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: 21-06-2025
Time: 09:00AM to 12:00PM | WTM-35 | Max. Marks: 300

KEY SHEET

MATHEMATICS

1)	**2**	2	**2**	3)	**1**	4)	**1**	5)	**3**
6)	**4**	7)	**1**	8)	**1**	9)	**2**	10)	**2**
11)	**3**	12)	**3**	13)	**4**	14)	**2**	15)	**1**
16)	**2**	17)	**3**	18)	**2**	19)	**3**	20)	**4**
21)	**29**	22)	**5**	23)	**1**	24)	**4**	25)	**11**

PHYSICS

26	**4**	27	**4**	28	**3**	29	**3**	30	**2**
31	**3**	32	**2**	33	**3**	34	**1**	35	**1**
36	**4**	37	**4**	38	**4**	39	**3**	40	**2**
41	**3**	42	**4**	43	**4**	44	**3**	45	**4**
49	**150**	47	**0**	48	**3**	49	**2**	50	**45**

CHEMISTRY

51	**4**	52	**1**	53	**2**	54	**3**	55	**4**
56	**3**	57	**4**	58	**4**	59	**1**	60	**1**
61	**2**	62	**4**	63	**4**	64	**4**	65	**1**
66	**4**	67	**2**	68	**3**	69	**4**	70	**4**
71	**0**	72	**1**	73	**1**	74	**3**	75	**256**

SOLUTION
MATHEMATICS

1. LET $S=20_{C_0}+20_{C_1}-1+20_{C_{10}}-(1)$

And $S=20_{C_{20}}+20_{C_{19}}-1+20_{C_{10}}-(2)$

Adding (1) and (2) we get

$2s=\left(20_{C_0}+20_{C_1}+----+20_{C_{20}}\right)+20_{40}$ $S=2^{19}+19_{C_9}$

2. $\left(\sqrt{2}+1\right)^6=I+f, I=\text{int}egr, 0<f<1=6_{C_0}\left(\sqrt{2}\right)^6+6_{C_1}\left(\sqrt{2}\right)^5t----+6_{C_6}$

$\left(\sqrt{2}-1\right)^6=G=6_{C_0}\left(\sqrt{2}\right)^6-6_{C_1}\left(\sqrt{2}\right)^5---+6_{C_6}, 0<G<1$

$I+f+G=2\left[6_{C_0}+6_{C_2}.2^2+6_{C_4}.2+6_{C_6}\right]=198$ $\therefore 197<I+f<197\Rightarrow n=198$

3. We have $\left(\dfrac{x+1}{x^{2/3}-x^{1/3}+1}-\dfrac{x-1}{x-x^{1/2}}\right)^{10}=\left(x^{1/3}-x^{-1/2}\right)^{10}$ $=r=\dfrac{np}{p+v}=\dfrac{10\times\frac{1}{3}}{\frac{1}{3}+\frac{1}{2}}=4$

$\therefore T_5=10_{C_4}=210$

4. $S=(1+x)^{1000}+2x(1+x)^{999}+3x^2(1+x)^{998}+----+1001x^{1000}$

$\dfrac{x.s}{1+x}=x(1+x)^{999}+2x^2(1+x)^{998}-----+1001\dfrac{x^{1001}}{1+x}$

On subs tracking these two we get

$S-\dfrac{x.s}{1+x}=\left[(1+x)^{1000}+x(1+x)^{999}+x^2(1+x)^{998}+---+x^{1000}\right]-1001\dfrac{x^{1001}}{1+x}$

$S=(1+x)^{1002}-1002.x^{1001}.x^{1002}$

Coefficient of x^{50} in $S=\text{coefficient of } x^{50} \text{ in } (1+x)^{1002}=1002_{C_{50}}$

5. $7^{103}=7(49)^{51}=7(50-1)^{51}=7\left[50^{51}-51_9.50^{50}----1\right]=7\left[50^{51}-51_{c_1}.50^{50}---\right]-(7+18)-18$

$=k+18\left[\therefore K \text{ is divisible by } 25\right]$

6. Conceptual

7. a) $\sum_{r=0}^{10}\left(r+2^r\right)10_{c_r}=\sum_{r=0}^{10}r.10_{c_r}+\sum_{r=0}^{10}2^r.10_{c_r}=10.2^9+\left[10_{c_0}+2.10_{c_1}+10_{c_1}+2^2.10_{c_2}+----2^{10}.10_{c_{10}}\right]$

$=10.2^9+3^{10}=a+b=19$

b) $T_{r+1}=m_{c_r}.x^{m-r}.\dfrac{1}{(ax)^r}=m_{c_r}.\dfrac{x^{m-2r}}{a^r}=5/2\Rightarrow m-2r=0\Rightarrow m=2r \text{ but } r=3\Rightarrow m=6$

