# NTSE STAGE – I (DELHI STATE)
# 05 – A (2019 – 20)
# (For Class – X)
# MENTAL ABILITY TEST (MAT)
## HINTS & SOLUTIONS

1. 2

1. Positive factors of 256 are
1, 2, 4, 8, 16, 32, 64, 128, 256

$\therefore$ $sq = \frac{a(r^n - 1)}{(r-1)} = \frac{1(2^9 - 1)}{(2-1)}$ [where a = 1, and r = 2, and n = 9]

$\therefore$ Sq = 511

2. 4

2. $\frac{X}{X+1} + \frac{X+1}{X} - \frac{1}{X(X+1)} = \frac{X^2 + (X+1)^2 - 1}{X(X+1)}$

$= \frac{X^2 + X^2 + 1 + 2X - 1}{X(X+1)} = \frac{2X^2 + 2X}{X(X+1)} = \frac{2X(X+1)}{X(X+1)}$

= 2

3. 1

3. 5 + 6 + 7 + … + 19
Here a = 5, d = 1 and n = 15

$\therefore$ $S_n = \frac{n}{2}[2a + (n-1)d]$

$S_{15} = \frac{15}{2}(10 + 14 \times 1) = \frac{15}{2} \times 24$

= 15 x 12 = 180

4. 1

4. $\frac{1}{2} : \frac{2}{3} : \frac{3}{4} = 6 : 8 : 9$

Let numbers be 6x, 8x and 9x

$\therefore$ 9x – 6x = 27

$\therefore$ x = 9

$\therefore$ Numbers are 54, 72, 81

5. 2 or 4

5. $3^{25} + 3^{26} + 3^{27} + 3^{28} = 3^{25}(3^0 + 3^1 + 3^2 + 3^3)$

$= 3^{25}(1 + 3 + 9 + 27)$

$= 3^{25} \times 40 = 3^{23} \times 9 \times 5 \times 8$

$= 3^{25} \times 40 = 3^{23} \times 8 \times 45$

6. 4

6. Rohan's final score = $\frac{90 \times 2 + 75 \times 1}{3}$

= 85

7. 1

7. Let Grand mother = G, mother = M and daughter = D
$\therefore$ Possible ways = GMD
GDM
MGD
MDG
DGM
DMG

8. 2

8. Let at time of marriage man's age = x years
And man's wife's age = y years
$\therefore$ x = y + 6 ….(1)
And $(x+12)=\frac{6}{5}(y+12)$
= 5x + 60 = 6y + 72
= 5x – 6y = 12 …(2)
Solving both equations we got x = 24 and y = 18

9. 3

9. P (number is even) = $\frac{1}{2}$

P (number is less than 4) = $\frac{1}{2}$

P (number is even and less than 4) = $\frac{1}{6}$

$\therefore P\left(\frac{\text{number is less than 4}}{\text{number is even}}\right)=\frac{P(\text{number is even and less than 4})}{P(\text{number is even})}=\frac{\frac{1}{6}}{\frac{1}{2}}=\frac{1}{3}$

10. 2

10. 10 balls $\rightarrow$ 5B and 5W
After removing 1 B balls, total balls left = 9 and
Total black balls left = 4
$\therefore$ P (B ball after removing 1$^{st}$ B ball) = $\frac{4}{9}$

11. 2

11. 10 – 3 = 12 $\rightarrow$ 10 – 3 + 5 = 12
12 – 4 = 13 $\rightarrow$ 12 – 4 + 5 = 13
14 – 5 = 14 $\rightarrow$ 14 – 5 + 5 = 14
16 – 6 = ? $\rightarrow$ 16 – 6 + 5 = 15

12. 2

12. If bus does not stops, then it will travel 9 km more with 54 kmph
$\therefore$ It will stop for $\frac{9}{54}\text{hr}=\frac{9}{54}\times 60\,\text{min}$
= 10 min

13. 4

13. $\frac{40\times1620}{100}+\frac{30\times960}{100}=\frac{x\times5200}{100}$

$\therefore\ x=\frac{40\times1620+30\times960}{5200}$

$\therefore\ x = 18$

14. 2

14. Between 1st and 25th tree there are 24 gap & let say each gap is of x m distance.

$\therefore\ 24\,x = 30$

$x=\frac{30}{24}$

Now between 3rd & 15th tree there are 12 gaps

$\therefore$ Distance between 3rd & 15th tree $=12\times\frac{30}{24}=15$ m

15. 4

15.

| Time | 8 | 8:30 | 9 | 9:30 | 10 | 10:30 | 11 | 11:30 | 12 | 12:30 | 1 | 1:30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bell | 3 | 1 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 3 |

$\therefore$ Bell rung 20 times.

