MATRIX HIGH SCHOOL

SOLUTIONS

NTSE STAGE 2 2020-21

SCHOLASTIC APTITUDE TEST (SAT)

1. Plasma membrane is a semipermeable membrane, water can move by osmosis and gases can cross by diffusion.

2. Vacuole in plant cell is larger than animal cell.

3. Mitochondria are more in cardiac muscles to generate more energy.

4. Grafting is possible among dicot plants due to presence of cambium.

5. Collenchyma have thickened wall at the corners & have either very little intercellular spaces or absent.

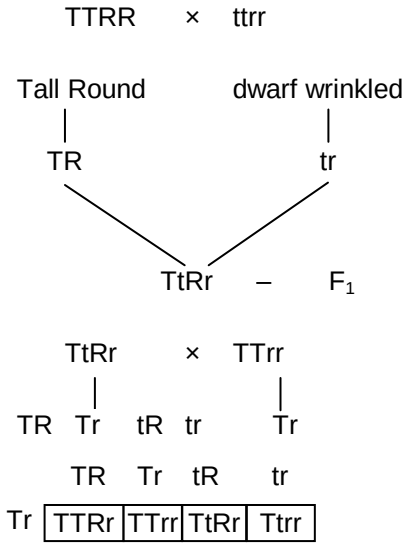
6. The *Marsilea* do not produce seed but *pinus* produces.

7. No option is correct (according to given information in the question).

8. Cyanobacteria (Blue green algae) if placed in pure water they will swell but not burst due to presence of cell wall.

9. The genotype of II-3 should be Hh and II-4 should be hh as these are formed by the cross of Hh $\times$ hh.

10. 50% plants will produce wrinkled seeds.



50% of plants will have wrinkled seeds.

11. If no CO_2 then no photosynthesis and no oxygen & earth would be devoid of life.

12. Producers will gate 1% of 100000 kcal

Producers	→	Primary consumers	→	Secondary consumers	→	Tertiary consumers
1000 kcal		100 kcal		10 kcal		1 kcal

(According to 10% law)

13. No fertilisation will be there so no fruit formation.

14. $m(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} xCr_2O_3 + yN_2 + zH_2O$

After Balancing

$1(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} 1Cr_2O_3 + 1N_2 + 4H_2O$

$\therefore$ The stoichiometric coefficients m, x, y and z are respectively 1, 1, 1, 4.

15. $2H_2S + 1SO_2 \longrightarrow 3S + 2H_2O$

As per balanced chemical equation,

1 mole of SO_2 produces $\longrightarrow$ 3 mole of sulphur

$\Rightarrow$ 64 g SO_2 produces $\longrightarrow$ 96 grams Sulphur

$\therefore$ 1 gram SO_2 produces $\longrightarrow \frac{96}{64}$ grams sulphur

= 1.5 g sulphur.

Hence statement 2 is wrong.

16.

Sample	With blue litmus	With red litmus	With phenolphi nalein
A	–	Turns blue	Turns pink
B	–	–	–
C	Turns red	–	–

The data provided in the above table indicates that the pH of the following solutions will be as follows:

pH of solution A > 7

pH of solution B = 7

pH of solution C < 7

Now as per options provided,

pH of $CH_3COO\,Na_{(aq)}$ > 7 (salt of strong base and weak acid)

pH of $NaCl_{(aq)}$ = 7 (salt of strong acid and strong base)

pH of $FeCl_3$ < 7 (salt of strong acid and weak base)

$\therefore$ A = CH_3COONa; B = NaCl; C = $FeCl_3$.

17. Acetic acid and water are miscible with each other, so separating funnel method can't be useful. The correct method of separation of miscible liquids is distillation. Hence statement III is wrong.