$\therefore T_4\dfrac{6_{c_3}}{a^3}=5/2\Rightarrow a=2=$ $ma=12$

c) $r=\dfrac{55}{6}=9.1$ $\therefore T_{9+1}=10_{c_9}.5^9=\lambda$

$\dfrac{\lambda}{10_{c_9}5^7}=5^2=25$

d) $n_{p_r}=5040.n_{c_r}\Rightarrow r!=5040=7$ $=$ $r=7$

8. $T_{r+1}=9_{c_r}\left(3^{1/3}\right)^{9-r}\left(5^{1/2}\right)^r=9_{c_r}.3^{3-2/3}.5^{r/2}$

$\frac{r}{3} \to r = 0,3,6,9$

$\frac{r}{2} \to r = 0,4,6,8$

Common 'r' = 0,6

Rotational terms T_1 *and* T_7

Sun $T_1 + T_7 = 31527$

9. $\left(1+x-2x^2\right)^7 = \sum_{r=0}^{7} 7_{c_r}\left(1+x\right)^{7-r}.\left(-2x^2\right)^r$

Thus required coefficient $= 7_{c_0}.7_{c_4} + 7_{c_4}\left(-2\right).6_{c_2} + 6_{c_2} + 7_{c_2}\left(-2\right)^2.5_{c_0} = 1.35 - 7.2.15 + 21.4.1 = -91$

10. Coefficient of $x^2 = coefficient\ of\ x^3$

$\therefore 9_{c_2}3^{9-2}.k^2 = 9_{c_3}.3^{9-3}.k^3$ $\quad 36 = 28k \to k = 9/7$

11. $A = 30_{c_0}.30_{c_{10}} - 30_{c_1}.30_{c_{11}} + ----+ 30_{c_{20}}.30_{c_{30}} = coefficient\ of\ x^{20}\ in\left(1+x\right)^{30}\left(1-x\right)^{30}$

$= \left(1-x^2\right)^{30} = \left(-1\right)^{10}.30_{c_{10}} = 30_{c_{10}}$

12. $\left(x^2+2x+2\right)^n = \left\{2+x\left(2+x\right)\right\}^n$

$2^n + n.2^{n-1}.x\left(2+x\right) + n_{c_2}.2^{n-2}.x^2\left(2+x\right)^2 + n_{c_3}.2^{n-3}.x^3\left(2+x\right)^3$

Coefficient of $x^3 = n_{c_2}.2^{n-2}4 + n_{c_3}.2^{n-3}.2^3 = 2^n.n+1_{c_3}$

13. Given $m_{c_0} + m_{c_1} + m_{c_2} = 46$

$\to 1 + m + \frac{m\left(m-1\right)}{2} = 46$

$\to m^2 + m - 90 = 0 \Rightarrow m = 9$

$\therefore T_{r+1} = 9_{c_r}\left(x^2\right)^{9-1}.\left(\frac{1}{x}\right)^r = 9_{c_r}.x^{18-3r}$

For constant terms $18 - 3r = 0 \Rightarrow r = 6$

$\therefore T_r = 9_{c_6} = 84$

14. Let $y = x - 3 \Rightarrow y + 1 = x - 2$

$b_n = coefficient\ of\ y^n\ in\left(1+y\right)^{n-1} + ----+\left(1+y\right)^{2n}$

$= coefficient\ of\ y^n\ in \sum_{r=n}^{2n}\left(y+1\right)^r \quad = coefficient\ of\ y^n\ in\ \frac{\left[\left(y+1\right)^{n+1}-1\right]\left(y+1\right)^n}{y}$

= coefficient of $= y^{n+1}\ in\left(y+1\right)^{2n+1} - \left(y+1\right)^n\ in\ 2n+1_{c_{n+1}}$

15. We have $\left[\sqrt{25^{x-1}+7} + \left(5^{x-1}+1\right)^{-1/8}\right]^{10}$

$T_9 = 180 \Rightarrow 10_{c_8}\left(25^{x-1}+7\right)\left(5^{x-1}+1\right)^{-1} = 180 \Rightarrow \frac{25^{x-1}+7}{5^{x-1}+1} = 4 \Rightarrow \frac{y^2+7}{y+1} = 4 where\ y = 5^{x-1}$

$\Rightarrow y^2 - 4y + 3 = 0 \Rightarrow y = 3\ or\ 1 \Rightarrow 5^{x-1} = 3\ cr\ 1 \Rightarrow 5^x = 15\ or\ 5 \Rightarrow x = \log_5^{15}\ or\ x = 1$

16. $T_n < T_{n+1} > T_{n+2} \Rightarrow 2n_{c_{n-1}}.x^{n-1} < 2n_{cn}.x^n > 2n_{c_{n+1}}x^{n+1} \Rightarrow \frac{2n_{c_n}.x^n}{2n_{c_{n-1}}x^{n-1}} > 1\ \&\ \frac{2n_{c_{n+1}}.x^{n+1}}{2n_{c_n}x^n} < 1$

