RRB Group D Previous Year Paper (Held on: 28 Sept 2022 Shift 1)

RRB Group D • 2022 • 100 questions • 90 minutes • Answer key and solutions

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CBT

Q1. A concave mirror forms a real image of three times the size of an object on a screen. The object and screen are then moved until the image is six times the size of the object. If the shift of the screen is 39 cm, then the focal length of the mirror is:

(a) 13 cm
(b) 10 cm
(c) 26 cm
(d) 39 cm

Q2. Which of the following is a symptom of Beriberi?

(a) Poor vision or partial blindness
(b) Weak muscles and low energy
(c) Weak teeth and bleeding gums
(d) Poor skin health and swollen belly

Q3. Which of the following is a private sector bank in India?

(a) Bank of Baroda
(b) Federal Bank
(c) Punjab National Bank
(d) UCO Bank

Q4. Each of six sports persons, Falak, Bala, Renu, Rekha, Priya and Pallavi, has a different weight. Rekha is heavier than only Falak and Renu but lighter than Bala and Priya. Pallavi is the heaviest. Priya is heavier than Bala and Falak is heavier than Renu. Who is the lightest among all the sports persons?

(a) Falak
(b) Priya
(c) Renu
(d) Bala

Q5. Extremely severe cyclonic storm 'Fani' hit Odisha in the year:

(a) 2019
(b) 2018
(c) 2017
(d) 2020

Q6. If α is an acute angle and $\tan^2 \alpha - \sec \alpha = 19$, then the value of cos α is:

(a) 1over5
(b) 1over4
(c) 2over3
(d) 1over2

Q7. Which of the following numbers will replace the question mark (?) in the given number series?

35, 34, 36, 33, 37,?

(a) 42
(b) 32
(c) 34
(d) 41

Q8. Indira point is located in the southern part of which of the following islands?

(a) Great Nicobar island
(b) Middle Andaman island
(c) Car Nicobar island
(d) Little Andaman island

Q9. Find the median of the below data.

2, 6, 5, 2, 4, 9, 6, 2, 6, 4, 10, 12, 6, 3, 4, 9

(a) 5
(b) 4.5
(c) 6
(d) 5.5

Q10. 'Kendriya Hindi Sansthan' has head office at which place as on July 2022?

(a) New Delhi
(b) Agra
(c) Prayagraj
(d) Varanasi

Q11. Refer to the following number series and answer the question that follows.

(left) 3 7 9 2 1 5 3 9 2 6 5 8 7 9 1 3 5 9 4 6 (right)

Which is the eighth digit to the left of the twelfth digit from the left end of the series?

(a) 5
(b) 9
(c) 2
(d) 1

Q12. A curve that joins all points representing bundles which are considered indifferent by the consumer is called a/an _____.

(a) consumer curve
(b) marginal curve
(c) indifference curve
(d) utility curve

Q13. Which of the following minerals help crops withstand pests?

(a) Magnesium, Iron and Boron
(b) Calcium, Potassium and Sodium
(c) Sodium, Calcium and Magnesium
(d) Potassium, Calcium and Magnesium

Q14. Respiration reaction in humans is an example of _____.

(a) exothermic reaction
(b) displacement reaction
(c) endothermic reaction
(d) redox reaction

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Q15. This question consists of a statement followed by two arguments I and II. Read the statement and the arguments carefully and select the appropriate answer from the given options.

Statement - Prices of tomatoes in Kerala will rise sharply as many trucks carrying them from other states have been stopped at the border

I. Tomatoes are mostly brought to Kerala from outside.

II. The quantity of tomatoes grown in Kerala is not enough to meet the demand in the state.

(a) I weakens while II strengthens the statement
(b) Both I and II strengthen the statement
(c) Both I and II weaken the statement
(d) II weakens while I strengthens the statement

Q16. At what pH level does tooth decay start?

(a) pH 6
(b) pH above 7
(c) pH 7
(d) pH below 5.5

Q17. A person 1.75 m tall casts a 2 m shadow. At the same instance, a lamp-post casts a shadow of 6.4 m. The height of the lamp-post is:

(a) 5.8 m
(b) 5.6 m
(c) 5.7 m
(d) 5.9 m

Q18. What is the major aim of the INSPIRE Awards 'MANAK' being executed by the Department of Science and Technology, Government of India?

(a) To motivate students studying in classes 6 to 10
(b) To motivate farmers who are doing commercial agriculture
(c) To motivate scientists for technological development
(d) To motivate scientists for space related research

Q19. Azim borrowed a certain sum which amounted to Rs. 19,800 in 36 months at 12.5% per annum simple interest. What is the borrowed sum?

(a) Rs. 14,400
(b) Rs. 13,600
(c) Rs. 9,600
(d) Rs. 12,800

Q20. A ray of light is travelling from medium A to medium B. The incident ray makes an angle 75° with respect to the normal, and the refracted ray makes an angle 40° with respect to the normal. The refractive index of the medium A relative to the medium B is:

(a) 0.67
(b) 1.50
(c) 1.34
(d) 0.87

Q21. Raju's sister is 6 years older than Raju. If his sister's age is 38 years, then find Raju's age?

(a) 28 years
(b) 30 years
(c) 23 years
(d) 32 years

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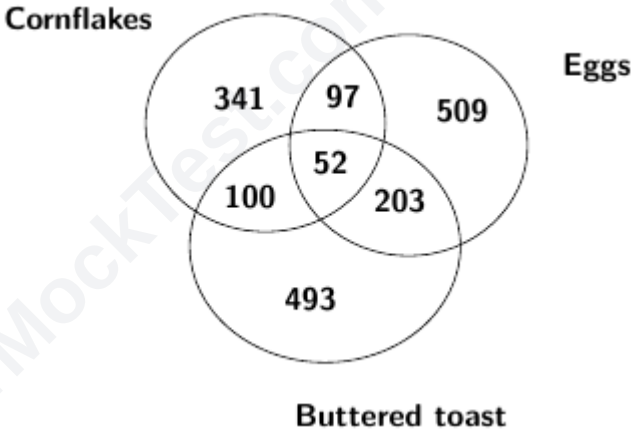
Q22. Where do mangroves grow?

(a) Mountain
(b) Coastal areas
(c) Swamp
(d) Desert

Q23. The phenomena behind the working of an electric oven is _____.

(a) electromagnetic induction
(b) Joule's heating effect
(c) induced current
(d) induced voltage

Q24. Study the given Venn diagram carefully and answer the question that follows. The numbers in different sections indicate the number of persons who consume a certain type of breakfast.



How many such persons are there, who consume both cornflakes and buttered toast?

(a) 152
(b) 100
(c) 341
(d) 52

Q25. Which Article of the Constitution of India lays down that the State shall take steps to organise village panchayats and endow them with such powers and authority as may be necessary to enable them to function as units of self government?

(a) Article 44
(b) Article 40
(c) Article 41
(d) Article 42

Q26. The product of the LCM and the HCF of two numbers is 270. If one of the numbers is 18, find the other number.

(a) 30
(b) 27
(c) 20
(d) 15

Q27. A, B, C, D, E and F are sitting around a circular table facing the centre. B is sitting third to the right of F. F is an immediate neighbour of both C and A. C sits second to the right of B. D is not the immediate neighbour of C. Who is sitting to the immediate left of E?

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

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Q28. 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 /subtracting /multiplying etc. to 13 can be performed. Breaking down 13 into 1 and 3 and then performing mathematical operations on 1 and 3 is not allowed)

(24, 42)

(36, 63)

(a) 36, 91
(b) 48, 96
(c) 52, 91
(d) 40, 82

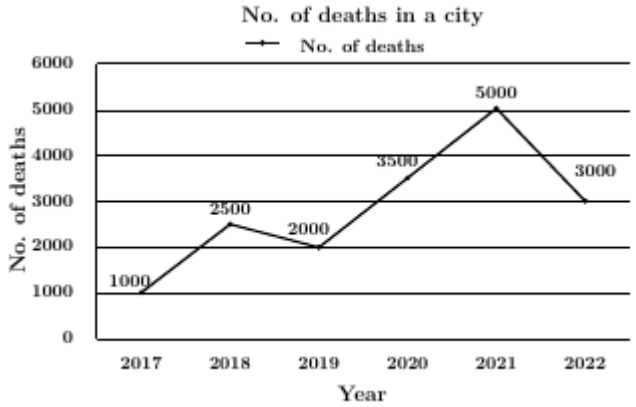
Q29. Which state government's forest department recognised its failures in reviving the degraded Sal forests in the south-western districts of the state

(a) Odisha
(b) West Bengal
(c) Madhya Pradesh
(d) Rajasthan

Q30. If each of the digits in the number 25731640 are arranged in descending order, the position of how many digits will remain unchanged as compared to that in the original number?

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

Q31. The given line graph shows the number of deaths in a city from the year 2017 to 2022. Study the graph and answer the question that follows.



What is the approximate percentage decrease in deaths from 2021 to 2022 and increase in deaths from 2020 to 2021, respectively?

(a) 32.93% and 30%
(b) 42.83% and 40%
(c) 40% and 42.83%
(d) 30% and 32.93%

Q32. Why is HIV spread through sexual contact?

(a) Blood is mixed during sexual intercourse
(b) Viral particles are abundant in seminal fluid
(c) The virus lives inside the sperm
(d) The virus lives on the skin of the sexual organ

Q33. Six friends, A, B, C, D, E, and F are sitting around a circular table facing the centre.

C is the immediate neighbour of A and E. F is second to the right of C and third to the left of A. If B is second to the left of C, where is D seated?

(a) Fourth to the right of C
(b) Second to the left of A
(c) Second to the left of B
(d) Third to the right of E

Q34. In which city was Jawaharlal Nehru born?

(a) Delhi
(b) Srinagar
(c) Lucknow
(d) Allahabad

Q35. If three metallic spheres of radii 3 cm, 4 cm and 5 cm respectively are melted to form a single sphere, then what will be the volume of the new sphere? [Use π = 22over 7]

(a) 8252/7 cm^3
(b) 6753/7 cm3
(c) 3455/7 cm3
(d) 9051/7 cm3

Q36. In which year was Lakhimi Baruah awarded the Padma Shri for social work?

(a) 2018
(b) 2017
(c) 2021
(d) 2020

Q37. The teachings of Mahavira and his followers were written down about 1500 years ago in the form in which they are presently available at which place?

(a) Pawapuri in Bihar
(b) Vaishali in Bihar
(c) Valabhi in Gujarat
(d) Lachhuar in Bihar

Q38. A certain number of people are sitting in a row, facing north. No one is sitting to the right of E. Only two people are sitting to the left of B. D is sitting third to the right of B. Only four people are seated between B and F. Only eight people are seated between D and C. E is seated second to the right of C. If no other person is sitting in the row, what is the total number of persons seated?

(a) 16
(b) 21
(c) 22
(d) 17

Q39. Simplify the given expression.

√2187×√432over√324

(a) 56
(b) 42
(c) 54
(d) 48

Q40. The police of which of the following States developed an app called 'Disha' for women's safety in February 2020?

(a) Uttarakhand
(b) Andhra Pradesh
(c) Goa
(d) Punjab

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Q41. If in a parallelogram ABCD, E and F are points on the diagonal AC such that AE = FC, then quadrilateral BEDF is a:

(a) parallelogram
(b) rectangle
(c) trapezium, but not a parallelogram
(d) square

Q42. The position of how many letters will remain unchanged if each of the letters in the word 'NOTED' is arranged in alphabetical order.

(a) Three
(b) Five
(c) Four
(d) None

Q43. In which year was the Steel Authority of India Ltd incorporated?

(a) 1956
(b) 1981
(c) 1973
(d) 1963

Q44. Read the given statement(s) and conclusions carefully and decide which of the conclusions logically follow(s) on basis of the statement(s).

Statements: B < D, C = E, F > D, E < G, K = G, C < F

Conclusions:

1. G > C
2. G < C

(a) Neither conclusion 1 nor 2 follows.
(b) Both conclusions 1 and 2 follow.
(c) Only conclusion 1 follows.
(d) Only conclusion 2 follows.

Q45. Rahul drives 80 km towards the north, and then he turns towards the west and drives 100 km. After that, he turns south and drives 80 km, and in the end, he turns east and drives 120 km. How far is the end point from the initial point?

(a) 20 km
(b) 140 km
(c) 50 km
(d) 80 km

Q46. The height of a right circular cylinder is 23 cm and the circumference of its base is 77 cm. What is its curved surface area?

(a) 1771 cm^2
(b) 2014 cm2
(c) 1823 cm2
(d) 1979 cm2

Q47. In a certain code language, 'SMART' is written as 'VKDPW', and 'FRAUD' is written as 'IPDSG'. How will 'PURGE' be written in that language?

(a) SSUEH
(b) RWTIG
(c) QTSFF
(d) RSTEG

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Q48. In this question, a group of numbers/symbols is coded using letters as per the table given below and the conditions which follow. The correct combination of codes following the condition is your answer.

Number/Symbol	**/**	**#**	**9**	**7**	**@**	**%**		**2**	**!**	**?**	**6**	**4**	**<**	**=**
Code	D	F	T	J	N	G	E	X	V	W	K	U	P	Z

Conditions:

(i) If the first element is a number and the last a symbol, the codes for these two are to be interchanged.

(ii) If the first element is an odd number and the last an even number, the first and the last elements are to be coded as ø.

(iii) If both the second and third elements are perfect squares, the third element is to be coded as the code for the second element.

How will '<9 4 # 2' be coded?

(a) PTUFX
(b) PTTFX
(c) PTPFV
(d) PUUFX

Q49. India's Jhulan Goswami was in the news on 16 March 2022 for becoming the highest wicket taker in Women's ODIs by claiming 250 wickets. Against which team did she achieve this fear?

(a) South Africa
(b) England
(c) New Zealand
(d) Australia

Q50. Two trains of equal length are running on parallel lines in the same direction at speeds of 36 km/h and 26 km/h. The faster train passes the slower train in 18 seconds. The length of each train is:

(a) 50 metres
(b) 75 metres
(c) 70 metres
(d) 25 metres

Q51. Three statements are followed by three conclusions numbered I, II and III. You have to consider these statements to be true, even if they seem to be at variance with commonly known facts. Decide which of the given conclusions logically follow(s) from the given statements.

Statements:

Some pliers are levers

All levers are ramps

Some cutters are pliers.

Conclusions:

(I) Some cutters are levers

(II) Some ramps are cutters

(III) All pliers are ramps

(a) Either conclusion I or III follows
(b) Only conclusion II follows
(c) None of the conclusions follow
(d) Only conclusion I follows

Q52. If p and q are the roots of $x^2 + 4x - 21 = 0$ and $p < q$, then the quadratic equation in x whose roots are $(p - 1)$ and $(q + 1)$ is:

(a) $x^2 + 4x - 32 = 0$
(b) $x^2 + 6x - 16 = 0$
(c) $x^2 + 6x + 16 = 0$

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(d) $x^2 + 4x + 32 = 0$

Q53. In the given letter-cluster pairs, the first letter-cluster is related to the second letter-cluster following a certain logic. Study the given pairs carefully, and from the given options, select the pair that follows the same logic.

YVQ : TQL

WKG : RFB

(a) QHK : JSP
(b) FHL : CIU
(c) DUR : APM
(d) SIY : NDT

Q54. 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:

1. Some cheese are custards.
2. All milk are cheese.
3. Some curds are cheese.

Conclusions:

I-All cheese are milk.

II-Some custards are cheese.

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

Q55. A, B, C, D, E and F live on six different floors of the same building. The lowermost floor in the building is numbered 1, the floor above it, number 2 and so on till the topmost floor is numbered 6.

Only one person lives below E. A does not live on the topmost floor. Only three people live between A and C. C lives below A. D lives immediately above B. Who lives immediately above A?

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

Q56. Which of the following allotropes of carbon is a good conductor of electricity?

(a) Charcoal
(b) Graphite
(c) Diamond
(d) Fullerene

Q57. If the forefinger indicates the direction of magnetic field and the thumb shows the direction of motion of a conductor, then the middle finger will show the direction of induced current, when the thumb, forefinger and middle finger are stretched perpendicular to each other. This is called _____.

(a) Fleming's left hand rule
(b) Fleming's right hand rule
(c) right hand thumb rule
(d) cork screw rule

Q58. How many such pairs of letters are there in the word 'ADVERSE' (in both forward and backward directions) which have as many letters between them in the word as there are in the English alphabetical order?

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

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(d) 3

Q59. When a number is divided by 15, it leaves a remainder of 3. If the same number is divided by 17, the remainder is 11. Which of the options below gives such a number?

(a) 198
(b) 185
(c) 183
(d) 190

Q60. Select the term from among the given options that can replace the question mark (?) in the following alpha-numeric series to make it logically complete.

O5U, L7S, I10Q, F140, ?

(a) D20N
(b) C20N
(c) D19N
(d) C19M

Q61. In case of an alternating current, _____.

(a) the direction of current as well as magnitude changes with time
(b) the direction of current as well as magnitude of current does not change with time
(c) the direction of current changes but magnitude is constant
(d) the direction of current is same but the magnitude changes with time

Q62. The power of Parliament to amend the Constitution of India is a constitutive power established in the:

(a) Twenty-Fourth Amendment Act
(b) Forty-Fourth Amendment Act
(c) Forty-Second Amendment Act
(d) Twenty-Sixth Amendment Act

Q63. Which of the following is an example of a combination reaction between two compounds to form new compound?

