



This booklet contains 24 printed pages.

Test Booklet Code

PAPER-1 : PHYSICS, CHEMISTRY & MATHEMATICS

A

Do not open this Test Booklet until you are asked to do so.

Read carefully the Instructions on the Back Cover of this Test Booklet.

Important Instructions :

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue/Black Ball Point Pen*. Use of pencil is strictly prohibited.
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are **three** parts in the question paper A, B, C consisting of **Physics, Chemistry and Mathematics** and having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No. 5 for correct response of each question. 1/4 (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use **Blue/Black Ball Point pen only** for writing particulars/markings responses on **Side-1** and **Side-2** of the Answer Sheet. **Use of pencil is strictly prohibited.**
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination room/hall.
10. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is give at the bottom of each page and in **three** pages (Pages **21 - 23**) at the end of the booklet.
11. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them.**
12. The CODE for the Booklet is **C**. Make sure that the CODE printed on **Side-2** of the Answer Sheet and also tally the serial number of the Test Booklet and Answer Sheet are the same as that on this booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
13. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters): _____

Roll Number : In figures

: in words _____

Examination Centre Number :

Name of Examination Centre (in Capital letters) : _____

Candidate's Signature : _____ 1. Invigilator's Signature : _____

2. Invigilator's Signature : _____

PART-B : CHEMISTRY

31. The ratio of mass percent of C and H of an organic compound ($C_XH_YO_Z$) is 6 : 1. If one molecule of the above compound ($C_XH_YO_Z$) contains half as much oxygen as required to burn one molecule of compound C_XH_Y completely to CO_2 and H_2O . The empirical formula of compound $C_XH_YO_Z$ is :

- (1) $C_3H_6O_3$ (2) C_2H_4O (3) $C_3H_4O_2$ (4) $C_2H_4O_3$

Ans. (4)

Sol. $\frac{m_c}{m_h} = \frac{6}{1} = \frac{12X}{Y}$

$$\Rightarrow \frac{X}{Y} = \frac{1}{2}$$

$$\Rightarrow y = 2X$$

1 molecule of $C_XH_YO_Z$ has

$$Z = \frac{1}{2} \left(X + \frac{Y}{4} \right) \times 2$$

$$Z = X + \frac{Y}{4}$$

$$Z = X + \frac{X}{2}$$

$$Z = \frac{3X}{2}$$

$$\Rightarrow (C_XH_YO_Z) = \left(C_XH_{2X}O_{\frac{3X}{2}} \right) = C_2H_4O_3$$

32. Which type of 'defect' has the presence of cations in the interstitial sites ?

- (1) Schottky defect (2) Vacancy defect
(3) Frenkel defect (4) Metal deficiency defect

Ans. (3)

Sol. Frenkel defect is self-interstitial defect in which few cations are present at interstitial space.

33. According to molecular orbital theory which of the following will not be a viable molecule ?

- (1) He_2^{2+} (2) He_2^+ (3) H_2^- (4) H_2^{2-}

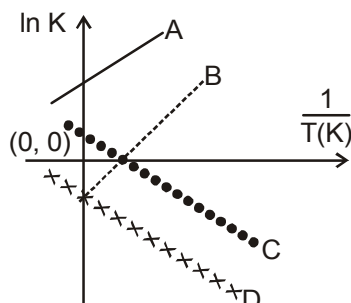
Ans. (4)

Sol. For H_2^{2-} , total electrons = 4

$$\sigma(1s^2)\sigma^*(1s^2)$$

$$\therefore \text{Bond order} = 0$$

34. Which of the following lines correctly show the temperature dependence of equilibrium constant, K, for an exothermic reaction ?



- (1) A and B (2) B and C (3) C and D (4) A and D

Ans. (1)

Sol. $\log K = \frac{-\Delta H}{2.303RT} + \frac{\Delta S}{2.303R}$

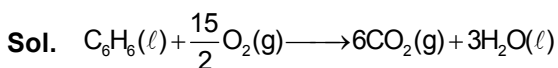
$\log K$ vs $\frac{1}{T}$ curve has +ve slope for $\Delta H = -ve$

for curve A and B.

