Sec: Sr.Super60_STERLING BT | JEE-ADV-2023_P1 | Date: 13-07-2025
Time: 09.00Am to 12.00Pm | WTA-37 | Max. Marks: 180

KEY SHEET

MATHEMATICS

1	**ABD**	2	**AB**	3	**ABC**	4	**A**	5	**A**	6	**A**
7	**C**	8	**720**	9	**150**	10	**41**	11	**380**	12	**6**
13	**4**	14	**C**	15	**D**	16	**A**	17	**A**		

PHYSICS

18	**ACD**	19	**BC**	20	**AD**	21	**A**	22	**D**	23	**C**
24	**B**	25	**7**	26	**2**	27	**5850**	28	**15**	29	**4**
30	**8**	31	**C**	32	**A**	33	**A**	34	**C**		

CHEMISTRY

35	**ABD**	36	**AC**	37	**AB**	38	**A**	39	**B**	40	**D**
41	**B**	42	**4**	43	**5**	44	**3**	45	**3**	46	**5**
47	**6**	48	**A**	49	**A**	50	**A**	51	**B**		

SOLUTIONS

MATHEMATICS

1. A). No. of subsets of r-members

$= \text{selecting r things}$

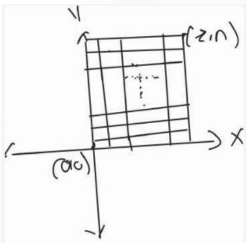
$= {}^{n}C_{r}$

B). Binary system is 0 & 1……..n-place

$\therefore$ Total no. of ways

=Number of ways of selecting r place from n place

$= {}^{n}C_{r}$

C). 

we have to cover $r+n$ steps

Number of ways

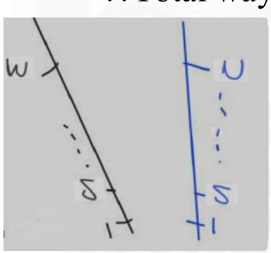
$= n + {}^{r}C_{r}$

$\neq {}^{n}C_{r}$

D). Number of ways of selecting r-different things from n- different things. When $\perp$ particular thing is always choosen $= {}^{n-1}C_{r-1}$

$\therefore$ Number of ways of selection of r different things from thing is excluded $= {}^{n-1}C_{r}$

$\therefore$ Total ways$= {}^{n-1}C_{r} + {}^{n-1}C_{r} = {}^{n}C_{r}$

2. 

Number of points of intersection $= {}^{m}C_{2} \times {}^{n}C_{2}$

$$= \frac{m!}{2!(m-2)!} \times \frac{n!}{2!(n-2)!}$$

$$= \frac{(m9m-1)n(n-1))}{4}$$

3. $\rightarrow \{0,1,2,3,4\}$

$(0,0)$

$$\left.\begin{matrix} (1,2) \ \& \ (2,1) \\ (1,3) \ \& \ (3,1) \\ (2,4) \ \& \ (4,3) \\ (3,4) \ \& \ (4,3) \end{matrix}\right\} \text{9 possible pairs}$$

4. --

(7-places)

For digit 2, No. of ways to select places= ${}^{7}C_{2}$

For remaining 5 places there are 2 choices of digits as (1 &3)

$\therefore$ Total no. of numbers

$= {}^{7}C_{2} \times 2^{5} = 672$

5. odd digits are 1,3,5,7,9

$\therefore$total number of numbers

Which has all odd digits$= 5 \times 5 \times 5 = 125$

$\therefore$total numbers which have at least one even digits=900-125 =775

6. Case-I

3 questions from first 5

$\therefore$no. of ways $= {}^{5}C_3 \times {}^{13-5}C_{10-3}$

Case-II

4 questions from first 5

$\therefore$no. of ways $= {}^{5}C_4 \times {}^{13-5}C_{10-4}$

Case-III

5 questions from first 5

$\therefore$no. of ways $= {}^{5}C_5 \times {}^{13-5}C_{10-5}$

$\therefore$total number of ways $= \text{case(I)} + \text{case(II)} + \text{case} + \text{(III)} = 276$

