JEE ADVANCED (Paper - 2)

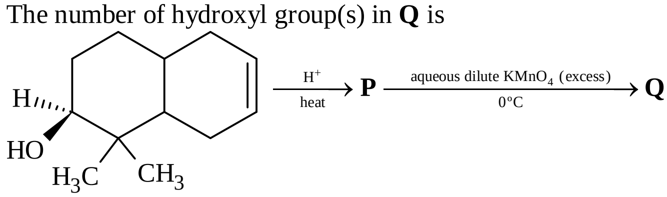
CHEMISTRY Code - 4

SECTION 1 (Maximum Marks: 32)

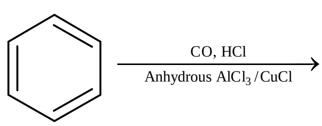
- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive
- For each question, darken the bubble corresponding to the correct integer in the ORS
- Marking scheme:
  +4 If the bubble corresponding to the answer is darkened
  0 In all other cases

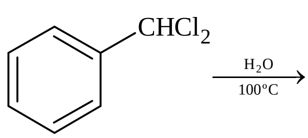
*21. In dilute aqueous H_2SO_4, the complex diaquodioxalatoferrate(II) is oxidized by MnO_4^-. For this reaction, the ratio of the rate of change of $[H^+]$ to the rate of change of $[MnO_4^-]$ is

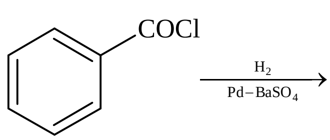
*22. The number of hydroxyl group(s) in **Q** is

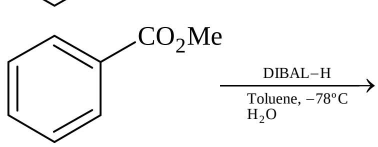


23. Among the following, the number of reaction(s) that produce(s) benzaldehyde is

I 

II 

III 

IV 

24. In the complex acetylbromidodicarbonylbis(triethylphosphine)iron(II), the number of Fe–C bond(s) is

25. Among the complex ions, $[Co(NH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2)_2Cl_2]^+$, $[CrCl_2(C_2O_4)_2]^{3-}$, $[Fe(H_2O)_4(OH)_2]^+$, $[Fe(NH_3)_2(CN)_4]^-$, $[Co(NH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2)_2(NH_3)Cl]^{2+}$ and $[Co(NH_3)_4(H_2O)Cl]^{2+}$, the number of complex ion(s) that show(s) *cis-trans* isomerism is

*26. Three moles of B_2H_6 are completely reacted with methanol. The number of moles of boron containing product formed is

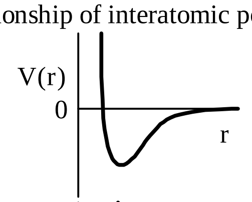
27. The molar conductivity of a solution of a weak acid HX (0.01 M) is 10 times smaller than the molar conductivity of a solution of a weak acid HY (0.10 M). If $\lambda^0_{X^-} \approx \lambda^0_{Y^-}$, the difference in their pK_a values, $pK_a(HX) - pK_a(HY)$, is (consider degree of ionization of both acids to be << 1)

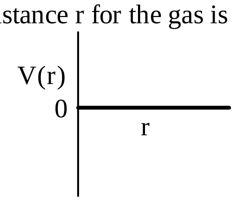
28. A closed vessel with rigid walls contains 1 mol of $^{238}_{92}U$ and 1 mol of air at 298 K. Considering complete decay of $^{238}_{92}U$ to $^{206}_{82}Pb$, the ratio of the final pressure to the initial pressure of the system at 298 K is

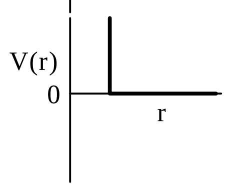
SECTION 2 (Maximum Marks: 32)

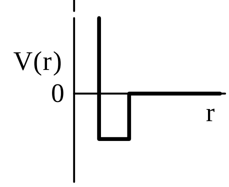
- This section contains **EIGHT** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- Marking scheme:
  +4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened
  0 If none of the bubbles is darkened
  –2 In all other cases

*29. One mole of a monoatomic real gas satisfies the equation p(V – b) = RT where b is a constant. The relationship of interatomic potential V(r) and interatomic distance r for the gas is given by