35. The combustion of benzene(l) gives $CO_2(g)$ and $H_2O(l)$. Given that heat of combustion of benzene at constant volume is $-3263.9 \text{ kJ mol}^{-1}$ at 25°C ; heat of combustion (in kJ mol^{-1}) of benzene at constant pressure will be : ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)

- (1) 4152.6 (2) -452.46 (3) 3260 (4) -3267.6

Ans. (4)



$\Delta H = \Delta E + \Delta n_{(g)}RT$

$= -3263.9 + \left(6 - \frac{15}{2}\right) \times 8.314 \times 10^{-3} \times 298$

$= -3263.9 - 3.716 = -3267.61 \text{ KJ/mol}$

36. For 1 molal aqueous solution of the following compounds. Which one will show the highest freezing point?

- (1) $[Co(H_2O)_6]Cl_3$
 (2) $[Co(H_2O)_5Cl]Cl_2 \cdot H_2O$
 (3) $[Co(H_2O)_4Cl_2]Cl \cdot 2H_2O$
 (4) $[Co(H_2O)_3Cl_3] \cdot 3H_2O$

Ans. (4)

Sol. T_f is highest when ΔT_f is minimum.

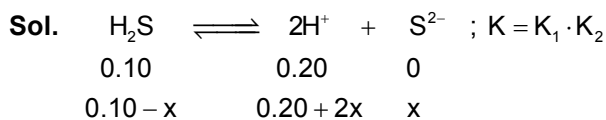
$\Delta T_f = i \cdot K_f \cdot m$

For equal 'm', 'i' should be minimum i.e. = 1 for $[Co(H_2O)_3Cl_3] \cdot 3H_2O$

37. An aqueous solution contains 0.10 M H_2S and 0.20 M HCl . If the equilibrium constants for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from HS^- ions is 1.2×10^{-13} then the concentration of S^{2-} ions in aqueous solution is :

- (1) 5×10^{-8} (2) 3×10^{-20} (3) 6×10^{-21} (4) 5×10^{-19}

Ans. (2)



$$K = \frac{[\text{H}^+]^2[\text{S}^{2-}]}{[\text{H}_2\text{S}]} = \frac{(0.20)^2 \cdot x}{(0.10)}$$

$$1.2 \times 10^{-20} = (0.4) \cdot x$$

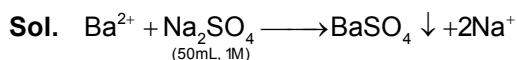
$$x = \frac{1.2}{0.4} \times 10^{-20} = 3 \times 10^{-20}$$

$$[\text{S}^{2-}] = 3 \times 10^{-20} \text{ M}$$

38. An aqueous solution contains an unknown concentration of Ba^{2+} . When 50 mL of a 1 M solution of Na_2SO_4 is added, BaSO_4 just begins to precipitate. The final volume is 500 mL. The solubility product of BaSO_4 is 1×10^{-10} . What is the original concentration of Ba^{2+} ?

- (1) $5 \times 10^{-9} \text{ M}$ (2) $2 \times 10^{-9} \text{ M}$ (3) $1.1 \times 10^{-9} \text{ M}$ (4) $1.0 \times 10^{-10} \text{ M}$

Ans. (3)



For ppt of BaSO_4 to start

$$Q_i > K_{sp}$$

$$[\text{Ba}^{2+}][\text{SO}_4^{2-}] > 1 \times 10^{-10}$$

$$[\text{Ba}^{2+}]_f \times \frac{50 \times 1}{500} > 1 \times 10^{-10}$$

$$[\text{Ba}^{2+}]_f > 10^{-9}$$

For Ba^{2+}

$$V_i M_i = V_f M_f$$

$$450 \times M_i = 500 \times 10^{-9}$$

$$M_i = \frac{500}{450} \times 10^{-9} \text{ M} = \frac{10}{9} \times 10^{-9}$$

$$[\text{Ba}^{2+}]_i = 1.1 \times 10^{-9} \text{ M}$$

42. Which of the following compounds contain(s) no covalent bond(s) ?

KCl, PH₃, O₂, B₂H₆, H₂SO₄

- (1) KCl, B₂H₆, PH₃ (2) KCl, H₂SO₄ (3) KCl (4) KCl, B₂H₆

Ans. (3)

Sol. KCl is an ionic compound.