7. Indians $\to$ 5 men & 5 women

Americans$\to$ 5 men & 5 women

Total hand shakes $= {}^{10}C_2 + {}^{10}C_2 + 5 \times 9 = 135$

8. No. of even digits=3

No. of odd digits=4

$\boxed{3}$ $\boxed{2}$ $\boxed{3}$ $\boxed{4}$ $\boxed{5}$ $\boxed{2}$

$\uparrow$ $\uparrow$

$(2,4,6)$ 2left

Number of digits $= 3 \times 3 \times 4 \times 5 \times 2 = 720$

9. Case-I

$A \to \perp$ ball $B \to \perp$ ball $C \to 3$ balls

No. of ways $= {}^{5}C_1 \times {}^{4}C_1 \times 3C_3 = 20$

Total ways in case-I $= \dfrac{3!}{2!} \times 20 = 60$

Case-II

As 2 balls , $B \to 2$ balls & $C \to \perp$ balls

No. of ways of distribution $= {}^{5}C_2 \times {}^{3}C_2 \times {}^{1}C_1$

$= 30$

Total ways in Case-II $= \dfrac{3!}{2!} \times 30 = 90$

Total no. of ways $= 60 + 90$

$= 150$

10. $S = \{1,2,3,4\}$

Let A,B be subsets of S such that $A \cap B = \phi$

$\therefore$for each element of S

There are 3 possibilities

$x \in A \,|\, x \in B \,|\, x \in A^C \cap B^C$

$\therefore$for 4 elements

Number of ways=3^4 & for unordered pair of subsets $\frac{3^4+1}{2}=41$

11. We have 6 girls & 4 boys

To select 4 members $= {}^6C_3 + {}^4C_1 + {}^6C_4$

Now selection of captain from 4 members $= {}^4C_1$

Number of ways $=\left({}^6C_3 + {}^4C_1 + {}^6C_4\right){}^4C_1 = \left(20\times4\times415\right)\times4 = 380$

12. Case-I

Both are bananas

Number of ways of selection = $\perp$

Case-II

Both are not bananas

a) both are same fruits

number of ways $= {}^2C_1 = 2$

b) both are different fruits

$\therefore$number of ways =$\perp$

Case-III

One fruit is banana

Number of ways $=1\times {}^2C_1$

$\therefore$total number of ways $=1+2+1+2$=6

13. total matches between boys of both teams $= {}^2C_1 \times {}^4C_1 = 28$

Total matches between girls of both teams $= {}^nC_1 \times {}^6C_1 = 6n$

$\therefore$ 28+6n=52 $\Rightarrow n=4$.

14. i). n- things to r objects (none or any)

i.e., $x_1 + x_2 + \dots\dots\dots\dots + x_z = n$

number of ways $= {}^{n+z-1}C_{z-1}$

here n=35, r=3

number of ways $= {}^{38-1}C_z = \frac{37!}{2!35!} = 37\times18$=666

ii) A deagon has 10 sides

$\therefore$there are 10 choices for common sides of triangle

Now for chosen side (AB) the third vertex of triangle must be one of remaining vertices of decagon that is not adjacent to AB

$\therefore$possible choices for third vertex (C)

$\therefore$total number of triangles=10×6

$=60$

iii) black balls=3 & non-black balls=6

$\therefore$number of ways $= {}^3C_1 \times {}^6C_2 + {}^6C_1 \times {}^3C_1 + {}^3C_3 \times {}^6C_0 = 45+16+1$=64

15. the number of straight line that can be drawn using 12 points out of which 8 are collinear is $= {}^{12}C_2 - {}^{8}C_2 + 1 = 39$

16. i) ${}^{n+4}C_{n+1} - {}^{n+3}C_n = 15(n+2)$

$$\Rightarrow \frac{(n+4)(n+3)(n+2)}{3\times2\times1} - \frac{(n+3)(n+2)(n+1)}{3\times2\times1} = 15(n+2)$$

$$\Rightarrow \frac{(n+3)(n+4)-(n+1)(n+3)}{6} = 15$$

$$\Rightarrow (n+3)(3) = 15\times6$$

$$n+3=30$$

$$\Rightarrow n=27$$

ii). ${}^{2n}C_3 = 11.{}^{n}C_3$

$$\frac{(2n)!}{3!(2n-3)!} = \frac{11\times n!}{3!(n-3)!}$$

$$\Rightarrow \frac{(2n)(2n-1)(2n-2)}{6} = \frac{11\times n\times(n-1)\times(n-2)}{6}$$

