Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

Sec: Sr.Super60_STERLING BT | JEE-ADV-2024_P1 | Date: 06-07-2025

Time: 09.00Am to 12.00Pm | QAT-12 | Max. Marks: 180

KEY SHEET

MATHEMATICS

1	**A**	2	**B**	3	**B**	4	**B**	5	**ABC**	6	**ABCD**
7	**BD**	8	**1405**	9	**1**	10	**4**	11	**8**	12	**3748**
13	**2**	14	**B**	15	**C**	16	**A**	17	**D**		

PHYSICS

18	**C**	19	**C**	20	**A**	21	**B**	22	**AD**	23	**ABCD**
24	**ABC**	25	**9**	26	**7**	27	**39**	28	**6**	29	**9**
30	**4**	31	**B**	32	**C**	33	**A**	34	**D**		

CHEMISTRY

35	**A**	36	**A**	37	**A**	38	**C**	39	**ACD**	40	**BCD**
41	**AC**	42	**8**	43	**9**	44	**36**	45	**7**	46	**3**
47	**4**	48	**C**	49	**B**	50	**B**	51	**A**		

SOLUTIONS
MATHEMATICS

1. 9 is selected at least once $\therefore 9^7 - 8^7$

2. ${}^4C_1{}^{100}C_1.9^{99} + {}^4C_1{}^{100}C_3 9^{97} + {}^4C_1{}^{100}C_5 9^{95} + ----- + {}^4C_1{}^{100}C_{99} 9 = 2\left[10^{100} - 8^{100}\right]$

3. $1^{\infty}\ e^{\underset{x\to 0}{Lt}\frac{\sin\frac{x}{2}}{x}+\frac{\sin\left(\frac{x}{22}\right)}{x}+-----} = e^{\frac{1}{2}+\frac{1}{22}+----+\frac{1}{2^n}}$

4. $\left(17^2\right)^{128} = (1-290)^{128}$

   $= 1000k + 681$

5. For maximum point, we will kept all the 30 red coloured points alternately and fill-up with blue and green colour in the vacant place. $R_{ew} = 20\times 20\times 2 + 2\times 10\times 1 = 100$

6. A) $I = \int_1^2 \frac{1}{x^2-2x+2} + \int_2^3 \frac{1}{x^2-4x+5} = \frac{\pi}{2}$

   B) $e^y - 1 = t^2 \qquad e^x = 4$

   C) $\int_{-n}^{n} (-1)^{[x]} = 0$ $f(x)$ is odd function

   D) $\int_0^1 f(x)dx + \int_1^2 f(x)dx + ----- + \int_{99}^{100} f(x)dx = e$

7. $.\overline{a}, .\overline{c}$ on both sides

8. Case-1 : Number is made up with 3 digits occurring twice $= {}^5C_3.6!/\ 2!2! = 900$

   Case-2: Number is made up with 2 digits occurring twice $= {}^5C_2.\frac{6!}{3!3!} = 200$

   Case-3 : Number is made up with 2 digits one digit occur 4 times ${}^5C_2.\frac{6!}{4!2!} = 300$

   Case-4 : All three digits same = 5

   $\therefore R_{ew} = 900 + 200 + 300 + 5 = 1405$

9. Let A_t, $t = 1,2,---6$ be the set of days on which the friend is present at dinner and B_t be the set of days on which the friend is absent at dinner.

   $\left|A_1 \cup A_2 \cup ---------UA_6\right| = {}^6C_1\times 7 - {}^6C_2\times 5 + {}^6C_3\times 4 - {}^6C_4\times 3 + {}^6C_5\times 2 - {}^6C_6\times 1 = 13$

10. Number of ordered pairs $(m,n) = 20\times 5 = 100$ pairs

11. $2^2.\sqrt{4}=8$

12. $n(X\cup Y)=n(x)+n(y)-n(x\cap y)=2018+2018-288$

13. $\sqrt{3}a\cos\alpha+2b\sin\alpha=c,\ \sqrt{3}a\cos\left(\frac{\pi}{3}-\alpha\right)+2b\sin\left(\pi/3-\alpha\right)=c$ by campare