43. Which of the following are Lewis acids?

- (1) PH₃ and BCl₃ (2) AlCl₃ and SiCl₄ (3) PH₃ and SiCl₄ (4) BCl₃ and AlCl₃

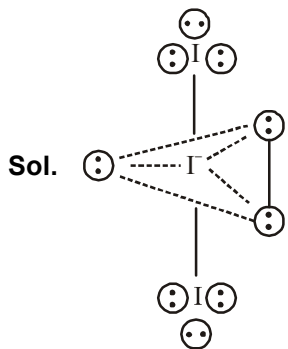
Ans. (4)

Sol. BCl₃ and AlCl₃ has electron deficient central atom so they are Lewis acid.

44. Total number of lone pair of electrons in I₃⁻ ion is :

- (1) 3 (2) 6 (3) 9 (4) 12

Ans. (3)

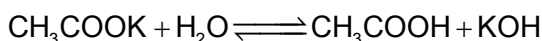


45. Which of the following salts is the most basic in aqueous solution?

- (1) Al(CN)₃ (2) CH₃COOK (3) FeCl₃ (4) Pb(CH₃COO)₂

Ans. (2)

Sol. CH₃COOK is the salt of weak acid and strong base.

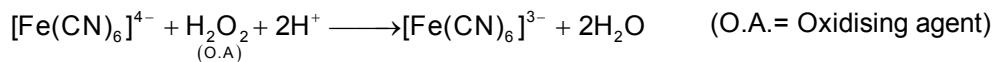


46. Hydrogen peroxide oxidises [Fe(CN)₆]⁴⁻ to [Fe(CN)₆]³⁻ in acidic medium but reduces [Fe(CN)₆]³⁻ to [Fe(CN)₆]⁴⁻ in alkaline medium. The other products formed are respectively :

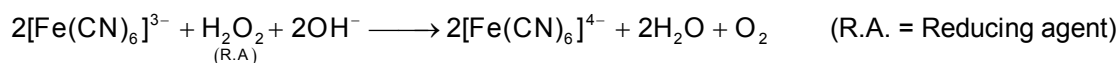
- (1) (H₂O + O₂) and H₂O (2) (H₂O + O₂) and (H₂O + OH⁻)
 (3) H₂O and (H₂O + O₂) (4) H₂O and (H₂O + OH⁻)

Ans. (3)

Sol. In acidic medium



In alkaline medium :

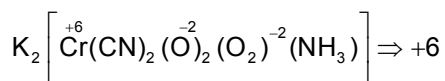
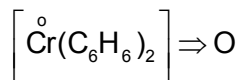
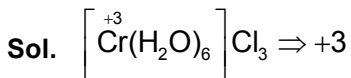


47. The oxidation states of :

Cr in $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$, $[\text{Cr}(\text{C}_6\text{H}_6)_2]$ and $\text{K}_2[\text{Cr}(\text{CN})_2(\text{O})_2(\text{O}_2)\text{NH}_3]$ respectively are :

- (1) +3, +4 and +6 (2) +3, -2 and +4 (3) +3, 0, and +6 (4) +3, 0 and +4

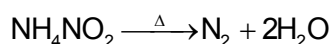
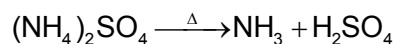
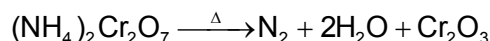
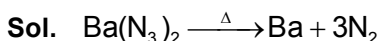
Ans. (3)



48. The compound that does not produce nitrogen gas by the thermal decomposition is :

- (1) $\text{Ba}(\text{N}_3)_2$ (2) $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ (3) NH_4NO_2 (4) $(\text{NH}_4)_2\text{SO}_4$

