

## 1 Mark Questions

1. On the basis of VSEPR theory, the molecule which has a linear structure is

- (a)  $\text{SO}_2$  (b)  $\text{N}_2\text{O}$   
(c)  $\text{Cl}_2\text{O}$  (d)  $\text{NO}_2$

2. The geometries of  $[\text{NiCl}_4]^{2-}$  and  $[\text{PdCl}_4]^{2-}$  respectively are

- (a) tetrahedral and square planar  
(b) both tetrahedral  
(c) both square planar  
(d) square planar and tetrahedral

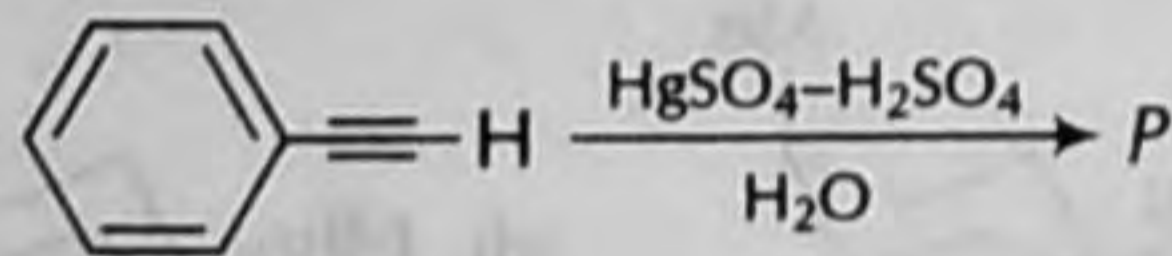
3. The ionisation energy of hydrogen atom in ground state is 13.6 eV. The ionisation energy of  $\text{Li}^{2+}$  in ground state would be

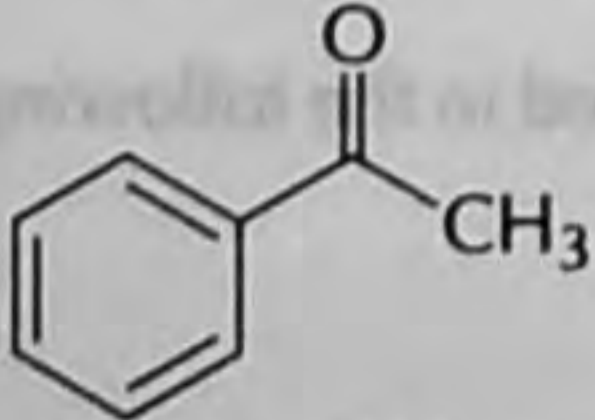
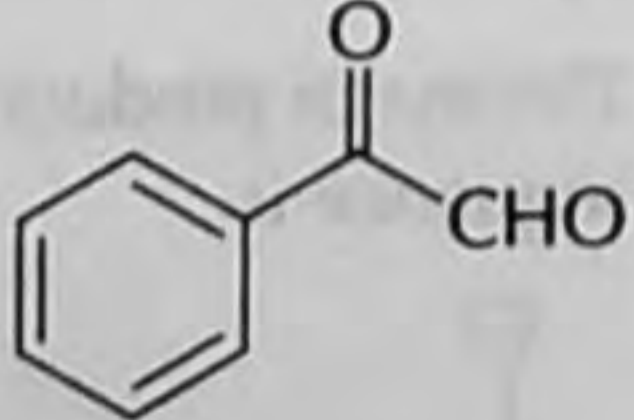
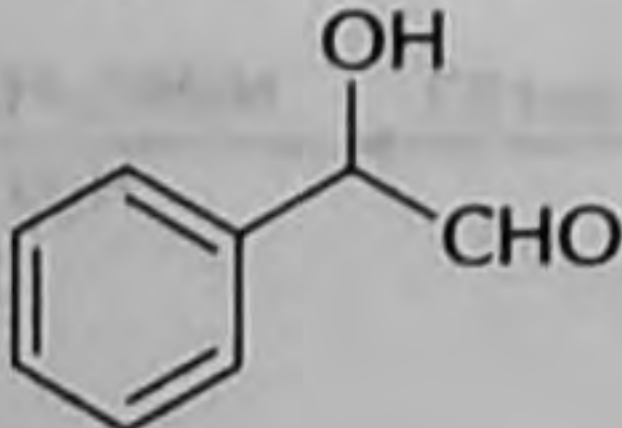
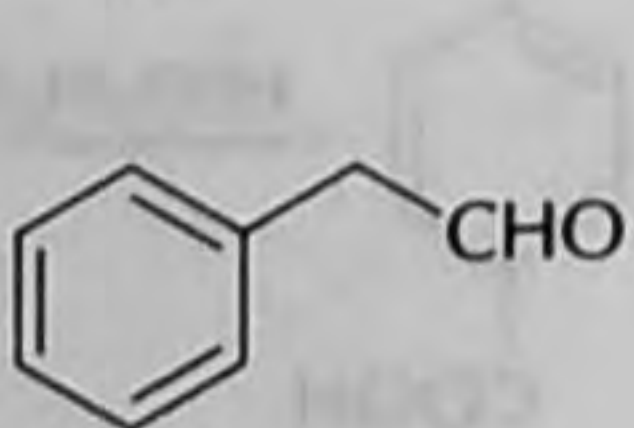
- (a) 1.51 eV (b) 4.53 eV  
(c) 40.8 eV (d) 122.4 eV