$$2\times2\times(n-1)(2n-1) = 11\times(n-1)(n-2)$$

$$\Rightarrow 8n-4 = 11n-22$$

$$\Rightarrow 3n=18$$

$$\Rightarrow n=6$$

31 objects

iii) 10 identical   21 distinct

possible ways

= 0 identical +10 distinct

= $\perp$I+ 3D

= 2I+8D

=10I+0D

$\therefore$ Total number of ways

$= {}^{21}C_{10} + {}^{21}C_9 + {}^{21}C_8 + ...$

as ${}^{n}C_r = {}^{n}C_{n-r}$

$\therefore$ tota ln umberofways $= 2^{20}$

$\therefore x = 20$

17. conceptual

PHYSICS

18. $I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 = \left(\sqrt{I} + \sqrt{\frac{I}{2}}\right)^2 < 4I \; I_{min} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 > 0 \; \beta = \frac{\gamma D}{d}$

For central maximum $\delta = 0$

19.

$\frac{yd}{1} + y_1 \frac{d}{4} = 0 \qquad y_1 = y(-4) = -4\sin \pi t$

For max Intensity $\delta = n\lambda$

$\frac{yd}{1} + y_p \frac{d}{4} = n\lambda$

Form first time n=1, $y_p = \frac{d}{2} \qquad yd + \frac{d^2}{8} = \lambda \; \therefore t = \frac{1}{\pi}\sin^{-1}\left(\frac{54}{80}\right)$

Similarly for min intensity $\frac{yd}{1} + y_p \frac{d}{y} = \left(n - \frac{1}{2}\right)\lambda \quad t = \frac{1}{\pi}\sin^{-1}\left(\frac{27}{80}\right)$

20. concrent waves can meet same phase (or) opposite phase also

21. $\delta = d\sin\theta$

For max $\delta = n\lambda$

$d\sin\theta = n\lambda$

$\sin\theta = \frac{n\lambda}{d} = n\left[\frac{0.5}{2}\right] = \frac{n}{4}$

$\sin\theta$ value lies between -1 to +1 so $\frac{n}{4} \le 1$

So, for each quadrant is maximum

22. $\beta = \frac{\lambda D}{d}$ is $\beta \; \alpha \; \lambda$

23. at P

$\Delta\phi = \frac{2\pi}{\lambda}\delta \; = \frac{2\pi}{\lambda} \frac{xd}{D} \qquad I_P = 4I\cos^2\left(\frac{\Delta\phi}{2}\right) \qquad \sin n \;\; 4x = I_0$

$= I_0\cos^2\left[\frac{\pi xd}{\lambda D}\right] \; = \; \beta = \frac{\lambda D}{d} = I_0\cos^2\left[\frac{\pi x}{\beta}\right]$

24. $I = I_{max}\cos^2\frac{\phi}{2}$

$\frac{I_{max}}{2} = I_{max}\cos^2\frac{\phi}{2}$

$\phi = \frac{\pi}{2}(2n+1)$

Phase diff. $= \frac{2\pi}{\lambda}.\delta$

$\delta = \frac{\lambda}{2\pi}\phi$

25. In the screen of YDSE

Distance of nth bright frings

$$y=\frac{n\lambda D}{d}$$

It n_1 bright of λ_1 overlaps with n_2 bright of λ_2 then

$$\frac{n_1\lambda_1 D}{d}=\frac{n_2\lambda_2 D}{d} = \frac{n_1}{n_2}=\frac{7}{4}$$

So 7^{th} bright of λ_1 overlaps with4th bright of λ_2

14^{th} bright of λ_1 overlaps with 8^{th} bright of λ_2

and so on so min order of λ_1 is 7

26. $I_P = I_{max}\cos^2\phi/2 \qquad \Rightarrow \cos\frac{\phi}{2}=\frac{1}{2} \qquad \phi=\frac{2\pi}{3}$

$$\frac{2\pi}{\lambda_1}\Delta x_1=\frac{2\pi}{3} = \Delta x_1=\frac{\lambda_1}{3}$$

Similarly $\Delta x_2=\frac{\lambda_2}{6}$

For same point P, $\Delta x_1=\Delta x_2 \qquad \frac{\lambda_1}{\lambda_2}=\frac{1}{2}$

