

Test Paper : III
Test Subject : CHEMICAL SCIENCE
Test Subject Code : K-2716

Test Booklet Serial No. : _____

OMR Sheet No. : _____

Roll No.

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(Figures as per admission card)

Name & Signature of Invigilator/s

Signature : _____

Name : _____

Paper : III
Subject : CHEMICAL SCIENCE

Time : 2 Hours 30 Minutes

Maximum Marks : 150

Number of Pages in this Booklet : 16

Number of Questions in this Booklet : 75

ಅಭ್ಯರ್ಥಿಗಳಿಗೆ ಸೂಚನೆಗಳು

- ಈ ಪುಟದ ಮೇಲ್ಭಾಗದಲ್ಲಿ ಒದಗಿಸಿದ ಸ್ಥಳದಲ್ಲಿ ನಿಮ್ಮ ರೋಲ್ ನಂಬರನ್ನು ಬರೆಯಿರಿ.
- ಈ ಪತ್ರಿಕೆಯು ಬಹು ಆಯ್ಕೆ ವಿಧದ ಎಪ್ಪತ್ತೈದು ಪ್ರಶ್ನೆಗಳನ್ನು ಒಳಗೊಂಡಿದೆ.
- ಪರೀಕ್ಷೆಯ ಪ್ರಾರಂಭದಲ್ಲಿ ಪ್ರಶ್ನೆಪತ್ರಿಕೆಯನ್ನು ನಿಮಗೆ ನೀಡಲಾಗುವುದು. ಮೊದಲ 5 ನಿಮಿಷಗಳಲ್ಲಿ ನೀವು ಪ್ರಶ್ನೆಪತ್ರಿಕೆಯನ್ನು ತೆರೆಯಲು ಮತ್ತು ಕೆಳಗಿನಂತೆ ಕಡ್ಡಾಯವಾಗಿ ಪರಿಶೀಲಿಸಲು ಕೋರಲಾಗಿದೆ.
(i) ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗೆ ಪ್ರವೇಶಾಪಕಾರ ಪಡೆಯಲು, ಈ ಹೊದಿಕೆ ಪುಟದ ಅಂಚಿನ ಮೇಲಿರುವ ಪೇಪರ್ ಸೀಲನ್ನು ಹರಿಯಿರಿ. ಸ್ವಿಚ್ಚರ್ ಸೀಲ್ ಇಲ್ಲದ ಅಥವಾ ತೆರೆದ ಪ್ರಶ್ನೆಪತ್ರಿಕೆಯನ್ನು ಸ್ವೀಕರಿಸಬೇಡಿ.
(ii) ಪ್ರಶ್ನೆಪತ್ರಿಕೆಯಲ್ಲಿನ ಪ್ರಶ್ನೆಗಳ ಸಂಖ್ಯೆ ಮತ್ತು ಪುಟಗಳ ಸಂಖ್ಯೆಯನ್ನು ಮುಖಪುಟದ ಮೇಲೆ ಮುದ್ರಿಸಿದ ಮಾಹಿತಿಯೊಂದಿಗೆ ತಾಳಿ ನೋಡಿರಿ. ಪುಟಗಳು/ಪ್ರಶ್ನೆಗಳು ಕಾಣೆಯಾದ, ಅಥವಾ ದ್ವಿಪ್ರತಿ ಅಥವಾ ಅನುಕ್ರಮವಾಗಿಲ್ಲದ ಅಥವಾ ಇತರ ಯಾವುದೇ ವ್ಯತ್ಯಾಸದ ದೋಷಪೂರಿತ ಪ್ರಶ್ನೆಪತ್ರಿಕೆಯನ್ನು ಕೊಡಲಾದ 5 ನಿಮಿಷದ ಅವಧಿ ಒಳಗೆ, ಸಂವೀಕ್ಷಕರಿಂದ ಸರಿ ಇರುವ ಪ್ರಶ್ನೆಗೆ ಬದಲಾಯಿಸಿಕೊಳ್ಳಬೇಕು. ಆ ಬಳಿಕ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಬದಲಾಯಿಸಲಾಗುವುದಿಲ್ಲ, ಯಾವುದೇ ಹೆಚ್ಚು ಸಮಯವನ್ನೂ ಕೊಡಲಾಗುವುದಿಲ್ಲ.