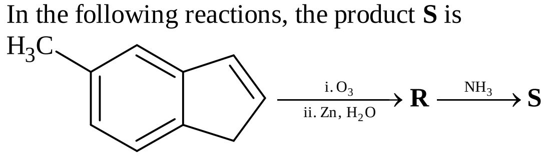
(A) 

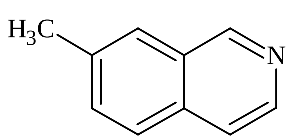
(B) 

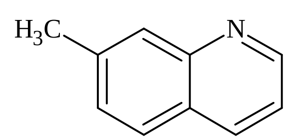
(C) 

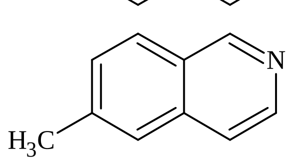
(D) 

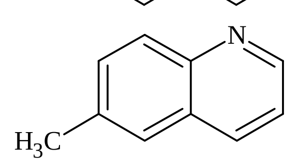
30. In the following reactions, the product **S** is



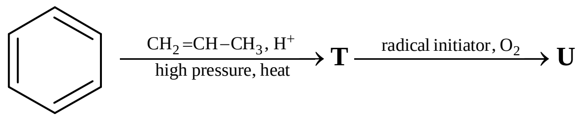
(A) 

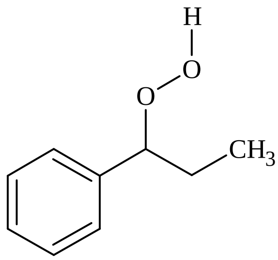
(B) 

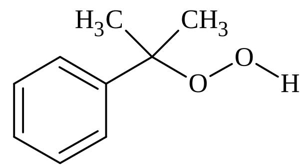
(C) 

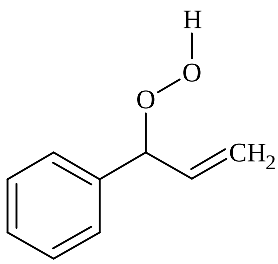
(D) 

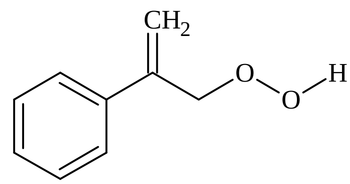
31. The major product **U** in the following reactions is



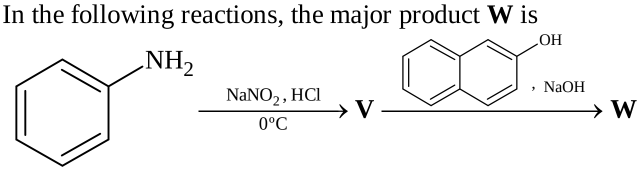
(A) 

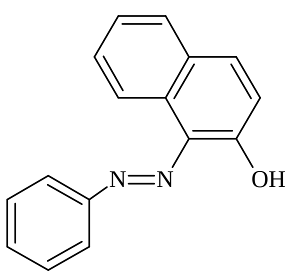
(B) 

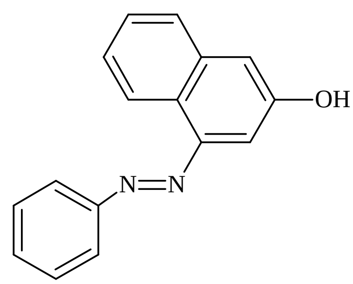
(C) 

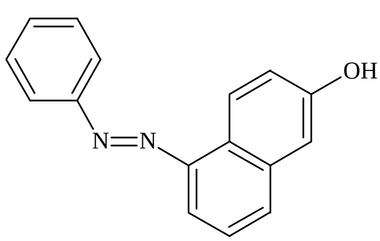
(D) 

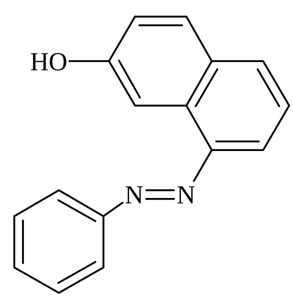
32. In the following reactions, the major product **W** is



(A) 

(B) 

(C) 

(D) 

*33. The correct statement(s) regarding, (i) $HClO$, (ii) $HClO_2$, (iii) $HClO_3$ and (iv) $HClO_4$, is (are)
(A) The number of $Cl = O$ bonds in (ii) and (iii) together is two
(B) The number of lone pairs of electrons on Cl in (ii) and (iii) together is three
(C) The hybridization of Cl in (iv) is sp^3
(D) Amongst (i) to (iv), the strongest acid is (i)

