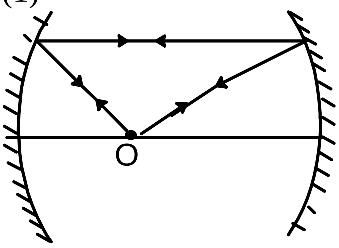
PCT - 4 - Physics (2017 Aspirants)
(SOLUTION)

1. (3)
Incident ray and final reflected rays are parallel to each other
$\Rightarrow \delta = 180^\circ$
As, $\delta = 360^\circ - 2\theta$
$180^\circ = 360^\circ - 2\theta \qquad \Rightarrow \theta = 90^\circ$

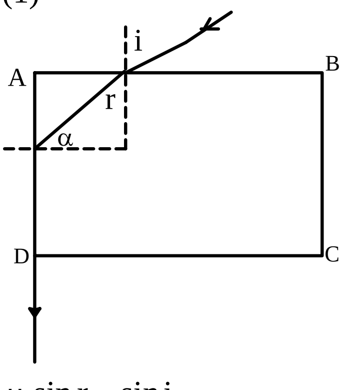
2. (1)



The object should be at the focus of each mirror
$\therefore$ Required minimum separation $= \frac{1}{2}(60 + 80)$
$= 70\,\text{cm}$

3. (1)
Fact

4. (1)



Snells law at surface AB
$\mu.\sin r = \sin i$
$\mu \sin(90^\circ - \alpha) = \sin i$
$\mu \cos\alpha = \sin i$
$\therefore \sin i = \mu\sqrt{1 - \sin^2\alpha}$

$= \mu\sqrt{1-\frac{1}{\mu^2}} = \sqrt{\mu^2 - 1}$

$\sin\alpha = \sqrt{\left(\sqrt{\frac{3}{2}}\right)^2 - 1} = \frac{1}{\sqrt{2}}$

$\therefore \alpha = 45^\circ$

5. (2)

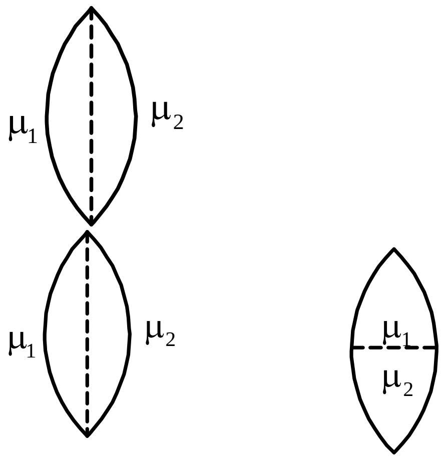
For conjugate positions, $m_1.m_2 = 1$

$m_1 = -\frac{8}{y}$ and $m_2 = -\frac{12.5}{y}$

$\therefore \left(-\frac{8}{y}\right)\left(-\frac{12.5}{y}\right) = 1$

$\Rightarrow y = 10\text{cm}$

6. (1)



7. (2)

Unless otherwise given, consider the telescope to be in normal adjustment

$m = \frac{f_0}{f_e} = 8$ and $L = f_0 + f_e = 54$

$\therefore f_e = 6\text{cm}$, and $f_0 = 48\text{cm}$

8. (2)

$m = m_0 \times m_e$

$30 = 5 \times m_e$

$\therefore m_e = \frac{30}{5} = 6$

9. (3)

Since $PS = QS$, path difference =zero

10. (1)

Number of fringes shifted $S=(\mu-1)\frac{t}{\lambda}$

$$S=(1.5-1)\frac{2\times10^{-6}}{5000\times10^{-10}}=2$$

11. (3)

$$\lambda' = \lambda\left(1-\frac{v}{c}\right)$$

$$\lambda' = 5890\left(1-\frac{4.5\times10^{6}}{3\times10^{8}}\right)=5802\,\overset{\circ}{A}$$

12. (4)

$$I_{max}+I_{min}=\left(I_1+I_2+2\sqrt{I_1I_2}\right)+\left(I_1+I_2-2\sqrt{I_1I_2}\right)$$

$$=2I_1+2I_2$$

$$=2I_1+2I_2$$

$$=2(I_1+I_2)$$

13. (2)