- ಪ್ರತಿಯೊಂದು ಪ್ರಶ್ನೆಗೂ (A), (B), (C) ಮತ್ತು (D) ಎಂದು ಗುರುತಿಸಿದ ನಾಲ್ಕು ಪರ್ಯಾಯ ಉತ್ತರಗಳಿವೆ. ನೀವು ಪ್ರಶ್ನೆಯ ಎದುರು ಸರಿಯಾದ ಉತ್ತರದ ಮೇಲೆ, ಕೆಳಗೆ ಕಾಣಿಸಿದಂತೆ ಅಂಡಾಕೃತಿಯನ್ನು ಕಪ್ಪಾಗಿಸಬೇಕು.
ಉದಾಹರಣೆ : (A) (B) (C) (D)
(C) ಸರಿಯಾದ ಉತ್ತರವಾಗಿದ್ದಾಗ.
- ಪ್ರಶ್ನೆಗಳಿಗೆ ಉತ್ತರಗಳನ್ನು ಪತ್ರಿಕೆ III ಪ್ರಶ್ನೆಪತ್ರಿಕೆಯೊಳಗೆ ಕೊಟ್ಟಿರುವ OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಮಾತ್ರವೇ ಸೂಚಿಸತಕ್ಕದ್ದು. OMR ಹಾಳೆಯಲ್ಲಿನ ಅಂಡಾಕೃತಿ ಹೊರತುಪಡಿಸಿ ಬೇರೆ ಯಾವುದೇ ಸ್ಥಳದಲ್ಲಿ ಗುರುತಿಸಿದರೆ, ಅದರ ಮೌಲ್ಯಮಾಪನ ಮಾಡಲಾಗುವುದಿಲ್ಲ.
- OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಕೊಟ್ಟ ಸೂಚನೆಗಳನ್ನು ಜಾಗರೂಕತೆಯಿಂದ ಓದಿರಿ.
- ಎಲ್ಲಾ ಕರೆಡು ಕೆಲಸವನ್ನು ಪ್ರಶ್ನೆಪತ್ರಿಕೆಯ ಕೊನೆಯಲ್ಲಿ ಮಾಡತಕ್ಕದ್ದು.
- ನಿಮ್ಮ ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಬಹುದಾದ ನಿಮ್ಮ ಹೆಸರು ಅಥವಾ ಯಾವುದೇ ಚಿಹ್ನೆಯನ್ನು, ಸಂಗತವಾದ ಸ್ಥಳ ಹೊರತು ಪಡಿಸಿ, OMR ಉತ್ತರ ಹಾಳೆಯ ಯಾವುದೇ ಭಾಗದಲ್ಲಿ ಬರೆದರೆ, ನೀವು ಅನರ್ಹತೆಗೆ ಬಾಧ್ಯರಾಗಿರುತ್ತೀರಿ.
- ಪರೀಕ್ಷೆಯು ಮುಗಿದನಂತರ, ಕಡ್ಡಾಯವಾಗಿ OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ಸಂವೀಕ್ಷಕರಿಗೆ ನೀವು ಹಿಂತಿರುಗಿಸಬೇಕು ಮತ್ತು ಪರೀಕ್ಷಾ ಕೊಠಡಿಯ ಹೊರಗೆ OMR ನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ಕೊಂಡೊಯ್ಯಕೂಡದು.
- ಪರೀಕ್ಷೆಯ ನಂತರ, ಪರೀಕ್ಷಾ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಮತ್ತು ನಕಲು OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ತೆಗೆದುಕೊಂಡು ಹೋಗಬಹುದು.
- ನೀಲಿ/ಕಪ್ಪು ಬಾಲ್ ಪಾಯಿಂಟ್ ಪೆನ್ ಮಾತ್ರವೇ ಉಪಯೋಗಿಸಿರಿ.
- ಕ್ಯಾಲ್ಕುಲೇಟರ್, ವಿದ್ಯುನ್ಮಾನ ಉಪಕರಣ ಅಥವಾ ಲಾಗ್ ಟೇಬಲ್ ಇತ್ಯಾದಿಯ ಉಪಯೋಗವನ್ನು ನಿಷೇಧಿಸಲಾಗಿದೆ.
- ಸರಿ ಅಲ್ಲದ ಉತ್ತರಗಳಿಗೆ ಋಣ ಅಂಕ ಇರುವುದಿಲ್ಲ.
- ಕನ್ನಡ ಮತ್ತು ಇಂಗ್ಲಿಷ್ ಆವೃತ್ತಿಗಳ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳಲ್ಲಿ ಯಾವುದೇ ರೀತಿಯ ವ್ಯತ್ಯಾಸಗಳು ಕಂಡುಬಂದಲ್ಲಿ, ಇಂಗ್ಲಿಷ್ ಆವೃತ್ತಿಗಳಲ್ಲಿರುವುದೇ ಅಂತಿಮವೆಂದು ಪರಿಗಣಿಸಬೇಕು.

