

FIITJEE Patna Centre
NTSE Stage – 1 (2014-15)
State Level Examination (Bihar)

Answer key

MAT

| | | | | | | | | | | | | | |
|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|
| 1. | 1 | 2. | 2 | 3. | 2 | 4. | 4 | 5. | 1 | 6. | 2 | 7. | 1 |
| 8. | 1 | 9. | 2 | 10. | 3 | 11. | 3 | 12. | 1 | 13. | 3 | 14. | 2 |
| 15. | * | 16. | * | 17. | 2 | 18. | 3 | 19. | 4 | 20. | 1 | 21. | 1 |
| 22. | 2 | 23. | 2 | 24. | 2 | 25. | 2 | 26. | 1 | 27. | 2 | 28. | 2 |
| 29. | 1 | 30. | 1 | 31. | 1 | 32. | 2 | 33. | 3 | 34. | 3 | 35. | 3 |
| 36. | 2 | 37. | 3 | 38. | 1 | 39. | 2 | 40. | 3 | 41. | 3 | 42. | 1 |
| 43. | 2 | 44. | 2 | 45. | 3 | 46. | 1 | 47. | 2 | 48. | 3 | 49. | 3 |
| 50. | 2 | | | | | | | | | | | | |

SAT

Physics

| | | | | | | | | | | | | | |
|----|---|----|---|-----|---|-----|---|-----|---|----|---|----|---|
| 1. | 1 | 2. | 4 | 3. | 4 | 4. | 3 | 5. | 3 | 6. | 2 | 7. | 4 |
| 8. | 3 | 9. | 3 | 10. | 3 | 11. | 4 | 12. | 2 | | | | |

Chemistry

| | | | | | | | | | | | | | |
|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|
| 13. | 4 | 14. | 1 | 15. | 3 | 16. | 1 | 17. | 2 | 18. | 3 | 19. | 2 |
| 20. | 4 | 21. | 2 | 22. | 1 | 23. | 2 | | | | | | |

Biology

| | | | | | | | | | | | | | |
|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|
| 24. | 4 | 25. | 2 | 26. | 4 | 27. | 2 | 28. | 3 | 29. | 4 | 30. | 3 |
| 31. | 3 | 32. | 4 | 33. | 3 | 34. | 3 | 35. | 2 | | | | |

Mathematics

| | | | | | | | | | | | | | |
|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|
| 36. | 1 | 37. | 2 | 38. | 1 | 39. | 3 | 40. | 4 | 41. | 4 | 42. | 2 |
| 43. | 3 | 44. | 4 | 45. | 4 | 46. | 1 | 47. | 1 | 48. | 2 | 49. | 3 |
| 50. | 1 | 51. | 1 | 52. | 3 | 53. | 1 | 54. | 3 | | | | |

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Hint and Solution

MAT

14. $16 + 96 \div 4 - 3 \times 6$
 $= 16 + 24 - 3 \times 6$
 $= 16 + 24 - 18$
 $= 22$

*15. $10 \times 6 \div 15 - 5 + 5$
 $= 10 \times \frac{6}{15} - 5 + 5$
 $= 4 - 5 + 5$
 $= 4$

*16. $215 \div 5 - 10 \times 3 + 3$
 $= 43 - 30 + 3$
 $= 13 + 3$
 $= 16$

17. $202 \div 25 + 5 \times 3$
 $= 400 \div 25 + 5 \times 3$
 $= 16 + 5$
 $= 31$

18. $9 \times 8 + 8 \div 4 - 9$
 $= 72 + 2 - 9$
 $= 74 - 9$
 $= 65$

19. $12 \div 2 \times 6 - 4 + 5$
 $= 6 \times 6 - 4 + 5$
 $= 36 + 5 - 4$
 $= 37$

20. $1, \frac{1}{3}, \frac{1}{9}, \frac{1}{27}, \frac{1}{81}, \frac{1}{243}, \frac{1}{729}$

