JEE Main - 2024 Solution

Physics . 30/01/24 . shift-2

Ans-31

$$(C_P)_{mix} = \frac{n_1 C_{P_1} + n_2 C_{P_2}}{n_1 + n_2}$$

$$= \frac{3 \times 5 + 2 \times 7}{3+2} = \frac{29}{5}$$

$$(C_V)_{mix} = \frac{n_1 C_{V_1} + n_2 C_{V_2}}{n_1 + n_2}$$

$$= \frac{3 \times 3 + 2 \times 5}{5} = \frac{19}{5}$$

$$\gamma = \frac{29}{19} = 1.52$$

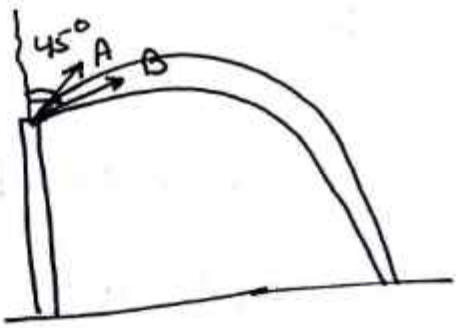
$\gamma = 1.52$

option (3) is correct

Ans-32

For A motion in Vertical direction

$$-400 = V_A \sin 45\, t - \frac{1}{2} g t^2$$



For B

$$-400 = V_B \sin 30\, t - \frac{1}{2} g t^2$$

[time of flight (t) same for both]

comparing

$$V_A \sin 45 = V_B \sin 30$$

$$\frac{V_A}{V_B} = \frac{1}{\sqrt{2}}$$

option (4) is correct

Ans-33

Unpolarised light passed through polaroid A then intensity after exit $= \frac{I_0}{2}$

It further passes to B which is at 45°, then intensity becomes $= \frac{I_0}{2}\cos^2 45 = \frac{I_0}{2} \times \frac{1}{2}$

Ans $= \frac{I_0}{4}$

option (1) is correct

Ans-34

$V(t) = 220 \sin 100\pi t$

$I(t) = \frac{220}{50} \sin 100\pi t$

$I(t) =$ Half of Peak value

$\sin 100\pi t = \frac{1}{2}$

$100\pi t = \frac{\pi}{6}$

$t_1 = \frac{1}{600}$ sec

$I(t) =$ Peak value

$\sin 100\pi t = 1$

$t_2 = \frac{1}{200}$ sec

Time taken to reach from half value to peak value

$= \frac{1}{200} - \frac{1}{600}$

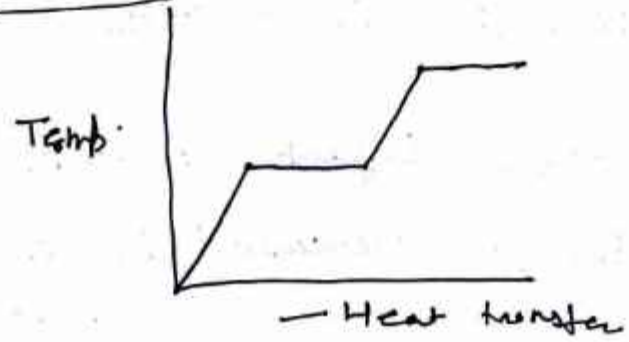
$= \frac{1}{300}$ sec

Ans = 3.33 ms

option (4) is correct

Ans-35 When block of Ice heated from $-10^{\circ}C$, first temp. rises on Heat transfer till $0^{\circ}C$ Ice. After this temp. not increases till Ice melts completely and absorbing heat at constant temp. on further heating temp. rises to $100^{\circ}C$ water and after that again remains constant till all water converts to steam.

