





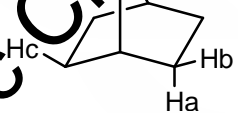




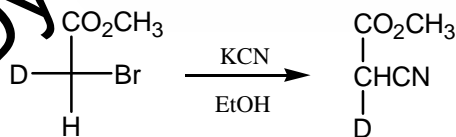




51.  $[\text{XeO}_6]^{4-}$  is octahedral whereas  $\text{XeF}_6$  is a disordered one, because  
 (a) fluorine is more electronegative than oxygen  
 (b) Xe has a lone-pair in  $\text{XeF}_6$   
 (c)  $\text{XeF}_6$  is neutral whereas  $[\text{XeO}_6]^{4-}$  is anionic.  
 (d) Xe-F bond has more ionic character
52. In biological systems, the metal ion involved in the dioxygen transport besides Fe is  
 (a) Co (b) Zn (c) Mg (d) Cu
53.  $[\text{Ru}(2,2' - \text{bipyridyl})_3]^{2+}$ , when it absorbs at 452 nm, is a very good oxidizing as well as reducing agent due to the formation of  
 (a)  $[\text{Ru}^{\text{I}}(2,2' - \text{bipyridyl})_3]^+$  (b)  $[\text{Ru}^{\text{I}}(2,2' - \text{bipyridyl})_2(2,2' \text{bipyridyl}^+)]^{2+}$   
 (c)  $[\text{Ru}^{\text{III}}(2,2' - \text{bipyridyl})_3]^{3+}$  (d)  $[\text{Ru}^{\text{III}}(2,2' - \text{bipyridyl})_2(2,2' - \text{bipyridyl})]^{2+}$
54. In the proton decoupled  $^{13}\text{C}$  and  $^{31}\text{P}$  NMR spectra of  $(\text{CH}_3)_3\text{P} = \text{O}$ , the number of lines observed, respectively, are  
 (a) two and one (b) one and two (c) three and one (d) two and two.
55. Among,  $\text{RO}^-$ ,  $\text{AsMe}_3$ ,  $\text{ROR}'$ ,  $\text{CN}^-$ ,  $\text{RCO}_2^-$ ,  $\text{SCN}^-$ , the set of ligands with good  $\pi$ -acceptor nature are  
 (a)  $\text{RO}^-$ ,  $\text{RCO}_2^-$ ,  $\text{SCN}^-$  (b)  $\text{RO}^-$ ,  $\text{RCO}_2^-$ ,  $\text{AsMe}_3$   
 (c)  $\text{AsMe}_3$ ,  $\text{CN}^-$ ,  $\text{SCN}^-$  (d)  $\text{RO}^-$ ,  $\text{ROR}'$ ,  $\text{RCO}_2^-$
56. Identify the correct stereochemical relationship among the hydrogen atoms  $\text{H}_a$ ,  $\text{H}_b$  and  $\text{H}_c$  in the following molecule:



- (a)  $\text{H}_a$  and  $\text{H}_b$ : enantiotopic (b)  $\text{H}_a$  and  $\text{H}_b$ : diastereotopic  
 (c)  $\text{H}_a$  and  $\text{H}_c$ : enantiotopic (d)  $\text{H}_b$  and  $\text{H}_c$ : diastereotopic.
57. The configurations of the reactant and the product in the following reaction, respectively, are



- (a) R, R (b) R, S (c) S, R (d) S, S
58. Match the reactions of some p-substituted benzene derivatives (a)–(d) given in **List I** with the Hammett's  $\rho$ -values (i) - (iv) in **List II** and identify the correct match.

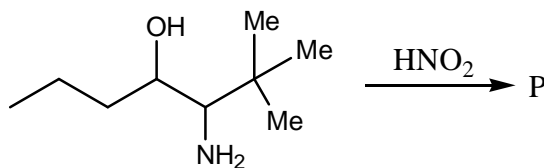
**List - I**

- (a)  $\text{ArCH}_2 - \text{Cl} \xrightarrow[70^\circ\text{C}]{\text{aq. acetone}} \text{ArCH}_2 - \text{OH} + \text{HCl}$   
 (b)  $\text{ArCH}_2 - \text{CO}_2\text{H} \xrightleftharpoons[25^\circ\text{C}]{\text{H}_2\text{O}} \text{ArCH}_2 - \text{COO}^- + \text{H}^+$   
 (c)  $\text{Ar} - \text{Cl} \xrightarrow[50^\circ\text{C}]{\text{MeONa/MeOH}} \text{Ar} - \text{OMe} + \text{Cl}^-$   
 (d)  $\text{Ar} - \text{CO}_2\text{H} \xrightleftharpoons[25^\circ\text{C}]{\text{H}_2\text{O}} \text{Ar} - \text{COO}^- + \text{H}^+$