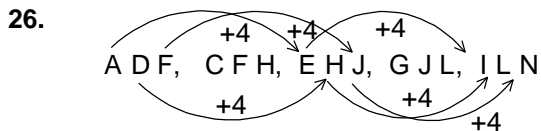
21. $\overset{+4}{\curvearrowright} \overset{+6}{\curvearrowright} \overset{+8}{\curvearrowright} \overset{+10}{\curvearrowright} \overset{+12}{\curvearrowright}$
3, 4, 7, 7, 13, 13, 21, 22, 31, 34, 3

22. $\overset{+3}{\curvearrowright} \overset{+3}{\curvearrowright} \overset{+3}{\curvearrowright} \overset{+3}{\curvearrowright}$
5, 4, 8, 6, 11, 8, 14, 10, 17

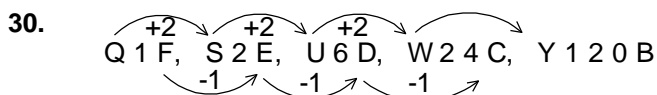
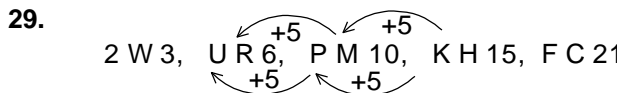
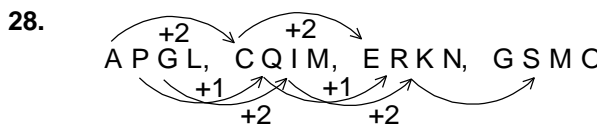
23. $\overset{\curvearrowright}{\curvearrowright} \overset{\curvearrowright}{\curvearrowright} \overset{\curvearrowright}{\curvearrowright}$
2, 7, 11, 8, 13, 17, 14, 14, 23, 2

24. $\overset{+3}{\curvearrowright} \overset{+4}{\curvearrowright} \overset{+5}{\curvearrowright} \overset{+6}{\curvearrowright}$
5, 4, 15, 7, 23, 11, 24, 16, 33, 2

25. $\overset{+2}{\curvearrowright} \overset{+2}{\curvearrowright}$
9, 12, 11, 14, 13, 7, 15



27. **A 2 B Y, C X H Y, E X F U, G T H S**



47. **Let rational amount be x**
Then $x + 2x + 3x = 90 - (10 + 10 + 10)$
 $\Rightarrow 6x = 60$
 $\Rightarrow x = 10$
Age of Q = $2x = 20$
Present age = $20 + 10 = 30$ years

48. **Let three person be x, y and z respectively**
Then $x + y + z = 60 \times 3 = 180$ (1)
According to question $x = \frac{1}{4}(y + z)$
 $\Rightarrow 4x = y + z$
Then $x + 4x = 180$
 $\Rightarrow 5x = 180$
 $\Rightarrow x = 36$ years

49. **let rational amount be x**
Then $3x + 5x + 7x = 35 \times 3$
 $\Rightarrow 15x = 105$
 $\Rightarrow x = \frac{105}{15}$
Then youngest girl age = $3x$
 $= 3 \times 7 = 21$ years

50. **Let age of B = x**
Then A = $x + 16$
According to question $\frac{x}{2} = \frac{x + 16}{3}$
 $\Rightarrow 3x = 2x + 32$
 $\Rightarrow x = 32$
 $\therefore B = 32$
A = $x + 16$
= 48

SAT

Physics

1. Velocity is constant in AB
 $\therefore a \& f = 0$

2. When lift is going up $t_2 < t_1$
 When lift is going down $t_2 > t_1$

3. \therefore tension is at 90° to the displacement.

