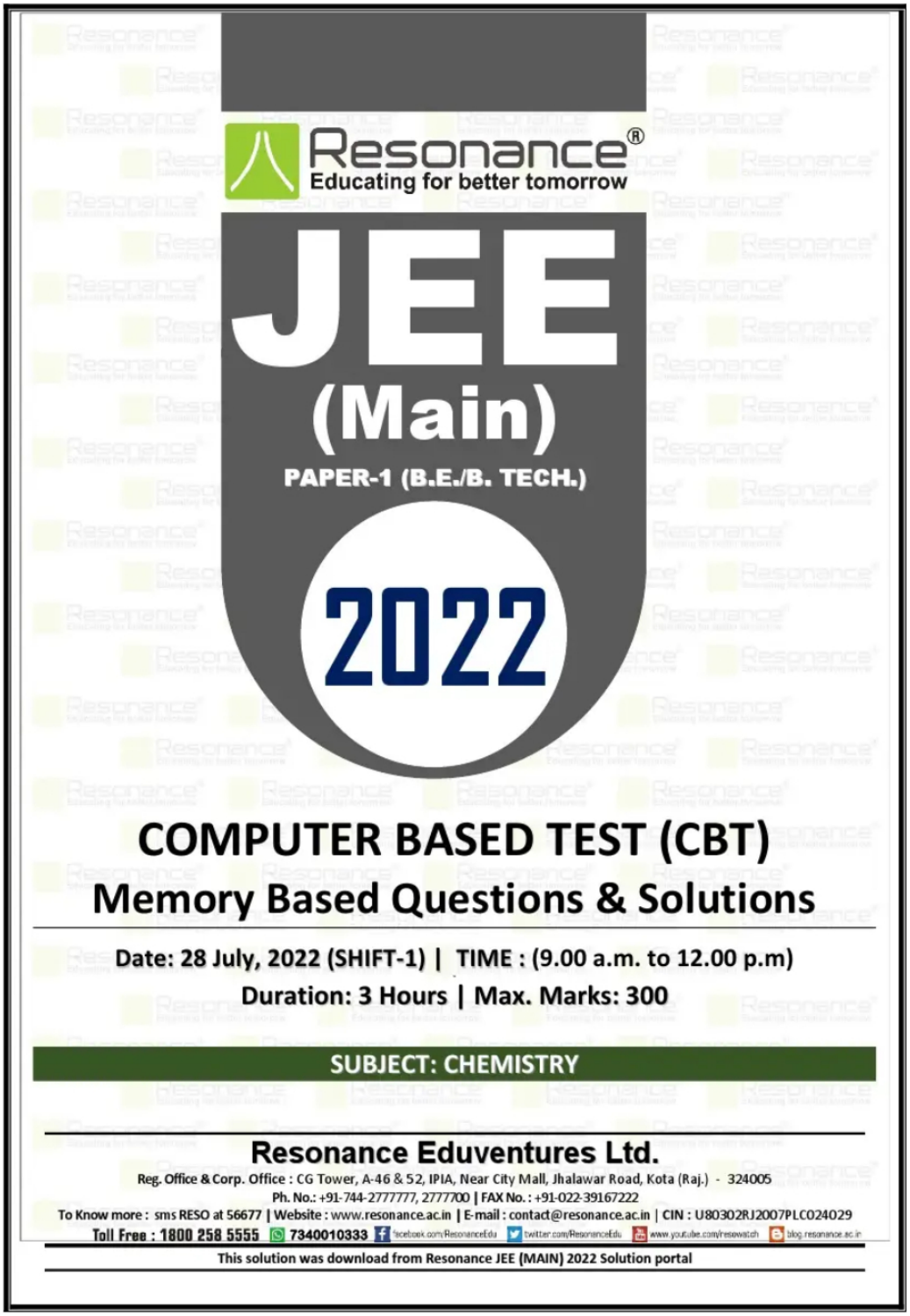


PART : CHEMISTRY

1. Which of the following is correct ?

(1) An orbital is represented by only n, ℓ.

