WEEKLY TEST RANKER'S BATCH TEST - 15 RAJPUR SOLUTION Date 05-01-2020

[PHYSICS]

1. **(d)** The energy of the field increases with the magnitude of the field. Lenz's law infers that there is an opposite field created due to increase or decrease of magnetic flux around a conductor so as to hold the law of conservation of energy.

2. **(d)** As the electron is moving from left to right, the flux linked with the loop (which is into the page) will first increase and then decrease as the electron passes by. So the induced current in the loop will be first anticlockwise and will change direction as the electron passes by. A cylindrical bar magnet is kept along the axis of a circular coil. If the magnet is rotated about its axis, then

(a) A current will be induced in a coil

(b) No current will be induced in a coil

(c) Only an e.m.f. will be induced in the coil

(d) An e.m.f. and a current both will be induced in the coil

3. **(c)** As it is seen from the magnet side induced current will be anticlockwise.

4. **(c)** By Lenz's law clockwise current is induced in closed loop. Hence direction of current $a \to b \to d \to c$.

5. **(c)** $e = -N\left(\frac{\Delta B}{\Delta t}\right).A\cos\theta$

$$= -100 \times \frac{(6-1)}{2} \times (40 \times 10^{-4})\cos 0$$

$\Rightarrow |e| = 1\text{V}$

6. **(b)** If the radius is r at a time t, then the instantaneous magnetic flux f is given by:

$\phi = \pi r^2 B$

Now, induced e.m.f. e is given by

$$e = \frac{d\phi}{dt} = -\frac{d}{dt}(\pi r^2 B) = \pi B\left(2r\frac{dr}{dt}\right) = 2\pi r B\left(2r\frac{dr}{dt}\right)$$

Induced e.m.f $2\pi r B r\left(\frac{dr}{dt}\right)$ numerically

7. **(b)** In the $r-t$ graph, it is clear that, from a to b, there is no change in radius and hence no change in area and magnetic flux. Same is the situation from c to d.

Now, $|e| = \frac{d}{dt}\phi$

$|e| = B\frac{d}{dt}(\pi r^2)$

$|e| = 2\pi r B\frac{d}{dt}$

Since $r \propto t$, $\Rightarrow \frac{dr}{dt} = \text{constant}$

$\therefore\ |e| \propto r.$

From 0 – 1, r is constant, $\therefore\ \frac{dr}{dt} = 0$ hence, $e = 0$

From 1 – 2, $r = \alpha t$. $\therefore\ \frac{dr}{dt} = \alpha$ hence $e \propto r \Rightarrow t \propto r$

From 2 – 3, again r is constant, $\therefore\ \frac{dr}{dt} = 0$ hence $e =$ 0

8. **(c)** According to Fleming right hand rule, the direction of B will be perpendicular to the plane of paper and act downward.

9. **(d)** By Fleming's right hand rule.

10. **(d)** Conductor cuts the flux only when, if it moves in the direction of M.

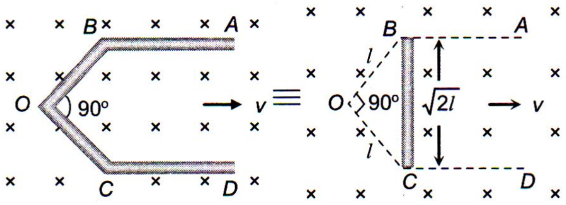
11. **(b)** Effective length between A and B remains same.

12. **(b)** Equivalent resistance of the given Wheatstone bridge circuit (balanced) is 3W so total resistance in circuit is $R = 3 + 1 = 4\Omega$. The emf induced in the loop $e = Bvl$.

So induced current $i = \frac{e}{R} = \frac{Bvl}{R}$

$\Rightarrow\ 10^{-3} = \frac{2 \times v \times (10 \times 10^{-2})}{4} \Rightarrow v = 2\,\text{cm/sec}.$

13. **(b)** There is no induced e.m.f. in the part AB and CD because they are moving along their length while e.m.f. induced between B and C *i.e.*, between A and D can be calculated as follows

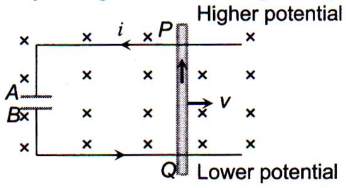


Induced e.m.f. between B and C = Induced e.m.f. between

A and B = $Bv(\sqrt{2}\,l) = 1\times1\times1\times\sqrt{2} = 1.41$ volt.