4. $\therefore \frac{4}{3}\pi r^3 \times 8 = \frac{4}{3}\pi R^3 \Rightarrow R = 2r$

$$g = \frac{GM}{r^2}, g' = \frac{GM}{R^2}$$

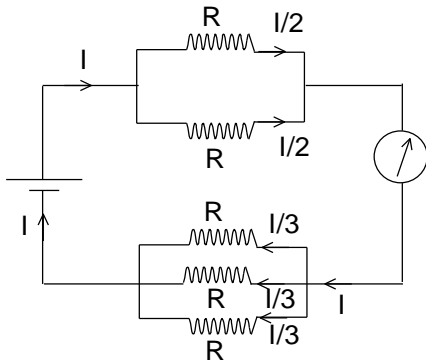
$$\Rightarrow \left(\frac{g'}{g}\right) = \frac{r^2}{R^2} \therefore g' = \frac{g}{4}$$

5. \therefore since light transmitting area is reduced.

6. This is due to virtual image.

7. Neutrino has low energy.

8.



$$\frac{\frac{I}{2}}{\frac{I}{3}} = \frac{3}{2}$$

9. $R_{eq} = \left(R + \frac{2R \cdot R}{2R + R} + R \right) = \frac{8R}{3}$

12. The direction can be given by $(\vec{B} \times \vec{V})$

Chemistry

13.
$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

For n = 1

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

At low pressure

V >> b

Hence

$$\left(P + \frac{a}{V^2}\right)V = RT$$

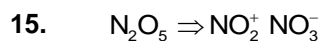
$$PV + \frac{a}{V} = RT$$

$$PV = RT - \frac{a}{V}$$

Dividing both side by RT

$$\frac{PV}{RT} = 1 - \frac{a}{VRT}$$

$$z = 1 - \frac{a}{VRT}$$



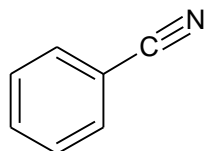
16. **According to Debye Huckel's theory for a strong electrolyte**

$$\lambda_c = \lambda_\infty - B\sqrt{C}$$



This reaction is known as carbylamines reaction or isocyanide test and is used as a test for primary amines.

20.



Benzonitrile

21. **From table it is clear that $\frac{dc}{dt}$ (initial rate of function of c) is independent of concentration of B**

Hence $\frac{dc}{dt} = K[A]$

Mathematics

36. $5a_5 = 8a_8$
 $5(a + 4d) = 8(a + 7d)$
 $\Rightarrow 3(a + 12d) = 0$
 $\Rightarrow a_{13} = 0$

37. $\left(x^3 + \frac{1}{x^3}\right) + \left(x + \frac{1}{x}\right) - 5\left(x^2 + \frac{1}{x^2}\right)$
 $\left[\left(x + \frac{1}{x}\right)^3 - 3\left(x\right)\left(\frac{1}{x}\right)\left(x + \frac{1}{x}\right)\right] + \left(x + \frac{1}{x}\right) - 5\left[\left(x + \frac{1}{x}\right)^2 - 2\left(x\right)\left(\frac{1}{x}\right)\right]$
 $\equiv (5^3 - 3.5) + 5 - 5(5^2 - 2)$
 $\equiv 0$

38. $2\pi rh = 628$
 $rh = 100 \dots\dots\dots(1)$
 $h - r = 15 \dots\dots\dots(2)$
By (1) & (2)
 $h = 20$
 $r = 5$
volume $\equiv \pi(20)(25)$
 $\equiv 500\pi$

39. $a + b + c = 0$
 $a = -b - c \dots\dots (1)$
 $(a + b + c)^2 = 0$
 $a^2 + b^2 + c^2 + 2(ab + bc + ca) = 0$
 $K(a^2 - bc) + 2(ab + bc + ca) = 0$
 $2(ab + bc + ca) = -K(a(-b - c) - bc)$
 $\equiv 2(ab + bc + ca) = K(ab + bc + ca)$
 $\equiv K = 2$

40.

| | |
|-------|-------|
| 1 | 2 |
| 5 | A 9 |
| 3 | B 7 |
| 2 | C 8 |
| <hr/> | |
| 1 | 1 1 4 |

