1. (a)

Sol. $\lambda = \frac{h}{P} = \frac{h}{\sqrt{2m(k.a.)}}$

2. (d)

Sol. $\lambda \propto \frac{1}{\sqrt{m}}$

3. (c)

Sol. $= \frac{h}{\sqrt{2mK}}$

$\log \lambda = \log \frac{h}{\sqrt{2m}} - \frac{1}{2} \log K$

4. (b)

Sol. Kinetic energy $K = \frac{1}{2}mv^2 = \frac{e^2}{8\pi\varepsilon_0 r}$

And P.E. $U = -\frac{e^2}{4\pi\varepsilon_0 r}$

Or $K = \frac{1}{2}mv^2 = \frac{e^2}{8\pi\varepsilon_0 r}$

$U = -2K$

5. (d)

Sol. $\frac{\text{Volume of atom}}{\text{Volume of nucleus}} = \frac{\frac{4}{3}\pi(10^{-10})^3}{\frac{4}{3}\pi(10^{-15})^3} = 10^{15}$

6. (d)

Sol. The wavelength of the Paschen series

$\frac{1}{\lambda} = R\left[\frac{1}{3^2} - \frac{1}{n^2}\right]$

For shortest wavelength $n = \infty$

$\therefore \frac{1}{\lambda} = R\left[\frac{1}{9} - \frac{1}{\infty^2}\right] = \frac{R}{9}$

$\lambda = \frac{9}{R} = \frac{9}{1.097 \times 10^7}$

$= 8.20 \times 10^{-7} \text{m} = 820 \text{nm}.$

7. (c)

Sol. The wavelength for Pfund series is given by

$$\frac{1}{\lambda}=R\left[\frac{1}{5^2}-\frac{1}{n^2}\right]$$

For series limit $n=\infty$

$$\therefore \frac{1}{\lambda}=R\left[\frac{1}{25}-\frac{1}{\infty^2}\right]=\frac{R}{25}$$

$$\therefore \lambda=\frac{25}{R}=\frac{25}{1.097\times10^7}=2278\text{nm}.$$

8. (b)

Sol. Jump to second orbit leads to Balmer series when an electron jumps from 4^{th} orbit to 2^{nd} orbit shall give rise to second line of Balmer series

9. (a)

Sol. For a Balmer series

$$\frac{1}{\lambda_B}=R\left[\frac{1}{2^2}-\frac{1}{n^2}\right] \quad \ldots\ldots \text{(i)}$$

Where n = 3, 4 …….

By putting n = ∞ in equation (i) we obtain the series limit of the Balmer series this is the shortest wavelength of the Balmer series

$$\text{or } \lambda_B=\frac{4}{R} \quad \ldots\ldots \text{(ii)}$$

For Lyman series

$$\frac{1}{\lambda_L}=R\left[\frac{1}{1^2}-\frac{1}{n^2}\right] \quad \ldots\ldots. \text{(iii)}$$

Where n = 2, 3, 4………

By putting $n=\infty$ g in equation (iii) We obtain the series limit of the Lyman series. This is the shortest wavelength of the Lyman series.

$$\text{Or } \lambda_L=\frac{1}{R} \quad \ldots\ldots..\text{(iv)}$$

Dividing (ii) by (iv) , we get

$$\frac{\lambda_B}{\lambda_L}=\frac{4}{1}$$

10. (a)

Sol. According to Bohr' second postulate

Angular momentum $L=\frac{nh}{2\pi}$

Angular momentum is also called a moment of momentum

For second orbit, n =2

$L = \frac{2h}{2\pi} = \frac{h}{\pi}$

11. (b)

Sol. Angular momentum

$L = mvr = \frac{nh}{2\pi}$ or $mv = \frac{nh}{2\pi r}$

Now, $r \propto n^2$

$\therefore mv = p \propto \frac{nh}{2\pi \times n^2}$

$p \propto \frac{h}{2\pi n}$ or $p \propto \frac{1}{n}$

Energy $E \propto \frac{1}{n^2}$

12. (d)

Sol. The minimum energy required to free the electron from the ground state of the hydrogen atom is called the ionization energy of hydrogen atom its value is $13.6\,eV$.