14. A) $57\times11=627$

B) $4\times5\times4=80$

C) $4\times4\times2=32$

D) $1\times6\times15=22$

15. A) $11\times9\times8-1=879$

B) $8\times5\times4\times2\times2\times2-2=1278$

C) Number of digit number $=9\times98\times7=4536$

$4536+648+81+9=5274$

16. P) Since A is idempotent, $A^2=A^3=A^4=-----A$. Now,

$(A+I)^n=I+(2^n-1)A\Rightarrow 2^2-1=127\Rightarrow n=7$

Q) Here A is a skew symmetric and since $|A|=|A^T|=(-1)^n|A|$. So $|A|=\left(1-(-1)^n\right)=0$ as n odd, $|A|=0$

R) $|A|=2\Rightarrow|2A^{-1}|=\frac{2^3}{|A|}=4$

S) $\left|Adj\left(Adj(2A)\right)\right|=|2A|^4=1$

17. A) $y+xt=2at+at3\uparrow(-6)\Rightarrow t=-1(2,-4)$

B) $t=\frac{1}{3}\quad x+3y-27=0$

C) $s_1^2=s_{11}^5,\ t\,and=\frac{2\sqrt{h^2-ab}}{a+b}=615$

D) P.I of $x^2+y^2=0,\ x+y=0$ i.e (0, 0)

PHYSICS

18. $k=\frac{2\pi}{k}=\frac{2\pi}{40}=\frac{\pi}{20}\text{rad cm}^{-1}, T=\frac{1}{f}=\frac{1}{8}\text{s}$

$\omega = 2\pi f = 2\pi(8) = 16\pi \text{ rads}^{-1}$

$v = f\lambda = 8\times 40 = 320\text{cms}^{-1}$

$At\ x = 0 \text{ and } t=0, y=15\text{cm}$

$y = A\sin(\omega t - kx + \delta)$

$\Rightarrow \quad 15 = 15\sin(0-0+\delta)$

$\sin\delta = 1 \Rightarrow \delta = \frac{\pi}{2}$

We equation is $y = 15\sin\left[16\pi t - \frac{\pi}{20}x + \frac{\pi}{2}\right]$

19. $B_1 = \frac{\mu_0 i}{4\pi R}(-\hat{k})$

$B_2 = \frac{3\mu_0 i_1}{8R}(-\hat{i}) = \frac{3\mu_0}{8R}\left(\frac{i}{4}\right)(-i)$

$B_3 = \frac{\mu_0 i_2}{8R}(\hat{i}) = \frac{\mu_0}{8R}\left(\frac{3i}{4}\right)(\hat{i})$

$B_4 = \frac{\mu_0 i}{4\pi R}(-\hat{i})$

$\overline{B} = \overline{B_1} + \overline{B}_2 + \overline{B}_3 + \overline{B}_4 \Rightarrow |\overline{B}| = \frac{\mu_0 i\sqrt{2}}{4\pi R}$

$i = i_1 + i_2$

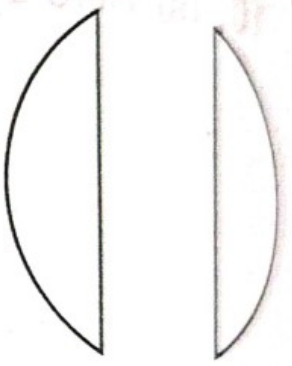
$i_1\left(\frac{3R}{4}\right) = i_2\left(\frac{R}{4}\right)$

20. Here, $\frac{1}{f_1} = (1.5-1)\left(\frac{1}{20}-\frac{1}{\infty}\right) = \frac{1}{40}$

And $\frac{1}{f_2} = (2-1)\left(\frac{1}{\infty}-\frac{1}{-20}\right) = \frac{1}{20}$

