ratna Award but was renamed in August 2021 in honor of the legendary hockey player Major Dhyan Chand.

• The first recipient of this prestigious award was the Chess Grandmaster Viswanathan Anand in the year 1991-92.

• Other Sports mentioned in the options:

• Badminton: India has a strong presence in this sport with athletes like P.V. Sindhu, who is a two-time Olympic medalist, and Saina Nehwal.

• Hockey: Often regarded as India's national game in spirit, the Indian Men’s Hockey Team has won multiple Olympic medals, including a bronze at both Tokyo 2020 and Paris 2024.

• Para-Athletics: This refers to sports for athletes with disabilities. India has seen a surge in performance here, with stars like Sumit Antil (Javelin Throw) winning gold medals at the Paralympic Games.

Important Points

• Early Achievements: Manu Bhaker became the youngest Indian to win a gold medal at the ISSF World Cup in 2018, held in Guadalajara, Mexico.

• Arjuna Award: Before receiving the Khel Ratna, she was honored with the Arjuna Award in 2020 for her consistent performance in international shooting competitions.

• Olympic History: Prior to Paris 2024, India’s shooting medals at the Olympics were won by Abhinav Bindra (Gold, 2008), Rajyavardhan Singh Rathore (Silver, 2004), Vijay Kumar (Silver, 2012), and Gagan Narang (Bronze, 2012). Manu Bhaker ended a 12-year medal drought for Indian shooting in 2024.

• Academic Background: Apart from her sporting career, she pursued a degree in Political Science from Lady Shri Ram College, Delhi University, balancing rigorous training with education.

**Q89. Answer: (c) 5.6%**

The correct answer is 5.6%.

Key Points

• The Ministry of Statistics and Programme Implementation (MOSPI) released the findings of the Periodic Labour Force Survey (PLFS) for the quarter ending May 2025.

• According to the official data, India’s overall unemployment rate was reported at 5.6%. This figure represents the percentage of the labor force that is unemployed and actively seeking employment.

• The PLFS is a primary source of high-frequency labor market data in India, helping policymakers understand the dynamics of employment across urban and rural sectors.

• The survey focuses on key indicators such as the Labour Force Participation Rate (LFPR) and the Worker Population Ratio (WPR) to provide a holistic view of the economy.

• For the period of May 2025, the data highlights the stabilization of the job market compared to previous fiscal quarters, reflecting the impact of various economic policies and industrial growth.

Additional Information

• Periodic Labour Force Survey (PLFS):

• Launched in April 2017 by the National Sample Survey Office (NSSO), the PLFS was designed to provide more frequent labor force statistics.

• It has two main objectives: to estimate key employment indicators in the Current Weekly Status (CWS) every three months for urban areas, and to provide annual estimates in both Usual Status and CWS for both rural and urban areas.

• Key Terminology:

• Unemployment Rate (UR): It is defined as the percentage of persons unemployed among the persons in the labour force.

• Labour Force Participation Rate (LFPR): This is defined as the percentage of persons in the labour force (i.e., working or seeking or available for work) in the total population.

• Worker Population Ratio (WPR): This is defined as the percentage of employed persons in the total population.

• Role of MOSPI:

• The Ministry of Statistics and Programme Implementation is the nodal agency for the planned and organized development of the statistical system in India.

• It consists of two wings: the Statistics Wing (consisting of the NSO) and the Programme Implementation Wing.

Important Points

• Survey Methodology: The PLFS utilizes a rotational panel sampling design in urban areas to measure short-term changes in the labor market every quarter.

• Activity Status: The survey classifies individuals based on their activity during a specific reference period. Usual Status considers a reference period of 365 days, while Current Weekly Status (CWS) considers a reference period of the last 7 days.

• Age Criteria: While the PLFS collects data for all ages, the key indicators for policy analysis are typically highlighted for the age group of 15 years and above.

• Data Utility: The reported 5.6% unemployment rate is used by the Government of India and international organizations like the ILO to monitor Sustainable Development Goals (SDG) related to decent work and economic growth.

