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

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

= 2

3. 1

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

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

$S_{15} = \frac{15}{2}[10 + 14] - \frac{15}{2} \times 24$
= 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. $3^{25} + 3^{26} + 3^{27} + 3^{28} + 3^{25} \quad 3^0 + 3^1 + 3^2 + 3^3$
$= 325 + 1 + 3 + 9 + 27$
$= 325 + 40 + 323 + 95 + 58$
$= 325 + 40 + 323 + 845$

6. 4

6. Rohan's final score = $\frac{90 + 2 + 75 + 1}{3}$
= 85

7. 1 Let Grand mother = G, mother = M and daughter
7. = D 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
 x = y + 6 ....(1)

$$\text{And } (x+12)=\frac{6}{5}(y+12)$$

= 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) = $\frac{1}{6}$

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

10. 2
10. 10 balls 5B and 5W
After removing 1 B balls, total balls left = 9 and
Total black balls left = 4

 P (B ball after removing 1st B ball) = $\frac{4}{9}$

11. 2 10 – 3 = 12 10 – 3 + 5 = 12
11. 12 – 4 = 13 12 – 4 + 5 = 13
14 – 5 = 14 14 – 5 + 5 = 14
16 – 6 = ? 16 – 6 + 5 = 15

12. 2
12. If bus does not stops, then it will travel 9 km more with 54 kmph
 It will stop for $\frac{9}{54}$ hr $\frac{9}{54} \times 60\text{min}$
= 10 min

13. 4

13. $\frac{40\%\ \text{of}\ 1620}{100} + \frac{30\%\ \text{of}\ 960}{100} = \frac{x\%\ \text{of}\ 5200}{100}$

$\Rightarrow x\% \text{ of } 5200 = 40\% \text{ of } 1620 + 30\% \text{ of } 960$

$\Rightarrow x = 18$

14. 2

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

$\Rightarrow 24x = 30$

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

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

$\Rightarrow$ 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

$\Rightarrow$ Bell rung 20 times.

16. 4

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

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

Now $B = \frac{x\%\ \text{of}\ A}{100} \Rightarrow x = \frac{B}{A} \times 100$

$\Rightarrow x = \frac{8}{5} \times 100 = 160$

17. 3

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

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

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

$\Rightarrow x = 7$

$\Rightarrow$ 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, $(x + y + z)^2 = x^2 + y^2 + z^2 + 2(xy + yz + zx)$

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

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

$= 15 \times (-36)$

$= -540$

19. 4

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

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

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

$384 = \sqrt{6x(3x)(2x)(x)}$

$384 = 6x^2$

$\therefore x = 8$

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

20. 3

20. (1) $\frac{1}{3 - \frac{1}{\frac{17}{16}}} - \frac{1}{3 - \frac{16}{17}} = \frac{17}{66}$

(2) $\frac{1}{3 - \frac{1}{1 - \frac{1}{\frac{9}{8}}}} - \frac{1}{3 - \frac{1}{\frac{17}{9}}} - \frac{1}{\frac{60}{17}} = \frac{17}{60}$

(3) $\frac{1}{3 - \frac{1}{1 - \frac{1}{\frac{9}{4}}}} - \frac{1}{3 - \frac{1}{\frac{13}{9}}} - \frac{1}{\frac{48}{13}} = \frac{13}{48}$

(4) $\frac{1}{3 - \frac{1}{\frac{9}{8}}} - \frac{1}{\frac{35}{8}} = \frac{8}{35}$