2 + A + B + C = 11
A + B + C = 9
Clearly max value of C = 9

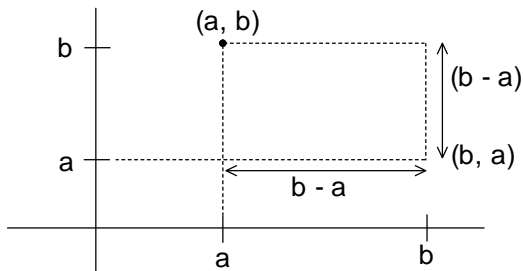
41. **favorable** $\equiv \{(1,5)(5,1)(2,4)(4,2)(3,3)\} \equiv 5$
Total $\equiv 6$
 $P(\text{sum} = 6) = \frac{5}{36}$

42. $\overset{A}{\bullet} \quad \lambda \quad \overset{B}{\bullet} \quad 1 \quad \overset{C}{\bullet}$
 $(3, -4) \quad (a, 0) \quad (-5, 6)$
B is on x axis so let B(a, 0)
Let B divides AC in $\lambda : 1$
 $\Rightarrow 0 = \frac{6.\lambda + 1.(-4)}{\lambda + 1}$

$$\equiv \lambda = \frac{2}{3}$$

Ratio $\equiv 2 : 3$

43.



$$\text{Area} = (b-a)^2 \\ \equiv (a-b)^2$$

44.

$$\sin x = 1 - \sin^2 x$$

$$\sin x = \cos^2 x$$

$$(\cos^2 x)^4 + 2(\cos^2 x)^3 + (\cos^2 x)^2$$

$$\equiv (\sin x)^4 + 2(\sin x)^3 + (\sin x)^2$$

$$\equiv \sin^2 x (\sin x + 1)^2$$

$$\equiv (1 - \sin x)(1 + \sin x)(1 + \sin x)$$

$$\equiv (1 - \sin^2 x)(1 + \sin x)$$

$$\equiv (\sin x)(1 + \sin x)$$

$$\equiv \sin x + \sin^2 x$$

$$\equiv 1$$

45.

$$1 - \frac{\sin^2 y}{1 + \cos y} + \frac{1 + \cos y}{\sin y} - \frac{\sin y}{1 - \cos y}$$

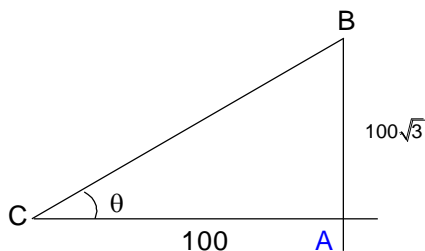
$$\equiv \frac{1 + \cos y - \sin^2 y}{1 + \cos y} + \frac{1 - \cos^2 y - \sin^2 y}{\sin y(1 - \cos y)}$$

$$\equiv \frac{\cos y + \cos^2 y}{1 + \cos y} + \frac{1 - (\sin^2 y + \cos^2 y)}{\sin(y)(1 - \cos y)}$$

$$\equiv \frac{\cos y(1 + \cos y)}{1 + \cos y} + \frac{1 - 1}{\sin y(1 - \cos y)}$$

$$\equiv \cos y$$

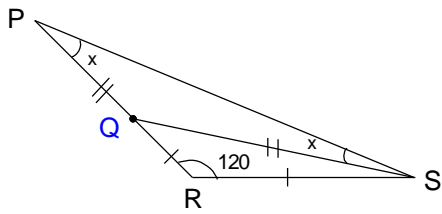
46.



$$\tan \theta = \frac{100\sqrt{3}}{100}$$

$$\theta = 60^\circ$$

47.