18. $A \xrightarrow{alk.KMnO_4} B$ (I)

$A \xrightarrow{conc.H_2SO_4} C \text{ and } D$ (II)

The reactions (I) and (II) are as follows

$\underset{(A)}{C_2H_5OH} \xrightarrow{alk.KMnO_4} \underset{(B)}{CH_3COOH}$ {Oxidation of alcohol}

And,

$C_2H_5OH \xrightarrow{conc.H_2SO_4} \underset{(C)}{C_2H_4} + \underset{(D)}{H_2O}$ {Dehydration of alcohol}

$\therefore$ A = C_2H_5OH

B = CH_3COOH

C = C_2H_4

D = H_2O

19. The reactions are as follows:

(I) $C_2H_5OH \xrightarrow{acd.K_2Cr_2O_7} CH_3COOH$

This is a redox reaction (Oxidation of alcohols)

(II) $C_2H_4 + H_2 \xrightarrow{Ni\,Catalyst} C_2H_6$

This is an addition reaction (Hydrogenation of alkenes)

(III) $CH_4 + Cl_2 \xrightarrow{hv} CH_3Cl + HCl$

This is a substitution reaction (chlorination of methane)

(IV) $C_2H_5OH \xrightarrow{conc.H_2SO_4} C_2H_4 + H_2O$

This is an elimination reaction (Dehydration of alcohol)

20. Beaker A

$FeSO_4 + Cu \longrightarrow \text{No Reaction}$

Beaker B

$FeSO_4 + Zn \longrightarrow ZnSO_4 + Fe$

The above observations indicate that Zinc is most reactive and copper is least reactive.

Hence the order of reactivity will be

Zn > Fe > Cu

21. Sulphur upon heating in a spatula in presence of air forms,

$S + O_2 \xrightarrow{\Delta} \underset{\text{acidic oxide}}{SO_2}$

SO_2 being an acidic oxide when comes in contact with moist Blue litmus paper, turns the litmus paper red, due to the formation of sulphurous acid.

22. In sample A,
5 g of sample contains 1.25 g Z
$\Rightarrow$ Weight of Y = 5 – 1.25 = 3.75 g
In sample B,
75% of y is present by weight
$\Rightarrow$ 100 g $\Rightarrow$ 75 g of Y
$\therefore$ 5 g of sample will weigh

$$= \frac{75}{100} \times 5 = 3.75 \text{ g}$$

$\therefore$ Given Data illustrates law of constant proportion.

23. Element $_{13}X - 2, 8, 3$
Element $_{17}Y - 2, 8, 7$
$\therefore$ According to their electronic configuration,
Valency of x = 3
Valency of y = 1
$\therefore$ Compound formed = XY_3
The nature of the compound is covalent due to high polarization [Fajan's Rule], Therefore Bond formed between X and Y is covalent.

24. (I) C – 12 and C – 14 are isotopes of each other.
(II) Carbon reacts with oxygen to form carbon dioxide/carbon monoxide which is a covalent compound
(III) Ca – 40 and Ar – 40 are isobars of each other.
(IV) $2Ca + O_2 \longrightarrow 2CaO$

$$CaO + H_2O \longrightarrow \underset{(\text{Lime Water})}{Ca(OH)_2}$$

Therefore, statements (III) and (IV) are correct.

25. The atomic size increases in a group from top to bottom due to addition of new shells with each period.
So correct order of atomic radii will be,
Li < K < Rb < Cs

26. (I) Kinetic energy is directly proportional to temperature. So with an increase in temperature, kinetic energy also increases.
(II) Solid State $\underset{\text{Sublimation}}{\overset{\text{Sublimation}}{\rightleftharpoons}}$ Gaseous State
(III) Movement of particles from higher concentration to lower concentration is called diffusion.
(IV) Rate of evaporation is directly proportional to temperature. Therefore with an increase in temperature, rate of evaporation also increases.

27. Speed of train = $90 \times \frac{5}{18} = 25\,m/sec$

$T = \left[\frac{1500}{25} - \frac{1250}{300}\right] + \frac{250}{300}$

T = 56.67 sec

28. Speed during upstream = 10 km/hr
Speed during downstream = 20 km/hr

Average speed $= \frac{2v_1v_2}{v_1+v_2} = \frac{2(10)(20)}{10+20}$

$= \frac{40}{3} km/hr$.