Instructions for the Candidates

- Write your roll number in the space provided on the top of this page.
- This paper consists of seventy five multiple-choice type of questions.
- At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as below :
(i) To have access to the Question Booklet, tear off the paper seal on the edge of the cover page. Do not accept a booklet without sticker seal or open booklet.
(ii) Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.
- Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
Example : (A) (B) (C) (D)
where (C) is the correct response.
- Your responses to the question of Paper III are to be indicated in the OMR Sheet kept inside the Booklet. If you mark at any place other than in the circles in OMR Sheet, it will not be evaluated.
- Read the instructions given in OMR carefully.
- Rough Work is to be done in the end of this booklet.
- If you write your name or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, you will render yourself liable to disqualification.
- You have to return the test OMR Answer Sheet to the invigilators at the end of the examination compulsorily and must NOT carry it with you outside the Examination Hall.
- You can take away question booklet and carbon copy of OMR Answer Sheet after the examination.
- Use only Blue/Black Ball point pen.
- Use of any calculator, Electronic gadgets or log table etc., is prohibited.
- There is no negative marks for incorrect answers.
- In case of any discrepancy found in the Kannada translation of a question booklet the question in English version shall be taken as final.



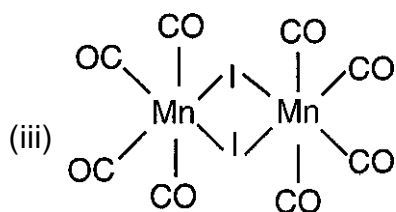
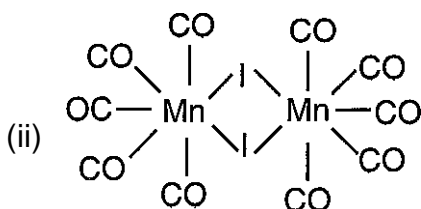
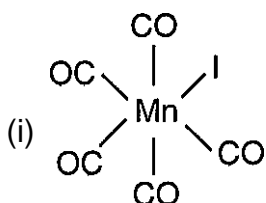
CHEMICAL SCIENCE
Paper – III

Note : This paper contains **seventy-five (75)** objective type questions. **Each** question carries **two (2)** marks. **All** questions are **compulsory**.