$\therefore \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

Or $\frac{1}{f} = \frac{1}{40} + \frac{1}{20} = \frac{1+2}{40} = \frac{3}{40}$



$\because \quad \frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

Or $\frac{1}{v}+\frac{1}{30}=\frac{3}{40}$

Or $\frac{1}{v}=\frac{3}{40}-\frac{1}{30}=\frac{9-4}{120}=\frac{5}{120}$

$\therefore \quad v=\frac{120}{5}=24\text{cm}$

21. for B, u=-30cm, f=+20cm

Lens formula

$\therefore \frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

$\therefore \ v=60\text{cm}$

For A,u' =-35cm, f'=20cm

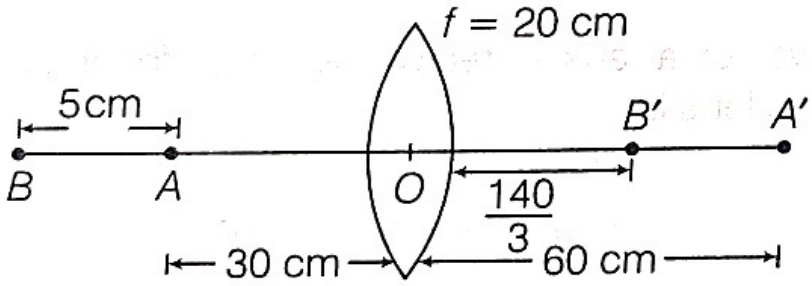
Lens $\frac{1}{v'}-\frac{1}{u'}=\frac{1}{f'}$

Or $\frac{1}{v'}+\frac{1}{35}=\frac{1}{20}$

Or $\frac{1}{v'}=\frac{1}{20}-\frac{1}{35}=\frac{7-4}{140}=\frac{3}{140}$

$\therefore \quad v'=\frac{140}{3}$

$\therefore \quad A'B'=(v-v')>5$



22. **First possibility**, if image due to first refraction through lens is at the pole of mirror, then image concides with object for this

$v=+20, f=+10cm$

U=-x

$\because \quad \frac{1}{v}-\frac{1}{u}=\frac{1}{f} \ or \ \frac{1}{20}-\frac{1}{u}=\frac{1}{10}$

Or $\frac{1}{u}=\frac{1}{20}-\frac{1}{10}=\frac{1-2}{20}$

$\therefore$ u = -20 cm

Or $-x=-20$

$\therefore$ x = 20cm

Second possibility, if image due to first refraction through lens is at the centre of curvature of mirror , then image coincides with object.

For this, $v=-10cm, f=+10cm, u=-x$

$\because \frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ *or* $\frac{1}{-10}+\frac{1}{x}=\frac{1}{10}$

Or $\frac{1}{x}=\frac{2}{10}=\frac{1}{5}$

$\therefore$ x=5cm

23. lane displant method

$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

$\frac{1}{(D-u)}-\frac{1}{-u}=\frac{1}{f}$

$\frac{1}{D-u}+\frac{1}{u}=\frac{1}{f}$

$\frac{u+D-u}{(D-u)u}=\frac{1}{f}$

$Du-u^2=Dt$

$u^2-Du+tD=0$

$u=\frac{D\pm\sqrt{D^2-4tD}}{2\times1}$

$\therefore u_1=\frac{D-\sqrt{D(D-4f)}}{2}; v_1=D-u_1=\frac{D+\sqrt{D(D+4f)}}{2}$

$u_2=\frac{D+\sqrt{D(D-uf)}}{2}; v_2=D-u_2=\frac{D-\sqrt{D(D+uf)}}{2}$

$u=u_1-u_2=d\left[\frac{D+\sqrt{D(D-uf)}}{2}\right]-\left[\frac{D-\sqrt{D(D-4f)}}{2}\right]$

