Sri Chaitanya IIT Academy.,India.

A.P T.S KARNATAKA TAMILNADU MAHARASTRA DELHI RANCHI

A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.Super60_STERLING BT	**JEE-MAIN**	**Date: 12-07-2025**
Time: 09:00AM to 12:00PM	**WTM-37**	**Max. Marks: 300**

KEY SHEET

MATHEMATICS

1	**4**	2	**1**	3	**2**	4	**1**	5	**3**
6	**1**	7	**3**	8	**3**	9	**4**	10	**2**
11	**2**	12	**4**	13	**1**	14	**4**	15	**3**
16	**1**	17	**3**	18	**2**	19	**4**	20	**2**
21	**55**	22	**150**	23	**28**	24	**7**	25	**6**

PHYSICS

26	**3**	27	**4**	28	**1**	29	**3**	30	**4**
31	**1**	32	**4**	33	**2**	34	**3**	35	**4**
36	**2**	37	**3**	38	**4**	39	**3**	40	**1**
41	**4**	42	**3**	43	**1**	44	**1**	45	**3**
46	**506**	47	**3**	48	**1**	49	**1**	50	**8**

CHEMISTRY

51	**1**	52	**1**	53	**4**	54	**1**	55	**2**
56	**1**	57	**3**	58	**4**	59	**3**	60	**2**
61	**1**	62	**2**	63	**1**	64	**1**	65	**3**
66	**3**	67	**1**	68	**4**	69	**1**	70	**2**
71	**1**	72	**6**	73	**10**	74	**2**	75	**7**

SOLUTIONS
MATHEMATICS

1.

X	Y	Selection
3L + 2M	2L + 3M	of 2L & 2M
2L	2M	$3_{C_2} \times 3_{C_2} = 9$
2M	2L	$2_{C_2} \times 2_{C_2} = 1$
1L & 1M	1L + 1M	$3_{C_1} \times 2_{C_1} \times 2_{C_1} \times 3_{C_1} = 36$

$\therefore$ Total = 46

2. A) No. of diagonals $= \dfrac{n(n-3)}{2}$

B) Required no. of ways $= 2^5 - 2 = 30$

C) Required no. of ways $= n(n-4) = 60$

D) No. of squares $= 8\times 8 \to 1\times 1 = 1 \quad = 7\times 7 \to 2\times 2 = 4 \quad = 6\times 6 \to 3\times 3 = 9$ $\quad \therefore$ Total = 14

3. 4 same → $1_{C_1} = 1$

3 same, 1 different → $6_{C_1} = 6$

2 same, 2 same → $2_{C_2} = 1$

2 same, 2 different → $2_{C_1} \times 6_{C_2} = 30$

4 different → $7_{C_4} = 35$

4. $9_{C_2} \times n_{C_1} + 9_{C_1} \times n_{C_2} = 198$

5. $\alpha = \max\{10_{C_p}\} = 10_{C_5}$, $\beta = \max\{11_{C_q}\} = 11_{C_5}\ or\ 11_{C_6}$, $\gamma = \max\{12_{C_r}\} = 12_{C_6} = \dfrac{12}{6}.11_{C_5} = \dfrac{12}{6}.\dfrac{11}{6}.10_{C_5}$

$\therefore \beta = \dfrac{11}{6}.10_{C_5} = \dfrac{11}{6}\alpha \qquad \therefore \gamma = \dfrac{11}{3}.\alpha \qquad \Rightarrow \dfrac{\alpha+\beta}{\gamma} = \dfrac{\alpha + \frac{11}{6}\alpha}{\frac{11}{3}\alpha} = \dfrac{17}{22}$

6. x^{30} - coefficient in $(x^0+x^1+x^2+....)^3(x^0+x^4+x^8+......) = x^{30}$ - coefficient in $(1-x)^{-3}(1-x^4)^{-1}$

$= {}^{3+30-1}C_{30} + {}^{3+26-1}C_{26} + {}^{3+22-1}C_{22} + {}^{3+18-1}C_{18} + {}^{3+14-1}C_{14} + {}^{3+10-1}C_{10}$

$+ {}^{3+6-1}C_6 + {}^{3+2-1}C_2$

$= 496+378+276+190+120+66+28+6 = 1560$

7. Conceptual

8.