14. **(a)** $Q = CV = C\,(Bvl) = 10\times10^{-6}\times4\times2\times1 = 80\ mC$

According to Fleming's right hand rule induced current flows from Q to P. Hence P is at higher potential and Q is at lower potential. Therefore A is positively charged and B is negatively charged.



15. **(c)** By using $e = \frac{1}{2}Bl^2\omega$

For part AO ; $e_{OA} = e_O - e_A = \frac{1}{2}Bl^2\omega$

For part OC; $e_{OC} = e_O - e_C = \frac{1}{2}B(3l)^2\omega$

$\therefore\ e_A - e_C = 4Bl^2\omega$

16. **(b)** $L = \mu ni \Rightarrow \frac{L_2}{L_1} = \frac{\mu}{\mu_0}$ (n and i are same)

$\Rightarrow L_2 = m_r L_1 = 900\times0.18 = 162\ mH$

17. **(d)** $e = -L\frac{di}{dt} \Rightarrow 2 = -L\left(\frac{8-2}{3\times10^{-2}}\right)$

$\Rightarrow L = 0.01\ H = 10\ mH$

18. **(b)** $\frac{L_B}{L_A} = \left(\frac{n_B}{n_A}\right)^2 \Rightarrow L_B = \left(\frac{500}{600}\right)^2\times108 = 75\ mH$

19. **(a)** $L \propto N^2$ *i.e.* $\frac{L_1}{L_2} = \left(\frac{N_1}{N_2}\right)^2 \Rightarrow L_2 = L_1\left(\frac{N_2}{N_1}\right)^2 = 4L_1$

20. **(a)** $e = L\frac{di}{dt} \Rightarrow 2 = L\times\frac{6}{3\times10^{-3}} \Rightarrow L = 1\ mH$

21. **(a)** $\varphi = Li \Rightarrow NBA = Li$

Since magnetic field at the centre of circular coil carrying current is given by $B = \frac{\mu_0}{4\pi}.\frac{2\pi Ni}{r}$

$\therefore \quad N.\frac{\mu_0}{4\pi}.\frac{2\pi Ni}{r}.\pi r^2 = Li \Rightarrow L = \frac{\mu_0 N^2 \pi r}{2}$

Hence self-inductance of a coil

$= \frac{4\pi \times 10^{-7} \times 500 \times 500 \times \pi \times 0.05}{2} = 25 \text{ mH}$

22. **(a)** Induced e.m.f. $e = M\frac{di}{dt} \Rightarrow 100 \times 10^{-3} = M\left(\frac{10}{0.1}\right)$

$\therefore \quad M = 10^{-3} H = \text{mH}$

23. **(c)** $\frac{\Delta i}{\Delta t} = \frac{10}{2} = 5 \, A/\sec \Rightarrow e = L\frac{\Delta i}{\Delta t} = 0.5 \times 5 = 2.5 \; volts$

24. **(b)** We know that $i = i_o\left[1 - e^{\frac{-Rt}{L}}\right]$ or $\frac{3}{4}i_o = i_o\left[1 - e^{-t/\tau}\right]$

(where $\tau = \frac{L}{R}$ = time constant)

$\frac{3}{4} = 1 - e^{-t/\tau}$ or $e^{-t/\tau} = 1 - \frac{3}{4} = \frac{1}{4}$

$e^{t/\tau} = 4$ or $\frac{t}{\tau} = \ln 4$

$\Rightarrow \tau = \frac{t}{\ln 4} = \frac{4}{2\ln 2} \Rightarrow \tau = \frac{2}{\ln 2}$ sec.

25. **(c)** The current at time t is given by

$i = i_0(1 - e^{-t/t})$

Here $i_0 = E/R$ and $\tau = \frac{L}{R}$

$\therefore \quad q = \int_0^{\tau} i dt = \int_0^{\tau} i_0(1 - e^{-t/\tau})\,dt$

$= \frac{i_0 \tau}{e} = \frac{\left(\frac{E}{R}\right)\left(\frac{L}{R}\right)}{e} = \frac{EL}{eR^2}$

26. **(b)** If resistance is constant (10Ω) then steady current in the circuit $i = \frac{5}{10} = 0.5\,A$. But resistance is increasing it means current through the circuit start decreasing. Hence inductance comes in picture which induces a current in the circuit in the same direction of main current. So $i > 0.5\,A$.