$d=u_1-u_2=\sqrt{D(D-uf)}$

$d^2=D^2-4fD \Rightarrow f=\frac{D^2-d^2}{4D}$

$m_1=\frac{v_1}{u_1}$ and $m_2=\frac{v_2}{u_2}$

24. Acc to eqn of contsnty

$a_1u_1=a_1u_2$

$s_1u=s_2u\cos\theta$

$\cos\theta=\frac{s_1}{s_2}$

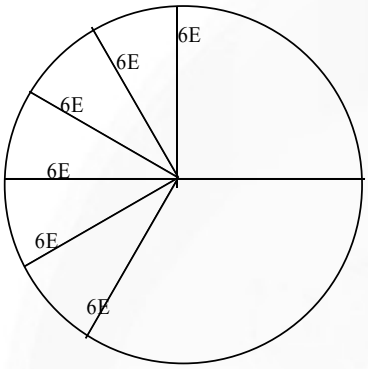
$\theta=\cos^{-1}\left(\frac{s_1}{s_2}\right)$

$$R=\frac{u^2 2\sin\theta\cos\theta}{g}$$

$$=\frac{2u^2}{g}\frac{s_1}{s_2}\sqrt{1-\left(\frac{s_1}{s_2}\right)^2}$$

$$H=\frac{u^2\sin^2\theta}{2\times g}=\frac{u^2}{2\times g}\left[1-\left(\frac{s_1}{s_2}\right)^2\right]$$

25. Super positson of electric field



By symmetry, Resultant field at 9:30 Hrs

26. $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}$

$$\frac{k_{eff}\ A_{eff}}{l}=\frac{k_1A_1}{l}+\frac{k_1A_2}{l}$$

$$\frac{k_{eff}\,\pi(2R)^2}{l}=\frac{k_1\pi R^2}{l}+\frac{k_2\pi\left[(2R)^2-R^2\right]}{l}$$

$$k_{eff}=\frac{k_1+3k_2}{4}$$

27. $C_1=\frac{k_1\in_0\frac{A}{2}}{\frac{d}{2}}=\frac{2\in_0 A}{d}=2C$

$$C_2=\frac{k_2\in_0\frac{A}{2}}{\frac{d}{2}}=\frac{4\in_0 A}{d}=4c$$

$$C_3=\frac{k_3\in_0 A}{\frac{d}{2}}=\frac{6\in_0 A}{\frac{d}{2}}=12c$$

$$2c+4c=6c$$

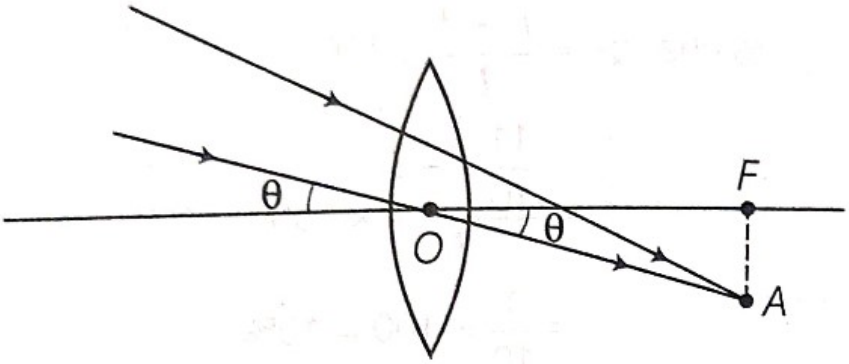
$$c_{eff}=\frac{6c\times12c}{6c+12c}=\frac{6c\times12c}{18c}=9c$$

28. $dF=(dm)x\omega^2$

$$\int dF=\int_x^L\left(\frac{m}{l}\right)dx.x\omega^2$$

$$F=\frac{m\omega^2}{2L}\left(L^2-x^2\right)=\frac{m\omega^2}{2}L\left(1-\frac{x^2}{L^2}\right)$$