1. The correct order of decreasing electronegativity and ionic size is as follows
(A) $\text{Al} > \text{Ca} > \text{S} > \text{As}$; $\text{K}^+ > \text{Cl}^- > \text{Ca}^{+2} > \text{S}^{2-}$
(B) $\text{S} > \text{As} > \text{Al} > \text{Ca}$; $\text{S}^{2-} > \text{Cl}^- > \text{K}^+ > \text{Ca}^{+2}$
(C) $\text{S} > \text{As} > \text{Ca} > \text{Al}$; $\text{S}^{2-} > \text{Cl}^- > \text{K}^+ > \text{Ca}^{+2}$
(D) $\text{As} > \text{Al} > \text{Ca} > \text{S}$; $\text{K}^+ > \text{Ca}^{+2} > \text{S}^{2-} > \text{Cl}^-$
2. The number of faces in the trigonal bipyramidal and trigonal prismatic geometry are, respectively
(A) Five and six (B) Six and five
(C) Four and five (D) Six and four
3. Which of the following equation represents the auto-ionization of liquid SO_2 ?
(A) $2\text{SO}_2 \rightleftharpoons \text{SO}_2^{2-} + \text{SO}_3^{2+}$
(B) $2\text{SO}_2 \rightleftharpoons \text{SO}_2^{2+} + \text{SO}_2^{2-}$
(C) $\text{SO}_2 \rightleftharpoons \text{O}_2^- + \text{SO}^{2+}$
(D) $2\text{SO}_2 \rightleftharpoons \text{SO}^{2+} + \text{SO}_3^{2-}$
4. The number of $(3c - 2e)$ B–H–B bonds and $(2c - 2e)$ B–H bonds in B_4H_{10} are, respectively
(A) 6 and 4 (B) 4 and 6
(C) 8 and 2 (D) 4 and 4
5. The electronic spectrum of $[\text{CrF}_6]^{3-}$ shows three bands at 14900, 22400 and 34800 cm^{-1} . The corresponding transitions and B' value correspond to
(A) ${}^3\text{T}_{1g}(\text{F}) \rightarrow {}^3\text{T}_{2g}$; ${}^3\text{T}_{1g}(\text{F}) \rightarrow {}^3\text{A}_{2g}$;
 ${}^3\text{T}_{1g}(\text{F}) \rightarrow {}^3\text{T}_{1g}(\text{P})$ and 833.3 cm^{-1}
(B) ${}^4\text{A}_{2g} \rightarrow {}^4\text{T}_{2g}$; ${}^4\text{A}_{2g} \rightarrow {}^4\text{T}_{1g}(\text{F})$;
 ${}^4\text{A}_{2g} \rightarrow {}^4\text{T}_{1g}(\text{P})$ and 833.3 cm^{-1}
(C) ${}^4\text{A}_{2g} \rightarrow {}^4\text{T}_{2g}$; ${}^4\text{A}_{2g} \rightarrow {}^4\text{T}_{1g}(\text{F})$;
 ${}^4\text{A}_{2g} \rightarrow {}^4\text{T}_{1g}(\text{P})$ and 166.6 cm^{-1}
(D) ${}^4\text{T}_{1g}(\text{F}) \rightarrow {}^4\text{T}_{2g}$; ${}^4\text{T}_{1g}(\text{F}) \rightarrow {}^4\text{A}_{2g}$;
 ${}^4\text{T}_{1g}(\text{F}) \rightarrow {}^4\text{T}_{1g}(\text{P})$ and 1250 cm^{-1}
6. The effective magnetic moment (μ_{eff}) for Ce^{3+} is expected to be close to
(A) 2.54 BM
(B) 1.73 BM
(C) 2.20 BM
(D) 3.83 BM



7. Molecular iodine reacts with $\text{Mn}_2(\text{CO})_{10}$ to give compound I without loss of CO. Compound I upon heating to 120°C loses a CO ligand to give compound II, that does not contain an M – M bond. Compounds I and II from the following are, respectively.



- (A) (i) and (iii)
(B) (ii) and (iii)
(C) (iii) and (i)
(D) (ii) and (i)
8. The total valence electrons in the cage $\text{H}_2\text{Ru}_3(\text{CO})_8(\mu - \text{PPh}_2)_2$ is
(A) 46
(B) 48
(C) 50
(D) 44

9. The height equivalent of theoretical plate and total number of plates if the elution peak is 9.34 minutes after sample injection with a width of peak base (W_b) of 0.43 minutes and column length of 18.3 cm
(A) 2.42×10^{-3} and 7.55×10^3 respectively
(B) 3.88×10^{-2} and 471.79 respectively
(C) 0.84 and 21.72 respectively
(D) 5.26×10^{-2} and 347.52 respectively
10. Nitrogenase catalyzes the reduction of N_2 to NH_3 in a reaction that is coupled to the hydrolysis of ATP molecules. The number of electrons and ATP molecules required per N_2 molecule for this purpose are
(A) $8 e^-$ and 10 ATP
(B) $6 e^-$ and 6 ATP
(C) $8 e^-$ and 8 ATP
(D) $8 e^-$ and 16 ATP
11. Assuming ClF_3 to be stereochemically rigid, its ^{19}F NMR spectrum (I for $^{19}\text{F} = \frac{1}{2}$) would be (ignore any NMR activity of Cl).
(A) A doublet and triplet for a T-shaped structure
(B) A singlet for a trigonal planar structure
(C) A doublet and a singlet for a T-shaped structure
(D) Two singlets for a trigonal pyramid structure
12. ^{11}C is a radioactive isotope of carbon. Its half life is 20 min. What fraction of the initial number of ^{11}C atoms in a sample will have decayed away after 80 min ?
(A) $\frac{1}{16}$ (B) $\frac{1}{8}$
(C) $\frac{1}{4}$ (D) $\frac{15}{16}$