27. (a) Steady-state current in $L = I_0 = \frac{E}{R_1}$

Energy stored in L

$= \frac{1}{2} L I_0^2 = \frac{1}{2} L \left(\frac{E^2}{R_1^2} \right)$

= heat produced in R_2 during discharge.

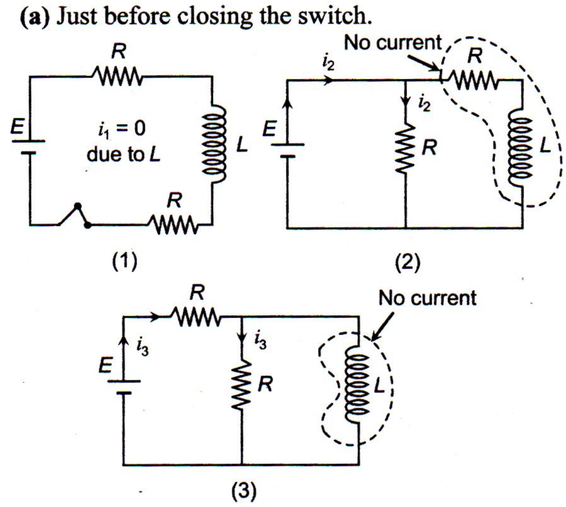
28. (d) $E = L \frac{dI}{dt}$

or $dI = \frac{E}{L} dt$

or $I = \frac{2}{4} t = 0.5t$

For $I = 5$ A, $t = 10$ sec

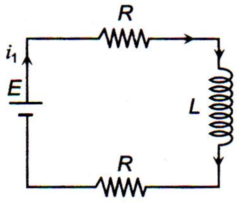
29. (a) Just before closing the switch.



$i_1 = 0, i_2 = \frac{E}{R}, i_3 = \frac{E}{2R}$ so $i_2 > i_3 > i_1$ $(i_1 = 0)$

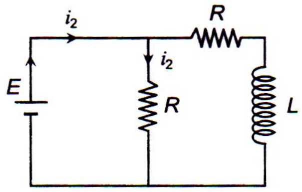
After a long time closing the switch

Hence $i_2 > i_3 > i_1$



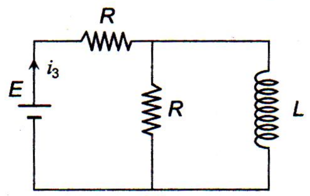
(1)

$R_{eq} = 2R$



(2)

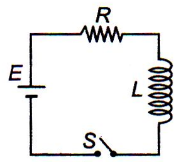
$R_{eq} = \frac{R}{2}$



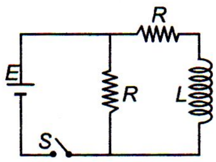
(3)

$R_{eq} = R$

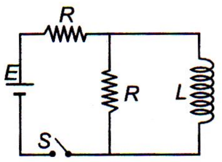
30. **(b)** At $t = 0$ current through L is zero so it acts as open circuit. The given figures can be redrawn as follows.



(i)



(ii)



(iii)

$i_1 = 0; i_2 = \frac{E}{R}$ $i_3 = \frac{E}{2R}$

Hence $i_2 > i_3 > i_1$.

31. **(c)** At the time $t = 0$, e is max and is equal to E, but current i is zero.

As the time passes, current through the circuit increases but induced elf decreases.

32. **(b)** At $t = 0$, inductor behave as open circuit so $i_1 = \frac{10}{10} = 1\,A$

At $t = \infty$, inductor behave as short circuit, so $i_2 = \frac{10}{8} = \frac{5}{4}A$

Hence, $\frac{i_1}{i_2} = \frac{1}{5/4} = \frac{4}{5} = 0.8$

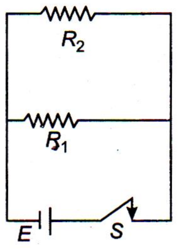
33. **(b)** Since resistance of the circuit is increasing and hence current in the circuit is decreasing so $\frac{di}{dt}$ is negative.

Current in the circuit is given by $i = \frac{6 - L\frac{di}{dt}}{12}$

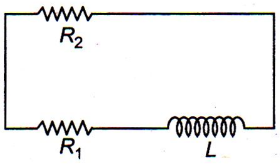
Since $\frac{di}{dt}$ is negative so the value of numerator will be more than 6V and hence current in the circuit at that instant will be more than 0.5 A.

34. **(d)** After a long time, steady current flows, so no emf is induced across inductor. Hence circuit reduces like shown.