**List - II**

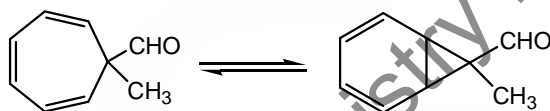
- (i) +8.50 (ii) +1 (iii) +0.49 (iv) -1.88  
 (a) a-i, b-iv, c-iii, d-ii (b) a-iv, b-i, c-ii, d-iii (c) a-i, b-ii, c-iv, d-iii (d) a-iv, b-iii, c-i, d-ii

59. On heating with dilute sulfuric acid, naphthalene-1 sulfonic acid gives predominantly  
 (a) naphthalene (b) naphthalene-2-sulfonic acid  
 (c) 1-naphthol (d) 2-naphthol
60. Predict the major product P in the following reaction



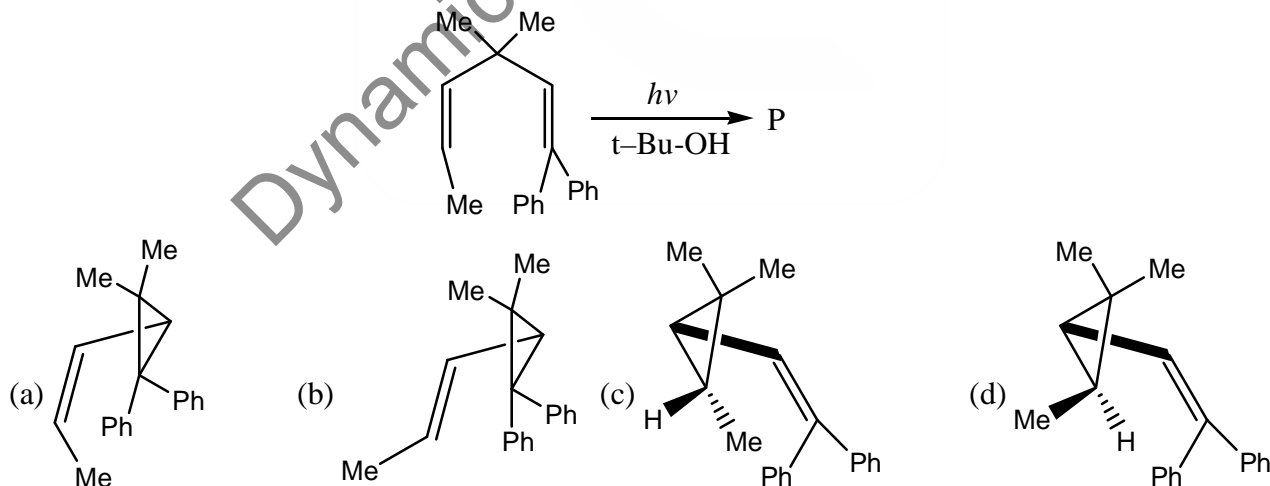
- (a)
- (b)
- (c)
- (d)

61. Select the correct classification in the following reaction from option I to IV gives below.

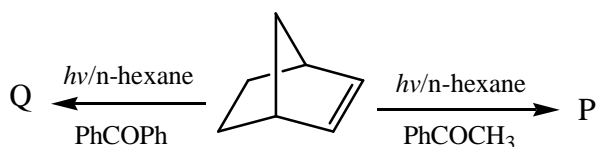


- (I) Conrotatory electrocyclic reaction (II) Disrotatory electrocyclic reaction  
 (III) Valence isomerization (IV)  $[x 4_s + \pi 2_a]$  cycloaddition reaction  
 (a) I and III (b) II and IV (c) II and III (d) I and IV