$\Rightarrow \left(\frac{n+1}{n}\right)x > 1 and \left(\frac{n}{n+1}\right)x < 1 \Rightarrow x > \frac{n}{n+1}\ and\ x < \frac{n+1}{n} \quad \Rightarrow \frac{n}{n+1} < r < \frac{n+1}{n}$

17. $(xy+yz+zx)^6 = \sum_{r+s+t=6} \frac{6!}{r!s!t!}(xy)^r.(yz)^s(zx)^t = \sum_{r+s+t=6}\frac{6!}{r!s!t!}x^{r+t},y^{r+s},z^{s+t}$

$\Rightarrow r+t=3, r+s=4 \text{ and } s+t=5$

Also $r+s+t=6 \Rightarrow r=1, s=3, t=2$

18. $\sum_{r=0}^{n}\frac{(-1)^r}{n_{c_r}} = \sum_{r=0}^{\left(\frac{n+1}{2}\right)}\left[\frac{(-1)^r}{n_{c_r}}+\frac{(-1)^{n-2}}{n_{c_{n-r}}}\right]$

$\sum_{r=0}^{\left(\frac{n+1}{2}\right)}(-1)^r\left[\frac{1}{n_{c_r}}+\frac{(-1)^n}{n_{c_{n-r}}}\right]$

$\sum_{r=0}^{\left(\frac{n+1}{2}\right)}(-1)^r\left[\frac{1}{n_{c_r}}-\frac{1}{n_{c_r}}\right]=0$

19. $T_2=135 \to n_{c_1}x^{n-1},y^1=135; T_3=30 \Rightarrow n_{c_2} \Rightarrow x^{n-2},y^2=30$

And $T_4=\frac{10}{3} \Rightarrow n_{c_3}.x^{n-2},y^3=\frac{10}{3}$

$\frac{T_2\times T_4}{T_3}=\frac{135\times 10/3}{(30)^2} \Rightarrow \frac{n_{c_1}\times n_{c_3}}{(n_{c_2})}=\frac{135\times 10}{900\times 3} \Rightarrow n=5$

20. $\sum_{r=1}^{n}\left(\sum_{r_1=0}^{r-1}n_{c_r}.r_{C_{r_1}}.2^{r_1}\right)=\sum_{r=1}^{n}n_{c_r}\left(\sum_{r_1=0}^{r-1}r_{c_{r_1}}2^{r_1}\right)=\sum_{r=1}^{n}n_{c_r}\left((1+2)^r-2r\right) = \sum_{r=1}^{n}n_{c_r}\left(3^r-2^r\right)$

$=\sum_{r=1}^{n}n_{c_r}.3^r-\sum_{r=1}^{n}n_{c_r}.2^r = \left[(1+3)^n-1\right]-\left[(1+2)^n-1\right]=4^n-3^n$

21. The expression $(2+x)^2(3+x)^3(4+x)^4$

$=(x+2)(x+2)(x+3)(x+3)(x+3)(x+4)(x+4)(x+4)$

$=x^9+(2+2+3+3+3+4+4+4+4+)x^8r$ = Coefficient of $x^8=29$

22. $=\sum_{k=0}^{4}\left(\frac{5^{4-k}}{(4-k)!}\right)\left(\frac{x^k}{k!}\right)=\sum_{k=0}^{4}\left(\frac{5^{4-k}}{(4-k)!}\right)\left(\frac{x^k}{k!}\right).\frac{4!}{4!}=\sum_{k=0}^{4}\frac{4_{c_k}.5^{4-k}x^k}{4!}=\frac{(5+x)^4}{4!}$

$n_{c_5}\frac{(5+x)^4}{4!}=\frac{8}{3}\Rightarrow x=2\sqrt{2}-5$

23. $\left(\sum_{r=0}^{10}10_{c_r}\right)\left(\sum_{k=0}^{10}(-1)^k\frac{10_{c_k}}{2^k}\right)=2^{10}\left(10_{c_0}-\frac{10_{c_1}}{2}+\frac{10_{c_2}}{2^2}---+\frac{10_{c_{10}}}{20^{10}}\right)=2^{10}.\left(1-\frac{1}{2}\right)^{10}=1$