16. 4

16. $\frac{80A}{100}=\frac{50B}{100}$

or $\frac{B}{A}=\frac{8}{5}$

Now $B=\frac{x\times A}{100}\Rightarrow x=\frac{B}{A}\times100$

$\therefore x=\frac{8}{5}\times100=160$

17. 3

17. Let numbers = (x – 2), (x – 1), (x + 1), (x + 2)

$\therefore\ \frac{(x-2)+(x-1)+x+(x+1)+(x+2)}{5}=7$

$\therefore\ \frac{5x}{5}=7$

$\therefore\ x = 7$

$\therefore$ highest number = 9

18. 2

18. $x^3+y^3+z^3-3xyz=(x+y+z)(x^2+y^2+z^2-xy-yz-zx)$

Now we know that, $(x+y+z)^2=x^2+y^2+z^2+2(xy+yz+zx)$

$\Rightarrow xy+yz+zx=\frac{15\times15-51}{2}=87$

$\therefore x^3+y^3+z^3-3xyz=15(51-87)$

$= 15 \times (-36)$

$= -540$

19. 4

19. Let sides = 3x, 4x & 5x cm

$\therefore S = \dfrac{3x + 4x + 5x}{2} = 6x$

$\therefore \text{Area} = \sqrt{S(S-a)(S-b)(S-c)}$

$384 = \sqrt{6x \times 3x \times 2x \times x}$

$384 = 6x^2$

$\therefore x = 8$

$\therefore P = 12x = 12 \times 8 = 96$ cm

20. 3

20. (1) $\dfrac{1}{3 + \dfrac{1}{\dfrac{17}{16}}} = \dfrac{1}{3 + \dfrac{16}{17}} = \dfrac{17}{66}$

(2) $\dfrac{1}{3 + \dfrac{1}{1 + \dfrac{1}{\dfrac{9}{8}}}} = \dfrac{1}{3 + \dfrac{1}{\dfrac{17}{9}}} = \dfrac{1}{\dfrac{60}{17}} = \dfrac{17}{60}$

(3) $\dfrac{1}{3 + \dfrac{1}{1 + \dfrac{1}{\dfrac{9}{4}}}} = \dfrac{1}{3 + \dfrac{1}{\dfrac{13}{9}}} = \dfrac{1}{\dfrac{48}{13}} = \dfrac{13}{48}$

(4) $\dfrac{1}{3 + \dfrac{1}{\dfrac{9}{8}}} = \dfrac{1}{\dfrac{35}{8}} = \dfrac{8}{35}$

21. 3

21. $a \$ b = a \times (a + b)$

$\therefore (2 \$ 0) \$ 1 = [2 \times (2 + 0)] \$ 1$

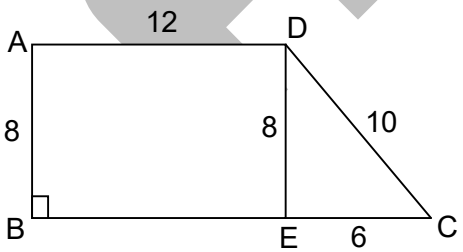
$= 4 \$ 1$

$= 4 \times (4 + 1)$

$= 20$

22. 2

22.