4. The half-life of  $^{14}\text{C}$  is 5730 years. An old sample of wood contains 25% of  $^{14}\text{C}$  as would be found in a current living tree. The age of the sample of wood would be

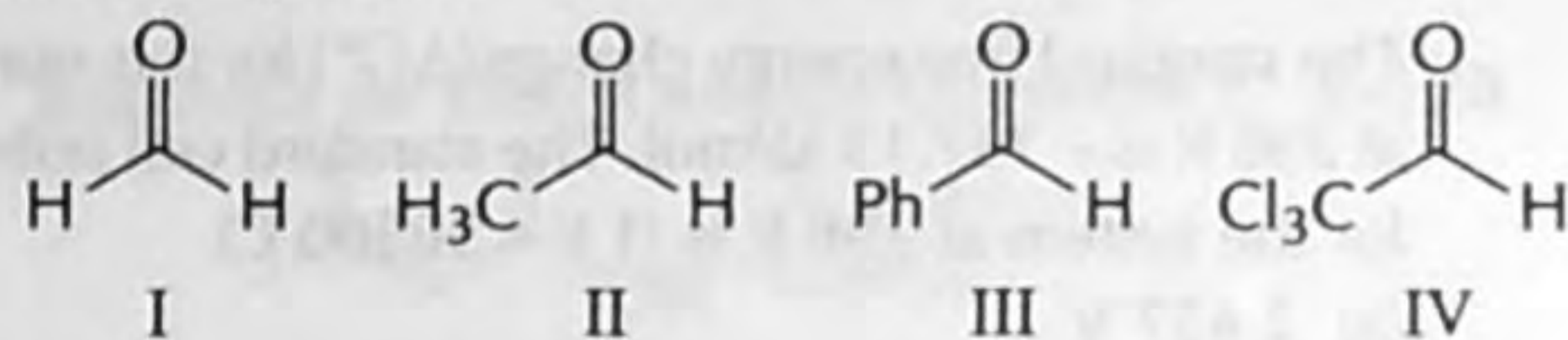
- (a) 1432 yr (b) 2865 yr  
(c) 5730 yr (d) 11460 yr

5. The product 'P' formed in the following reaction is



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

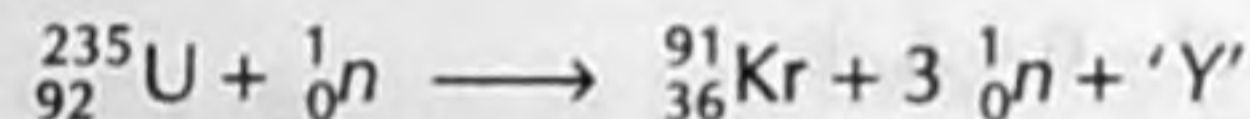
6. The order of reactivity of the following aldehydes with a nucleophile is



- (a)  $\text{I} > \text{II} > \text{III} > \text{IV}$  (b)  $\text{IV} > \text{I} > \text{II} > \text{III}$   
(c)  $\text{IV} > \text{III} > \text{II} > \text{I}$  (d)  $\text{I} > \text{IV} > \text{II} > \text{III}$

## 2 Marks Questions

7. In the nuclear reaction of  $^{235}_{92}\text{U}$  with a neutron, two elements Kr and 'Y' are formed along with three neutrons.



The element 'Y' is

- (a)  $^{142}_{56}\text{Ba}$  (b)  $^{142}_{55}\text{Cs}$   
(c)  $^{142}_{54}\text{Xe}$  (d)  $^{142}_{53}\text{I}$

8. Which of the following statements is true about diatomic species  $\text{He}_2$  and  $\text{He}_2^+$ ?

- (a)  $\text{He}_2$  is stable and  $\text{He}_2^+$  is stable  
(b)  $\text{He}_2$  is stable and  $\text{He}_2^+$  is unstable  
(c)  $\text{He}_2$  is unstable and  $\text{He}_2^+$  is stable  
(d)  $\text{He}_2$  is unstable and  $\text{He}_2^+$  is unstable

9. For the reaction  $\text{A} \rightleftharpoons \text{B}$ , the activation energy for the forward reaction is 123 kJ/mol. The activation energy for the reverse reaction is 140 kJ/mol. The enthalpy change for the forward reaction is