24. Coefficient of x^3 $in\left(1+x+2x^2+3x^3\right)^4=a$

Coefficient of x^3 $in\left[f(x)\right]^4=a$

$b = coefficient\ of\ x^3\ in\left(1+x+2x^2+3x^3+4x^4\right)^4$

$b = coefficient\ of\ x^3\ in\left(f(x)+4x^4\right)^4\ where f(x)=4x+2x^2+3x^3$

= coefficient of $=x^3\ in\left(f(x)\right)^4=a\Rightarrow a-b=0$

25. $\frac{1}{11!}\left[\frac{11!}{1!10!}+\frac{11!}{2!9!}+\frac{11!}{3!10!}+---+\frac{11!}{1!10!}\right]=\frac{1}{11!}\left[11_{c_1}+11_{c_2}+---+11_{c_{10}}\right]=\frac{1}{11!}\left(2^{11}-2\right)$

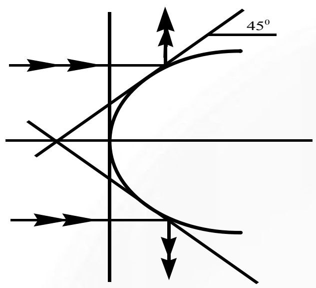
PHYSICS

26. At the point incidence slope should be $\pm\ 1$

$Y^2 = 2x$

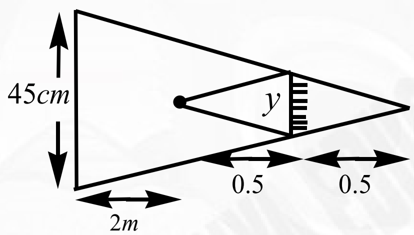
$y = \sqrt{2x}$

$\frac{dy}{dx} = \sqrt{2}.\frac{1}{2\sqrt{x}} = \frac{1}{\sqrt{2x}} = 1 \Rightarrow \sqrt{2x} = 1 \ \Rightarrow 2x = 1 \Rightarrow x = \frac{1}{2} \Rightarrow y = \pm 1$

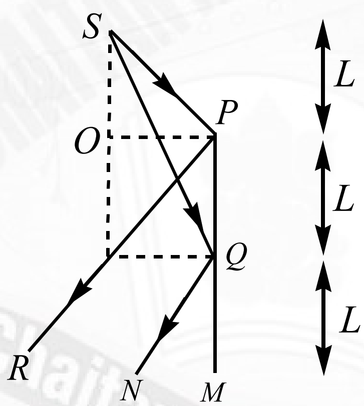


27. $\frac{0.5}{3} = \frac{y}{0.45}$ $\qquad \frac{0.5}{3} = \frac{x}{1.2}$

$y = 7.5cm \quad \Rightarrow x = 20cm$



28. Ray diagram is as shown in the figure below



Here, $\frac{SO}{OP} = \frac{PM}{RM} \Rightarrow RM = 2L$

Also $\frac{ST}{TQ} = \frac{QM}{SN} \quad \Rightarrow SN = \frac{L}{2}$

$\therefore RS = RM - SN = \frac{3L}{2}$

29. $f = 10cm \qquad m = \frac{f}{f-u}$

$m = \frac{1}{2} \qquad \frac{1}{2} = \frac{10}{10-u}$

$10 - u = 20 \Rightarrow u = -10$

30. Here $\vec{a}=|\vec{a}|\sin\theta\hat{i}-|\vec{a}|\cos\theta\hat{j}$

As $\vec{a}$ is an unit vector, So $|\vec{a}|=1$

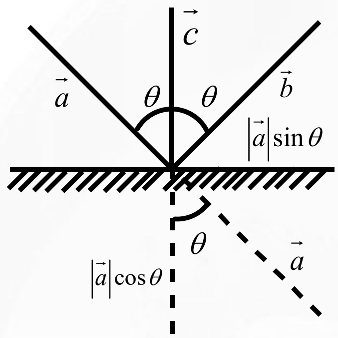
$\therefore \vec{a}=|\vec{a}|\sin\theta\hat{i}-|\vec{a}|\cos\theta\hat{j}=\sin\theta\hat{i}-\cos\theta\hat{j}$

Similarly $\vec{b}=\sin\theta\hat{j}$

And $\vec{c}=\hat{j}$

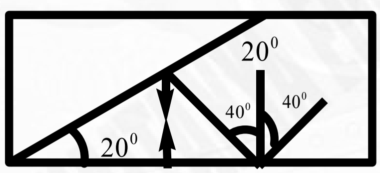
From option (B)

$\vec{a}-2(\vec{a}.\vec{c})\vec{c} \quad =\sin\theta\hat{i}+\cos\theta\hat{j}=\vec{b}$



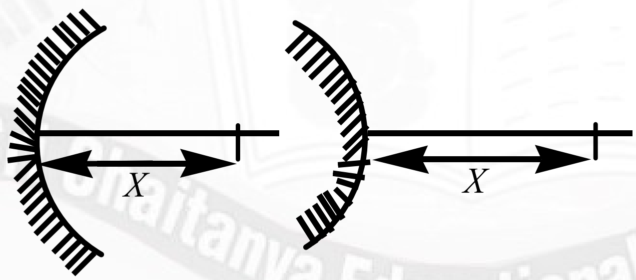
31. $\delta_1=\pi-2\times40^0=100^0-clockwise$