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. A 12 D

8 8 10

B E 6 C

Construction: Draw $DE \perp BC$

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

$= b \times h + \frac{1}{2} \times b \times h$

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

$= 96 + 24 = 120$ m2

23. 3

23. 4, 8, 28, 80, 244

4 →(× 3 – 4) 8 →(× 3 + 4) 28 →(× 3 – 4) **80** →(× 3 + 4) 244

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

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

$\Rightarrow \frac{1149}{1000}0 = \left(\frac{107}{100}\right)^n$

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

$\therefore$ n = 2

27. 2

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

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

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

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

28. 3

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

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

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

$\Rightarrow x = 1$

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

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

$(P + Q)3 = P3 + Q3 = 3PQ\ (P + Q)$

$\Rightarrow P3 + Q3 = (x + y)3 - 3xy\ (x + y) = x3 + y3$

31. 1

31. $\frac{x - 5}{12} = \frac{x}{16} - 1$

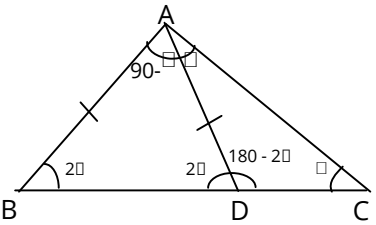
$= \frac{4x - 20}{48} = 1$

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

$\Rightarrow x = 4$ min

32. 3

32.



In ΔABD, $90 - \theta + 2\theta + 2\theta = 180^o$

$4\theta - \theta = 90$ - - - (1)

In ΔABC $3\theta + 90 = 180^o$

$\theta = 30$ - - - (2)

$\theta = 4\theta - 90 = 30^o$

33. 2

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

$\Rightarrow \theta$ in shaded region $= \frac{360}{6} = 60°$

$\Rightarrow \theta$ in Arc AQB $= 360 - 120 = 240$

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

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

$= \frac{2}{3} \times 2 \times \pi \times 10 = \frac{40}{3}\pi$

34. 4

34. Let original length = ℓcm & width = b cm

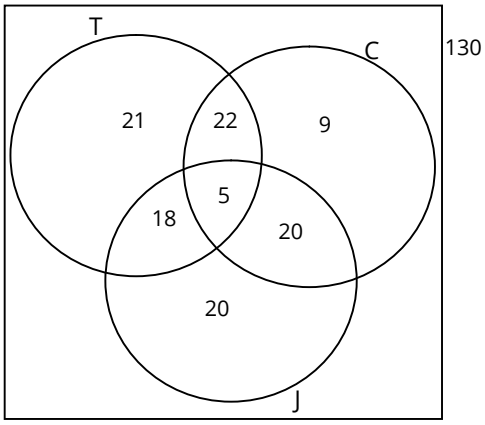
$\Rightarrow$ Original Area = $\ell b cm^2$

New area $= \frac{12}{5} \ell \times \frac{80}{100} b = \ell b cm^2$

Since original area = new area

$\Rightarrow$ 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 = $\frac{12000}{270\,00} \times 100 = 44.44\%$

For L = $\frac{6000}{15\,000} \times 100 = 40\%$

For M = $\frac{21\,000}{45000} \times 100 = 46.66\%$

For N = $\frac{9000}{210\,00} \times 100 = 42.85\%$

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

M = 4n, S = 5n

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

$\frac{4n+5}{5n+5} = \frac{7}{9}$

36n – 45 = 35n – 35

n = 10

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 = ℓ

And original breadth = b

$\therefore$ Original area = ℓb

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

$= 1.0125\ \ell b$

$\therefore$ 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) Odd2 + Even2 + 1 = Even = Even

45. 1

45. Volume of liquid in cuboidal container
= Volume of liquid in cylindrical container
□ × b × h = □r2h

2 × 10 × 20 = □ × 52 × h

□ h□ $\frac{400}{25}$ □$\frac{16}{□}$

46. 1

46. tan □ + □t □ = 2

tan□□ $\frac{1}{\tan□}$ □2 ; $\frac{\tan2□ □1}{\tan□}$ □2

□ tan2 □ – 2 tan □ + 1 = 0
□ (tan □ – 1)2 = 0
□ tan □ = 1
□ cot □ = 1.
□ tan □100 + cot □100
1 + 1 = 2

47. 2

47. 2(a + b)4 = □□(a□b)2□□
= (a2 + b2 + 2ab)2
= a4 + b4 + 4a2b2 + 4a3b + 2a2b2 + 4ab3
= a4 + b4 + 6a2b2 + 4a3b + 4ab3
□ Coefficient of a2b2 = 6.

