Paper-2

JEE Advanced, 2015

PART II: CHEMISTRY

Note: Answers have been highlighted in "Yellow" color and Explanations to answers are given at the end

READ THE INSTRUCTIONS CAREFULLY:

GENERAL:

1. This sealed booklet is your Question Paper. Do not break the seal till you are told to do so.

2. The question paper CODE is printed on the left hand top corner of this sheet and the right hand top corner of the back cover of this booklet.

3. Use the Optical Response Sheet (ORS) provided separately for answering the questions.

4. The ORS CODE is printed on its left part as well as the right part. Ensure that both these codes are identical and same as that on the question paper booklet. If not, contact the invigilator.

5. Blank spaces are provided within this booklet for rough work.

6. Write your name and roll number in the space provided on the back cover of this booklet.

7. After breaking the seal of the booklet, verify that the booklet contains **32** pages and that all the **60** questions along with the options are legible.

QUESTIONS PAPER FORMAT AND MARKING SCHEME:

8. The question paper has three parts: Physics, Chemistry and Mathematics, Each part has three sections.

9. Carefully read the instructions given at the beginning of each section.

10. Section 1 contains 8 questions. The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

Marking scheme: +4 for correct answer and 0 in all other cases.

11. Section 2 contains 8 multiple choice questions with one or more than one correct option.

Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

12. Section 3 contains 2 "paragraph" type questions. Each paragraph describes an experiment, a situation or a problem. Two multiple choice questions will be asked based on this paragraph. One of or more than one option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

OPTICAL RESPONSE SHEET:

13. The ORS consists of an original (top sheet) and its carbon- less copy (bottom sheet.)

14. Darken the appropriate bubbles on the original by applying sufficient pressure. This will leave an impression at the corresponding place on the carbon – less copy.

15. The original is machine – gradable and will be collected by the invigilator at the end of the examination.

16. You will be allowed to take away the carbon – less copy at the end of the examination,

17. Do not tamper with or mutilate the ORS.

18. Write your name, roll number and the name of the examination center and sign with pen in the space provided for this purpose on the original. **Do not write any of these details anywhere else**. Darken the appropriate bubble under each digit of your roll number.

Note: Answers have been highlighted in "Yellow" color and Explanations to answers are given at the end

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

Q.21 In the complex acetylbromidodicarbonylbis (triethylphosphine)iron(II), the number of Fe-C bond(s) is

Ans.21 (3)

Q.22 Among the complex ions, $[Co(NH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2)_2Cl_2]^+$,$[CrCl_2(C_2O_4)_2]^{3-}$, $[Fe(H_2O)_4(OH)_2]^+$,$[Fe(NH_3)_2(CN)_4]$, $[Co(NH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2)_2(NH_3)Cl]^{2+}$ and $[Co(NH_3)_4(H_2OCl)]^{2+}$, the number of complex ion(s) that show(s) cis-trans isomerism is

Ans.22 (6)

Q.23 Three moles of B_2H_6 are completely reacted with methanol. The number of moles of boron containing product formed is

Ans.23 (6)

Q.24 The molar conductivity of a solution of a weak acid HX (0.001 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 is their pK_a values, $pKa(HX)$- pK_a (HY), is (consider degree of ionization of both acids be << 1)

Ans.24 (3)

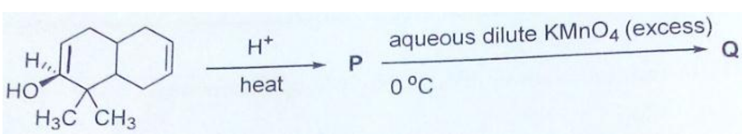
Q.25 A closed vessel with rigid walls contains 1 mol of ${}^{238}_{92}U$ and 1 mol of air at 298 K. Considering complete decay of ${}^{238}_{92}U$ to ${}^{206}_{82}Pb$, the ratio of the final pressure to the initial pressure of the system at 298 K is

Ans.25 (9)

Q.26 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

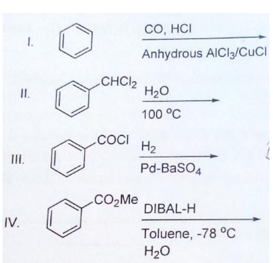
Ans.26 (8)

Q.27 The number of hydroxyl group(s) in Q is



Ans.27 (4)

Q.28 Among the following, the number of reaction(s) that produce (s) benzaldehyde is



Ans.28 (4)

SECTION 2 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- Each question has **FOUR** option (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option (s) is (are) correct
- For each questions, 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 case