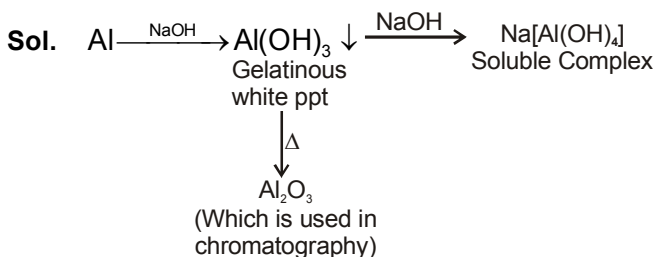
Ans. (4)



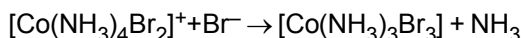
49. When metal 'M' is treated with NaOH, a white gelatinous precipitate 'X' is obtained, which is soluble in excess of NaOH. Compound 'X' when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal 'X' is :

- (1) Zn (2) Ca (3) Al (4) Fe

Ans. (3)



50. Consider the following reaction and statements :



- (I) Two isomers are produced if the reactant complex ion is a cis-isomer.
 (II) Two isomers are produced if the reactant complex ion is a trans-isomer.
 (III) Only one isomer is produced if the reactant complex ion is a trans-isomer.
 (IV) Only one isomer is produced if the reactant complex ion is a cis-isomer.

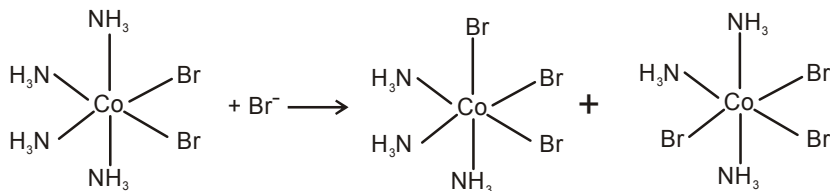
The correct statements are :

- (1) (I) and (II) (2) (I) and (III) (3) (III) and (IV) (4) (II) and (IV)

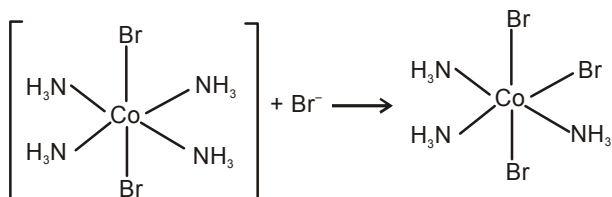
Ans. (2)

Sol. $[\text{Co}(\text{NH}_3)_4\text{Br}_2] (\text{A})$

If A is in cis form then possible isomer = 2



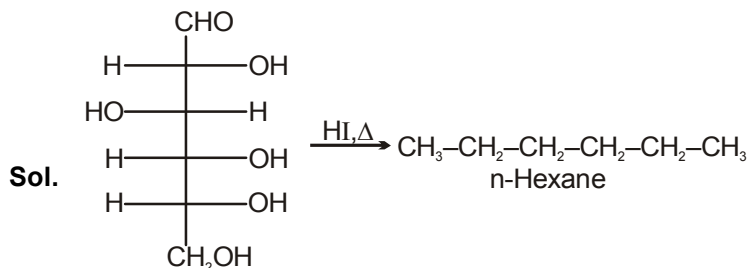
If A is in trans form then possible isomer = 1



51. Glucose on prolonged heating with HI gives:

- (1) n-Hexane (2) 1-Hexene
(3) Hexanoic acid (4) 6-iodohexanal

Ans. (1)



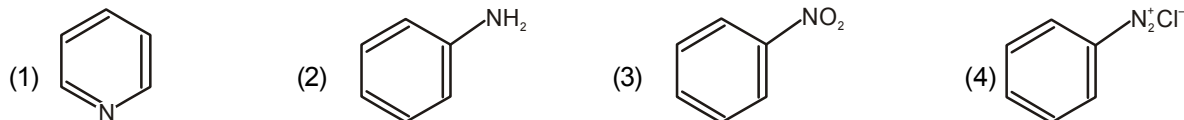
52. The trans-alkenes are formed by the reduction of alkynes with