**Q90. Answer: (c) 27th February**

The correct answer is 27th February.

Key Points

• The 94th martyrdom day of the legendary Indian revolutionary Chandra Shekhar Azad was observed across India on 27th February 2025.

• Born as Chandra Shekhar Tiwari on July 23, 1906, in the Bhabhra village of Alirajpur district in Madhya Pradesh, he was a key figure in the Indian independence movement.

• Azad attained martyrdom on February 27, 1931, at Alfred Park in Allahabad (now officially known as Prayagraj), after a fierce gunfight with the British Police.

• He was a prominent leader and the chief strategist of the Hindustan Socialist Republican Association (HSRA), which aimed to establish a socialist republic in India through armed revolution.

• Azad was famously involved in revolutionary acts such as the Kakori Train Action in 1925 and the killing of J.P. Saunders in 1928 to avenge the death of Lala Lajpat Rai. Hence, the correct option is 27th February.

Additional Information

• The Origin of 'Azad': At the young age of 15, he participated in the Non-Cooperation Movement launched by Mahatma Gandhi in 1921. When arrested and presented before a magistrate, he declared his name as 'Azad' (The Free), his father's name as 'Swatantrata' (Independence), and his residence as 'Jail'. This defiant act earned him the moniker Chandra Shekhar Azad.

• Evolution of HSRA: Initially, the organization was known as the Hindustan Republican Association (HRA), founded by Sachindra Nath Sanyal in 1924. After the arrest of several leaders during the Kakori case, Azad reorganized it with Bhagat Singh in September 1928 at Feroz Shah Kotla in Delhi, renaming it the Hindustan Socialist Republican Association (HSRA).

• Mentorship: Azad served as a mentor and idol for younger revolutionaries like Bhagat Singh, Rajguru, and Sukhdev. His organizational skills and ability to evade the British intelligence for years made him a symbol of resistance.

• The Final Encounter: On the fateful day of February 27, 1931, Azad was betrayed by an informant while meeting a comrade. Surrounded by police led by John Nott-Bower, he fought until his last bullet, which he used to shoot himself, staying true to his pledge of never being captured alive by the British Raj.

Important Points

• Commemoration: To honor his ultimate sacrifice, Alfred Park was renamed Chandra Shekhar Azad Park after Independence. It remains a major site of pilgrimage for nationalists in Prayagraj.

• Bhabhra Renaming: In tribute to his roots, the Government of Madhya Pradesh renamed his birthplace, Bhabhra, to Azad Nagar

in 2010.

• Legacy in Modern India: His life and revolutionary philosophy continue to be a subject of numerous films, books, and educational curricula, inspiring generations with the spirit of Self-Rule and Socialism.

• Other Options: 27th January and 26th February do not hold specific historical significance regarding Azad's martyrdom, while 15th August is celebrated as India's Independence Day.

**Q91. Answer: (c) Rs. 1,000 crore**

The correct answer is Rs. 1,000 crore.

Key Points

• The Government of India has significantly increased the budget for its flagship sports initiative, allocating Rs. 1,000 crore for the Khelo India programme for the financial year 2025-26. This reflects a continued commitment to fostering a sports culture at the grassroots level.

• The allocation is part of the broader Union Budget outlay for the Ministry of Youth Affairs and Sports, which aims to improve sports infrastructure and talent identification across the country.

• The funding for FY 2025-26 is intended to support the various verticals of the scheme, including the Khelo India Youth Games, University Games, and the Winter Games.

• This financial support is crucial for the National Programme for Development of Sports, ensuring that young athletes receive the necessary training, equipment, and exposure to international standards. Hence, the correct answer is Rs. 1,000 crore.

Additional Information

• Origin and Vision:

• The Khelo India Programme was introduced in 2017-18 by the Ministry of Youth Affairs and Sports. It was formed by merging three existing schemes: Rajiv Gandhi Khel Abhiyan (RGKA), Urban Sports Infrastructure Scheme (USIS), and the National Sports Talent Search Scheme (NSTSS).

• The primary objective is to revive the sports culture in India by engaging with children at a young age and providing a platform for excellence.