(2) Hydrogen spectrum helps to prove Bohr's model.

(3) Electron revolve in circular orbit proposed by Bohr's.

(4) An atomic orbital is the wave function ψ for an electron in an atom.

Ans. (4)

Sol. An orbital is represented by only n, ℓ, m
Bohr model fails for explanation of the details of hydrogen atom spectrum.

2. Which of the following have least tendeny to liberated $H_2(g)$ on reaction with acidic solution.
(1) Cu (2) Fe (3) Ni (4) Mn

Ans. (1)

Sol. As $E^{\circ}_{Cu^{2+}/Cu}$ = 0.34 V, $E^{\circ}_{Fe^{2+}/Fe}$ = –0.44 V ; $E^{\circ}_{Ni^{2+}/Ni}$ = –0.24 V
As $E^{\circ}_{H^+/H_2}$ = 0.0 V
So cu does not liberated $H_2(g)$ on reaction with acid.

3.

	List-I Process/Reaction		**List-II Catalyst**
(i)	$N_2 + 3H_2 \rightarrow 2NH_3$	(a)	Fe
(ii)	$2SO_2 + O_2 \rightarrow 2SO_3$	(b)	NO
(iii)	Sucrose $\rightarrow$ Glucose + Fructose	(c)	Pt
(iv)	$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$;	(d)	H_2SO_4

Identify correct matching

	i	ii	iii	iv
(1)	a	b	d	c
(2)	b	a	d	c
(3)	a	b	c	d
(4)	a	c	d	b

Ans. (1)

Sol. $N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$

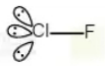
$2SO_2 + O_2 \xrightarrow{Pt} 2SO_3$

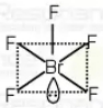
$4NH_3(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O(g)$

$C_{12}H_{22}O_{11}(aq) + H_2O(l) \xrightarrow{H_2SO_4(l)} \underbrace{C_6H_{12}O_6(aq)}_{\text{Glucose}} + \underbrace{C_6H_{12}O_6(aq)}_{\text{Fructose}}$
Solution — Solution

4. Which of the following have square pyramidal geometry.
ClF, BrF_5, ClF_5, IF_5, BrF_3, I_2Cl_6, ICl_3

Ans. (3)

Sol. ClF ⇒  ⇒ Linear

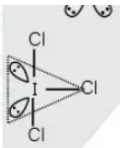
BrF_5  Square pyramidal

ClF_5  Square pyramidal

IF_5  Square pyramidal

BrF_3  T-shape

I_2Cl_6  Square planer



ICl_3 T-shape

5. pH of 0.2M Butyric acid [Ka (acid) = 2×10^{-5}, log 2 = 0.3]
Is $[x] \times 10^{-1}$ then value of x is–
(Report your answer to nearest integer for weak acid)

Ans. (27)

Sol. $pH = \frac{1}{2}[pKa - \log c]$

$pH = \frac{1}{2}[4.7 - \log 2 \times 10^{-1}]$

$pH = \frac{1}{2}[4.7 - \log 2 + 1]$

$pH = \frac{1}{2}[4.7 + 1 - 0.3]$

$pH = \frac{1}{2}[5.4]$

$= 2.7$

$= 27 \times 10^{-1}$

6. K_2MnO_4 on disproportionation in acidic medium give two products of Mn, A and B the oxidation state of B is less than that of A. Then find magnetic moment (spin only) of B
[Report your answer to nearest integer]

Ans. (4)

Sol. $\overset{+6}{3MnO_4^{2-}} + 4H^+ \longrightarrow \underset{\text{'A'}}{\overset{+7}{2MnO_4^-}} + \underset{\text{'B'}}{\overset{+4}{MnO_2}} + H_2O$

Magnetic moment of is $\overset{+4}{MnO_2}$ is

$Mn^{4+} = 3d^3$ so unpaired $e^- = 3$

μ (spin only) $= \sqrt{3(3+2)}$

$= \sqrt{15}$ BM $= 3.87$ BM ≈ 4BM

7. Which set of element have almost same value of electron gain enthalpy

(a) Rb, Cs (b) At, I (c) Kr, Ar (d) Na, K

(1) a, b only (2) b, c only (3) a, c only (4) b, d only

Ans. (3)

Sol.