34. The pair(s) of ions where BOTH the ions are precipitated upon passing H_2S gas in presence of dilute HCl, is(are)

(A) Ba^{2+}, Zn^{2+}
(B) Bi^{3+}, Fe^{3+}
(C) Cu^{2+}, Pb^{2+}
(D) Hg^{2+}, Bi^{3+}

*35. Under hydrolytic conditions, the compounds used for preparation of linear polymer and for chain termination, respectively, are

(A) CH_3SiCl_3 and $Si(CH_3)_4$
(B) $(CH_3)_2SiCl_2$ and $(CH_3)_3SiCl$
(C) $(CH_3)_2SiCl_2$ and CH_3SiCl_3
(D) $SiCl_4$ and $(CH_3)_3SiCl$

36. When O_2 is adsorbed on a metallic surface, electron transfer occurs from the metal to O_2. The **TRUE** statement(s) regarding this adsorption is(are)

(A) O_2 is physisorbed
(B) heat is released
(C) occupancy of π^*_{2p} of O_2 is increased
(D) bond length of O_2 is increased

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** paragraphs
- Based on each paragraph, there will be **TWO** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
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PARAGRAPH 1

When 100 mL of 1.0 M HCl was mixed with 100 mL of 1.0 M NaOH in an insulated beaker at constant pressure, a temperature increase of 5.7°C was measured for the beaker and its contents **(Expt. 1).** Because the enthalpy of neutralization of a strong acid with a strong base is a constant (–57.0 kJ mol^{-1}), this experiment could be used to measure the calorimeter constant. In a second experiment **(Expt. 2)**, 100 mL of 2.0 M acetic acid ($K_a = 2.0 \times 10^{-5}$) was mixed with 100 mL of 1.0 M NaOH (under identical conditions to **Expt. 1)** where a temperature rise of 5.6°C was measured.
(Consider heat capacity of all solutions as 4.2 J g^{-1} K^{-1} and density of all solutions as 1.0 g mL^{-1})

*37. Enthalpy of dissociation (in kJ mol^{-1}) of acetic acid obtained from the **Expt. 2** is

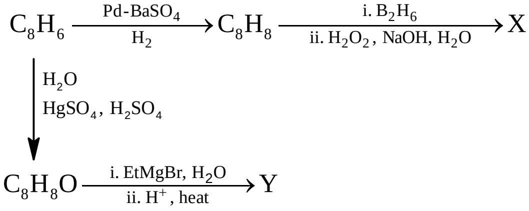
(A) 1.0
(B) 10.0
(C) 24.5
(D) 51.4

*38. The pH of the solution after **Expt. 2** is

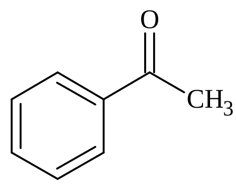
(A) 2.8
(B) 4.7
(C) 5.0
(D) 7.0

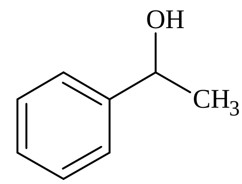
PARAGRAPH 2

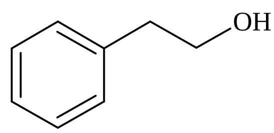
In the following reactions

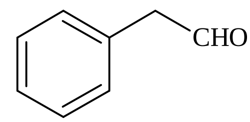


39. Compound **X** is

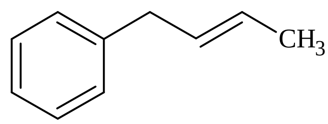
(A) 

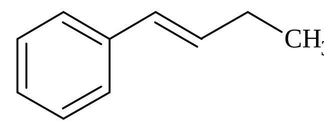
(B) 

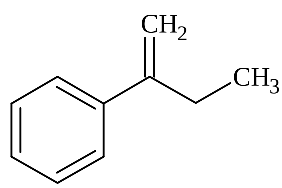
(C) 

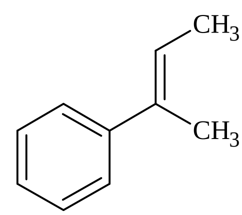
(D) 

40. The major compound **Y** is

(A) 

(B) 

(C) 

(D) 