• Scholarship Support:

• Under the Talent Identification and Development vertical, selected athletes are provided an annual financial assistance of Rs. 5 lakh per annum for 8 consecutive years.

• This scholarship helps cover the costs of training, nutrition, and participation in national and international tournaments for over 2,800 athletes currently supported under the scheme.

• Administrative Body:

• The Sports Authority of India (SAI) is the nodal agency responsible for the implementation and monitoring of the Khelo India scheme across various states and Union Territories.

• The program focuses on 12 specific verticals, including State Level Khelo India Centres, Annual Sports Competitions, and Sports for Peace and Development.

Important Points

• Impact on Infrastructure:

• The allocation of Rs. 1,000 crore assists in the creation and up-gradation of community coaching and playfield development, especially in rural and tribal areas.

• In 2024, the government emphasized the Khelo India Rising Talent Identification (KIRTI) program, which aims to conduct 20 lakh assessments to identify talent among school-going children between the ages of 9 to 18 years.

• Inclusivity in Sports:

• The scheme includes a dedicated vertical for Promotion of Sports among persons with disabilities and Sports for Women to ensure balanced participation across all demographics in India.

• The Khelo India Winter Games held in locations like Gulmarg and Leh serve to promote winter sports and tourism in the Himalayan region.

**Q92. Answer: (a) Alwar District**

The correct answer is Alwar District.

Key Points

• The state of Rajasthan achieved a new milestone in environmental conservation with the inauguration of its first Namo Biodiversity Park in October 2025.

• This prestigious project is located in the Alwar District, a region known for its rich ecological heritage and proximity to the Aravalli Range.

• The park has been developed to serve as a natural habitat for various indigenous species of flora and fauna, ensuring the preservation of the local ecosystem.

• The Namo Biodiversity Park is designed to promote eco-tourism and provide a dedicated space for environmental research and nature education for students and researchers.

• The establishment of this park in Alwar highlights the Government of Rajasthan's commitment to increasing green cover and mitigating the effects of climate change in the semi-arid regions of the state.

Additional Information

• Alwar District:

• Alwar is often referred to as the Gateway to Rajasthan and is a significant part of the National Capital Region (NCR).

• It is home to the famous Sariska Tiger Reserve, which was the first reserve in the world to successfully relocate tigers.

• The district features diverse topography, including the Aravalli Hills, which play a crucial role in preventing the expansion of the Thar Desert.

• Biodiversity Parks in India:

• A Biodiversity Park is a unique landscape of community-based ecosystems that helps in the restoration of degraded land and provides ecosystem services such as carbon sequestration and groundwater recharge.

• These parks act as lungs for urban and semi-urban areas, significantly improving air quality and providing a refuge for migratory birds and pollinators.

• Other Ecological Initiatives in Rajasthan:

• Jaipur: Known for the Kishan Bagh Sand Dune Park and the Jhalana Leopard Reserve, which are key sites for ecological restoration.

• Udaipur: Famous for its Sajjangarh Biological Park and numerous lakes that support diverse aquatic biodiversity.

• Kota: Home to the Mukundra Hills Tiger Reserve and various riverine ecosystems along the Chambal River.

Important Points

• The Namo Biodiversity Park project aligns with the National Biodiversity Action Plan and the United Nations Sustainable Development Goals (SDGs), specifically Goal 15 (Life on Land).

• Key features of the park include herbal gardens, butterfly zones, and walking trails designed to minimize human impact on the core conservation zones.

• The October 2025 inauguration marks a strategic move to utilize the post-monsoon season, which is the most favorable time for the growth of new plantations and the arrival of winter migratory birds in the Alwar region.

• Local Panchayati Raj Institutions and the State Forest Department are the primary bodies responsible for the long-term maintenance and protection of this biodiversity hotspot.

**Q93. Answer: (a) Small Industrial Development Bank of India (SIDBI)**

The correct answer is Small Industrial Development Bank of India (SIDBI).