$\delta_2=\pi-2\times40^0=140^0-anticlockwise$



$\delta_3=\pi-2\times00^0=140^0-clockwise \Rightarrow Deviation(Net)=140^0-clockwise$

32.



$$m=\frac{f}{f-u}=\frac{-\frac{R}{2}}{-\frac{R}{2}+\frac{3R}{2}}=-\frac{1}{2}$$

$$m=\frac{f}{f-u}=\frac{\frac{R}{2}}{\frac{R}{2}+x}=\frac{1}{4}\Rightarrow 4R=R+2x\Rightarrow x=\frac{3R}{2}$$

33. $\frac{1}{-0.5}+\frac{1}{0.2}=\frac{2}{r}\Rightarrow\frac{1}{r}=\frac{3}{2};r=0.667m$

34. Using Newton's formula

$$(f+d_1)(f-d_2)=f^2$$

$$f^2+fd_1-fd_2-d_1d_2=f^2$$

$$f=\frac{d_1d_2}{d_1-d_2}$$

$$\therefore R=\frac{2d_1d_2}{d_1-d_2}$$

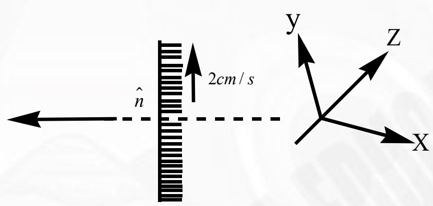
35. $$\frac{2\hat{i}-3\hat{j}+4\hat{k}}{\sqrt{29}}-2\left(\left(\frac{3\hat{i}-6\hat{j}+2\hat{k}}{7}\right)\left(\frac{2\hat{i}-3\hat{j}+4\hat{k}}{\sqrt{29}}\right)\right)\frac{3\hat{i}-6\hat{j}+2\hat{k}}{7}=\frac{2\hat{i}-3\hat{j}+4\hat{k}}{\sqrt{29}}-2\left[\frac{6+18+8}{7\times\sqrt{29}\times 7}\right](3\hat{i}-6\hat{j}+2\hat{k})$$

$$=\frac{98\hat{i}-147\hat{j}+196\hat{k}-(192\hat{i}-384\hat{j}+128\hat{k})}{\sqrt{29}\times 49}=\frac{-98\hat{i}+237\hat{j}+68\hat{k}}{49\sqrt{29}}$$

36. υ_0 is decreasing $\Rightarrow a_0\ is-Ve \Rightarrow a_1$ is in opposite direction $\Rightarrow a_1\ is+Ve$

37. The velocity of image

$$\upsilon'=\vec{\upsilon}=2(\vec{\upsilon}.\vec{n})\hat{n}\quad=(\hat{i}+\hat{j})-2\left[(\hat{i}+\hat{j})-\hat{i}\right](-\hat{i})=(-\hat{i}+\hat{j})cm/s$$



Velocity of image with respect to mirror,

$$\upsilon''=\vec{\upsilon}-\overrightarrow{\upsilon_m}=(-\hat{i}+\hat{j})-2\hat{j}=(-\hat{i}-\hat{j})cm/s$$

Velocity of image with respect to object

$$\upsilon'-\upsilon_0=(-\hat{i}+\hat{j})-(\hat{i}+\hat{j})=-2\hat{i}\ cm/s$$

Unit vector in the direction of reflected ray $=\dfrac{(-\hat{i}+\hat{j})}{\sqrt{2}}$

38. Here $\dfrac{1}{\upsilon}+\dfrac{1}{u}=\dfrac{1}{f}$..........(1)

$$\Rightarrow\frac{1}{\upsilon}+\frac{1}{-190}=\frac{1}{10}\quad\Rightarrow V=\frac{19}{2}$$

Differentiating equation (1) w.r.t.t we get

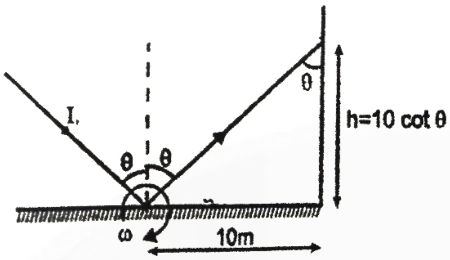
$$-\frac{1}{\upsilon^2}\left(\frac{dv}{dt}\right)-\frac{1}{u^2}\left(\frac{du}{dt}\right)=0\Rightarrow\left(\frac{dv}{dt}\right)=\frac{\upsilon^2}{u^2}\left(\frac{du}{dt}\right)\Rightarrow\left(\frac{d\upsilon}{dt}\right)=-\left(\frac{\frac{19}{2}}{190}\right)^2\times 40=\frac{1}{400}\times 40=0.1\ m/s$$