Element	Rb	Cs	At	I	Kr	Ar	Na	K
Electron gain enthalpy (kJ/mole)	46	46	233	296	–96	–96	53	48

8. How many of the following species are paramagnetic in character

B_2, He_2^+, O_2^{2-}, O_2^+ C_2 O_2^-

Ans. (4)

Sol. $He_2^+ : (\sigma 1s)^2 (\sigma^* 1s)^1$

$B_2 : (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p^1_x = \pi 2p^1_y) (\sigma p_z)^0$

$C_2 : (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p^2_x = \pi 2p^2_y)$

$C_2^- : (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p^2_x = \pi 2p^2_y) (\sigma 2p_z)^2$

$O_2^+ : (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2 (\pi 2p^2_x = \pi 2p^2_y) (\pi^* 2p_x^1 = \pi^* 2p^0_y)$

$O_2^{2-} : (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2 (\pi 2p^2_x = \pi 2p^2_y) (\pi^* 2p_x^2 = \pi^* 2p^2_y)$

Species	B_2	He_2^+	O_2^{2-}	O_2^+	C_2	C_2^-
Magnetic character	PM	PM	DM	PM	DM	PM

9. Identify incorrect relation from the following

(1) $\Delta H = \Delta U - \Delta PV$ (2) $\Delta G = \Delta H - T\Delta S$

(3) $\Delta S_{sys} + \Delta S_{surr} \geq 0$ [For spontaneous process] (4) $\Delta U = q + w$

Ans. (1)

Sol. $\Delta H = \Delta U + P\Delta V$

10. Clark method is used to remove temporary hardness of water. Which of the following product are formed during this process.

(1) $Mg(OH)_2$ & $Ca(OH)_2$ (2) Na_2CO_3, $MgCO_3$

(3) $CaCO_3$, & $Mg(OH)_2$ (4) Na_2CO_3, $Ca(OH)_2$

Ans. (3)

Sol. Clark method

$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$

$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2 + 2H_2O$

11. A metal crystalize in bcc structure with edge length of unit cell 300 pm. If density of solid is 6 gram /c.c, than number of atom present in 180 gram of solid is $[x] \times 10^{23}$, than value of x is.

[Report your answer in nearest integer]

Ans. (22)

Sol. $d = \dfrac{Z \times M}{N_A \times \text{volume}}$

$b = \dfrac{2 \times M}{6.02 \times 10^{23}[3 \times 10^{-8}]^3}$

$M = \dfrac{6 \times 6.02 \times 10^{23} \times 27 \times 10^{-24}}{2}$

$M = 48.762$ gram

No. of atom in 180 gram $= \dfrac{180}{48.762} \times N_A = 22.22 \times 10^{23}$

12. Half life of a first order reaction is 0.30min. then find the ratio of initial concentration to final concentration after 2min.

Ans. (100)

Sol. $T_{1/2} = \dfrac{0.693}{k} \Rightarrow k = \left(\dfrac{0.693}{0.30}\right) = 2.303\ min^{-1}$

$C_t = C_0\, e^{-kt}$

$\dfrac{C_0}{C_t} = e^{kt} = e^{2.303 \times 2}$

$\dfrac{C_0}{C_t} = e^{(\ln 10)2} = {}_e\ln(10)^2$

$\dfrac{C_0}{C_t} = 100$

13. Which of the following statement is incorrect

(1) LiF is less soluble in water due to less hydration enthalpy

(2) Na has higher density than K

(3) KO_2 is paramagnetic

(4) Sodium solution in liquid ammonia conduct electricity

Ans. (1)