**Construction:** Draw DE $\perp$ BC

$\therefore$ Area of ABCD = Area of rec ABED + Area of $\Delta$DEC

$= \ell \times b + \dfrac{1}{2} \times b \times h$

$= 8 \times 12 + \dfrac{1}{2} \times 6 \times 8$

$= 96 + 24 = 120\ m^2$

23. 3

23. 4, 8, 28, 80, 244

× 3 – 4 × 3 + 4 × 3 – 4 × 3 + 4

24. 2

24. 4, 7, 12, 19, 28, 39, 52

+3 +5 +7 +9 +11 +13

25. 4

25. 10080, 1680, 336, 84, 28, 14

÷ 6 ÷ 5 ÷ 4 ÷ 3 ÷ 2

26. 2

26. $CI = P\left[\left(1+\frac{r}{100}\right)^n - 1\right]$

$4347 = 30000\left[\left(1+\frac{7}{100}\right)^n - 1\right]$

$= \frac{11490}{10000} = \left(\frac{107}{100}\right)^n$

$= \left(\frac{107}{100}\right)^2 = \left(\frac{107}{100}\right)^n$

$\therefore n = 2$

27. 2

27. $2^{\frac{1}{2}}, 9^{\frac{1}{3}}, 16^{\frac{1}{4}}, 32^{\frac{1}{5}}$

$= 2^{\frac{1}{2}}, 9^{\frac{1}{3}}, 2^1, 2^1$

$= 2^{\frac{6}{2}}, 9^{\frac{6}{3}}, 2^6, 2^6$

$= 2^3, 9^2, 2^6, 2^6$

28. 3

28. $x + \frac{1}{x} = 2$

$\Rightarrow x^2 + 1 - 2x = 0$

$\Rightarrow (x - 1)^2 = 0$

$\Rightarrow x = 1$

$\therefore x^{17} + \frac{1}{x^{19}} = 1^{17} + \frac{1}{1^{19}} = 2$

29. 3

29. Let runs required = x

$\therefore 15 \times 6 + x \times 5 = 7.2 \times 20$

$\therefore x = 54$

$\therefore$ required run rate = $\frac{54}{5} = 10.8$

30. 1

30. $P + Q = x + y$, $PQ = xy$

$(P + Q)^3 = P^3 + Q^3 = 3PQ\,(P + Q)$

$\Rightarrow P^3 + Q^3 = (x + y)^3 - 3xy\,(x + y) = x^3 + y^3$

31. 1

31. $\dfrac{x+5}{12} + \dfrac{x}{16} = 1$

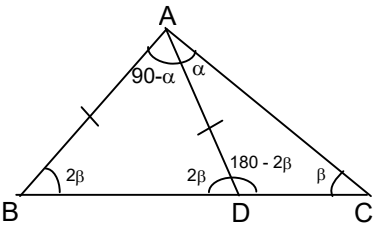
$= \dfrac{4x + 20 + 3x}{48} = 1$

$\Rightarrow x = \dfrac{48 - 20}{7} = \dfrac{28}{7} = 4$

$\therefore$ x = 4 min

32. 3

32.




In $\Delta ABD$, $90 - \alpha + 2\beta + 2\beta = 180^\circ$

$4\beta - \alpha = 90$ - - - (1)

In $\Delta ABC$ $3\beta + 90 = 180^\circ$

$\Rightarrow \beta = 30$ - - - (2)

$\therefore \alpha = 4\beta - 90 = 30^\circ$

33. 2

33. Since shaded region has $\dfrac{1}{6}$ of area of circle

$\therefore \angle$ in shaded region = $\dfrac{360}{6} = 60°$

$\therefore \angle$ in Arc AQB = 360 – 120 = 240

$\therefore$ length of arc AQB = $360 \times 2\pi r$

$= \dfrac{240}{360} \times 2\pi \times 10$

$= \dfrac{2}{3} \times 2\pi(10) = \dfrac{40}{3}\pi$

34. 4

34. Let original length = $\ell$cm & width = b cm

$\therefore$ Original Area = $\ell b cm^2$

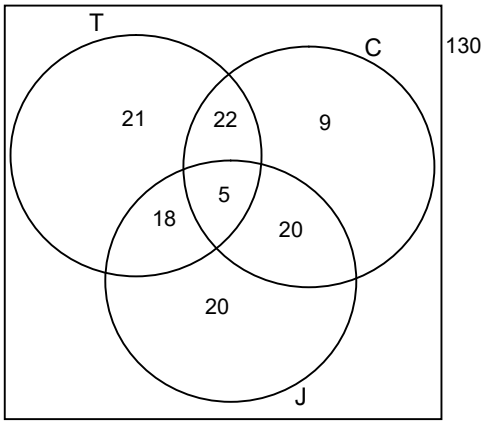
New area = $\dfrac{125}{100}\ell \times \dfrac{80}{100} b = \ell b cm^2$

Since original area = new area

$\therefore$ no change in area

35. 1

35.