For second order minima

$$a\sin\theta=2\lambda$$

$$\sin\theta=\frac{2\lambda}{a}$$

14. (3)

$$\Delta\theta=\frac{\Delta y}{y}=1.22\left(\frac{\lambda}{d}\right)$$

$$\Delta y=1.22\times\left(\frac{5\times10^{-7}}{0.1}\right)\times10^{3}=6.1\times10^{-3}m=6.1mm$$

15. (2)

At polarising angle of incidence, the reflected and the refracted rays are perpendicular to each other

$i_p+r=90^\circ$ and $\delta=i_p-r=24^\circ$

From the two equations, $i_p=\frac{90^\circ+24^\circ}{2}=57^\circ$

16. (1)

Incident beam intensity $=I_0$

Intensity of light emerging from the first polarizer sheet $=\frac{I_0}{2}$

$\therefore$ Intensity of light emerging from the second polariser sheet $=\frac{I_0}{2}\cos^2 30^\circ=\frac{I_0}{2}\times\frac{3}{4}=\frac{3I_0}{8}$

17. (4)

$$\lambda=\frac{h}{mv}=\frac{6.6\times10^{-34}}{10\times10^{-3}\times2\times10^{4}}=3.3\times10^{-36}m$$

18. (1)

$$\frac{1}{\lambda}=R(z-1)^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

$$\frac{\lambda_1}{\lambda_2}=\left(\frac{z_2-1}{z_1-1}\right)^2=\left(\frac{42-1}{78-1}\right)^2=\left(\frac{41}{77}\right)^2$$

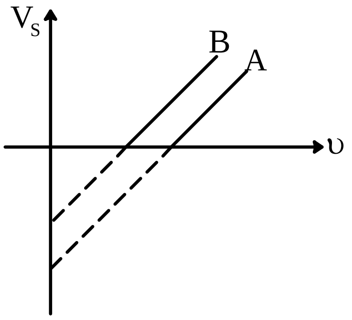
$$\lambda_2=\lambda_1\left(\frac{77}{41}\right)^2=1.30\left(\frac{77}{41}\right)^2=4.58A^{\circ}$$

19. (2)

The saturation current (I) of a photocell varies directly as the intensity of radiation, as intensity $\propto \frac{1}{d^2}$

$\therefore I \propto \frac{1}{d^2}$

20. (2)



Since the y- intercept for A is greater than that for B, the work function for A is greater than for B.

21. (3)

When the frequency is halved, the energy of incident radiation becomes 0.75ϕ where ϕ is the work function. Now incident energy is less than work function, no electrons are emitted, and hence photo current becomes zero.

22. (1)

$$\lambda=\frac{12400}{40,000}=0.31A^{\circ}$$

23. (2)

$$\tau=\frac{\tau_\alpha\tau_\beta}{\tau_\alpha+\tau_\beta}=\frac{1620\times520}{1620+520}=394\text{ yrs}$$

$$t=\frac{2,303}{\lambda}\log_{10}\left(\frac{N_0}{N}\right)=2.303\tau.\log_{10}\left(\frac{N_0}{N}\right)$$

$$=2.303\times394\times\log_{10}(4)=2.303\times394\times2\times0.301=546\text{ yrs}$$

24. (3)

$$\frac{1}{\lambda}=R(z-1)^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

$$\frac{1}{\lambda}=R(z-1)^2\left(\frac{1}{1^2}-\frac{1}{2^2}\right)=\frac{3}{4}R(z-1)^2$$

$$(z-1)^2 = \frac{4}{3R\lambda} = \frac{4}{3\times1.097\times10^7\times0.76\times10^{-10}} = 1599.25 \simeq 1600$$

$$(z-1) = 40$$

$$z = 41$$

25. (3)

$${}_1^2H + {}_1^2H \longrightarrow {}_2^4He + Q$$

Total binding energy of helium nucleus $= 4\times7 = 28\text{Mev}$

Total binding energy of each deuteron $= 2\times1.1 = 2.2\text{Mev}$

$\therefore$ energy released $= 28 - 2.2 = 23.6\,\text{Mev}$

26. (3)

$$\text{Power} = \frac{\text{total energy}}{\text{total time}} = \frac{n\times E}{t}$$

