FIITJEE Patna Centre

STATE LEVEL NATIONAL TALENT SEARCH EXAMINATION, 2016
MENTAL ABILITY AND SCHOLASTIC APTITUDE TEST
For Class X

Hint & Solution

Part – I

MAT

1. Hints:- $40\times3=120, \frac{120}{2}=60, \ 60\times3=180, \frac{180}{2}=90, 90\times3=270$

2. Hints:- 3, 6, 9,12, 15, 18

3. Hints:- $\frac{a+b+c+d}{4}=100$

$\Rightarrow a+b+c+d=4\times100=400$

$\Rightarrow a+b+d=400-70=330$

$\text{Mean}=\frac{330}{3}=110$

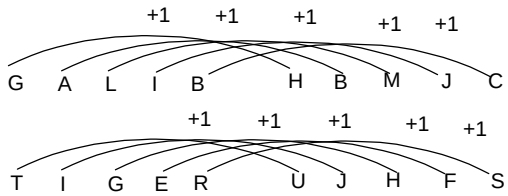
4. Hints:- Perimeter of circle = $2\pi r$

New perimeter of circle = $3\pi r$

Percentage increase of perimeter = $\frac{3\pi r-2\pi r}{2\pi r}\times100\%=\frac{\pi r}{2\pi r}\times100\%=50\%$

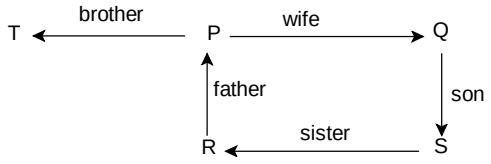
5. 4

6. Hints:-



7. 4

8 Hints:-



9. Total horticulture

2006 - 07 $\rightarrow$ 3.74%

2007 - 08 $\rightarrow$ 4.12%

2008 – 09 $\rightarrow$ 2.47%

2009 – 10 $\rightarrow$ 0.96%

10. Hints:- Fruits = $\frac{63}{209}\times100\%=30.14\%$

Vegetables = $\frac{79}{209}\times 100\% = 37.79\%$

Flowers= $\frac{2}{209}\times 100\% = 95\%$

11. [3] Hints:- Increase % of Fruits = $\frac{63-53}{53}\times 100\% = 18.86\%$

Increase % of vegetable = $\frac{79-72}{72}\times 100\% = 8.86\%$

Increase % of flowers = $\frac{2-1}{1}\times 100\% = 100\%$

Increase % of horticulture = $\frac{209-187}{187}\times 100\% = 11.76\%$

12. Hints:- Answer Question number 11

13. Hints:- Percentage area = $\frac{138}{202}\times 100\% = 68.31\%$

14. Hints:- 2006 – 07 $\rightarrow \frac{56-53}{53}\times 100\% = 5.66\%$

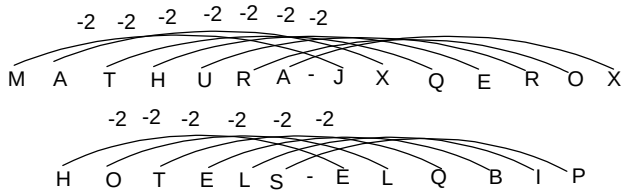
2007 – 08 $\rightarrow \frac{58-56}{56}\times 100\% = 3.57\%$