Option (4) is correct



Ans-36 $m = K c^{p} G^{-\frac{1}{2}} h^{\frac{1}{2}}$

$G = [M^{-1} L^{3} T^{-2}]$ $\quad h = [M L^{2} T^{-1}]$

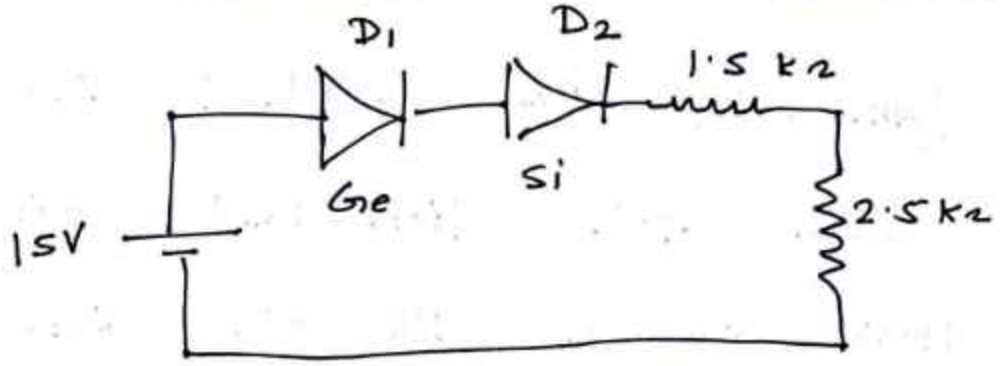
$c = [L T^{-1}]$

$[M] = [L T^{-1}]^{p} [M^{-1} L^{3} T^{-2}]^{-\frac{1}{2}} [M L^{2} T^{-1}]^{\frac{1}{2}}$

$p - \frac{3}{2} + \frac{2}{2} = 0$ $\quad \boxed{p = \frac{1}{2}}$

Option (1) is correct

Ans - 37



Now barrier potential for Ge = 0·3V

for Si = 0·7V

Potential net to resistance

$= 15 - (0.3 + 0.7)$

$= 14V$

Voltage drop across 2·5 kΩ

$= 2.5 \times \frac{14}{4} = 8.75V$

Option (3) is correct

Ans - 38

Mass defect. $= \Delta M$

Energy released in fission

$= \Delta M c^2$

energy of daughter nuclei $= \frac{1}{2}\left(\frac{M}{3}\right) v^2$

By energy conservation.

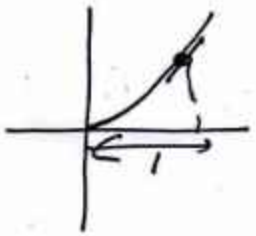
$\Delta M c^2 = 3 \times \frac{1}{2}\left(\frac{M}{3}\right) v^2$

$v^2 = \frac{2\Delta M c^2}{M}$, $v = c\sqrt{\frac{2\Delta M}{M}}$

Option (1) is correct

Ans- 39 In case of just slipping angle of friction is equal to angle of surface

$y = \frac{x^2}{4}$



Slope $y = \frac{x^2}{4}$

$$\frac{dy}{dx} = \frac{2x}{4} = \frac{x}{2}$$

In just slipping condition

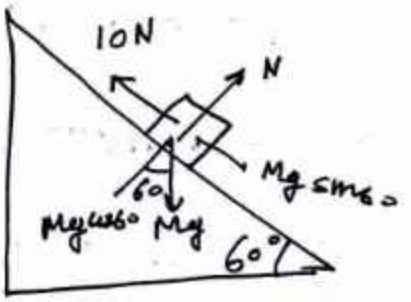
$\frac{x}{2} = 0.5$ $\quad x = 1$

$$y = \frac{x^2}{4} = \frac{1}{4}$$

$h = \frac{1}{4}$

option (2) is correct

Ans-40



Friction force

$= \mu N = \mu mg \cos 60$

Work done by friction in moving 10m along the incline

$= \mu Mg \cos 60 \times 10 = 0.1 \times 1 \times 10 \times \frac{1}{2} \times 10 = 5$