29. Let Q travels x and P travels (525 – x)m

$\therefore \quad x = \frac{1}{2}(2)t^2 = t^2$ (1)

and 525 – x = 20t (2)
From (1) and (2)
$t^2 + 20t - 525 = 0$
t = 15 sec
and $x = t^2 = 225$ m

30. Rate of energy dissipation

$\Rightarrow \frac{\frac{1}{2}mv^2}{t} = \frac{\frac{1}{2}\left(50\times10^{-3}\right)(80)^2}{8}$

$\Rightarrow$ 20 J/sec.

31. After 3 bounces total energy will be

$\Rightarrow \left(\frac{9}{10}\right)^3 mgh \Rightarrow \left(\frac{9}{10}\right)^3 (0.1)(10)(1)$

$= \left(\frac{9}{10}\right)^3 J$

at half the maximum height

$K.E = \frac{\left(\frac{9}{10}\right)^3}{2} = 0.36\,J$

32. T = truweight – B.Force

$T = (3g) = \frac{Q}{3}\left(\frac{3}{\rho}\right)(g) = 2g$

$\therefore$ Spring balance reads 2 kg

33. 1 Kg coal produces $20\times10^6\times\frac{25}{100}$

$\Rightarrow 5\times10^6\ J/kg$

1 Kwh = 3.6×10^6 J.

$\therefore$ for 1 kwh coal required

$=\frac{3.6\times10^6}{5\times10^6}=\frac{3.6}{5}kg$

Cost will be $=\frac{3.6}{5}\times5=Rs.36$

34. Option is self expanatory.

35. $2d = v \times t$

$d=\frac{v\times t}{2}$

$d=\frac{1450\times4}{2}$

= 2.900 km.

36. Image of tip will form at pole itself for image of other point

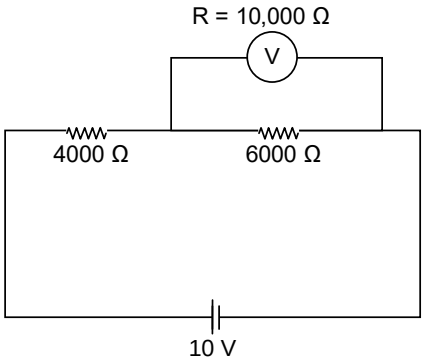
u = –10 cm; $f=\frac{-40}{2}=-20\ cm$

as $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$

we get v = + 20 cm

$\therefore$ Size of image will be 20 cm.

37.



$R_{eq}=\frac{10,000\times6,000}{(10,000+6,000)}+4000$

R_{eq} = 7750 Ω

$i=\frac{10}{7750}$

$v_1=\frac{10}{7750}\times4000=5.16$

So v_2 = 10 – 5.16

$v_2 = 4.838$.

38. $P_A = \frac{E^2}{N^2R}$; $P_B = \frac{E^2}{R}$

$P_{AT} = \frac{E^2}{NR}$; $P_{BT} = \frac{NE^2}{R}$

$\therefore$ We get $P_E = N^2P_A$

39. $\frac{1}{3}R$ in series with $(2R \,P\, 2R)$ in series with $(2R \,P\, 2R)$

We get R_{AB} as 2 R

40. $\text{Average Speed} = \frac{\text{total distance}}{\text{total time}}$

$$\text{Average Speed} = \frac{l + l' + (l - l')}{\frac{l}{2} + \frac{l'}{1.5} + \frac{(l - l')}{0.5}} \qquad (1)$$

Givne $\frac{l'}{1.5} = \frac{l - l'}{0.5} \;\therefore\; l' = \frac{3l}{4}$ (2)

From (1) and (2)

We get average speed = 1.33 m/sec

41.

$$\begin{array}{r} x - 2a \\ x^2 + 2ax + a^2 \overline{)\; x^3 - 3px + 2q} \\ \underline{x^3 + a^2x + 2ax^2} \\ -2ax^2 + x(-3p - a^2) + 2q \\ \underline{-2ax^2 - 4a^2x - 2a^3} \\ x(-3p + 3a^2) + (2q + 2a^3) \end{array}$$