13. (a)

Sol. Absorption is from the ground state n = 1 to n' where $n' > 1$

14. (a)

Sol. In a hydrogen atom the energy of electron in nth orbit is

$E_n = -\frac{13.6}{n^2} eV$

15. (a)

Sol. Here,

$E = -13.6\,eV = 13.6 \times 1.6 \times 10^{-19} = 2.2 \times 10^{-18}\,J$

$E = \frac{e^2}{8\pi\varepsilon_0 E}$

$\therefore$ As orbital radius $r = \frac{-e^2}{8\pi\varepsilon_0 E}$

$= \frac{9 \times 10^9 \times (1.6 \times 10^{-19})^2}{2 \times (-2.2 \times 10^{-18})}$

$= 5.3 \times 10^{-11}\,m$

16. (c)

Sol. As $r_n = n^2 a_0$

Here $a_0 = 0.529\text{Å}$ and $n = 3$

$\therefore r_{n=3} = (3)^2 a_0$

$= 9 \times 0.529Å = 4.761Å$

17. (b)

Sol. Energy, $E_n = -\frac{13.6}{n^2} eV$

In ground state energy $E_1 = \frac{13.6}{1^2} = -13.6eV$

In first excited state energy $E_2 = \frac{13.6}{2^2} = -3.4eV$

Then the required energy $= E_2 - E_1$

$= -3.4 - (-13.6) = 10.2$ eV

18. (d)

Sol. As, P.E. = -2K.E.

Here, K.E. $= 13.6eV = 2.18 \times 10^{-18} J$

Hence, P.E. $= -2 \times 2.18 \times 10^{-18} J$

$= -4.36 \times 10^{-18} J$

19. (b)

Sol. As $r_n = n^2 a_0$

Here $a_0 = 5.3 \times 10^{-11} m$

$n = 2$

$\therefore r_2 = (2)^2 a_0$

$= 4a_0 = 4 \times 5.3 \times 10^{-11} m$

$= 21.2 \times 10^{-11} m = 2.12Å$

20. (a)

Sol. Since $\upsilon = \frac{c}{\lambda}$

Here $c = 3 \times 10^8 ms^{-1}$

$\lambda = 9.7 \times 10^{-8} m$

$\therefore \upsilon = \frac{3. \times 10^8}{9.7 \times 10 -^8} = 3.1 \times 10^{15} Hz$

21. (c)

Sol. According to Bohr's model

$v = \frac{2Ke^2Z}{nh}$

$v \propto \frac{1}{n} \quad \therefore \frac{V_A}{V_B} = \frac{n_B}{n_A}$

Here, $V_A = 2.2 \times 10^6 ms^{-1}$

$n_A = 1, n_B = 4n$

$\therefore V_B = v_A \times \frac{n_A}{n_B}$

$= 2.2\times10^6 \times \frac{1}{4} = 0.55\times10^6 = 5.5\times10^5 \text{ ms}^{-1}$

22. (d)

Sol. Since $r_n \propto n^2$

$\frac{r_n}{r_1} = \frac{n^2}{(1)^2} \quad \therefore r_n = n^2 r_1$

Or $n^2 = \frac{r_n}{r_1}$

$\Rightarrow n = \sqrt{\frac{r_n}{r_1}} = \sqrt{\frac{4.2}{0.529}} = \sqrt{7.939} = 2.81 = n^2$

23. (a)

Sol. Electromagnetic radiation only

24. (d)

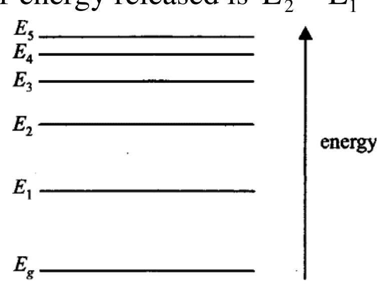
Sol. $\omega = \frac{v}{r}$ Further $v \propto \frac{1}{n}$ and $r \propto n^2$, hence

$\omega \propto (1/n^3)$

25. (d)

Sol. The energy level diagram schematically looks like this as we move to higher and higher levels, the energy increase but the energy gap between any two levels decreases hence in the transition from $n = 4$ to $n = 3$energy released will be $E_4 - E_3$

And in the transition from n = 2 to n = 1 energy released is $E_2 - E_1$



Now as $E_4 - E_3 < E_2 - E_1$

$\Rightarrow h\upsilon_{43} < h\upsilon_{21} \Rightarrow \upsilon_{43} < \upsilon_{21}$

26. (c)