So, current flowing $i = \frac{E(R_1 + R_2)}{R_1 R_2}$



35. **(c)** When the switch is opened the circuit looks like as shown. Now, the circuit discharges with resistances R_1 and R_2 in series, so time constant is $\frac{L}{R_1 + R_2}$.



36. **(b)** Hot wire ammeter is not based on the phenomenon of electromagnetic induction.

37. **(c)** $i = \frac{|e|}{R} = \frac{N}{R} \cdot \frac{\Delta B}{\Delta t} A \cos\theta$

$= \frac{20}{100} \times 1000 \times (25 \times 10^{-4}) \cos 0°$

$\Rightarrow i = 0.5\ \text{A}$

38. **(b)** By using $e = \frac{-NBA(\cos\theta_2 - \cos\theta_1)}{\Delta t}$

$e = -\frac{1000 \times 2 \times 10^{-5} \times 500 \times 10^{-4} (\cos 180° - \cos 0°)}{0.2}$

$= 10^{-2}$ volt $= 10$ mV

39. **(d)** $e = \dfrac{-NBA(\cos\theta_2 - \cos\theta_1)}{\Delta t}$

$= -\dfrac{500 \times 4 \times 10^{-4} \times 0.1(\cos 90 - \cos 0)}{0.1} = 0.2\ V$

40. **(c)** $e = Bvl \quad \Rightarrow e \propto v \propto gt$

41. **(c)** $e = Bvl = 0.5 \times 2 \times 1 = 1V$

42. **(d)** $e = Bvl \Rightarrow e = 0.9 \times 7 \times 0.4 = 2.52\ V$

43. **(b)** When a conductor lying along the magnetic north-south, moves eastwards it will cut vertical component of B_0. So induced emf
$e = vB_V l = v\,(B_0 \sin \delta l) = B_0 l \sin \delta.$

44. **(b)** This is the case of periodic EMI

45. **(c)** The induced emf between centre and rim of the rotating disc is $E = \dfrac{1}{2}B\omega R^2$

$= \dfrac{1}{2} \times 0.1 \times 2\pi \times 10 \times (0.1)^2 = 10\pi \times 10^{-3}$ volt

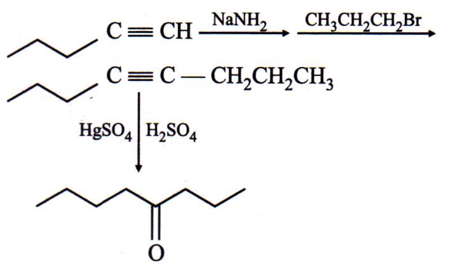
[CHEMISTRY]

46. **(d)** Mild oxidizing agents like PCC [Pyridinium chlorochromate] are particularly used for the conversion of $R - CH_2OH \rightarrow R - CHO$.

47. (d)

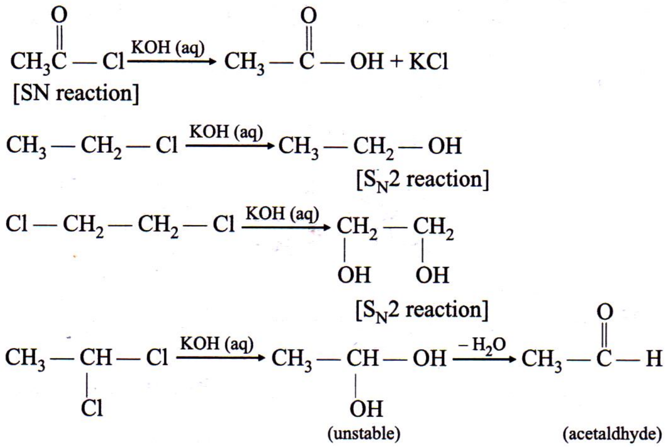
48. **(c)** $CH_3COCl \xrightarrow[Pd/BaSO_4]{2H} CH_3CHO + HCl$

49.

(b)


50.

(d) Gem dihalides.

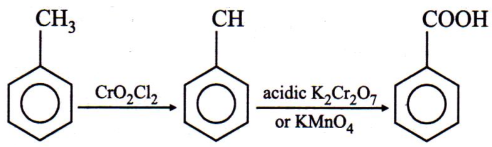


51.

(c)

52.

(c)



This is Etard's reaction

53.

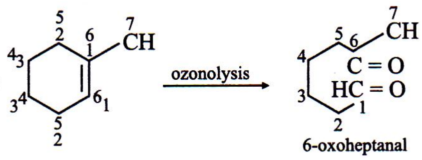
(a)

54.