$-3p + 3a^2 = 0$ …(i)

$2q + 2a^3 = 0$ …(ii)

$\Rightarrow a^2 = p \Rightarrow a = \sqrt{p}$

Put in (ii)

$\Rightarrow 2q + 2\left(\sqrt{p}\right)^3 = 0$

$\Rightarrow q = -\left(\sqrt{p}\right)^3$

$q = -p\sqrt{p}$

$q^2 = p^3$

42. $\left(3^{\frac{1}{2}}-1\right)\left(3^{\frac{1}{2}}+3^{\frac{1}{4}}+1\right)\left(3^{\frac{1}{2}}-3^{\frac{1}{4}}+1\right)$

$= \left(3^{\frac{1}{2}}-1\right)\left[\left(3^{\frac{1}{2}}+1\right)+3^{\frac{1}{4}}\right]\left[\left(3^{\frac{1}{2}}+1\right)-3^{\frac{1}{4}}\right]$

$= \left(3^{\frac{1}{2}}-1\right)\left[\left(3^{\frac{1}{2}}+1\right)^2-\left(3^{\frac{1}{4}}\right)^2\right]$

$= \left(\sqrt{3}-1\right)\left[3+1+2\sqrt{3}-\sqrt{3}\right]$

$= \left(\sqrt{3}-1\right)\left[4+\sqrt{3}\right]$

$= 3\sqrt{3}-1$

43. $mx + 2y = 10$ …(i)

$3x – 2y = 0$

$\Rightarrow 3x = 2y$ …(ii)

Put in equation (i)

$(m + 3)x = 10$

$x = \frac{10}{m+3}$

$y = \frac{3}{2}\times\frac{10}{m+3} = \frac{15}{m+3}$

Q x and y and integers

$\therefore$ m = – 2, 2, – 8

Option (2) or (3) correct.

44. $a_n = a + (n – 1)d$

If d increased to d + 1

$a_n^1 = a_n + 19$

$a + (n – 1)(d + 1) = a + (n – 1)d + 19$

$(n – 1)d + n – 1 = (n – 1)d + 19$

n = 20

$a_5 = 28$

$a + 4d = 28$ …(i)

$\frac{a+a+(n-1)d}{2} = 61$

$2a + 19d = 122$ …(ii)

From equation (i) and (ii)

$2a+19d=122$

$2a+8d=56$

$11d = 66$

d = 6

a = 4

$a_{10} = a + 9d$

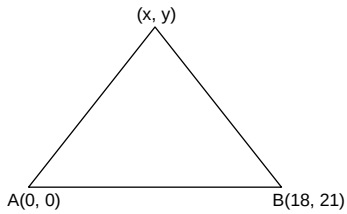
$= 4 + 54$

$= 58$

45. s_n = 300 years
a = 9 years
d = $\frac{1}{4}$ year
$\frac{n}{2}\{2a+(n-1)d\} = 300$
$\frac{n}{2}\left\{18+(n-1)\times\frac{1}{4}\right\}$ = 300
n{72 + n – 1} = 300 × 8
n^2 + 71n – 2400 = 0
(n + 96)(n – 25) = 0
n = 25
a_{25} = 9 + 24 × $\frac{1}{4}$
= (9 + 6) year
= 15 years

46. let number of persons = n
Indivisual share = $\frac{27000}{n}$
$\frac{27000}{n+20} = \frac{27000}{n} - 480$
$\Rightarrow 480 = 27000\left[\frac{1}{n} - \frac{1}{n+20}\right]$
$\Rightarrow$ n(n + 20) = $\frac{27000\times 20}{480}$
$\Rightarrow$ n^2 + 20n – 1125 = 0
$\Rightarrow$ (n + 45)(n – 25) = 0
$\Rightarrow$ n = 25