(a) Formation of calcium hydroxide
(b) Formation of water
(c) Formation of carbon dioxide
(d) Formation of ammonia

Q64. Festival lights in buildings are an example of _____.

(a) a parallel circuit
(b) magnetic effect
(c) electromagnetic induction
(d) a series circuit

Q65. The sum of two consecutive even numbers is 842. What is the smaller number?

(a) 422
(b) 423
(c) 420
(d) 421

Q66. Five friends have their interview on different dates in the month February of a leap year. All have their interviews on even dates. There are exactly five days gap between each interview. On which date does the first person will have the interview, if none of them have their interview on 28^(th) February?

(a) 2^(nd)
(b) 8^(th)
(c) 4^(th)
(d) 6^(th)

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Q67. Which of the following is/are correct with respect to the reflection by spherical mirrors?

(a) A concave mirror will diverge the rays of light if the object is placed between the pole and the focus.

(b) A convex mirror can converge a beam of rays.

(a) (a) is only correct
(b) (a) and (b) both are correct
(c) Both (a) and (b) are incorrect
(d) (b) is only correct

Q68. What is the primary reason that river Ganga is called an endangered river?

(a) The river is drying up
(b) Aquatic life is diminishing
(c) There are too many dams on it
(d) The water is not potable

Q69. Which of the following elements is a metal?

(a) Fe
(b) B
(c) C
(d) Si

Q70. Simplify the following.

0.11...+0.55...

(a) 2over3
(b) 4over9
(c) 1over9
(d) 1over90

Q71. If '+' means '×', '×' means '÷', '÷' means '−', and '−' means '+', then what will be the value of the given expression?

93 − 91 × 7 + 8 ÷ 3

(a) 198
(b) 194
(c) 89
(d) 201

Q72. A cistern has a hole in the bottom through which the water is leaking. A tap can fill the cistern in 3 hours and the hole in the bottom can empty the fully filled cistern in 5 hours. If both the tap and the hole are open, then what will be the time taken to completely fill the empty cistern?

(a) 7.5 hours
(b) 6.5 hours
(c) 8.5 hours
(d) 7 hours

Q73. A normal adult human being produces _____ mL per day of urine daily.

(a) 100 − 200
(b) 10 − 20
(c) 10000 − 20000
(d) 1000 − 2000

Q74. A person sells an item X at a 10% loss and item Y at a 15% profit, making an overall profit of Rs. 7. If he sells X at a 12% profit and Y at a 5% profit, he makes an overall profit of Rs. 10. What is the total cost price (Rs.) of X and Y?

(a) 125
(b) 120
(c) 130
(d) 140

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Q75. Select the option that is related to the fifth number in the same way as the second number is related to the first number, the fourth number is related to the third number.

48 : 5 :: 96 : 7 :: 6 : ?

(a) 2
(b) 10
(c) 36
(d) 4

Q76. How many 6s are there in the following sequence each of which is NOT immediately preceded by 3 but immediately followed by 3?

8 6 3 6 4 8 6 8 1 8 6 3 6 5 4 8 6 2 4 3 6 8 6 9 8 8 6 4 6 9

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

Q77. Which of the following statements is correct about striated muscles?

(a) Cells are long, cylindrical, non-tapering and are unbranched
(b) Prominent light and dark bands are present
(c) Cells are long with tapering ends and are unbranched
(d) Cells are non-tapering and cylindrical in shape and are branched

Q78. The population of a city increased by 10% in 2020 and then decreased by 8% in 2021. Find the percentage change in the population of the city at the end of 2021 with respect to its population at the beginning of 2020.

(a) 0.9% decrease
(b) 0.9% increase
(c) 1.2% decrease
(d) 1.2% increase

Q79. The simplest form of the ratio 722 : 1083 is:

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

Q80. Select the option that is related to the third term in the same way as the second term is related to the first term and the sixth term is related to the fifth term.

12 : 20 :: 30 : ? :: 56 : 72

(a) 45
(b) 44
(c) 41
(d) 42

Q81. In the evening, a person was standing such that his shadow was to his left. In which direction was he facing?

(a) South
(b) North
(c) East
(d) West

Q82. Who among the following was one of the recipients of the Nobel Prize in Physics 2021?

(a) Maria Ressa
(b) Syukuro Manabe
(c) David Julius
(d) Dmitry Muratov

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Q83. To celebrate Azadi Ka Amrit Mahotsav (75 years of India's Independence), to which school did the Government of India donate 50 computers?

(a) Ermysted's Grammar School, Skipton
(b) Tokyo Metropolitan Asuka High School
(c) Lycee Moderne Ampefiloha, Madagascar
(d) The European School Copenhagen

Q84. Which of the following numbers will replace the question mark (?) in the given series?

8 ? 4 6 12 30

(a) 2
(b) 4
(c) 6
(d) 8

Q85. What is the value of x, y and z in the following chemical equation?

$xPbO(S) + C(S) \rightarrow yPb(S) + zCO2(g)$

(a) x = 2, y = 2, z = 1
(b) x = 2, y = 1, z = 2
(c) x = 2, y = 1, z = 1
(d) x = 1, y = 1, z = 2

Q86. A trader claims to sell rice at a profit of 25%, but also dishonestly uses a weight which is 15% less than what is mentioned on it. Find the total percentage of profit earned by the trader. (Round the answer to the nearest whole number.)

(a) 57%
(b) 50%
(c) 47%
(d) 49%

Q87. Study the given table and answer the following question.

	Distance travelled (in km) by	
	Train A	Train B
Day 1	362	480
Day 2	282	596
Day 3	421	640

What was the average of the distance travelled (in km) by Train A on the given three days?

(a) 355km
(b) 336km
(c) 345km
(d) 356km

Q88. Simplify the given expression.

$x^2 + 3x + 12 - 2(x^3 - x + 4)$

(a) $4 + 5x - x^2 - 2x^3$
(b) $4 + 5x + x^2 + 2x^3$
(c) $4 + 5x + x^2 - 2x^3$
(d) $4 - 5x + x^2 - 2x^3$

Q89. In which sports, Amit Panghal won a gold medal in Commonwealth Games 2022?

(a) Boxing
(b) Wrestling
(c) Athletics

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(d) Judo

Q90. The thick white and yellowish clouds of the planet Venus are made up of which of the following acids?

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

Q91. 100 eggs were purchased for Rs. 100. 12 eggs broke in transit. The trader sold the remaining eggs at Rs. 1.20 per egg. Find his profit.

(a) Rs. 5.60
(b) Rs. 15.60
(c) Rs. 17.60
(d) Rs. 7.60

Q92. Which part of the Constitution of India deals with rights of citizenship of certain persons who have migrated to India from Pakistan?

(a) PART IV
(b) PART II
(c) PART I
(d) PART III

Q93. In macroeconomic analysis, the ratio of the total increment in equilibrium value of final goods output to the initial increment in autonomous expenditure is called the _____ of the economy.

(a) investment multiplier
(b) income multiplier
(c) savings multiplier
(d) consumption multiplier

Q94. The following is a cumulative frequency distribution (less than type) of 900 persons, each of age 30 years and above. What is the modal age (in years) (correct to one decimal place)?

Age below (in years)	**40**	**50**	**60**	**70**	**80**
Number of persons	120	250	650	850	900

(a) 55.2
(b) 54.5
(c) 54.8
(d) 55.7

Q95. If a and b (a >b) are the roots of equation $x^2 - 5x - 6 = 0$, then the value of $(a - b)^2$ is:

(a) 18
(b) 24
(c) 25
(d) 49

Q96. Three resistors, each of resistance 2 Ω, 3 Ω and 5 Ω, are connected in series to a battery of voltage V. If the current through the 2 Ω resistor is 4 A, then V is _____.

(a) 80 V
(b) 60 V
(c) 20 V
(d) 40 V

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Q97. Law of Octaves became irrelevant after the discovery of:

(a) fullerene
(b) isotopes
(c) noble gases
(d) radioactivity

Q98. If a 12 V power supply supplies a power of 24 W to a bulb, then the power supplied would be when connected to a 6 V supply:

(a) 12W
(b) 9W
(c) 6W
(d) 18W

Q99. Which among the following is not a change noticed among children who entered teenage (boys and girls)?

(a) Hair growth in some parts of the body
(b) Skin in many becomes oily
(c) Some develop pimples
(d) Hair growth is seen in all parts of the body

Q100. Express 1.22... in the form pover q, where p and q are integers and q ≠ 0.

(a) 4over3
(b) 13over9
(c) 11over9
(d) 10over9

ANSWER KEY

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

SOLUTIONS

Q1. Answer: (a) 13 cm

The correct answer is 13 cm.

Key Points

Given: A concave mirror forms a real image 3 times the size of the object, we have m1=3 and v1=3u1.

Formula: 1/f=1/u+1/v

Given: m2=6, the new image distance v2=6u2, and the screen shift v2-v2=39cm

We solve the system of equations to find f :

From v1=3u1: 1/f=1/3u1+1/u1=4/3u1, Thus u1=4f/3

From v2=6u2: 1/f=1/6u2+1/u2=7/6u2, Thus u2=7f/6

Using v2-v1=39: 6u2-3u1=39.

Substituting u1 and u2 : 6× 7f/6-3×4f/3=39, which simplifies to 7f-4f=39.

Hence, 3f=39, and f=13cm.

Additional Information

• Concave Mirror:

• A concave mirror, or converging mirror, has a reflecting surface that curves inward like the inside of a sphere.

• It converges light to a focal point, making it useful for focusing light and forming real images.

• Magnification (m):

• Magnification is the ratio of the height of the image to the height of the object.

• For mirrors, it is also given by the ratio of the image distance to the object distance (m=-v/u).

• Mirror Formula:

• The mirror formula relates the object distance (u), image distance (v), and focal length (f) of a mirror: 1/f=1/u+1/v 1f=1v+1u1f=1v+1u1f=1v+1u1f=1v+1u1f=1v+1u1f=1v+1u.

• This formula is applicable to both concave and convex mirrors.

Q2. Answer: (b) Weak muscles and low energy

The correct answer is option 2) Weak muscles and low-energy

Beriberi is a condition caused by a deficiency of vitamin B1 (thiamine), and it can lead to symptoms such as weakness, muscle atrophy, and fatigue due to the effect of thiamine deficiency on the nervous system and muscle function.

Key Points

• There are two main types of beriberi: Wet beriberi, and Dry beriberi.

• Wet beriberi is characterized by edema and heart-related symptoms,

• Dry beriberi primarily involves nervous system issues.

• Early diagnosis and thiamine supplementation are crucial for the successful treatment of beriberi.

• Supplementation with thiamine and dietary improvements are common approaches to managing the condition.

Additional Information Common symptoms of beriberi include:

Muscle Weakness	**Weakness and fatigue, particularly in the legs and extremities.**
Peripheral Neuropathy	Numbness, tingling, and loss of sensation in the hands and feet.
Edema	Swelling of the lower legs, ankles, and feet due to fluid retention.
Cardiac Symptoms	In some cases, beriberi can lead to heart problems, including an enlarged heart, which may cause heart failure.
Difficulty Walking	Impaired coordination and difficulty walking due to muscle weakness and nerve damage.
Confusion and Cognitive Impairment	Cognitive changes, including confusion, memory problems, and difficulty concentrating.
Anorexia	Loss of appetite and weight loss.
Wernicke-Korsakoff Syndrome	In severe cases, beriberi can lead to a neurological disorder characterized by confusion, amnesia, and eye movement abnormalities.

Q3. Answer: (b) Federal Bank

The correct answer is Federal Bank.

Key Points

• Federal Bank is a major Indian commercial bank in the private sector headquartered in Aluva, Kochi, Kerala.

• It was incorporated in 1931 and has a strong presence in India with over 1,200 branches and 1,600 ATMs spread across the country.

• The bank offers a variety of products and services including loans, savings and current accounts, debit and credit cards, and investment products.

• Federal Bank has been known for its significant contributions to the banking sector through technological innovations and customer-focused services.

Additional Information

• Bank of Baroda

• It is a public sector bank in India, owned by the government.

• It was founded on July 20, 1908, by Maharaja Sayajirao Gaekwad III.
• Headquartered in Vadodara, Gujarat, it is one of the largest public sector banks in India.
• It offers a wide range of banking products and financial services.
• Punjab National Bank
• It is another major public sector bank in India.
• Founded in 1894, it is one of the oldest banks in India.
• Headquartered in New Delhi, it has a wide network of branches and ATMs across the country.
• It provides a variety of banking and financial services to its customers.
• UCO Bank
• UCO Bank is a public sector bank established in 1943.
• Headquartered in Kolkata, it was formerly known as United Commercial Bank.
• It provides a wide range of banking products and services, including loans, deposits, and payment services.
• UCO Bank has a significant presence in India with numerous branches and ATMs.

Q4. Answer: (c) Renu

Given: Each of six sports persons, Falak, Bala, Renu, Rekha, Priya and Pallavi, has a different weight.

1) Pallavi is the heaviest.

Pallavi > _ > _ > _ > _ > _

2) Rekha is heavier than only Falak and Renu but lighter than Bala and Priya.

Pallavi > Bala/Priya > Bala/Priya > Rekha > Falak/Renu > Falak/Renu

3) Priya is heavier than Bala and Falak is heavier than Renu.

Pallavi > Priya > Bala > Rekha > Falak > Renu

Thus, according to the final arrangement, Renu is the lightest among all the sports persons.

Hence, "Option 3" is the correct answer.

Q5. Answer: (a) 2019

The correct answer is 2019.

Key Points

• Extremely severe cyclonic storm 'Fani' hit the Indian state of Odisha in May 2019.
• Fani was the strongest tropical cyclone to strike the Indian state of Odisha since the 1999 Odisha cyclone.
• The storm caused widespread damage to infrastructure, homes, and crops, particularly in the coastal regions of Odisha.
• The Indian government and various NGOs launched extensive relief and rehabilitation efforts to support the affected populations.

Additional Information

• Cyclone Fani:
• Cyclone Fani (pronounced as 'Foni') was the first severe cyclonic storm of the 2019 North Indian Ocean cyclone season.
• It originated from a tropical depression that formed west of Sumatra in the Indian Ocean on 26 April 2019.
• Fani intensified into an extremely severe cyclonic storm and made landfall in Odisha near Puri on 3 May 2019.
• The cyclone had wind speeds of up to 215 km/h (130 mph), causing significant destruction.
• Impact and Response:
• The government of India and the Odisha state government conducted one of the largest evacuations in history, moving around 1.2 million people to safer locations.
• Post-cyclone, the government and various organizations provided relief in the form of food, water, medical aid, and temporary shelters.
• Efforts were also made to restore electricity, telecommunications, and other essential services in the affected areas.
• International aid and support were also extended to help with the recovery and rebuilding process.
• Terminologies:
• Extremely Severe Cyclonic Storm: A category in the tropical cyclone intensity scale used by the India Meteorological Department (IMD), which includes cyclones with wind speeds of 166-220 km/h (103-137 mph).
• Landfall: The event of a storm moving over land after being over water, often leading to significant weather changes and potential damage in the affected area.
• Evacuation: The process of moving people from a dangerous place to safety, often used in response to natural disasters like cyclones, floods, and earthquakes.

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Q6. Answer: (a) 1over5

Shortcut Trick

Use the identity tan2α = sec2α − 1.

The equation becomes sec2α − secα − 20 = 0.

Factorizing the quadratic: (secα − 5)(secα + 4) = 0.

Since α is acute, secα = 5 => cosα = 1/5.

Therefore The correct answer is 1/5.

Alternate Method

Given: tan2α − secα = 19, where α is an acute angle.

Formula Used: sec2α − tan2α = 1 => tan2α = sec2α − 1

Calculations:

=> (sec2α − 1) − secα = 19

=> sec2α − secα − 1 − 19 = 0

=> sec2α − secα − 20 = 0

=> sec2α − 5secα + 4secα − 20 = 0

=> secα(secα − 5) + 4(secα − 5) = 0

=> (secα − 5)(secα + 4) = 0

=> secα = 5 or secα = −4

=> Since α is acute (0° < α < 90°), secα must be positive and ≥ 1.

=> secα = 5

=> cosα = 1 / secα = 1/5

Therefore The correct answer is 1/5.

Additional Information

Trigonometric Identities

Fundamental Pythagorean identities include sin2θ + cos2θ = 1, 1 + tan2θ = sec2θ, and 1 + cot2θ = cosec2θ.

Acute Angle Ratios

For an acute angle α, all trigonometric ratios (sin, cos, tan, cot, sec, cosec) are always positive.

Reciprocal Relations

secα = 1/cosα, cosecα = 1/sinα, and cotα = 1/tanα.

Q7. Answer: (b) 32

The logic follows here is:

Thus, 32 will replace the question mark in the given series.

Hence, the correct answer is "Option 2".

Q8. Answer: (a) Great Nicobar island

The correct answer is Great Nicobar island.

Key Points

• Indira Point is the southernmost point of India, located on the Great Nicobar island in the Andaman and Nicobar Islands.

