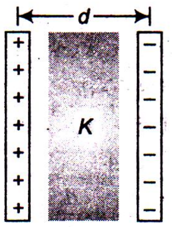
WEEKLY TEST MEDICAL PLUS - 03 TEST - 22 RAJPUR
SOLUTION Date 05-01-2020

[PHYSICS]

1. Potential difference between plates A and B



V = PD in air + PD in medium

$$V = \frac{\sigma}{\varepsilon_0}(d-t) + \frac{\sigma}{K\varepsilon_0}t$$

$$\therefore \quad V = \frac{\sigma}{\varepsilon_0}\left[d - t + \frac{t}{K}\right]$$

$$= \frac{Q}{A\varepsilon_0}\left(d - t + \frac{t}{K}\right) \qquad \left(\because \sigma = \frac{Q}{A}\right)$$

$$\therefore \quad C = \frac{Q}{V} = \frac{Q}{\frac{Q}{A\varepsilon_0}\left(d - t + \frac{t}{K}\right)}$$

$$= \frac{\varepsilon_0 A}{d - t + \frac{t}{K}}$$

$$= \frac{\varepsilon_0 A}{d - t\left(1 - \frac{1}{K}\right)}$$

2. According to question,

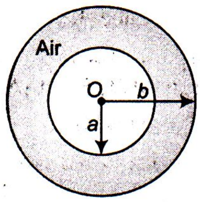
Capacity of spherical condenser = Capacity of parallel plate capacitor

$$\therefore \quad 4\pi\varepsilon_0 r = \frac{\varepsilon_0 A}{d}$$

$$\therefore \quad d = \frac{A}{4\pi r} = \frac{\pi R^2}{4\pi r}$$

$$= \frac{\pi(20 \times 10^{-3})^2}{4\pi \times 1} = 0.1 \text{ mm}$$

3. Capacity of spherical condenser when outer sphere is earthed



$$C_1 = 4\pi\varepsilon_0 \cdot \frac{ab}{b-a}$$

Capacity of spherical condenser when inner sphere is earthed

$$C_2 = 4\pi\varepsilon_0 b + \frac{4\pi\varepsilon_0 ab}{b-a}$$

$\therefore$ Difference in their capacity $= C_2 - C_1 = 4\pi\varepsilon_0 b$

4. Three capacitors are in series their resultant capacity is given by

$$\frac{1}{C_s} = \frac{1}{\left(\frac{\varepsilon_0 K_1 A}{d_1}\right)} + \frac{1}{\left(\frac{\varepsilon_0 K_2 A}{d_2}\right)} + \frac{1}{\left(\frac{\varepsilon_0 K_3 A}{d_3}\right)}$$

or $$\frac{1}{C_s} = \frac{d_1}{\varepsilon_0 K_1 A} + \frac{d_2}{\varepsilon_0 K_2 A} + \frac{d_3}{\varepsilon_0 K_3 A}$$

$$\frac{1}{C_s} = \frac{1}{\varepsilon_0 A}\left(\frac{d_1}{K_1} + \frac{d_2}{K_2} + \frac{d_3}{K_3}\right)$$

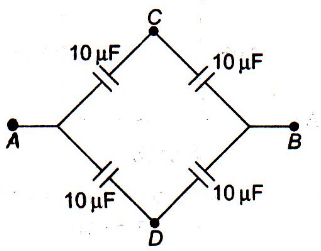
$\therefore$ $$C_s = \frac{\varepsilon_0 A}{\left(\frac{d_1}{K_1} + \frac{d_2}{K_2} + \frac{d_3}{K_3}\right)}$$

5. $$\frac{\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{(d + \Delta d) - t + \frac{t}{K}} \text{ or } K = \frac{t}{t - \Delta d}$$

6. The given figure is equivalent to two identical capacitors in parallel combination

$\therefore$ $$C = \frac{\varepsilon_0 A}{d} + \frac{\varepsilon_0 A}{d} = \frac{2\varepsilon_0 A}{d}$$