$n =$ number of uranium atom fissioned

$E =$ energy released in each fission

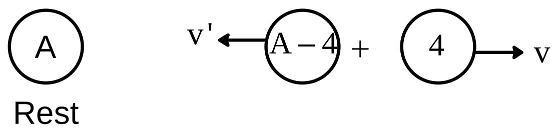
$$\text{So, } 300\times10^6 = \frac{n\times\left(170\times10^6\right)\times1.6\times10^{-19}}{3600}$$

$$n = 40\times10^{21}$$

27. (3)

From conservation of linear momentum : $4v = (A-4)v'$

$$\therefore v = \frac{4v}{A-4}$$



28. (1)

$$N = N_0\left(\frac{1}{2}\right)^n$$

$$\frac{N_0}{16} = N_0\left(\frac{1}{2}\right)^n$$

$\therefore$ $n = 4$ half lives $= 4\times100 = 400\mu s$

29. (4)

$\omega = \frac{v}{r}$ $r = 0.529n^2 A^\circ$, $v = \left(\frac{c}{137}\right)\frac{n}{z} m/s$

$v \propto \frac{1}{n}$ and $r \propto n^2$

$$\therefore \omega \propto \frac{1}{n^3}$$

30. (4)

Energy difference $= z^2\left(E_2 - E_1\right)$

For hydrogen atom, $z = 1$, $E_2 - E_1 = 10.2\,eV$

For doubly ionized lithium atom, $z = 3$

$$\Delta E = 3^2(10.2eV) = 91.8\,eV$$

31. (4)

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

$$\frac{1}{\lambda} = R\left[1 - \frac{1}{4}\right] = \frac{3R}{4}$$

Wave number $= \frac{3R}{4}$

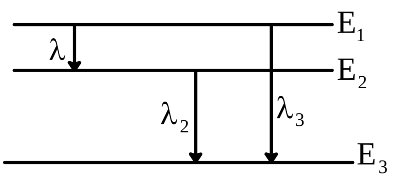
32. (3)

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

Angular momentum in 2^{nd} orbits $= 2\left(\frac{h}{2\pi}\right) = \frac{h}{\pi}$

Angular momentum in 3^{rd} orbit $= 3\left(\frac{h}{2\pi}\right) = \frac{3L}{2}$

33. (2)



From energy level diagram

$$E_1 - E_3 = (E_1 - E_2) + (E_2 - E_3)$$

$$\frac{hc}{\lambda_3} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$

$$\frac{1}{\lambda_3} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$$

$$\therefore \lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$$

34. (2)

$$R = R_0 (A)^{\frac{1}{3}} = 1.2 \times 10^{-15} (64)^{\frac{1}{3}} = 1.2 \times 10^{-15} \times 4$$

$$= 4.8 \times 10^{-15} = 4.8\,\text{fermi}$$

35. (4)

In a nuclear reaction, the charge, mass, energy , momentum and spin are conserved.

36. (2)

When a diode is in the reverse bias, the majority charge carriers are pulled away from the junction due to the applied electric field. Therefore, the width of the p-n junction increases.

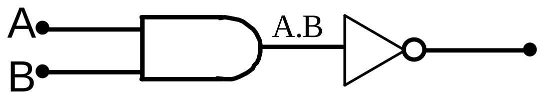
37. (3)

$$\alpha = \frac{\Delta I_c}{\Delta I_e} = 0.98$$

$$\therefore \Delta I_c = 0.98 \times 2 = 1.96\text{mA}$$

$$\Delta I_b = \Delta I_e - \Delta I_c = 2 - 1.96 = 0.04\text{mA}$$

38. (1)



$y = \overline{A.B} = \text{NAND gate}$

39. (1)

$n_e.n_h = n_1^2$

$$n_e = \frac{n_i^2}{n_h} = \frac{\left(3\times10^{16}\right)}{4.5\times10^{22}} \simeq 2\times10^{10}\,m^{-3}$$

40. (2)

$\beta = 50$

$$\alpha = \frac{\beta}{1+\beta} = \frac{50}{51} = 0.98$$

41. (2)

In case of forward biasing, resistance across p-n junction diode is zero. So, whole voltage appear across the resistance.

