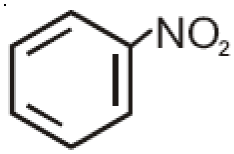
JEE Main 2018 Paper with Solutions
Chemistry-Shift 1-10th Jan

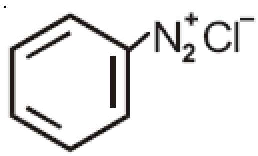
1. Which of the following salts is the most basic in aqueous solution?
(1) CH_3COOK
(2) $FeCl_3$
(3) $Pb(CH_3COO)_2$
(4) $Al(CN)_3$

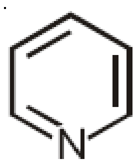
Solution:
$CH_3COOK + H_2O \rightarrow CH_3COOH + KOH$ (basic)
$FeCl_3$ - Acidic solution
$Al(CN)_3$ - Salt of weak acid and weak base
$Pb(CH_3COO)_2$ - Salt of weak acid and weak base
CH_3COOK is salt of weak acid and strong base.
Hence solution of CH_3COOK is basic.
Answer: (1)

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

(1) 

(2) 

(3) 

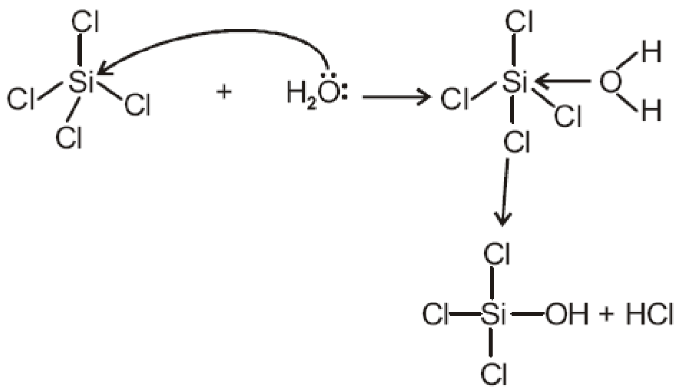
(4) 

Solution:
Kjeldahl method is not applicable for compounds containing nitrogen in nitro, and azo groups and nitrogen in ring, as N of these compounds does not change to ammonium sulphate under these conditions. Hence only aniline can be used for estimation of nitrogen by Kjeldahl's method.
Answer: (1)

3. Which of the following are Lewis acids?
(1) $AlCl_3$ and $SiCl_4$
(2) PH_3 and $SiCl_4$
(3) BCl_3 and $AlCl_3$
(4) PH_3 and BCl_3

Solution:
BCl_3 - electron deficient, incomplete octet

$AlCl_3$ - electron deficient, incomplete octet
$SiCl_4$ can accept lone pair of electron in d-orbital of silicon hence it can act as Lewis acid.
Although the most suitable answer is (3). However, both option (3) and (1) can be considered as correct answers.
Eg. Hydrolysis of $SiCl_4$



Answer: (3)

4. 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 $(CH_3CO)_2O$ in the presence of catalytic amount of H_2SO_4 produces

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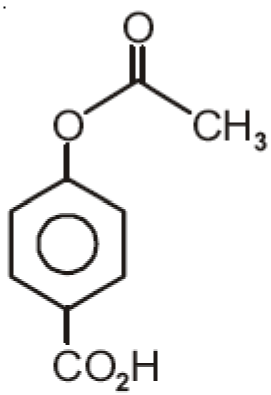

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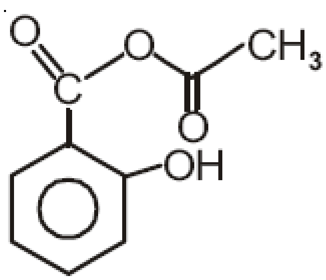

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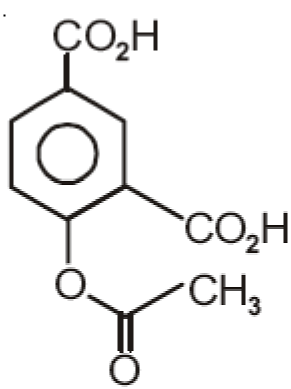

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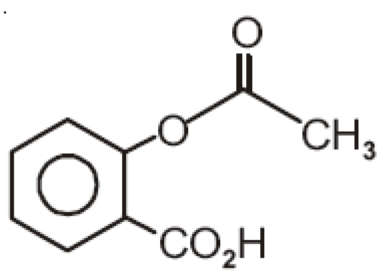