7. Given circuit is balanced Wheatstone bridge circuit.



Their is no current in branch CD.
So, equivalent capacitance between AB,

$$C_{AB} = 5 + 5 = 10\,\mu F$$

8. When capacitors are connected in series then,

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$= \frac{1}{3} + \frac{1}{9} + \frac{1}{18}$$

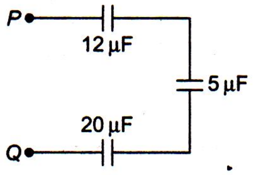
$$\frac{1}{C_s} = \frac{1}{2} \Rightarrow C_s = 2\,\mu\text{F}$$

When capacitors are joined is parallel, then

$$C_p = 3 + 9 + 18 = 30\,\mu\text{F}$$

$$\therefore \quad \frac{C_s}{C_p} = \frac{2}{30} = \frac{1}{15}$$

9. In circuit, condenser of capacity $2\,\mu$F and $3\,\mu$F are in parallel. Their resultant capacity is $5\,\mu$F.

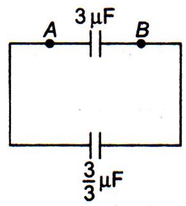


Now, capacitor $12\,\mu$F, $5\,\mu$F and $20\,\mu$F are in series. So, their resultant capacity

$$\frac{1}{C} = \frac{1}{5} + \frac{1}{20} + \frac{1}{12} = \frac{1}{3}$$

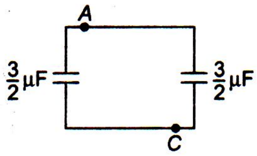
$$\therefore \quad C = 3\,\mu\text{F}$$

10. Capacitance between A and B



$$C_{AB} = 3 + 1 = 4\,\mu\text{F}$$

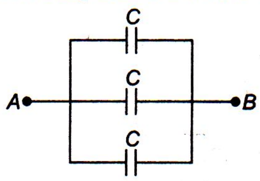
Capacitance between A and C



$$C_{AC} = \frac{3}{2} + \frac{3}{2} = 3\,\mu\text{F}$$

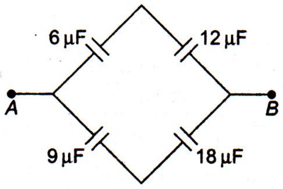
$$\therefore \quad \frac{C_{AB}}{C_{AC}} = \frac{4}{3}$$

11. Three capacitors are in parallel. So, their equivalent capacity



$$C_p = C + C + C = 3C$$

12. Given circuit is balanced Wheatstone bridge circuit.

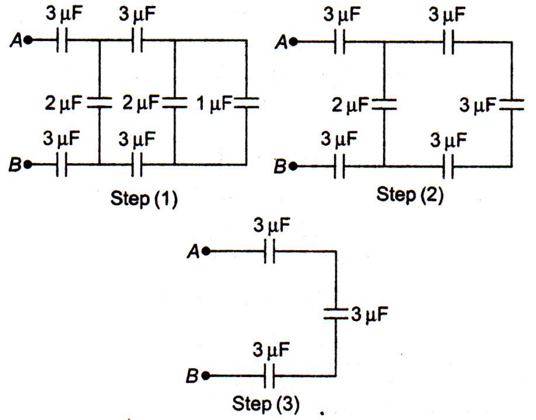


Now capacitor of capacity $6\,\mu F$, $12\,\mu F$ are in series and $9\,\mu F$, $18\,\mu F$ are also in series.