PQ = QS

$\Rightarrow \angle QPS = \angle QSP = x$ (say)

$\Rightarrow \angle SQR = 2x$ (exterior angle)
 $= \angle RSQ$

From ΔQRS

$120 + 2x + 2x = 180$

$\Rightarrow x = 15^\circ = \angle QPS$

48. **Area of minor segment**

$$= \frac{\pi \times R^2}{4} - \frac{1}{2} \times R^2$$

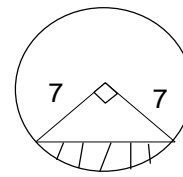
$$= \frac{(\pi - 2)}{4} R^2 \dots \dots \dots (1)$$

Area of major segment

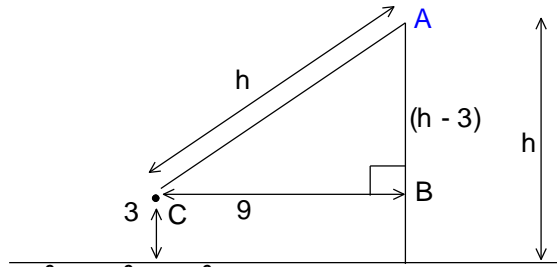
$$= \pi R^2 - \frac{(\pi - 2)}{4} R^2$$

$$= \frac{[4\pi - (\pi - 2)]}{4} R^2 \dots \dots \dots (2)$$

$$\therefore \text{required ratio} = \frac{\pi - 2}{3\pi - 2} = \frac{8}{80} = \frac{1}{10}$$



49.



$$\begin{aligned} AB^2 + BC^2 &= AC^2 \\ (h - 3)^2 + 9^2 &= h^2 \\ \Rightarrow 6h &= 90 \\ \mathbf{h} &= \mathbf{15 \text{ m}} \end{aligned}$$

50. **Volume of block = $(10 \times 5 \times 2) \text{ cm}^3$
= 100 cm^3**

**Volume of cone = $\left(\frac{22}{7} \times 9 \times 7\right) \text{ cm}^3$
= 66 cm^3**

**\Rightarrow volume of wood wasted = 34 cm^3
 \therefore percentage of wood wasted = 66%**

51. $\frac{(x_1 + x_2 + \dots + x_n)}{n} = M$

$$\Rightarrow x_1 + (x_2 + \dots + x_n) = M_n$$

$$\Rightarrow (x_2 + \dots + x_n) = M_n - x_1$$

$$\Rightarrow a + (x_2 + \dots + x_n) = M_n - x_1 + a$$

$$\Rightarrow \frac{(a + x_2 + \dots + x_n)}{n} = \frac{M_n - x_1 + a}{n}$$

52. **24, 38, 55, 69, 89**

$$\mathbf{\text{Mean} = \frac{275}{5} = 55}$$

Median = 55

Mean = median

53. **let x_1, x_2, \dots, x_n be the 'n' numbers**

$$\frac{x_1 + x_2 + \dots + x_n}{n} = M$$

$$\frac{x_1 + 1 + x_2 + 2 + \dots + x_n + n}{n} = \frac{(1 + 2 + \dots + n) + (x_1 + x_2 + \dots + x_n)}{n}$$

$$= M + \left[\frac{\frac{n(n+1)}{2}}{n} \right] = M + \frac{n+1}{2}$$

54. **let x be the number of blue balls**

Total balls = $5 + x$

$$P(\text{red}) = \frac{5}{5 + x}$$

$$P(\text{blue}) = \frac{x}{5 + x}$$

$$P(\text{blue}) = 3 \times P(\text{red})$$

$$\Rightarrow \frac{x}{5 + x} = \frac{3 \times 5}{5 + x}$$

$$\Rightarrow x = 15$$

55.
$$\frac{\tan x}{\sec x - 1} - \frac{\sin x}{1 + \cos x}$$
$$= \frac{\frac{\sin x}{\cos x}}{1 - \cos x} - \frac{\sin x}{1 + \cos x}$$
$$= \sin \left(\frac{1}{1 - \cos x} - \frac{1}{1 + \cos x} \right)$$
$$= \sin x \left(\frac{2 \cdot \cos x}{1 - \cos^2 x} \right)$$
$$= \frac{2 \cdot \sin x \cdot \cos x}{\sin^2 x} = 2 \cot x$$