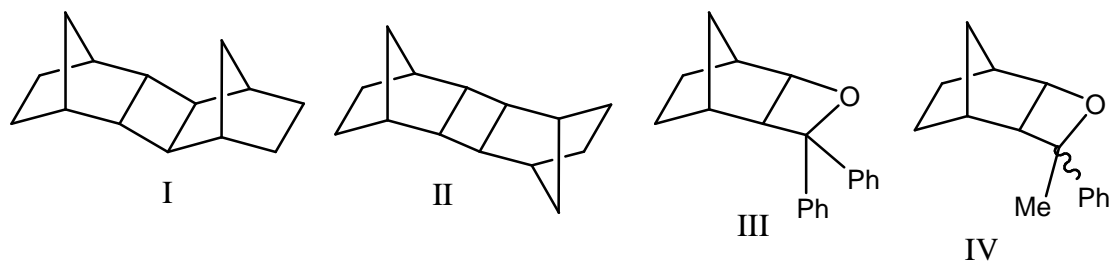
62. Identify the major product P in the following reaction.



63. Identify the major product P and Q in the following reactions from the list of compounds I to IV.

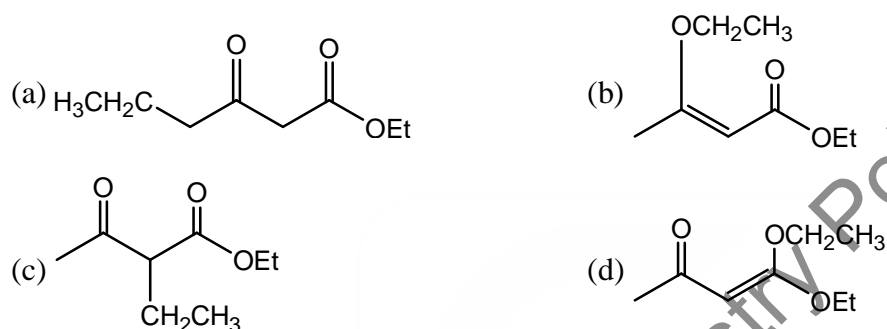
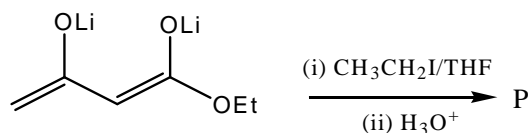




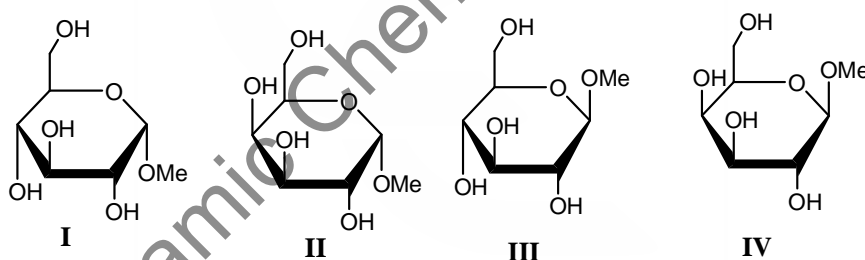


- (a) P:I and Q:II      (b) P:II and Q:III      (c) P:IV and Q:II      (d) P:IV and Q: III

64. Identify the major product P in the following reaction:



65. Identify the **Correct** set of stereochemical relationships amongst the following monosaccharides I-IV



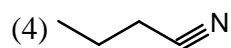
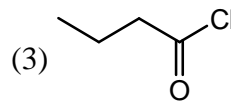
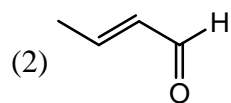
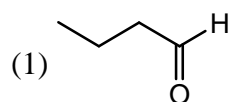
- (a) I and II are anomers; III and IV are epimers  
(b) I and III are epimers; II and IV are anomers  
(c) I and II are epimers; III and IV are anomers  
(d) I and III are anomers; I and II are epimers.

66. Select the correct pair of statements:

- (I) Complementary strands run antiparallel in a double stranded DNA.  
(II) The triplet codons, represented by the genetic code, are expressed by ribonucleic acids.  
(III) t-RNA carries the genetic information to the site of DNA replication.  
(IV) A nucleoside contains a ribose or deoxyribose and phosphate constituents only.
- (a) I and II      (b) II and III      (c) III and IV      (d) I and IV.

67. Match the compounds in **List - I** with the stretching frequencies ( $\text{cm}^{-1}$ ) of the principal functional groups given in **List-II**.