Part	maximum marks	marks secured
1	10	x_1
2	10	x_2
3	10	x_3
4	20	x_4

Where $0 \le x_1 \le 10, \quad 0 \le x_2 \le 10, \quad 0 \le x_3 \le 10, \quad 0 \le x_4 \le 20$

$\therefore$ No. of ways = coefficient of x^{30} in $(x^0+x^1+x^2+......+x^{10})^3.(x^0+x^1+x^2+......+x^{20})$

= coefficient of x^{30} in $\left(\dfrac{1-x^{11}}{1-x}\right)^3\left(\dfrac{1-x^{21}}{1-x}\right)$ = coefficient of x^{30} in $(1-x^{11})^3(1-x^{21})(1-x)^{-4}$

= coefficient of x^{30} in $\left(1-3x^{11}+3x^{22}-x^{21}\right)(1-x)^{-4}$

$$=\frac{(4+30-1)!}{(30)!(4-1)!}+(-3)\frac{(4+19-1)!}{(19)!(4-1)!}+(3)\frac{(4+8-1)!}{8!(4-1)!}+(-1)\frac{(4+9-1)!}{9!(4-1)!}=1111$$

9. Consider 4 boxes like as

Case – I :

$\boxed{3R, 2B}$	$\boxed{3R, 2B}$	$\boxed{3R, 2B}$	$\boxed{3R, 2B}$
4	2	2	2
2	4	2	2
2	2	4	2
2	2	2	4

Case – II :

3R, 2B	3R, 2B	3R, 2B	3R, 2B
3	3	2	2
3	2	3	2
2	3	3	2
2	2	3	3
2	3	2	3
3	2	2	3

$\therefore$ Required number of ways $=4_{C_1}\left[2_{C_1}+3_{C_1}\right]\left(3_{C_1}.2_{C_1}\right)^3+4_{C_2}\left[3_{C_2}.2_{C_1}+3_{C_1}.2_{C_2}\right]^2\left(3_{C_1}.2_{C_1}\right)^2$

$=4\times5\times6^3+6(6+3)^2(6)^2=21816$

10. $M=\begin{bmatrix}a_1 & a_2 & a_3\\ a_4 & a_5 & a_6\\ a_7 & a_8 & a_9\end{bmatrix}$ where $a_i\in\{0,1,2\}$

Here sum of diagonal entries in $M^TM=5\Rightarrow a_1^2+a_4^2+a_7^2+a_2^2+a_5^2+a_8^2+a_3^2+a_6^2+a_9^2=5$

Which is possible when

Case – I : $5a_i$'s are 1 & $4a_i$'s are 0

Which can be done in 9_{C_4} $ways=126$

Case – II : One a_i is 1, one a_i is 2 and rest $7a_i$'s are 0

Which can be done in $9_{C_1}\times8_{C_1}=72$ ways $\quad\therefore$ Total no. of ways = 198

11. No. of ways of giving 1 vote = $=10_{C_1}=10$

No. of ways of giving 2 votes $=10_{C_2}=45$

No. of ways of giving 3 votes $=10_{C_3}=120$

No. of ways of giving 4 votes $=10_{C_4}=210$

$\therefore$ Total = 385

12. No. of ways $=6_{C_1}\times5_{C_2}\times2^2=240$

13. Let the two natural numbers are a & b then a & b divide the remaining 98 – numbers into three parts.

First we find no. of ways selecting a & b such that the difference is at least 11.

So, we get $x_1+x_2+x_3=98$ where $x_1,x_3\geq0$ & $x_2\geq10$

$\therefore$ The no. of solutions = coefficient of t^{98} in $\left(1+t+t^2+......\right)^2\left(t^{10}+t^{11}+t^{12}+.......\right)$

= coefficient of t^{88} in $(1-t)^{-3}=$ $3+88-1_{C_{88}}=90_{C_2}$ So. The no. of ways $=100_{C_2}-90_{C_2}$

14. Statement – I : No. of ways = $\dfrac{15!}{(5!)^3.3!}$, Statement – II: No. of ways = $\dfrac{52!}{(13!)^4}$

15. The candidate is unsuccessful if he fails in 9 or 8 or 7 or 6 or 5 papers. So that the number of ways to be unsuccessful is $=9_{C_9}+9_{C_8}+9_{C_7}+9_{C_6}+9_{C_5}=2^8$