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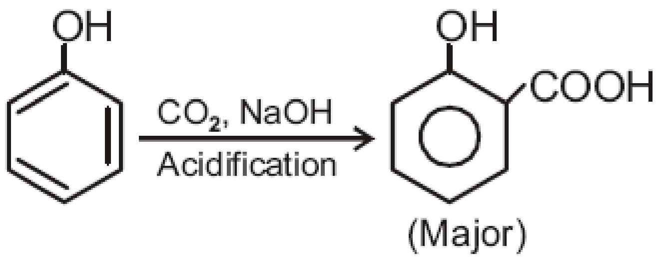
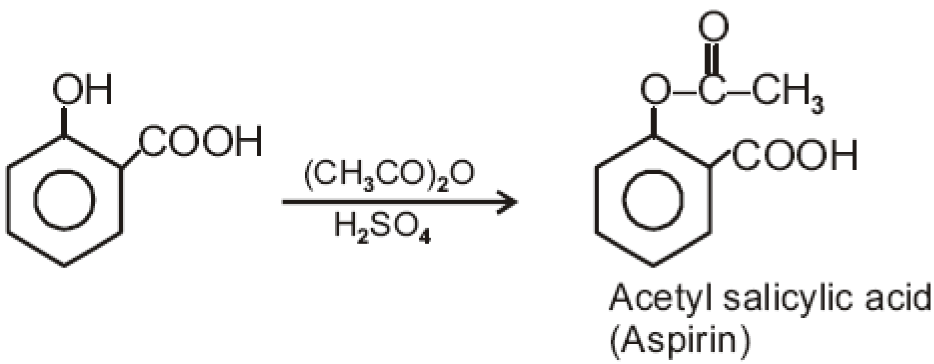




Answer: (4)

5. 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.	Strong	Strong	Pinkish red to yellow
2.	Weak	Strong	Yellow to Pinkish red
3.	Strong	Strong	Pink to colourless
4.	Weak	Strong	Colourless to pink

Solution:
The pH range of methyl orange is

Weak base is having pH greater than 7. When methyl orange is added to weak base solution, the solution becomes yellow. This solution is titrated by strong acid and at the end point pH will be less than 3.1. Therefore solution becomes pinkish red.
Answer: (2)

6. An aqueous solution contain 0.10 M H_2S and 0.20 M HCl. If the equilibrium constant 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) 3×10^{-20}

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

Solution:

$$H_2S \rightleftharpoons 2H^+ + S^{2-}, \; K_{a_1} \cdot K_{a_2} = K_{eq}$$

$$\therefore \; \frac{[H^+]^2[S^{2-}]}{[H_2S]} = 1\times10^{-7}\times1.2\times10^{-13}$$

$$\frac{[0.2]^2[S^{2-}]}{[0.1]} = 1.2\times10^{-20}$$

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

Answer: (1)

7. 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 kJ mol $^{-1}$ at 25^0C ; heat of combustion (in kJ/mol) of benzene at constant pressure will be (R = 8.314 JK^{-1} mol^{-1})
(1) -452.46
(2) 3260
(3) -3267.6
(4) 4152.6

Solution:
C_6H_6 (*l*) + (15/2)O_2 (g) $\rightarrow$ $6CO_2$ (g) + $3H_2O$ (*l*)
$\triangle n_g$ = 6-(15/2)
= -3/2
$\triangle H = \triangle U + \triangle n_g RT$
= $-3263.9 + (-3/2)\times8.314\times298\times10^{-3}$
= -3263.9 + (-3.71)
= -3267.6 kJ mol^{-1}
Answer: (3)

8. The compound that does not produce nitrogen gas by the thermal decomposition is
(1) $(NH_4)_2Cr_2O_7$
(2) NH_4NO_2
(3) $(NH_4)_2SO_4$
(4) $Ba(N_3)_2$

Solution:

$$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + 4H_2O + Cr_2O_3$$

$$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$$

$$(NH_4)_2SO_4 \xrightarrow{\Delta} 2NH_3 + H_2SO_4$$

$$Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$$

Among all the given compounds, only $(NH_4)_2SO_4$ do not form dinitrogen on heating, it produces ammonia gas.

Answer: (3)

9. How long (approximate) should water be electrolysed by passing through 100 amperes current so that the oxygen released can completely burn 27.66 g of diborane? (Atomic weight of B = 10.8 u)

(1) 0.8 hours
(2) 3.2 hours
(3) 1.6 hours
(4) 6.4 hours

Solution:

$B_2H_6 + 3O_2 \rightarrow B_2O_3 + 3H_2O$

27.66 of B_2H_6 = 1 mole of B_2H_6 which requires three moles of oxygen (O_2) for complete burning

$6H_2O \rightarrow 6H_2 + 3O_2$ (On electrolysis)