39. The maximum velocity of the insect is $A\sqrt{\dfrac{K}{M}}$

Its component perpendicular to the mirror is $A\sqrt{\dfrac{K}{M}}\sin 60^0$

Thus, maximum relative speed $=\dfrac{\sqrt{3}}{2}A\sqrt{\dfrac{k}{M}}.$

40. When mirror is rotated with angular speed ω_1 the reflected ray rotates with angular speed $2\omega\left(=36\, rads^{-1}\right)$



Speed of the spot $=\left|\frac{dh}{dt}\right|=\left|\frac{d}{dt}(10\cot\theta)\right|=\left|-10\operatorname{cosec}^2\theta\frac{d\theta}{dt}\right|=\left|-\frac{10}{(0.6)^2}\times 36\right|=1000ms^{-1}$

41. When object is at 8 cm

Image $V_1=\frac{f\times u}{u-f}=\frac{5\times 8}{8-5}=-\frac{40}{3}cm$

When object is at 12 cm

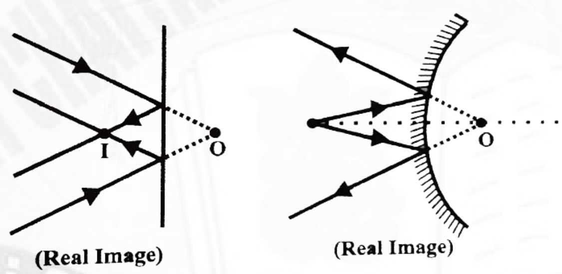
Image $V_2=\frac{f\times u}{u-f}=\frac{5\times 12}{12-5}=-\frac{60}{7}cm$

Separation $=|V_1-V_2|=\frac{40}{3}-\frac{60}{7}=\frac{100}{21}cm$

So A,C and D are correct statements

42. If the mirror is shifted parallel to itself such that the velocity of the mirror is parallel to its surface, the image shall not shift. Hence statement I is false.

43. We can produce a real image by a plane or convex mirror



Focal length of a convex mirror is taken positive.

44. Laws of reflection can be applied to any type of surface.

45. Multiple reflection from two mirrors

Option a

Image	Mirror	Angle
I_1	M_1	30^o
I_2	M_2	90^o
I_3	M_1	150^o
I_1^1	M_2	30^o
I_2^1	M_1	90^o
I_3^1	M_2	150^o

Here I_3 and I_3^1 coincide hence $N=5$

Option b

Image	Mirror	Angle
I_1	M_1	36^o
I_2	M_2	108^o
I_1^1	M_2	36^o
I_2^1	M_1	108^o

$N=4$

Option c

Image	Mirror	Angle
I_1	M_1	42^o
I_2	M_2	114^o
$\cancel{I_1^1}$	$\cancel{M_2}$	$\cancel{30^o}$
I_2^1	M_1	102^o
I_3	M_2	176^o

$N=5$

Option d

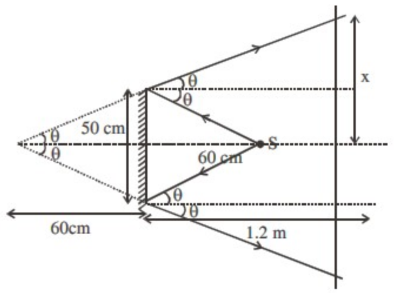
Image	Mirror	Angle
I_1	M_1	50^o
I_2	M_2	120^o
I_1^1	M_2	20^o
I_2^1	M_1	90^o
I_3	M_2	160^o