47. area of $\Delta ABC = \frac{1}{2}|0(y-21)+x(21-0)+18(0-y)|$
= $\frac{1}{2}|21x-18y|$
= $\frac{3}{2}|7x-6y|$
Q x and y are integer
$\therefore$ it will be minimum at x = y = 1
$\therefore$ minimum integral value of |7x – 6y| = 1
$\therefore$ minimum non zero area of ΔABC = $\frac{3}{2}\times 1 = \frac{3}{2}$ sq. unit



48. $\frac{1-\cos\theta}{\sin\theta} = \frac{1}{5}$, $0° < \theta < 90°$

$\Rightarrow 5 - 5\cos\theta = \sin\theta$

$\Rightarrow 5\sec\theta - 5 = \tan\theta$

$\Rightarrow 5\sqrt{1+\tan^2\theta} = 5 + \tan\theta$

$\Rightarrow 25(1 + \tan^2\theta) = 25 + 10\tan\theta + \tan^2\theta$

$\Rightarrow 24\tan^2\theta - 10\tan\theta = 0$

$12\tan^2\theta - 5\tan\theta = 0$

$\tan\theta(12\tan\theta - 5) = 0$

$\tan\theta = 0$ ar $\tan\theta = \frac{5}{12}$

$1 + \tan\theta = 1$ or $\frac{17}{12}$

49. let BC = x m

DB = x + 7.3m

AB = DB

BC = 10m

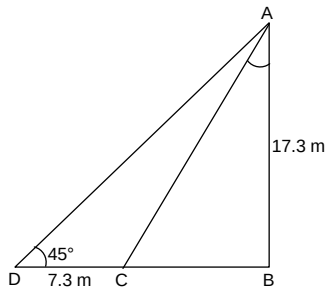
let $\angle BAC = \theta$

$\tan\theta = \frac{BC}{AB}$

$= \frac{10}{17.3}$

$= 0.578$

$\theta = 30°$



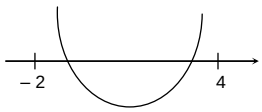
50. $x^2 - 2mn + m^2 - 1 = 0$

$\alpha + \beta = 2m$

$\alpha\beta = m^2 - 1$

$\therefore -2 < \frac{2m}{2} < 4$

$-2 < m < 4$



$f(-2) > 0$	$f(4) > 0$
$m^2 + 4m + 3 > 0$	$m^2 - 8m + 15 > 0$
$(m + 3)(m + 1) > 0$	$(m - 3)(m - 5) > 0$
$m < 3$ or $m > -1$	$m < 3$ or $m > 5$

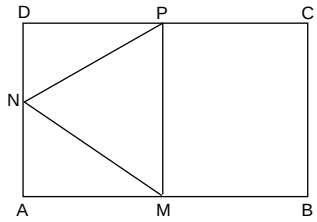
$\therefore -1 < m < 3$

51. $n(s) = 11 \times 11 = 121$

$p(E) = \frac{13}{121}$

E = {(0, 0), (1, 0), (1, 1), (2, 0), (– 1, 0), (– 2, 0), (0, 2), (0, 1), (0, – 1), (0, – 2), (– 1, 1), (1, – 1), (– 1, – 1)}

52. P is mid point of CD.



ar(ANM) = $\frac{1}{4}$ ar(AMPD)

= $\frac{1}{8}$ ar(ABCD)

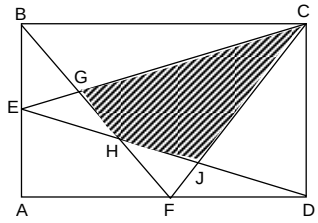
$\therefore \frac{\text{ar}(\text{ANM})}{\text{ar}(\text{ABCD})} = \frac{1}{8}$

53. by carpet law

area(GHJC) = ar(BGE) + ar(AEHF) + ar(FJD)