2008 – 09 $\rightarrow \frac{61-58}{58}\times 100\% = 5.17\%$

2009 – 10 $\rightarrow \frac{63-61}{61}\times 100\% = 3.27\%$

15. 2

16. Hints:-



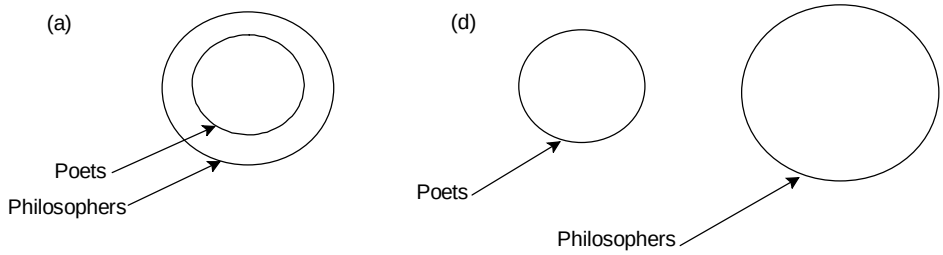
17. 2

18. 3

19. 3

20. Hints:- Let present age of son's = x years
Present age of father's = 4x years
Present age of mother's (4x – 3) years
After 3 years
Son's age = x + 3 = 15
$\therefore$ x = 15 – 3= 12 year.
Father's age = 12$\times$ 4 = 48 years
Mother's age = 48 – 3 = 45 years
After 5 years mother's age = 50 year.

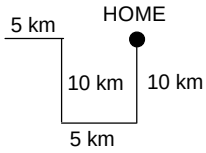
21. Hints:-



22. Hints:- $2\times2+1=5, 5\times2-1=9, 9\times2+1=19, 19\times2-1=37, 37\times2+1=75$

23. 1

24. Hints:-



25. Hints:- Average (41 – 45) years $\Rightarrow$ 35
Average (46 – 50) years $\Rightarrow$ 50
Average (51 -55) years $\Rightarrow$ 53.33
Average (36 – 40) years $\Rightarrow$ 37.5

26. Hints:- Average = $\frac{340}{8}=42.5$

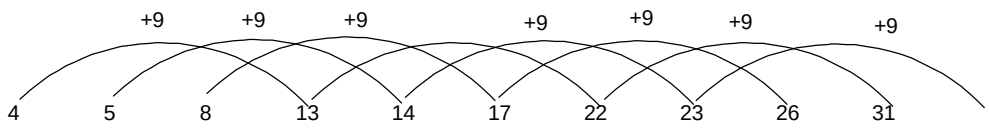
27. Hints:- Percentage salary $\geq$ 40,000 per months
$=\frac{9}{\cancel{20}}\times\cancel{100\%}^{5}=45\%$

28. Hints:- Average = $\frac{775}{20}=38.75$
% employees $=\frac{11}{20}\times100\%=55\%$

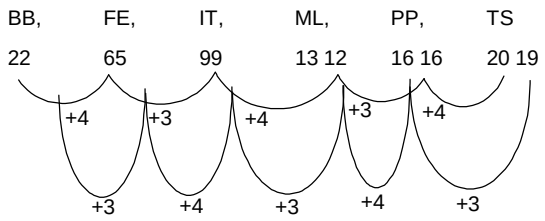
29. Hints:- Average age = $\frac{808}{2}=40.4$