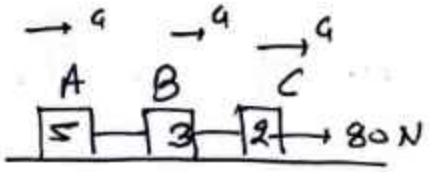
Work = 5J

option (1) is correct

Ans-41

$$a = \frac{80}{10} = 8 \text{ m/sec}^2$$

$$T_1 = 5 \times 8 = 40 \text{ N}$$



$$T_2 - T_1 = 3 \times 8$$

$$T_2 = 24 + 40 = 64 \text{ N}$$

$$\boxed{T_1 = 40 \text{ N}, \; T_2 = 64 \text{ N}}$$

$$\boxed{\text{option (3) is Correct}}$$

Ans-42

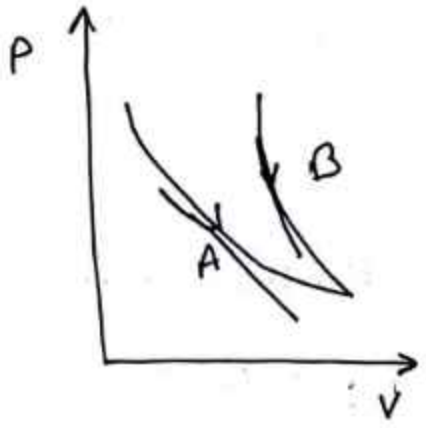
$$PV^n = C$$

~~$\log P + n \log V = \log C$~~

$$V^n dP + P n V^{n-1} dV = 0$$

$$\frac{dP}{dV} = - \frac{P n V^{n-1}}{V^n}$$

$$\frac{dP}{dV} = - n \frac{P}{V}$$



For adiabatic $n = \gamma$

For isothermal $n = 1$

Clearly slope of B is more than A

A is isothermal $PV = K$

B is adiabatic $PV^\gamma = K$

$$\boxed{\text{option (1) is correct}}$$

Ans - 43

Gauss's law of magnetostatics

A — II $\oint \vec{B} \cdot \vec{da} = 0$

Faraday's law of electromagnetic Induction

B

$$\mathcal{E} = -\frac{d\phi}{dt}$$

$$\int E \cdot dl = -\frac{d}{dt} \int \vec{B} \cdot d\vec{a} \qquad \text{III}$$

Ampere's law $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$

C — IV

Gauss law of electrostatics

D — $\oint B \cdot d\vec{a} = \frac{Q}{\varepsilon_0} = \frac{\int \rho dV}{\varepsilon_0}$

I

Option (3) is correct

Ans - 44

$$V_e = \sqrt{\frac{2GM_e}{R_0}}$$

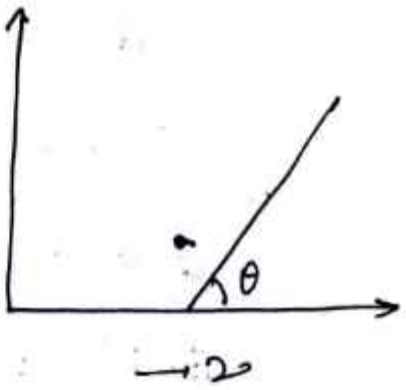
Now $M' = \frac{M_e}{8}$; $R' = \frac{R_e}{3}$

$$V_e' = \sqrt{\frac{2G\frac{M}{8}}{\frac{R_e}{3}}}^2 = \sqrt{\frac{2GM_e}{2R_e}} = \frac{11.2}{\sqrt{2}}$$

$V_e' = 7.9$ km/sec

Option (3) is correct

Ans-45



Graph between Maximum kinetic energy E_K & stopping potential and frequency is shown it's slope gives the value of Plank's Constant h.

Option (4) is Correct

Ans-46

First case $W = \frac{V^2}{R}$

In second case $W' = \frac{V^2}{R'}$

$$R' = \frac{\frac{R}{2} \times \frac{R}{2}}{\frac{R}{2} + \frac{R}{2}} = \frac{R}{4}$$

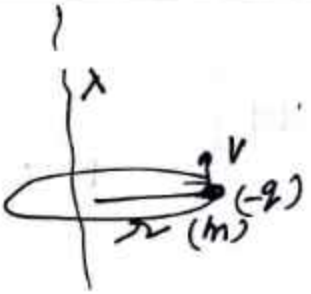
$$W' = \frac{V^2}{\frac{R}{4}} = 4\frac{V^2}{R} = 4W$$