- (a) 263 kJ/mol (b) -263 kJ/mol  
(c) 17 kJ/mol (d) -17 kJ/mol

10. The acid dissociation constant of a weak acid HA is  $10^{-5}$ . A 0.20 M solution of the acid HA also contains 0.10 M of salt  $\text{MA}_2$ . The pH of the solution is



- (a) 0.69 (b) 1.0  
(c) 2.85 (d) 5.0

11. The attractive part of the van der Waals' interaction,  $-\frac{B}{r^6}$ , where  $B$  is a positive coefficient and  $r$  is the distance between the molecules, is governed by  
(a) dipole-dipole interaction  
(b) charge-dipole interaction  
(c) induced dipole-induced dipole interaction  
(d) dipole-induced dipole interaction

12. A fuel cell is based on the idea of the reaction  $H_2(g) + \frac{1}{2} O_2(g) \longrightarrow H_2O(l)$  generating electricity.

The standard free energy change ( $\Delta G^\circ$ ) for this reaction at 298 K is  $-237.13$  kJ/mol. The standard cell potential for the system at 298 K is ( $1 F = 96500$  C)

- (a) 2.457 V  
(b) 1.228 V  
(c)  $-1.228$  V  
(d)  $-2.457$  V

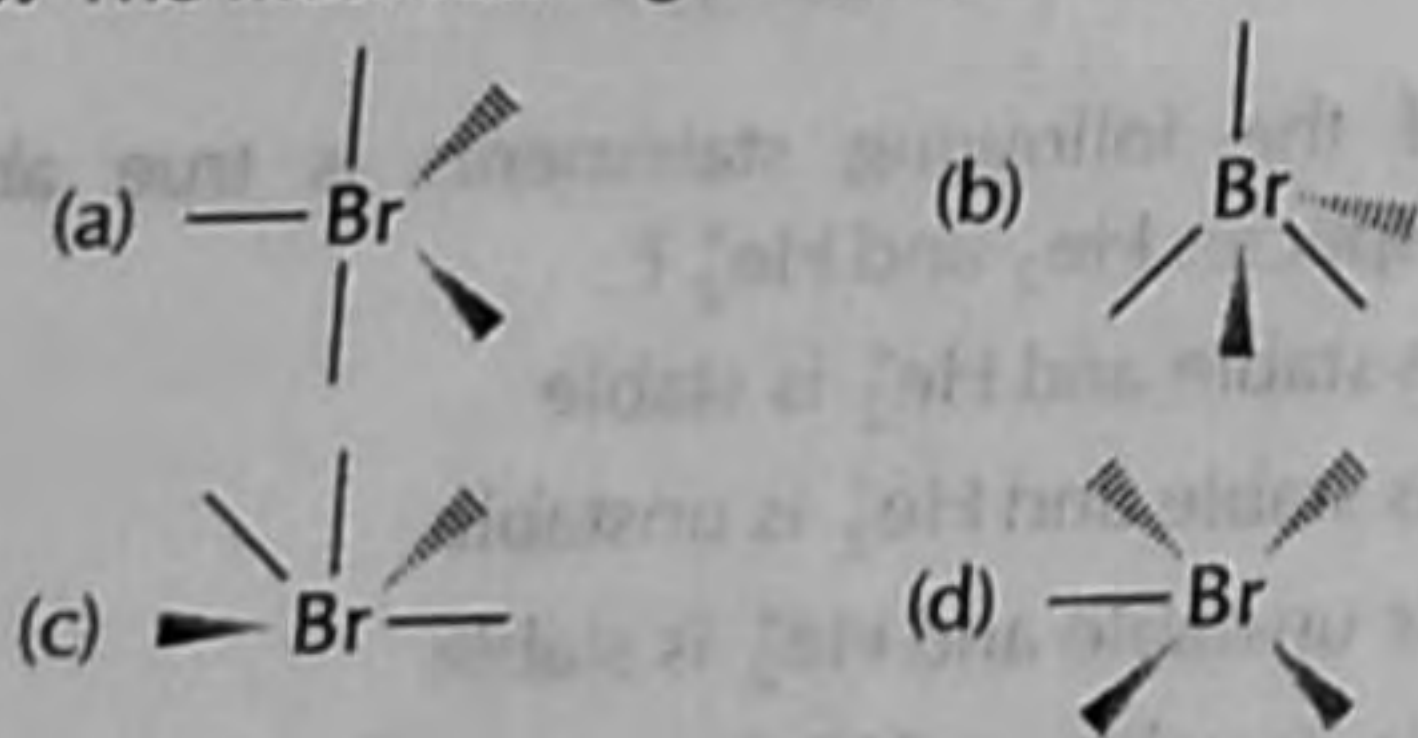
13. The electron-deficient molecule is

- (a)  $N_2H_4$  (b)  $C_2H_6$   
(c)  $B_2H_6$  (d)  $O_2H_2$

14. The complex with crystal field stabilization energy (CFSE) of  $-0.4 \Delta_t$  is

- (a)  $[TiCl_4]$  (b)  $[MnCl_4]^{2-}$   
(c)  $[CoCl_4]^{2-}$  (d)  $[CuCl_4]^{2-}$