29. The beam converges in focal plane of the lens



$\therefore \quad \tan\theta \simeq \theta = \frac{AF}{OF}$

Or $2\times\frac{\pi}{180}=\frac{AF}{20}$

$\therefore AF=\frac{\pi}{90}\times 20=\frac{2\pi}{9}cm$

30. In the focal length of the unsilvered lens is f

$\because \quad \frac{1}{f}=(\mu-1)\left(\frac{1}{r_1}-\frac{1}{r_2}\right)$

Or $\frac{1}{f}=(1.5-1)\left(\frac{1}{40}+\frac{1}{40}\right)$

$=\frac{1}{40}$

$\because$ f=40cm

For image formation due to unsilvered part,

$u=-30cm, f=+40cm$

Or $\frac{1}{v}+\frac{1}{30}=\frac{1}{40}$

Or $\frac{1}{v}=\frac{1}{40}-\frac{1}{30}=\frac{3-4}{120}$

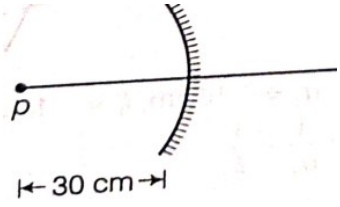
$\because \quad v=-120cm$

Thus, the silvered part behaves mirror.

u'=-30cm,F=-10cm

$\frac{1}{v'}+\frac{1}{u'}=\frac{1}{F}$

Or $\frac{1}{v'}-\frac{1}{30}=\frac{-1}{10}$



Or $\frac{1}{v}=\frac{1}{30}-\frac{1}{10}=\frac{1-3}{30}$

$\therefore$ $v' = -15\text{cm}$

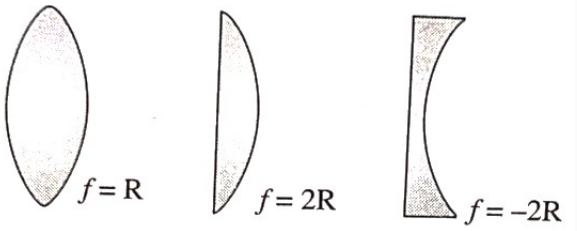
Thus, the distance between images is $|v' - v|$

$= |15 \sim 120| = 105\text{cm}$

$\Rightarrow \dfrac{420}{n}$

$\therefore n = \dfrac{420}{105} = 4$

31. $\dfrac{1}{f} = (\mu - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$



Use $\dfrac{1}{f_{eq}} = \dfrac{1}{f_1} + \dfrac{1}{f_2}$

P) $\dfrac{1}{f_{ed}} = \dfrac{1}{R} + \dfrac{1}{R} = \dfrac{2}{R}; f_{eq} = \dfrac{R}{2}$

q) $\dfrac{1}{f_{ed}} = \dfrac{1}{2R} + \dfrac{1}{2R} = \dfrac{1}{R}; f_{eq} = R$

r) $\dfrac{1}{f_{ed}} = -\dfrac{1}{2R} - \dfrac{1}{2R} = -\dfrac{2}{2R}; f_{eq} = -R$

s) $\dfrac{1}{f_{ed}} = \dfrac{1}{R} - \dfrac{1}{2R} = \dfrac{1}{2R}; f_{eq} = 2R$

32. $P = 2P_L + P_m$

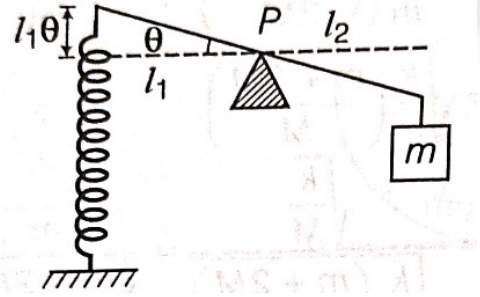
$A)\ P = 2(\mu - 1)\dfrac{2}{R} + \dfrac{2}{R} = \dfrac{4}{R}$

$B) P = -2(\mu - 1)\dfrac{1}{R} + \dfrac{(-2)}{R} = \dfrac{-1}{R} + \dfrac{-2}{R} = \dfrac{-3}{R}$