$N=5$

46. $\tan\theta = \frac{25}{60} = \frac{x}{180}$

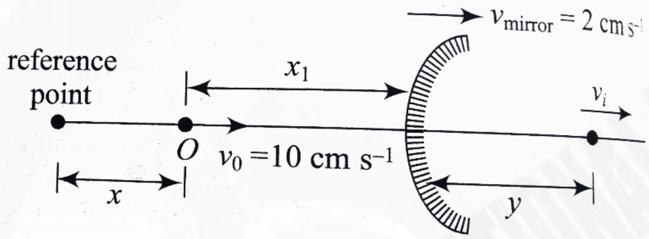
$x = 75cm$

So distance between extreme points $= 2x = 2\times 75 = 150cm$



47. $\frac{1}{y}+\frac{1}{-x_1}=\frac{1}{10}$

$\frac{1}{y}-\frac{1}{10}=\frac{1}{10}\Rightarrow y=5cm$



$\frac{dx}{dt}=10cm/s,\frac{d(x+x_1)}{dt}=2cm/s$

$\frac{dx_1}{dt}=-8cm/s$

$\frac{dy}{dt}=v_1=2$

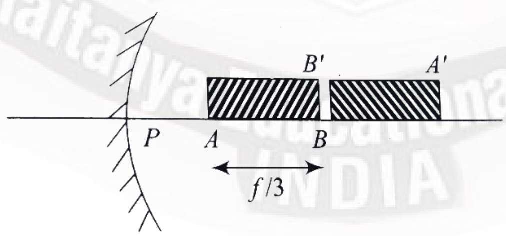
From(i): $\frac{dy}{dt}=\left(\frac{y}{x_2}\right)^2\frac{dx_1}{dt}\Rightarrow v_1-2=\left(\frac{5}{10}\right)^2(-8)\Rightarrow v_i=0$

48. For $v_1=50/7m,u_1=-25m$

$v_2=25/3m,u_2=-50m$

Speed of object $=\frac{25}{30}\times\frac{18}{3}=3kmph$

49. Since the image formed is real and elongated, the situation is as shown in the figure. Since the image of B is formed at B' itself, therefore



B is situated t at the center of curvature that is at a distance 2f from the pole.

$\therefore PA=2f-\frac{f}{3}=\frac{5f}{3}$

Let us find the image of A for point A

$u=-\frac{5f}{3},v=?$ Applying $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$

$$\Rightarrow \frac{1}{\frac{-5f}{3}}+\frac{1}{v}=\frac{1}{-f} \Rightarrow \frac{1}{f}+\frac{3}{5f} \Rightarrow \frac{1}{\upsilon}=\frac{-5+3}{5f}=\frac{-2}{5f} \Rightarrow v=-2.5f$$

$\therefore$ Image length $=2.5f-2f=0.5f=\frac{f}{2}$

$\therefore$ Magnification $=\frac{\frac{f}{2}}{\frac{f}{3}}=1.5$

50. For n mirror 1

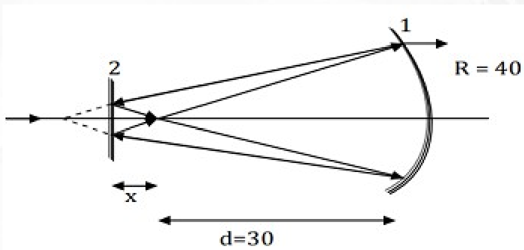
$$\frac{1}{\upsilon}+\frac{1}{u}=\frac{1}{f}\left| \begin{array}{l} u=\ \ -30 \\ f=\ \ -20 \end{array}\right.$$

$$\frac{1}{\upsilon}-\frac{1}{30}=-\frac{1}{20}$$

$$\frac{1}{\upsilon}=\frac{1}{30}-\frac{1}{20}$$

$\upsilon=-60cm$

So $x=15cm$



So distance between two mirrors = 45 cm

CHEMISTRY

51. In final product D-atom is attached to 2nd carbon during duterolysis, hence compound C is

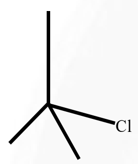
$$\begin{array}{c} CH_3-CH-CH_3 \\ | \\ MgBr \end{array}$$

And

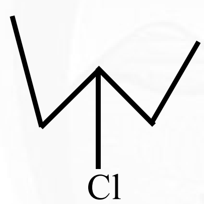
Alkyl group R is

$CH_3-\underset{|}{C}H-CH_3$

52.



forms 3^0 carbanion in SN_1 reaction which is more stable compared to 2^0 carbanion ion formed by



53. 1st step is diazotization of aniline X is $C_6H_5N_2^+Cl^-$

2nd step is sand Meyers reaction Y is C_6H_5Cl

54. Addition of HCl across double bond of side chain follows Markonikoff's addition giving $C_6H_5-CH_2-CH(Cl)-CH_3$

55. Presence of –M group increases the reactivity for aromatic nuclepohilic substitution, –M group at O,P increases reactivity to greater extent compared to same group at Meta position $(a<C<b)$

56. As OH- is attached on same side as leaving group i.e Cl-. This indicates SN_1 mechanism and intermediate formed will be a carbocation.