27. $\beta=\frac{\lambda D}{d}$

For lens

$u=-30\,cm \qquad v=70\,cm$

$$m=\frac{v}{u}=\frac{d_1}{d}=\frac{h_1}{h_0}$$

$$\frac{70}{-30}=\frac{0.7}{d}$$

Given $d_1=0.7\,cm \qquad d=-0.3\,cm$

$$\lambda=\frac{13d}{D}=5850\ A^0$$

28. $S=(\mu-1)t\frac{D}{d} \qquad \beta=\frac{\lambda D}{d}$

$S=n\beta$

29. $I=I_1+I_2+2\sqrt{I_1I_2}\ \cos\phi$

$\phi=0 \qquad I_1=I_2=1$

30. $S=\frac{\beta}{\lambda}(\mu-1)t = \Delta S=\frac{\beta}{\lambda}(\mu_2-\mu_1)\,t$

$$y_5=\frac{5\lambda D}{d} = \frac{5\lambda D}{d}=\frac{D}{d}\ (\mu_2-\mu_1)\ t$$

31. By introducing plate frings pattern will shifted

32. . i). at P

$$\delta = d\sin\theta_0 + d\sin\theta$$

$$n\lambda = \frac{dy_0}{D_1} + \frac{dy}{D_2}$$

$$n = 280$$

ii) at 0 $\delta^1 = \frac{dy_0}{D_1}$

$$n^1 = \frac{\delta^1}{\lambda} = 80$$

Iii). $\delta = (\mu - 1)t = n\ \delta^{11}$

$$\delta^{11} = 0.14 - 0.09 = 0131$$

$$n = 262$$

Iv). At O

$$\delta = \delta^1 - (\mu - 1)t$$

$$= (0.04 = 0.009) - 0.031$$

$$n = \frac{0.031}{0.5\times 10^{-3}} = 62$$

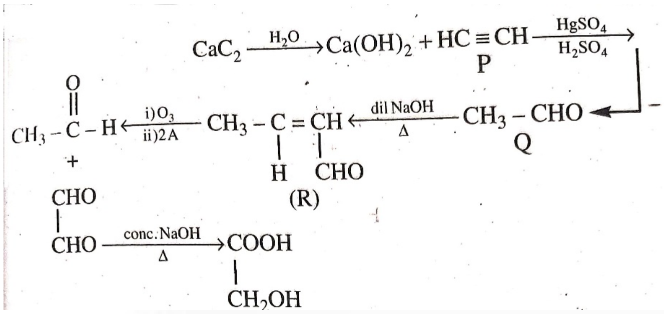
33. $\beta = \frac{\lambda D}{d}$ $\beta\ \alpha\ \gamma$ and $\lambda\ \alpha\ \frac{1}{\mu}$

34. $\beta = \frac{\lambda D}{d}$ $\text{int ensity}\ (I) = \frac{P}{A}\ \alpha\ \frac{P}{r^2}$

CHEMISTRY

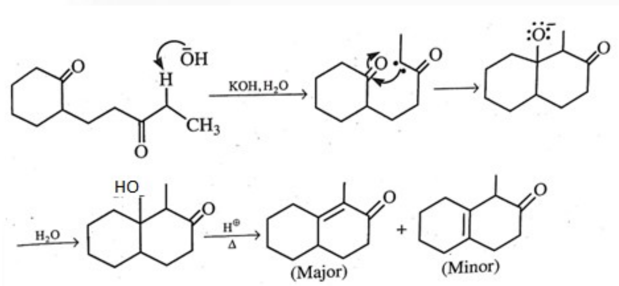
35. A new C – C bond formed in (a) Aldol (b) Friedel – Crafts alkylation, (d) Reimer Tiemann reaction

36.

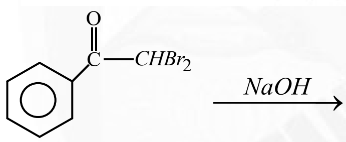


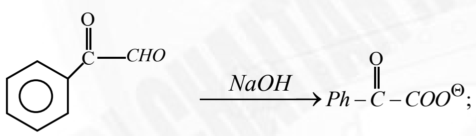
37. Mechanism of HVZ reaction

38.



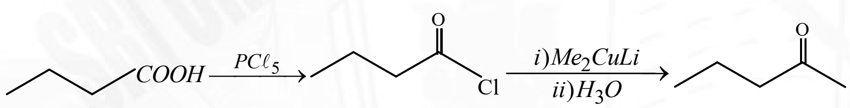
39.





cannizarro reaction

40.