42. (3)

$$\lambda\left(\text{in } A^\circ\right) = \frac{12400}{E\left(\text{in eV}\right)} = \frac{12400}{57\times10^{-3}} = 217543\,A^\circ$$

43. (4)

Fact

44. (3)

$$d = \sqrt{2Rh_T} = \sqrt{2\times6.4\times10^6\times240} = 55\,km$$

45. (4)

$$A = 2\pi Rh_T = 2\pi\times\left(6.4\times10^6\right)\times150$$

$= 1.92\pi\times10^9.m^2$

$= 1.92\pi\times10^3\,km^2$

PCT - 4 - Chemistry (2017 Aspirants)
(SOLUTION)

46) (3)

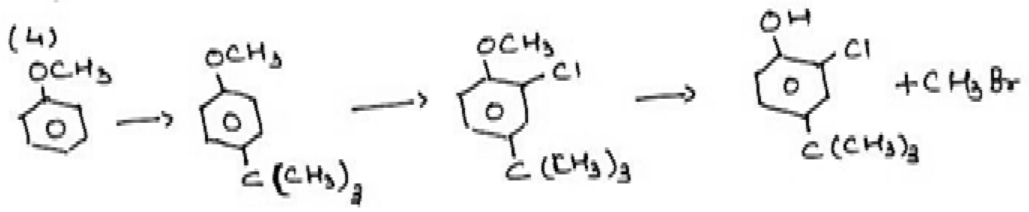
47) (2)
Due to C-Cl double-bond character, it will not provide the required electrophile.

48) (3)
due to absence of $\left[CH_3-\overset{O}{\overset{\|}{C}}-\right]$ group in it.

49) (1)
Phenol is more acidic than aliphatic alcohols.

50) (1)
More reactive is less selective; so goes to that type of H-atom which is more in number.

51) (4)



52) (2)

53) (1)

54) (1)
NBS causes allylic or benzylic H-atom by Br-atom.

55) (4)

$H_3C-CH_2-CH_2-\underset{Cl}{\underset{|}{C}}H_2 \rightarrow CH_3-CH_2-CH=CH_2$

$H_3C-CH_2-\underset{Cl}{\underset{|}{C}}H-CH_3 \rightarrow CH_3-CH=CH-CH_3$

56) (2)
Dipole moment of CH_4 and CCl_4 is zero and among chloroderivatives of methane, as the no. of Cl-atom increases, dipole moment decreases.

57) (3)

58) (1)

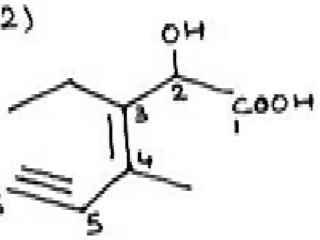
$$CH_3CH_2CH=CH_2 \xrightarrow{HBr/H_2O_2} CH_3CH_2CH_2-CH_2Br \ (Y)$$

$$\downarrow C_2H_5ONa$$

$$CH_3CH_2CH_2CH_2-OCH_2CH_3$$

59) (4)

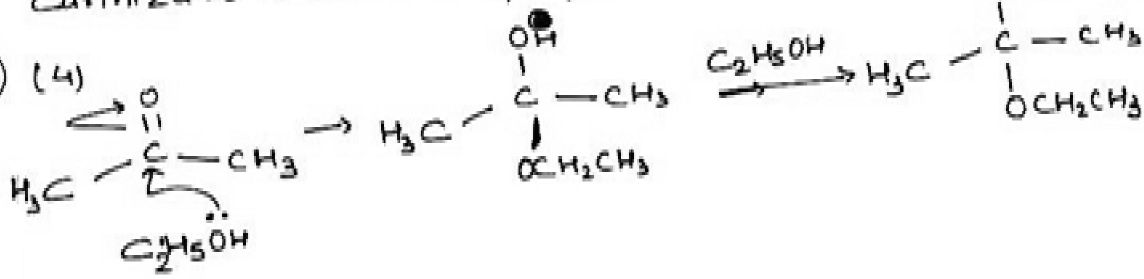
60) (2)