Q.29 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) heart is released

(C) occupancy of π^*_{2p} of O_2 is increased

(D) bond length of O_2 is increased

Ans.29 (B,C,D)

Q.30 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 $(CH_3)_3SiCl$

Ans.30 (B)

Q.31 The pair(s) of ions where BOTH the ions are precipitated upon passing H_2S gas in presence of dilute HCI, is(are)

(A) Ba^{2+}, Zn^{2+}

(B) Bi^{3+}, Fe^{3+}

(C) Cu^{2+}, Pb^{2+}

(D) Hg^{2+}, Bi^{3+}

Ans.31 (C,D)

Q.32 The correct statements(s) regarding, (i) HCIO, (ii) $HCIO_2$, (iii) $HCIO_3$ and (iv) $HCIO_4$, is (are)

(A) The number of $CI = O$ bonds in (ii) and (iii) together is two

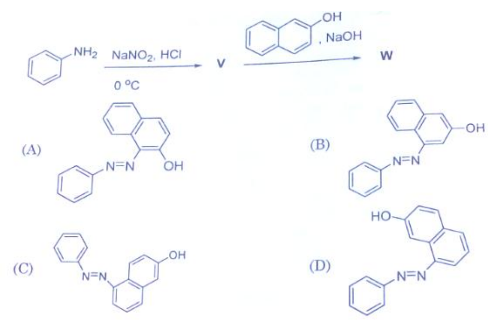
(B) The number of lone pairs of electrons on Cl in (ii) and (iii) together is three

(C) The hybridization of Cl in (iv) is sp^3

(D) Amongst (i) to (iv), the strongest acid is (i)

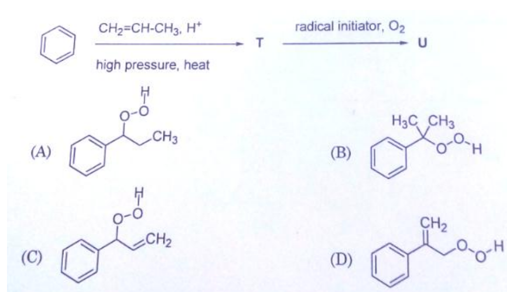
Ans.32 (B,C)

Q.33 In the following reactions, the major product W is



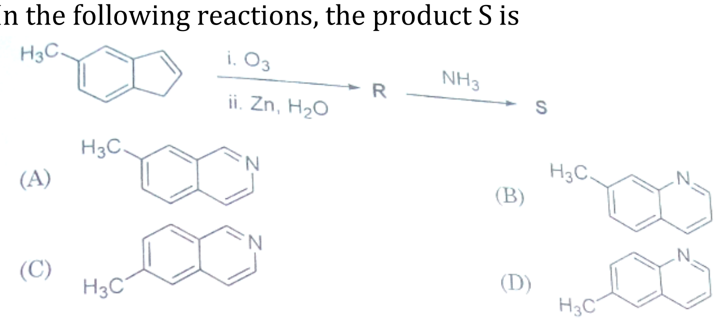
Ans.33 (A)

Q.34 The major product U in the following reactions is



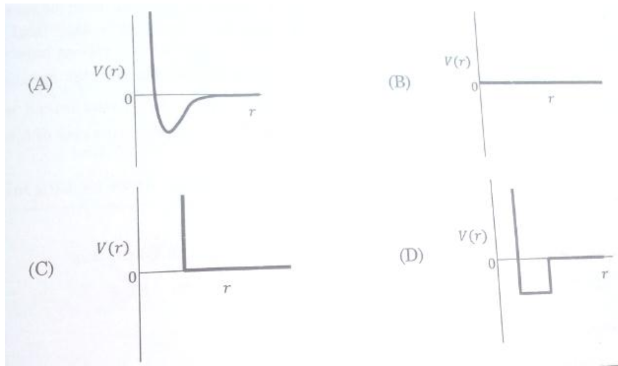
Ans.34 (B)

Q.35 In the following reactions, the product S is



Ans.35 (A)

Q.36 One mole of a monatomic 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



Ans.36 (C)

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
- 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

PARAGRAPH 1

When 100 mL of 1.0 M HCI 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 1000 mL of 1.0 M NaOH (under identical conditions to Expt.1) where a temperature rise of 5.6° 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