**List - I**



**List - II**

(i) 2240

(ii) 1795

(iii) 1750

(iv) 1725

(v) 1695

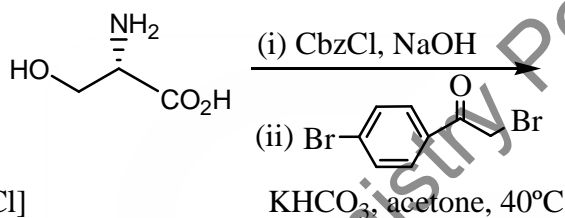
(a) 1-iii, 2-iv, 3-i, 4-v

(b) 1-iii, 2-iv, 3-ii, 4-v

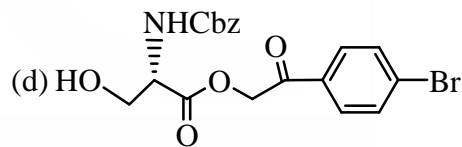
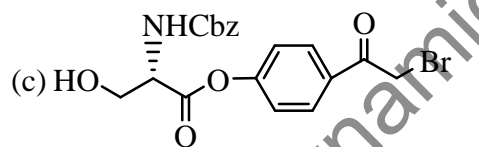
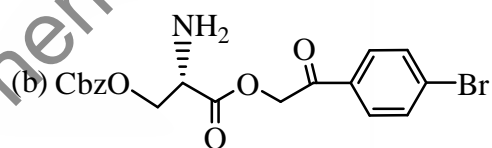
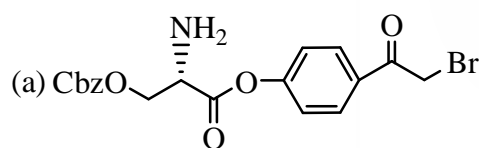
(c) 1-iv, 2-v, 3-ii, 4-i

(d) 1-iv, 2-iii, 3-v, 4-i

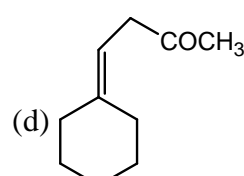
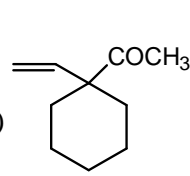
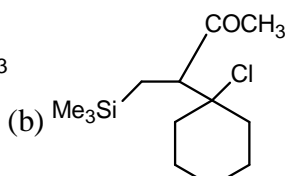
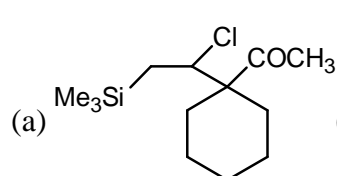
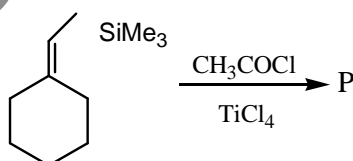
68. Pick the major product P in the following reaction



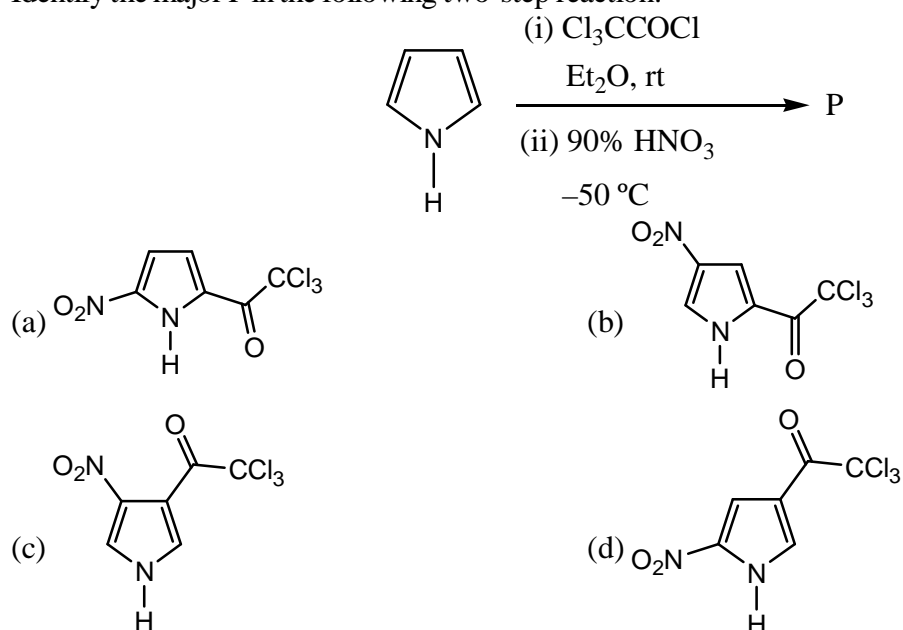
[CbzCl is  $\text{PhCH}_2\text{OCOCl}$ ]