• It was named in honor of the former Prime Minister of India, Indira Gandhi.

• The point is located at latitude 6°45'10" N and longitude 93°49'36" E.

• Indira Point was formerly known as Pygmalion Point and Parsons Point.

Additional Information

• Great Nicobar Island

• Great Nicobar is the largest of the Nicobar Islands, with an area of about 1,045 square kilometers.

• It is located in the Indian Ocean, south of the Andaman Islands, and is part of the Union Territory of Andaman and Nicobar Islands.

• The island is known for its rich biodiversity, including the Great Nicobar Biosphere Reserve, which is home to several endemic species.

• It is sparsely populated, with the majority of its inhabitants being the indigenous Nicobarese people.

• Middle Andaman Island

• Middle Andaman Island is part of the Andaman Islands, located in the Bay of Bengal.

• It is the second largest island in the Andaman group and is known for its lush green forests and diverse wildlife.

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• The island is home to several indigenous tribes, including the Jarwa people.
• Middle Andaman Island is also known for its beautiful beaches and tourist attractions.
• Car Nicobar Island
• Car Nicobar is the northernmost island in the Nicobar group, located in the Bay of Bengal.
• It is the administrative capital of the Nicobar district and is known for its coconut plantations and scenic beauty.
• The island was significantly affected by the 2004 Indian Ocean tsunami, which caused extensive damage and loss of life.
• The indigenous Nicobarese people are the main inhabitants of Car Nicobar.
• Little Andaman Island
• Little Andaman is the fourth largest island in the Andaman group, situated south of Port Blair.
• The island is known for its pristine beaches, waterfalls, and dense tropical forests.
• It is home to the Onge tribe, one of the indigenous tribes of the Andaman Islands.
• Little Andaman is a popular destination for eco-tourism and adventure activities.

Q9. Answer: (d) 5.5

Given:
Data = 2, 6, 5, 2, 4, 9, 6, 2, 6, 4, 10, 12, 6, 3, 4, 9
Formula used:
If N is an even number, then
Median = Value of [(N/2)^(th)term + (N/2 + 1)^(th)term]/2
Where, N = Number of terms
Calculation:
Arranging numbers in ascending order = 2, 2, 2, 3, 4, 4, 4, 5, 6, 6, 6, 6, 9, 9, 10, 12
According to the question
Here, N = 9
Median =[(N/2)th term + (N + 1)/2th term]/2 = [(16/2)th term + (16/2 + 1)th term]/2
=> (5 + 6)/2 = 5.5
Therefore The median of the given data is 5.5.
Therefore Option 4 is the correct answer.

Q10. Answer: (b) Agra

The correct answer is Agra.
Key Points
• The head office of Kendriya Hindi Sansthan is located in Agra.
• Kendriya Hindi Sansthan is an autonomous organization under the Ministry of Education, Government of India.
• It was established in 1960 with the objective of promoting and propagating Hindi as a common link language in India.
• The institute offers various courses and conducts research in Hindi language and literature.
Additional Information
• Kendriya Hindi Sansthan
• Also known as the Central Institute of Hindi, it plays a crucial role in the development and promotion of Hindi language education across India and abroad.
• The institute runs various programs such as teaching Hindi to non-Hindi speakers, advanced research in Hindi, and training teachers in Hindi education.
• It collaborates with several international organizations and institutions to promote Hindi globally.
• Ministry of Education, Government of India
• The Ministry of Education is responsible for the development of educational policies and administration of various educational institutions and initiatives in India.
• It oversees primary, secondary, and higher education and formulates policies to improve the quality of education in the country.
• One of the key objectives of the ministry is to promote the use of Hindi and other regional languages in education.
• Hindi Language
• Hindi is one of the official languages of India and is widely spoken across the country.
• The language has its roots in Sanskrit and has evolved over centuries, incorporating elements from various other languages.
• Efforts are constantly made by the Indian government and various organizations to promote the use and learning of Hindi both within and outside India.

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Q11. Answer: (c) 2

Given series: 3 7 9 2 1 5 3 9 2 6 5 8 7 9 1 3 5 9 4 6

The twelfth digit from the left end is: 8

and the eighth digit to the left of 8 is: 2

So, the eighth digit to the left of the twelfth digit from the left end of the series will be '2'.

Hence, the correct answer is "Option 3".

Q12. Answer: (c) indifference curve

The correct answer is indifference curve.

Key Points

• An indifference curve represents a series of combinations of two goods that provide equal utility or satisfaction to a consumer.

• It is a graphical representation in microeconomics used to illustrate consumer preferences.

• The curve is typically downward sloping, indicating that as the quantity of one good increases, the quantity of the other good must decrease to maintain the same level of satisfaction.

• Indifference curves do not intersect, as each curve represents a different level of utility.

Additional Information

• Consumer Curve:

• There is no specific economic concept termed as a "consumer curve". This term is incorrect in this context.

• Marginal Curve:

• A marginal curve typically represents the marginal utility or marginal cost. Marginal utility refers to the additional satisfaction gained from consuming one more unit of a good.

• Indifference Curve:

• An indifference curve shows combinations of goods that provide the same level of utility to the consumer, implying that the consumer is indifferent between these combinations.

• It is used in consumer theory to analyze consumer preferences and the trade-offs they are willing to make between different goods.

• Utility Curve:

• A utility curve represents the relationship between the quantity of goods consumed and the total utility derived from consuming those goods.

• It is typically used to illustrate the concept of total utility rather than showing combinations of goods that provide equal satisfaction.

Q13. Answer: (d) Potassium, Calcium and Magnesium

The correct answer is Potassium, Calcium and Magnesium.

Key Points

• Potassium helps strengthen cell walls and promotes overall plant health, making crops more resistant to diseases and pests.

• Calcium is crucial for cell wall structure and stability, which can help protect plants against pathogens.

• Magnesium is an essential component of chlorophyll, aiding in photosynthesis and promoting healthy plant growth, indirectly helping in pest resistance.

• These minerals work synergistically to enhance the plant's immune system, thus helping crops withstand various pest attacks.

Additional Information

• Potassium (K)

• It is a vital nutrient for plant growth and development, involved in enzyme activation, photosynthesis, water regulation, and protein synthesis.

• Potassium helps in the formation of strong stalks and enhances resistance to diseases and pests by improving the plant's overall vigor.

• Calcium (Ca)

• It plays a key role in maintaining the structural integrity of cell walls and membranes, which is essential for the plant's defense mechanisms.

• Calcium deficiency can lead to weaker cell walls, making plants more susceptible to diseases and pests.

• Magnesium (Mg)

• It is the central atom in the chlorophyll molecule, which is crucial for photosynthesis and energy production in plants.

• Magnesium also helps in the activation of many plant enzymes needed for growth and contributes to the plant's overall health and resistance to pests.

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• Importance of Pest Resistance

• Pest resistance is vital for maintaining crop yields and reducing the need for chemical pesticides, which can be harmful to the environment.

• Healthy plants with adequate nutrition are better equipped to resist pest attacks and recover from any damage caused.

Q14. Answer: (a) exothermic reaction

The correct answer is exothermic reaction.

In this process, glucose and oxygen are metabolized in cells to produce carbon dioxide, water, and energy (in the form of ATP), while releasing heat. This release of energy in the form of heat is a characteristic feature of exothermic reactions.

Key Points

• Respiration begins with the act of breathing, where air is inhaled through the nose and/or mouth and travels into the lungs.

• In the lungs, oxygen from the air is exchanged with carbon dioxide from the bloodstream.

• Oxygen is taken up by red blood cells, and carbon dioxide is released into the lungs.

• Oxygen-rich blood is then pumped by the heart to various tissues and cells in the body via the circulatory system.

• Within cells, oxygen is used in a process called cellular respiration to produce energy (in the form of ATP) from glucose and other organic molecules.

• During cellular respiration, glucose is broken down in a series of chemical reactions, releasing energy that is essential for various cellular functions and activities.

• ATP (adenosine triphosphate) is the primary energy currency of cells and is generated during cellular respiration.

• Carbon dioxide, a waste product of cellular respiration, is produced and transported back to the lungs through the bloodstream.

• Carbon dioxide is expelled from the body when you exhale, completing the respiratory cycle.

Additional Information The main organ systems in the human body;

Circulatory System	**This system is responsible for the circulation of blood throughout the body. It includes the heart, blood vessels, and blood.**
Respiratory System	The respiratory system is involved in breathing and gas exchange. It comprises the lungs, trachea, bronchi, and diaphragm.
Digestive System	The digestive system is responsible for the breakdown of food and absorption of nutrients. It includes the mouth, esophagus, stomach, small intestine, and large intestine, among other organs.
Excretory System	This system is involved in removing waste and excess substances from the body. It includes the kidneys, ureters, bladder, and urethra.
Nervous System	The nervous system controls and coordinates body functions. It comprises the brain, spinal cord, and peripheral nerves.
Endocrine System	The endocrine system regulates body functions through the secretion of hormones. It includes glands like the pituitary gland, thyroid gland, and adrenal glands.
Muscular System	This system is responsible for movement and includes skeletal muscles, smooth muscles, and cardiac muscles.
Skeletal System	The skeletal system provides structural support and protection for the body. It consists of bones, cartilage, and ligaments.
Integumentary System	The integumentary system includes the skin, hair, and nails and serves as a protective barrier for the body.
Reproductive System	The reproductive system is responsible for the production of offspring. It includes the male and female reproductive organs.
Immune System	The immune system protects the body against infections and diseases. It includes white blood cells, antibodies, and various immune organs and tissues.

Q15. Answer: (b) Both I and II strengthen the statement

Given statement: Prices of tomatoes in Kerala will rise sharply as many trucks carrying them from other states have been stopped at the border

Argument I. Tomatoes are mostly brought to Kerala from outside - This argument strengthens the statement because if tomatoes are primarily sourced from outside Kerala, stopping trucks at the border would severely limit the supply, thereby potentially causing prices to rise.

Argument II. The quantity of tomatoes grown in Kerala is not enough to meet the demand in the state - This argument also strengthens the statement because it indicates that Kerala depends on external sources for its tomato supply to meet demand. Thus, if supply lines are disrupted, it's logical that prices would increase due to the scarcity.

Thus, Both I and II strengthen the statement.

Hence, the correct answer is "Option 2".

Q16. Answer: (d) pH below 5.5

The correct answer is option 4) pH below 5.5

The critical pH level for tooth decay to start is generally around pH 5.5.

Key Points

• Dental caries, commonly referred to as tooth decay or cavities, is a condition in which the hard surface of the teeth is damaged, leading to small holes.

• Dental decay begins when the pH level in the mouth drops below a critical threshold.

• This drop in pH occurs when acids produced by bacteria in the mouth (often as a result of the fermentation of sugars) erode the enamel of the teeth.

• When the pH falls below 5.5, it causes the demineralization of tooth enamel, leading to the breakdown and the formation of cavities.

• Saliva in the mouth plays a crucial role in neutralizing acids and helping to prevent tooth decay by maintaining a balanced pH level.

Additional Information Main types of dental fillings;

Amalgam Fillings:	**• Also known as silver fillings, amalgam fillings are made from a combination of metals, including silver, tin, copper, and mercury. - They are strong and durable, making them suitable for filling cavities in molars and back teeth. - Amalgam fillings are silver in color and, therefore, more noticeable.**
Composite Resin Fillings:	• Composite fillings are tooth-colored and are made of a mixture of plastic and fine glass particles. - They are often used for front teeth or more visible areas of the mouth because they blend in with the natural tooth color. - Composite fillings bond directly to the tooth, which can help to strengthen the tooth structure.
Ceramic (Porcelain) Fillings:	• Ceramic fillings, also known as porcelain fillings, are made of a tooth-colored material that closely resembles natural teeth. - They are highly resistant to staining and are an aesthetic choice for visible teeth. - Ceramic fillings are durable and long-lasting.
Glass Ionomer Fillings:	• Glass ionomer fillings are made of glass and organic acid combination and are typically used for small fillings or on exposed root surfaces. - They release fluoride, which can help prevent further tooth decay. - Glass ionomer fillings are less durable than amalgam or composite fillings.
Gold Fillings (Inlays/Onlays):	• Gold fillings are made from gold alloy and are highly durable. - They are custom-made in a dental lab and then cemented into place. - Gold fillings are well-tolerated by gum tissues and can last for many years.
Resin-Modified Glass Ionomer Fillings:	• These fillings combine the benefits of glass ionomer and composite resins. - They release fluoride-like glass ionomer fillings and have the aesthetics and strength of composite fillings.
Temporary Fillings:	• Temporary fillings are used in situations where a more permanent filling will be placed later. - They are typically made of a softer material and are meant to protect the tooth until a final restoration can be done.

Q17. Answer: (b) 5.6 m

Given:

1.75 m tall person casts 2 m shadow.

lamp-post casts a shadow 6.4 m.

Calculation:

Let θ be the unknown angle of elevation.

Let the height of lamp post is x m.

=> tan θ = 1.75/2 = x/6.4

=> 2x = 11.2

=> x = 5.6

The height of lamp post is 5.6 m.

Therefore Option 2 is the correct answer.

Q18. Answer: (a) To motivate students studying in classes 6 to 10

The main objective of the INSPIRE Awards 'MANAK' is to motivate students at early age and studying in classes 6 to 10.

Hence, "Option 1" is the correct answer.

Additional InformationThe first component i.e. INSPIRE Award MANAK (Million Minds Augmenting National Aspiration and Knowledge) scheme, previously known as INSPIRE Award Scheme, is being implemented through State and UT governments with objectives:

(i) to attract young students to study science and pursue research career

(ii) to promote creative thinking and foster a culture of innovation among them.

Q19. Answer: (a) Rs. 14,400

Shortcut Trick

Rate 12.5% = 1/8. For 3 years (36 months), total interest = 3 × 1/8 = 3/8.

Amount = Principal + Interest = 1 + 3/8 = 11/8 units.

Given Amount = 11 units = Rs. 19,800 => 1 unit = Rs. 1,800.

Principal = 8 units = 8 × 1,800 = Rs. 14,400.

Therefore The correct answer is Rs. 14,400.

Alternate Method

Given:

Amount (A) = Rs. 19,800

Rate (R) = 12.5% per annum

Time (T) = 36 months = 36 ÷ 12 = 3 years

Formula Used:

Amount (A) = P + SI = P + (P × R × T) / 100 = P[1 + (R × T) / 100]

Calculations:

=> 19,800 = P [1 + (12.5 × 3) / 100]

=> 19,800 = P [1 + 37.5 / 100]

=> 19,800 = P [1 + 0.375]

=> 19,800 = 1.375 × P

=> P = 19,800 / 1.375

=> P = (19,800 × 1,000) / 1,375

=> P = 14,400

Therefore The correct answer is Rs. 14,400.

Additional Information

Simple Interest (SI) Formula

SI = (P × R × T) ÷ 100, where P is Principal, R is Rate, and T is Time in years.

Time Conversion

If time is given in months, convert it to years by dividing by 12. If given in days, divide by 365.

Difference between SI and CI

In Simple Interest, the interest remains constant every year, whereas in Compound Interest, interest is earned on the interest of previous years.

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Q20. Answer: (a) 0.67

The correct answer is 0.67.

Key Points

• The refractive index (n) of a medium determines how much the path of light is bent, or refracted, when entering a medium.

• The refractive index of medium A relative to medium B is calculated using Snell's Law: $n1 \times \sin(\theta1) = n2 \times \sin(\theta2)$.

• Given the angles, we can rearrange the formula to find the relative refractive index: $n(A/B) = (\sin(\theta2))/(\sin(\theta1))$.

• Substituting the given angles: $n(A/B) = (\sin(40°))/(\sin(70°))$.

Additional Information

• Snell's Law:

• Snell's Law describes how light rays are bent when they pass through the boundary between two different isotropic media.

• The law is formulated as $n1 \times \sin(\theta1) = n2 \times \sin(\theta2)$, where n1 and n2 are the refractive indices of the two media and θ1 and θ2 are the angles of incidence and refraction, respectively.

• Refractive Index:

• The refractive index of a medium is a measure of how much the speed of light is reduced inside the medium.

• It is calculated as the ratio of the speed of light in a vacuum to the speed of light in the medium.

• For example, the refractive index of water is about 1.33, meaning that light travels 1.33 times slower in water than in a vacuum.

• Angles of Incidence and Refraction:

• The angle of incidence is the angle between the incident ray and the normal to the surface at the point of incidence.

• The angle of refraction is the angle between the refracted ray and the normal to the surface at the point of refraction.

• These angles are crucial for calculating the refractive index using Snell's Law.

Q21. Answer: (d) 32 years

Shortcut Trick

Raju's age = Sister's age − Age difference

Raju's age = 38 − 6 = 32 years.

Therefore The correct answer is 32 years.

Alternate Method

Given:

Sister's age = 38 years

Difference = 6 years (Sister is older)

Formula Used:

Relative Age Equation: Sister's Age = Raju's Age + Difference

Calculations:

=> Let Raju's age be x.

=> x + 6 = 38

=> x = 38 − 6

=> x = 32 years

Therefore The correct answer is 32 years.

Additional Information

Constant Age Difference

The age difference between two people always remains constant, regardless of how many years pass.