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

(A) 1.0 (B) 10.0

(C) 24.5 (D) 51.4

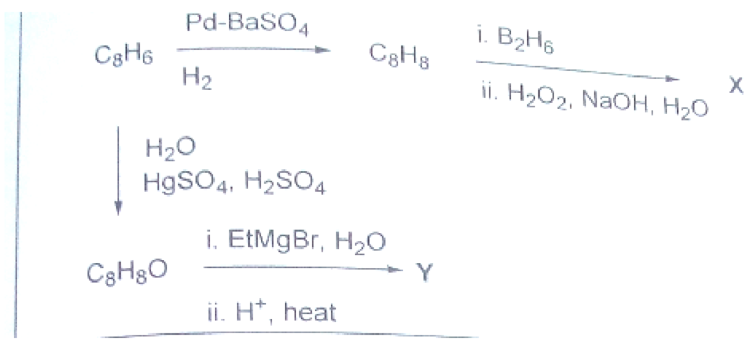
Ans.37 (A)

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

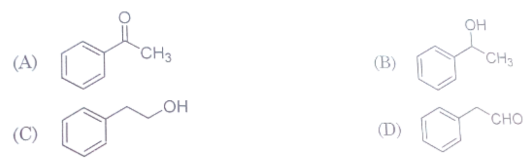
(A) 2.8 (B) 4.7

(C) 5.0 (D) 7.0

Ans.38 (B)

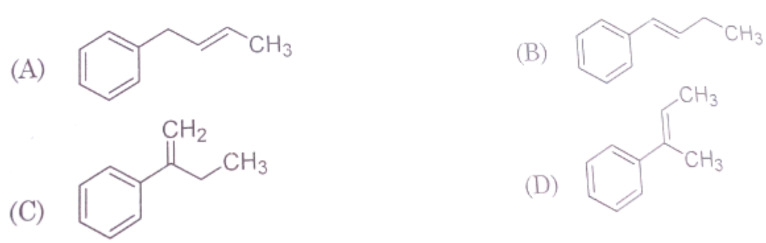


Q.39 Compound X is



Ans.39 (C)

Q.40 The major compound Y is



Ans.40 (D)

Answer Keys and Explanations

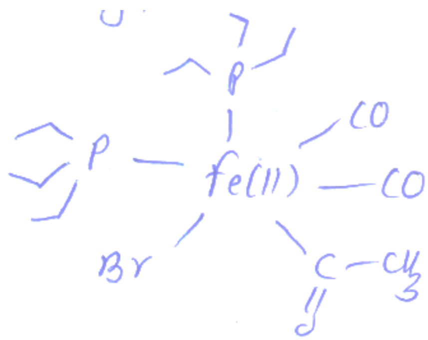
Sol.21 (3)

acetyl CH_3 CO ⟶ mono coordination

Bromido Br^- ⟶ mono coordination

dicarbonyl CO & CO ⟶ di coordination

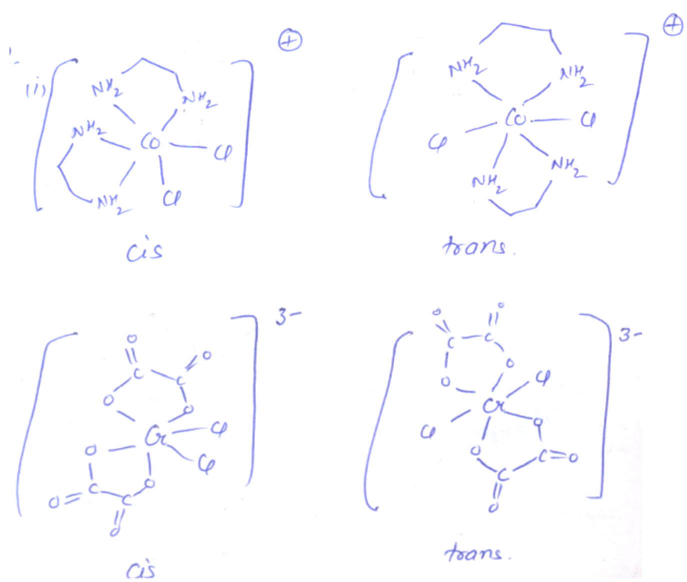
bis (triethylphosphene) ⟶ di coordination

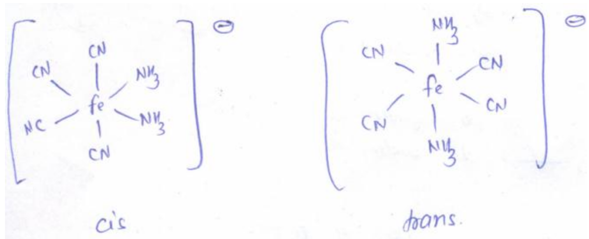


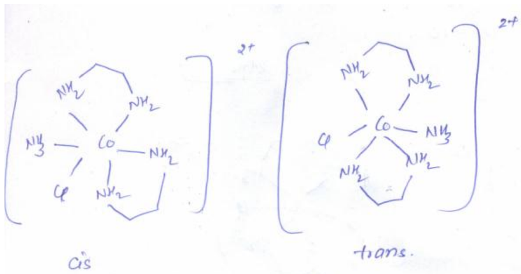
no. of Fe – C (bonds) is 3.