PAPER-2 [Code – 4]
JEE (ADVANCED) 2015
ANSWERS

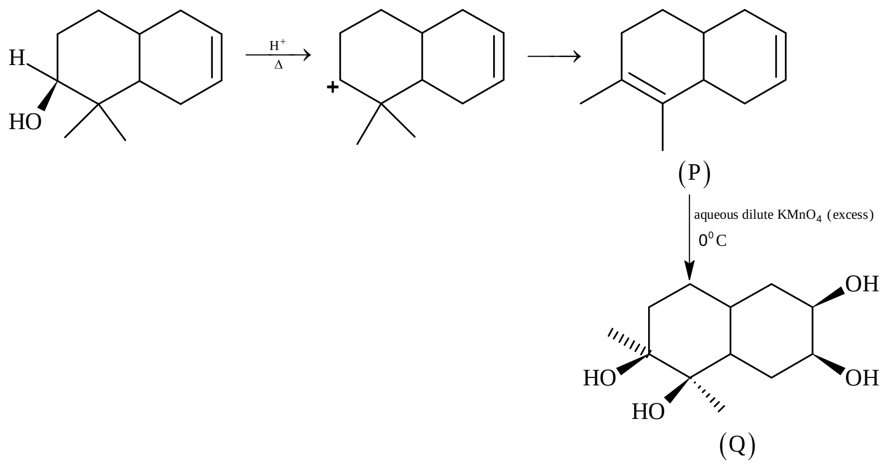
CHEMISTRY

21.	**8**	22.	**4**	23.	**4**	24.	**3**
25.	**5**	26.	**6**	27.	**3**	28.	**9**
29.	**C**	30.	**A**	31.	**B**	32.	**A**
33.	**B, C**	34.	**C, D**	35.	**B**	36.	**B,C,D**
37.	**A**	38.	**B**	39.	**C**	40.	**D**

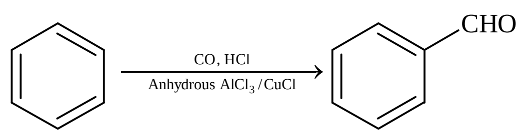
21. $\left[Fe(C_2O_4)(H_2O)\right]^{2-} + MnO_4^{2-} + 8H^+ \longrightarrow Mn^{2+} + Fe^{3+} + 4CO_2 + 6H_2O$

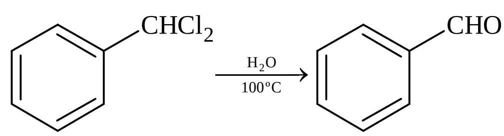
So the ratio of rate of change of $[H^+]$ to that of rate of change of $[MnO_4^-]$ is 8.

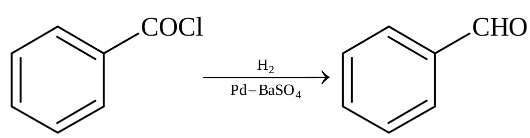
22.

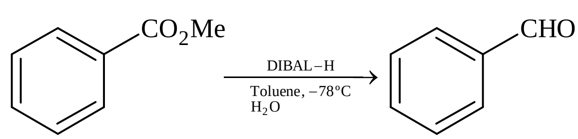


23.

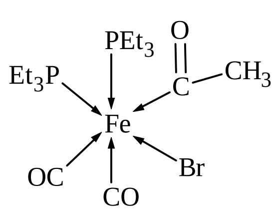
I 

II 

III 

IV 

24.



The number of Fe – C bonds is 3.

25. $\left[Co(en)_2Cl_2\right]^+ \longrightarrow$ will show cis – trans isomerism

$\left[CrCl_2(C_2O_4)_2\right]^{3-} \longrightarrow$ will show cis – trans isomerism

$\left[Fe(H_2O)_4(OH)_2\right]^+ \longrightarrow$ will show cis – trans isomerism

$\left[Fe(CN)_4(NH_3)_2\right]^- \longrightarrow$ will show cis – trans isomerism

$\left[Co(en)_2(NH_3)Cl\right]^{2+} \longrightarrow$ will show cis – trans isomerism

$\left[Co(NH_3)_4(H_2O)Cl\right]^{2+} \longrightarrow$ will **not** show cis – trans isomerism (Although it will show geometrical isomerism)

26. $B_2H_6 + 6MeOH \longrightarrow 2B(OMe)_3 + 6H_2$

1 mole of B_2H_6 reacts with 6 mole of MeOH to give 2 moles of $B(OMe)_3$.
3 mole of B_2H_6 will react with 18 mole of MeOH to give 6 moles of $B(OMe)_3$