Sol. Speed of the electron in the ground state of hydrogen atom is

$$v = \frac{2\pi e^2}{4\pi\varepsilon_0 h} = \frac{c}{137} = c\alpha$$

Where c = speed of light in vacuum

$\alpha = \frac{e^2}{2\varepsilon_0 hc}$ is the find structure constant it Is a pure number whose value is $\frac{1}{137}$

$$\therefore \frac{v}{c} = \frac{1}{137}$$

27. (d)

Sol. Angular momentum $= \frac{nh}{2\pi}$

$\Rightarrow$ moment of momentum $= \frac{nh}{2\pi}$

$$\Rightarrow p \times r_n = \frac{nh}{2\pi}$$

$$\frac{h}{\lambda} r_n = \frac{nh}{2\pi} \Rightarrow \lambda = \frac{2\pi r_n}{n}$$

For 1^{st} orbit, n = 1, $\lambda = 2\pi r_1$

$\Rightarrow \lambda =$ Circumference of 1^{st} orbit.

28. (c)

Sol. Since $_2He^4$ atom has two electrons whereas Bohr model is applicable only for one electron atom like H-atom.

29. (c)

Sol. Here, $a_0 = 53$ pm, $n = 1$ for ground state

For Li^{++}ion, $Z = 3$

Radius of nth orbit

$$r = \frac{n^2h^2}{4\pi^2 mKZe^2} = \frac{a_0 n^2}{Z}$$

$$\therefore r = \frac{53 \times (1)^2}{3}\left[\therefore a_0 = \frac{h^2}{4\pi^2 mKe^2} = 53\text{pm}\right]$$

$$= 17.66 \approx 18\text{pm}$$

30. (c)

Sol. For last line of Balmer series $n_1 = 2$ and $n_2 = \infty$

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = \frac{1.1 \times 10^7}{4} m^{-1} = 2.75 \times 10^6 m^{-1}$$

31. (b)

Sol. $n_\alpha = \frac{222-210}{4} = \frac{12}{4} = 3$

$n_\beta = 2n_\alpha - Z + Z' = 2 \times 3 - 86 + 84 = 6 - 2 = 4$

32. (d)

Sol. $E = 2\ B.E._{_2He^4} - (B.E_{_3Li^7} + B.E_{_1P^1})$

33. (b)

Sol. $E = mc^2$

$\Rightarrow \frac{E_2}{E_1} = \left(\frac{c_2}{c_1}\right)^2 = (2/3)^2 = \frac{4}{9}$

34. (d)

Sol. ${}_{92}U^{238} \rightarrow {}_{90}Th^{234} + {}_2He^4$

35. (d)

Sol. $\left.\begin{matrix} 13+2=15+Z \Rightarrow Z=0 \\ 27+4=30+A \Rightarrow A=1 \end{matrix}\right]$ i.e. ${}_0n^1$

36. (c)

Sol. $\Delta E = 0.21 \times 931$ MeV

$\frac{\Delta E}{A} = \frac{0.21 \times 931}{23}$ MeV

37. (b)

Sol. Order of magnitude of nuclear density

$= 10^{17}\ kg\ m^{-3}$

38. (a)

Sol. Here $A_1 = 197$ and $A_2 = 107$

$\therefore \frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3} = \left(\frac{197}{107}\right)^{1/3} = 1.225$

39. (a)

Sol. Binding energy, E_b of ${}_3^7Li \ = \Delta m \times 931 MeV$

$= 0.042 \times 931 MeV$

Binding energy per nucleon

$= \frac{0.042 \times 931}{7} = 5.586\ MeV$

40. (a)

Sol. Here, $P = 500\,MW = 5\times10^{8}\,W, t = 1\,h = 3600\,s$

Energy produced,

$E = p\times t = 5\times10^{8}\times3600 = 18\times10^{11}\,J$

As $E = mc^2$

$$\therefore m = \frac{E}{c^2} = \frac{18\times10^{11}}{(3\times10^{8})^2} = \frac{18\times10^{11}}{9\times10^{16}} = 2\times10^{-5}\,kg$$

41. (d)

Sol. For nuclei having $A > 56$, binding energy per nucleon gradually decreases

42. (c)

Sol. After three half lives, the fraction of un decayed nuclei

$$= \left(\frac{1}{2}\right)^3 = \frac{1}{8}$$

$\therefore$ Time taken for the sample to decay by $(1-1/8)^{th}$ or $\frac{7^{th}}{8}$ of initial value