$$W' = 4W$$

Option (4) is Correct

Ans-47

$$\frac{mv^2}{r} = \frac{\lambda q}{2\pi\varepsilon_0 r}$$



$$V = \sqrt{\frac{\lambda q}{2\pi\varepsilon_0 m}}$$

$$K = \frac{1}{4\pi\varepsilon_0}$$

$$V = \sqrt{\frac{2K\lambda q}{m}}$$

$$\frac{1}{2\pi\varepsilon_0} = 2K$$

$$T = \frac{2\pi r}{V}, \quad \boxed{T = 2\pi r\sqrt{\frac{m}{2K\lambda q}}}$$

optim (3) is correct

Ans-48

Magnetic moment $= IA$

For n_{th} orbit $mvr = \frac{nh}{2\pi}$

$$I = e^- f = \frac{e^-}{T}$$

$$T = \frac{2\pi r}{v} \qquad r \propto n^2$$

$$v \propto \frac{1}{n}$$

$$T \propto n^3$$

$$A = \pi r^2 = \pi (r)^2 \qquad A \propto n^4$$

$$\mu_n = \frac{(n^4)}{(n^3)} = n^1$$

optim (1) is Correct

Ans- 49

$$P = \frac{E}{C}$$

$$P = \frac{6.48 \times 10^5}{3 \times 10^8}$$

$$P = 2.16 \times 10^{-3} \text{ kg-m/sec}$$

Option (4) is Correct

Ans- 50

50 VSD = 49 MSD

1 MSD = $\frac{50}{49}$ VSD

1 VSD = $\frac{49}{50}$ MSD

Least Count = 1 MSD - 1 VSD

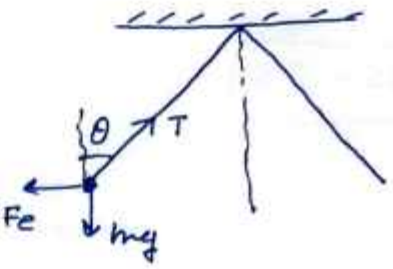
$= \left(1 - \frac{49}{50}\right)$ MSD

$= \frac{1}{50} \times 0.5$ mm

Ans = 0.01 mm

Option (2) is Correct

Ans-51



$T\cos\theta = mg$

$T\sin\theta = Fe$

$$\tan\theta = \frac{Fe}{mg}$$

$$= \frac{Fe}{\rho_B V g} \quad - (1)$$

$$Fe' = \frac{Fe}{K}$$

$(\rho_B - \rho_L) V g$ ← due to buoyancy

In second case

$$\tan\theta = \frac{Fe}{K(\rho_B - \rho_L) V g} \quad - (2)$$

From (1) and (2)

$$\rho_B V g = K(\rho_B - \rho_L) V g$$

$$1.4 = 0.7K$$

$$\boxed{K = 2}$$

Ans-52

$\vec{A} = 3\hat{i} + 4\hat{j}$ $\quad |\vec{A}| = \sqrt{(3)^2 + (4)^2} = 5$

$\vec{B} = 4\hat{i} + 3\hat{j}$

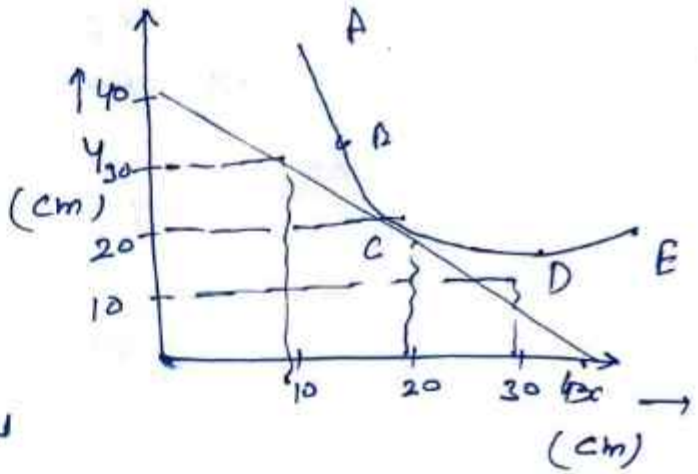
$$\hat{B} = \frac{\vec{B}}{|\vec{B}|} = \frac{4\hat{i} + 3\hat{j}}{5}$$