48. 3

48. $\frac{\text{Girls}}{\text{Totalclass}}$ □ x $\frac{x}{□}$ y

49. 4

49. 26n – 42n
64n – 16n
We know that an – bn is always divisible by (a – b)
□ 64n – 16n is divisible by 48.

50. 3

50. x□21□21/3□22/3
x – 2 = 22/3 – 21/3
Cubing both sides
x3 – 8 – 3(2x) (x – 2) = 22 – 21 – 3(2) (x – 2)
□ x3 – 8 – 6x2 + 12x = 4 – 2 – 6x + 12
□ x3 – 6x2 + 18x = 22
□ x3 – 6x2 + 18x + 18 = 40

51. 1 1 figure □s=6 2

51. figure □s=4 3
figure □s= 2 □
Total number of
□s= 12

52. 3

52. F ather (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 QS O M V W
TEAC H E R

FD V S Z D B
C A PI T A L
So,

S V M O F V W

55. 1

55. R OP E D OU B T L I V E

% 5 7 $ 3 5 # 8 * @ 2 4 $

□ TRO U B L E

* %5 # 8 @ $

56. 3

56. $ □□□+
□□□–
@ □□□□

*□□□□

16 $ 4 @ 5 # 72 * 8 = 16 + 4 □ 5 – 72 □8
= 16 + 20 – 9
= 36 – 9
= 27

57. 2
57. 5 3 2 1 6 4 8 1 
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
□ Total number of girls = 43

60. 3.
60. 1 970 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 □
□17 5□□2,8□4□4,9□3□6 □
□ □82□□6,6□4□2,□3□1□2
□ 622

62. 2
62. □□□□□
□□□□□
□□□□□
□□□□□
□ 4□6□9□6□2□5
□4□6□9□6□2□
□5
2 3 □9□12 □5 □ 2 □2
3
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. $132 - 42 = 153$
$112 - 12 = 120$
Similarly $62 - 22 = 32$

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
1600 + 300 + 12LY + 37NLY
0 + 1 + 24 + 37
62
6

26th Jan
26
5

$\therefore$ Total number of odd days = 11
= 4
$\therefore$ 26th Jan 1950 was Thursday

74. 1

74. $|12 - 30 - 48 - 5.5 - 96$
$\therefore$ 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 = $\frac{24}{71} \times 71 \times 3$

= 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

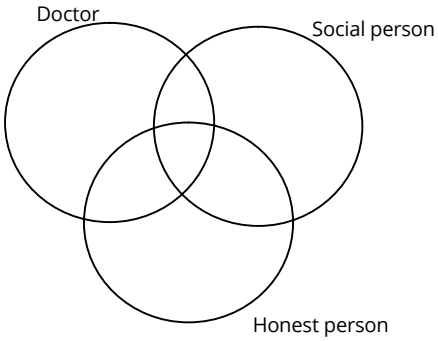
77. 3

77. Here, $\square = 4$
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 × 7 = 28
3 × 15 = 45
Similarly 2 × 5 = 10
Logic of letter 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. A^- B^-

Clearly B is the aunt of S.

Daughter R^+ B^+

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

87. 3 18 – 10 = 8 18 – 4
87. = 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.
 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

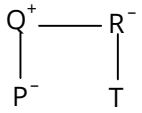
94. No option correct

94. 3 surface painted with red = corner cubes which are 8 in number.

95. 3

95. Number of cubes obtained along each axis = 3
 Total number of cubes = 3 × 3 × 3 = 27

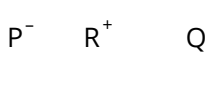
96. 4

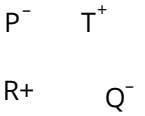
96. 

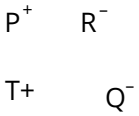
X Father
+ Daughter
  Mother
– Brother
Clearly T is the cousin of P.

97. 4

97. (i) 

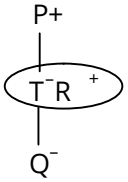
(ii) 

(iii) 

(iv) 

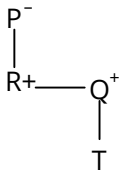
98. 3

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.