13. Which of the following pairs has the highest difference in their first ionization energy ?
(A) Xe, Cs (B) Ne, Na
(C) Kr, Rb (D) Ar, K
14. A solution of NaNO_2 will be oxidized to NaNO_3 by KMnO_4 solution in dilute H_2SO_4 . How many moles of NaNO_2 will be oxidized by one mole of KMnO_4 ?
(A) 5.0 (B) 1.5
(C) 3.0 (D) 2.5
15. The compound that behaves as an acid in anhydrous H_2SO_4 is
(A) HCl (B) HClO_4
(C) HNO_3 (D) CH_3COOH
16. When silicon is doped with a group 15 element,
(A) Donor levels are created close to the conduction band
(B) Acceptor levels are created close to the conduction band
(C) Acceptor levels are created close to the valence band
(D) Donor levels are created close to the valence band
17. What is the correct order of spin only magnetic moment (in BM) of tetrahedral Mn^{2+} , Co^{2+} and Ni^{2+} complexes ?
(A) $\text{Mn}^{2+} < \text{Co}^{2+} < \text{Ni}^{2+}$
(B) $\text{Ni}^{2+} < \text{Co}^{2+} < \text{Mn}^{2+}$
(C) $\text{Mn}^{2+} < \text{Ni}^{2+} < \text{Co}^{2+}$
(D) $\text{Ni}^{2+} < \text{Mn}^{2+} < \text{Co}^{2+}$
18. Which of the following statements is true for base hydrolysis of $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$?
(A) It is a first order reaction involving the conjugate base of the complex
(B) The rate does not depend on the concentration of base
(C) The rate determining step does not involve dissociation of Cl^- and NH_3 in $[\text{Co}(\text{NH}_3)_4(\text{NH}_2)\text{Cl}]^+$
(D) It involves both associative and dissociative types of substitution
19. Consider the following statements for uranium
(i) UO_2^+ is linear
(ii) U_3O_8 is its most stable oxide of U
(iii) UO_2^+ disproportionates easily compared to UO_2^{2+}
- The correct statement(s) is/are
(A) (i), (ii) and (iii)
(B) (i) and (iii)
(C) (i) and (ii)
(D) (i) only
20. In a regular B_{12} icosahedron, the number of edges and the number of boron atoms equidistant from a given boron atom are, respectively.
(A) 30 and 5
(B) 30 and 12
(C) 20 and 11
(D) 20 and 12



21. Match the following :

List – I

- a) Mass of compound is plotted against temperature during decomposition
- b) Endo – and/or exothermic peaks will be observed depending upon nature of the reaction
- c) Heat of fusion is obtained directly and quantitatively

List – II

- i. TMA
- ii. DSC
- iii. TGA
- iv. DTA

- | | | | |
|-----|----------|----------|----------|
| | a | b | c |
| (A) | iii | iv | i |
| (B) | iii | ii | iv |
| (C) | iii | iv | ii |
| (D) | ii | iv | i |

22. The number of isomers for trigonal bipyramidal PF_3Cl_2 with a dipole moment is

- (A) 2 (B) 1
(C) 0 (D) 3

23. Identify the species with the lowest bond order among C_2 , NO , Cl_2^+ , O_2^+ .

- (A) C_2 (B) NO
(C) Cl_2^+ (D) O_2^+

24. The diseases caused due to excess accumulation and deficiency of copper in the human body is

- (A) Menkes disease and pernicious anemia, respectively
- (B) Wilson's disease and pernicious anemia, respectively
- (C) Wilson's disease and Menkes disease, respectively
- (D) Anemia and Menkes disease, respectively

25. The reduced form of a metal ion, M in a complex is NMR active. This on oxidation shows an EPR signal with $g_{11} \approx 2.2$ and $g_{\perp} \approx 2.0$. Mössbauer spectroscopy can not characterize the metal complex. The M is

- (A) Fe (B) Sn
(C) Zn (D) Cu

26. What would be the concentration of Cu^{2+} in (ppm) in the unknown sample if it exhibits an absorbance of 0.455 when analyzed by a colorimetric method? The corresponding regression equation by the least squares method is $Y = 0.0453x + 0.002$.