Linear Age Equations

For 'n' years later, add 'n' to current age; for 'n' years ago, subtract 'n' from current age (Age ± n).

Q22. Answer: (b) Coastal areas

The correct answer is Coastal areas.

Key Points

• Mangroves are salt-tolerant trees that grow in coastal intertidal zones.

• They are usually found in tropical and subtropical regions.

• Mangroves have specialized root systems, such as prop roots and pneumatophores, that allow them to thrive in harsh coastal conditions.

• These ecosystems are critical for coastal protection, reducing erosion, and providing habitat for a wide range of marine species.

Additional Information

• Mangrove Ecosystems

• Mangroves are unique ecosystems found at the interface of land and sea in tropical and subtropical coastal regions.

• They act as buffers, protecting coastal areas from storm surges, tsunamis, and erosion.

• Mangrove forests provide critical breeding, feeding, and nursery grounds for a variety of marine and terrestrial species.

• They are highly productive and contribute significantly to coastal food webs and carbon sequestration.

• Adaptations of Mangroves

• Mangroves exhibit several adaptations to survive in saline and anaerobic (low oxygen) conditions.

• They have specialized root structures like prop roots, stilt roots, and pneumatophores that help in gas exchange and stability in soft, muddy soils.

• Some mangrove species excrete excess salt through specialized glands in their leaves.

• Others store salt in their leaves, which are later shed to get rid of the accumulated salt.

• Importance of Mangroves

• Mangroves are crucial for coastal protection, reducing the impact of storm surges and preventing coastal erosion.

• They play a significant role in carbon sequestration, helping to mitigate climate change by absorbing large amounts of CO2.

• Mangrove ecosystems support biodiversity by providing habitat and nursery grounds for numerous marine and terrestrial species.

• They also support local communities by providing resources such as fish, timber, and non-timber forest products.

Q23. Answer: (b) Joule's heating effect

The correct answer is Option 2. i.e. Joule's heating effect.

Key Points

• Joule's heating effect, also known as Joule heating, is the process by which the passage of an electric current through a conductor produces heat. This effect is named after James Prescott Joule who first discovered it.

• Joule heating is a result of collisions between moving charges in a conductor, typically electrons, and the atomic ions that make up the rest of the material. These collisions transfer energy from the moving charges to the ions, making them vibrate more, which is perceived as heat.

• The amount of heat produced according to Joule's first law can be calculated using the equation:

• $H = I^2Rt$

• Where,

• H = Heat energy produced (in joules) I = Current flow (in amperes) R = Resistance of the conductor (in ohms) t = Time for which the current is applied (in seconds)

• This effect is the principle behind many common applications, such as the heating elements in electric heaters and stoves, electric ovens, incandescent light bulbs, and electric fuses. It can also be unwanted, as in the case of power lines or electronic devices where excess heat can cause damage or reduce efficiency.

Important Points

Examples of the heating effect of electricity -

-

Q24. Answer: (a) 152

From the given Venn diagram,

The total number of persons who consume both cornflakes and buttered toast is,

100 + 52 = 152

Hence, the correct answer is "Option 1".

Q25. Answer: (b) Article 40

The correct answer is Article 40.

Key Points

• Article 40 of the Indian Constitution specifically directs the State to take steps to organize village panchayats and endow them with powers to function as units of self-government.

• This article falls under Part IV of the Constitution, which deals with the Directive Principles of State Policy.

• The aim is to promote democratic decentralization and rural self-governance to improve the socio-economic conditions of the village population.

• This article forms the constitutional basis for the establishment of the Panchayati Raj system in India.

Additional Information

• Directive Principles of State Policy (DPSP)

• DPSPs are guidelines for the framing of laws by the government. These provisions are not enforceable by any court but aim to create social and economic conditions under which the citizens can lead a good life.

• They are included in Part IV (Articles 36-51) of the Constitution of India.

• They embody the concept of a 'welfare state' and aim to establish social and economic democracy in the country.

• Panchayati Raj System

• The Panchayati Raj is a three-tier system of rural local governance in India, comprising village, intermediate, and district levels.

• The 73rd Amendment Act of 1992 gave constitutional status to the Panchayati Raj institutions and added Part IX to the Constitution, which deals with the Panchayats (Articles 243 - 243O).

• The Act provides for the establishment of Gram Sabhas and sets out the composition, powers, and functions of the Panchayats.

• Gram Sabha

• The Gram Sabha is the foundation of the Panchayati Raj system. It is a body consisting of persons registered in the electoral rolls of a village within the area of the Panchayat at the village level.

• It is a forum for the people to directly participate in the decision-making process and discuss local issues.

• Decentralization

• Decentralization refers to the transfer of authority and responsibility from higher levels of government to lower levels, particularly to local governments.

• It is aimed at empowering local bodies to manage local affairs, ensuring greater efficiency, accountability, and responsiveness to the needs of the community.

Q26. Answer: (d) 15

Shortcut Trick

Product of LCM and HCF = Product of Two Numbers

270 = 18 × Other Number

Other Number = 270 ÷ 18 = 15

Therefore The correct answer is 15.

Alternate Method

Given:

Product of HCF and LCM = 270

First Number (a) = 18

Formula Used:

LCM × HCF = a × b

Calculations:

=> Let the other number be b.

=> 270 = 18 × b

=> b = 270 ÷ 18

=> b = 15

Therefore The correct answer is 15.

Additional Information

LCM (Least Common Multiple)

The smallest positive integer that is divisible by both numbers a and b.

HCF (Highest Common Factor)

The largest positive integer that divides each of the numbers a and b without leaving a remainder.

Co-prime Numbers

Two numbers are co-prime if their HCF is 1. For co-prime numbers, LCM is simply the product of the numbers.

Q27. Answer: (b) B

Given: A, B, C, D, E and F are sitting around a circular table facing the centre.

1) B is sitting third to the right of F.

2) F is an immediate neighbour of both C and A.

3) C sits second to the right of B.

4) D is not the immediate neighbour of C.

After positioning D only position is left which will be occupied by the only person left i.e. E.

Thus, according to the final arrangement, B is sitting to the immediate left of E.

Hence, "Option 2" is the correct answer.

Q28. Answer: (c) 52, 91

The logic follows here is:

Logic: (First number × 2) - (First number ÷ 4) = Second Number

(24, 42) → (24 × 2) - (24 ÷ 4)

=> 48 - 6 = 42

And,

(36, 63) → (36 × 2) - (36 ÷ 4)

=> 72 - 9 = 63

Similarly,

(52, 91) → (52 × 2) - (52 ÷ 4)

=> 104 - 13 = 91

Hence, the correct answer is "Option 3".

Q29. Answer: (b) West Bengal

The correct answer is West Bengal.

Key Points

• The forest department of West Bengal has recognized its shortcomings in reviving the degraded Sal forests in the south-western districts of the state.

• Sal forests are predominantly found in the eastern regions of India, and West Bengal is one of the states where these forests are located.

• The Sal forests are crucial for the ecological balance and livelihood of the local communities in the south-western districts of West Bengal.

• The degradation of these forests has impacted biodiversity and the overall health of the ecosystem in these regions.

Additional Information

• Sal Forests

• Sal (Shorea robusta) is a species of tree that dominates the forests of the eastern and central regions of India.

• These forests are known for their high-quality timber, which is used in construction, furniture, and other industries.

• Sal forests play a vital role in maintaining the ecological balance, supporting biodiversity, and providing livelihoods to local communities.

• The degradation of Sal forests can lead to soil erosion, loss of habitat for wildlife, and adverse climatic changes.

• Forest Degradation

• Forest degradation refers to the decline in forest quality, including the loss of biodiversity, forest structure, and function.

• It is often caused by human activities such as deforestation, over-exploitation of forest resources, and unsustainable land use practices.

• Degraded forests are less capable of providing ecosystem services, such as carbon sequestration, water regulation, and soil protection.

• Restoration efforts are essential to reverse degradation and ensure the sustainability of forest ecosystems.

• Ecological Importance of Forests

• Forests are vital for maintaining the Earth's biodiversity, providing habitat for numerous plant and animal species.

• They play a critical role in the global carbon cycle by sequestering carbon dioxide and mitigating climate change.

• Forests regulate water cycles, prevent soil erosion, and protect watersheds.

• They also offer recreational, cultural, and economic benefits to human societies.

Q30. Answer: (d) One

Given number: 25731640

Let's arrange the number in descending order, we get

Original number	**2**	**5**	**7**	**3**	**1**	**6**	**4**	**0**
Number after arrangement	7	6	5	4	3	2	1	0

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Since only '0' remains unchanged after the arrangement. Thus, only one digit is unchanged.

Hence, the correct answer is "Option 4".

Q31. Answer: (c) 40% and 42.83%

Calculation:

Decrease in deaths from 2021 to 2022 is = 5000 - 3000 = 2000

% in decrease is given by:

=> (2000/5000) × 100

=> 40%

Increase in deaths from 2020 to 2021 is = 5000 - 3500 = 1500

% in decrease is given by:

=> (1500/3500) × 100

=> 42.83%

Therefore Option 3 is the correct answer.

Q32. Answer: (b) Viral particles are abundant in seminal fluid

The correct answer is Viral particles are abundant in seminal fluid.

Key Points

• HIV (Human Immunodeficiency Virus) is primarily spread through contact with certain body fluids of an infected person, including blood, semen, vaginal fluids, and breast milk.

• During sexual contact, seminal fluid from an infected individual can carry a high concentration of viral particles, facilitating the transmission of the virus to their partner.

• HIV targets the immune system, specifically the CD4 cells (T cells), which are crucial in helping the body fight infections.

• Unprotected sexual intercourse (vaginal, anal, or oral) increases the risk of transmitting HIV, especially if there are cuts or sores present in the genital area which provide an entry point for the virus.

Additional Information

• HIV (Human Immunodeficiency Virus)

• HIV is a virus that targets the immune system and weakens people's defense systems against infections and some types of cancer.

• As the virus destroys and impairs the function of immune cells, infected individuals gradually become immunodeficient.

• HIV is transmitted through the exchange of a variety of body fluids from infected individuals, such as blood, breast milk, semen, and vaginal secretions.

• It is important to note that HIV cannot be transmitted through casual contact such as hugging, shaking hands, or sharing personal objects, food, or water.

• AIDS (Acquired Immunodeficiency Syndrome)

• AIDS is the most severe phase of HIV infection. It occurs when the immune system is badly damaged, and the body becomes vulnerable to opportunistic infections and certain cancers.

• Without treatment, people with AIDS typically survive about three years. Once someone has a dangerous opportunistic illness, life expectancy without treatment falls to about one year.

• Common symptoms include rapid weight loss, recurring fever or profuse night sweats, extreme and unexplained tiredness, prolonged swelling of the lymph glands in the armpits, groin, or neck.

• Prevention of HIV

• Consistent and correct use of condoms during sexual intercourse significantly reduces the risk of HIV transmission.

• Regular testing and treatment for sexually transmitted infections (STIs) can reduce the risk of HIV infection.

• Pre-exposure prophylaxis (PrEP) is an HIV prevention method in which people who do not have HIV take HIV medicine daily to reduce their risk of getting HIV.

• Avoiding the sharing of needles, syringes, or other drug injection equipment can prevent the transmission of HIV among people who inject drugs.

• Treatment of HIV

• While there is no cure for HIV, it can be controlled with proper medical care. Antiretroviral therapy (ART) is the use of HIV medicines to treat HIV infection.

• People on ART take a combination of HIV medicines every day. ART helps to control the virus and live a longer, healthier life, and reduces the risk of HIV transmission.

• Adherence to ART is crucial. Skipping doses can lead to drug resistance and treatment failure.

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Q33. Answer: (b) Second to the left of A

Given: Six friends, A, B, C, D, E, and F are sitting around a circular table facing the centre.

1) F is second to the right of C and third to the left of A.

2) C is the immediate neighbour of A and E.

3) B is second to the left of C.

After positioning B only position is left which will be occupied by the only person left i.e. D.

Thus, according to the final arrangement, D is second to the left of A.

Hence, "Option 2" is the correct answer.

Q34. Answer: (d) Allahabad

The correct answer is Allahabad.

Key Points

• Jawaharlal Nehru, the first Prime Minister of independent India, was born on 14 November 1889 in Allahabad.

• Allahabad, now known as Prayagraj, is a city in the Indian state of Uttar Pradesh.

• He was born into a wealthy and politically active family, with his father Motilal Nehru being a prominent lawyer and nationalist leader.

• Jawaharlal Nehru played a pivotal role in India's struggle for independence and was a central figure in Indian politics both before and after independence.

Additional Information

• Jawaharlal Nehru

• Jawaharlal Nehru was an Indian independence activist and, subsequently, the first Prime Minister of India.

• He emerged as a prominent leader of the Indian independence movement under the tutelage of Mahatma Gandhi.

• Nehru's vision of India was rooted in secularism, socialism, and democracy.

• He is also remembered for his efforts in establishing institutes of higher learning, such as the Indian Institutes of Technology (IITs) and the All India Institute of Medical Sciences (AIIMS).

• Allahabad (Prayagraj)

• Allahabad, officially known as Prayagraj, is a historic city in the state of Uttar Pradesh in India.

• It is one of the oldest cities in India, with a history dating back to ancient times.

• The city is known for its confluence of three rivers – the Ganges, the Yamuna, and the mythical Saraswati – a site called Triveni Sangam.

• Prayagraj is also famous for the Kumbh Mela, a mass Hindu pilgrimage held every 12 years.

• Motilal Nehru

• Motilal Nehru was an Indian lawyer, activist, and politician who was a leader of the Indian National Congress.

• He was a prominent figure in the Indian independence movement and the father of Jawaharlal Nehru.

• Motilal Nehru was an advocate of constitutional reforms and played a key role in the drafting of the Nehru Report, which outlined a proposed constitutional framework for India.

Q35. Answer: (d) 9051/7 cm3

Shortcut Trick

Total Volume = Sum of individual volumes.

$V = 4/3 \times \pi \times (r1^3 + r2^3 + r3^3)$

$V = 4/3 \times 22/7 \times (3^3 + 4^3 + 5^3) = 4/3 \times 22/7 \times (27 + 64 + 125)$

$V = 4/3 \times 22/7 \times 216 = 88/21 \times 216 = 88 \times 72/7 = 6336/7 = 905\ 1/7\ cm^3$.

Therefore The correct answer is $905\ 1/7\ cm^3$.

Alternate Method

Given: Radii of three spheres are r1 = 3 cm, r2 = 4 cm, and r3 = 5 cm. $\pi = 22/7$.

Formula Used: Volume of a sphere = $4/3 \times \pi \times r^3$.

=> Volume of 1st sphere = $4/3 \times \pi \times 3^3 = 4/3 \times \pi \times 27 = 36\pi$

=> Volume of 2nd sphere = $4/3 \times \pi \times 4^3 = 4/3 \times \pi \times 64 = 256\pi/3$

=> Volume of 3rd sphere = $4/3 \times \pi \times 5^3 = 4/3 \times \pi \times 125 = 500\pi/3$

=> Total Volume = $36\pi + 256\pi/3 + 500\pi/3 = (108\pi + 256\pi + 500\pi) / 3$

=> Total Volume = $864\pi / 3 = 288\pi$

=> Total Volume = $288 \times 22/7 = 6336/7$

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=> Total Volume = 905 1/7 cm^3

Therefore The correct answer is 905 1/7 cm^3.

Additional Information

Surface Area of Sphere

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

Radius of Resulting Sphere

When n spheres are melted to form one, the new radius R satisfies $R^3 = r1^3 + r2^3 + ... + r_n^3$.

Volume of Hemisphere

The volume of a hemisphere is exactly half of a sphere: $2/3 \times \pi r^3$.

Q36. Answer: (c) 2021

The correct answer is 2021.

Key Points

• Lakhimi Baruah was awarded the Padma Shri in the year 2021 for her contributions in the field of social work.

• She is the founder of the Konoklota Mahila Urban Cooperative Bank, which is dedicated to empowering women in Assam.

• The Padma Shri is the fourth highest civilian award in India, recognizing distinguished contributions in various fields including arts, education, industry, literature, science, sports, medicine, social service and public affairs.

• Lakhimi Baruah's efforts have significantly contributed to the financial independence and empowerment of women in her community.

Additional Information

• Padma Awards

• The Padma Awards are one of the highest civilian honors in India and are categorized into three awards: Padma Vibhushan, Padma Bhushan, and Padma Shri.

• Padma Vibhushan is awarded for exceptional and distinguished service, Padma Bhushan for distinguished service of a high order, and Padma Shri for distinguished service in any field.

• The awards are announced annually on the occasion of Republic Day.

• The awardees are selected based on their contributions to various disciplines such as arts, social work, public affairs, science and engineering, trade and industry, medicine, literature and education, sports, civil service, and others.

• Konoklota Mahila Urban Cooperative Bank

• Founded by Lakhimi Baruah, this bank aims to provide financial services to women, especially those who are economically disadvantaged.

• The bank offers various schemes and financial products that help women in starting their own businesses, thereby promoting women entrepreneurship and economic independence.

• It is a significant initiative towards the financial inclusion of women in the rural and urban areas of Assam.

Q37. Answer: (c) Valabhi in Gujarat

The correct answer is Valabhi in Gujarat.