27. $HX \rightleftharpoons H^+ + X^-$

$$Ka = \frac{[H^+][X^-]}{[HX]}$$

$HY \rightleftharpoons H^+ + Y^-$

$$Ka = \frac{[H^+][Y^-]}{[HY]}$$

Λ_m for $HX = \Lambda_{m_1}$

Λ_m for $HY = \Lambda_{m_2}$

$$\Lambda_{m_1} = \frac{1}{10}\Lambda_{m_2}$$

$Ka = C\alpha^2$

$$Ka_1 = C_1 \times \left(\frac{\Lambda_{m_1}}{\Lambda^0_{m_1}}\right)^2$$

$$Ka_2 = C_2 \times \left(\frac{\Lambda_{m_2}}{\Lambda^0_{m_2}}\right)^2$$

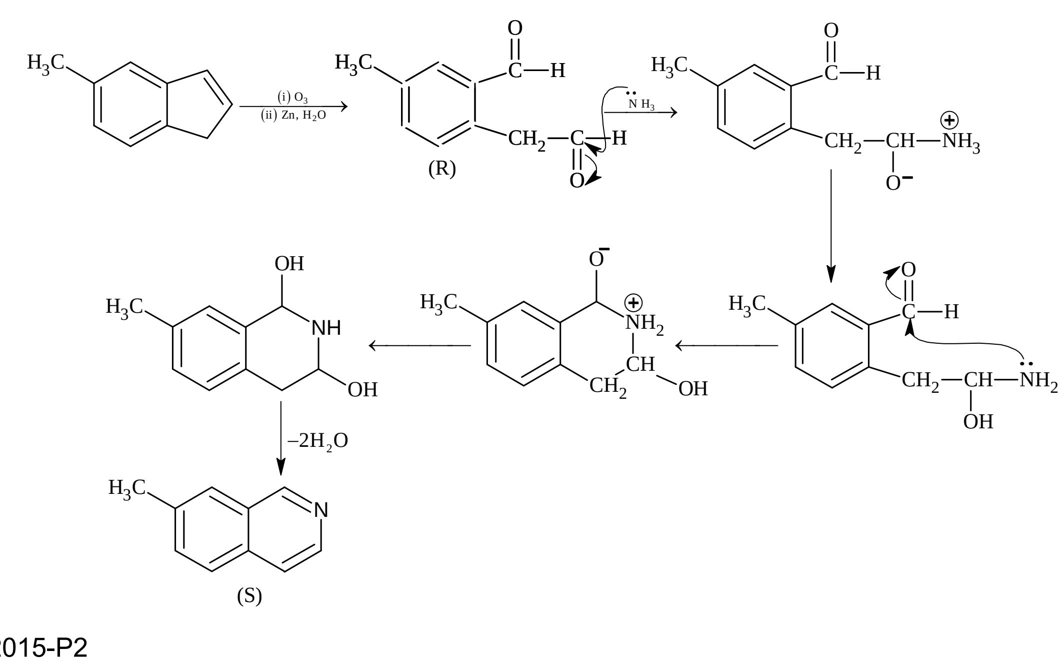
$$\frac{Ka_1}{Ka_2} = \frac{C_1}{C_2} \times \left(\frac{\Lambda_{m_1}}{\Lambda_{m_2}}\right)^2 = \frac{0.01}{0.1} \times \left(\frac{1}{10}\right)^2 = 0.001$$

$pKa_1 - pKa_2 = 3$

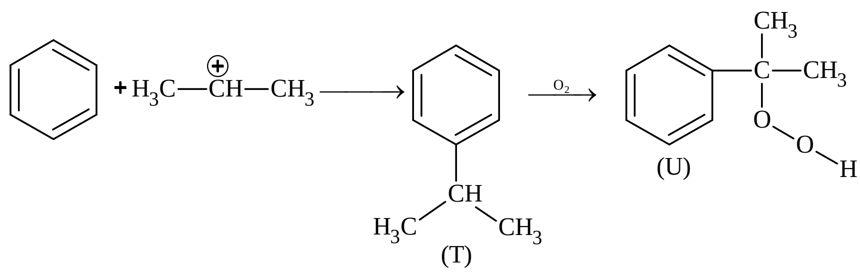
28. In conversion of ${}^{238}_{92}U$ to ${}^{206}_{82}Pb$, 8α - particles and 6β particles are ejected.
The number of gaseous moles initially = 1 mol
The number of gaseous moles finally = 1 + 8 mol; (1 mol from air and 8 mol of ${}_2He^4$)
So the ratio = 9/1 = 9