Number of faradays = 12 = amount of charge

$12\times96500 = i\times t$

$12\times96500 = 100\times t$

$t = 12\times96500/100$ sec

$t = 12\times96500/(100\times3600)$ hour

$t = 3.2$ hours

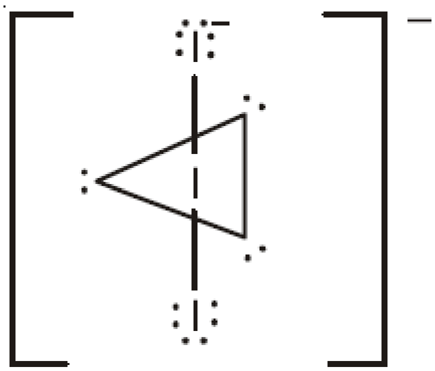
Answer: (2)

10. Total number of lone pair of electrons in I_3 ion is

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

Solution:

Structure of I_3^-



Number of lone pairs in I_3^- is 9.
Answer: (2)

11. 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 'M' is
(1) Ca
(2) Al
(3) Fe
(4) Zn

Solution:

$$Al^{3+} \xrightarrow{NaOH} \underset{\text{White gelatinous ppt.}}{Al(OH)_3 \downarrow} \xrightarrow[\text{NaOH}]{\text{Excess}} \underset{\substack{\text{Sodium meta} \\ \text{aluminate} \\ \text{(soluble)}}}{NaAlO_2}$$

$$2Al(OH)_3 \xrightarrow{\text{Strong heating}} Al_2O_3 + 3H_2O$$

Al_2O_3 is used in column chromatography.
Answer: (2)

12. According to molecular orbital theory, which of the following will not be a viable molecule?
(1) He_2^+
(2) H_2^-
(3) H_2^{2-}
(4) He_2^{2+}

Solution:

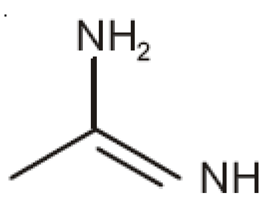
	Electronic configuration	Bond order
He_2^+	$\sigma_{1s^2}\sigma^*_{1s^1}$	$\frac{2-1}{2}=0.5$
H_2^-	$\sigma_{1s^2}\sigma^*_{1s^1}$	$\frac{2-1}{2}=0.5$
H_2^{2-}	$\sigma_{1s^2}\sigma^*_{1s^2}$	$\frac{2-2}{2}=0$
He_2^{2+}	σ_{1s^2}	$\frac{2-0}{2}=1$

Molecule having zero bond order will not be a viable molecule.
Answer: (3)

13. The correct order of basicity of the following compound is :

(a)

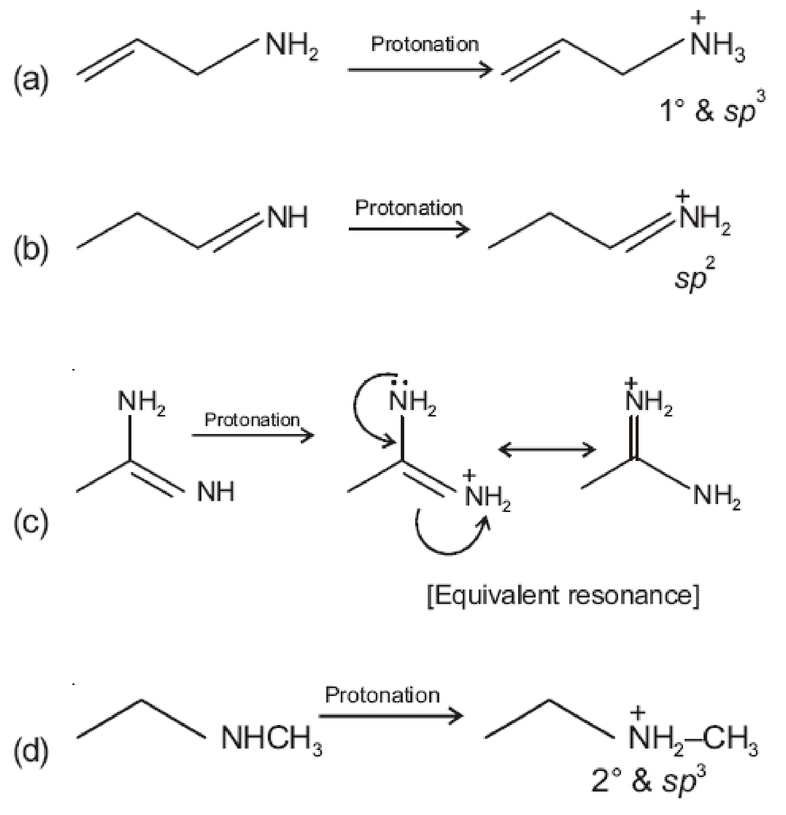

(b)


(c)


(d)


(1) (b) < (a) < (c) < (d)
(2) (b) < (a) < (d) < (c)
(3) (d) < (b) < (a) < (c)
(4) (a) < (b) < (c) < (d)

Solution:



$\therefore$ Correct order of basicity is: b < a < d < c

Answer: (2)

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

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

Solution:

In Frenkel defect, cation is dislocated from its normal lattice site to an interstitial site.