15. The most stable geometry of  $BrF_5$  is



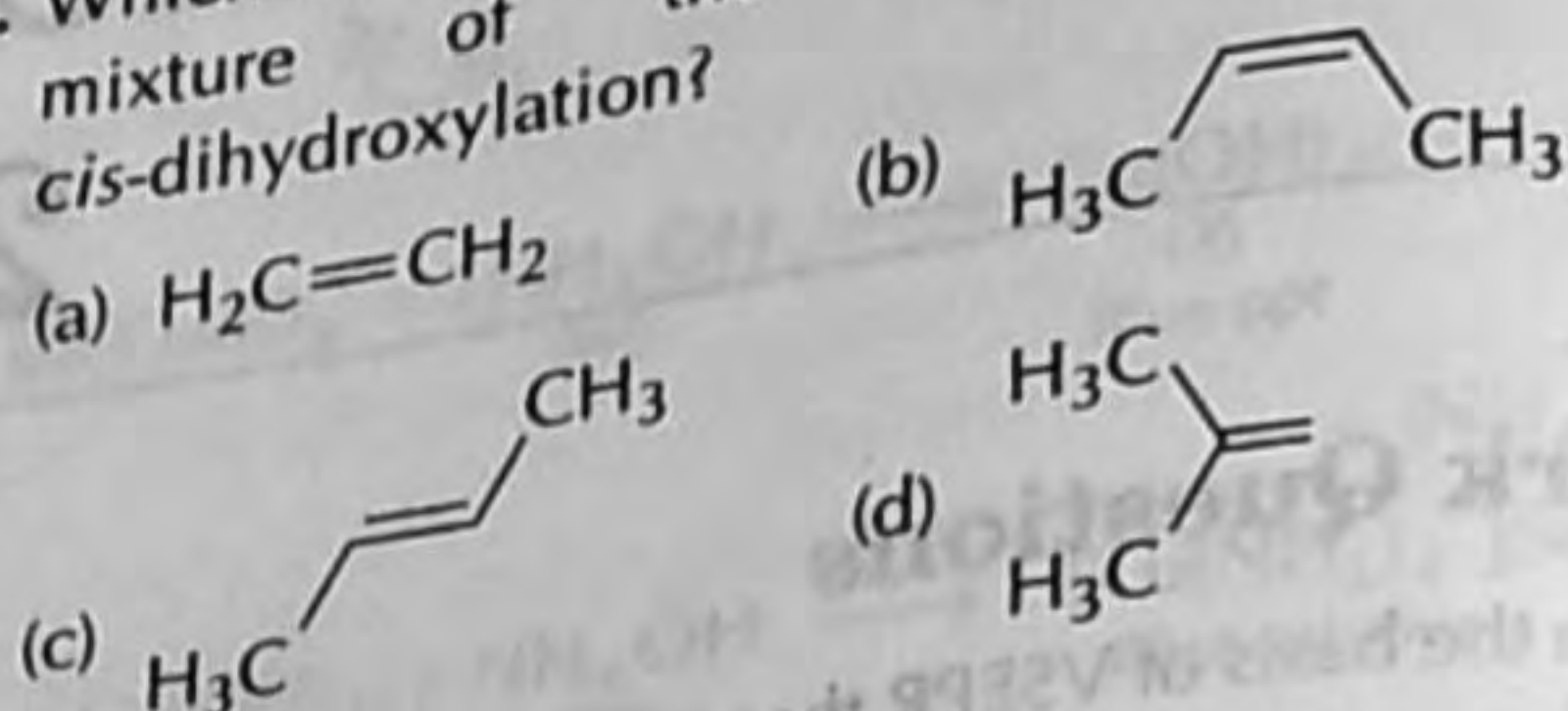
16. The species having three unpaired electrons and tetrahedral geometry is

- (a)  $[Co(CN)_6]^{4-}$   
(b)  $[CoCl_4]^{2-}$   
(c)  $[Ni(CN)_4]^{2-}$   
(d)  $[NiCl_4]^{2-}$