Key Points

• The teachings of Mahavira and his followers were compiled and written down in the form of Jain Agamas at Valabhi in Gujarat.

• The Jain Agamas are canonical scriptures of Jainism and were orally transmitted for many centuries before being written down.

• The compilation of these teachings took place around the 5th to 6th century CE.

• Valabhi was an important center of Jain scholarship and education during that period.

Additional Information

• Mahavira:

• Mahavira, also known as Vardhamana, was the 24th Tirthankara of Jainism.

• He was born in 599 BCE in Kundagrama, near Vaishali (now in Bihar).

• Mahavira preached non-violence, truth, and asceticism and is considered a reformer of the Jain community.

• Jain Agamas:

• The Jain Agamas are a collection of texts based on the teachings of Mahavira and his disciples.

• They form the primary scriptures of Jainism, particularly for the Svetambara sect.

• The Agamas were composed of various types of works such as sutras, commentaries, and philosophical texts.

• Compilation at Valabhi:

• Valabhi, located in present-day Gujarat, was a major center of learning and a hub for Jain monks and scholars.

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• The Jain council held at Valabhi under the leadership of Devardhigani Kshamashramana is believed to have finalized the compilation of the Agamas.

• This event ensured the preservation and propagation of Jain teachings for future generations.

Q38. Answer: (d) 17

Given: A certain number of people are sitting in a row, facing north.

1) No one is sitting to the right of E.

2) Only two people are sitting to the left of B.

3) D is sitting third to the right of B.

4) Only four people are seated between B and F.

5) Only eight people are seated between D and C.

6) E is seated second to the right of C.

Thus, according to the final arrangement, 17 is the total number of persons seated.

Hence, "Option 4" is the correct answer.

Q39. Answer: (c) 54

Calculation:

=> √2187×√432over√324

=> 27√3×12√3over18

=> 54

Therefore Option 3 is the correct answer.

Q40. Answer: (b) Andhra Pradesh

The correct answer is Andhra Pradesh.

Key Points

• The Andhra Pradesh police developed an app called 'Disha' for women's safety in February 2020.

• The 'Disha' app was named after a woman who was a victim of a heinous crime in the state, sparking outrage and a call for enhanced safety measures.

• The app aims to provide rapid assistance to women in distress with features such as SOS, police station locator, and nearby hospital locator.

• It is part of a larger initiative by the Andhra Pradesh government to improve women's safety, including the Disha Act which aims to expedite the trial and punishment of crimes against women.

Additional Information

• Disha App

• The Disha app was developed to enhance the safety and security of women in the state of Andhra Pradesh.

• It includes features such as an SOS button which, when pressed, sends an immediate alert to the nearest police control room.

• The app also provides information on the nearest police stations and hospitals, making it easier for women to seek help in emergencies.

• It is part of the broader Disha initiative, which includes the Disha Act, aimed at fast-tracking the trial and conviction of offenders in crimes against women.

• Women's Safety Initiatives in India

• Various states in India have launched different initiatives to enhance women's safety, including the She Teams in Telangana and the Suraksha app in Karnataka.

• The Ministry of Women and Child Development, Government of India, has also launched initiatives like the One Stop Centre Scheme and the Women's Helpline 181.

• These initiatives aim to provide immediate assistance to women in distress and ensure their safety and protection.

Q41. Answer: (a) parallelogram

Shortcut Trick

In any parallelogram, the diagonals bisect each other. Let the diagonals AC and BD of parallelogram ABCD intersect at point O.

Since O is the midpoint of diagonal AC, we have OA = OC.

Given that AE = FC, subtracting these equal lengths from OA and OC gives: OA − AE = OC − FC => OE = OF.

Thus, O is also the midpoint of segment EF, which means the diagonals BD and EF of quadrilateral BEDF bisect each other.

A quadrilateral whose diagonals bisect each other is always a parallelogram.

Therefore The correct answer is parallelogram.

Alternate Method

Given:

=> ABCD is a parallelogram.

=> E and F are points on the diagonal AC such that AE = FC.

Properties Used:

=> In a parallelogram, opposite sides are equal and parallel.

=> SAS (Side-Angle-Side) Congruence Criterion: If two sides and the included angle of one triangle are equal to two sides and the included angle of another triangle, the triangles are congruent.

=> If both pairs of opposite sides of a quadrilateral are equal, then the quadrilateral is a parallelogram.

Calculations:

In triangles ΔADE and ΔCBF:

=> AD = BC (Opposite sides of parallelogram ABCD are equal)

=> angle DAE = angle BCF (Alternate interior angles, since AD || BC and diagonal AC is a transversal)

=> AE = FC (Given)

=> ΔADE ~= ΔCBF (By SAS congruence criterion)

=> DE = BF (By CPCT) --- (Equation 1)

Similarly, in triangles ΔABE and ΔCDF:

=> AB = CD (Opposite sides of parallelogram ABCD are equal)

=> angle BAE = angle DCF (Alternate interior angles, since AB || CD and diagonal AC is a transversal)

=> AE = FC (Given)

=> ΔABE ~= ΔCDF (By SAS congruence criterion)

=> BE = DF (By CPCT) --- (Equation 2)

In quadrilateral BEDF, from Equation 1 and Equation 2:

=> DE = BF and BE = DF

Since both pairs of opposite sides of quadrilateral BEDF are equal, BEDF is a parallelogram.

Why other options are incorrect:

=> Rectangle: A rectangle requires all interior angles to be 90°. Since the angles of the original parallelogram ABCD are not specified as 90°, the angles of BEDF are also not necessarily 90°.

=> Square: A square requires all sides to be equal and all angles to be 90°, which is not guaranteed here.

=> Trapezium, but not a parallelogram: A trapezium has only one pair of parallel sides, whereas BEDF has both pairs of opposite sides parallel and equal, making it a full parallelogram.

Therefore The correct answer is parallelogram.

Additional Information

Properties of a Parallelogram

Opposite sides are equal and parallel, opposite angles are equal, consecutive angles are supplementary, and diagonals bisect each other.

Sufficient Conditions for a Quadrilateral to be a Parallelogram

A quadrilateral is a parallelogram if both pairs of opposite sides are equal, both pairs of opposite angles are equal, or its diagonals bisect each other.

SAS Congruence Criterion

If two sides and the included angle of one triangle are equal to two sides and the included angle of another triangle, then the two triangles are congruent.

Q42. Answer: (d) None

Given word: NOTED

Let's arrange the letters in alphabetical order, we get

Alphabets	**N**	**O**	**T**	**E**	**D**
Alphabetical order	D	E	N	O	T

Since the position of none of the letters remains unchanged.

Hence, the correct answer is "Option 4".

Q43. Answer: (c) 1973

The correct answer is 1973.

Key Points

• Steel Authority of India Ltd (SAIL) was incorporated on 24th January 1973.

• SAIL is one of the largest steel-making companies in India and one of the Maharatnas of the country's Central Public Sector Enterprises.

• It operates and owns 5 integrated steel plants at Bhilai, Rourkela, Durgapur, Bokaro, and Burnpur (Asansol) and 3 special steel plants at Salem, Durgapur, and Bhadravathi.

• SAIL traces its origins to the Hindustan Steel Limited (HSL) which was set up in 1954, with which it was merged later on to form a single entity.

Additional Information

• Maharatna Status:

• The Maharatna status is the highest recognition for public sector enterprises in India.

• It allows greater autonomy for investment and operations compared to other public sector enterprises.

• To qualify as a Maharatna, a company must have an annual turnover of more than Rs 25,000 crore, net profit after tax of more than Rs 5,000 crore, and a significant global presence.

• Integrated Steel Plants:

• An integrated steel plant is a factory where all the processes required for steel production are carried out from raw material handling to finished steel production.

• These processes include melting, casting, rolling, and finishing.

• SAIL's integrated steel plants are located at various strategic locations across India, enhancing its production capacity and market reach.

• Public Sector Enterprises:

• Public Sector Enterprises (PSEs) are companies in which the majority of the equity is owned by the government.

• They play a crucial role in the economic development of a country by contributing to GDP, employment, and industrialization.

• In India, PSEs are classified into Maharatna, Navratna, and Miniratna based on their performance and scale of operations.

Q44. Answer: (c) Only conclusion 1 follows.

Statements: B < D, C = E, F > D, E < G, K = G, C < F

Conclusions:

1. G > C → True (C = E < G, it gives G > C)

2. G < C → False (C = E < G, it gives G > C)

Thus, only Conclusion 1 follows.

Hence, the correct answer is "Option 3".

Q45. Answer: (a) 20 km

According to the given information,

Rahul drives 80 km towards the north,

then he turns towards the west and drives 100 km.

After that, he turns south and drives 80 km,

He turns east and drives 120 km.

Thus, the endpoint is 20 km far from the initial point.

Hence, the correct answer is "Option 1".

Q46. Answer: (a) 1771 cm²

Shortcut Trick

Curved Surface Area of a cylinder = Base Circumference × Height.

Given Circumference = 77 cm and Height = 23 cm.

CSA = 77 × 23 = 1771 cm².

Therefore The correct answer is 1771 cm².

Alternate Method

Given:

Height (h) = 23 cm

Circumference ($2\pi r$) = 77 cm

Formula Used:

Curved Surface Area (CSA) = 2 × π × r × h

=> 2πr = 77

=> CSA = (2πr) × h

=> CSA = 77 × 23

=> CSA = 1771 cm²

Therefore The correct answer is 1771 cm².

Additional Information

Total Surface Area of Cylinder

TSA includes the top and bottom circles: TSA = 2πr(h + r).

Volume of Cylinder

The space occupied by the cylinder is given by Volume = πr²h.

Base Area

The area of the circular base is πr². It can be found from circumference (C) as Area = C² / (4π).

Q47. Answer: (a) SSUEH

The logic follows here is:

And,

Similarly,

Thus, 'PURGE' is written as 'SSUEH'.

Hence, the correct answer is "Option 1".

Q48. Answer: (b) PTTFX

Given solution in given html code format:

Given:

Number/Symbol	/	#	9	7	@	%		2	!	?	6	4	<	=
Code	D	F	T	J	N	G	E	X	V	W	K	U	P	Z

Conditions	Coded As
first element is a number and the last a symbol	codes for these two are to be interchanged
first element is an odd number and the last an even number	the last elements are to be coded as ø
both the second and third elements are perfect squares	third element is to be coded as the code for the second element

Now, the group of numbers and symbols is: < 9 4 # 2

Here, Here, Third conditions followed in the given group,

So, third element is to be coded as the code for the second element.

Then, the code for '< 9 4 # 2' is → 'PTTFX'.

Hence, the correct answer is "Option 2".

Q49. Answer: (b) England

The correct answer is England.

Key Points

• Jhulan Goswami, an Indian cricketer, is one of the most successful bowlers in women's cricket history.

• On 16 March 2022, she became the highest wicket-taker in Women's ODIs by claiming her 250th wicket.

• She achieved this milestone during a match against England.

• Jhulan Goswami is celebrated for her significant contributions to Indian women's cricket, particularly as a bowler.

Additional Information

• Jhulan Goswami

• She made her debut in international cricket in 2002 and has since been a pivotal player for the Indian women's cricket team.

• She is known for her pace and accuracy, making her one of the most feared bowlers in women's cricket.

• In addition to her ODI success, she has also made notable contributions in Test and T20I formats.
• Jhulan has been awarded several honors, including the ICC Women's Player of the Year in 2007.
• Women's One Day International (ODI) Cricket
• ODI cricket is a format of limited overs cricket, played between two teams with international status.
• Each team faces a fixed number of overs, usually 50.
• Women's ODI cricket has gained significant popularity and recognition over the years, with many countries actively participating in international tournaments.
• The ICC Women's Cricket World Cup is the premier international championship of women's ODI cricket.
• Wicket-taking in Cricket
• In cricket, taking a wicket refers to the dismissal of a batsman by the bowler or the fielding team.
• Dismissals can occur in several ways, including being bowled, caught, leg before wicket (LBW), run out, and stumped.
• Wicket-taking is a crucial aspect of the game, as it helps to restrict the opposing team's score and bring about their batting collapse.
• Successful bowlers like Jhulan Goswami play a key role in their team's success by consistently taking wickets.

Q50. Answer: (d) 25 metres

Shortcut Trick

Relative Speed (Same direction) = 36 − 26 = 10 km/h.

Convert to m/s = 10 × (5/18) m/s.

Total Distance (2L) = Speed × Time = [10 × (5/18)] × 18 = 50 m.

Length of each train (L) = 50 ÷ 2 = 25 m.

Therefore The correct answer is 25 metres.

Alternate Method

Given:

Speed of faster train (S1) = 36 km/h

Speed of slower train (S2) = 26 km/h

Time taken to cross (t) = 18 seconds

Let the length of each train be 'L' metres.

Formula Used:

Relative Speed (Same Direction) = S1 − S2

Distance = Speed × Time

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

Calculations:

=> Relative Speed = 36 − 26 = 10 km/h

=> Relative Speed in m/s = 10 × (5/18) = 25/9 m/s

=> Total distance covered = Length of Train 1 + Length of Train 2 = L + L = 2L

=> 2L = (25/9) × 18

=> 2L = 25 × 2

=> 2L = 50

=> L = 25 m

Therefore The correct answer is 25 metres.

Additional Information

Relative Speed Rules

When moving in the same direction, relative speed is (S1 − S2). When moving in the opposite direction, relative speed is (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 Distance

When one train crosses another train (stationary or moving), the total distance to be covered is always the sum of their lengths (L1 + L2).

Q51. Answer: (c) None of the conclusions follow

Given Statements:

Some pliers are levers

All levers are ramps

Some cutters are pliers.

Conclusions:

(I) Some cutters are levers → False (No direct relationship given between cutters and levers so, it is possible but not definite)

(II) Some ramps are cutters → False (No direct relationship given between ramps and cutters so, it is possible but not definite)

(III) All pliers are ramps → False (No direct relationship given between pliers and ramps so, it is possible but not definite)

Thus, None of the Conclusions follow.

Hence, the correct answer is "Option 3".

Q52. Answer: (a) $x^2 + 4x - 32 = 0$

Shortcut Trick

Solve x2 + 4x − 21 = 0: Factors of −21 that sum to 4 are 7 and −3, so roots are −7 and 3.

Since p < q, we have p = −7 and q = 3.

New roots are (p − 1) = −8 and (q + 1) = 4.

Sum of new roots = −8 + 4 = −4; Product of new roots = −8 × 4 = −32.

New equation: x2 − (−4)x + (−32) = 0 => x2 + 4x − 32 = 0.

Therefore The correct answer is x2 + 4x − 32 = 0.

Alternate Method

Given quadratic equation: x2 + 4x − 21 = 0

To find the roots p and q, we factorize the expression:

=> x2 + 7x − 3x − 21 = 0

=> x(x + 7) − 3(x + 7) = 0

=> (x + 7)(x − 3) = 0

=> x = −7 or x = 3

According to the condition p < q:

=> p = −7 and q = 3

The roots of the required quadratic equation are:

=> First root (α) = p − 1 = −7 − 1 = −8

=> Second root (β) = q + 1 = 3 + 1 = 4

Forming the new equation using the sum and product of roots:

=> Sum of roots (α + β) = −8 + 4 = −4

=> Product of roots (αβ) = −8 × 4 = −32

=> The equation is: x2 − (α + β)x + αβ = 0

=> x2 − (−4)x + (−32) = 0

=> x2 + 4x − 32 = 0

Therefore The correct answer is x2 + 4x − 32 = 0.

Additional Information

Sum and Product of Roots

For any quadratic equation ax2 + bx + c = 0, the sum of roots is −b/a and the product of roots is c/a.

Formation of Quadratic Equation

If α and β are the roots, the quadratic equation is constructed as x2 − (α + β)x + αβ = 0.

Nature of Roots

The discriminant (D = b2 − 4ac) determines if roots are real and distinct (D > 0), real and equal (D = 0), or imaginary (D < 0).

Q53. Answer: (d) SIY : NDT

The logic follows here is :

And,

Now, let's check the options one by one,

Option 1: QHK : JSP

Option 2: FHL : CIU

Option 3: DUR : APM

Option 4: SIY : NDT

Thus, 'SIY : NDT' follows the same logic.

Hence. the correct answer is "Option 4".

Q54. Answer: (a) Only conclusion II follows.

The least possible Venn diagram for the given statements is as shown below :

Conclusions:

I. All cheese are milk → Does not follow (As all milk are cheese. So it is possible but not definite.)

II. Some custards are cheese → Follow (As some cheese are custards. As some part of cheese is common with custards, therefore it is true.)

Therefore Here, Only conclusion II follows.

Hence, the correct answer is "Option 1".

Q55. Answer: (a) F

Given: A, B, C, D, E and F live on six different floors of the same building. The lowermost floor in the building is numbered 1, the floor above it, number 2 and so on till the topmost floor is numbered 6.

1) Only one person lives below E.

Floor	Person
6	
5	
4	
3	
2	E
1	

2) A does not live on the topmost floor.

3) Only three people live between A and C.

4) C lives below A.

Floor	Person
6	
5	A
4	
3	
2	E
1	C

5) D lives immediately above B.

After positioning D and B, only one floor is left which will be occupied by the only person left i.e. F.