$\therefore$ Equivalent capacitance between A and B is

$$C_{AB} = 4 + 6 = 10\,\mu F$$

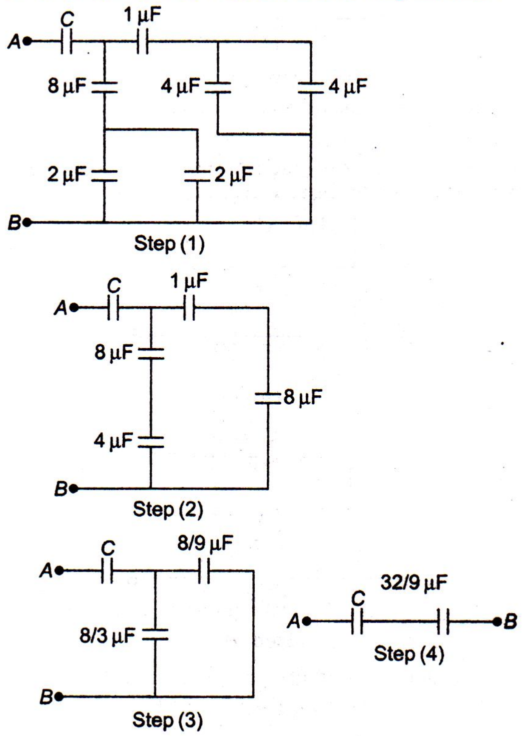
13. The given circuit can be reduced in following manner



$\therefore$ Resultant capacity between A and B

i.e., $C_{AB} = 1\,\mu F$

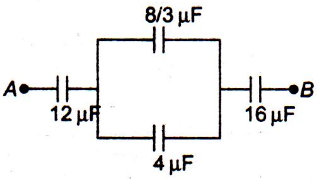
14. Given circuit can be reduced in following manner :



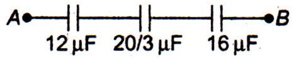
So, equivalent capacitance between A and B

$$C_{eq.} = 1 = \frac{\frac{32}{9} \times C}{\frac{32}{9} + C} \quad \therefore \quad C = \frac{32}{23}\,\mu F$$

15. Given circuit can be reduced as following.



Step (1)



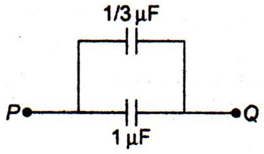
Step (2)

Hence, equivalent capacitance between A and B

$$\frac{1}{C_{AB}} = \frac{1}{12} + \frac{1}{20/3} + \frac{1}{16}$$

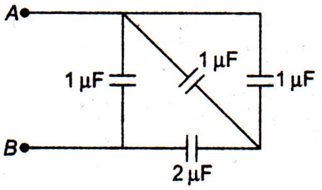
$$\therefore \quad C_{AB} = \frac{240}{71}\,F$$

16. Given circuit can be simplified as shown

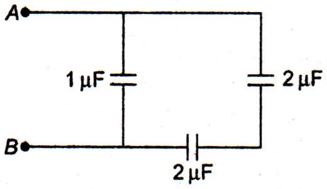


$$\therefore \quad C_{PQ} = \frac{1}{3} + 1 = \frac{4}{3}\,\mu F$$

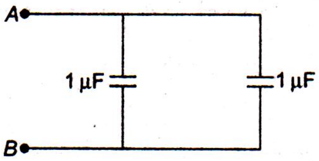
17. Given circuit can be simplified as follows



Step (1)



Step (2)

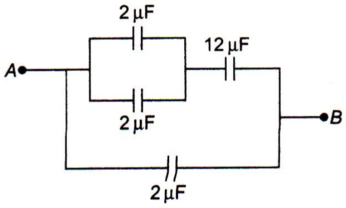


Step (3)

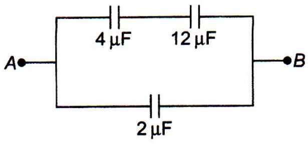
So, equivalent capacitance between A and B,

$$C_{AB} = 1 + 1 = 2\ \mu F$$

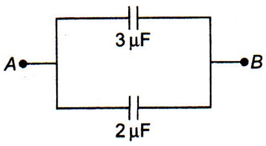
18. Given circuit can be expressed as



Step (1)



Step (2)