16. $(1I,2F)+(2I,4F)+(3I,6F)=5_{C_1}\times 7_{C_2}+5_{C_2}\times 7_{C_4}+5_{C_3}\times 7_{C_6}=525$

17. Number of ways $=5_{C_3}=10$

18. No. of possible triangles $=14_{C_3}-7_{C_3}-4_{C_3}-3_{C_3}=324$

19. Maximum no. of possible partitions with equal elements 6 in each is $18_{C_6}\times 12_{C_6}\times 6_{C_6}$

20. $y+z=25\ \&\ yz=100\Rightarrow\therefore y=20,\ z=5\Rightarrow\therefore n=2^x.3^{20}.5^5$

$\therefore$ No. of odd divisors $=(20+1)(5+1)=126$

21. Let us initially distribute 2 mangoes to each children, so the remaining are 9 can be distributed in $=n+r-1_{C_{r-1}}=9+3-1_{C_{3-1}}=11_{C_2}=55$

22. $xyz=2^4\times 3^3$

No. of positive integral solutions= distribution of 2,2,2,2 and 3,3,3, in three persons x,y,z

$=4+3-1_{C_{3-1}}\times 3+3-1_{C_{3-1}}=6_{C_2}\times 5_{C_2}=150$

23. $\left[\dfrac{x}{3}\right]=\dfrac{x}{3}-\left\{\dfrac{x}{3}\right\},\left[\dfrac{3x}{2}\right]=\dfrac{3x}{2}-\left\{\dfrac{3x}{2}\right\}$

Similarly $\left[\dfrac{y}{2}\right]=\dfrac{y}{2}-\left\{\dfrac{y}{2}\right\}$ & $\left[\dfrac{3y}{4}\right]=\dfrac{3y}{4}-\left\{\dfrac{3y}{4}\right\}$

So that, $\dfrac{x}{3}-\left\{\dfrac{x}{3}\right\}+\dfrac{3x}{2}-\left\{\dfrac{3x}{2}\right\}+\dfrac{y}{2}-\left\{\dfrac{y}{2}\right\}+\dfrac{3y}{4}-\left\{\dfrac{3y}{4}\right\}=\dfrac{11x}{6}+\dfrac{5y}{4}\Rightarrow\therefore\left\{\dfrac{x}{3}\right\}+\left\{\dfrac{3x}{2}\right\}+\left\{\dfrac{y}{2}\right\}+\left\{\dfrac{3y}{4}\right\}=0$

$\Rightarrow\left\{\dfrac{x}{3}\right\}=\left\{\dfrac{3x}{2}\right\}=\left\{\dfrac{y}{2}\right\}=\left\{\dfrac{3y}{4}\right\}=0$ $\{\because 0\le\{x\}<1\}\Rightarrow\therefore\dfrac{x}{3},\dfrac{3x}{2},\dfrac{y}{2},\dfrac{3y}{4}$ are integers

$\Rightarrow\therefore x=6,12,18,24$ & $y=4,8,12,16,20,24,28$

$\therefore$ No. of possible ordered pairs of (x,y) is $4\times 7=28$

24. $x_1+x_2+x_3+x_4+x_5+x_6+x_7+x_8=7$

Where each x_i is non negative integer.

so the no. of solutions is $=n+r-1_{C_{r-1}}=7+8-1_{C_{8-1}}=14_{C_7}$

25. Let $x_1=$No. of elements in A, that are mapped to 7

$x_2=$No. of elements in A, that are mapped to 8

$x_3=$No. of elements in A, that are mapped to 9

Then $x_1+x_2+x_3=5$ where $x_1,x_2,x_3\ge 1$

Let $y_i=x_i-1$, then $y_1+y_2+y_3=2$, where $y_1,y_2,y_3\ge 0$

$\therefore$ No. of solutions $=n+r-1_{C_{r-1}}=2+3-1_{C_{3-1}}=4_{C_2}=6$

PHYSICS

26. For a maximum to be observed in YDSE, the path difference between the waves from the two slits must be an integer multiple of the wavelength (λ). The path difference is given by $d\sin\theta$, where d is the slit separation and θ is the angle of the maximum. $d\sin\theta = m\lambda$, where m = 0, ±1, ±2, ... For the first maximum (m=1), we need $d\sin\theta = \lambda$. Since the maximum value of $\sin\theta$ is 1, the minimum value of d that satisfies this condition is $d = \lambda$. Therefore, a slit separation of at least one wavelength is needed to produce any maxima other than the central maximum in YDSE