Floor	Person
6	F
5	A
4	D
3	B
2	E
1	C

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Thus, according to the final arrangement, F lives immediately above A.

Hence, "Option 1" is the correct answer.

Q56. Answer: (b) Graphite

The correct answer is Option - 2. i.e. Graphite.

Key Points

• For electricity conduction, Free electrons /ions are needed.

• Graphite is the only allotrope of carbon, in which free electrons are present because of its unique structure.

• Because of this Graphite is a good conductor of electricity.

• Graphite conducts electricity due to its unique electronic structure.

• To understand why, we need to look at the crystalline structure and bonding of graphite.

• Graphite is a form of carbon in which the carbon atoms are arranged in layers in a hexagonal lattice.

• Each carbon atom is bonded to three other carbon atoms. The fourth outer shell electron of each atom is delocalized, allowing for electrons to move freely across the layers - these are the electrons that carry an electric current.

• This structure and the delocalization of an electron in each carbon atom are why graphite can conduct electricity. Furthermore, this conduction is directional, meaning that graphite is a better conductor of electricity along the layers ('ab' plane) than across them.

• This conductivity gives graphite its use in various applications, such as in electrodes in batteries and fuel cells, and in electric motor brushes.

• However, graphite's electrical conductivity is lower than many metals, such as copper, meaning that it won't conduct electricity as efficiently. Despite this, its ability to withstand high temperatures and resist chemical erosion makes it useful in settings where these factors come into play.

Additional InformationStructure of Graphite -

Allotropes of Carbon -

Q57. Answer: (b) Fleming's right hand rule

The correct answer is Fleming's right hand rule.

Key Points

• Fleming's right hand rule is used to determine the direction of induced current when a conductor moves through a magnetic field.

• According to this rule, if you point your thumb in the direction of the conductor's motion and your forefinger in the direction of the magnetic field, your middle finger will point in the direction of the induced current.

• It is especially useful in applications involving electromagnetic induction, such as electric generators.

• This rule helps in understanding the relationship between motion, magnetic field, and induced current in a conductor.

Additional Information

• Fleming's Left Hand Rule

• It is used to find the direction of force experienced by a current-carrying conductor in a magnetic field.

• If the thumb, forefinger, and middle finger of the left hand are held mutually perpendicular to each other, and the forefinger points in the direction of the magnetic field and the middle finger in the direction of the current, then the thumb will point in the direction of the force on the conductor.

• This rule is commonly used in the design of electric motors.

• Right Hand Thumb Rule

• This rule is used to find the direction of the magnetic field around a current-carrying conductor.

• If you hold the conductor in your right hand with the thumb pointing in the direction of the current, the direction in which your fingers curl represents the direction of the magnetic field.

• Corkscrew Rule

• The corkscrew rule is similar to the right-hand thumb rule.

• It states that if a right-handed screw is turned in the direction of the current, the direction of advance of the screw represents the direction of the magnetic field lines.

Q58. Answer: (b) 2

Given word: ADVERSE

According to the question:

Forward pairs: RS

Backward pairs: SV

Therefore The total number of pairs in both forward and backward directions is 'two'.

Hence, "Option 2" is the correct answer.

Q59. Answer: (a) 198

The solution is in Hindi. Read it online.

Q60. Answer: (d) C19M

The logic followed here is:

Hence, "Option 4" is the correct answer.

Q61. Answer: (a) the direction of current as well as magnitude changes with time

The correct answer is Option - 1

Key Points

• In alternating current, the electric charge changes direction periodically means the direction varies from instant to instant.

• The voltage in the AC circuit also periodically reverses because the current changes direction.

• So, a change in both the direction and magnitude happens.

Important Points

• Alternating current (AC) is a type of electrical current that periodically reverses direction, in contrast to direct current (DC) which flows only in one direction.

• AC is the form in which electric power is delivered to businesses and residences.

• Alternating current is produced by most power stations and is used in homes and businesses. The AC in most homes and offices has a frequency of 60 hertz, which means it changes direction, or cycles, 60 times each second.

• The advantage of AC is that it can be transmitted over long distances due to its ability to be easily transformed to high voltage. High voltage transmission is more efficient because it reduces the energy lost to heat due to the resistance in wires over long distances*. Transformers are used to increase the voltage for transmission and decrease it for user-end applications.*

• Please note that AC can also be dangerous because it can stop the human heart due to the frequency similar to the heart's electrical signals. Therefore, careful precautions are always taken when working with AC.

Additional InformationDifference between AC and DC -

Q62. Answer: (a) Twenty-Fourth Amendment Act

The correct answer is Twenty-Fourth Amendment Act.

Key Points

• The Twenty-Fourth Amendment of the Constitution of India was enacted in 1971.

• This amendment affirmed the power of Parliament to amend any part of the Constitution, including Part III which deals with Fundamental Rights.

• It was a response to the Supreme Court's ruling in Golaknath v. State of Punjab (1967) which held that Parliament could not curtail any of the Fundamental Rights.

• The amendment made it explicit that the Parliament has the power to amend any provision of the Constitution by way of addition, variation, or repeal.

Additional Information

• Golaknath v. State of Punjab (1967)

• This landmark case in Indian constitutional history held that Parliament could not amend Fundamental Rights.

• It placed restrictions on the Parliament's power to amend the Constitution under Article 368.

• The ruling prompted the government to seek ways to reassert parliamentary sovereignty, leading to the Twenty-Fourth Amendment.

• Kesavananda Bharati v. State of Kerala (1973)

• This case re-examined the scope of Parliament's power to amend the Constitution.

• The Supreme Court ruled that while Parliament could amend any part of the Constitution, it could not alter its 'basic structure'.

• The 'basic structure' doctrine emerged as a significant judicial innovation ensuring that certain fundamental principles remain inviolable.

• Forty-Fourth Amendment Act (1978)

• This amendment was enacted to restore certain provisions and checks that were altered during the Emergency (1975-77).

• It ensured that some of the rights and freedoms curtailed during the Emergency were reinstated.

• The amendment also provided that certain emergency powers and provisions would require a more stringent process to be invoked in the future.

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Q63. Answer: (a) Formation of calcium hydroxide

The correct answer is Formation of calcium hydroxide.

Key Points

• Formation of calcium hydroxide involves the combination of calcium oxide (CaO) and water (H_2O) to form calcium hydroxide ($Ca(OH)_2$).

• It is an example of a combination reaction where two reactants combine to form a single product.

• The balanced chemical equation for this reaction is: $CaO + H_2O \rightarrow Ca(OH)_2$.

• Calcium hydroxide is commonly known as slaked lime and is used in various applications such as water treatment, construction, and the production of mortar and plaster.

Additional Information

• Combination Reaction

• A combination reaction is a chemical reaction where two or more substances (reactants) combine to form a single new substance (product).

• These reactions are also known as synthesis reactions.

• Combination reactions can involve elements or compounds, and they usually release energy in the form of heat and light.

• Examples include the formation of water from hydrogen and oxygen ($2H_2 + O_2 \rightarrow 2H_2O$) and the formation of carbon dioxide from carbon and oxygen ($C + O_2 \rightarrow CO_2$).

• Calcium Hydroxide

• Calcium hydroxide, also known as slaked lime, is an inorganic compound with the chemical formula $Ca(OH)_2$.

• It is produced by adding water to calcium oxide (quicklime), a process called slaking.

• Calcium hydroxide is used in various industries, including construction (for making mortar and plaster), water treatment (to adjust pH levels), and in the food industry (for processing corn in nixtamalization).

• It appears as a white powdery solid and is slightly soluble in water, forming a solution known as lime water.

• Other Options Explained

• Formation of water: This is also a combination reaction but involves elements (hydrogen and oxygen) rather than compounds.

• Formation of carbon dioxide: This is a combination reaction involving an element (carbon) and a compound (oxygen).

• Formation of ammonia: This involves the combination of nitrogen and hydrogen, which are elements, not compounds.

Q64. Answer: (d) a series circuit

The correct answer is a series circuit.

Key Points

• In a series circuit, all components are connected end-to-end, forming a single path for the current to flow.

• Festival lights or decorative lights are typically connected in series, meaning if one light fails, the entire circuit is interrupted, causing all lights to go out.

• This setup is beneficial for ensuring that the same current flows through each bulb, giving a uniform brightness.

• Series circuits are simple to design and implement but can be less reliable due to the "one-fault-all-fail" nature.

Additional Information

• Parallel Circuit

• In a parallel circuit, components are connected across common points or junctions, creating multiple paths for the current to flow.

• If one component in a parallel circuit fails, the current can still flow through the other paths, so other components remain operational.

• Parallel circuits are commonly used in household wiring to ensure that all devices receive the same voltage.

• Magnetic Effect

• Magnetic effect refers to the phenomenon where a current-carrying conductor generates a magnetic field around it.

• This principle is used in devices like electromagnets, electric motors, and transformers.

• Electromagnetic Induction

• Electromagnetic induction is the process of generating an electromotive force (EMF) by changing the magnetic flux through a coil.

• This principle is the working foundation for generators, inductors, and transformers.

Q65. Answer: (c) 420

Shortcut Trick

Average of two consecutive even numbers = 842 ÷ 2 = 421.

Since the numbers are consecutive even numbers, they must lie on either side of the average.

Numbers = 421 − 1 and 421 + 1.

Smaller number = 420.

Therefore The correct answer is 420.

Alternate Method

Given: Sum of two consecutive even numbers = 842.

Let the smaller even number be x.

Then the next consecutive even number is x + 2.

=> x + (x + 2) = 842

=> 2x + 2 = 842

=> 2x = 842 − 2

=> 2x = 840

=> x = 840 ÷ 2

=> x = 420

Therefore The correct answer is 420.

Additional Information

Consecutive Even Numbers

These are even numbers that follow each other in order, having a common difference of 2. Example: n, n+2, n+4.

Consecutive Odd Numbers

Similar to even numbers, consecutive odd numbers also have a difference of 2. Example: 1, 3, 5 or x, x+2.

Average Property

For any set of n consecutive numbers, the average is exactly the middle term (if n is odd) or the mean of the two middle terms (if n is even).

Q66. Answer: (a) 2^(nd)

Given:

1) The interviews are on even dates.

2) There's a 5-day gap between interviews.

3) None of the interviews are on 28th February.

The even dates in February (leap year) are:

2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28

Starting with the first date, each subsequent interview is on the 6th day (5-day gap). For example:

First date: 2nd

Next interview: 2nd + 6 = 8th

Next interview: 8th + 6 = 14th

Next interview: 14th + 6 = 20th

Next interview: 20th + 6 = 26th

So, the first person's interview will be on 2nd February.

Hence, the correct answer is "Option (1)".

Q67. Answer: (a) (a) is only correct

The correct answer is Option 1.

Key Points

• A concave mirror will diverge the rays of light if the object is placed between the pole and the focus.

• Convex mirrors always diverge light rays; they cannot converge them.

• In concave mirrors, when the object is placed between the pole and the focus, the image formed is virtual, erect, and magnified.

• Convex mirrors are used for rearview mirrors in vehicles because they provide a wider field of view as they diverge light rays.

Additional Information

• Spherical Mirrors:

• A spherical mirror is a mirror that has the shape of a piece cut out of a spherical surface. There are two types of spherical mirrors: concave and convex.

• Concave Mirrors: These mirrors are curved inward like a spoon. They can form real and virtual images depending on the position of the object.

• Convex Mirrors: These mirrors are curved outward. They always form virtual, erect, and diminished images regardless of the

position of the object.

• Focus (F):

• It is the point where light rays parallel to the principal axis converge (concave mirror) or appear to diverge from (convex mirror) after reflection.

• Pole (P):

• It is the center of the spherical mirror.

• Principal Axis:

• It is the straight line passing through the pole and the center of curvature of the spherical mirror.

• Applications of Spherical Mirrors:

• Concave mirrors are used in torches, searchlights, and vehicle headlights to produce parallel beams of light.

• Convex mirrors are used as rearview mirrors in vehicles due to their wider field of view.

Q68. Answer: (c) There are too many dams on it

The correct answer is There are too many dams on it.

Key Points

• The construction of numerous dams on river Ganga has significantly altered its natural flow.

• These dams obstruct the migration patterns of aquatic species, impacting biodiversity.

• The dams have led to the reduction of water flow downstream, affecting the riverine ecosystem and local communities.

• These infrastructural interventions have contributed to the river being classified as endangered due to the ecological imbalances caused.

Additional Information

• Endangered River:

• A river is classified as endangered when it faces severe threats to its ecological health and biodiversity.

• Threats include pollution, over-extraction of water, dam construction, and climate change.

• Endangered rivers often suffer from reduced water quality, loss of aquatic life, and disruption of natural processes.

• Impact of Dams on Rivers:

• Dams can disrupt the natural flow of rivers, affecting sediment transport and deposition.

• They can lead to the creation of stagnant reservoirs, which can become hotspots for pollution and invasive species.

• Downstream ecosystems can be deprived of nutrients and sediments, affecting agriculture and natural habitats.

• Fish and other aquatic organisms often rely on free-flowing rivers for spawning and migration, which dams can obstruct.

• Biodiversity and Ecosystem Services:

• Biodiversity in rivers includes a variety of fish, plants, and microorganisms that contribute to the ecological balance.

• Rivers provide ecosystem services such as water filtration, nutrient cycling, and habitat for wildlife.

• Healthy river ecosystems support livelihoods, agriculture, and cultural practices of local communities.

• Conservation Efforts:

• Conservation efforts for endangered rivers include measures to reduce pollution, manage water extraction, and restore natural flow regimes.

• Environmental impact assessments are crucial before the construction of new dams or other infrastructural projects.

• Community involvement and sustainable practices are essential for the long-term health of river ecosystems.

Q69. Answer: (a) Fe

The correct answer is Fe.

Key Points

• Fe, also known as Iron, is a chemical element with the symbol Fe and atomic number 26.

• It is a metal in the first transition series and is by mass the most common element on Earth, forming much of Earth's outer and inner core.

• Iron is used in construction, manufacturing, and various industrial applications due to its strength and durability.

• It is also a crucial element in biology, playing a key role in oxygen transport and storage in the form of hemoglobin and myoglobin.

Additional Information

• Boron (B)

• Boron is a metalloid with the atomic number 5.

• It is not a metal but has properties of both metals and non-metals.

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• It is used in borosilicate glass, detergents, and as a semiconductor in electronics.
• Carbon (C)
• Carbon is a non-metal with the atomic number 6.
• It is a fundamental element in organic chemistry and is the basis of all known life forms.
• It exists in various forms, including graphite, diamond, and fullerenes.
• Silicon (Si)
• Silicon is a metalloid with the atomic number 14.
• It is widely used in electronics, particularly in semiconductors, and in the production of silicon-based materials like glass and ceramics.

Q70. Answer: (a) 2over3

Shortcut Trick
For pure recurring decimals, replace the bar with 9 in the denominator.
$0.1^{\bar{}}$ = 1/9 and $0.5^{\bar{}}$ = 5/9
Sum = 1/9 + 5/9 = 6/9 = 2/3
Therefore The correct answer is 2/3.
Alternate Method
Given:
Expression: $0.1^{\bar{}} + 0.5^{\bar{}}$
Formula Used:
A recurring decimal $0.a^{\bar{}}$ can be written as the fraction a/9.
Calculations:
=> Let x = 0.111... => 10x = 1.111... => 9x = 1 => x = 1/9
=> Let y = 0.555... => 10y = 5.555... => 9y = 5 => y = 5/9
=> Total Value = 1/9 + 5/9
=> Total Value = (1 + 5) / 9
=> Total Value = 6 / 9
=> Total Value = 2 / 3
Therefore The correct answer is 2/3.
Additional Information
Pure Recurring Decimal to Fraction
If the decimal is $0.ab^{\bar{}}$, the fraction is ab/99. The number of 9s equals the number of repeating digits.
Mixed Recurring Decimal to Fraction
For $0.abc^{\bar{}}$, the formula is (abc − ab) / 900. Use 9s for repeating digits and 0s for non-repeating digits after the decimal.
Rational Numbers
All recurring decimals are rational numbers because they can be expressed in the form p/q.

Q71. Answer: (b) 194

Given:
93 - 91 × 7 + 8 ÷ 3
Formula used:
Given the operations: '+' means '×', '×' means '÷', '÷' means '-', and '-' means '+'
Calculations:
We replace the operations as per the given meanings:
93 + 91 ÷ 7 × 8 - 3
Perform the operations step by step:
=> 93 + 13 × 8 - 3
=> 93 + 104 - 3
=> 197 - 3
=> 194
Therefore The correct answer is option 2.

Q72. Answer: (a) 7.5 hours

Shortcut Trick

Net time taken = (Filling time × Emptying time) ÷ (Emptying time − Filling time)

Net time = (3 × 5) ÷ (5 − 3)

Net time = 15 ÷ 2 = 7.5 hr

Therefore The correct answer is 7.5 hr.

Alternate Method

Given: Filling Tap (A) = 3 hr, Emptying Hole (B) = 5 hr

Source	Time (hr)	Total Work (LCM)	Efficiency
Tap A (Fill)	3	15 units	+5
Hole B (Empty)	5	−3	

=> Net efficiency of (A + B) = 5 − 3 = 2 units/hr

=> Total time to fill empty cistern = Total Work ÷ Net Efficiency

=> Time = 15 ÷ 2

=> Time = 7.5 hr

Therefore The correct answer is 7.5 hr.