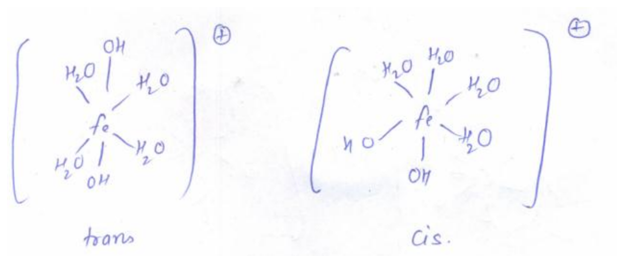
Ans = 3

Sol.22 (6)









Similar to the above structures, [CO $(NH_3)_4(H_2O)$ (Cl)]

Also exists in cis & tarns forms

Ans – 6.

Sol.23 (6)

The rxn is

$B_2H_6 + 6\ CH_3OH \longrightarrow 2\ B\ (OCH_3)_3 + 6\ H_2$

Ans $\longrightarrow$ 6.

Sol.24 (3)

$\Lambda_{mHX} = 10\ \lambda_{mHY}$

$M_{HX} = 0.01$ M

$M_{HY} = 0.10$ M

given that $\lambda_{x-}^{\infty} = \lambda_{y-}^{\infty}$

$\left(\frac{1000 \times k_{HX}}{M_{HX}}\right) = \left(\frac{1000 \times k_{HY}}{M_{HY}}\right)(10)$

Solving this, we get

$\left(\frac{k_a HY}{k_a HX}\right) = 1000$

$\Longrightarrow \log \ \frac{k_a(HY)}{k_a(HX)} = 3$

$\Longrightarrow$ log Ka(HY) – log Ka (HX) = 3

– þKa(HY) + þKa(HX) = 3

$\Longrightarrow$ Ans 3.

Sol.25 (9)

We have to apply equation of state

PV = n R T

According to this, the pressure of mixture in the container is directly proportional to the no. of particles in the container.

$^{238}_{92}U$ undergoes ∝ (alpha) dissociation.

Till it reaches $^{206}_{82}Pb$

Finally, in the container,

$\frac{no.of\ particles\ after\ decay}{no.of\ particles\ before\ decay} = \frac{9}{1}$

$\because \qquad \frac{P_f}{P_i} = \frac{9}{1}$

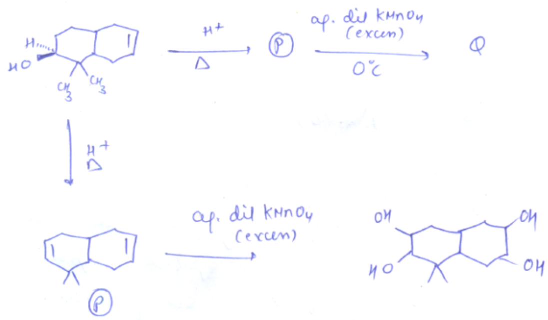
Ans 9.

Sol.26 (8)

$8H^+ + MnO_4^- + [Fe(H_2O)_2(ox)_2]^{2-} \longrightarrow Mn^{2+} + Fe^{3+} + 4CO_2 + 6H_2O$

$\frac{rate\ of\ change\ of [H^+]}{rate\ of\ change\ of\ [MnO_4^-]} = 8 \qquad \frac{[H^+]}{[MnO_4^-]} = 8$

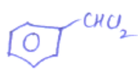
Sol.27 (4)



Ans. (4).

Sol.28 (4)

(i) Rxn is Gattermann Koch Rxn & gives benzaldehyde.

(ii) Treatment of  with water at high temp also yields benzaldehyde.

Also, on reduction of benzoylchoride

With H_2 yields benzaldehyde.

Reduction of (iv) also yields the product

∴ Ans (4)

Sol.29 (B,C,D)

Surface + $O_2 \longrightarrow e^-$ transfer taken place.