Vector of magnitude ($\vec{A}$) parallel to $\vec{B}$

$$= |\vec{A}|\,\hat{B} = 5\left(\frac{4\hat{i} + 3\hat{j}}{5}\right)$$

x - component = 4

Ans - 53



We know from experiment u and v and same for centre of curvature

~~$2f = 20$~~

~~$f = 10$ cm~~

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

$$\frac{1}{f} = \frac{1}{f+20} - \frac{1}{-(f+20)}$$

on solving $\boxed{f = 20 \text{ cm}}$

Ans - 54

$$\frac{4}{3}\pi R^3 = 1000 \times \frac{4}{3}\pi r^3$$

$$R = 10r$$

$$E_1 = 1000 \times \pi r^2 \times S$$

$$E_2 = 1 \times \pi (10R)^2 \times S$$

$$\frac{E_1}{E_2} = \frac{10}{1}$$

$$\boxed{x = 10}$$

Ans-55 $I_{r^2} \propto \frac{K}{r^2}$

$$I_2 = \frac{I_0}{2^2}$$

$$I_4 = \frac{I_0}{4^2}$$

$$\text{difference} = \frac{I_0}{4} - \frac{I_0}{16} = \frac{3I_0}{16}$$

$$\text{Intensity difference} = \frac{3 \times 16 \times 10^{-8}}{16}$$

$$= 3 \times 10^{-8} \ \text{w/m}^2$$

Ans = 3

Ans-56

$$I_1\omega_1 + I_2\omega_2 = (I_1 + I_2)\omega$$

$$4 \times 10 + 2 \times 4 = (4+2)\omega$$

$$\omega = 8 \ \text{rad/sec}$$

$$\text{Initial Energy} = \frac{1}{2} I_1\omega_1^2 + \frac{1}{2} I_2\omega_2^2$$

$$= \frac{1}{2} \times 4 \times (10)^2 + \frac{1}{2} \times 2 \times (4)^2$$

$$= 216 \ \text{J}$$

$$\text{Final energy} = \frac{1}{2}(I_1 + I_2)\omega^2$$

$$= \frac{1}{2} \times 6 \times (8)^2$$

$$= 192 \ \text{J}$$

$$\text{Energy difference} = 216 - 192 = 24 \ \text{J}$$

Ans = 24 J

Ans - 57

$$\eta = \frac{\text{output power}}{\text{Input Power}}$$

$$0.9 = \frac{230 \times I}{2.3 \times 10^{3} \times 5}$$

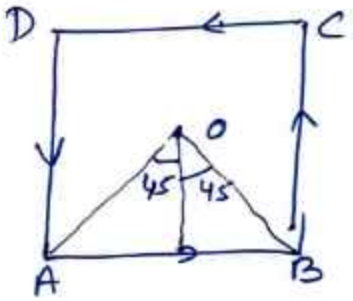
$$\boxed{I = 45\ A}$$

Ans - 58

$$B_1 = \frac{\mu_0 I}{4\pi\left(\frac{d}{2}\right)}(\sin 45 + \sin 45)$$

$$= \frac{\mu_0 I 2}{4\pi d}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right)$$

$$= \frac{2\sqrt{2}\,\mu_0 I}{4\pi d}$$



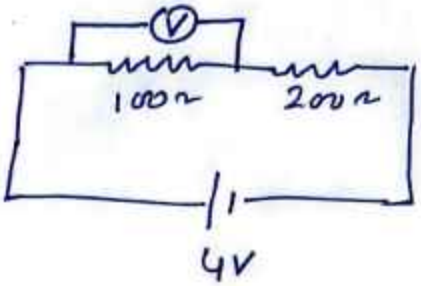
$$\text{Total} = 4 \times B_1 = \frac{8\sqrt{2}\,\mu_0 I}{4\pi d}$$