Answer (2)

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

KCl, PH_3, O_2, B_2H_6, H_2SO_4

(1) KCl, H_2SO_4
(2) KCl
(3) KCl, B_2H_6
(4) KCl, B_2H_6, PH_3

Solution:

KCl - Ionic bond between K^+ and Cl^-

PH_3- Covalent bond between P and H

O_2 - Covalent bond between O atoms
B_2H_6 - Covalent bond between B and H atoms
H_2SO_4- Covalent bond between S and O and also between O and H.
$\therefore$ Compound having no covalent bonds is KCl only.
Answer: (2)

16. The oxidation states of Cr in $[Cr(H_2O)_6]Cl_3$, $[Cr(C_6H_6)_2]$ and $K_2[Cr(CN)_2(O)_2(O_2)(NH_3)]$ respectively are
(1) +3, +2 and +4
(2) +3, 0 and +6
(3) +3, 0 and +4
(4) +3, +4 and +6

Solution:
$[Cr(H_2O)_6]Cl_3 \Rightarrow x+0\times6-1\times3 = 0$
$\therefore x = +3$
$[Cr(C_6H_6)_2] \Rightarrow x+2\times0 = 0$
$x = 0$
$K_2[Cr(CN)_2(O)_2(O_2)(NH_3)] \Rightarrow 1\times2+x-1\times2-2-2\times1 = 0$
$\Rightarrow x-6 = 0$
So $x = +6$
Answer: (2)

17. 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) (H_2O+O_2) and (H_2O+OH^-)
(2) H_2O and (H_2O+O_2)
(3) H_2O and $(H_2O+ OH^-)$
(4) (H_2O+O_2) and H_2O

Solution:

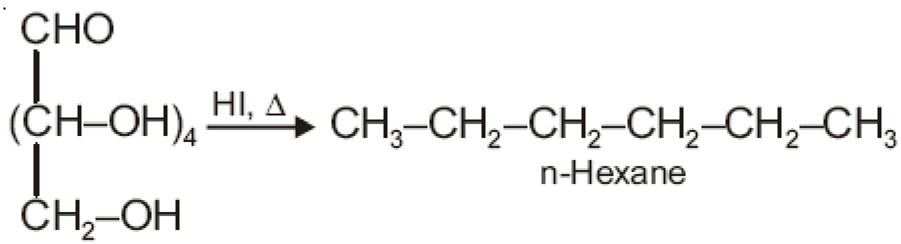
$$[Fe(CN)_6]^{4-} + \frac{1}{2}H_2O_2 + H^+ \longrightarrow [Fe(CN)_6]^{3-} + H_2O$$

$$[Fe(CN)_6]^{3-} + \frac{1}{2}H_2O_2 + OH^{\ominus} \longrightarrow [Fe(CN)_6]^{4-} + H_2O + \frac{1}{2}O_2$$

Answer: (2)

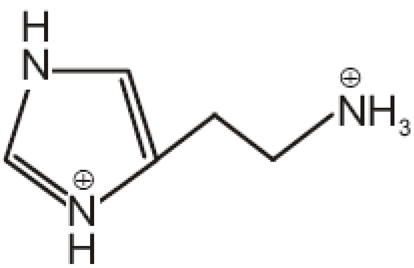
18. Glucose on prolonged heating with HI gives
(1) 1-Hexene
(2) Hexanoic acid
(3) 6-iodohexanal
(4) n-Hexane

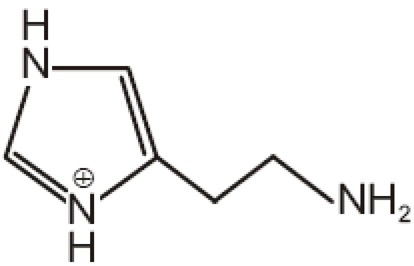
Solution:

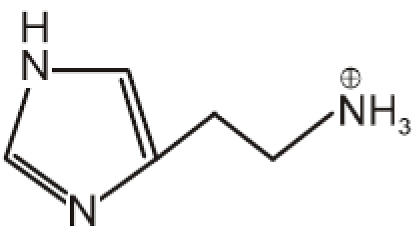


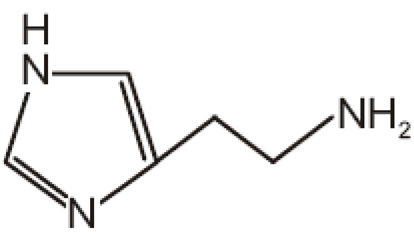
Answer: (4)