69. Identify the major product P in the following reaction:



70. Identify the major P in the following two-step reaction:



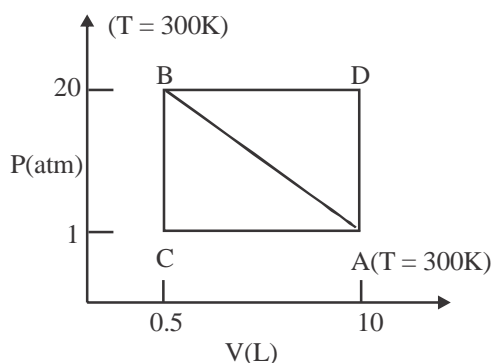
**Common Data for Q.71, Q.72 and Q.73:**

Methyl ethyl ether (A) and diborane (B) form a compound, which melts congruently at 133 K. The system exhibits two eutectics, one at 25 mole percent B and 123 K and a second at 90 mole percent B and 104 K. The melting points of pure A and B are 131 K and 110 K, respectively.

71. The phases at 55 mole percent B and 108 K are,  
 (a) solid AB and a solid B phase (b) solid AB and a liquid phase  
 (c) solid B and a liquid phase (d) solid A and a liquid phase
72. What happens if a small amount of solid B is added to the above mixture while keeping the temperature constant?  
 (a) added B forms compound AB  
 (b) added B precipitates out  
 (c) overall liquid phase percentage increases with respect to the overall solid phase  
 (d) complete solidification takes place
73. The mixture at 25 mole percent B and at 124 K is cooled slowly to 114 K. The resulting phases are  
 (a) solid AB and solid A (b) solid AB and liquid  
 (c) solid AB and solid B (d) liquid and solid A

**Common Data for Q. 74 and Q. 75.**

Consider the following P-V diagram for an ideal gas that follows the diagonal path from A to B.



74. The work done (in atm-L) on the gas in the process is  
 (a) 9.5 (b) 99.75 (c) 190 (d)  $10 \ln(20)$

75. For the above process,  
 (a)  $\Delta H = W$       (b)  $\Delta H = Q$       (c)  $\Delta H = \Delta G$       (d)  $\Delta H = \Delta E$

**Linked Answer Q. 76 and Q.77.**

76. The first excited state wavefunction for a particle in a box that spans from  $-a$  to  $+a$  is

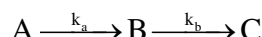
(a)  $\sqrt{\frac{1}{a}} \cos\left(\frac{\pi x}{a}\right)$     (b)  $\sqrt{\frac{1}{a}} \sin\left(\frac{\pi x}{a}\right)$     (c)  $\sqrt{\frac{2}{a}} \cos\left(\frac{2\pi x}{a}\right)$     (d)  $\sqrt{\frac{2}{a}} \sin\left(\frac{2\pi x}{a}\right)$

77. A perturbation  $V = \delta(x - a/2)$  is introduced in the box. The first order energy correction to the first excited state is

(a) 0      (b)  $2/a$       (c)  $1/a$       (d)  $1/2a$

**Linked Answer Q. 78 and Q.79.**

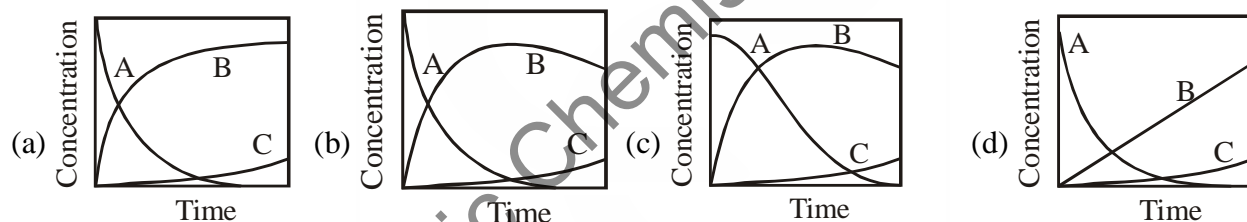
78. A reaction proceeds through the formation of an intermediate B in an unimolecular reaction