30. Hints:- Percentage (30 – 35) years employees
$=\frac{7}{20}\times100\%=35\%$

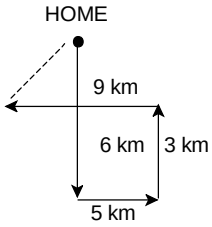
31. Hints:-



32. Hints:-



33. Hints:-



34. Hints:- Rs. 20 $\rightarrow$ 2×10
Rs. 23 $\rightarrow$ $2\times8+7$
Rs. 29 $\rightarrow$ $3\times7+1\times8$

35. Hints:- QUESTION – DOMESTIC
(Code Similar letters)
RESPONSE – OMESICEM

36. 4

37. Hints:- 50 digits –18 digits = 32 digits
$[52,57,62,67,70,71,72,73,74,75,76,77,78,79,82,87,92,97]$

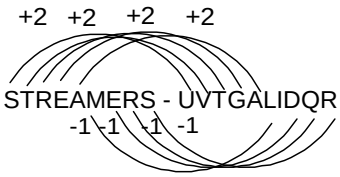
38. 1

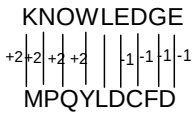
39. 3

40. 2

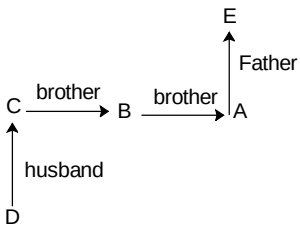
41. Hints:- AB, ED, IH, NM

42. Hints:-





43. Hints:-



44. Hints:- $\frac{3x-9}{5x-9}=\frac{12}{23}$

$\Rightarrow 69x-207=60x-108$

$\Rightarrow 69x-60x=207-108$

$\Rightarrow 9x=99$

$\Rightarrow x=11$

$\therefore 3x=33$

$\therefore 5x=55$

45. Hints:- Let present age of son's = x year

Present age of father's = y year

$\Rightarrow \frac{x+y}{2}=27$

$\Rightarrow x+y=54 \quad ..(i)$

$\Rightarrow y+18=2(x+18)$

$\Rightarrow y-2x=18 \quad ....(ii)$

equation (i) & (ii)

$x=12$

$y=42$

46. Hints:- $1^3+1, 2^3-1, 3^3+1, 4^3-1, 5^3-1, 6^3+1$

47. 3

48. Hints:-

6, 4, 1, 2, 2, 8, 7, 4, 2, 1, 5, 3, 8, 6, 2, 2, 7, 1, 4, 1, 3, 5, 8, 6

49. Hints:- Total marks of remaining 20 students

$=65\times 40-45\times 20=1700$

$\text{mean}=\frac{1700}{20}=85$

50. Hints:-Let Present age of Sunita = x years

Present age of Anil = 2x years

Before 3 years:-

$\Rightarrow 2x-3=3(x-3)$

$\Rightarrow 2x-3=3x-9$

$\Rightarrow x=6$

$\therefore 2x=12$

Part – II

SCHOLASTIC APTITUDE TEST II

(b) OTHER SUBJECTS

(A) SCIENCE DISCIPLINE

SAT

Physics

1. As wave carries energy and momentum.

2. By equation of motion $v^2 = u^2 + 2gh$
$\Rightarrow v^2 = 0^2 + 2gh \Rightarrow v = \sqrt{2gh}$
$\Rightarrow v = \sqrt{2\times10\times20} = 20\,m/s$

3. It retraces its path.

4. $\lambda_v = 4000\,\mathring{A}$

5. Convex lens in used to correct long sightedness.

6. In sun proton-proton cycle is given as $4^1H \longrightarrow {}^4He + 2e^+ + 2v + 2\gamma + 26\,MeV$
$\therefore$ energy released = 26 MeV.

7. By equation of mass-energy equibalance
$E = mc^2 = \left(1.66\times10^{-27}\right)\times\left(3\times10^8\right)^2$
= 934 MeV

8. Time period of pendulum $T = 2\pi\sqrt{\frac{\ell}{g}}$
$\Rightarrow T \propto \sqrt{\ell}$

9. As outward flux is increasing that's why according to Lenz's law current will be clockwise.

10. For Ist bulb resistance $R_1 = \frac{V^2}{P_1} = \frac{(220)^2}{50} = 968\Omega$

For IInd bulb resistance $R_2 = \frac{V^2}{P_2} = \frac{(220)^2}{100} = 484\Omega$

When bulbs are connected in series 50W bulb will glow brighter and when connected in parallel 100W bulb will glow more.

11. Hearing range for a man is 20Hz to 20000Hz.

12. From given options (3) is correct as voltmeter and ammeter are connected correctly.

13. 0 to 2A is divided into 20 parts. So the least count of ammeter is 0.1 A.

14. $V_{rms} = \sqrt{\frac{3PV}{M}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3P}{d}}$

15. D_2O

16. Neopentane

17. $K_P = K_C (RT)^{\Delta n}$

Where (I) $\Delta n > 0$
(II) $\Delta n = 0$
(III) $\Delta n < 0$

18. Li, Mg

19. $CH_3 - \overset{O}{\overset{\|}{C}} - CH_3 \rightleftharpoons CH_2 = \overset{OH}{\overset{|}{C}} - CH_3$

$CH_3 - \overset{O}{\overset{\|}{C}} - O - C_2H_5 \rightleftharpoons CH_2 = \overset{OH}{\overset{|}{C}} - O - C_2H_5$