$= 3T_{1/2} = 3\times20 = 60\,s$

43. (b)

Sol. Here $m_0 = 16\,g, m = 16-15 = 1\,g$

As $\frac{m}{m_0} = \left(\frac{1}{2}\right)^n \quad or \quad \frac{1}{16} = \left(\frac{1}{2}\right)^4 = \left(\frac{1}{2}\right)^n$

$\Rightarrow n = 4$

Time taken to disintegrate=

$T_{12}\times n = 140\times4 = 560\,days$

44. (b)

Sol. Here, $T_{1/2} = 28\,years = 28\times3.154\times10^{7}\,s$

As number of atoms in 90 g of ${}^{90}_{38}sr \ = 6.023\times10^{23}$

$\therefore$ Number of atoms in 15 mg of ${}^{90}_{38}sr$

$$= \frac{6.023\times10^{23}}{90}\times\frac{15}{1000}$$

i.e. $N = 1.0038\times10^{20}$

Rate of disintegration, $= \frac{0.693}{T_{1/2}}N$

$$= \frac{0.693\times1.0038\times10^{20}}{28\times3.15\times10^{7}} = 7.877\times10^{10}\,Bq = 10^{10}\,Bq$$

45. (c)

Sol. ${}_{Z}^{A}X \xrightarrow{2\beta^-} {}_{Z+2}^{A}Y_1 \xrightarrow{\alpha} {}_{Z}^{A-4}Y_2$

The resultant daughter is an isotope of the original parent nucleus.

46. (a)

Sol. Here, $n = \frac{72000}{24000} = 3, \frac{N}{N_0} = \left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$

47. (a)

Sol. Mean life, $\tau = \frac{1}{\lambda}$

And half life , $T_{1/2} = \frac{\ln 2}{\lambda} = \frac{0.693}{\lambda}$

$\because \tau > T_{1/2}$ Greater fraction will decay in longer time. Hence, fraction decayed in one mean life must be greater than the fraction decayed in one half life i.e.

$f_1 > f_2$

48. (a)

Sol. ${}_{Z}^{A}A \rightarrow {}_{Z-2}^{A-4}B + {}_{2}^{4}He$

${}_{Z-2}^{A-4}B \rightarrow {}_{Z}^{A-4}C + 2{}_{-1}^{0}e$

Hence, A and C are isotopes.

49. (c)

Sol. During nuclear fusion, two or more lighter nuclei combine to form a heavier nucleus.

50. (d)

Sol. In any nuclear reaction mass, energy and momentum all are conserved.

51. (a)
 Sol. Haloform reaction converts methyl ketones to acids directly
52. (d)
 Sol. If the electrophilic character of carbon is considerably reduced, then the reaction will be slow.

53. (a)
 Sol.

$$\left(CH_3CH_2-\overset{O}{\overset{\|}{C}}-O\right)_2 Ca \xrightarrow{\Delta}$$

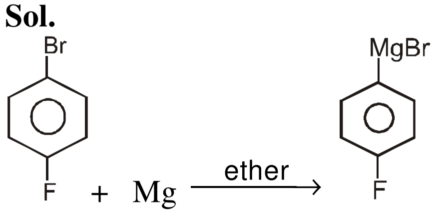
$$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3 + CaCO_3$$

54. (a)
 Sol.

$$CH_3-CH\begin{matrix}\diagup Cl\\ \diagdown Cl\end{matrix} \xrightarrow{\text{aq. KOH}} CH_3-CH\begin{matrix}\diagup OH\\ \diagdown OH\end{matrix}$$

$$\xrightarrow{-H_2O} CH_3CHO$$

55. (b)
 Sol. As the positive charge decreases and steric hinderance increases on carbonyl group the rate of nucleophilic addition reaction decreases.
56. (d)
 Sol.CH_3 – CHO (a – Hydrogen is present)
57. (b)
 Sol. If base sensitive group is present on carbonyl compound then Clemmensen reduction is used
58. (c)
 Sol. Iodoform test.
59. (b)
 Sol.

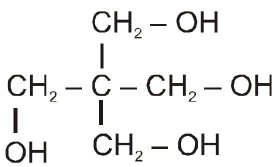


60. (a)

 Sol. $(CH_3)_3$ CMgCI + $D_2O \longrightarrow (CH_3)_3CD$
61. (c)
 Sol.

$$C_5H_{12}O_4 \xrightarrow{CH_3MgBr} 4CH_4\text{-}.$$

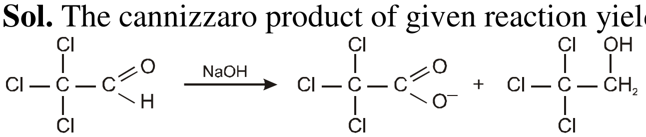
It means compound (X) contains 4 acidic hydrogen.