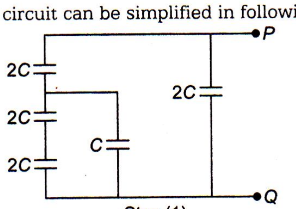


Step (3)

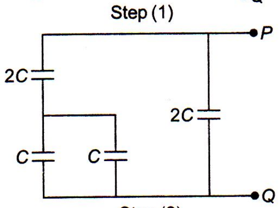
So, Net capacitance between AB

$$C_{AB} = 3 + 2 = 5\ \mu F$$

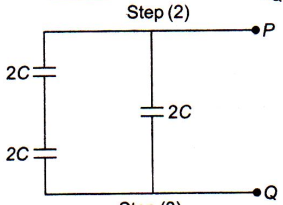
19. The given circuit can be simplified in following way.



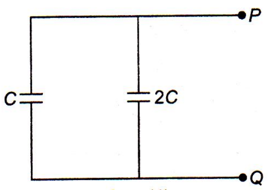
Step (1)



Step (2)



Step (3)



Step (4)

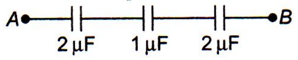
So, capacity between P and Q

$$C_{PQ} = 2C + C$$
$$= 3C$$

20. Capacitors C_1 and C_2 are in parallel and, they are in series with C_3, then equivalent capacity between A and B

$$C = \frac{C_P \times C_3}{C_P + C_3} = \frac{15 \times 4}{15 + 4} = \frac{60}{19} = 3.2\ \mu F$$

21. *The situation can be simplified as follows*

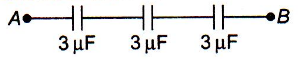


$\therefore$ Equivalent capacity between A and B

$$C_{AB} = \frac{2}{1 + 2 + 1} = \frac{2}{4}$$

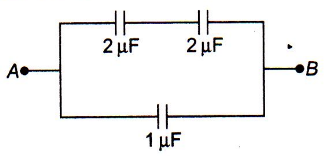
$\therefore$ $C_{AB} = 0.5\ \mu F$

22. The circuit can be redrawn as

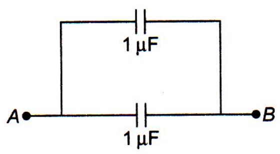


So, $C_{AB} = \frac{3}{3} = 1\ \mu F$

23. Given circuit can be redrawn as follows.



Step (1)

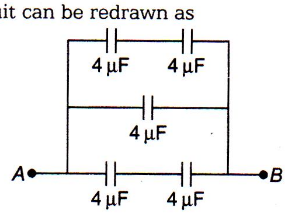


Step (2)

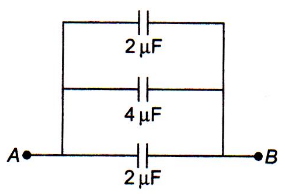
So, equivalent capacitance between A and B

$$C_{AB} = 1 + 1 = 2\ \mu F$$

24. Given circuit can be redrawn as



Step (1)



Step (2)

So, equivalent capacitance between A and B,

$$C_{AB} = 2 + 4 + 2 = 8\ \mu F$$

25. Capacitors C_1 and C_2 are in series with C_3 in parallel with them.

Now, $$C_1 = \frac{K_1\varepsilon_0(A/2)}{(d/2)} = \frac{K_1\varepsilon_0 A}{d}$$

$$C_2 = \frac{K_2\varepsilon_0(A/2)}{(d/2)} = \frac{K_2\varepsilon_0 A}{d}$$

and $$C_3 = \frac{K_3\varepsilon_0 A}{2d}$$

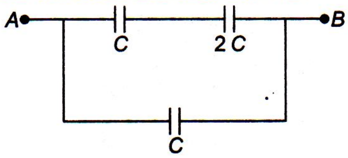
$$C_{\text{equivalent}} = C_3 + \frac{C_1C_2}{C_1 + C_2}$$

$$= \frac{K_3\varepsilon_0 A}{2d} + \frac{\left(\frac{K_1\varepsilon_0 A}{d}\right)\left(\frac{K_2\varepsilon_0 A}{d}\right)}{\frac{K_1\varepsilon_0 A}{d} + \frac{K_2\varepsilon_0 A}{d}}$$