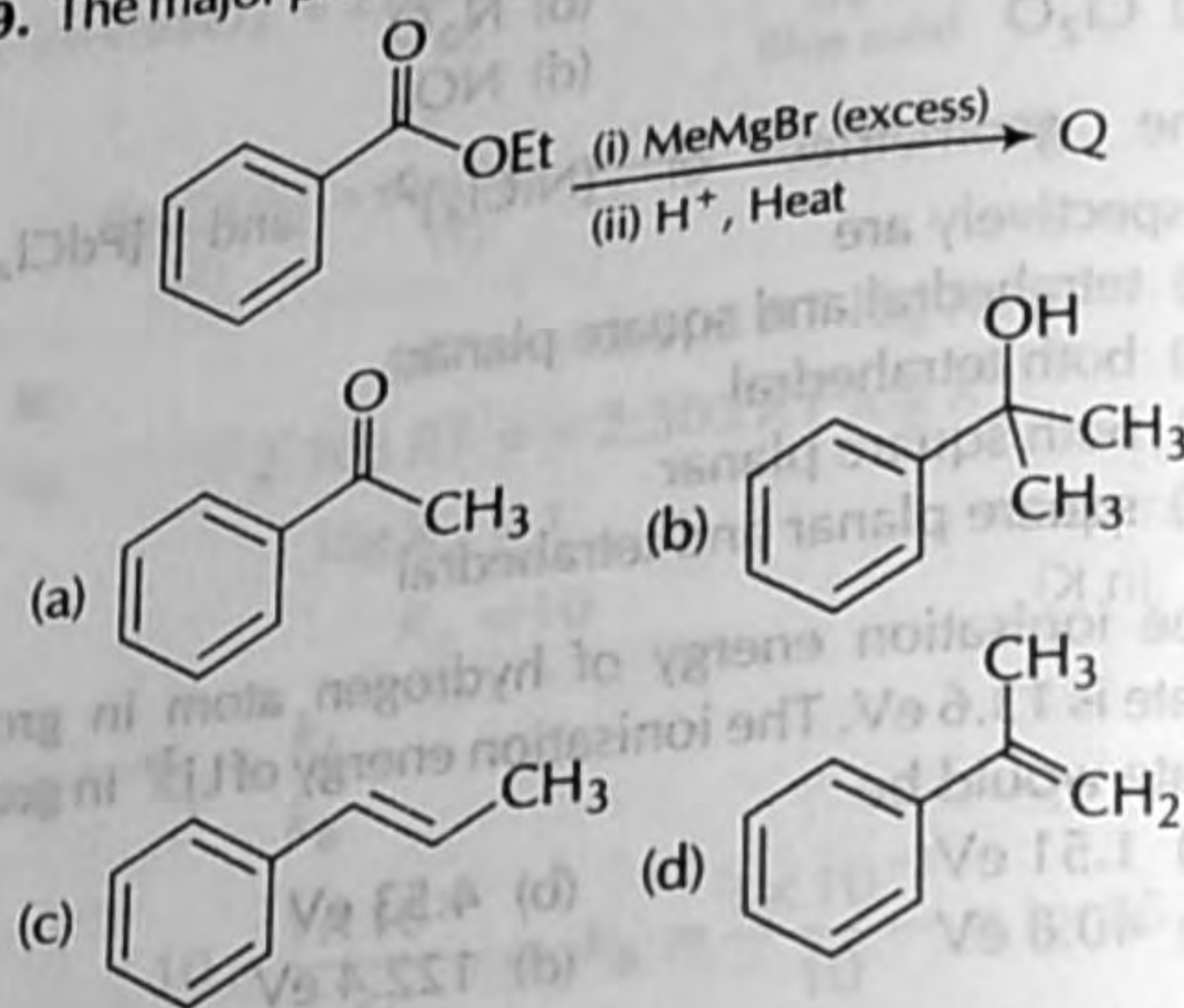
17. The correct arrangement of group 13 elements in terms of increasing average  $M-Cl$  bond energy in  $MCl_3$  compounds is

- (a)  $Al > Ga > In > Tl$   
(b)  $Tl > In > Ga > Al$   
(c)  $Al > Ga > Tl > In$   
(d)  $Ga > In > Tl > Al$