Key Points

• The Small Industrial Development Bank of India (SIDBI) is the principal financial institution in India for the promotion, financing, and development of the Micro, Small, and Medium Enterprises (MSME) sector.

• According to the Department of Financial Services (DFS) Annual Report 2024-25, published in March 2025, SIDBI continues to serve as the apex body for coordinating the functions of institutions engaged in similar activities.

• SIDBI was established on April 2, 1990, under an Act of the Indian Parliament. It originally operated as a wholly-owned subsidiary of the Industrial Development Bank of India (IDBI), but is currently an independent All-India Financial Institution (AIFI).

• The headquarters of SIDBI is located in Lucknow, Uttar Pradesh. Its primary objective is to facilitate and strengthen credit flow to MSMEs and address both financial and developmental gaps in the MSME ecosystem.

• It serves as the nodal agency for several government schemes, including the Credit Linked Capital Subsidy Scheme (CLCSS) and the PM Vishwakarma scheme, ensuring financial inclusion for small-scale entrepreneurs. Hence, the correct answer is Small Industrial Development Bank of India (SIDBI).

Additional Information

• Export-Import Bank of India (Exim Bank):

• Established in 1982 under the Export-Import Bank of India Act, 1981, it is headquartered in Mumbai.

• Its primary function is to provide financial assistance to exporters and importers and function as the principal financial institution for coordinating the working of institutions engaged in financing export and import of goods and services.

• National Bank for Agriculture and Rural Development (NABARD):

• Established on July 12, 1982, based on the recommendations of the B. Sivaraman Committee.

• Headquartered in Mumbai, it is the apex regulatory body for the overall regulation and licensing of regional rural banks and apex cooperative banks in India. It focuses on rural prosperity and agricultural credit.

• National Bank for Financing Infrastructure and Development (NaBFID):

• Set up in 2021 under the NaBFID Act, 2021, it is the newest All-India Financial Institution.

• It is headquartered in Mumbai and functions as a specialized Development Financial Institution (DFI) for long-term infrastructure financing in India, supporting projects in sectors like energy, transport, and water.

• MSME Classification (Revised 2020):

• Micro: Investment up to Rs. 1 crore and Turnover up to Rs. 5 crore.

• Small: Investment up to Rs. 10 crore and Turnover up to Rs. 50 crore.

• Medium: Investment up to Rs. 50 crore and Turnover up to Rs. 250 crore.

Important Points

• Regulatory Framework: There are currently five All-India Financial Institutions (AIFIs) regulated and supervised by the Reserve Bank of India (RBI): SIDBI, NABARD, EXIM Bank, NHB (National Housing Bank), and NaBFID.

• MUDRA Bank: The Micro Units Development and Refinance Agency (MUDRA) is a subsidiary of SIDBI, launched in 2015 to provide loans up to 10 lakh to non-corporate, non-farm small/micro-enterprises.

• Udyam Registration: It is the official portal launched by the Ministry of MSME for the registration of MSMEs, which SIDBI uses to identify and provide credit assistance to valid enterprises.

**Q94. Answer: (a) Vice Chairman, NITI Aayog**

The correct answer is Vice Chairman, NITI Aayog.

Key Points

• The Vice Chairman of NITI Aayog is the designated authority to present India's Voluntary National Review (VNR) report at the international level. This report is a formal document that tracks the progress made by the country toward achieving the Sustainable Development Goals (SDGs).

• In July 2025, the Third VNR report was presented at the United Nations High-Level Political Forum (HLPF) on Sustainable Development in New York. This forum is the primary global platform for reviewing the 2030 Agenda for Sustainable Development.

• The report outlines India's journey in localized implementation of the 17 SDGs, emphasizing the philosophy of "Viksit Bharat" (Developed India) and the principle of "Antyodaya" (leaving no one behind).

• The VNR serves as a platform for India to share its best practices, such as the Digital Public Infrastructure (DPI), clean energy transitions, and large-scale social welfare schemes, with the global community.

• The preparation of the report is led by NITI Aayog, involving extensive consultations with State Governments, Union Territories, Civil Society Organizations (CSOs), and the private sector. Hence, the correct answer is Vice Chairman, NITI Aayog.