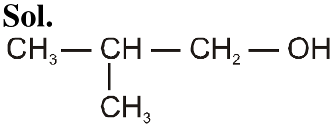
62. (c)
Sol. C – Mg bond
63. (d)
Sol. Benzaldehyde undergoes disproportionation with 50% NaOH to given benzyl alcohol and sodium benzoate

$C_6H_6CHO \xrightarrow{50\%\ NaOH}$
$C_6H_5CH_2OH + C_6H_5COONa$

This is Cannizzaro's reaction.
64. (d)
Sol. As increase steric hinderance around carbonyl group then rate of nucleophilic addition reaction decreases
65. (c)
Sol.
$CH_3–CH=CH–CH_3 \xrightarrow{O_3/Zn} CH_3–CHO$
66. (a)
Sol. The cannizzaro product of given reaction yields 2, 2, 2-trichloroethanol.

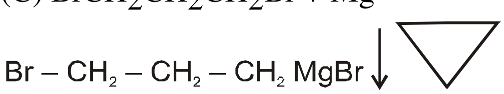


67. (d)
Sol.

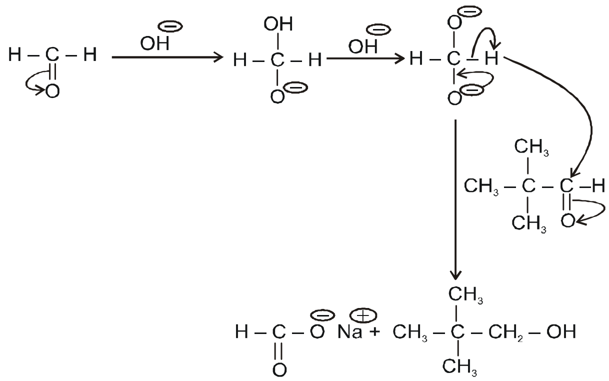


isobutyl alcohol does'nt give positive iodoform test.
68. (c)
Sol.

(C) $BrCH_2CH_2CH_2Br + Mg \xrightarrow{Et_2O}$

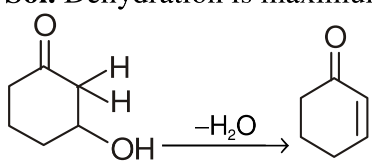


$+ MgBr_2$
69. (b)
Sol. Acetaldehyde has CH_3CHO-groups as well as –CHO
70. (d)
Sol. D is a specific oxidizing agent.
71. (a)
Sol.



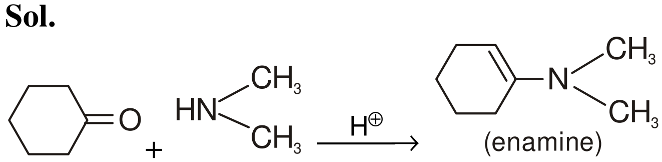
72. (b)

Sol. Dehydration is maximum



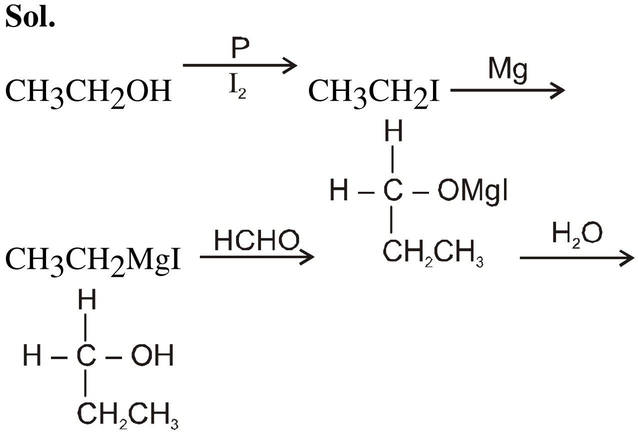
73. (c)

Sol.