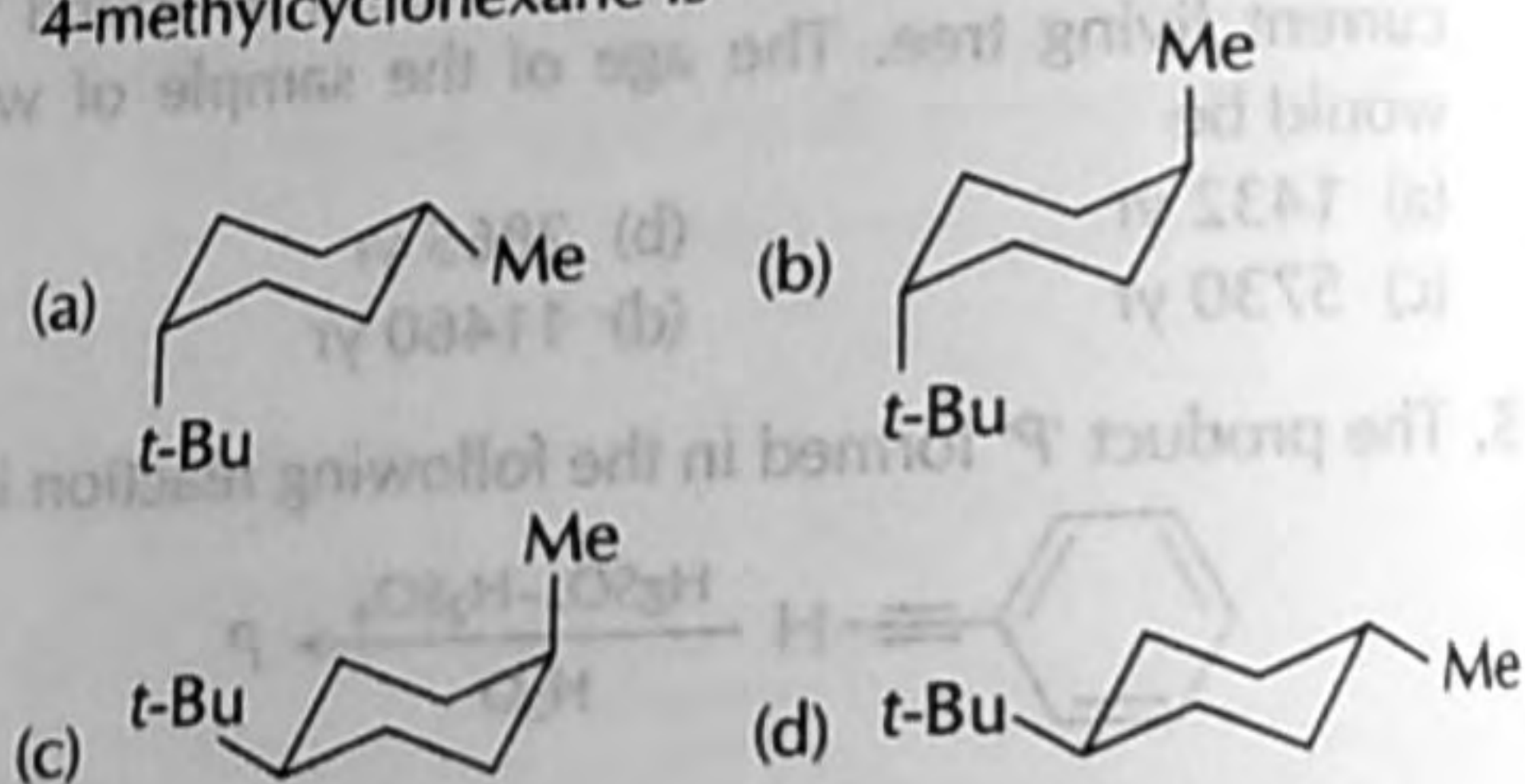
18. Which of the following olefins leads to a racemic diol product upon  $cis$ -dihydroxylation?



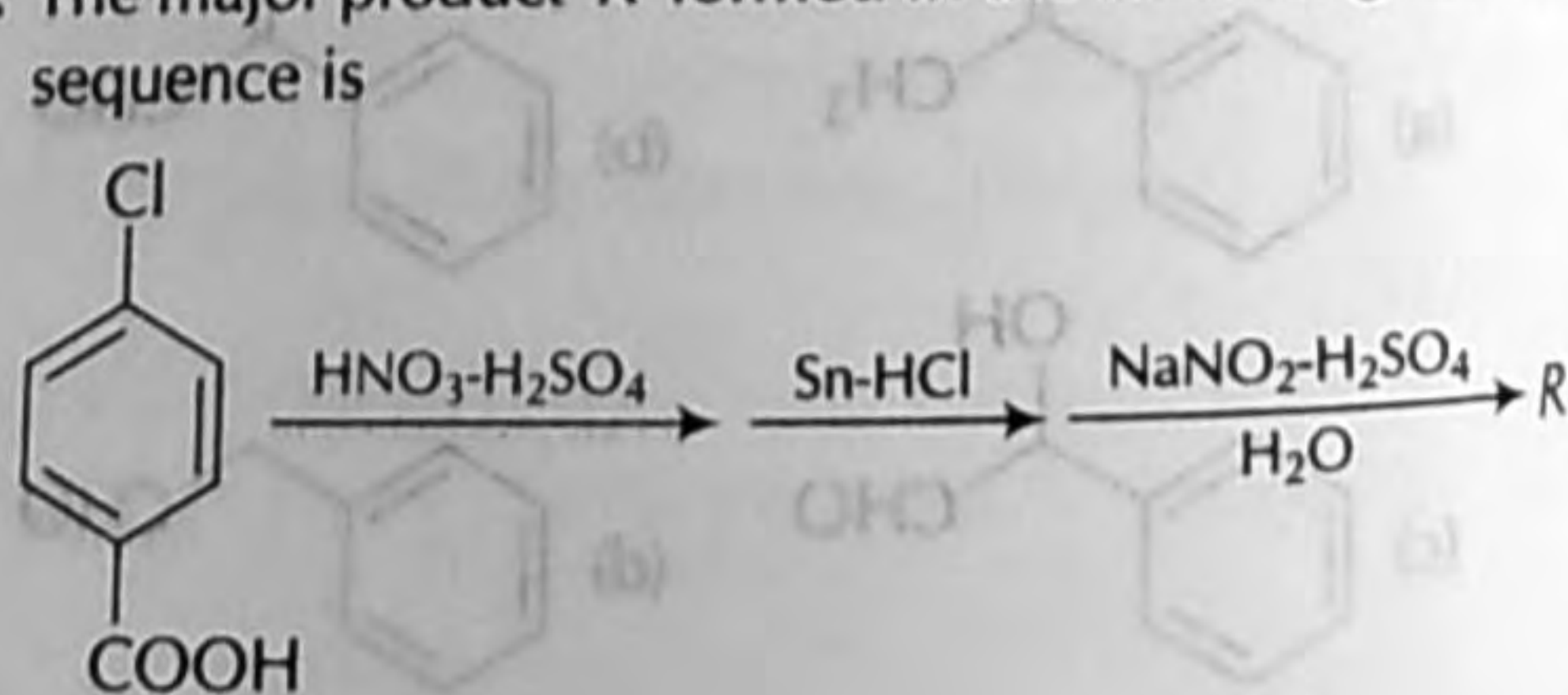
19. The major product 'Q' formed in the following reaction is