$CH_3 - \overset{O}{\overset{\|}{C}} - CH_2 - \overset{O}{\overset{\|}{C}} - O - C_2H_5 \rightleftharpoons CH_2 = \overset{OH}{\overset{|}{C}} - CH_2 - \overset{O}{\overset{\|}{C}} - O - C_2H_5$ or

$CH_2 = \overset{OH}{\overset{|}{C}} - CH_2 - \overset{O}{\overset{\|}{C}} - O - C_2H_5$

20. $\left(P + \frac{an^2}{v^2}\right)(v - nb) = nRT$

$P = \frac{an^2}{v^2} \Rightarrow a = \frac{P.v^2}{n^2}$

= atm L^2 / mol^2.

21. $Mg^{2+} \rightarrow 1s^2\ 2s^2\ 2p^6$

22. Alkene

23. $PV = nRT$

$\frac{PV}{N_A} = \frac{n}{N_A}.RT$

$\frac{PV}{N_A} = nKT$

$PV = nN_A.KT$

$PV = NKT$

24. (1) $CH_3CO\overset{-}{O}\overset{+}{N}a + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$

(2) $CH_3I \xrightarrow{LiAlH_4} CH_4$

(3) $Al_4C_3 + 12H_2O \longrightarrow 3CH_4 + 4Al(OH)_3$

25. NO_2^+ & SO_3

26. NaOH

Biology

27. Homologous organs are same in origin but are different in function.

28. 3

29. Chromoplast contains xanthophyll and carotene pigment which are responsible for different colour.

30. It was used for digestion of cellulose before discovery of fire but now is functional only in ruminants.

31. 4

32. 1

33. Medula oblongala controls all the involuntary activities of body.

34. 4

35. In asexual reproduction fertilization do not take place.

36. 1

37. 1

38. Bile does not contain any enzyme.

39. 2

40. 3

(B) Mathematics

41. Sample space will contain 36 elements in which only 10 are favorable namely {(1, 2), (2, 1), (2, 3), (3, 2), (3, 4), (4, 3), (4, 5), (5, 4), (5, 6), (6, 5)}. So required probability $= \frac{10}{36} = \frac{5}{18}$

42. A/q, $\alpha + \beta = \frac{-b}{a}$ ...(1)

$\alpha\beta = \frac{c}{a}$ ..... (2)

Also $\alpha + \beta + 2k = \frac{-q}{p}$, using (1) we have $2k = \frac{b}{a} - \frac{q}{p}$ ..... (3) and $(\alpha + k)(\beta + k) = \frac{r}{p}$, expanding and using (1) and (2), we have $\frac{c}{a} - \frac{b}{a}k + k^2 = \frac{r}{p}$. Now using (3) and on simplification, we have $\frac{b^2 - 4ac}{q^2 - 4pr} = \frac{a^2}{p^2}$

43. Since $x = 2 + \sqrt{3}$ and $xy = 1 \Rightarrow y = 2 - \sqrt{3}$

As x, y > 0, so $2x = 4 + 2\sqrt{3}$ & $2y = 4 - 2\sqrt{3}$

$\Rightarrow 2x = \left(1 + \sqrt{3}\right)^2$ & $2y = \left(\sqrt{3} - 1\right)^2$

$\therefore \sqrt{2}\sqrt{x} = 1 + \sqrt{3}$ & $\sqrt{2}.\sqrt{y} = \sqrt{3} - 1$

As $\frac{x}{\sqrt{2} + \sqrt{x}} + \frac{y}{\sqrt{2} - \sqrt{y}} = \sqrt{2}\left\{\frac{x}{2 + \sqrt{2}\sqrt{x}} + \frac{y}{2 - \sqrt{2}\sqrt{y}}\right\}$

$= \sqrt{2}\left\{\frac{2 + \sqrt{3}}{2 + 1 + \sqrt{3}} + \frac{2 - \sqrt{3}}{2 - \sqrt{3} + 1}\right\} = \sqrt{2}$, on simplification

44. Given equation cause simplified as

$(a + b)x^2 + (2a - 3b + 1)x + a - 2b + 1 = 0$ ..... (1)

If (1) is an identify, then
a + b = 0 …. (2)
2a – 3b + 1 = 0 …… (3) and
a – 2b + 1 = 0 ……. (4)

solving (2) and (3), we have , $a = \frac{-1}{5}, b = \frac{1}{5}$, but these two values do not satisfy (4) so ordered pair (a, b) doesn't exist.