- (1) H_2 -Pd/C, BaSO_4 (2) NaBH_4
(3) Na/liq. NH_3 (4) Sn-HCl

Ans. (3)

Sol. Birch reduction (Na/liq NH_3) is used for reduction of alkyne into trans-alkene

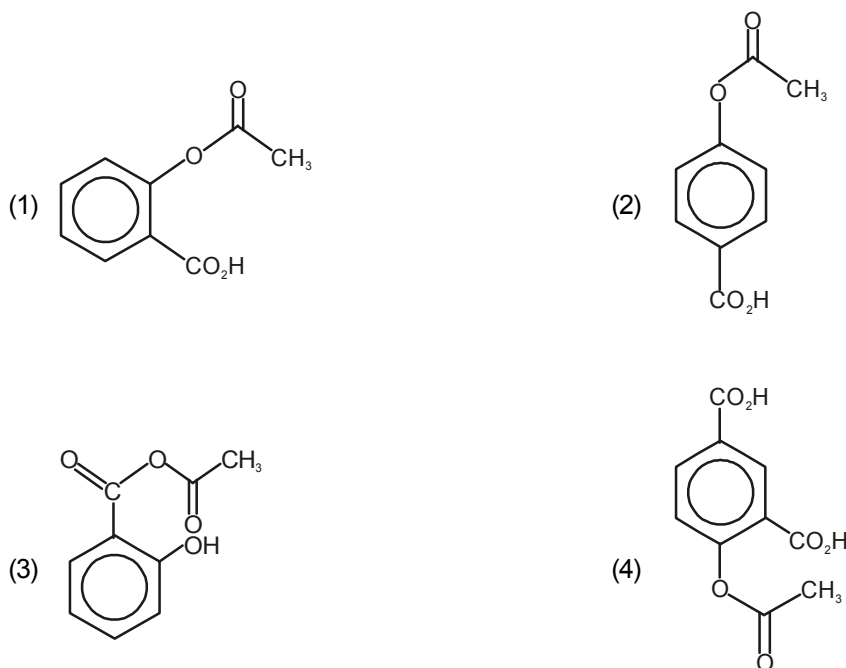
53. Which of the following compounds will be suitable for Kjeldahl's method for nitrogen estimation?



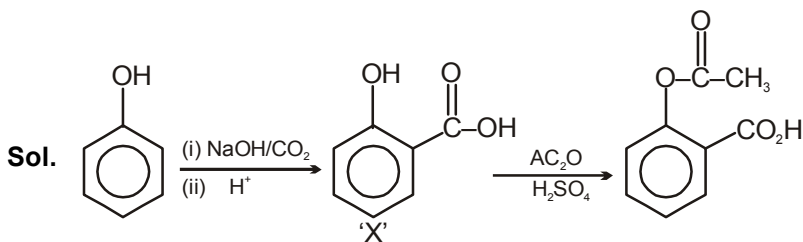
Ans. (2)

Sol. Kjeldahl's is not applicable of Nitro group, diazo group and 'N' in ring.

54. Phenol on treatment with CO_2 in the presence of NaOH followed by acidification produces compound X as the major product. X on treatment with $(\text{CH}_3\text{CO})_2\text{O}$ in the presence of catalytic amount of H_2SO_4 produces:



Ans. (1)



55. An alkali is titrated against an acid with methyl orange as indicator, which of the following is a correct combination?

Base	Acid	End point
(1) Weak	Strong	Colourless to pink
(2) Strong	Strong	Pinkish red to yellow
(3) Weak	Strong	Yellow to pinkish red
(4) Strong	Strong	Pink to colourless

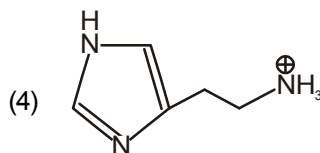
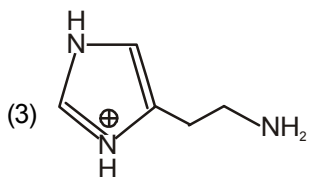
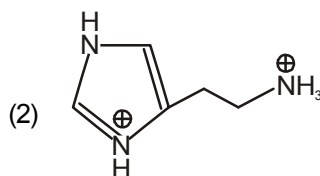
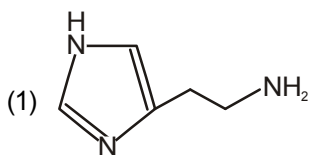
Ans. (3)