$$= \frac{8\sqrt{2} \times 10^{-7} \times 5}{1}$$

$$= 40\sqrt{2} \times 10^{-7}$$

$$\boxed{\text{Ans} = 40}$$

Ans - 59



Voltage across

$200 = 3V$

$i = \frac{3}{200}$

current in $100\Omega = \frac{1}{100}$

current in Voltameter $= \frac{3}{200} - \frac{1}{100} = \frac{1}{200} A$

Let Resistance of Voltameter is V_R

$V_R \times \frac{1}{200} = 1 \ V$

$\boxed{V_R = 200\Omega}$

Ans-60

$\frac{g'}{g} = \frac{R^2}{(R+R)^2} = \frac{R^2}{4R^2}$

$g' = \frac{g}{4}$

$T = 2\pi\sqrt{\frac{\ell}{g'}} = 2\pi\sqrt{\frac{4}{\frac{g}{4}}}$

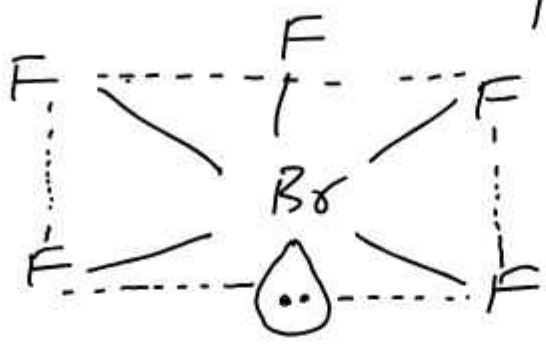
$T = \frac{2\pi}{\pi} \times 4 = 8 \text{ sec}$

$\boxed{\text{Ans} = 8}$

[NTA - JEE SOLUTIONS - 30TH JAN.24 SHIFT-2]

A-1 3-Aminobutanenitrile · correct option is (3).

A 2 Correct option is BrF_5 (4) contains one lone pair and five bond pairs Hybridisation is sp^3d^2 with



Structure and rest are

$\left\{ \begin{matrix} PCl_5 \\ PF_5 \end{matrix} \right\}$ – sp^3d with Tri

$[Ni(CN)_4]^{2-}$

A-3 Option 4 Because both Cr^{6+} & Mn^{7+}, both are complete d-Subshell so they haven't d-d transition but they have charge transfer transition

A-4. Correct option is (1) column chromatography

A 5 Correct option is (2). Octahedral geometry with hybridization d^2sp^3

A-6 Correct option is (3). both statements are false

A-7 Correct option is (2) it is cannizaro Reaction

A-8 Correct option is (2). Statement - I is false & Statement - II is true

A-9. Correct option is (2) tertiary-C^+ > Sec-C^+ > Prim-C^+ > Methyl-C^+

A-10 correct option is (1)

A is formed by catalytic hydration of alkene under Markownikoff's Rule

B is formed by Borohydration oxidation.

square Pyramidal molecule

gonal bipyramidal

square Planar with dsp²

B is formed by Borohydration oxidation.

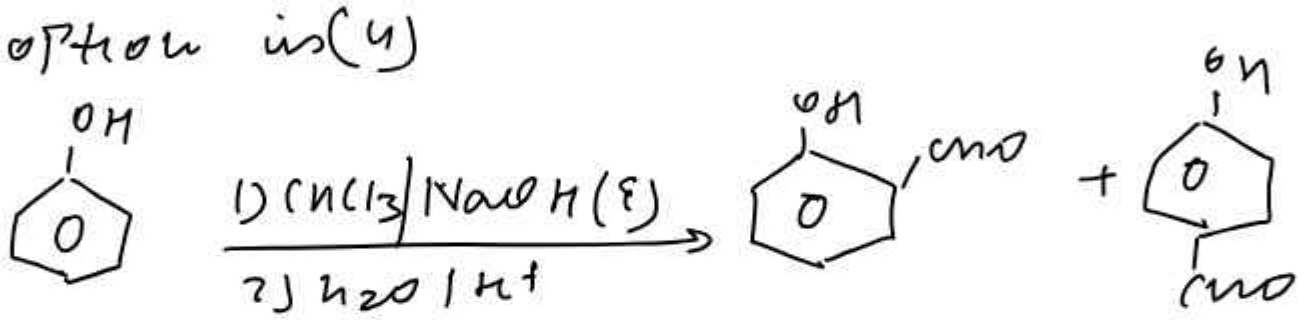
A-11 Correct option is (1) 180 gm acetic acid in water
. it ionises so inc mole of solute & colligative Properties

A-12 Correct option is (1) : oxidising nature $\propto E^{\circ}_{M^{n+}/M}$.