Additional Information

• NITI Aayog (National Institution for Transforming India):

• Established on January 1, 2015, it replaced the erstwhile Planning Commission. It acts as the premier policy think tank of the Government of India.

• The Prime Minister of India serves as the Ex-officio Chairperson, while the Vice Chairman is the administrative head appointed by the Prime Minister. As of current tenures, Shri Suman Bery serves as the Vice Chairman.

• Evolution of VNRs in India:

• India presented its First VNR in 2017, which focused on early implementation strategies.

• The Second VNR was presented in 2020, titled "Decade of Action: Taking SDGs from Global to Local."

• The Third VNR continues this trajectory, highlighting the integration of SDGs into national development plans and the Annual Budget.

• SDG India Index:

• To monitor progress domestically, NITI Aayog publishes the SDG India Index. It ranks States and Union Territories based on their performance across various social, economic, and environmental indicators.

• This index fosters a spirit of competitive federalism, encouraging states to improve their rankings by achieving specific targets like Zero Hunger (SDG 2) and Gender Equality (SDG 5).

Important Points

• Key Themes of the Report: The Third VNR specifically highlights the impact of schemes like Pradhan Mantri Jan Dhan Yojana for financial inclusion and the Jal Jeevan Mission for providing tap water to rural households.

• International Collaboration: By presenting the VNR, India reinforces its commitment to the Global South, promoting South-South Cooperation and sharing scalable models for poverty eradication and climate resilience.

• Monitoring Framework: The Ministry of Statistics and Programme Implementation (MoSPI) maintains the National Indicator Framework (NIF), which provides the data backbone for the VNR and the SDG India Index.

• HLPF Role: The High-Level Political Forum meets annually under the auspices of the Economic and Social Council (ECOSOC) to evaluate global progress toward the 2030 targets.

**Q95. Answer: (d) Virtual Digital Assets**

The correct answer is Virtual Digital Assets.

Key Points

• The term Virtual Digital Assets (VDA) was introduced into the Income Tax Act to provide a specific legal framework for the taxation of digital assets like cryptocurrencies and tokenized assets.

• As per Section 2(47A) of the Income Tax Act, 1961, a Virtual Digital Asset is defined as any information, code, number, or token generated through cryptographic means or otherwise, providing a digital representation of value.

• This definition is broad enough to include Non-Fungible Tokens (NFTs) and any other digital asset of a similar nature, ensuring that the digital economy is brought under the tax net.

• The Finance Act, 2022 originally established the taxation regime for these assets, which has been refined in subsequent updates like the Income Tax Act, 2025, to ensure transparency and prevent tax evasion.

• Income derived from the transfer of any Virtual Digital Asset is taxed at a high flat rate of 30%, regardless of whether the holding period is short-term or long-term.

Additional Information

• Tax Deducted at Source (TDS): To track the transaction trail of Virtual Digital Assets, the government introduced Section 194S, which mandates a 1% TDS on payments made for the transfer of such assets if the transaction value exceeds Rs. 10,000 (or Rs. 50,000 for specified persons) in a Financial Year.

• Treatment of Losses: One of the most stringent features of the VDA tax regime is that losses incurred from the transfer of one Virtual Digital Asset cannot be set off against gains from another VDA or any other source of income. Furthermore, such losses cannot be carried forward to future Assessment Years.

• Cost of Acquisition: While calculating the taxable income from VDAs, no deduction is allowed for any expenditure (such as mining costs or platform fees) other than the actual cost of acquisition of the asset.

• Gifts of VDAs: If a Virtual Digital Asset is received as a gift, it is taxable in the hands of the recipient under the head "Income from Other Sources," provided the value exceeds the threshold of Rs. 50,000.

• Exclusion of Central Bank Digital Currency (CBDC): It is important to note that the Digital Rupee or CBDC issued by the Reserve Bank of India (RBI) is generally not classified as a Virtual Digital Asset because it is considered a digital form of legal tender (currency).