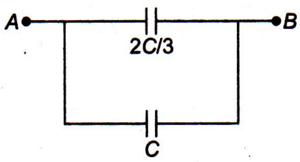
$$= \frac{\varepsilon_0 A}{d}\left(\frac{K_3}{2} + \frac{K_1K_2}{K_1 + K_2}\right)$$

So, none option is correct.

26. Given circuit can be redrawn as follows.



Step (1)



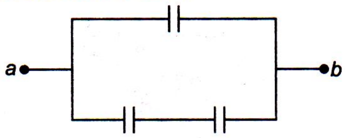
Step (2)

Equivalent capacitance between A and B

$$C_{AB} = \frac{2C}{3} + C = \frac{5C}{3}$$

27. In the given figure, the metallic plates forms a combination of two capacitors in series with one capacitor in parallel,

Let capacity of each capacitor is C, then, equivalent capacitance between a and b



$$C_{ab} = \frac{C}{2} + C = \frac{3C}{2}$$

$\because$ $$C = \frac{\varepsilon_0 A}{d}$$

$\therefore$ $$C_{ab} = \frac{3}{2}\frac{\varepsilon_0 A}{d}$$

28. $$C_s = \frac{C_0}{7}$$

and $$C_P = 7C_0$$

$\therefore$ $$C_P = 49\,C_s$$

Here, C_0 = capacity of one capacitor.

29. $$V = \frac{q}{C} \quad \text{or} \quad V \propto \frac{1}{C}$$

V has reduced to $\frac{1}{8}$th its original value. Therefore, C has increased 8 times.

30.
31.
32.
33.

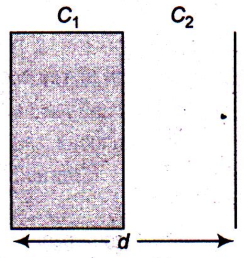
34. Force on one plate due to another is

$$F = QE = Q \times \frac{\rho}{2\varepsilon_0}$$

$$= Q\left[\frac{Q}{2A\varepsilon_0}\right] = \frac{Q^2}{2A\varepsilon_0}$$

35.
36.

37. Initial capacitance



$$C = \frac{\varepsilon_0 A}{d}$$

When it is half filled by a dielectric of dielectric constant K, then

$$C_1 = \frac{K\varepsilon_0 A}{d/2}$$

$$= 2K\,\frac{\varepsilon_0 A}{d}$$

and $$C_2 = \frac{\varepsilon_0 A}{d/2} = \frac{2\varepsilon_0 A}{d}$$

$\therefore$ $$\frac{1}{C'} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{d}{2\varepsilon_0 A}\left(\frac{1}{K} + 1\right)$$

$$= \frac{d}{2\varepsilon_0 A}\left(\frac{1}{5} + 1\right) = \frac{6}{10}\,\frac{d}{\varepsilon_0 A}$$

$\therefore$ $$C' = \frac{5\varepsilon_0 A}{3d}$$

Hence, increase in capacitance $= \dfrac{\frac{5}{3}\frac{\varepsilon_0 A}{d} - \frac{\varepsilon_0 A}{d}}{\frac{\varepsilon_0 A}{d}} = \frac{2}{3} = 66.6\%$

38.
39.
40.
41.
42.
43.
44. $\frac{2C}{3} = 4\,\mu F \quad \therefore\ C = 6\,\mu F$

45. $\frac{C'}{C} = \frac{\varepsilon_0 A/d\text{-}t}{\varepsilon_0 A/d} = \frac{d}{d-t} = \frac{d}{d/2} = 2:1$

[CHEMISTRY]

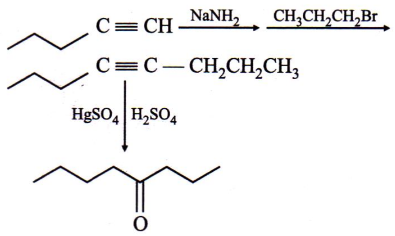
46. **(d)** Mild oxidizing agents like PCC [Pyridinium chlorochromate] are particularly used for the conversion of $R - CH_2OH \rightarrow R - CHO$.