Sol. Methyl orange colour change 3.3 – 4.4

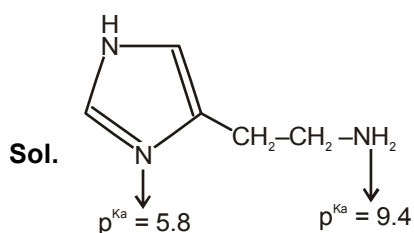
At $\text{pH} < 3.3$: Colour : red

$\text{pH} > 4.4$: Colour : yellow

56. The predominant form of histamine present in human blood is (pK_a , Histidine = 6.0)

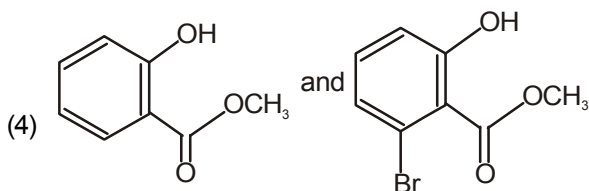
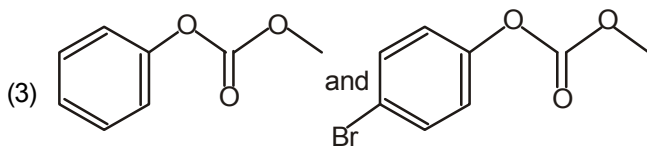
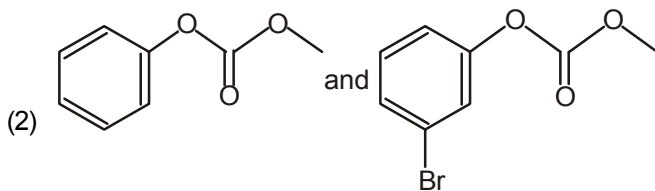
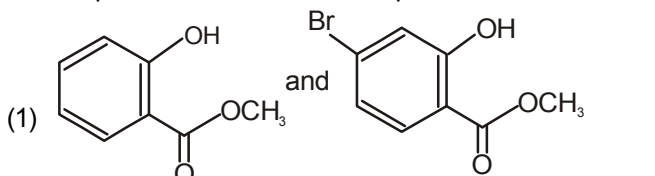


Ans. (4)

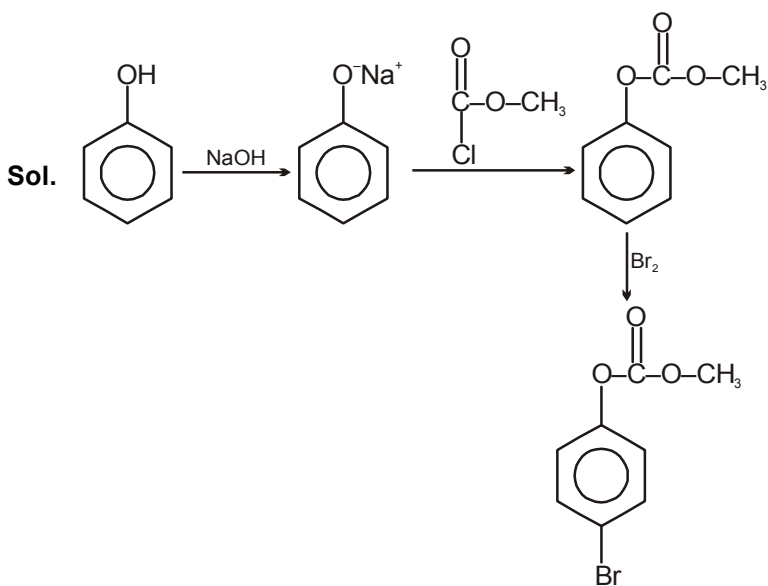


Under physiological conditions the aliphatic amino group will be protonated, whereas nitrogen of imidazole ring will not be protonated.