45. Let first term = a, common difference = d. Then
a/q, a + d = x – y …….. (1) and a + 4d = x + y …….. (2)
eliminating d from (1) & (2) and simplify for a, we have,
3a = (3x – 5y)

46. Using the fact that $i^{4n} = 1$ and $i^{4n+2} = -1$, $n \in N$.

$$\frac{1-1+1-1+1}{-1+1-1+1-1} - 3 = -1-3 = -4$$

47. The possible triangles with side length are (2, 6, 6), (3, 5, 6), (4, 4, 6), (4, 5, 5). Using the fact that sum of two sides is always greater than the third side in a triangle.

48. As median is a mid value (in general). Here median is 10. Additional two data are 7(< 10) and 20(> 10). So median will not change.

49. A/q $\frac{x_1 + x_2 + ... + x_{49} + x_{50}}{50} = 169$

$\Rightarrow x_1 + ... + x_{49} + x_{50} = 50 \times 169$

Let us suppose that $x_{50} = 134$

Then $x_1 + x_2 + ... x_{49} = 50 \times 169 - 134$

Correct mean = $\frac{x_1 + x_2 + ... + x_{49} + 143}{50} = \frac{50 \times 169 - 134 + 143}{50}$

$= 169 + \frac{9}{50} = 169.18$ (in rupees)

50. Let $\frac{x_1 + x_2 + ... + x_{11}}{11} = k\,(\text{say})$, then

a/q $\frac{x_1 + x_2 + ...x_{11} + 15}{12} = k$

$\Rightarrow 11k + 15 = 12k \Rightarrow k = 15$

51. As $\sin\theta \le 1$ and $\sin\theta_1 + \sin\theta_2 + \sin\theta_3 = 3$. This is possible only when $\theta_1 = \theta_2 = \theta_3 = 90^\circ \;\therefore \cos\theta_1 + \cos\theta_2 + \cos\theta_3 = 0$

52. Given $\text{cosec}A + \cot A = \frac{11}{2}, \Rightarrow \text{cosec}A = \frac{11}{2} - \cot A$. On squaring and using $\text{cosec}^2 A = 1 + \cot^2 A$, we have

$1 + \cot^2 A = \frac{121}{4} - 2.\frac{11}{2}\cot A + \cot^2 A \Rightarrow 11\cot A = \frac{117}{4} \Rightarrow \tan A = \frac{44}{117}$.

53. As $x = \sec\theta - \tan\theta,\ y = \text{cosec}\theta + \cot\theta$

$\therefore xy + 1 = (\sec\theta - \tan\theta)(\text{cosec}\theta + \cos\theta) + 1 = \sec\theta\,\text{cosec}\theta + \text{cosec}\theta - \sec\theta - 1 + 1$

$= \sec\theta\,\text{cosec}\theta + \text{cosec}\theta - \sec\theta$

$= \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta} + \text{cosec}\theta - \sec\theta = \tan\theta + \cot\theta + \text{cosec}\theta - \sec\theta$

= y – x

54. A/q, $c^2 = a^2 + b^2$ ……. (1)

$\cos B = \frac{a}{c}$

$\sin B = \frac{b}{c} = \frac{ab}{ac} = \frac{ab}{b^2} = \frac{a}{b}$

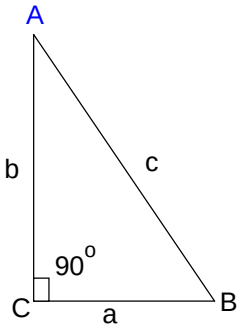
Given $b^2 = ac$

$\therefore \cos B = \frac{a^2}{ac} = \frac{a^2}{b^2}$

Also $\sin^2 B + \cos^2 B = 1$

$\Rightarrow \frac{a^2}{b^2} + \left(\frac{a^2}{b^2}\right)^2 = 1 \Rightarrow \left(\frac{a^2}{b^2}\right)^2 + \left(\frac{a^2}{b^2}\right) - 1 = 0$