**Q96. Answer: (b) Fino Payments Bank**

The correct answer is Fino Payments Bank.

Key Points

• In June 2025, the Reserve Bank of India (RBI) imposed a significant monetary penalty of Rs. 29.6 lakh on Fino Payments Bank Limited.

• The penalty was imposed due to the bank's non-compliance with specific directions issued by the RBI regarding regulatory guidelines and operational standards expected of Payments Banks.

• The action was taken under the powers vested in the RBI under the provisions of Section 47A(1)(c) read with Section 46(4)(i) of the Banking Regulation Act, 1949.

• The RBI stated that the penalty was based on deficiencies in regulatory compliance and was not intended to pronounce upon the validity of any transaction or agreement entered into by the bank with its customers.

• A statutory inspection and scrutiny of the bank revealed that it failed to adhere to the RBI's directions on maintaining customer identification records and reporting mechanisms.

Additional Information

• Fino Payments Bank:

• It was incorporated in 2017 and is a subsidiary of Fino Paytech Limited.

• Headquartered in Navi Mumbai, it operates as a Scheduled Commercial Bank under the RBI.

• The bank primarily focuses on financial inclusion, offering savings accounts, current accounts, and remittance services to the unbanked and underbanked population.

• Payments Banks in India:

• These are specialized banks introduced by the RBI to provide basic financial services to small businesses and low-income households.

• They can accept demand deposits up to a limit of Rs. 2 lakh per individual customer but are not permitted to issue loans or credit cards.

• Key players in this sector include Airtel Payments Bank, India Post Payments Bank, and Paytm Payments Bank.

• Regulatory Oversight:

• The Reserve Bank of India, established on April 1, 1935, serves as the central bank and regulatory body for the Indian banking system.

• It uses monetary penalties as a tool to ensure that financial institutions maintain transparency, integrity, and security in their operations.

Important Points

• Banking Regulation Act, 1949: This Act provides the legal framework for the supervision of commercial banks in India, granting the RBI the authority to license banks, regulate shareholding, and impose penalties for violations.

• KYC Norms: Know Your Customer guidelines are mandatory for banks to prevent money laundering and financial fraud. Failure to comply with these often leads to monetary fines.

• Compliance Audits: The RBI conducts periodic audits and supervisory reviews to check the health of the banking sector and protect depositor interests.

• Financial Inclusion: The Nachiket Mor Committee recommended the creation of Payments Banks to reach the last mile of the Indian economy.

**Q97. Answer: (a) Rio de Janeiro, Brazil**

The correct answer is Rio de Janeiro, Brazil.

Key Points

• The 17th BRICS Summit is scheduled to be held in Rio de Janeiro, Brazil, on 6–7 July 2025. Hence, option 1 is correct.

• Brazil assumed the BRICS Presidency for the year 2025, following the 16th Summit held in Kazan, Russia, in October 2024.

• The 2025 summit marks a significant milestone as it continues to integrate the new member nations that officially joined the bloc on January 1, 2024.

• The primary agenda for the Rio de Janeiro summit includes global governance reform, sustainable development, and strengthening economic cooperation among the expanded membership.

• The summit serves as a platform for the Global South to discuss multilateralism and the transition toward a multipolar world order.

Additional Information

• Evolution of BRICS:

• The acronym BRIC was coined in 2001 by Jim O'Neill of Goldman Sachs to represent the fast-growing economies of Brazil, Russia, India, and China.

• The first formal summit took place in Yekaterinburg, Russia, on June 16, 2009.

• South Africa was invited to join the group in December 2010, transforming BRIC into BRICS.

• Member Countries (Expanded):

• As of 2024, the core members are Brazil, Russia, India, China, and South Africa.

• New full members include Egypt, Ethiopia, Iran, and the United Arab Emirates (UAE). Saudi Arabia has also been invited to join the bloc.

• New Development Bank (NDB):

• The NDB was established during the 6th BRICS Summit in Fortaleza, Brazil, in 2014.

• Headquartered in Shanghai, China, the bank provides financial assistance for infrastructure and sustainable development projects in BRICS and other emerging economies.