The integrated rate law for this reaction is

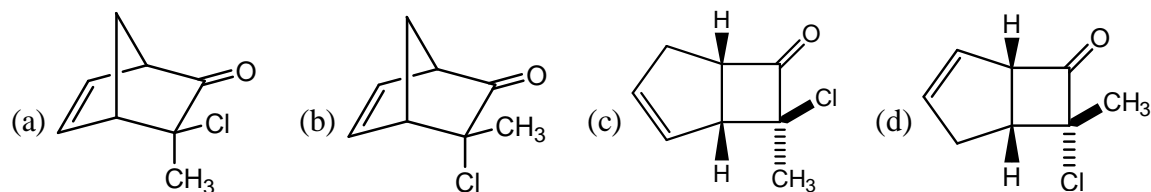
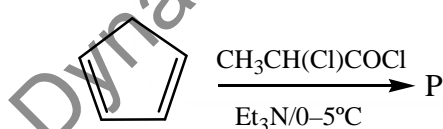
(a)  $[A] = [A]_0 e^{-k_a t}$       (b)  $[A] = [A]_0 (e^{-k_a t} - e^{-k_b t})$   
 (c)  $[A] = \frac{[A]_0}{2} \left( 1 + \frac{k_a e^{-k_b t} - k_b e^{-k_a t}}{k_a - k_b} \right)$       (d)  $[A] = [A]_0 (1 + e^{-k_a t} - e^{-k_b t})$

79. If  $k_a \gg k_b$ , then concentration vs. time plot for the above reaction is:

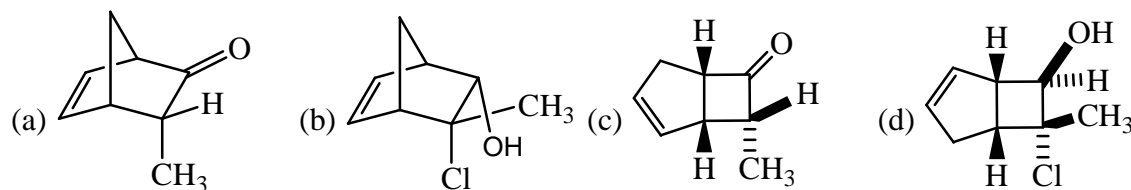


**Linked Answer Q.80 and Q.81:**

80. Identify the major product P in the following reaction

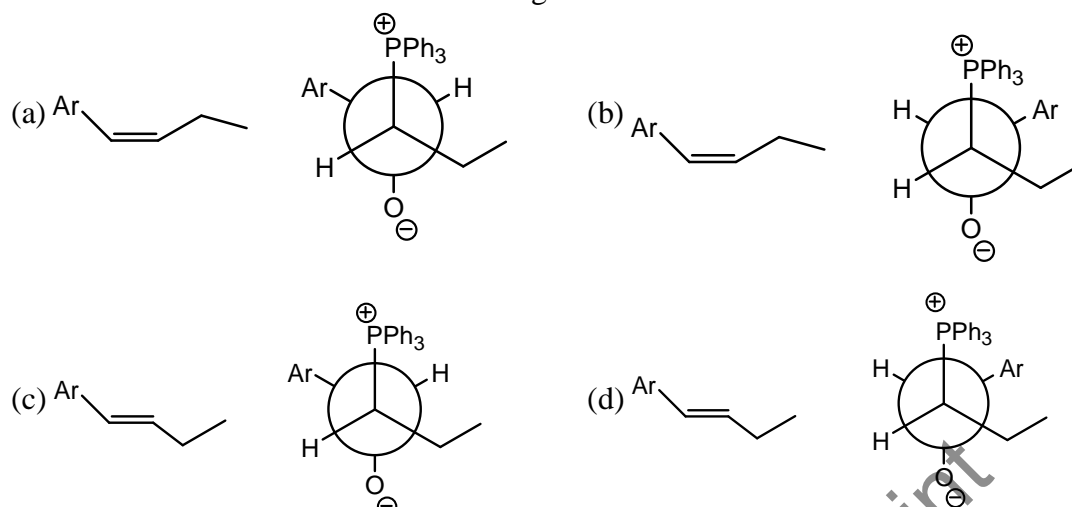
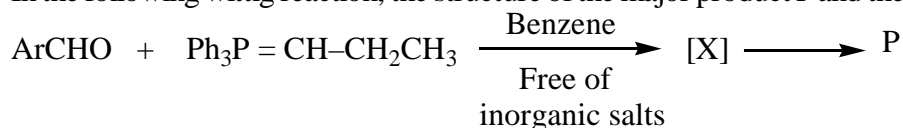