Sol. LiF is less soluble in water due to high value of lattice energy

14. **List I** **List**

Cell reaction **Type of cell**

(I) $Zn(Hg) + HgO(s) \longrightarrow ZnO(s) + Hg(l)$ (a) Primary cell

(II) $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$ (b) Fuel cell

(III) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$ (c) Secondary cell

(IV) $Cd(s) + 2Ni(OH)_3(s) \longrightarrow CdO(s) + 2Ni(OH)_2(s) + H_2O(l)$ (d) discharging reaction of Secondary cell

	I	II	III	IV		I	II	III	IV
(1)	a	d	b	c	(2)	a	b	c	d
(3)	c	b	a	d	(4)	a	d	c	b

Ans. (1)

Sol. $Zn(Hg) + HgO(s) \longrightarrow ZnO(s) + Hg(l)$ – Primary cell

$Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \longrightarrow 2PbSO_4(s) + 2H_2O(l)$ – discharging reaction of Secondary cell

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$ – Fuel cell

$Cd(s) + 2Ni(OH)_3(s) \longrightarrow CdO(s) + 2Ni(OH)_2(s) + H_2O(l)$ – Secondary cell

15.

List I (Reactant)	List II (Gas released on heating or reaction)
(I) $(NH_4)_2Cr_2O_7$	(a) H_2
(II) $KMnO_4 + HCl$	(b) N_2
(III) $Al + NaOH + H_2O$	(c) O_2
(IV) $NaNO_3$	(d) Cl_2

	I	II	III	IV
(1)	b	d	a	c
(2)	a	b	c	d
(3)	c	d	a	b
(4)	a	d	c	b

Ans. (1)

Sol. (i) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2(g) + Cr_2O_3 + H_2O$

(ii) $MnO_4^- + Cl^- \longrightarrow Cl_2(g) + Mn^{2+}$

(iii) $Al + NaOH + H_2O \longrightarrow Na[Al(OH)_4] + H_2(g)$

(iv) $NaNO_3(s) \xrightarrow{\Delta} NaNO_2(s) + O_2(g)$

16. 1 mole of X, 1 mole of Y and 0.05 mole Z on reaction give XYZ_3. Then yield of XYZ_3 is..... gram
[given Atomic masses of X, Y, Z are : 10, 20, 30 gram/mole]

Ans. (2)

Sol.

	X	+	Y	+	3Z	⟶	XYZ_3
Initial mole	1 mole		1 mole		0.05 mole LR is Z		
	$\left(1-\frac{0.05}{3}\right)$		$\left(1-\frac{0.05}{3}\right)$		0		$\left(\frac{0.05}{3}\right)$ mole

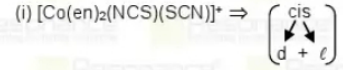
Molar mass of XYZ_3 is = [10 + 20 + 90] = 120 gram

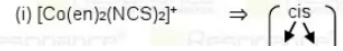
yield of $XYZ_3 = \left[\frac{0.05}{3} \times 120\right] = 2$ gram

17. Find total number of isomers of $[Co(en)_2(SCN)_2]^+$ which is more stable than this compound.

Ans. (6)

Sol. $[Co(en)_2(NCS)(SCN)]^+$ & $[Co(en)_2(NCS)_2]^+$ Both are more stable than $[Co(en)_2(SCN)_2]^+$ and both of these complex have total 6 isomer.

(i) $[Co(en)_2(NCS)(SCN)]^+ \Rightarrow$  + trans $\Rightarrow 3$

(i) $[Co(en)_2(NCS)_2]^+ \Rightarrow$  + trans $\Rightarrow 3$

$(d + \ell)$

$\frac{\qquad\qquad\qquad}{6}$

18. An organic compound is formed by carbon, Hydrogen and oxygen. 0.462 gram of this compound on complete combustion give 0.7938 gram of CO_2 (g) and 0.4428 gram of H_2O, then % of oxygen in compound is-
[Report your answer to nearest integer]

Ans. (42)

Sol. $C_xH_yO_z + O_2(g) \rightarrow CO_2(g) + H_2O$
0.462gram 0.7938gram 0.4428 gram