= 503 + 1113 + 408

= 2024



54. BD = BC

$\angle BEF = 10^o$

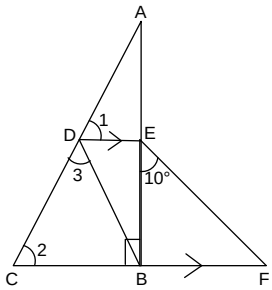
Q DE || BC

$\therefore \angle 1 = \angle 2 = \angle 3 = \theta$ (let)

but $\angle DBC = 90 - 10 = 80°$

$\therefore 2\theta = 100°$

$\therefore \theta = 50°$



55. AD = DC

In ΔADC

$2\theta = 80°$

$\therefore \theta = 40°$

In ΔABC

AB = AC

$\therefore 2\alpha = 160°$

$\alpha = 80°$

In □ABCD

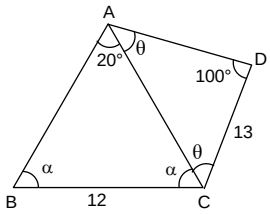
$\angle ABC + \angle ADC = 180^o$

$\therefore$ ABCD is a cyclic □

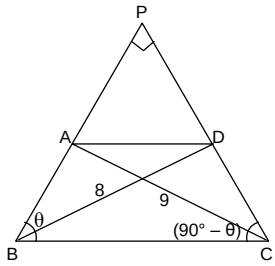
$\therefore$ length of DC will be double of length CB

Q Angle opposite to chord CD is double of angle opposite to chord BC.

$\therefore$ the given information is wrong



56. In ΔPBD = $BP^2 + PD^2 = BD^2$ …(i)
In ΔPAD = $PA^2 + PC^2 = AC^2$ …(ii)
from equation (i) and (ii)
$BP^2 + PA^2 + PD^2 + PC^2 = BD^2 + AC^2$
$(BP^2 + PC^2) + (PA^2 + PD^2) = BD^2 + AC^2$
$BC^2 + AD^2 = 9^2 + 8^2$
AD = $\sqrt{81+64-100}$
AD = $3\sqrt{5}$
arWADEF = $(AD)^2 = 45$



57. using power of point for the circle w.r.t. point 'C'
CD.CB = CG.CF

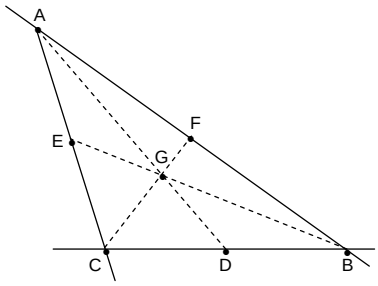
$$\frac{a}{2}.a = \frac{2}{3}CF^2 = \frac{2}{3}\left(\frac{a^2}{2}+\frac{b^2}{2}-\frac{c^2}{4}\right)$$

$$\frac{a^2}{2} = \frac{a^2}{3}+\frac{b^2}{3}-\frac{c^2}{6}$$

$a^2 + c^2 = 2b^2$
also, 'C' is obtuse $\Rightarrow$ cosC < 0
$a^2 + b^2 < c^2$
$\Rightarrow a^2 + b^2 < 2b^2 – a^2$
$\Rightarrow 2a^2 < b^2$

$$\Rightarrow \frac{a^2}{b^2} < \frac{1}{2}$$

$$\Rightarrow \frac{a}{b} < \frac{1}{\sqrt{2}}$$

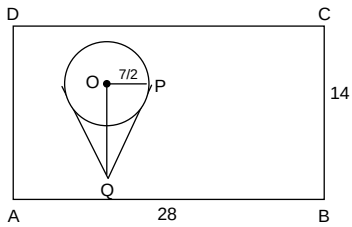


58. $ax^2 + bx + c = 0$
Q a + b + c = 0
$1 + \beta = -\frac{b}{a}$, $1.\ \beta = \frac{c}{a}$

$$\beta = \frac{c}{a}$$

Roots are 1, $\frac{c}{a}$

59. OP = r = $\frac{7}{2}$
OQ = 3
area of top circular surface of pit = $\pi\left(\frac{7}{2}\right)^2 = \frac{22}{7}\times\frac{7}{2}\times\frac{7}{2} = \frac{77}{2}$
= 38.5 m^2
area of the plot on which dug soil is spreaded = 28 × 14 – 38.5
= 353.5 m^2



volume of dug soil = $\frac{1}{3}\times\frac{22}{7}\times\frac{7}{2}\times\frac{7}{2}\times 3$ = 38.5 m^3