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

(1) 

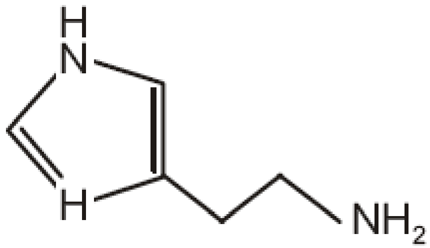
(2) 

(3) 

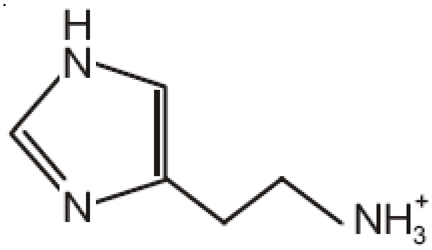
(4) 

Solution:

Histamine



At pH (7.4) major form of histamine is protonated at primary amine.



20. The recommended concentration of fluoride ion in drinking water is up to 1 ppm as fluoride ion is required to make teeth enamel harder by converting $[3Ca_3(PO_4)_2.Ca(OH)_2]$ to
(1) $[3Ca(F)_2.Ca(OH)_2]$
(2) $[3Ca_3(PO_4)_2.CaF_2]$
(3) $[3\{Ca(OH)_2\}.Ca(F)_2]$
(4) $[CaF_2]$

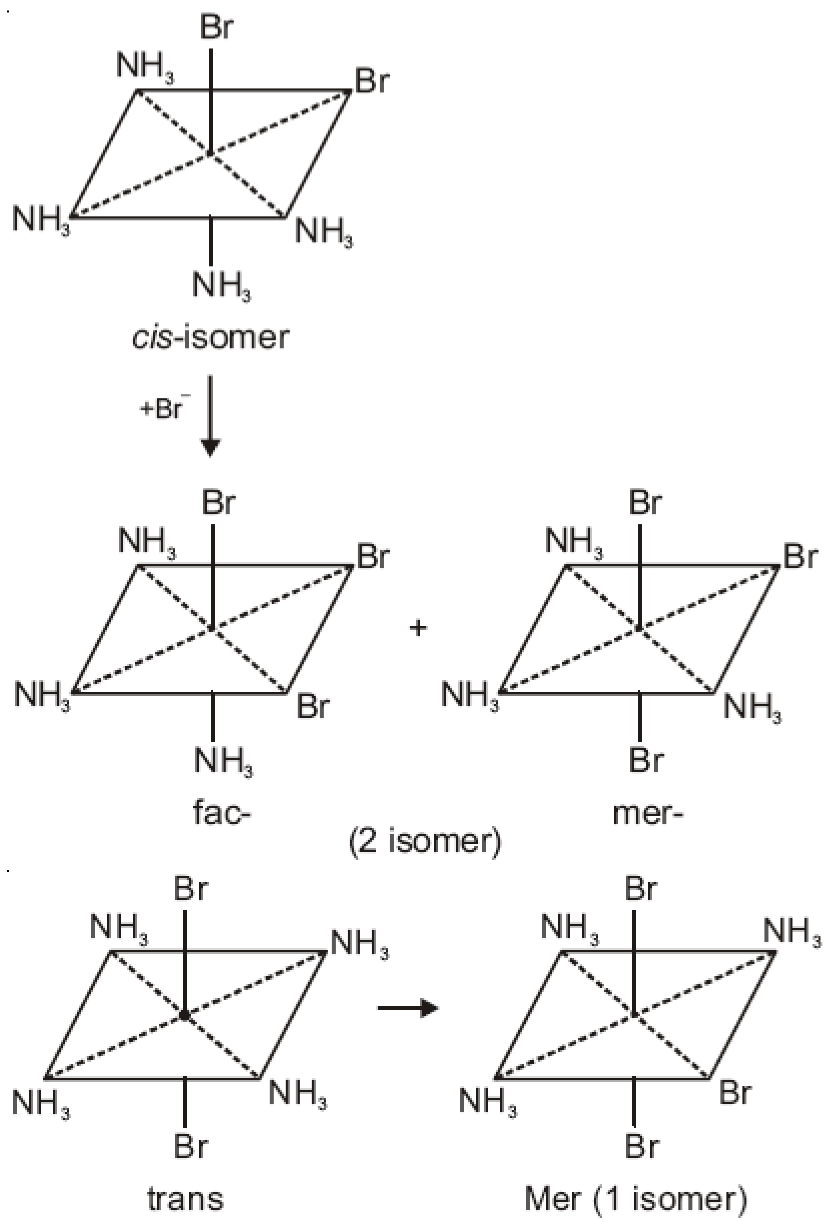
Solution:
F^- ions make the teeth enamel harder by converting

$$\underset{\text{Hydroxyapatite}}{[3Ca_3(PO_4)_2.Ca(OH)_2]} \text{ to } \underset{\text{Fluorapatite}}{[3Ca_3(PO_4)_2.CaF_2]}$$