A-13 Correct option is (4) and final answer is MnO_4^{2-} & MnO_4^{-1}.

$$2MnO_2 + 4OH^- + O_2 \longrightarrow 2MnO_4^{2-} + 2H_2O$$
$$MnO_4^{-2} \longrightarrow MnO_4^{-1} + e^{-1}$$

A-14 Correct option is (4)



A-16 Correct option is (A) . $\chi_C = \frac{n_C}{n_A + n_B + n_C}$

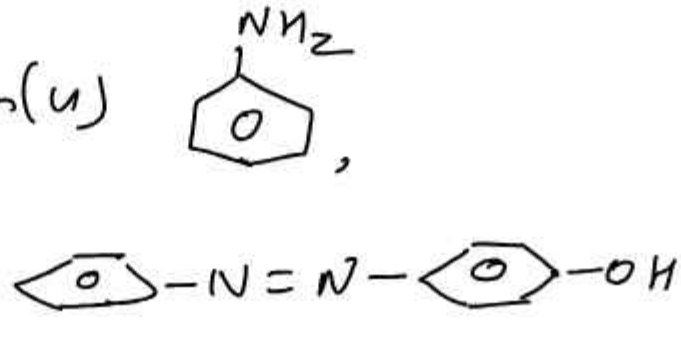
A-15 Both statements are correct because Sconda undergo both S_N1 and S_N2 - Reaction Acc. to S_N2

A-17 Correct option is (1). lower is the bond dissociat is the acidic and Reducing nature & lower is c

A-18 Correct option is (3). Both "A" and "B" are correct. Down the group, stability of hi reducing nature & Acidic nature. both

A-19 Correct option is (2) Na_2CrO_4 & CrO_5

A-20 Correct option is (4)

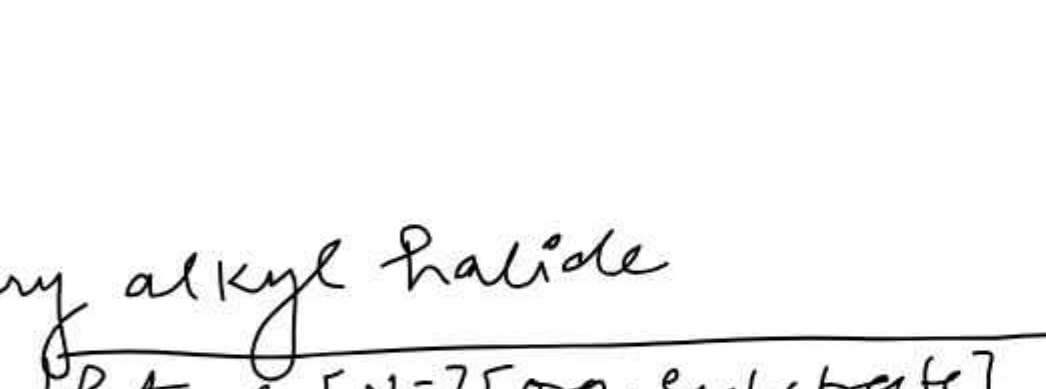


ry alkyl halide

Rate ∝ [Nu⁻][org. substrate]

ion enthalpy, greater
the stability of hydride

ydride decreases, so
are decreased



A-21 The enthalpy change of the reaction is

$$\Delta_r H^\circ = +110 \times 3 + (-822)$$
$$= +330 - 822$$
$$= -492 \text{ KJ/mol}$$

A-22 Total number of Geometrical isomers are 4

A-23 Correct answer is three (3) Statement 1 & 2 are t

A-24 Total no. of optically active isomers are 3.

A-25 Total no. of species carry disproportionation [H_2O_2, Cl
reaction is 6.

A-26 Flame colours are shown by Ca^{2+}, Ba^{2+}, Sr^{2+} and

A-27 Rate of formation of NO_2,

$$+\frac{d[NO_2]}{dt} = 4 \times \left\{-\frac{1}{2}\frac{d[N_2O_5]}{dt}\right\}$$

$$= \frac{4}{2} \times 1 \left\{-\frac{d[N_2O_5]}{dt}\right\}$$

$$= 2\left\{\frac{3.00 - 2.75}{30}\right\}$$

$$= 2 \times 0.25 = 0.50$$
$$\overline{30} \qquad \overline{3000}$$

$$= 1.67 \times 10^{-2}$$
$$= 16.7 \times 10^{-3}$$

on comparing with $= x \times 10^{-3}$

$$x = 16.7.$$

A-28 let the vol. of benzoic acid = V ml
" " benzoate = (300 - V) ml

$$[\text{benzoic acid}] = \frac{1 \times V}{300}$$

pH =

pH =

300 - V

false while others are right.