Mass of carbon = $\left[\frac{0.7938}{44}\right] 12 = 0.2165$ gram

Mass of hydrogen = $\left[\frac{0.4428}{18}\right] 2 = 0.0492$ gram

Total mass of oxygen = 0.4620 – [0.2165 + 0.0492]
= 0.4620 –0.2657
= 0.1963 gram

% of oxygen = $\frac{0.1963}{0.4620} \times 100 = 42.48\%$
= 42.49

19. When 10.2 gram of ascorbic acid (GMM = 176 gram/mole) is dissolved in 500 gram of CH_3COOH then depression is freezing point is [X] $\times 10^{-1}$ K. The value of X is –
[Given K_f (CH_3COOH) = 3.9 K.Kg / mole]
(Report your answer of nearest integer)

Ans. (5)

Sol. $\Delta T_f = K_f \times m$

$= 3.9 \left[\frac{10.2 \times 1000}{176 \times 500}\right]$

$= \left[\frac{3.9 \times 10.2}{176}\right] 2$

= 0.4520
= 4.52×10^{-1}K

20. Which of the following reaction is involved in leaching process.
(1) $Al_2O_3(s) + 2NaOH(aq) + 3H_2O(l) \longrightarrow 2Na[Al(OH)_4](aq)$
(2) $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$
(3) $2PbS + 3O_2 \xrightarrow{\Delta} 2PbO + 2SO_2$
(4) $Cr_2O_3 + Al \rightarrow Al_2O_3 + Cr$

Ans. (1)

Sol. $Al_2O_3(s) + 2NaOH(aq) + 3H_2O(l) \longrightarrow 2Na[Al(OH)_4](aq)$ —— Leaching process
$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$ —— Self-reduction method
$2PbS + 3O_2 \xrightarrow{\Delta} 2PbO + 2SO_2$ —— Roasting
$2Al + Cr_2O_3 \longrightarrow Al_2O_3 + 2Cr$ (molten) —— Thermite reaction.

21. Enzyme inhibitors are of two types
1. Competitive Inhibitor
2. Non Competitive Inhibitor
Which of the following statements is correct
(1) Competitive inhibitor bind to allosteric site and non competitive inhibitor bind to active site
(2) Competitive inhibitor bind to active site and non competitive inhibitor bind to allosteric site
(3) Both competitive inhibitor and non competitive inhibitor bind to active site
(4) Both competitive inhibitor and non competitive inhibitor bind to allosteric site

Ans. (2)

Sol. From NCERT

22. (i)  (A) Spiro compound

(ii)  (B) Bicyclo compound

(iii)  (C) Aromatic compound

(iv)  (D) Heterocyclic nonplanar

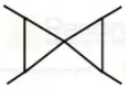
(1) (i) – (D), (ii) – (A), (iii) – (B), (iv) – (C) (2) (i) – (D), (ii) – (A), (iii) – (C), (iv) – (B)

(3) (i) – (A), (ii) – (D), (iii) – (B), (iv) – (C) (4) (i) – (D), (ii) – (B), (iii) – (A), (iv) – (C)

Ans. (4)

Sol. 
Heterocyclic non planar


Bicyclo compound


Spiro compound


Aromatic compound

23. Terylene is composed of

(1) 1,4- benzene dicarboxylic acid & ethane-1,2-diol

(2) 1,3- benzene dicarboxylic acid & ethane-1,2-diol

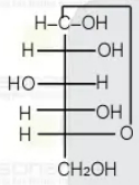
(3) 1,4- benzene dicarboxylic acid & propane-1,2-diol

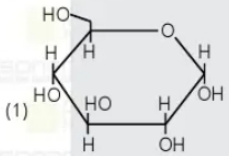
(4) 1,3- benzene dicarboxylic acid & propane-1,2-diol

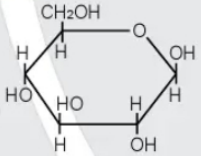
Ans. (1)

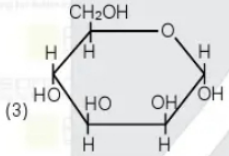
Sol. Monomers of Terelyne (Dacron) are 1,4- benzene dicarboxylic acid & ethane-1,2-diol

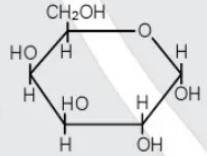
24. Correct pyranose structure of the following compound



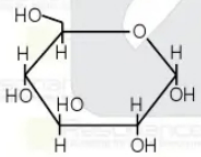
(1) 

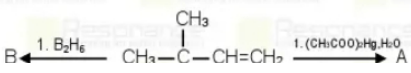
(2) 

(3) 

(4) 

Ans. (1)

Sol. 