$C) P = 2(\mu - 1)\left(\dfrac{1}{-R} - \dfrac{1}{R}\right) + \dfrac{2}{R} = 1.\left(\dfrac{-1}{R} + \dfrac{1}{R}\right) + \dfrac{2}{R} = \dfrac{2}{R}$

$D) P = 2(\mu - 1)\dfrac{1}{R} + 0 = \dfrac{1}{R}$

33. For small θ, restoring torque is



$\tau = -(kl_1\theta)l_1 = -kl_1^2\theta$

$\alpha = \frac{\tau}{l} = \frac{-kl_1^2\theta}{ml_2^2}$

On comparing with $\alpha = -\omega^2\theta$

$\omega = \sqrt{\frac{kl_1^2}{ml_2^2}}$

$T = \frac{2\pi}{\omega} = 2\pi\frac{l_2}{l_1}\sqrt{\frac{m}{k}}$

Energy of oscillation is

$$E = \frac{1}{2}KA^2$$

$$= \frac{1}{2}k(l_1\theta)^2$$

Hence ,(a)-(q),(b)-(r),(c)-(p),(d)-(s)

34. d) :m =20g,l=25,cm=$\frac{1}{4}$m

R= 10Ω,B_0=4T

In equilibrium

By using Newton's second law

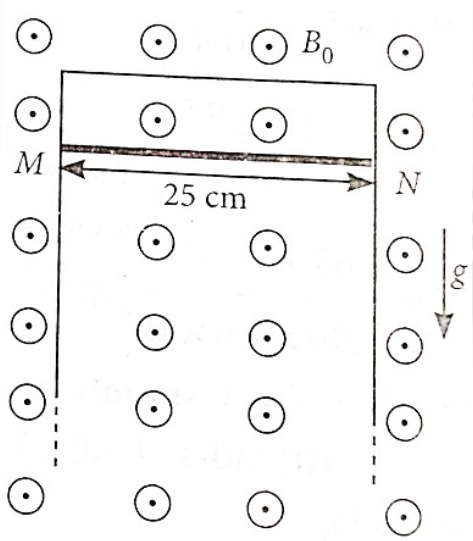
Mg-Bil=ma

As, $i = \frac{\varepsilon}{R} = \frac{Blv}{R}$

$mg - \frac{B^2l^2v}{R} = \frac{mv}{dt}$

$\frac{mgR}{B^2l^2} - v = \frac{mR}{B^2l^2}\cdot\frac{dv}{dt}$

$\int_0^v \frac{dv}{\left(\frac{mgR}{B^2l^2} - v\right)} = \int_0^t \frac{B^2l^2}{mR}dt$



$$\frac{mgR}{B^2l^2}=\frac{20\times10^{-3}\times10\times10}{16\times\frac{1}{16}}=2$$

$$\frac{B^2l^2}{mR}=\frac{16\times\frac{1}{16}}{20\times10^{-3}\times10}=\frac{1}{0.2}=5$$

$$\int_0^v\frac{dv}{(2-v)}=\int_0^t 5dt \text{ So, } 5t=\left[-\ln(2-v)\right]_0^v$$

$$-5t=\ln(2-v)-\ln(2)$$

$$-5t=\ln\left(\frac{2-v}{2}\right);\frac{2-v}{2}=e^{-5t}$$

$$2-v=2e^{-5t}$$

$$v=2\left(1-e^{-5t}\right)$$

$$For\ P\ At\ t=0.2\sec, v=2\left(1-e^{-5\times0.2}\right)$$

$$v=2\left(1-e^{-1}\right)=2(1-0.4)=1.5m/s$$

$$\varepsilon=Bvl=4\times1.2\times\frac{1}{4}=1.2V$$

For Q: At t =0.2s

$$F=Bli\sin\theta=B\times\frac{Blv}{R}l\sin90^0\left(As,i=\frac{\varepsilon}{R}=\frac{Blv}{R}\right)$$

$$F=\frac{4\times4\times\frac{1}{4}\times1.2\times\frac{1}{4}\times1}{10}=0.12N$$