• Other Options Analysis:

• New Delhi, India: India hosted the 13th BRICS Summit in 2021 via virtual mode due to the pandemic. Hence, statement 2 is incorrect.

• Johannesburg, South Africa: Hosted the 15th BRICS Summit in August 2023, where the historic expansion of the group was announced. Hence, statement 3 is incorrect.

• Shanghai, China: China hosted the 14th BRICS Summit virtually in 2022. Shanghai is also the permanent headquarters of the New Development Bank. Hence, statement 4 is incorrect.

Important Points

• Presidency Rotation: The chairmanship of the BRICS forum is rotated annually among the members in accordance with the acronym B-R-I-C-S.

• Economic Significance: BRICS now represents approximately 45% of the world's population and nearly 28% of the global economy (GDP nominal), surpassing the G7 in terms of Purchasing Power Parity (PPP).

• Focus Areas: The group focuses on three pillars: Political and Security cooperation, Economic and Financial cooperation, and Cultural and People-to-People exchanges.

• 2025 Priorities: Under the Brazilian Presidency, emphasis is placed on technological innovation and reducing dependence on Western-dominated financial systems through local currency trade.

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**Q98. Answer: (a) Armand Duplantis**

p>The correct answer is Armand Duplantis.

Key Points

• Armand "Mondo" Duplantis, the Swedish-American pole vaulter, was named the 2025 Laureus World Sportsman of the Year in recognition of his unprecedented achievements throughout the 2024 sporting calendar.

• During the Paris 2024 Olympic Games, he successfully defended his Olympic gold medal and captivated the global audience by breaking the world record with a vault of 6.25 meters.

• Shortly after the Olympics, in August 2024, he further pushed the boundaries of the sport by clearing 6.26 meters at the Silesia Diamond League in Poland, marking his tenth world record breaking performance.

• The Laureus World Sports Awards are often described as the "Oscars of Sport," and winning this category places Duplantis among the elite legends of athletics who have demonstrated sustained excellence and dominance.

• His selection was based on his ability to consistently outperform his own benchmarks, making him the standout male athlete in a year filled with high-level international competition.

Additional Information

• Laureus World Sports Awards:

• Established in 1999, these awards celebrate the greatest sporting triumphs of the year. The inaugural ceremony was held in 2000 in Monte Carlo.

• The winners are selected by the Laureus World Sports Academy, a unique jury composed of over 70 of the greatest living sporting legends.

• Max Verstappen:

• The Dutch racing driver and three-time Formula 1 World Champion for Red Bull Racing was a fellow nominee. He previously won the Sportsman of the Year title in 2022.

• Leon Marchand:

• A French swimming sensation who became a national hero during the Paris 2024 Olympics by winning four individual gold medals and setting multiple Olympic records in a single week.

• Carlos Alcaraz:

• The Spanish tennis prodigy had a stellar 2024, winning both the French Open and Wimbledon, cementing his status as the future of men's tennis following the era of the "Big Three."

• Significance of the Award:

• The World Sportsman of the Year trophy is one of the most coveted individual honors in global sport, previously won by icons such as Roger Federer, Usain Bolt, Lionel Messi, and Novak Djokovic.

**Q99. Answer: (b) Nara Lokesh**

The correct answer is Nara Lokesh.

Key Points

• In October 2024, the Andhra Pradesh Minister for Information Technology, Electronics and Communications, Nara Lokesh, embarked on an official visit to the United States to attract investments.

• During his visit to Redmond, Washington, he met with Microsoft CEO Satya Nadella at the company's headquarters.

• Nara Lokesh officially invited Satya Nadella to visit Andhra Pradesh and requested Microsoft's collaboration in transforming the state into a technological leader.

• The discussions primarily revolved around leveraging Artificial Intelligence (AI) for e-governance and establishing IT hubs in the state to generate employment for the youth.

• A key proposal discussed was the setting up of an AI University in Amaravati, the capital city of Andhra Pradesh, where Microsoft could play a pivotal role as a technical partner.