$O_2 + e^- \longrightarrow O_2^-$ (bond length of $O_2^- > O_2$)

heat is released during the rxn.

& on acceptance of e^- by O_2 , the occupancy of π_{2p}^* of O_2 increases

Ans: (B) (C) (D)

Sol.30 (B)

$(CH_3)_3$ SiCl is used for chain termination rxn.

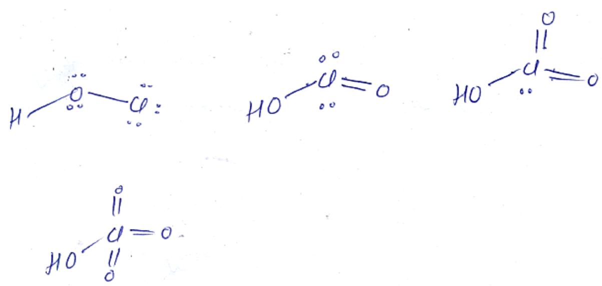
for chain propagation, we use $(CH_3)_2$ $SiCl_2$ ∴ Ans. (B)

Sol.31 (C,D)

By looking at the concept of Qualitative analysis, we can say that Cu^{2+}, Pb^{2+} and Hg^{2+} can be precipitated upon passing H_2S in dil aq. sol of salts.

Ans: (c) (d)

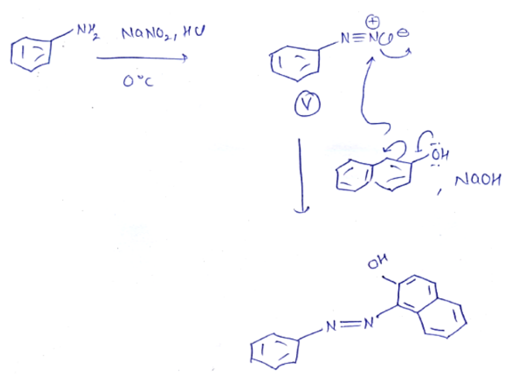
Sol.32. (B,C)



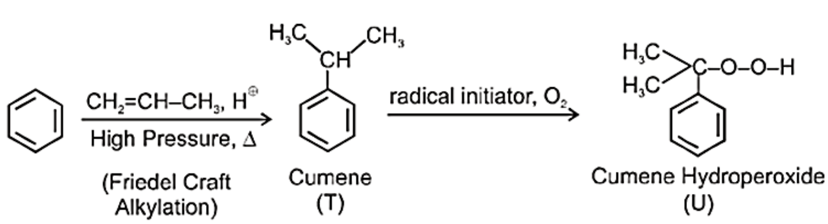
Acc. to the above structures,

the correct statements are (C) (B)

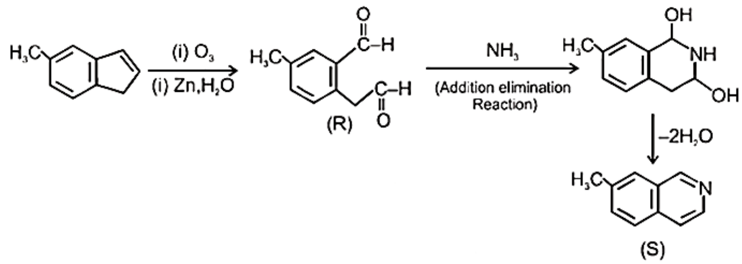
Sol.33 (A)



Sol.34 (B)



Sol.35 (A)



Sol.36 (C)

P(V-b) = RT

$\Rightarrow$ PV – Pb = RT $\qquad \Rightarrow \frac{PV}{RT} = \frac{PB}{RT} + 1$

$\Rightarrow$ Z = 1+$\frac{Pb}{RT}$

Hence Z > 1 at all pressures.

This means, repulsive tendencies will be dominant when interatomic distance are small.

This means, interatomic potential is never negative but becomes positive at small interatomic distances.

Hence answer is (C)

Sol.37 (A)

Let the heat capacity of insulated beaker be C.

Mass of aqueous content in expt. 1 = $(100 + 100) \times 1$

$= 200$ g

$\Rightarrow$ Total heat capacity = $(C + 200 \times 4.2)$ J/K

Moles of acid, base neutralised in expt. 1 = $0.1 \times 1 = 0.1$

$\Rightarrow$ Heat released in expt 1 = $0.1 \times 57 = 5.7$ KJ

$\Rightarrow 5.7 \times 1000 = (C + 200 \times 4.2) \times \Delta T$.