81. Product P of the above reaction transforms to a product Q on treatment with  $n\text{-Bu}_3\text{SnH}$  in the presence of AIBN in benzene solution. Identify Q.



**Linked Answer Q.82 and Q.83:**

82. In the following Wittig reaction, the structure of the major product P and the intermediate [X], respectively, are

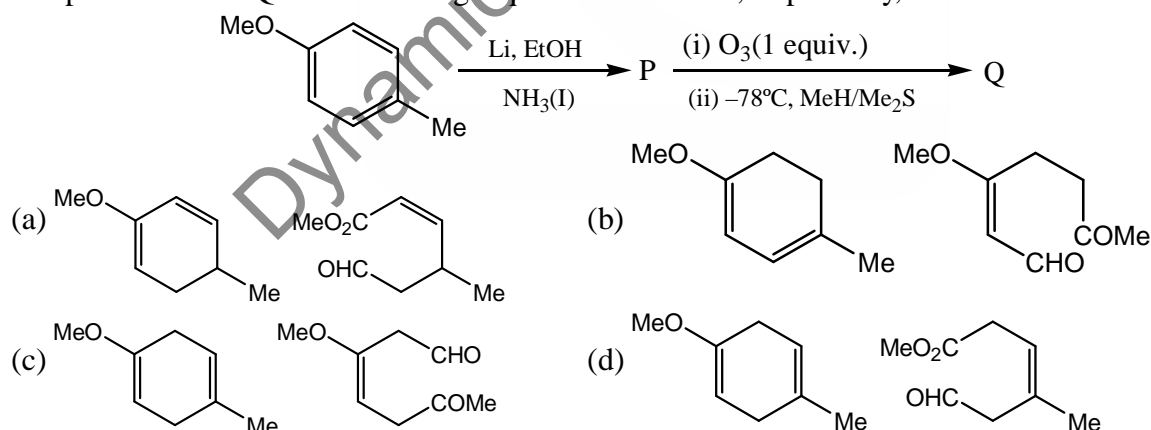


83. Which of the following sets of characteristic NMR signals will be compatible with the structure of P in the above reaction ?

- (a)  $\delta 7.18$  (d,  $J = 6$  Hz, 2H),  $7.01$  (d,  $J = 6$  Hz, 2H),  $6.41$  (d,  $J = 18$  Hz, 1H)  
 (b)  $\delta 7.11$  (d,  $J = 6$  Hz, 1H),  $7.10$  (s, 1H),  $7.09$  (t,  $J = 5$  Hz, 1H),  $6.94$  (d,  $J = 5$  Hz, 1H),  $6.41$  (d,  $J = 17$  Hz, 1H)  
 (c)  $\delta 7.18$  (d,  $J = 6$  Hz, 2H),  $7.01$  (d,  $J = 6$  Hz, 2H),  $6.35$  (d,  $J = 9$  Hz, 1H)  
 (d)  $\delta 7.11$  (d,  $J = 6$  Hz, 1H),  $7.10$  (s, 1H),  $7.09$  (t,  $J = 5$  Hz, 1H),  $6.94$  (d,  $J = 5$  Hz, 1H),  $6.35$  (d,  $J = 10$  Hz, 1H)

**Linked Answer Type Q.84 and Q.85**

84. The products P and Q in the following sequence of reactions, respectively, are



85. The reagent for selective reduction of the aldehyde group in Q obtained in the above reaction is

- (a)  $\text{H}_2, (\text{Ph}_3\text{P})_3\text{RhCl}$  (b)  $((\text{H}_3\text{C})_2\text{CHCH}_2)_2\text{AlH}$   
 (c)  $\text{Na}(\text{CH}_3\text{COO})_3\text{BH}$  (d)  $\text{LiAlH}_4$