47. (d)

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

49.

(b)



50. **(d)** Gem dihalides.

$CH_3\overset{O}{\overset{\|}{C}} - Cl \xrightarrow{KOH\,(aq)} CH_3 - \overset{O}{\overset{\|}{C}} - OH + KCl$

[SN reaction]

$CH_3 - CH_2 - Cl \xrightarrow{KOH\,(aq)} CH_3 - CH_2 - OH$

[S_N2 reaction]

$Cl - CH_2 - CH_2 - Cl \xrightarrow{KOH\,(aq)} \underset{OH}{\underset{|}{CH_2}} - \underset{OH}{\underset{|}{CH_2}}$

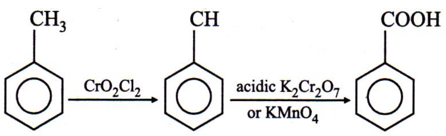
[S_N2 reaction]

$CH_3 - \underset{Cl}{\underset{|}{CH}} - Cl \xrightarrow{KOH\,(aq)} CH_3 - \underset{OH}{\underset{|}{CH}} - OH \xrightarrow{-H_2O} CH_3 - \overset{O}{\overset{\|}{C}} - H$

(unstable) (acetaldhyde)

51.
(c)

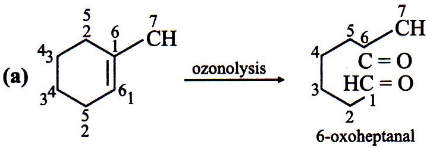
52. **(c)**



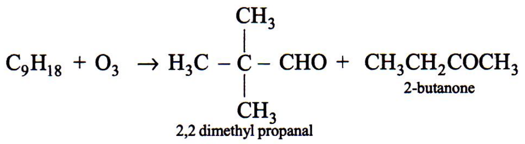
This is Etard's reaction

53. (a)
54. (d)

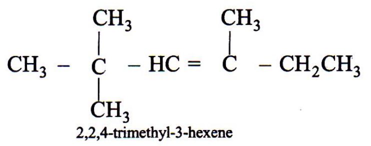
55. **(a)**

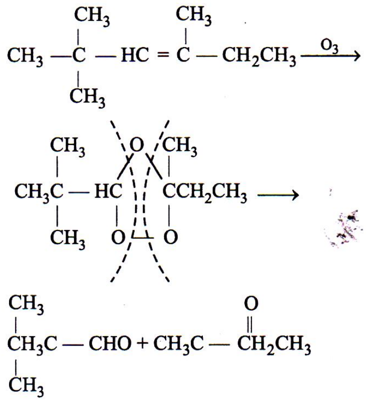


56. **(a)**



On the basis of product formation, it would be alkene

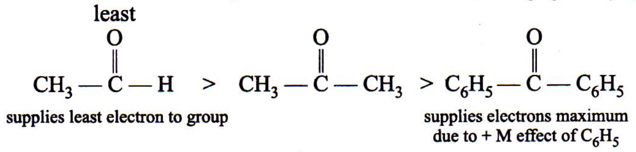




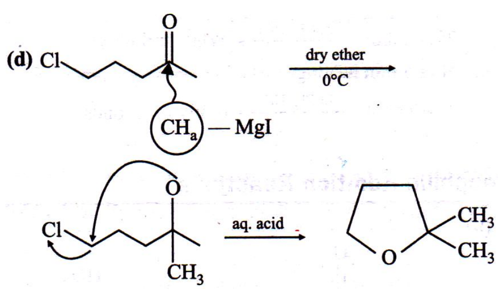
57. **(c)** Reactivity follows the ease with which a nucleophile can attack at carbonyl carbon. Greater the steric hindrance at carbonyl carbon, smaller is the reactivity.