36. 3 (Incomplete question in English language but according to hindi part it should be 3 (35))

36. Let 3 nos = x, y & z

$\therefore$ x + y = 55 - - - - (1)

y + z = 65 - - - - (2)

3x + z = 110 - - - - (3)

Form eq (1) & (2)

55 – x + z = 65

$\therefore$ z – x = 10 - - - - (4)

From eq (3) & (4)

3x + z + 3z – 3x = 110 + 30

$$z = \frac{140}{4} = 35$$

37. 4

37. For K ratio = $\frac{6000}{12000} = \frac{1}{2}$

For L ratio = $\frac{5400}{6000} = \frac{9}{10}$

For M ratio = $\frac{12000}{21000} = \frac{4}{7}$

For N ratio = $\frac{4200}{9000} = \frac{7}{15}$

For O ratio = $\frac{7500}{12000} = \frac{5}{8}$

Clearly N has the minimum ratio

38. 2

38. For K ratio = $\frac{2400}{27000} = 0.088$

For L ratio = $\frac{1200}{15000} = 0.08$

For M ratio = $\frac{4500}{45000} = 0.10$

For N ratio = $\frac{2400}{21000} = 0.114$

For O ratio = $\frac{3000}{30000} = 0.10$

Clearly N has maximum bonus in comparison to his total income.

39. 3

39. For K $= \frac{12000}{27000} \times 100 = 44.44\%$

For L $= \frac{6000}{15000} \times 100 = 40\%$

For M $= \frac{21000}{45000} \times 100 = 46.66\%$

For N $= \frac{9000}{21000} \times 100 = 42.85\%$

For O $= \frac{12000}{30000} \times 100 = 40\%$

Clearly M has maximum percentage

40. 1

40. $\frac{6000}{7500} \times 100 = 80\%$

41. 1

41. $\frac{M}{S} = \frac{4}{5}$

$\therefore$ M = 4n, S = 5n

$\frac{M-5}{S-5} = \frac{7}{9}$

$\Rightarrow \quad \frac{4n-5}{5n-5} = \frac{7}{9}$

$\Rightarrow$ 36n – 45 = 35n – 35

$\Rightarrow$ n = 10

$\therefore$ Present ayes are 40 and 50 years.

42. 4

42. Number of different combinations = $3_{C_1} \times 4_{C_1} \times 2_{C_1}$

$= \frac{3!}{1! \times 2!} \times \frac{4!}{1! \times 3!} \times \frac{2!}{1! \times 1!} = 4! = 24$

43. 4

43. Let original length = $\ell$

And original breadth = b

$\therefore$ Original area = $\ell$b

New area $= \frac{112.5\,\ell}{100} \times \frac{90\,b}{100}$

$= 1.0125\,\ell b$

$\therefore$ Charge in area $= \frac{(1.0125-1)}{1} \times 100 = 1.25\%$ increase

44. 1

44. x = Even number

P = Odd number

(1) Odd – Even – 1 = Even $\neq$ Odd

(2) Odd + Even + 1 = Even = Even

(3) Odd × Even + Odd = Odd = Odd

(4) $Odd^2 + Even^2 + 1$ = Even = Even

45. 1

45. Volume of liquid in cuboidal container
= Volume of liquid in cylindrical container
$\ell \times b \times h = \pi r^2 h$
$2 \times 10 \times 20 = \pi \times 5^2 \times h$
$\therefore \quad h = \frac{400}{25\pi} = \frac{16}{\pi}$

46. 1

46. $\tan\theta + \omega t\,\theta = 2$
$\tan\theta + \frac{1}{\tan\theta} = 2 \quad ; \quad \frac{\tan^2\theta + 1}{\tan\theta} = 2$
$\Rightarrow \tan^2\theta - 2\tan\theta + 1 = 0$
$\Rightarrow (\tan\theta - 1)^2 = 0$
$\Rightarrow \tan\theta = 1$
$\Rightarrow \cot\theta = 1.$
$\therefore \tan\theta^{100} + \cot\theta^{100}$
$1 + 1 = 2$

47. 2

47. $(a + b)^4 = \left[(a+b)^2\right]^2$
$= (a^2 + b^2 + 2ab)^2$
$= a^4 + b^4 + 4a^2b^2 + 4a^3b + 2a^2b^2 + 4ab^3$
$= a^4 + b^4 + 6a^2b^2 + 4a^3b + 4ab^3$
$\therefore$ Coefficient of $a^2b^2 = 6.$

48. 3

48. $\frac{\text{Girls}}{\text{Total class}} = \frac{x}{x+y}$

49. 4

49. $2^{6n} - 4^{2n}$
$64^n - 16^n$
We know that $a^n - b^n$ is always divisible by $(a - b)$
$\therefore \quad 64^n - 16^n$ is divisible by 48.