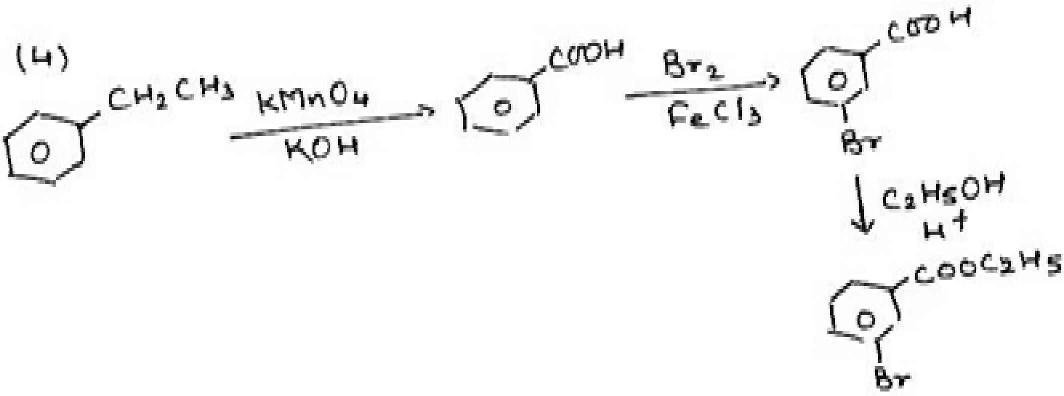
61) (3)

Cannizaro reaction (Disproportionation)

62) (4)



63) (4)



64) (1)

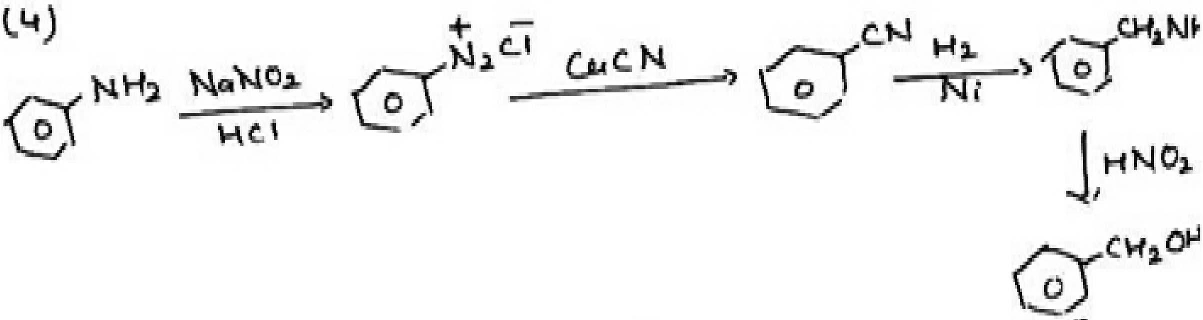
65) (4)

66) (3)

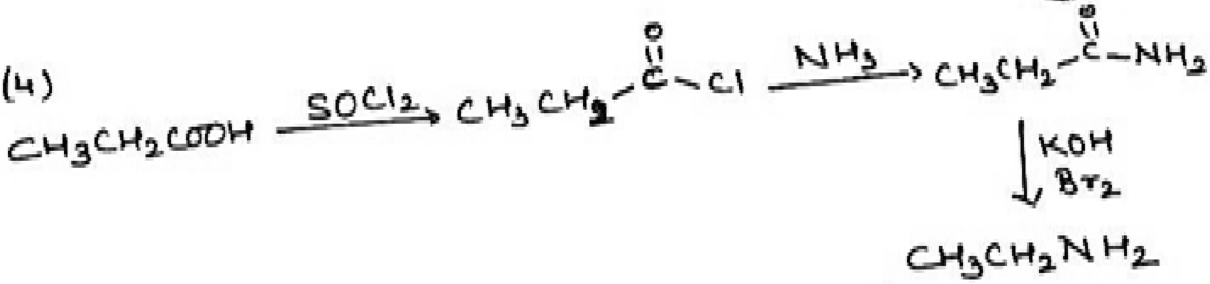
67) (1) $n\,H_2N(CH_2)NH_2 + n\,HOOC(CH_2)_4COOH \xrightarrow[-H_2O]{\text{Polymerization}} [NH(CH_2)NHCO(CH_2)_4CO]_n$