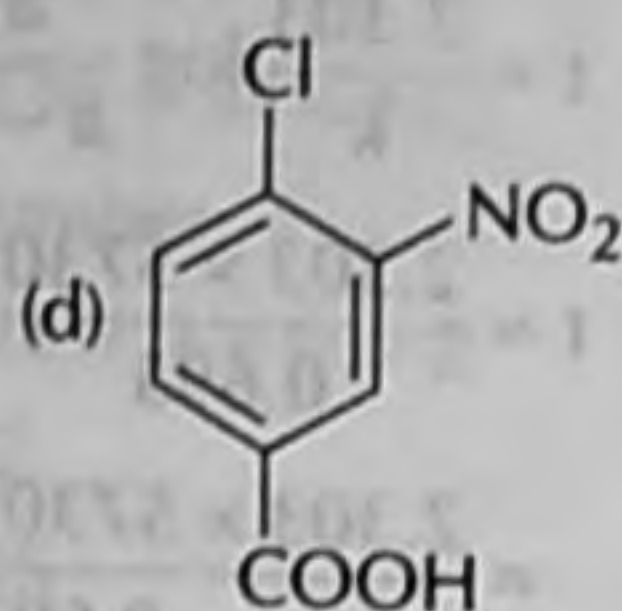
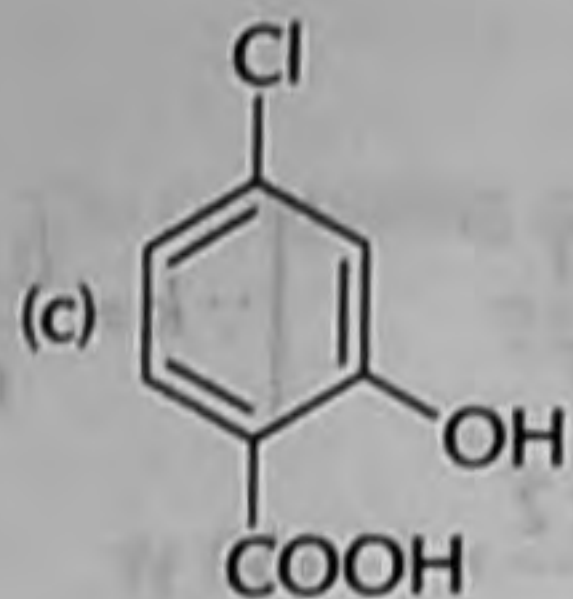
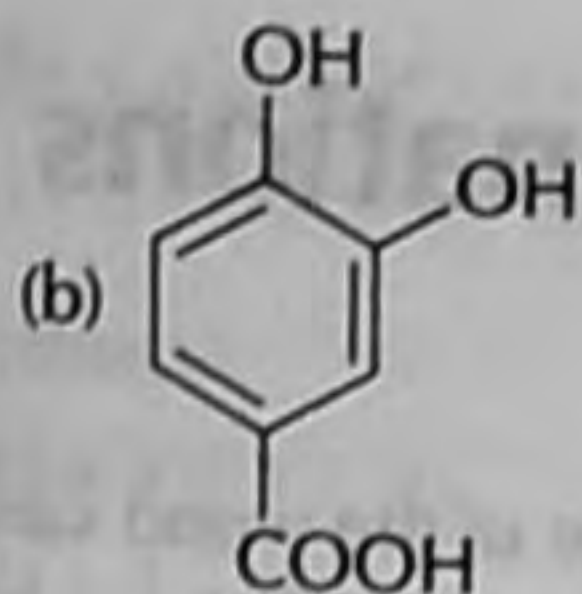
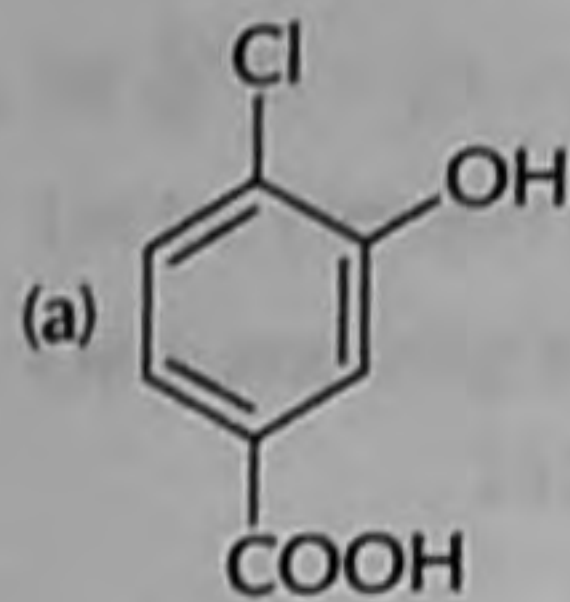
20. The most stable conformation of  $cis$ -1-*tert*-butyl-4-methylcyclohexane is