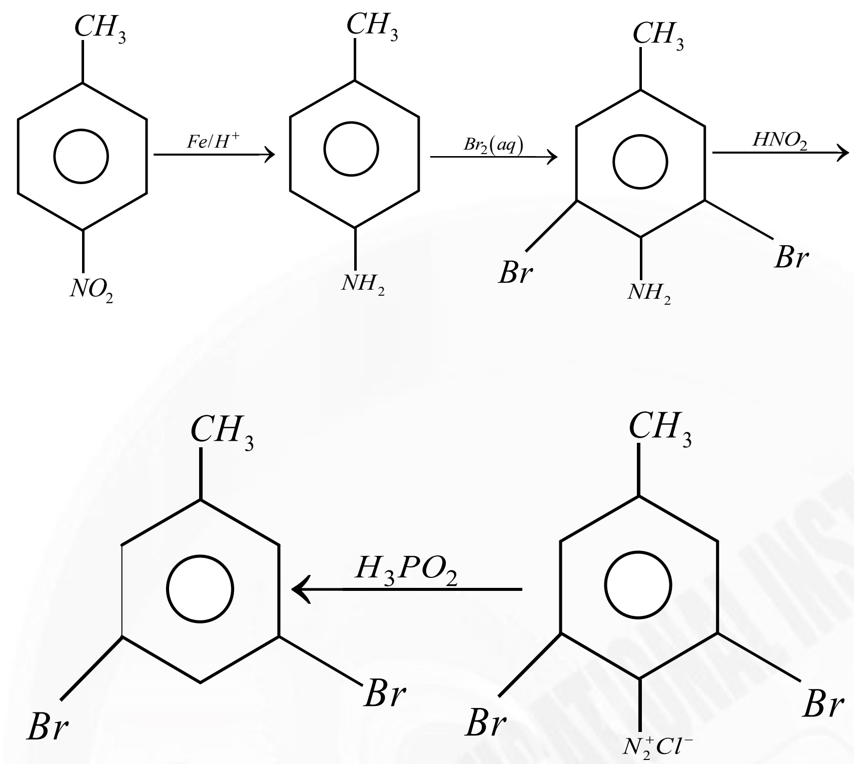
57. In aryl halides, halogen is directly bonded to benzene ring. Hence a & d, are aryl halides. b and c are benzylic halides

58. Cl is O,P-directing group, hence nitration of chlorobenzene will give mixture of O-nitro chlorobenzene and p-chloronitrobenzene, NO_2 is –M group & hence metadirecting

59. NO_2 Group at ortho or para position to halogen in benzene makes carbon attached to halogen electron deficient, this facilitates attack of nucleophile on this carbon atom

60. $A-2, B-1, C-4, D-3$ Factual

61.



62. Freon – 12 - CCl_2F_2, Chloral - CCl_3CHO, Chloropierin - CCl_3NO_2, gammaxene - $C_6H_6Cl_6$

63. $-OH$ group can react with C_2H_5MgBr releasing C_2H_6 gas

$-CH=CH_2$ group attached to ring can decolorize Br_2 water

64. Ethanolic KOH causes dehydrahologenation to give cyclohexene

65. In friedel craft's alkylation R^+ is attacking electrophile

a) $C_6^+H_5$ is unstable

b) Cl^+ can attack benzene ring for electrophilic substitution

c) $CH_2=CH-CH_2^+$ is stable

d) $CH_2=CH^+$ is unstable

66. $NaBH_4$ can only reduce

$-\underset{\underset{O}{\|}}{C}-group$ and does not affect ester group

67. i) Reduction of propanal gives 1-propanol

ii)

$$CH_3-CH=CH_2+H_2O\xrightarrow{H^+}CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$$

iii) Reaction of propanone with grignard's reagent followed by hydrolysis gives 3^0 alcohol

68.

$$CH_3-CH_2-CH_2-CH_2-OH \xrightarrow{+H^+} CH_3-CH_2-CH_2-CH_2-\overset{+}{O}H_2 \xrightarrow{-H_2O} CH_3-CH_2-CH_2-\overset{+}{C}H_2$$

1^0 carbocation (less stable)

$\downarrow$ 1,2 hydride shift

$$CH_3-CH=CH-CH_3 \xleftarrow{-H^+} CH_3-CH_2-\overset{+}{C}H-CH_3$$

2-Butene (major product) 2^0 carbocation (more stable)

69. Given product is 3^0 alcohol which can be formed by reaction of ketone with C_6H_5MgBr followed by hydrolysis

70.

$$CH_3-CH=CH_2 \xrightarrow[H^+]{H_2O} \underset{(A)}{CH_3-\underset{OH}{\underset{|}{CH}}-CH_3} \xrightarrow[\text{dil.KOH}]{\text{KIO}} \underset{(B)}{CHI_3} + \underset{(C)}{CH_3COOK}$$

71. 3^0 alkyl halide (2) - 1,6
allylic halides (2) - 3,5
X = 2, y = 2

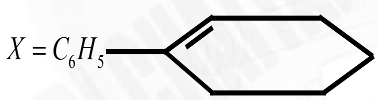
72. Cl attached to SP^3 c-atom only can give AgCl

73. Only 2-butanol is chiral in nature

$$CH_3-CH_2-\underset{OH}{\underset{|}{CH}}-CH_3$$

74. a,c,d only. $KMnO_4/H^+$ will give carboxylic acid

75.



$a=8$
$b=24$

$(24-8)^2=256$