Additional Information

Pipes and Cisterns Efficiency

Efficiency of a filling pipe is taken as positive (+), while the efficiency of an emptying pipe (leak/outlet) is taken as negative (−).

Work Done Formula

Total Work = Time × Efficiency. In these problems, the capacity of the tank is generally assumed to be the LCM of the individual times.

Combined Rate

If one pipe fills in x hours and another empties in y hours (where y > x), the net work done per hour is (1/x − 1/y).

Q73. Answer: (d) 1000 − 2000

The correct answer is 1000 - 2000 mL.

Key Points

• A normal adult human being produces approximately 1000 - 2000 mL of urine per day.

• This range can vary based on factors such as fluid intake, diet, and overall health.

• Urine production is an essential bodily function for removing waste products and excess substances from the bloodstream.

• Maintaining this range of urine output helps ensure proper kidney function and overall fluid balance in the body.

Additional Information

• Urine Production:

• Urine is produced by the kidneys through a process called filtration.

• The kidneys filter waste products, excess substances, and fluids from the blood to form urine.

• Urine is then passed from the kidneys to the bladder through the ureters and eventually excreted from the body via the urethra.

• Factors Affecting Urine Output:

• Fluid intake: Increased fluid consumption typically results in higher urine output.

• Diet: Certain foods and beverages can influence urine production.

• Health conditions: Diseases such as diabetes and kidney disorders can affect urine output.

• Medications: Diuretics and other medications can increase urine production.

• Importance of Proper Hydration:

• Maintains electrolyte balance: Proper hydration helps maintain the balance of electrolytes in the body.

• Prevents kidney stones: Adequate fluid intake reduces the risk of kidney stones by diluting substances in urine that can form stones.

• Supports overall health: Proper hydration is crucial for bodily functions, including digestion, circulation, and temperature regulation.

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Q74. Answer: (c) 130

Shortcut Trick

Let the cost price of X be x and Y be y.

From first condition: −0.10x + 0.15y = 7 => −10x + 15y = 700 => −2x + 3y = 140 --- (i)

From second condition: 0.12x + 0.05y = 10 => 12x + 5y = 1000 --- (ii)

Multiply (i) by 6: −12x + 18y = 840. Add to (ii): 23y = 1840 => y = 80.

Substitute y in (i): −2x + 240 = 140 => 2x = 100 => x = 50.

Total cost price = x + y = 50 + 80 = 130.

Therefore The correct answer is Rs. 130.

Alternate Method

Given → Profit/Loss percentages and total profit values.

Formulas: Profit = SP − CP | Loss = CP − SP | Total Profit = (Profit on Y) − (Loss on X).

=> Let CP of X = x and CP of Y = y.

=> Case 1: 0.15y − 0.10x = 7

=> Case 2: 0.12x + 0.05y = 10

=> Multiply Case 2 by 3: 0.36x + 0.15y = 30

=> Subtract Case 1 from this: (0.36x + 0.15y) − (−0.10x + 0.15y) = 30 − 7

=> 0.46x = 23 => x = 23 ÷ 0.46 = 50.

=> Substitute x = 50 in Case 1: 0.15y − 5 = 7 => 0.15y = 12 => y = 12 ÷ 0.15 = 80.

=> Total Cost Price = 50 + 80 = 130.

Therefore The correct answer is Rs. 130.

Additional Information

Linear Equations in Profit and Loss

When profit or loss occurs on multiple items, the net profit is the algebraic sum of individual profits and losses (Profit is positive, Loss is negative).

Simultaneous Equations

To find two unknowns (CP of X and Y), we need two independent linear equations derived from the given conditions.

Q75. Answer: (a) 2

The logic followed here is:

Logic: (2nd number^2× 2) - 2 = 1st number.

Now,

For, 48 : 5

=> (5^2 × 2) - 2 = 25 × 2 - 2 = 50 - 2 = 48.

For, 96 : 7

=> (7^2 × 2) - 2 = 49 × 2 - 2 = 98 - 2 = 96.

Similarly, for 6 : ?

=> (2^2 × 2) - 2 = 4 × 2 - 2 = 8 - 2 = 6.

Hence, the correct answer is "Option 1".

Q76. Answer: (d) Two

Given series:

8 6 3 6 4 8 6 8 1 8 6 3 6 5 4 8 6 2 4 3 6 8 6 9 8 8 6 4 6 9

Condition to be checked:

6s which are NOT immediately preceded by 3 but immediately followed by 3

Not 3 → 6 → 3

8 6 3 6 4 8 6 8 1 8 6 3 6 5 4 8 6 2 4 3 6 8 6 9 8 8 6 4 6 9

Thus there are two such patterns (8 6 3, 8 6 3) that are following the above conditions.

Hence,"2" is the correct answer.

Mistake Points

Immediately preceded by means immediately before or to come just before.

Immediately followed by means immediately after or to come just after.

Q77. Answer: (b) Prominent light and dark bands are present

The correct answer is Prominent light and dark bands are present.

Key Points

• Striated muscles are also known as skeletal muscles or voluntary muscles.
• They exhibit a pattern of light and dark bands, which are visible under a microscope.
• These muscles are attached to bones and are responsible for body movements.
• The cells of striated muscles are long, cylindrical, and multinucleated, which means they have multiple nuclei per cell.

Additional Information

• Striated Muscles:
• Striated muscles are named for their striped appearance due to the arrangement of actin and myosin filaments.
• These muscles are under conscious control, meaning we can control their movement voluntarily.
• They are responsible for locomotion, posture, and various voluntary movements.
• Non-Striated Muscles:
• Non-striated muscles, also known as smooth muscles, do not have the banded appearance seen in striated muscles.
• They are found in the walls of internal organs such as the stomach, intestines, and blood vessels.
• These muscles are involuntary and are controlled by the autonomic nervous system.
• Cardiac Muscles:
• Cardiac muscles are found only in the heart and have properties of both striated and non-striated muscles.
• They are striated like skeletal muscles but are involuntary like smooth muscles.
• Cardiac muscle cells are branched and connected at intercalated discs, which allow for coordinated contractions.

Q78. Answer: (d) 1.2% increase

Shortcut Trick

Apply the successive percentage change formula: x + y + (xy/100).

Here, increase x = +10% and decrease y = −8%.

Net Change = 10 − 8 + [10 × (−8) / 100]

Net Change = 2 − 0.8 = 1.2%

Since the result is positive, it is an increase.

Therefore The correct answer is 1.2% increase.

Alternate Method

Let the Initial Population be 100.

=> Population after 2020 increase = 100 + (10% of 100) = 110.

=> Population after 2021 decrease = 110 − (8% of 110) = 110 − 8.8 = 101.2.

=> Net Change = 101.2 − 100 = 1.2.

=> Percentage Change = (1.2 / 100) × 100 = 1.2%.

Therefore The correct answer is 1.2% increase.

Additional Information

Successive Percentage Formula

For two successive changes of a% and b%, the net effective change is given by (a + b + ab/100)%.

Base Value Concept

In percentage change, the second change is always calculated on the modified value, not the original initial value.

Multiplying Factor

An increase of x% means multiplying by (1 + x/100) and a decrease of y% means multiplying by (1 − y/100).

Q79. Answer: (d) 2 : 3

Shortcut Trick

To find the simplest form, divide both numbers by their Highest Common Factor (HCF).

Check common factors: Both numbers are not even, so 2 is not common. Sum of digits (7+2+2=11, 1+0+8+3=12), so only 1083 is divisible by 3.

Try dividing by primes: 361 × 2 = 722 and 361 × 3 = 1083.

Since 361 is 19^2, the HCF is 361.

Therefore The correct answer is 2 : 3.

Alternate Method

Given: Ratio = 722 : 1083

Formula Used: Simplest Form = (A ÷ HCF) : (B ÷ HCF)

=> Finding HCF of 722 and 1083 using Long Division Method:

=> 1083 = 722 × 1 + 361

=> 722 = 361 × 2 + 0

=> Therefore, HCF = 361

=> Divide both terms by 361:

=> 722 ÷ 361 = 2

=> 1083 ÷ 361 = 3

=> Simplest Form = 2 : 3

Therefore The correct answer is 2 : 3.

Additional Information

Simplest Form of Ratio

A ratio a : b is in its simplest form if the Highest Common Factor (HCF) of a and b is 1.

Division Algorithm for HCF

For any two numbers, HCF can be found by dividing the larger number by the smaller number until the remainder is zero.

Properties of Ratios

Multiplying or dividing both terms of a ratio by the same non-zero constant does not change the value of the ratio.

Q80. Answer: (d) 42

The logic follows here:

The relationship is based on the product of consecutive integers.

For, 12 : 20

=> 12 = 3 × 4

=> 20 = 4 × 5

For, 56 : 72

=> 56 = 7 × 8

=> 72 = 8 × 9

Similarly, 30 : ?

=> 30 = 5 × 6

=> 42 = 6 × 7

Hence, the correct answer is "Option (4)".

Q81. Answer: (a) South

Given: In the evening, a person was standing such that his shadow was to his left.

As, it is mentioned 'evening', therefore it is sunset time, thus the position of the sun will be in the west direction. Since the shadow is to the left of the person, which is the west direction, therefore the person facing towards the south direction.

Thus, the person for facing in the south direction.

Hence, "Option 1" is the correct answer.

Q82. Answer: (b) Syukuro Manabe

The correct answer is Syukuro Manabe.

Key Points

• Syukuro Manabe is a Japanese-American climatologist who was awarded the Nobel Prize in Physics in 2021.

• He received the Nobel Prize for his work on the physical modeling of Earth's climate, quantifying variability, and predicting global warming.

• Manabe's research in the 1960s demonstrated how increased levels of carbon dioxide in the atmosphere would lead to higher temperatures at the Earth's surface.

• His pioneering work has been foundational in the field of climate science, contributing significantly to our understanding of climate change and its impacts.

Additional Information

• Nobel Prize

• The Nobel Prizes are international awards given annually in several categories such as Physics, Chemistry, Medicine, Literature, and Peace.

• Established by the 1895 will of Alfred Nobel, the prizes are awarded to individuals or organizations that have made significant contributions to humanity.

• The Nobel Prize in Physics is awarded by the Royal Swedish Academy of Sciences.

• Climate Models

• Climate models are mathematical representations of the climate system based on physical principles governing the atmosphere, oceans, and land surface.

• These models are used to simulate the interactions of the atmosphere, oceans, land surface, and ice.

• They help in predicting future climate changes by taking into account various factors like greenhouse gas emissions, solar radiation, and other climatic variables.

• Global Warming

• Global warming refers to the long-term rise in the average temperature of the Earth's climate system.

• It is primarily caused by the increase in greenhouse gases such as carbon dioxide and methane due to human activities like burning fossil fuels and deforestation.

• Global warming has significant impacts on the environment, including rising sea levels, extreme weather events, and loss of biodiversity.

• Greenhouse Gases

• Greenhouse gases are gases that trap heat in the Earth's atmosphere, leading to the greenhouse effect.

• Major greenhouse gases include carbon dioxide, methane, nitrous oxide, and fluorinated gases.

• Human activities such as burning fossil fuels, industrial processes, and agricultural practices have significantly increased the concentration of these gases in the atmosphere.

Q83. Answer: (c) Lycee Moderne Ampefiloha, Madagascar

The correct answer is Lycee Moderne Ampefiloha, Madagascar.

Key Points

• The Government of India donated 50 computers to Lycee Moderne Ampefiloha in Madagascar as part of the celebrations for Azadi Ka Amrit Mahotsav, marking 75 years of India's Independence.

• This initiative is part of India's efforts to strengthen bilateral relations with Madagascar and promote educational collaboration.

• Lycee Moderne Ampefiloha is a prominent educational institution in Madagascar, known for its contribution to the educational sector in the country.

• The donation aims to enhance the digital literacy and educational infrastructure of the school, providing better learning opportunities for its students.

Additional Information

• Azadi Ka Amrit Mahotsav

• Azadi Ka Amrit Mahotsav is an initiative of the Government of India to celebrate and commemorate 75 years of progressive India and the glorious history of its people, culture, and achievements.

• The Mahotsav is dedicated to the people of India who have not only been instrumental in bringing India thus far in its evolutionary journey but also hold within them the power and potential to enable Prime Minister Narendra Modi's vision of activating India 2.0, fueled by the spirit of Atmanirbhar Bharat.

• The official journey of Azadi Ka Amrit Mahotsav commenced on 12th March 2021 which started a 75-week countdown to our 75th anniversary of independence and will end post a year on 15th August 2023.

• This Mahotsav is a tribute to the people of India who have been instrumental in shaping India through their tireless efforts and have a vision to make India a self-reliant nation.

• India-Madagascar Relations

• India and Madagascar enjoy friendly and cordial relations.

• India has extended several lines of credit to Madagascar for developmental projects and has also provided humanitarian assistance in times of natural disasters.

• The bilateral relations between the two countries have been further strengthened through various cultural exchanges and educational initiatives.

• India's outreach to Madagascar is part of its broader strategy to enhance its engagement with African countries.

Q84. Answer: (b) 4

The logic followed here is:

Hence, "Option 2" is the correct answer.

Q85. Answer: (a) x = 2, y = 2, z = 1

The correct answer is Option 1: x = 2, y = 2, z = 1.

Key Points

• The chemical equation to balance is: xPbO(s) + C(s) → yPb(s) + zCO2(g).

• Option 1 gives us the balanced equation: 2PbO(s) + C(s) → 2Pb(s) + CO2(g).

• In this balanced equation, the number of atoms of each element on the reactant side is equal to the number of atoms on the product side.

• The equation is balanced for all elements: Lead (Pb), Oxygen (O), and Carbon (C).

Additional Information

• Balancing Chemical Equations:

• Balancing a chemical equation involves making sure that the number of atoms of each element on the left side of the equation (reactants) is equal to the number of atoms of each element on the right side (products).

• This follows the Law of Conservation of Mass, which states that mass is neither created nor destroyed in a chemical reaction.

• Steps to Balance a Chemical Equation:

• Write down the unbalanced equation.

• List the number of atoms of each element present in the unbalanced equation.

• Add coefficients (numbers in front of the compounds or elements) to balance the number of atoms of each element on both sides of the equation.

• Check your work to ensure that the number of atoms for each element is balanced on both sides.

• Ensure that all coefficients are in the lowest possible whole number ratio.

• Example of Balancing:

• Unbalanced equation: PbO + C → Pb + CO2

• Count atoms:

• Reactants: Pb = 1, O = 1, C = 1

• Products: Pb = 1, O = 2, C = 1

• Add coefficients to balance: 2PbO + C → 2Pb + CO2

• Count atoms again to confirm balance:

• Reactants: Pb = 2, O = 2, C = 1

• Products: Pb = 2, O = 2, C = 1

• Now the equation is balanced.

Q86. Answer: (c) 47%

Shortcut Trick

Successive profit formula for a dishonest dealer can be simplified via ratios.

Profit due to price: 25% => Ratio = 100 : 125 = 4 : 5.

Profit due to weight: 15% less => Ratio = (100 − 15) : 100 = 85 : 100 = 17 : 20.

Overall ratio = (4 × 17) : (5 × 20) = 68 : 100.

Profit% = [(100 − 68) ÷ 68] × 100 = (32 ÷ 68) × 100 ≈ 47%.

Therefore The correct answer is 47%.

Alternate Method

Given → Profit claimed = 25% | Weight used = 15% less than original.

Formulas: Total Profit% = [(100 + Profit%) ÷ (100 − Less weight%)] × 100 − 100

=> Let the true weight be 1000g and Cost Price (CP) be Rs. 1 per gram.

=> Weight mentioned = 1000g, but Actual weight used = 850g (15% less).

=> Effective CP for the trader = Rs. 850.

=> Selling Price (SP) at 25% profit = 1000 × (125 ÷ 100) = Rs. 1250.

=> Total Profit = SP − CP = 1250 − 850 = Rs. 400.

=> Profit% = (400 ÷ 850) × 100 = (4000 ÷ 85) ≈ 47.05%.

Therefore The correct answer is 47%.

Additional Information

Dishonest Dealer Concept

A dealer gains profit in two ways: by increasing the price and by decreasing the quantity (using false weights). The net profit is

calculated on the actual weight delivered.

Effective Profit Percentage

Profit% = [(True Weight − False Weight) ÷ False Weight] × 100. If profit is also charged on price, these two are applied successively.

Q87. Answer: (a) 355km

Shortcut Trick

Sum of distance by Train A = 362 + 282 + 421 = 1065 km.

Average = Total distance ÷ Number of days = 1065 ÷ 3.

Average = 355 km.

Therefore The correct answer is 355 km.

Alternate Method

Given:

Distance on Day 1 = 362 km

Distance on Day 2 = 282 km

Distance on Day 3 = 421 km

Formula Used:

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

Calculations:

=> Total distance = 362 + 282 + 421

=> Total distance = 1065 km

=> Average distance = 1065 ÷ 3

=> Average distance = 355 km

Therefore The correct answer is 355 km.

Additional Information

Average Concept

The average or arithmetic mean is the central value of a set of numbers, calculated by dividing the sum of the values by the count of the values.