$\therefore \cos B = \frac{a^2}{b^2} = \frac{-1+\sqrt{1+4}}{2} = \frac{\sqrt{5}-1}{2}$ as $0^o < \angle B < 90^o$



55. A/q $\alpha + \beta = 4$ ….. (1)

Also $\alpha = \frac{5k-1}{k+1}$ ……. (2)

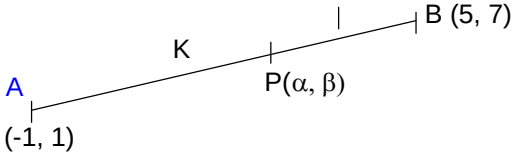
$\beta = \frac{7k+1}{k+1}$ …….. (3)

Using (2) and (3) in (1) we have

$\frac{5k-1}{k+1} + \frac{7k+1}{k+1} = 4 \Rightarrow 5k - 1 + 7k + 1 = 4k + 4$

$8k = 4$

$k = 1/2$



56. Only option (4), for which OA = OB = AB

57. If $A \equiv (-a,-b), B \equiv (0,0), C \equiv (a,b), D \equiv (a^2, ab)$

Here slope of AD = slope of AC = slope of AB = b/a

So they are collinear

58. Let radius of the conical heap = r

a/q $\frac{1}{3}\pi r^2.24 = \pi.18 \times 18 \times 32 \Rightarrow r = 36cm$

59. Perpendiculars from B to AC and from C to AB meet at the point A. So orthocenter is the point A itself.

60. As, $\frac{BD}{CD} = \frac{4}{3}$

$BD = \frac{4}{7}BC$

$CD = \frac{3}{7}BC$

Apply cosine formula in ΔABC & ΔACD

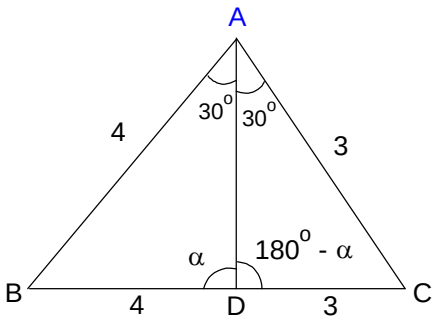
$\cos\alpha = \frac{AD^2 + BD^2 - 16}{2AD.BD}$ …… (1)

$-\cos\alpha = \cos(180^o - \alpha) = \frac{AD^2 + CD^2 - 9}{2AD.CD}$ ……. (2)

Dividing (1) by (2), we have

$-1 = \frac{AD^2 + BD^2 - 16}{2AD.BD} \times \frac{2AD.CD}{AD^2 + CD^2 - 9}$

$\Rightarrow -\frac{BD}{CD} = \frac{AD^2 + BD^2 - 16}{AD^2 + CD^2 - 9} \Rightarrow -\frac{4}{3} = \frac{AD^2 + BD^2 - 16}{AD^2 + CD^2 - 9}$



$$4AD^2 + 4CD^2 - 36 = -3AD^2 - 3BD^2 + 48$$

$$7AD^2 = -3BD^2 - 4CD^2 + 84$$

$$= -3.\frac{16}{49}BC^2 - 4.\frac{9}{49}BC^2 + 84$$

$$= 84 - \frac{84}{49}BC^2$$

But $BC^2 = 16 + 9 - 2.4.3.\cos 60^o$

$= 25 - 2 \cdot 4 \cdot 3 \cdot 1/2$

$= 13$

$$\therefore 7AD^2 = 84\left(1 - \frac{13}{49}\right) = AD^2 = 12\frac{36}{49} = \frac{2^2.3.6^2}{7^2}$$

$$\therefore AD = \frac{12\sqrt{3}}{7}$$