(d)

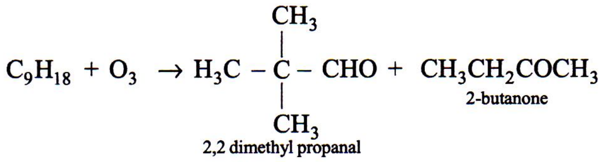
55.

(a)

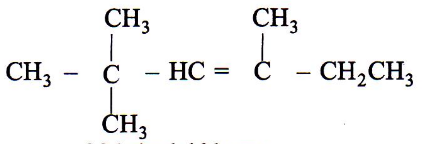


56.

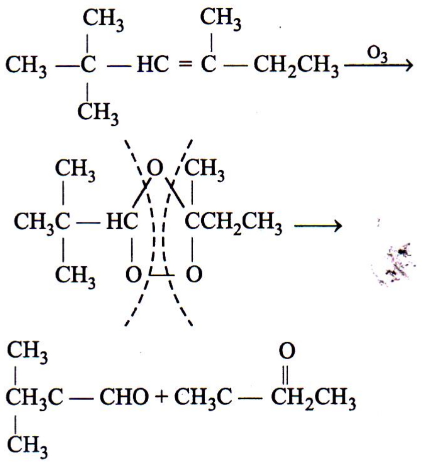
(a)



On the basis of product formation, it would be alkene



2,2,4-trimethyl-3-hexene



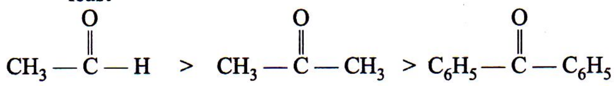
57.

(c) Reactivity follows the ease with which a nucleophile can attack at carbonyl carbon. Greater the steric hindrance at carbonyl carbon, smaller is the reactivity.

58.

(c) Reaction of PhMgBr with carbonyl compounds is an example of nucleophilic addition on carbonyl group which increases with the increase in electron-deficiency of carbonyl carbon and less steric hindrance on carbonyl carbon.

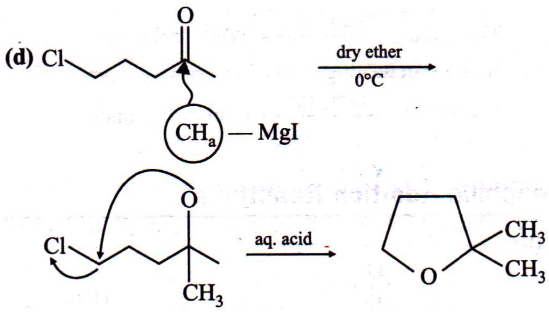
Thus acetaldehyde is the most reactive while $C_6H_5COC_6H_5$ least



supplies least electron to group

supplies electrons maximum due to + M effect of C_6H_5

59.



60.

(c) $CH_3COCH_3 \xrightarrow{CH_3MgI} (CH_3)_3COH$
Acetone — tert-Butyl alcohol

61.

(c) $CH_3COCH_3 + CH_3MgCl \rightarrow \underset{(X)}{(CH_3)_3C - OMgCl}$

$\xrightarrow{\text{hydrolysis}} \underset{(Y)}{(CH_3)_3C - OH} + Mg(OH)Cl$

62.

(a) Increase in alkyl group, the reactivity decreases.

63.

(d)

64.

(c) Addition of HCN to carbonyl compounds is an example of nucleophilic addition.

65.

(a) Acetone forms sodium bisulphate adduct but acetophenone does not. Aromatic ketones do not gives addition product with $NaHSO_3$.

66.

(a) $6HCHO + 4NH_3 \rightarrow \underset{\text{Urotropine}}{(CH_2)_6N_4} + 6H_2O$

67.

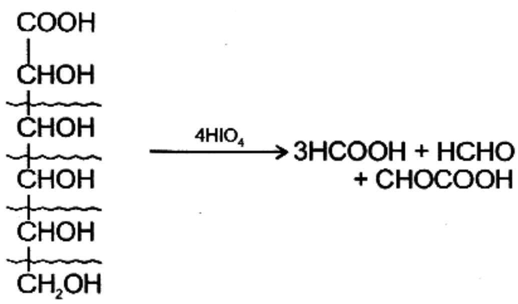
(c) $C_2H_5CHO + 2Cu^{+2} + 5OH^- \rightarrow \underset{\text{Red ppt}}{Cu_2O} + 3H_2O + C_2H_5COO^-$

$CH_3COCH_3 + 2Cu^{+2} + 5OH^- \rightarrow$ No reaction

68.