50. 3

50. $x = 2^1 - 2^{1/3} + 2^{2/3}$
$x - 2 = 2^{2/3} - 2^{1/3}$
Cubing both sides
$x^3 - 8 - 3(2x)(x - 2) = 2^2 - 2^1 - 3(2)(x - 2)$
$\Rightarrow x^3 - 8 - 6x^2 + 12x = 4 - 2 - 6x + 12$
$\Rightarrow x^3 - 6x^2 + 18x = 22$
$\Rightarrow x^3 - 6x^2 + 18x + 18 = 40$

51. 1

51. 1 figure $\Delta s = 6$
2 figure $\Delta s = 4$
3 figure $\Delta s = 2$
$\therefore$ Total number of $\Delta s = 12$

52. 3

52. Father (Ketan's

|

Ketan (Amit's father)

|

Amit

53. 4

53. si po re → book is thick …(1)
ti na re → bag is heavy …(2)
ka si → interesting book …(3)
de ti → that bag …(4)
From (2) & (4) code of 'bag' = ti, so code of 'that' = de
From (1) & (2) code of 'is' is re
From (1) & (3) code of 'book' = si, so code of 'interesting' = ka
∴ code of that bag is interesting' = de ti re ka

54. 1

54.

| P | R | I | N | C | I | P | A | L |
|---|---|---|---|---|---|---|---|---|
| M | B | O | Q | S | O | M | V | W |

| T | E | A | C | H | E | R |
|---|---|---|---|---|---|---|
| F | D | V | S | Z | D | B |

| | C | A | P | I | T | A | L |
|---|---|---|---|---|---|---|---|
| So, | S | V | M | O | F | V | W |

55. 1

55.

| R | O | P | E | | D | O | U | B | T | | L | I | V | E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | , | | | | | | , | | | | | |
| % | 5 | 7 | $ | | 3 | 5 | # | 8 | * | | @ | 2 | 4 | $ |

∴

| T | R | O | U | B | L | E |
|---|---|---|---|---|---|---|
| * | % | 5 | # | 8 | @ | $ |

56. 3

56. $ ⟶ +
# ⟶ –
@ ⟶ ×

$* \longrightarrow \div$

$16 \$ 4 @ 5 \# 72 * 8 = 16 + 4 \times 5 - 72 \div 8$

$= 16 + 20 - 9$

$= 36 - 9$

$= 27$

57. 2

57. 5 3 2 1 6 4 | 8
1 2 3 4 5 6 | 8

58. 2

58. 8 S 9 P 9 K 6

59. 2

59. 12 R 3 M 5 P 20

$\therefore$ Total number of girls = 43

60. 3.

60. 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 | 1981
1 1 2 1 1 1 2 1 1 1 2

Same calendar repeats after 7 or multiple of 7 odd days, So 1981 will have same calendar as 1970.

61. 2

61. $(9-3)=6,(6-1)=5,(5-4)=1$

$(7-5)=2,(8-4)=4,(9-3)=6$

$\therefore (8-2)=6,(6-4)=2,(3-1)=2$

$\therefore$ 622

62. 2

62. $+ \longrightarrow \div$

$- \longrightarrow \times$

$\times \longrightarrow +$

$\div \longrightarrow -$

$\therefore\ 4+6\times 9\div 6-2\times 5$

$=4\div 6+9-6\times 2+5$

$=\frac{2}{3}+9-12+5=\frac{2}{3}+2$

$=\frac{8}{3}$

63. 1

63. As per observation

64. 4

64. As per observation

65. 1

65. As per observation

66. 3

66. As per observation

67. 1

67. $13^2 - 4^2 = 153$

$11^2 - 1^2 = 120$

Similarly $6^2 - 2^2 = 32$

68. 2

68. Total number of Biharis = 2 + 1 + 3 = 6

69. 1

69. Total number of Punjabis = 1 + 7 + 3 + 5 + 6 = 22

70. 4

70. Total number of Marathis = 3 + 6 + 4 + 8 = 21

71. 2

71. Only 2 Biharis are not Punjabis.

72. 4

72. Punjabis who are not Marathis = 5 + 1 + 7 = 13

73. 3

73.

| | |
|---|---|
| 1949 | $26^{th}$ Jan |
| 1600 + 300 + 12LY + 37NLY | 26 |
| 0 + 1 + 24 + 37 | 5 |
| 62 | |
| 6 | |