Answer: (2)

21. Consider the following reaction and statements
$[Co(NH_3)_4Br_2]^+ + Br^- \rightarrow [Co(NH_3)_3Br_3]+NH_3$
(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 (III)
(2) (III) and (IV)
(3) (II) and (IV)
(4) (I) and (II)

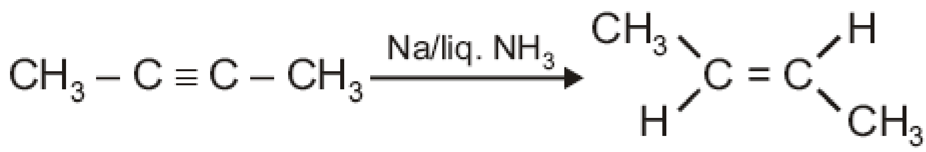
Solution:



So option (1) is correct.
Answer: (1)

22. The trans-alkenes are formed by the reduction of alkynes with
(1) $NaBH_4$
(2) Na/liq. NH_3
(3) Sn - HCl
(4) H_2-Pd/C, $BaSO_4$

Solution:



Trans alkene

So, option (2) is correct.
Answer: (2)

23. 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

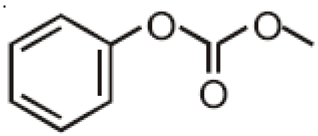
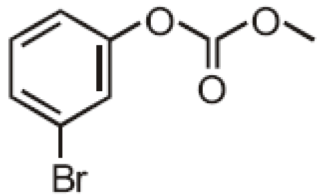
(1) C_2H_4O
(2) $C_3H_4O_2$
(3) $C_2H_4O_3$
(4) $C_3H_6O_3$

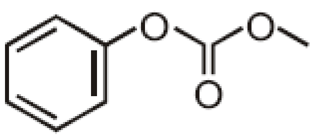
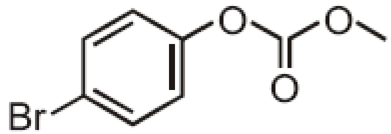
Solution:

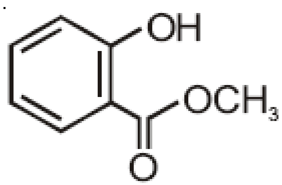
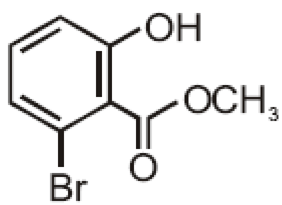
Element	Relative mass	Relative mole	Simplest whole number ratio
C	6	6/12 = 0.5	1
H	1	1/1 = 1	2

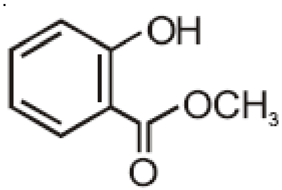
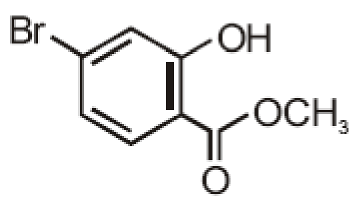
So, X = 1, Y = 2
Equation for combustion of C_XH_Y
$C_XH_Y + (X+Y/4)O_2 \rightarrow XCO_2 + (Y/2)H_2O$
Oxygen atoms required = 2(X+Y/4)
Given 2(X+Y/4) = 2Z
$\Rightarrow (1+2/4) = Z$
$\Rightarrow Z = 1.5$
Molecule can be written as $C_XH_YO_Z$
$\Rightarrow C_1H_2O_{3/2}$
$\Rightarrow C_2H_4O_3$
Answer: (3)