74. (a)

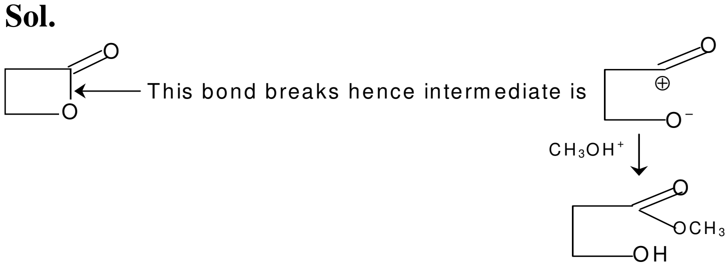
Sol.



n-propyl alcohol
(D)

75. (a)

Sol.

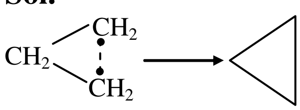


76. (a)
Sol.
$NaBH_4$ reduces reactant to
$CH_3-\underset{\displaystyle OH}{\underset{|}{C}H}-CH_2-CH_2-CH_2-CO_2H$ which forms ester

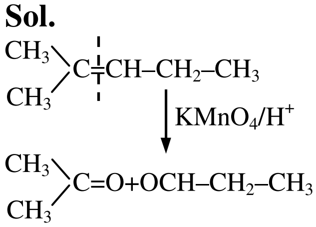
77. (a)
Sol.
$RCH_2CH_2OH \xrightarrow{PBr_3} RCH_2CH_2Br \xrightarrow{KCN} RCH_2CH_2CN \xrightarrow{H_2O/H^+} RCH_2CH_2COOH$

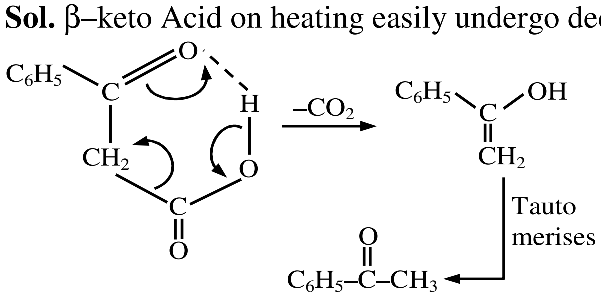
78. (d)
Sol. More ionized in basic medium and less ionized in acidic medium, common ion effect

79. (c)
Sol.
SO_3H is most acidic

80. (c)
Sol.


81. (d)
Sol. X = $CH_3–CH_2–CH_2–C \equiv N$
Y = $CH_3–CH_2–CH_2–CO_2H$
Z = $CH_3–CH_2–Cl_2–\overset{\displaystyle O}{\overset{||}{C}}–OEt$
Y $\longrightarrow$ Z is esterificatin reaction

82. (d)
Sol.


83. (a)
Sol. β–keto Acid on heating easily undergo decarboxylation via a six-membered. Cyclic transition state.


84. (c)
Sol.
$HCOOH \xrightarrow{AgNO_3+NH_4OH} CO_2 + H_2O + Ag\downarrow$

85. (a)

Sol. α-halogenation reaction [α-H must present].

86. (a)

Sol. $Ph\text{–}COCl \xrightarrow{NH_3} Ph\text{–}CONH_2 + HCl$

87. (c)

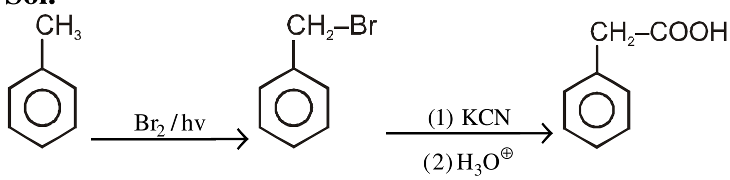
Sol. $CH_3\text{–}COOH + C_2H_5OH \xrightarrow{H^{\oplus}} CH_3COOC_2H_5$ (ester)

88. (b)

Sol. $CH_3CH_2COOH \xrightarrow{SOCl_2} CH_3CH_2COCl \xrightarrow{NH_3} CH_3CH_2CONH_2 \xrightarrow{Br_2+KOH} CH_3CH_2NH_2$

89. (d)

Sol.

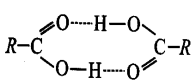


90. (a)

Sol. Among the given option Cl^- is the best leaving group hence the rate of reaction will be fastest in case of RCOCl.