$\therefore$ Total number of odd days = 11

= 4

$\therefore$ $26^{th}$ Jan 1950 was Thursday

74. 1

74. $|12 \times 30 - 48 \times 5.5| = 96$

$\therefore$ Larger angle = 360 – 96

= 264

75. 2

75. $23\frac{40}{60}$ hrs of faulty clock = 24 hrs of actual clock

or $\frac{71}{3}$ hrs of faulty clock = 24 hrs of actual clock

$\therefore$ 71 hrs of faulty clock = $\frac{24 \times 71}{71} \times 3$

= 72 hrs of actual clock

$\therefore$ Correct time = 4 am

76. 3

76. Clearly 2 & 5 are opposite

1 & 6 are opposite

4 & 3 are opposite

77. 3

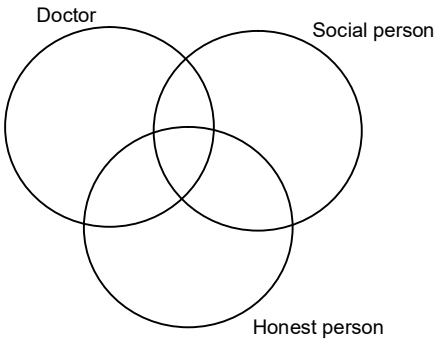
77. Here, $\Lambda = 4$

Clearly corner (8) cubes are 3 face coloured.

78. 4
78. $12(n-2) = 24$

79. 2
79. $6(n-2)^2 = 24$

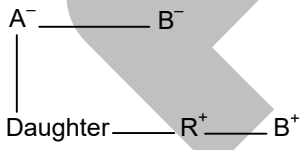
80. 3
80. $4 \times 7 = 28$
$3 \times 15 = 45$
Similarly $2 \times 5 = 10$
Logic of letter $\rightarrow$ In every row A, B & C are present.

81. 2
81. 


82. 2
82. (1) Difference between B & Q = 15.
(2) Difference between D & Y = 21.
(3) Difference between U & F = 15
(4) Difference between V & E = 17

83. 3
83. In given sequence PO & in alphabetical order it is OP.

84. 4
84. In given series letters between Y & L are 12 which is same as original alphabetical order & letters between L and F are 5 which is same as original alphabetical order.

85. 1
85. 

Clearly B is the aunt of S.

86. No option correct
86. Sohan and Neeraj have no mentioned correlation with Abhay, Neena & Sunita.

87. 3
87. $18 - 10 = 8$
$18 - 4 = 14$
$10 - 4 = 6$
Similarly $15 - 5 = 10$

88. 2
88. As per observation.

89. 1

89. As per observation.

90. 3
90. Horizontal lines = 3
Vertical lines = 5
Other lines = 8
Total number of lines required = 16

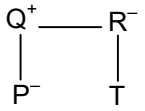
91. 3
91. Here, n = 4.
$\therefore$ Cubes with no surface coloured = $(n-2)^3 = 8$

92. 3
92. At least 2 face coloured = 2 face coloured + 3 face coloured
$= 12(n-2)^2 + 8 = 24 + 8 = 32$

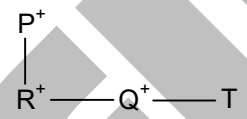
93. 1
93. 2 surface painted red = $12(n-2) = 24$

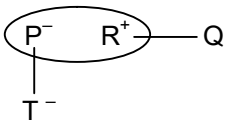
94. No option correct
94. 3 surface painted with red = corner cubes which are 8 in number.

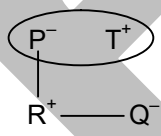
95. 3
95. Number of cubes obtained along each axis = 3
$\therefore$ Total number of cubes = $3 \times 3 \times 3 = 27$

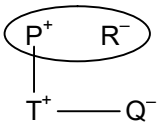
96. 4
96. 

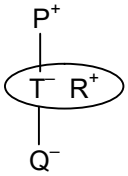
X → Father
+ → Daughter
÷ → Mother
– → Brother
Clearly T is the cousin of P.

97. 4
97. (i) 

(ii) 

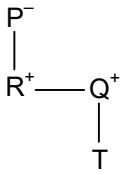
(iii) 

(iv) 


98. 3
98. Clearly R is the son in law of P.



99. 1

99. Clearly P is the grand mother of T.




100. 2

100. Clearly Q is the sister of T.