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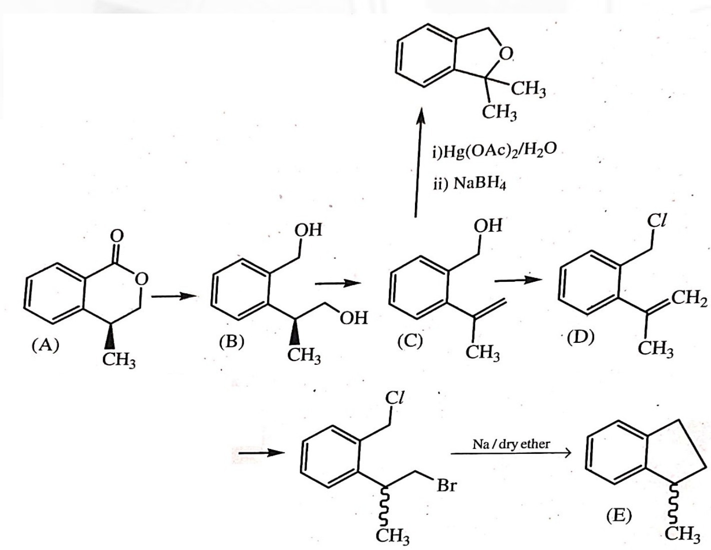
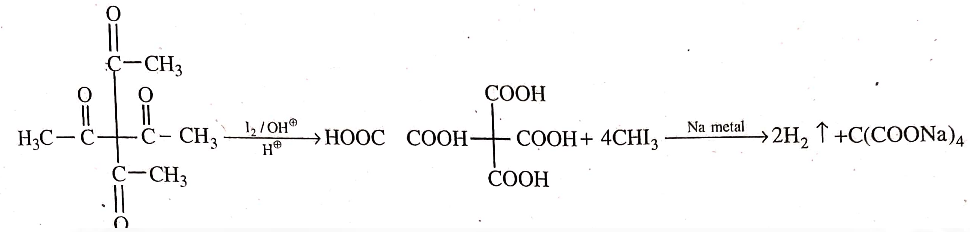


42.

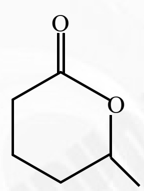
$$C_9H_{12}O_4 \xrightarrow[H^{\oplus}]{I_2/OH^{\oplus}} CHI_3 + y \xrightarrow{Na\ metal} 2H_2\uparrow + salt$$

DU = 4 (No. of active H = 4)

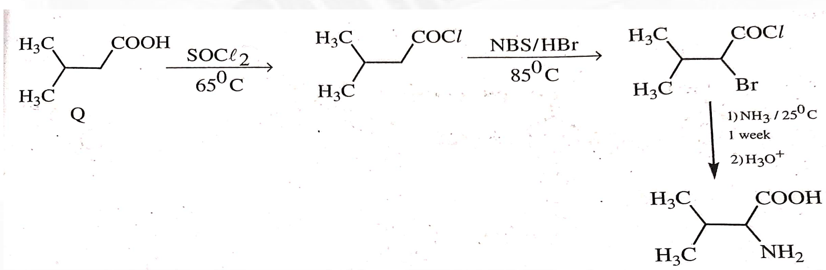


43. Iodoform test, Sodium bisulfite test, Tollen's test, fehling's solution test, 2,4-DNP test

44. $Zn-Hg/HCl, N_2H_4/OH^-, \begin{array}{l} CH_2-SH \\ | \\ CH_2-SH \end{array}, H_2/Ni$

45. $x=2, y=1$, Final product is 

46.



47. 3, 4, 6, 7, 8, 10 of given acids

48. Conceptual

49. Reactions between different carbonyl compounds

50.

$$Ph-CH_2-COOH \xrightarrow{PCl_5} Ph-CH_2-\underset{\underset{O}{\|}}{C}-Cl$$

$$Ph-CH_2-COOH \xrightarrow{CH_3-Mg-Br} CH_4\uparrow$$

$$Ph-CH_2-COOH \xrightarrow[\Delta]{NH_3}$$

$$Ph-CH_2-\underset{\underset{O}{\|}}{C}-NH_2$$

51. A- Claisen condensation B- HVZ Reaction

C- F.C. acylation D-Reduction with $LiAlH_4$