(c)

69.



70.

(b) Wolff–Kishner reduction does not convert >CO to CHOH but converts it to > CH_2.

71. D

72.

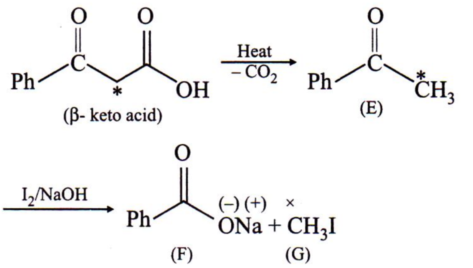
(b) Zn(Hg), HCl cannot be used when acid sensitive group like –OH is present, but NH_2NH_2, OH^- can be used. (c) and (d) will convert it to alcohol.

73.

(c) $\underset{\text{(Fehling solution)}}{CH_3CHO + 2Cu^{2+} + OH^-} \rightarrow CH_3COOH + \underset{\text{(red)}}{Cu_2O^-}$

74.

(c)



β-keto acids undergo decarbonylation by simple heating, from that we get carbonyl compound of type $CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-$ which undergoes iodoform reaction.

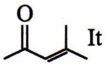
75.

(c)

76.

(b) $CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3 + 3Cl_2 \rightarrow CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CCl_3 + 3HCl$

77.

(c)  It is an α, β-unsaturated ketone which can be formed in an aldol condensation followed by dehydration.

78.

(c) Although both $CH_3CH_2COCH_3$ and $(CH_3)_3COOH_3$ contain α-hydrogen, yet $(CH_3)_3CCOH_3$ does not undergo aldol condensation due to steric hindrance.

79. Cationic detergents are quaternary ammonium salts of amine with acetates, chlorides or bromides as anion.

80.

(b)

81.

(c) $2CH_3CHO \xrightarrow[\text{NaOH}]{\text{dil.}} CH_3-\overset{\overset{\displaystyle OH}{|}}{CH}-CH_2CHO$

82.

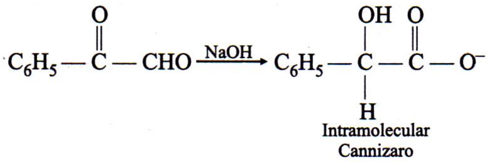
(d)

83.

(c)

84.

(b)



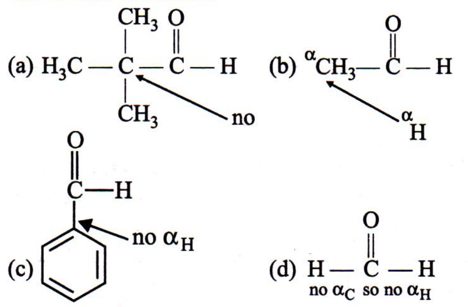
85.

(b) This is Cannizzaro's reaction:

$2C_6H_5CHO + NaOH \rightarrow C_6H_5COONa + C_6H_5CH_2OH$

86.

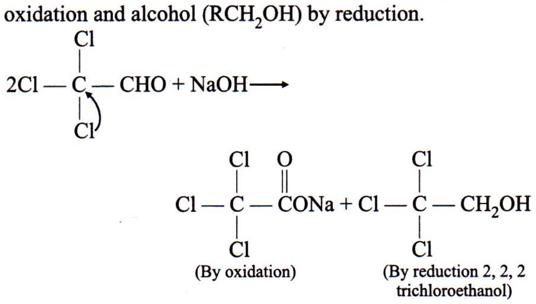
(b) The compound containing α-H atom does not undergo Cannizzaro's reaction.



87. $-NH_2$ is electron donating group but-CN is electron withdrawing group.

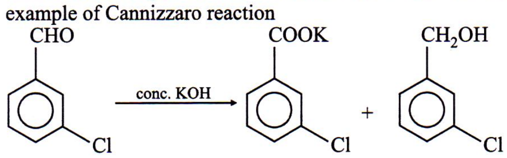
88.

(a) Cannizzaro's reaction is given by aldehydes (RCHO) lacking H at α-carbon or lacking α-carbon (as in HCHO). With NaOH, there is formation of acid salt ($RCOO^-$) by oxidation and alcohol (RCH_2OH) by reduction.



89.

(d) Chlorobenzaldehyde does not contain α-H atom. It is an example of Cannizzaro reaction



90.