$^{-1}$
$_3$, P_4, Cl_2 · Cu^{+1}, NO_2 etc]
^{1} Cu^{2+} ions.

$pK_a + \log \frac{[salt]}{[acid]}$

$4.2 + \log \frac{300 - V}{V} = 4.5$

$$[\text{benzoate}] = \frac{1 \times (300 - V)}{300}$$

$$\frac{300}{V}$$

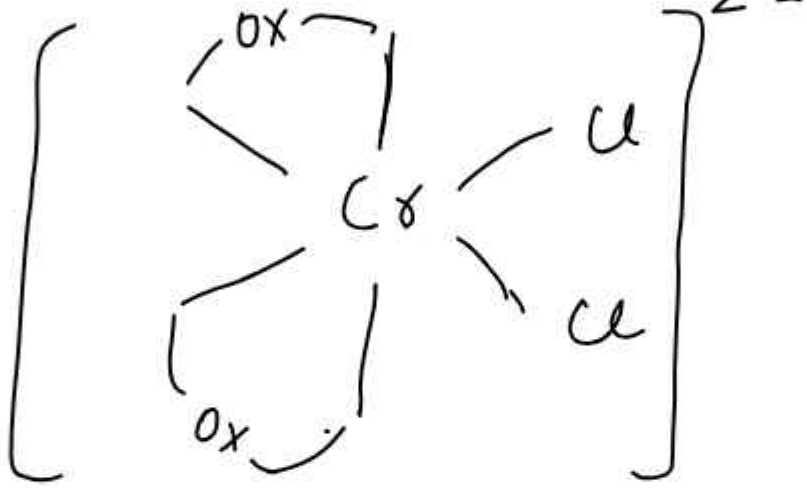
$$300$$

$$3$$

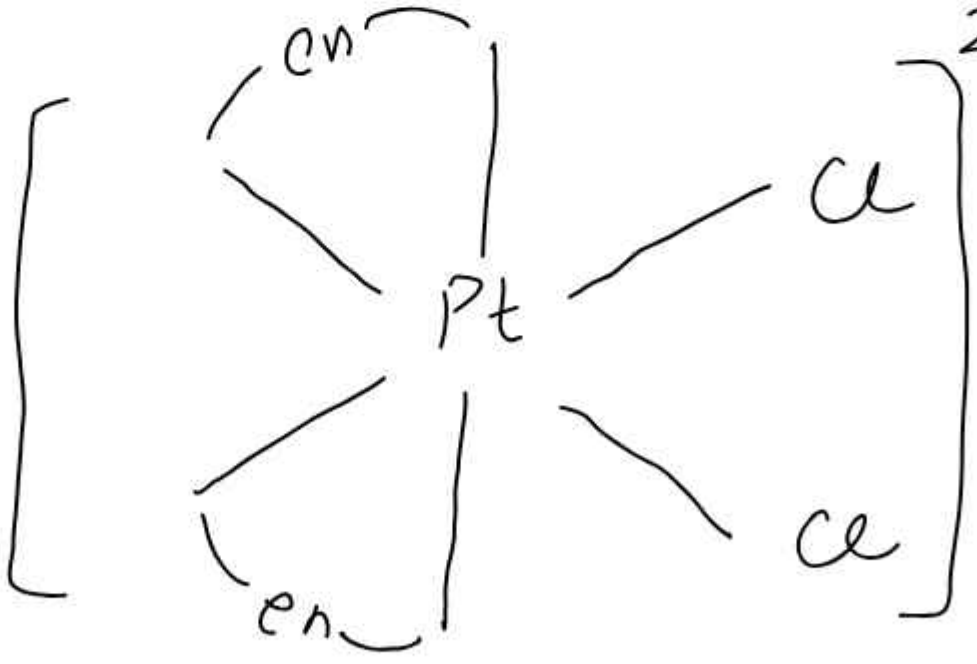
A-29 Total spectral lines are $= \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$

$$= \frac{(5-1)(5-1+1)}{2} = \frac{4 \times 5}{2} = \underline{10}$$

A-30 Total no of complexes that gives optical isomerism is 4.

(a) Cis - 

(b) 

(c) Cis - 

(d) Cis - 

U V

$= \text{Antilog}(0.3U) = 2$

$-V = 2V$

$0 = 3V \Rightarrow \boxed{V = 100\,mL}$