91 (c)

Sol. :

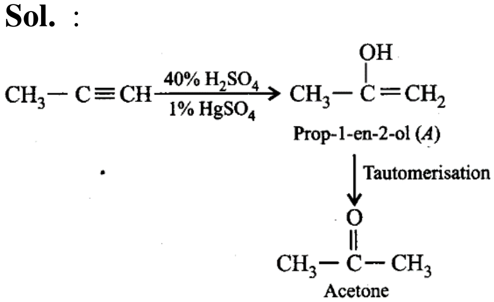


92. (c)

Sol. : Due to –I effect of Cl, chloroacetic acid is a stronger acid than acetic acid, Due to stabilization of phenoxide ion by resonance, phenol is a stronger acid than ethanol.

93. (d)

Sol. :



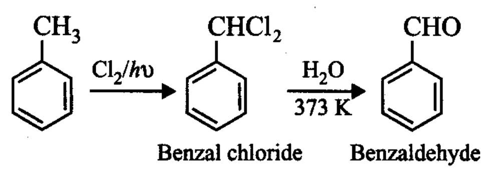
94. (a)

Sol. : In Clemmensen reduction the carbonyl group of aldehydes and ketones is reduced to CH_2 group on treatment with zinc amalgam and concentrated hydrochloric acid.

$>C{=}O \xrightarrow[HCl]{Zn\text{-}Hg} >CH_2 + H_2O$ (Clemmensen reduction)

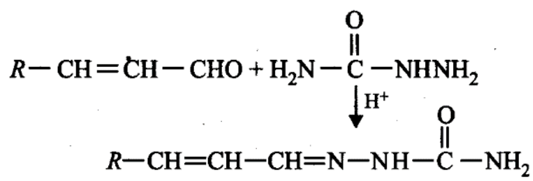
95. (d)

Sol. :



96. (b)

Sol. :



97. (a)

Sol. : Aldehydes and ketones form insoluble crystalline compounds with Na_2CO_3 again give the aldehydes and ketones.

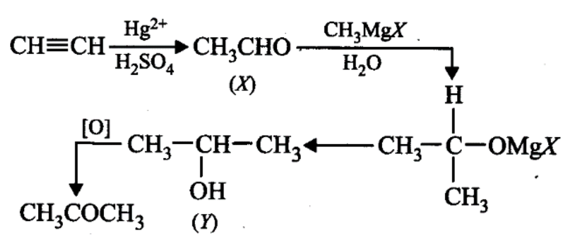
98. (b)

Sol. : Aldehydes give silver mirror test with Tollens' reagent while ketones form oximes with hydroxylamimne.

Hence the compound is a ketone. Alcohol and ethers do not give this test.

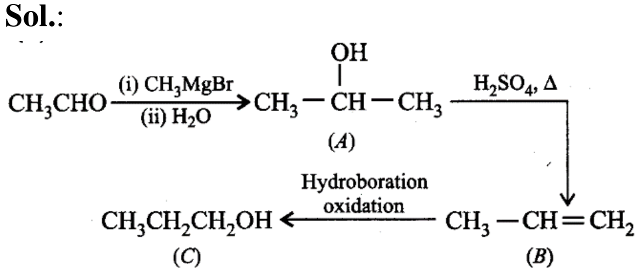
99. (c)

Sol. :



100. (b)

Sol.:



Compounds (*A*) and (*C*) are positional isomers.

BOTANY	
Q. NO.	[ANS]
101	B
102	D
103	B
104	A
105	A
106	D
107	D
108	C
109	D
110	C
111	D
112	C
113	B
114	D
115	C
116	B
117	A
118	C
119	D
120	C
121	B
122	A
123	C
124	B
125	D

ZOOLOGY	
Q. NO.	[ANS]
151	B
152	B
153	C
154	A
155	B
156	B
157	C
158	C
159	B
160	D
161	C
162	C
163	B
164	B
165	B
166	C
167	B
168	A
169	C
170	A
171	B
172	B
173	C
174	B
175	B

BOTANY	
126	B
127	C
128	A
129	B
130	D
131	C
132	D
133	C
134	B
135	A
136	B
137	B
138	A
139	A
140	D
141	B
142	B
143	B
144	B
145	B
146	A
147	C
148	B
149	A
150	C

ZOOLOGY	
176	B
177	D
178	A
179	A
180	C
181	D
182	A
183	A
184	B
185	A
186	D
187	C
188	D
189	A
190	B
191	C
192	D
193	A
194	D
195	C
196	B
197	C
198	A
199	B
200	B