For R:At t=0.2s

$$p=i^2R=\frac{V^2}{R}=\frac{1.2^2}{10}=0.144N$$

For S: At terminal velocity ,net force is zero

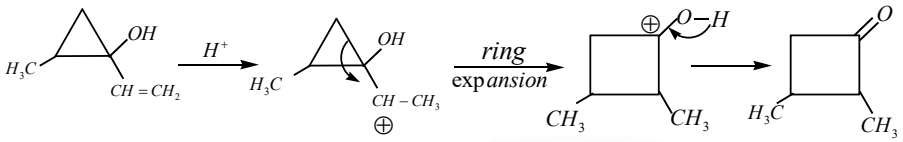
So,mg=Bil= $B\times\frac{Blv_T}{R}.l$

$$v_T=\frac{mgR}{B^2l^2}=\frac{20\times10^{-3}\times10\times10}{16\times\frac{1}{16}}$$

v_T=2m/s

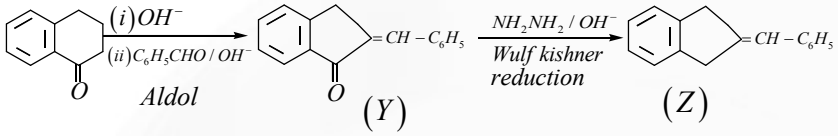
CHEMISTRY

35.



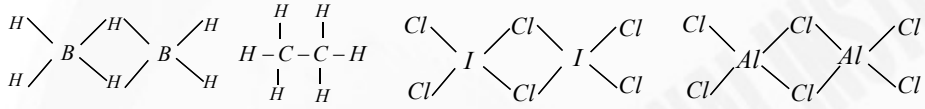
36. Beckmann rearrangement

37.



38. In permanganate in π-bonds are formed by $d^{\pi}-p^{\pi}$ overlapping

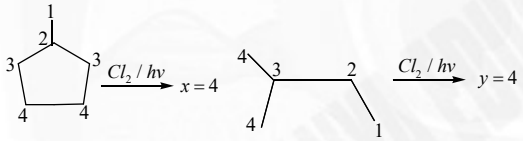
39.



40. Beckmann rearrangement

41. intramolecular aldol condensation

42.

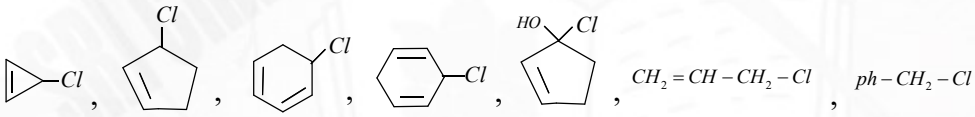


$$x+y=4+4=8$$

43. Cross aldol condensation

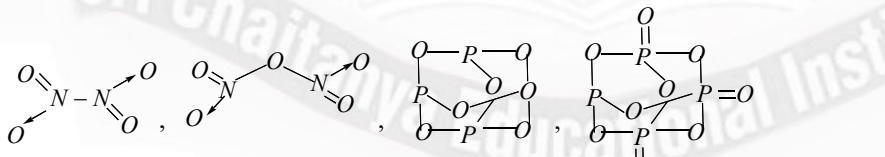
44. Atomic number $-36-1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$

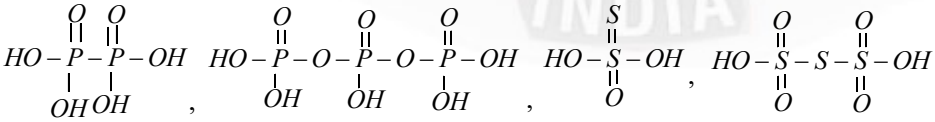
45.



46. Aldehyde are more reactive than ketone and reactivity increases with electron withdrawing groups

47.





48. $P \to 3; Q \to 2; R \to 1; S \to 4$

49. $P \to 2; Q \to 1; R \to 4; S \to 3$

50. $A \to P,T; B \to R; C \to R,T; D \to P,Q,R$

51. CONECPETUL