(68) (1) Product is yellow oily liquid.

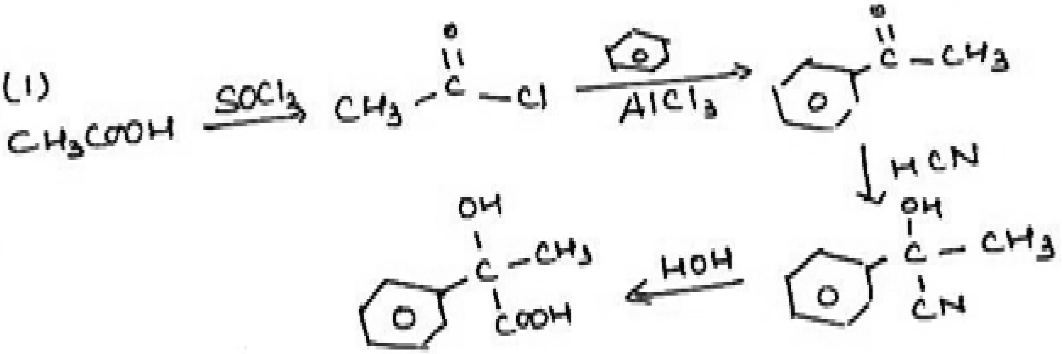
(69) (4)



(70) (4)

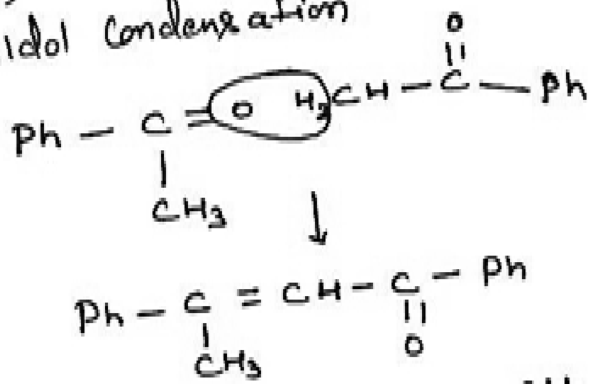


(71) (1)

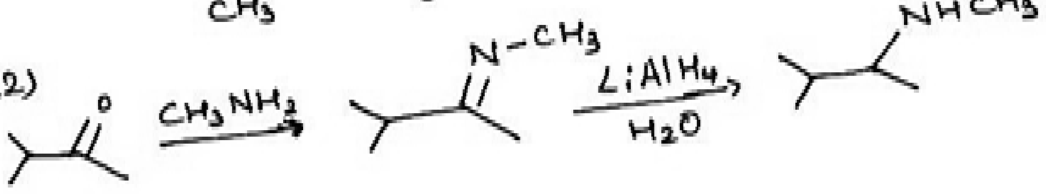


(72) (1)

Aldol Condensation



(73) (2)

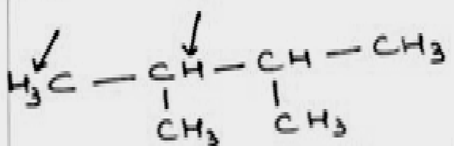


(74) (2)

(75) (2)

4 isomers are possible, out of which 2 are Chiral.