24. 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 respectively

(1)  and 

(2)  and 

(3)  and 

(4)  and 

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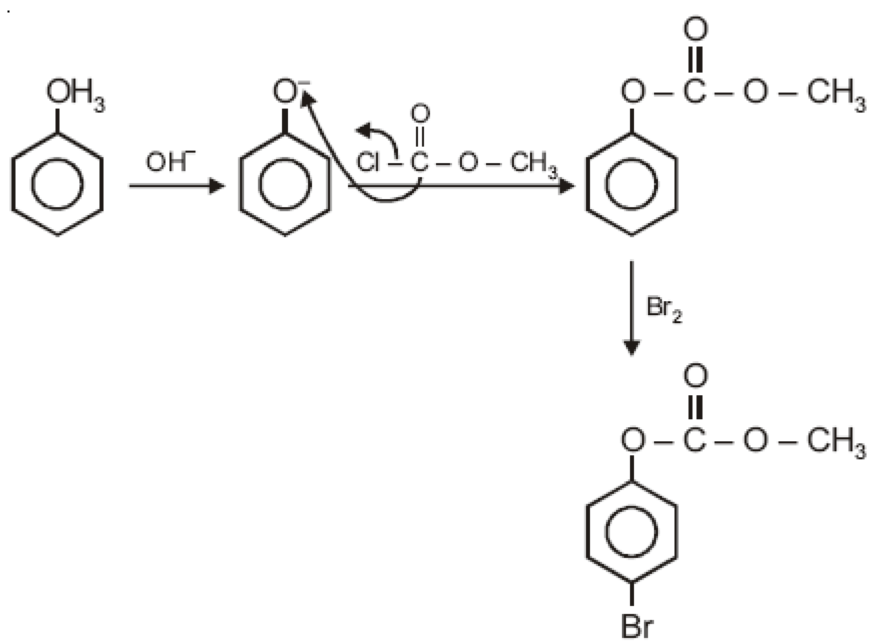
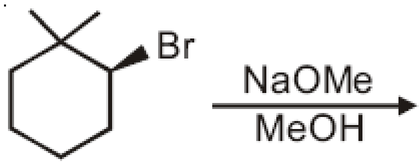
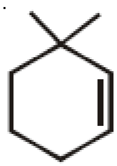
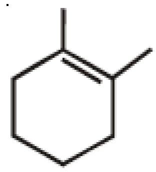


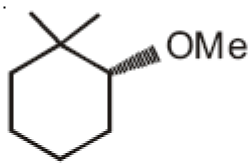
Answer: (2)

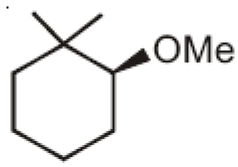
25. The major product of the following reaction is



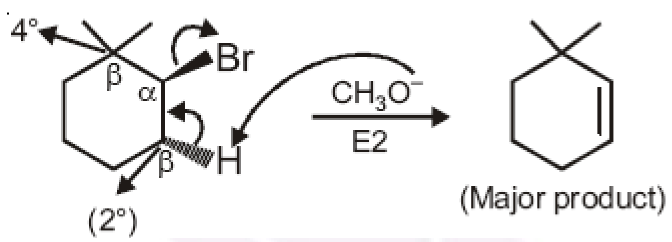
(1) 

(2) 

(3) 

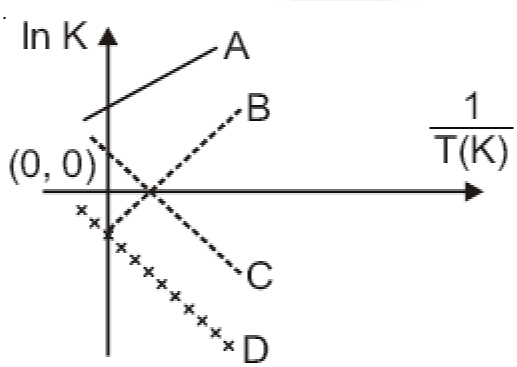
(4) 

Solution:
CH_3O^- is a strong base and strong nucleophile, so favourable condition is S_N2/E2.
Given alkyl halide is 2^0 and β C's are 4^0 and 2^0 , so sufficiently hindered, therefore, E2 dominates over S_N2.
Also, polarity of CH_3OH (solvent) is not as high as H_2O so E1 is also dominated by E2.



Answer: (1)

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



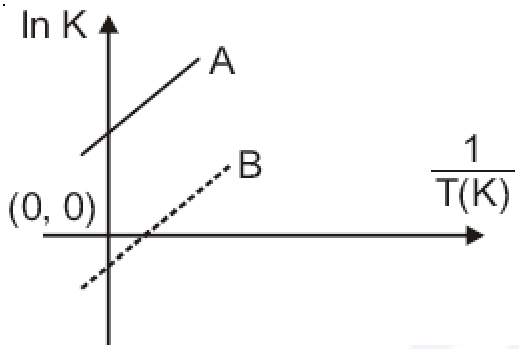
(1) B and C
(2) C and D

(3) A and D
(4) A and B

Solution:
Equilibrium constant,

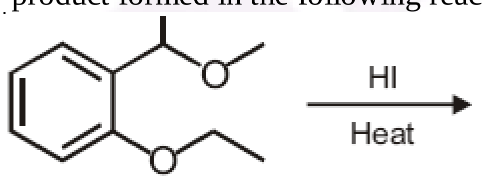
$$K = \left(\frac{A_f}{A_b}\right)e^{-\frac{\Delta H^\circ}{RT}}$$

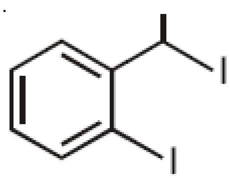
$\ln K = \ln (A_f/A_b) - (\triangle H^0/R)(1/T)$
$y = c+mx$
comparing with equation of straight line,
slope = $-\triangle H^0/R$
Since, reaction is exothermic, $\triangle H^0$ = -ve, therefore,
slope = +ve.