$5.7 \times 1000 = (C + 200 \times 4.2) \times 5.7$

$\Rightarrow (C + 200 \times 4.2) = 1000$

In second experiment,

$nCH_3COOH = 0.2$, $n_{NaOH} = 0.1$

Total mass of aqueous content = 200 g

$\Rightarrow$ Total heat capacity $= (C + 200 \times 4.2) = 1000$

$\Rightarrow$ Heat released $= 1000 \times 5.6 = 5600$ J.

Overall, only 0.1 mol of CH_3COOH undergo neutralization.

$\Rightarrow \Delta H_{neutralization}$ of $CH_3COOH = -\frac{5600}{0.1}$ = - 56000 J/mol.

$\Rightarrow \Delta H_{ionization}$ of CH_3COOH = 57 – 56 = 1KJ/mol. = –56 KJ/mol.

$\Rightarrow \Delta H_{ionization}$ of CH_3COOH = 57 – 56 = 1 KJ/mol

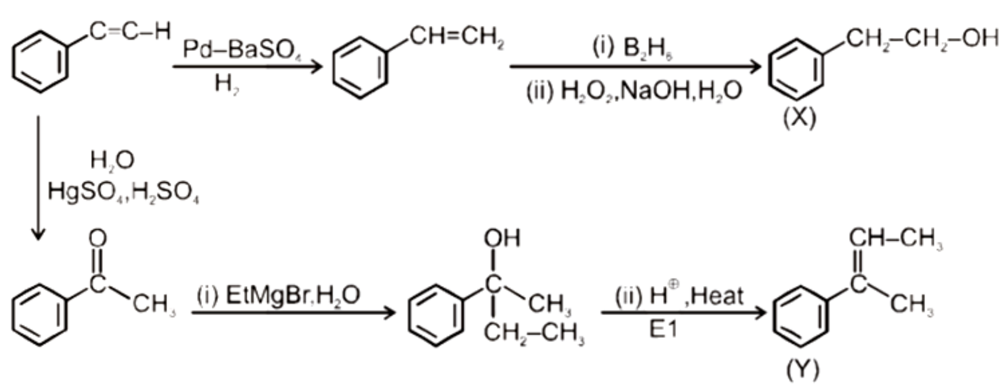
Sol.38 (B)

Final solution contains 0.1 mole of CH_3COOH and CH_3COONa each.

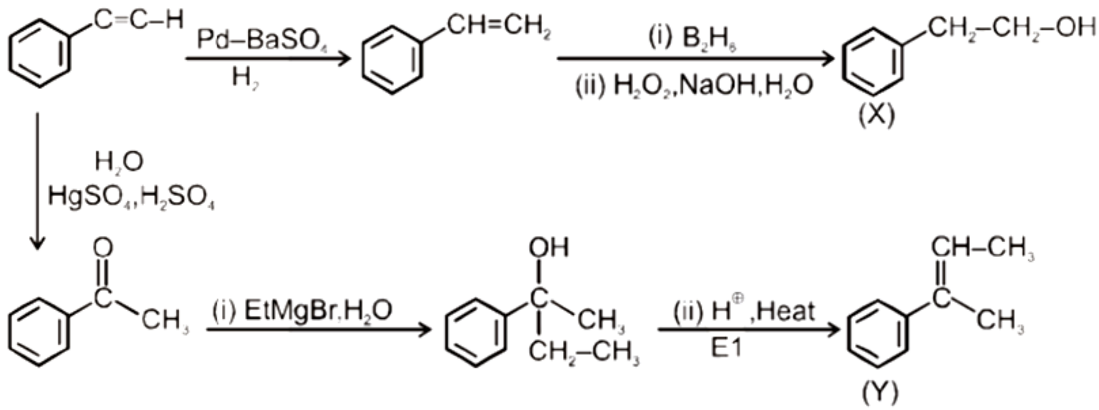
Hence it is a buffer solution

$p_H = pk_a + \log \frac{C[H_3COO]}{[CH_3COOH]}$

Sol.39 (C)



Sol.40 (D)


C=C–H
Pd–BaSO4
H2
CH=CH2
(i) B2H6
(ii) H2O2,NaOH,H2O
CH2–CH2–OH
(X)
H2O
HgSO4,H2SO4
O
C
CH3
(i) EtMgBr.H2O
OH
C
CH3
CH2–CH3
(ii) H⊕,Heat
E1
CH–CH3
C
CH3
(Y)