- (A) 0.453 (B) 10
(C) 0.455 (D) 1.0

27. Character Table for the point group C_{2v} is given below :

C_{2v}	E	C_2	σ_{xz}	σ_{yz}		
A_1	1	1	1	1	z	z^2, x^2, y^2
A_2	1	1	-1	-1	R_z	X_y
B_1	1	-1	1	-1	x, R_y	X_z
B_2	1	-1	-1	1	y, R_x	Y_z

The reducible representation corresponding to the three translational degrees of freedom, Γ_{tr} is

- (A) 3, 1, 1, 1 (B) 3, -1, 1, 1
(C) 3, -1, -1, -1 (D) 3, 1, -1, -1

28. Total number of microstates associated with d^2 and p^3 configurations are

- (A) 45 and 6 (B) 6 and 30
(C) 45 and 30 (D) 45 and 20



29. A molecule, AX, has a vibrational energy of 990 cm^{-1} and rotational energy of 10 cm^{-1} . Another molecule, BX, has a vibrational energy of 400 cm^{-1} and rotational energy of 40 cm^{-1} . Which one of the following statements about the coupling of vibrational and rotational motion true ?
- (A) The coupling is stronger in AX
(B) The coupling is stronger in BX
(C) There is no coupling in both AX and BX
(D) Magnitude of coupling is equal in both AX and BX
30. The simplest ground state VB wave function of a HCl molecule is given as $\psi = \psi_{\text{H}}(1s, 1) \psi_{\text{Cl}}(3p_z, 2) + B$ where B represents
- (A) $\psi_{\text{Cl}}(1s, 1) \psi_{\text{H}}(3p_z, 3)$
(B) $\psi_{\text{H}}(3p_z, 3) \psi_{\text{Cl}}(1s, 3)$
(C) $\psi_{\text{Cl}}(2s, 2) \psi_{\text{H}}(1s, 1)$
(D) $\psi_{\text{H}}(1s, 2) \psi_{\text{Cl}}(3p_z, 1)$
31. In atomic combination reactions
- (A) $E_a = 0, \Delta S^\ddagger = -ve, \Delta H^\ddagger = -ve$
(B) $E_a = 0, \Delta S^\ddagger = -ve, \Delta H^\ddagger = +ve$
(C) $E_a = +ve, \Delta S^\ddagger = +ve, \Delta H^\ddagger = -ve$
(D) $E_a = 0, \Delta S^\ddagger = +ve, \Delta H^\ddagger = +ve$
32. In a certain reaction 10% of the reactant is consumed in 15 minutes at 310 K, but only in 5 minutes at 303 K. The energy of activation of the reaction in K Cals mol^{-1} is
- (A) 302 (B) 30.2
(C) 50.5 (D) 11.2
33. Calculate the standard cell potential for the reaction
- $$\text{Zn(s)} \mid \text{Zn}^{2+}(\text{aq}) \parallel \text{MnO}_4^-(\text{aq}), \text{Mn}^{2+}(\text{aq}), \text{H}^+(\text{aq}) \mid \text{Pt(s)}$$
- (Given : $\text{MnO}_4^- + 8\text{H}^+ \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$; $E^0 = +1.51 \text{ V}$; $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$; $E^0 = -0.76 \text{ V}$)
- (A) + 0.75 V (B) + 2.27 V
(C) - 0.75 V (D) - 2.27 V
34. Stability of lyophobic dispersions is determined by
- (A) Inter-particle electric double layer attraction and intra-particle Van der Waals repulsion
(B) Inter-particle excluded volume attraction and intra-particle Van der Waals repulsion
(C) Inter-particle electric double layer repulsion and intra-particle Van der Waals attraction
(D) Inter-particle excluded volume repulsion and intra-particle Van der Waals attraction
35. The unperturbed energy levels of a system are $E_0 = 0, E_1 = 2$ and $E_2 = 4$. The second order correction to energy for the ground state in the presence of the perturbation V for which $V_{10} = 2, V_{20} = 4$ and $V_{12} = 6$, is found to be
- (A) + 6 (B) - 6
(C) - 8 (D) + 8
36. Silver crystallises in face-centered cubic structure. The 2nd order diffraction angle of a beam of X-ray ($\lambda = 1.0 \text{ \AA}$) of (111) plane of the crystal is 30° . So the unit cell length of the crystal would be
- (A) $a = 3.464 \text{ \AA}$ (B) $a = 3.064 \text{ \AA}$
(C) $a = 3.150 \text{ \AA}$ (D) $a = 3.272 \text{ \AA}$



37. There are several types of mean molar masses for polymer and they are dependant on experimental methods like : (a) osmometry (b) light scattering and (c) sedimentation. Correct relation between mean molar masses and experimental method is