$\therefore$ value of increment in the level of remaining plot = $\frac{38.5}{353.5}$; 10.9 cm

60. $\sum x_i - 50n = -10$

$\sum x_i = 50n - 10$ …(i)

$\sum x_i - 46n = 70$

$\sum x_i = 46n + 70$ …(ii)

From (i) and (ii)

50n – 10 = 46n + 70

4n = 80

n = 20

$\sum x_i = 990$

$\bar{x} = \frac{990}{20}$ = 49.5

$\therefore \bar{x}$ – 48 = 49.5 – 48 = 1.5

61. Arrangement of the division of power between different religious communities is not true.

62. The president appoints a leader who can muster majority support in the Lok Sabha and can prove majority support in the Lok Sabha.

63. B and C options are not presenting true picture.

64. In some cases caste division leads to tensions, conflict and even violence.

65. A political prisoner during Pinochet dictatorship.

66. Freedom to acquire, hold and dispose any property any where in country.

67. A – G, B – H, C – E, D – F.

68. It lays down limits on the powers of the govt. And tells us what the rights of the citizens are.

69. Right to freedom.

70. Both option A and D

71. Non-availability, inaccessibility, non-affordability.

72. Option A, C and D

73. Options a, b, d, e, f

74. Both A and R are true and R is the correct explanations of A.

75. Fall in productivity of the agricultural workers.

76. Rate of extraction of all resources is less than rate of its regeneration and creation.

77. Rithish, Rahul, Ramesh, Ramu

78. Let the carpenter pay on the basis of hours of work.

79. Disguised unemployment.

80. Right to choose

81. Jharkhand – Odisha – Andhra Pradesh – Telangana – Maharashtra – Madhya Pradesh

82. Ganga – Narmada – Godabari – Krishna – Penneru – Palar

83. Formation of high pressure over Tibetan plateau.

84. Meghalaya

85. Both are true and statement 1 provides explanations for statement 2.

86. Chennai is not an inland riverine port.

87. 8:16 am – 6:48 am

88. Both are true

89. Wetlands

90. A3, B1, C4, D2

91. I, II, and IV

92. Oak leaves stand for heroism.

93. I, III and IV

94. I, II and IV

95. I, II and III

96. III and IV

97. Both are true and R is the correct explanation of A.

98. I, II and IV

99. Acquiring new territories to enhance the area of the mother country.

100. I, II and IV

Answer Key
NTSE Stage 2 2020-21 (SAT)

1.	4	2.	3	3.	4	4.	1
5.	2	6.	2				
7.	no option correct (according to given information)					8.	3
9.	1	10.	3	11.	3	12.	4
13.	1	14.	3	15.	2	16.	2
17.	2	18.	3	19.	3	20.	1
21.	2	22.	1	23.	2	24.	3
25.	2	26.	4	27.	2	28.	3
29.	2	30.	3	31.	2	32.	4
33.	2	34.	3	35.	2	36.	3
37.	4	38.	4	39.	1	40.	2
41.	3	42.	3	43.	2 and 3	44.	3
45.	2	46.	2	47.	1	48.	2
49.	2	50.	1	51.	4	52.	3
53.	option incorrect						
54.	1	55.	wrong information				
56.	4	57.	2				
58.	4	59.	2	60.	1	61.	4
62	2	63.	2	64.	4	65.	4
66.	4	67.	2	68.	1	69.	3
70.	3	71.	3	72.	2	73.	4
74.	1	75.	1	76.	4	77.	2
78.	2	79.	3	80.	2	81.	3
82.	4	83.	3	84.	2	85.	3
86.	2	87.	3	88.	4	89.	2
90.	4	91.	4	92.	4	93.	3
94.	4	95.	2	96.	3	97.	4
98.	4	99.	4	100.	2		