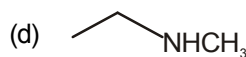
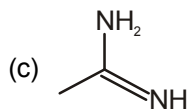
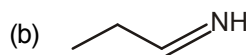
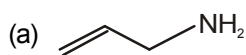
57. Phenol reacts with methyl chloroformate in the presence of NaOH to form product A. A reacts with Br_2 to form product B. A and B are respective:



Ans. (3)



58. The increasing order of basicity of the following compounds is:



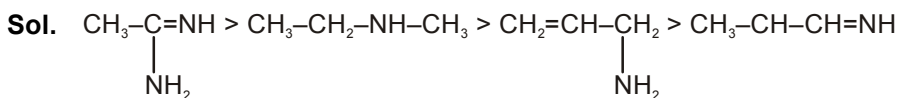
(1) (a) < (b) < (c) < (d)

(2) (b) < (a) < (c) < (d)

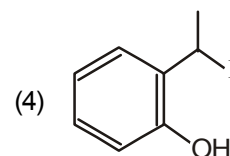
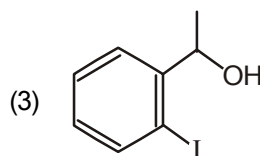
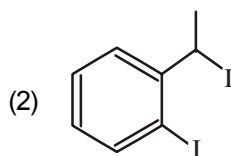
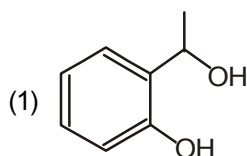
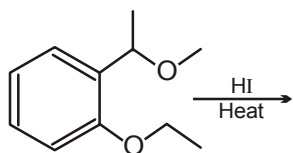
(3) (b) < (a) < (d) < (c)

(4) (d) < (b) < (a) < (c)

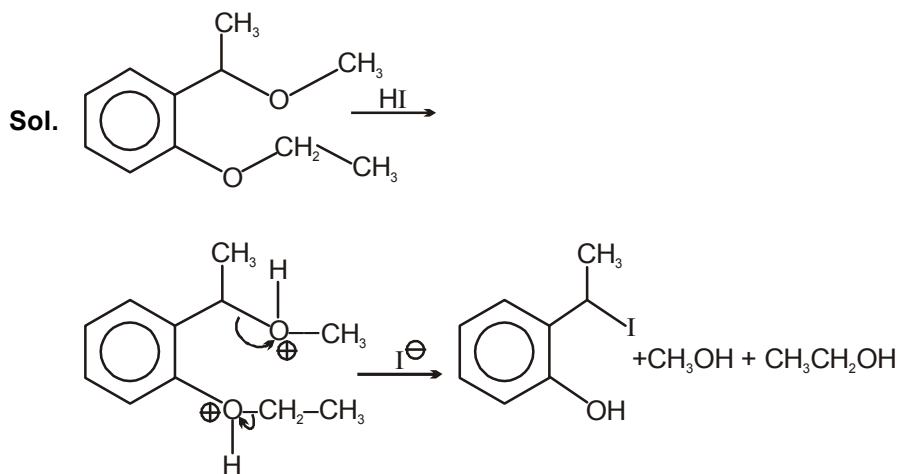
Ans. (3)



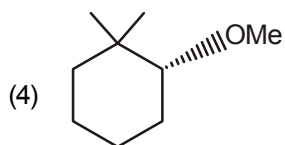
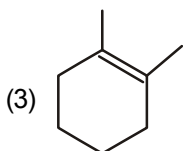
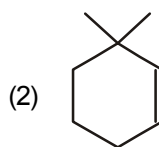
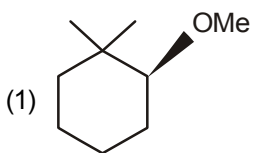
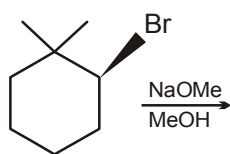
59. The major product formed in the following reaction is:



Ans. (4)



60. The major product of the following reaction is:



Ans. (2)