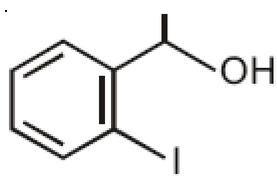


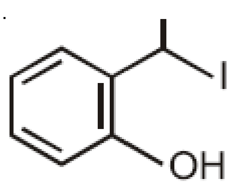
Answer: (4)

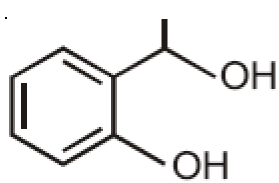
27. The major product formed in the following reaction is



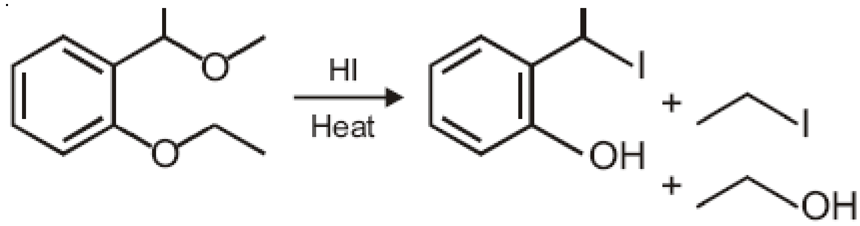
(1) 

(2) 

(3) 

(4) 

Solution:



Answer: (3)

28. 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 original concentration of Ba^{2+} ?
(1) 2×10^{-9} M
(2) 1.1×10^{-9} M
(3) 1.0×10^{-9} M
(4) 5×10^{-9} M

Solution:
Final concentration of $[SO_4^{--}] = 50\times1/500 = 0.1M$
K_{sp} of $BaSO_4$,
$[Ba^{2+}]\ [SO_4^{2-}] = 1\times10^{-10}$
$[Ba^{2+}]\ [0.1] = 10^{-10}/0.1 = 10^{-9}$ M
Concentration of Ba^{2+} in final solution = 10^{-9} M
Concentration of Ba^{2+} in original solution.
$M_1V_1 = M_2V_2$
$M_1(500-50) = 10^{-9}(500)$
$M_1 = 1.11\times10^{-9}$ M
Answer: (2)

29. At 518^0 C, the rate of decomposition of a sample of gaseous acetaldehyde, initially at a pressure of 363 torr, was 1.00 torr s^{-1} when 5% had reacted and 0.5 torr s^{-1} when 33% had reacted. The order of the reaction is
(1) 3
(2) 1
(3) 0
(4) 2

Solution:
Assume the order of reaction with respect to acetaldehyde is x.
Condition 1:
Rate = $k[CH_3CHO]^x$
$1 = k[363\times0.95]^x$
$1 = k[344.85]^x$ ..(i)
Condition 2:
$0.5 = k[363\times0.67]^x$
$0.5 = k[243.21]^x$ ..(ii)

Divide equation (i) by (ii),
$1/0.5 = (344.85/243.21)^x$
$\Rightarrow 2 = 1.414^x$
$\Rightarrow x = 2$
Answer: (4)

30. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point?
(1) $[Co(H_2O)_5Cl]Cl_2 . H_2O$
(2) $[Co(H_2O)_4Cl_2]Cl. 2H_2O$
(3) $[Co(H_2O)_3Cl_3]. 3H_2O$
(4) $[Co(H_2O)_6]Cl_3$

Solution:
The solution which shows maximum freezing point must have minimum number of solute particles.
(1) $[Co(H_2O)_5Cl]Cl_2 . H_2O \rightarrow [Co(H_2O)_5Cl]^{2+} + 2Cl^-$, $i = 3$
(2) $[Co(H_2O)_4Cl_2]Cl. 2H_2O \rightarrow [Co(H_2O)_4Cl_2]^+ + Cl^-$, $i = 2$
(3) $[Co(H_2O)_3Cl_3]. 3H_2O \rightarrow [Co(H_2O)_3Cl_3]$, $i = 1$
(4) $[Co(H_2O)_6]Cl_3 \rightarrow [Co(H_2O)_6]^{3+} + 3Cl^-$, $i = 4$
So, solution of 1 molal $[Co(H_2O)_3Cl_3]. 3H_2O$ will have minimum number of particles in aqueous state.
Answer: (3)