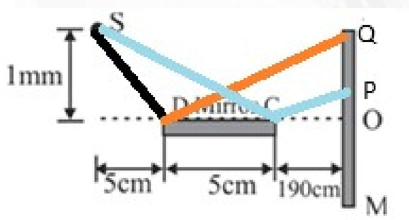
27. $(\mu - n) \times P = d\sin\phi$

28. Here a thin film is formed between curve surface of cylinder and flat surface of glass which results in interference pattern. For a fringe, locus and all point having equal thickness will be straight line parallel to length of the piece.

29. The wave speed is different in the two media, frequency remains same. The distance between wavefronts and the direction of wavefront both changed.

30. In Young's double-slit experiment, the fringe width (β) is given by the formula $\beta = (\lambda D)/d$, where λ is the wavelength of light, D is the distance between the slits and the screen, and d is the distance between the slits. This formula clearly shows that fringe width is directly proportional to the wavelength.
Therefore, if we have two wavelengths, λ_1 and λ_2 with corresponding fringe widths β_1 and β_2, and number of fringes m_1 and m_2 in a distance y, the following relationship should hold: $\beta_1/\beta_2 = \lambda_1/\lambda_2$ and $m_1/m_2 = \lambda_2/\lambda_1$

31.



Interference will be obtained between direct rays from S and reflected rays from S' (image of S on mirror).Since, the reflected rays will lie between region P and Q on the screen. So, interference is obtained in this region only. From geometry will can show that, OP = 1.9cm and OQ = 3.9cm. $\therefore$PQ=2cm

32. $2d\sin\frac{\theta}{2} = n\lambda$

33. Person B has stronger ciliary muscles than person A. So, the muscles in his case can be strained more and the focal length of his eye can be reduced more compared to those of person A. While seeing far objects, the muscles are relaxed, so their strength will not affect the far point of the eye

34. When two coherent sources are very close together, the interference pattern essentially becomes a single, very broad fringe, or the fringe width becomes so large that the entire screen appears uniformly illuminated. The assertion is true, but the reason is false. While it's true that no interference pattern is detected when two coherent sources are infinitely close

35. White spot will be obtained where net path difference is zero. or path from both slits is equal. The desired distance is $y = (\frac{d}{2}) - \frac{(\frac{2d}{3})}{2} = \frac{d}{6}$

36. Conceptual

37. fringe width is uniform

38. Conceptual

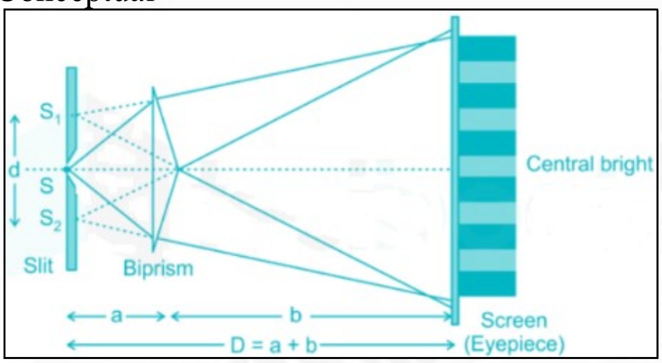
39. A rainbow forms after a rain shower due to the interaction of sunlight and water droplets in the air. The process involves refraction, reflection of light within the raindrops.

40. Conceptual

41. Conceptual

42. $30\left(\frac{D}{f_e}\right)$

43. Conceptual

44.


Let the separation between S_1 and S_2 be 'd' and the distance of slits and the screen from the biprism be a and b respectively, $D=(a+b)$.If the angle of the prism is α and the refractive index is μ, then $d=2a(\mu-1)\alpha$.