- (A) $\bar{M}_n \leftrightarrow (c)$, $\bar{M}_w \leftrightarrow (b)$, $\bar{M}_z \leftrightarrow (a)$
(B) $\bar{M}_n \leftrightarrow (b)$, $\bar{M}_w \leftrightarrow (c)$, $\bar{M}_z \leftrightarrow (a)$
(C) $\bar{M}_n \leftrightarrow (a)$, $\bar{M}_w \leftrightarrow (b)$, $\bar{M}_z \leftrightarrow (c)$
(D) $\bar{M}_n \leftrightarrow (a)$, $\bar{M}_w \leftrightarrow (c)$, $\bar{M}_z \leftrightarrow (b)$

38. A polymer sample has the following distribution of molecular weights :

Number of molecules	10	13	20	13
Molecular weight (10^4)	35	40	45	50

The number average and weight average molecular weights of the polymer are respectively

- (A) $14.0, 42.5 \times 10^4$
(B) $43.2 \times 10^4, 43.2 \times 10^4$
(C) $42.5 \times 10^4, 43.5 \times 10^4$
(D) $43.2 \times 10^4, 43.8 \times 10^4$

39. The first two lines in the R-branch of the vibrational spectrum of HCl appear at 2900 cm^{-1} and 2924 cm^{-1} . The first line in the R-branch of DCL spectrum appears at 2090 cm^{-1} . The second line is expected to appear at

- (A) 2094 cm^{-1} (B) 2096 cm^{-1}
(C) 3002 cm^{-1} (D) 2098 cm^{-1}

40. Calculate the change in entropy suffered by 2 moles of an ideal gas upon heating from a volume of 100 litres at 323 K to a volume of 150 litres at 423 K. ($C_V = 7.88 \text{ cal K}^{-1} \text{ mol}^{-1}$).

- (A) 44.63 JK^{-1} (B) 34.23 JK^{-1}
(C) 64.53 JK^{-1} (D) 24.53 JK^{-1}

41. When a crystal with a primitive cubic lattice undergoes a crystallographic phase transition, the (1, 1, 1) X-ray diffraction peak shifts from $\theta = 22^\circ$ to $\theta = 20^\circ$. What is the % change in the unit cell volume associated with the phase transition ?

- (A) +31% (B) -9%
(C) -24% (D) +24%

42. When a particle of mass $9.10 \times 10^{-28} \text{ g}$ in a certain 1-D box goes from $n = 5$ level to the $n = 2$ level, it emits a photon of frequency $6.0 \times 10^{14} \text{ cm}^{-1}$. The length of the box is

- (A) $1.8 \times 10^{-7} \text{ m}$
(B) $1.8 \times 10^{-7} \text{ cm}$
(C) $8.1 \times 10^{-7} \text{ cm}$
(D) $8.1 \times 10^{-7} \text{ m}$

43. When an electron in an excited M_0 atom, falls from L to K shell, an X-ray is emitted. These X-rays are diffracted at an angle of 7.75° by planes with a separation of 2.64 \AA . The difference in energy between K-shell and L-shell in M_0 assuming a first order diffraction is ($\sin 7.75^\circ = 0.1349$).

- (A) $2.788 \times 10^{-16} \text{ J}$
(B) $27.88 \times 10^{-16} \text{ J}$
(C) $2.788 \times 10^{16} \text{ J}$
(D) $27.88 \times 10^{16} \text{ J}$

44. The volume of a perfect gas of N atoms is doubled, the energy being held constant. Change in entropy is

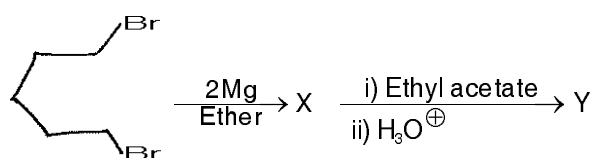
- (A) $N \log 2$
(B) $N^2 \log 2$
(C) $N \log \frac{1}{2}$
(D) $N^2 \log \frac{1}{2}$