Deviation Method

To find average quickly, assume a mean (e.g., 300) and calculate the net deviation: (+62 − 18 + 121) = +165. Then, Average = 300 + (165 ÷ 3) = 355.

Q88. Answer: (c) $4 + 5x + x^2 - 2x^3$

Shortcut Trick

Multiply the outer term −2 into each term inside the bracket.

$-2 \times x^3 = -2x^3$, $-2 \times -x = +2x$, and $-2 \times 4 = -8$.

Combine these with the existing terms $x^2 + 3x + 12$.

Group terms: $-2x^3 + x^2 + (3x + 2x) + (12 - 8) = 4 + 5x + x^2 - 2x^3$.

Therefore The correct answer is $4 + 5x + x^2 - 2x^3$.

Alternate Method

Given: $x^2 + 3x + 12 - 2(x^3 - x + 4)$

Method: Apply the Distributive Property and combine Like Terms.

=> $x^2 + 3x + 12 - [2 \times x^3 - 2 \times x + 2 \times 4]$

=> $x^2 + 3x + 12 - 2x^3 + 2x - 8$

=> $-2x^3 + x^2 + (3x + 2x) + (12 - 8)$

=> $-2x^3 + x^2 + 5x + 4$

=> $4 + 5x + x^2 - 2x^3$

Therefore The correct answer is $4 + 5x + x^2 - 2x^3$.

Additional Information

Distributive Property

The rule states that $a(b + c) = ab + ac$. When multiplying by a negative number, the signs of all terms inside the parentheses are reversed.

Like Terms in Polynomials

Terms can only be added or subtracted if they have the exact same variable and exponent (e.g., 3x and 2x are like terms, but x^2 and x^3 are not).

Standard Form

A polynomial is usually written in descending order of powers (from highest exponent to constant) or ascending order as seen in this answer choice.

Q89. Answer: (a) Boxing

The correct answer is Boxing.

Key Points

• Amit Panghal is a renowned Indian boxer who has represented India in various international competitions.

• He won the gold medal in the men's flyweight category (51kg) at the Commonwealth Games 2022 held in Birmingham, UK.

• His victory in the Commonwealth Games added to his already impressive career, which includes medals at the Asian Games and World Championships.

• Amit Panghal is known for his tactical prowess, quick footwork, and strong defensive abilities in the boxing ring.

Additional Information

• Boxing

• Boxing is a combat sport in which two people wearing protective gloves throw punches at each other for a predetermined amount of time in a boxing ring.

• The sport is overseen by a referee over a series of one- to three-minute intervals called rounds.

• Boxing matches are won either by points or by stopping the opponent through knockout or technical knockout.

• Boxing is divided into different weight classes, ensuring fair competition among boxers of similar sizes.

• Commonwealth Games

• The Commonwealth Games is an international multi-sport event involving athletes from the Commonwealth of Nations.

• The event was first held in 1930 and takes place every four years.

• The Commonwealth Games include a variety of sports, with the number of participating nations and athletes growing over the years.

• It is considered one of the major international sports events, alongside the Olympics and the Asian Games.

• Amit Panghal's Achievements

• Amit Panghal has won multiple medals in his boxing career, including a silver medal at the 2018 Asian Games and a bronze medal at the World Boxing Championships.

• He is known for his skill and agility in the ring, making him one of India's top boxing talents.

• His performance at the Commonwealth Games 2022 further solidified his status as an elite boxer.

• Amit Panghal continues to train and compete at the highest level, representing India on the international stage.

Q90. Answer: (d) Sulphuric acid

The correct answer is Sulphuric acid.

Key Points

• The clouds of Venus are primarily composed of droplets of sulphuric acid, along with water vapor and sulfur dioxide.

• Sulphuric acid clouds contribute to Venus's extreme greenhouse effect, making it the hottest planet in our solar system.

• The high concentration of sulphuric acid in the atmosphere leads to acid rain, though it evaporates before reaching the surface due to the high temperature.

• The discovery of sulphuric acid in Venus's atmosphere has been confirmed through various space missions, including those by NASA and the Soviet Union.

Additional Information

• Venus's Atmosphere:

• Venus's atmosphere is composed mainly of carbon dioxide (96.5%) and nitrogen (3.5%), with trace amounts of other gases, including sulphur dioxide.

• The atmosphere is extremely dense and hot, with surface temperatures reaching up to 465°C (869°F).

• The pressure at the surface is about 92 times that of Earth's sea level pressure.

• Greenhouse Effect on Venus:

• The dense atmosphere of Venus leads to a runaway greenhouse effect, trapping heat and causing extremely high surface temperatures.

• The presence of sulphuric acid clouds further enhances this effect by reflecting and absorbing solar radiation.

• Space Missions to Venus:

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• Several missions have been sent to Venus to study its atmosphere and surface, including NASA's Magellan and the Soviet Union's Venera program.

• The European Space Agency's Venus Express and the Japanese Space Agency's Akatsuki have also provided valuable data on Venus's atmospheric composition and dynamics.

Q91. Answer: (a) Rs. 5.60

Shortcut Trick

Total Cost Price (CP) = Rs. 100 for 100 eggs.

Remaining eggs = 100 − 12 = 88 eggs.

Selling Price (SP) of 88 eggs = 88 × 1.20 = Rs. 105.60.

Profit = SP − CP = 105.60 − 100 = Rs. 5.60.

Therefore The correct answer is Rs. 5.60.

Alternate Method

Given: Total eggs = 100, CP = Rs. 100, Broken eggs = 12, SP per egg = Rs. 1.20.

Formulas: Profit = SP − CP | Profit% = (Profit ÷ CP) × 100

=> Total investment (CP) = Rs. 100.

=> Total number of eggs available for sale = 100 − 12 = 88.

=> Total Selling Price (SP) = 88 × 1.20 = Rs. 105.60.

=> Profit = 105.60 − 100 = Rs. 5.60.

Therefore The correct answer is Rs. 5.60.

Additional Information

Handling Wastage in Profit & Loss

When items are broken or lost, the Cost Price remains the same, but the total Selling Price is calculated only on the remaining good items.

Profit Percentage

Profit% = (Profit ÷ CP) × 100. In this case, Profit% = (5.60 ÷ 100) × 100 = 5.6%.

Q92. Answer: (b) PART II

The correct answer is PART II

Key Points

• The rights of citizenship of people who migrated to India from Pakistan are covered in Part II of the Constitution of India, in Article 6

• Part II of the Constitution of India covers citizenship and includes Articles 5–11.

• Article 6 deals with the citizenship of people who migrated to India from Pakistan after the partition.

• Article 6:

• The person, their parent, or grandparent must have been born in India as defined in the Government of India Act of 1935

• If the person migrated before July 19, 1948, they must have been an ordinary resident of India since their migration

• If the person migrated on or after July 19, 1948, they must have registered as a citizen of India before the Constitution came into effect

Additional Information

• The parts of the Indian Constitution are:

• Part I: The Union and its Territory, which includes articles 1–4

• Part II: Citizenship, which includes articles 5–11

• Part III: Fundamental Rights, which includes articles 12–35

• Part IV: Directive Principles of State Policy, which includes articles 36–51

• The Constitution of India has 25 parts, 12 schedules, and 448 articles as of November 2022.

• The Constitution was originally formed with 22 parts, but was amended and expanded over time.

Q93. Answer: (a) investment multiplier

The correct answer is Investment Multiplier

Key Points

• In macroeconomic analysis, the ratio of the total increment in equilibrium value of final goods output to the initial increment in autonomous expenditure is called the investment multiplier of the economy.

• The investment multiplier is also the ratio of the change in national income to the initial change in planned investment

expenditure.

• The expenditure multiplier shows how a change in autonomous spending affects total spending and aggregate demand in the economy.

• To calculate the expenditure multiplier, divide the final change in real GDP by the change in autonomous spending.

Additional Information

• The multiplier can be represented by the following formula.

• $K = \Delta Y / \Delta I$

• Where, ΔY = Increase in GDP or National Income

• ΔI = Increase in Investment

• Autonomous Investment :

• Autonomous investment is the portion of the total investment made by a government or other institution independent of economic considerations.

• These can include government investments, funds allocated to public goods or infrastructure, and any other type of investment that is not dependent on changes in GDP.

• Autonomous expenditure:

• It also known as autonomous spending, is spending that occurs regardless of the level of income in an economy.

• It's considered essential and relatively stable, and is a key component of understanding how economic factors and policies impact the economy

Q94. Answer: (d) 55.7

Shortcut Trick

Identify the modal class by finding the maximum frequency from the cumulative data.

Frequencies: 120, (250−120)=130, (650−250)=400 (Max), (850−650)=200, (900−850)=50.

Modal Class = 50 − 60 | l = 50, f1 = 400, f0 = 130, f2 = 200, h = 10.

Mode = 50 + [(400 − 130) / (800 − 130 − 200)] × 10 ≈ 50 + 5.7 = 55.7.

Therefore The correct answer is 55.7 years.

Alternate Method

Given: Cumulative frequency (less than type) for 900 persons.

First, we convert the cumulative frequency into a simple frequency distribution table:

Age (years)	Frequency (f)
30 − 40	120
40 − 50	250 − 120 = 130
50 − 60	650 − 250 = 400 (Modal Class)
60 − 70	850 − 650 = 200
70 − 80	900 − 850 = 50

Formula Used: Mode = l + [(f1 − f0) / (2f1 − f0 − f2)] × h

Where:

l = 50 (lower limit of modal class)

f1 = 400 (frequency of modal class)

f0 = 130 (frequency of class preceding the modal class)

f2 = 200 (frequency of class succeeding the modal class)

h = 10 (class interval size)

=> Mode = 50 + [(400 − 130) / (2 × 400 − 130 − 200)] × 10

=> Mode = 50 + [270 / (800 − 330)] × 10

=> Mode = 50 + [270 / 470] × 10

=> Mode = 50 + (27 / 47) × 10

=> Mode = 50 + 270 / 47

=> Mode ≈ 50 + 5.744

=> Mode ≈ 55.7 years

Therefore The correct answer is 55.7 years.

Additional Information

Empirical Relationship

The relationship between the three measures of central tendency is given by: Mode = 3 Median − 2 Mean.

Median Formula for Grouped Data

Median = l + [(N/2 − cf) / f] × h, where cf is the cumulative frequency of the class preceding the median class.

Cumulative Frequency Types

There are two types: Less than (summing from top to bottom) and More than (summing from bottom to top).

Q95. Answer: (d) 49

Shortcut Trick

For any quadratic equation $ax^2 + bx + c = 0$ with roots a and b, use the identity $(a - b)^2 = (a + b)^2 - 4ab$.

From the equation $x^2 - 5x - 6 = 0$, the sum of roots $(a + b) = 5$ and product of roots $(ab) = -6$.

Substitute these values: $(a - b)^2 = (5)^2 - 4(-6)$

=> $(a - b)^2 = 25 + 24 = 49$.

Therefore The correct answer is 49.

Alternate Method

Given: The quadratic equation is $x^2 - 5x - 6 = 0$, where a and b are roots and a > b.

Formula Used: Factorization method to find individual roots.

=> $x^2 - 6x + x - 6 = 0$

=> $x(x - 6) + 1(x - 6) = 0$

=> $(x - 6)(x + 1) = 0$

=> $x = 6$ or $x = -1$

=> Since the condition is a > b, we have $a = 6$ and $b = -1$.

=> $(a - b) = 6 - (-1) = 7$

=> $(a - b)^2 = (7)^2 = 49$

Therefore The correct answer is 49.

Additional Information

Sum and Product of Roots

For a standard quadratic equation $ax^2 + bx + c = 0$, the sum of roots is $-b/a$ and the product of roots is c/a.

Nature of Roots

The nature is determined by the Discriminant $(D) = b^2 - 4ac$. If $D > 0$, roots are real and distinct; if $D = 0$, roots are real and equal; if $D < 0$, roots are imaginary.

Difference of Roots Formula

The absolute difference between roots is given by $|a - b| = \sqrt{D} / |a|$. In this case, $(a - b)^2 = D / a^2 = ((-5)^2 - 4(1)(-6)) / 1^2 = 49$.

Q96. Answer: (d) 40 V

The correct answer is 40 V

Key Points

• In a series circuit, the same current flows through all resistors.

• The total resistance Unknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strongUnknown node type: strong R_{total} in a series connection is the sum of the individual resistances

• $R_(total)=R1+R2+R3$

• Here:

• R1=2Ω

• R2=3Ω

• R3=5Ω

• So, the total resistance is: $R_(total)=2+3+5=10Ω$

• Now, we can use Ohm's law to calculate the voltage

V.

• Ohm's law states:

• $V=I×R_(total)$

• We are given that the current

II through the 2 Ω resistor is 4 A, so:

• V=4A×10Ω=40V

• Thus, the voltage

VV is 40 V.

Additional Information

• Ohm's Law

• Ohm's law states that if the physical state (i.e. length, temperature, mechanical strain, material) of the conductor remains the same then the voltage applied across its ends is directly proportional to the current flowing through it.

• V prop. to I

• V = I R (V = Voltage, I = current, R = resistance)

• This graph between V and I of a conductor at constant temperature shows that the gradient of change in the voltage (Δ V) is proportional to the change in current (Δ I).

• This makes the graph a straight line.

• R=VI

• The SI Unit of electrical resistance is "ohm (Ω)" or volt/amp

• The resistance of the conductor depends on the following factors:

• Length (l): The resistance of the conductor directly proportional to its length R prop. to l.

• Area of cross-section (A): Resistance is inversely proportional to the cross-sectional area of the conductor R prop. to 1/A

• The resistance of the conductor also depends on the nature of the material and temperature.

Q97. Answer: (c) noble gases

The correct answer is noble gases

Key Points

• After the discovery of the Noble gases, the Law of Octaves became irrelevant.

• Thus, Newlands' Law of Octaves worked well with lighter elements only.

• It was also not applicable to heavier elements,

• as Newlands placed cobalt and nickel in the same slot, even though they have different properties.

Additional Information

• The 'Law of Octaves' was propounded by the English chemist J.A.R. Newlands in 1865.

• The 'Law of Octaves'states that if the chemical elements are arranged according to increasing atomic weight, those with similar physical and chemical properties occur after each interval of seven elements.

• J.A.R. Newlands was the first to disclose a periodic pattern in the properties of the elements and anticipated later developments of the periodic law.

Q98. Answer: (c) 6W

The correct answer is 6W

Key Points

• We know Power (P) = V^2/R,

• where V is voltage and R is resistance.

• When V = 12V and P = 24W,

• we can find R: $24 = 12^2/R$

• 24 = 144/R

• R = 144/24

• R = 6 ohms

• Calculate the power at 6V:

• Now, we use the same formula with V = 6V

• and the resistance we just calculated:

• $P = 6^2/6$

• P = 36/6

• P = 6W

• Therefore, the correct answer is 3) 6W.

Additional Information

Q99. Answer: (d) Hair growth is seen in all parts of the body

The correct answer is Hair growth is seen in all parts of the body

Key Points

• While hair growth in some parts of the body, such as underarms and pubic areas, is common during puberty, it is not observed in all parts of the body for everyone.

• Some areas, like the chest, back, or face, may develop hair in varying degrees depending on genetics and hormonal changes

• Boys typically start to grow facial hair (like a mustache or beard)

• They experience more body hair growth in areas like the chest and underarms

Additional Information

• Common changes noticed in children as they enter their teenage years:

• Growth Spurts: Teenagers experience rapid growth in height during puberty, which is particularly noticeable during the early teenage years.

• This can happen earlier for girls than boys.

• Voice Changes: In boys, the voice deepens due to the growth of the larynx (voice box). In girls, the voice may also become slightly deeper, but the change is typically less pronounced.

• Body Shape and Composition: Hormonal changes lead to the development of secondary sexual characteristics.

• In girls, this includes the development of breasts and wider hips, while in boys, it typically includes broader shoulders and muscle growth.

• Increased Sweating: Puberty triggers an increase in sweat production, particularly under the arms and on the feet, due to the activation of sweat glands.

• Mood Swings and Emotional Changes: Hormonal fluctuations during puberty can lead to increased mood swings, feelings of self-consciousness, and changes in behavior. Teens may experience a stronger desire for independence and self-identity.

• Acne and Skin Changes: Puberty often causes an increase in oil production in the skin, leading to pimples and acne, which can be more pronounced during the teenage years.

• Menstruation (in girls): One of the most significant changes for girls entering adolescence is the onset of menstruation, marking the ability to conceive.

• Sexual Attraction and Interest: Teenagers often experience increased interest in romantic and sexual relationships as their sexual identity develops.

Q100. Answer: (c) 11over9

Given:

1.22...

Concept used;

To convert pure recurring decimal fractions into simple fraction: Firstly, write down the repeated digits only once in numerator and then place as many nines in the denominator as the number of digits repeating.

To convert mixed recurring decimal fractions into simple fractions: In the numerator take the difference between the number formed by all the digits after decimal point and the number formed by non repeating digits in the denominator place as many nines as there are repeating digits and after nine, put as many zeros as the number of non repeating digits.

Calculation:

1.22...

(12-1)/9

11/9

Therefore The answer is 11over9.

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