$\lambda=\frac{wd}{D}=\frac{w[2a(\mu-1)\alpha]}{a+b}$ If a convex lens is mounted between the biprism and eyepiece. There will be two positions of the lens when the sharp images of coherent sources will be observed in the eyepiece. The separation of
the images in the two positions are measured. Let these be d_1 and d_2 then $d=\sqrt{d_1d_2}$

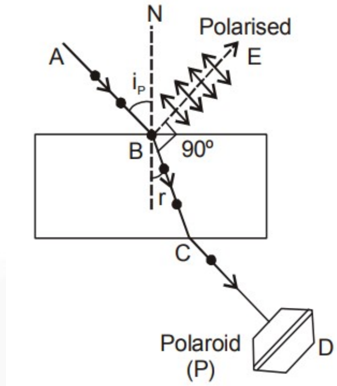
$\lambda=\frac{wd}{D}=\frac{w\sqrt{d_1d_2}}{(a+b)}$

Given, $d_1=5\ mm,\ d_2=2.25\ mm,\ 589.6nm,\ D=1.0m$

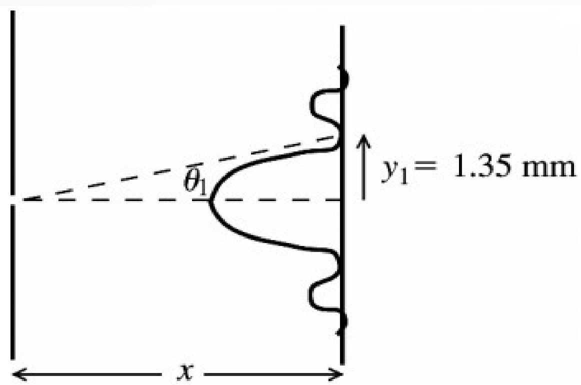
We know that for two positions of images, the distance between the two slits is given by $d=\sqrt{d_1d_2}=\sqrt{0.005\times0.00225}=3.35\times10^{-3}m$ Fringe width:

$w=\frac{\lambda D}{d}=\frac{589.6\times10^{-9}\times1.0}{3.35\times10^{-3}}=1.76\times10^{-4}\ m\ \Rightarrow w=0.176\ mm$

45. Let us consider the diagram shown below the light beam incident from air to the glass slab at Brewster's angle (i_p). The angle between reflected ray BE and BC is 90°. Then only reflected ray is plane polarised represented by arrows. As the emergent and incident ray are unpolarised, so, polaroid rotated in the way of CD then the intensity cannot be zero but varies in one complete rotation.



46.

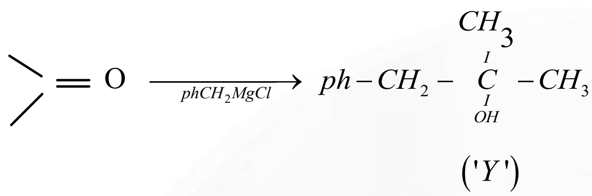


47. Conceptual
48. The diameter of the bright ring is proportional to the square root of the odd natural numbers. The diameter of the dark ring is proportional to the square root of the even natural numbers. $D_n = \sqrt{4n\lambda R}$
49. Conceptual
50. Conceptual

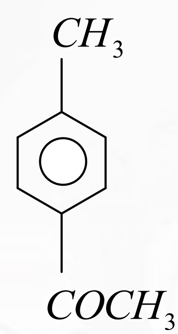
CHEMISTRY

51. SeO_2 oxidises, $-CH_2$ group to $\overset{\overset{O}{\|}}{C}$; 2[nd] reaction is (cannizzaro's reaction)

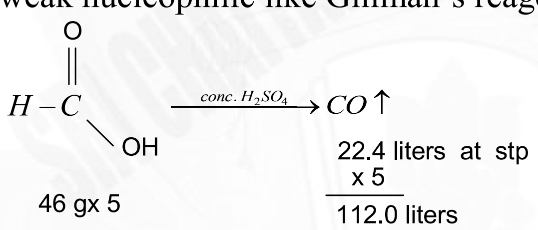
52. Both (A) & (R) are correct, and (R) is the correct explanation of (A).

53. 