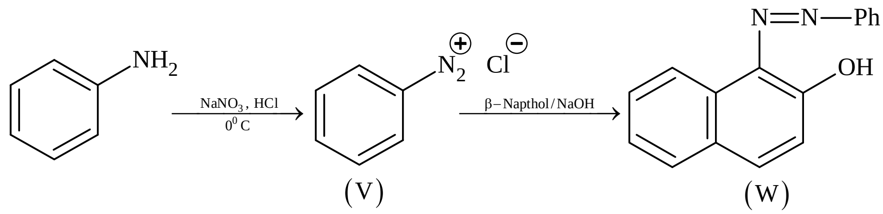
29. At large inter-ionic distances (because a $\rightarrow$ 0) the P.E. would remain constant.
However, when r $\rightarrow$ 0; repulsion would suddenly increase.

30.



(S)

31. 

32. 

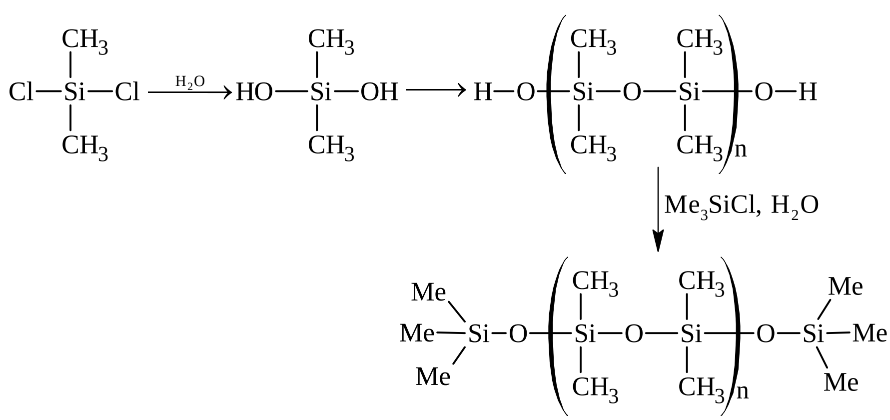
33. H—O—Cl (I)

H—O—$\ddot{\underset{\cdot\cdot}{Cl}}$=O (II)

H—O—$\ddot{Cl}$(=O)=O (III)

H—O—Cl(=O)(=O)=O (IV)

34. Cu^{2+}, Pb^{2+}, Hg^{2+}, Bi^{3+} give ppt with H_2S in presence of dilute HCl.

35. 

36. * Adsorption of O_2 on metal surface is exothermic.
* During electron transfer from metal to O_2 electron occupies π^*_{2p} orbital of O_2.
* Due to electron transfer to O_2 the bond order of O_2 decreases hence bond length increases.

37. $HCl + NaOH \longrightarrow NaCl + H_2O$

n = 100 ×1 = 100 m mole = 0.1 mole
Energy evolved due to neutralization of HCl and NaOH = 0.1 × 57 = 5.7 kJ = 5700 Joule
Energy used to increase temperature of solution = 200 × 4.2 × 5.7 = 4788 Joule
Energy used to increase temperature of calorimeter = 5700 – 4788 = 912 Joule
$ms.\Delta t = 912$
$m.s \times 5.7 = 912$
ms = 160 Joule/°C [Calorimeter constant]
Energy evolved by neutralization of CH_3COOH and NaOH
$= 200 \times 4.2 \times 5.6 + 160 \times 5.6 = 5600$ Joule
So energy used in dissociation of 0.1 mole CH_3COOH = 5700 – 5600 = 100 Joule
Enthalpy of dissociation = 1 kJ/mole

38. $CH_3COOH = \frac{1 \times 100}{200} = \frac{1}{2}$

$CH_3CONa = \frac{1 \times 100}{200} = \frac{1}{2}$

$pH = pK_a + \log \frac{[salt]}{[acid]}$

$pH = 5 - \log 2 + \log \frac{1/2}{1/2}$

pH = 4.7

39. $C_8H_6 \longrightarrow =$ double bond equivalent $= 8 + 1 - \frac{6}{2} = 6$