25. 

2. H_2O_2, OH^- | CH_3 | 2. $NaBH_4$

(1) Product A is formed by Markownikoffi's rule & product B is formed by Anti Markownikoff's rule.
(2) Product A is formed by Anti Markownikoff's rule & product B is formed by Markownikoff's rule.
(3) Product A is formed by Markownikoffi's rule & product B is formed by Markownikoff's rule.
(4) Product A is formed by Anti Markownikoff's rule & product B is formed by Anti Markownikoff's rule.

Ans. (1)

Sol. Product (A) is formed by oxymercuration-Demercuration reaction in which Markownikoff's product is formed as major product, while product (B) is formed by hyroboration oxidation reaction in which Anti Markownikoff's product is formed as major product.

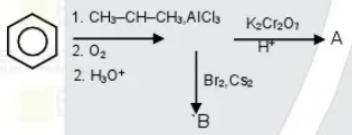
26. $CH_3–CH_2–CH_2–\underset{\underset{+N(CH_3)_3}{|}}{CH}–CH_3 \xrightarrow[C_2H_5OH]{C_2H_5O^-Na} \underset{\text{Major}}{A} + \underset{\text{Minor}}{B}$

(1) Product A is $CH_3–CH_2–CH=CH–CH_3$; product B is $CH_3–CH_2–CH_2–CH=CH_2$ (Hoffman product)
(2) Product A is $CH_3–CH_2–CH_2–CH=CH_2$ (Hoffman product); product B is $CH_3–CH_2–CH=CH–CH_3$
(3) Both Product A and B are $CH_3–CH_2–CH_2–CH=CH_2$ (Hoffman product)
(4) Both Product A and B are $CH_3–CH_2–CH=CH–CH_3$ (Hoffman product)

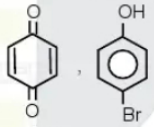
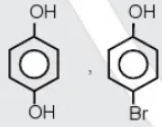
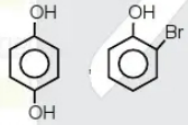
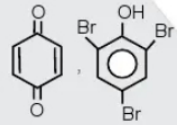
Ans. (2)

Sol. $CH_3–CH_2–CH_2–\underset{\underset{+N(CH_3)_3}{|}}{CH}–CH_3 \xrightarrow[C_2H_5OH]{C_2H_5O^-Na} \underset{\text{(Hoffman product)}}{CH_3–CH_2–CH_2–CH=CH_2}\ \text{Major} + CH_3–CH_2–CH=CH–CH_3\ \text{Minor}$

27.

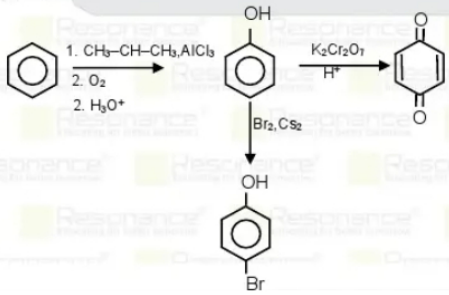


Products A & B are respectively

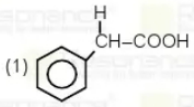
(1) 
(2) 
(3) 
(4) 

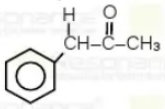
Ans. (1)

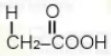
Sol.

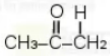


28. Which of the following indicate H-atom has lowest value of pKa

(1) 

(2) 

(3) 

(4) 

Ans. (2)