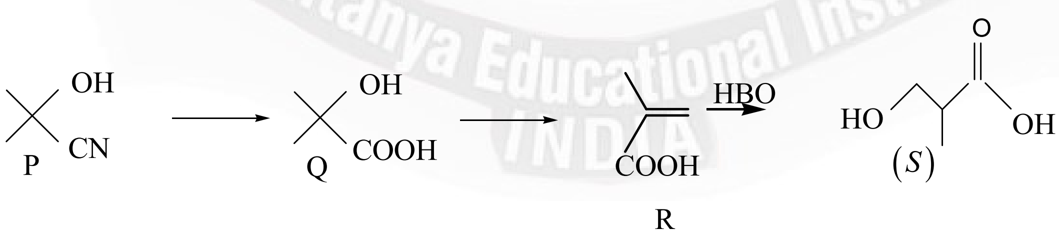
54. Conceptual

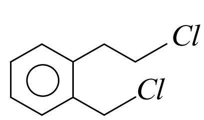
55. 'X' is 

56. Strong nucleophile, (like H^- from $LiAlH_4$) bring about direct addition at $\overset{\overset{O}{\|}}{C}$ not weak nucleophilic like Gillman's reagent.

57. 

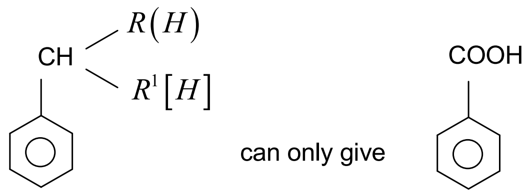
58. CH_2O doesnot give of iodoform test of yellow precipitate
Acetone doesnot give Fehling's test

59. 

60. In 1 ether also should react to give 

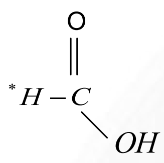
In 3 and 4 other groups interfere the reduction.

61.



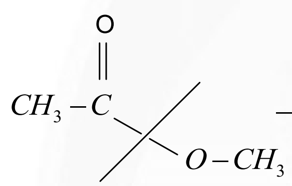
62. $HCOOH + KOH \rightarrow HCOOK + H_2O$

63.



, Marked 'H' gives reducing character to formic acid.

64.



$\xrightarrow{H_2O/H^-}$ CH_3COOH ; $CH_3COOK \xrightarrow[\text{electrolysis}]{\text{Kolbe's}} C_2H_6$

65. $CH_3 - C \equiv C - COOH$ (1 mole of this compound is formed) $(C_4H_4O_2)$ MW = 84

66. EWG increases rate of hydrolysis

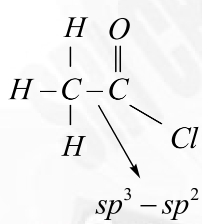
67. A & B contain acidic hydrogen with which RMgx reacts to give RH (alkane)

68. HCHO gives oxidation product while phCHO gives reduction product.

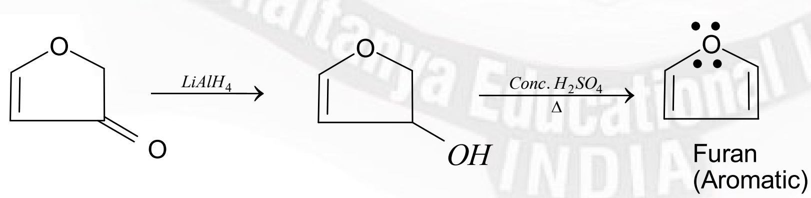
69. Conceptual

70. This is Perkin reaction.

71. $CH_3COOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$



72.



73. Each β - keto acid lose one $CO_2 \uparrow$

While a dicarboxylic acid (gem) lose one $CO_2 \uparrow$

74. Double bond is reduced when phenyl group is attached to β - carbon as in cinnamal dehyde.

75.

$$\begin{array}{c} CH_2OH \\ | \\ HO-CH_2-C-CHO \\ | \\ CH_2OH \end{array} \quad ; \quad \begin{array}{c} CH_2OH \\ | \\ HO-CH_2-C-CH_2OH \\ | \\ CH_2OH \end{array}$$

1 mole 'X' (3) ; 1 mole 'Y' (4)