• The minister emphasized the state's vision of "Speed of Doing Business" to streamline administrative processes and foster a startup-friendly ecosystem.

Additional Information

• Satya Nadella:

• He has been serving as the CEO of Microsoft since 2014.

• Born in Hyderabad, India, he is widely recognized for leading Microsoft's shift toward Cloud Computing and AI.

• Nara Lokesh:

• He is the son of the current Chief Minister of Andhra Pradesh, N. Chandrababu Naidu.

• Apart from the IT portfolio, he also holds the portfolio for Human Resources Development (HRD) and Real-Time Governance (RTG).

• Other Options:

• Vangalapudi Anitha: She is the current Home Minister and Minister for Disaster Management in the Andhra Pradesh government.

• N. Chandrababu Naidu: He is the Chief Minister of Andhra Pradesh and the National President of the Telugu Desam Party (TDP).

• Kolusu Parthasarathy: He serves as the Minister for Housing and Information & Public Relations (I&PR) in the state cabinet.

Important Points

• The meeting is part of the Andhra Pradesh government's broader strategy to revive the IT sector, similar to the growth witnessed in Hyderabad during the 1990s under TDP governance.

• The state government aims to make Amaravati a global destination for Deep Tech and Software Development by collaborating with Big Tech companies like Microsoft, Google, and Tesla.

• The IT hubs mentioned in the proposal are expected to be developed in cities like Visakhapatnam, Vijayawada, and Tirupati, besides the capital Amaravati.

• In 2024, the state government also focused on Digital Infrastructure policies to provide high-speed internet to rural areas, supporting the e-governance vision discussed with Satya Nadella.

**Q100. Answer: (b) Godrej & Boyce Manufacturing Company Limited**

The correct answer is Godrej & Boyce Manufacturing Company Limited.

Key Points

• Godrej Aerospace, a business unit of Godrej & Boyce, signed a landmark Memorandum of Understanding (MoU) with the Aeronautical Development Agency (ADA).

• The agreement was finalized during Aero India 2025, which was the 15th edition of the biennial air show held in Bengaluru.

• The primary objective of this collaboration is the indigenous development and manufacturing of Flight Control Actuators for India’s Advanced Medium Combat Aircraft (AMCA) programme.

• This partnership marks a significant milestone in the participation of the private sector in critical high-technology defense projects, moving away from reliance on foreign original equipment manufacturers (OEMs).

• Under the MoU, Godrej & Boyce will focus on the design, development, and testing of complex mechanical and hydraulic systems required for the flight control of fifth-generation stealth aircraft.

Additional Information

• Advanced Medium Combat Aircraft (AMCA):

• The AMCA is an Indian programme to develop a fifth-generation, multirole, stealth fighter.

• It is designed for the Indian Air Force to perform roles like air superiority, ground attack, and bombing, featuring stealth characteristics and internal weapons bays.

• Aeronautical Development Agency (ADA):

• ADA is an autonomous body under the Department of Defence Research and Development (DRDO), established in 1984.

• It is the lead agency for the design and development of combat aircraft in India, including the Light Combat Aircraft (LCA) Tejas.

• Flight Control Actuators:

• These are electro-hydraulic or mechanical devices that move the control surfaces (like ailerons and rudders) of an aircraft in response to inputs.

• In high-performance stealth jets like the AMCA, these actuators must be highly precise to maintain flight stability and maneuverability at supersonic speeds.

• Aero India 2025:

• The event was organized at Air Force Station Yelahanka, Bengaluru in February 2025.

• It served as a major hub for Atmanirbhar Bharat initiatives, showcasing domestic manufacturing capabilities in the aerospace and defense sectors.

Important Points

• The AMCA project is a core component of India's long-term defense strategy, aiming to reduce dependence on imported platforms like the Rafale or F-35.

• Godrej Aerospace has been a key contributor to India’s space and defense missions for over three decades, supplying critical components for Chandrayaan and Mangalyaan.

• The Cabinet Committee on Security (CCS) approved the development of the AMCA in March 2024, with a budget of approximately Rs. 15,000 crore for the design and prototype phase.

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