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



59. **(d)**



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 $NaHSO_3$.

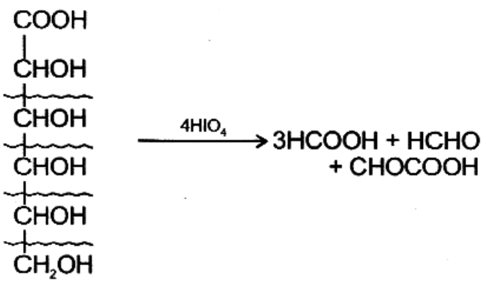
66. **(a)** $6HCHO + 4NH_3 \rightarrow \underset{\text{Urotropine}}{(CH_2)_6N_4} + 6H_2O$

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.



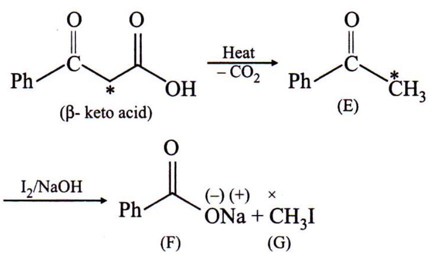
70. **(b)** Wolff–Kishner reduction does not convert >CO to CHOH but converts it to > CH_2.

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

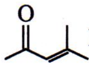
74. **(c)**



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

75. (c)

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

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)** $2CH_3CHO \xrightarrow[NaOH]{dil.} CH_3-\underset{}{\overset{OH}{\overset{|}{C}H}}-CH_2CHO$

82. (d)

83. (c)

84.

(b) $C_6H_5-\overset{O}{\overset{\|}{C}}-CHO \xrightarrow{NaOH} C_6H_5-\underset{H}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-\overset{O}{\overset{\|}{C}}-O^-$

Intramolecular Cannizaro

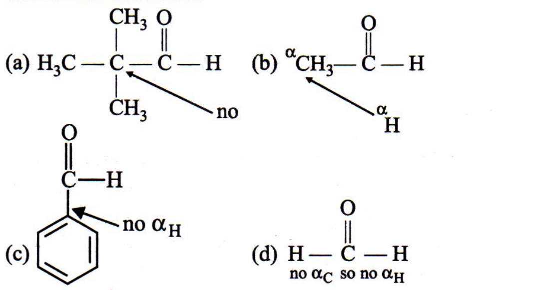
85.

(b) This is Cannizzaro's reaction:

$2C_6H_5CHO + NaOH \rightarrow C_6H_5COONa + C_6H_5CH_2OH$

86.

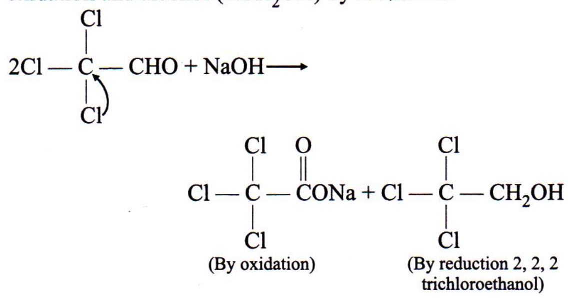
(b) The compound containing α-H atom does not undergo Cannizzaro's reaction.



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

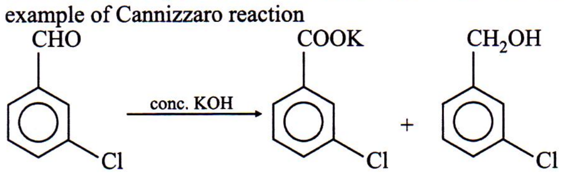
88.

(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.