76 (3)



(only 2 type of H-atoms)

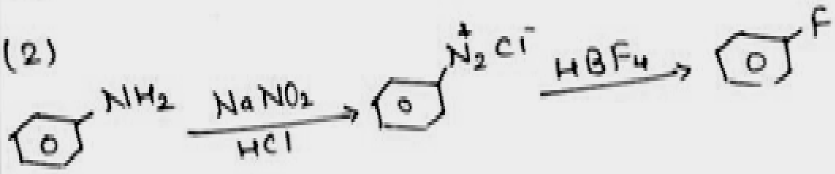
77 (3)

78 (3)
3° alcohols are easily dehydrated.
(3° > 2° > 1°)

79 (2)
Cannizaro Reaction requires aldehyde without H atom at α-carbon.

80 (3)

81 (2)



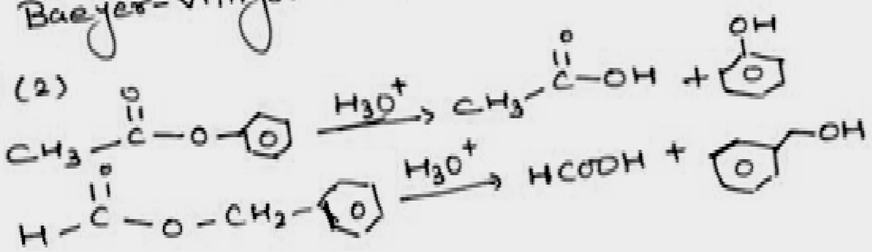
82 (1)

83 (4)

84 (2)
Beckmann Rearrangement
↳ only that group migrates which is anti to -OH group.
Migratory aptitude has no role to play.

85 (2)
Baeyer-villiger oxidation

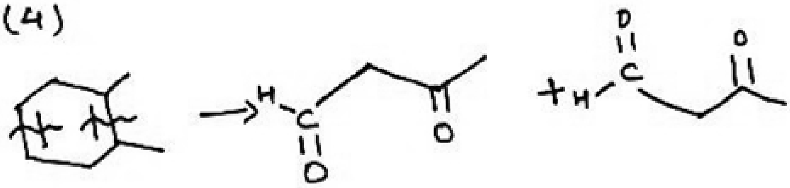
86 (2)



(87) (1)
Wolf-Kishner Reduction

(88) (1)
Pinacole-Pinacolone Rearrangement

(89) (4)



(90) (2)

PCT - 04 - Zoology (2017 Aspirants)
(SOLUTION)

91. (1)
92. (1)
93. (1)
94. (4)
95. (3)
96. (1)
97. (1)
98. (2)
99. (1)
100. (4) Increase in population is 150-50 = 100 per hour
101. (2)
102. (2)
103. (2)
104. (1)
105. (1)
106. (1) Birth rate = 25/30 x 100 = 0.83 and Death rate = 8/30 x 100 = 0.26
107. (4)
108. (4)
109. (2)
110. (3)
111. (4)
112. (4)
113. (1)
114. (1)
115. (1)
116. (4)
117. (4)
118. (3)
119. (3)
120. (2)
121. (2)
122. (3)
123. (2)
124. (4)
125. (3)
126. (1)
127. (1)
128. (4)
129. (2)
130. (3)
131. (3)
132. (4)
133. (4)
134. (3)
135. (3)
136. (2)
137. (2)
138. (2)
139. (2)
140. (1)
141. (1)
142. (2)
143. (4)
144. (3)
145. (1) In a grassland ecosystem, no. of consumers will be less than producers
146. (4)
147. (3)
148. (2)
149. (3)
150. (2)
151. (3)
152. (2)
153. (1)
154. (4) According to Central Pollution Control Board (CPCB), particulate size of 2.5 μm or less in diameter are responsible for causing the greatest harm to human health.
155. (2)
156. (4)
157. (3)
158. (3)
159. (3)
160. (2)
161. (1)
162. (1)

163. (3)

164. (2) Birth control pills inhibit ovulation. Copper T is inserted in uterine cavity. Tubectomy is cutting and ligation of fallopian tube. Diaphragm is inserted in the vagina.

165. (3)

166. (4)

167. (3)

168. (4)

169. (1)

170. (1)

171. (1)

172. (2)

173. (2)

174. (2)

175. (3)

176. (4)

177. (3)

178. (2)

179. (1)

180. (2)