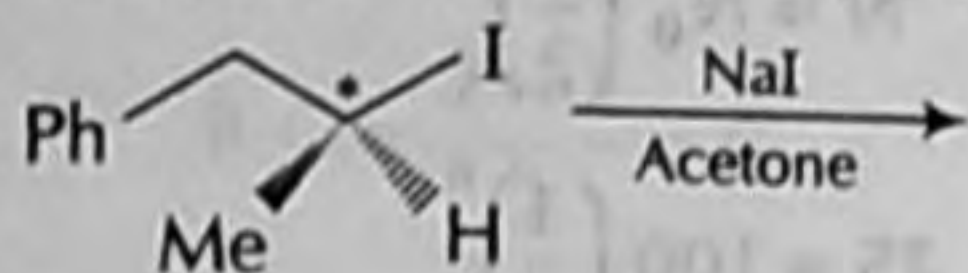
21. The major product 'R' formed in the following reaction sequence is







22. The following optically active compound undergoes racemisation upon reaction with NaI in acetone



The pathway followed by the reaction is

- (a)  $S_N1$  (b)  $S_N2$  (c) E1 (d) E2

**Common Data for Questions 23 and 24**

The equilibrium constant ( $K$ ) for the reaction  $Ag_2CO_3(s) \rightleftharpoons Ag_2O(s) + CO_2(g)$  varies with temperature  $T$  as

$T$ (in K)	400	500
$K$	$1.41 \times 10^{-2}$	1.41

23. The standard free energy change ( $\Delta G^\circ$ ) for the above reaction at 500 K is ( $R = 8.314 \text{ J/K mol}$ )

- (a)  $-0.62 \text{ kJ/mol}$  (b)  $-1.43 \text{ kJ/mol}$   
(c)  $0.62 \text{ kJ/mol}$  (d)  $1.43 \text{ kJ/mol}$

24. Assuming that the standard enthalpy change ( $\Delta H^\circ$ ) for the above reaction is constant in this temperature range, its value is

- (a)  $33.3 \text{ kJ/mol}$  (b)  $76.6 \text{ kJ/mol}$   
(c)  $-33.3 \text{ kJ/mol}$  (d)  $-76.6 \text{ kJ/mol}$

**Statement for Linked Answer Questions 25 and 26**

A solid compound  $X$  on heating produces a new solid  $P$  and a gas  $Q$ . The gas  $Q$  is absorbed by KOH.

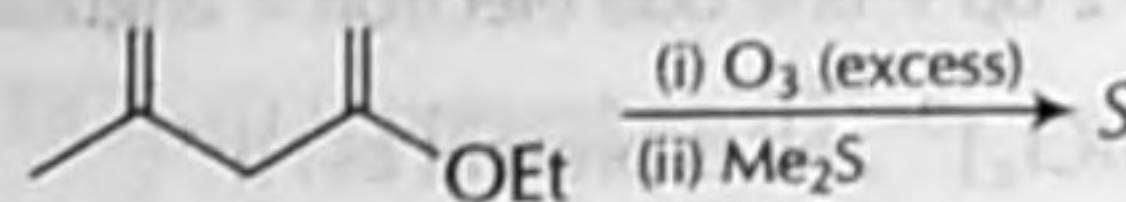
25. The gas  $Q$  is

- (a)  $CO_2$  (b)  $O_2$   
(c)  $N_2$  (d)  $NH_3$

26. The reaction between  $P$  and water forms a new compound  $R$ . Compound  $R$  gives bleaching powder on reaction with  $Cl_2$ . The compound  $X$  is

- (a)  $NH_4NO_2$  (b)  $KClO_3$   
(c)  $CaCO_3$  (d)  $CuFeS_2$

**Statement for Linked Answer Questions 27 and 28**



27. The structure of 'S' is

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

28. The name reaction by which the product 'S' may be readily prepared is

- (a) Aldol condensation  
(b) Benzoin condensation  
(c) Claisen condensation  
(d) Perkin condensation