45. A gas X at 1 atm is bubbled through a solution containing a mixture of 1 M Y^- and 1 M Z^- at 25°C . If the order of the reduction potential is $Z > Y > X$, then
(A) Y will oxidize Z and not X
(B) Y will oxidize X and not Z
(C) Y will oxidize both X and Z
(D) Y will reduce both X and Z
46. The standard potential E° for a given cell is 1.1 V at 298 K and $(\partial E^\circ / \partial T)_p = -6.5 \times 10^{-5} \text{ VK}^{-1}$. Calculate ΔH° for the reaction assuming $n = 2$.
(A) -208 kJ mol^{-1} (B) -104 kJ mol^{-1}
(C) -216 kJ mol^{-1} (D) 104 kJ mol^{-1}
47. The rate of the reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI
(A) Decreases with increase in ionic strength
(B) Does not change with change in ionic strength
(C) Increases with increase in ionic strength
(D) Depends on the purity of the catalyst used
48. In a chemical reaction :
 $\text{PCl}_{5(g)} \rightleftharpoons \text{PCl}_{3(g)} + \text{Cl}_{2(g)}$, Xenon gas is added at constant volume. Then the equilibrium
(A) Will shift towards the products
(B) Will shift towards the reactant
(C) Will increase both reactant and products
(D) Will not change the amount of reactant and products
49. The temperature-dependence of an electrochemical cell potential is
(A) $\Delta S/nF$ (B) $\Delta S/nFT$
(C) $\Delta S/nT$ (D) $\Delta H/nF$
50. Though a constant shift of energy levels of a system changes the partition function, the properties that do not change are
(A) Average energy and heat capacity
(B) Average energy and entropy
(C) Average energy, entropy and heat capacity
(D) Entropy and heat capacity
51. Match the following two lists with correct answers :
- | List – I | List – II |
|--------------------|---|
| i) Meso compound | a. An equimolar mixture of enantiomers |
| ii) Enantiomers | b. Stereo isomers that are not mirror images |
| iii) Diastereomers | c. Non-super imposable mirror images |
| iv) Racemates | d. An optically inactive compound containing chiral centres |
- | | i | ii | iii | iv |
|-----|---|----|-----|----|
| (A) | c | d | a | b |
| (B) | c | b | d | a |
| (C) | b | c | a | d |
| (D) | d | c | b | a |

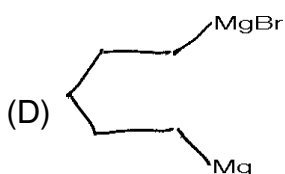
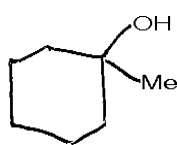
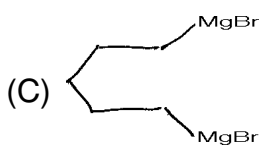
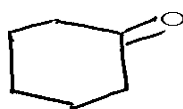
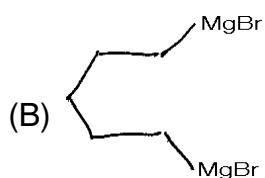
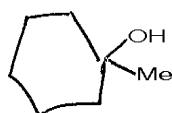
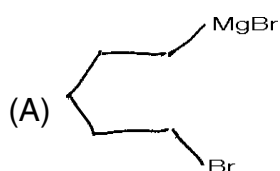


52. Predict the product for the following :



X

Y

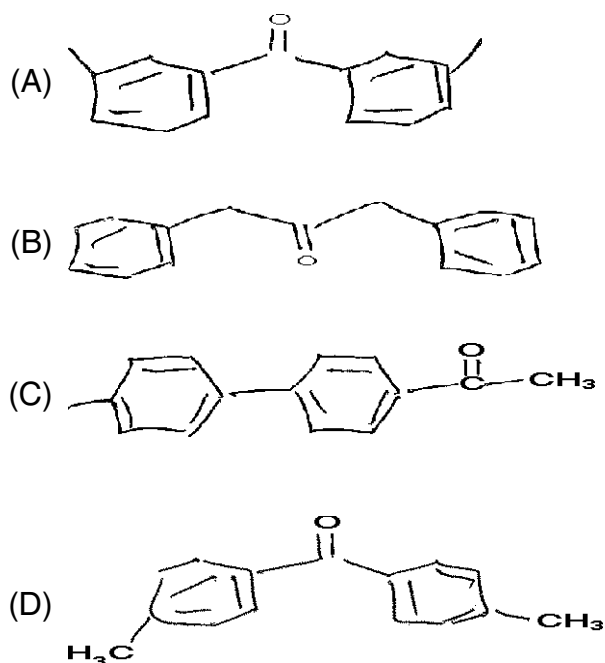


53. An organic compound having molecular formula $\text{C}_{15}\text{H}_{14}\text{O}$ exhibited the following ^1H and ^{13}C NMR spectral data.

^1H NMR : δ 2.4 (s), 7.2 (d, J, 8Hz)
7.7 (d, J, 7 Hz).

^{13}C NMR : δ 21.0, 129.0, 130, 136, 141, 190.

The compound is



54. Which of the following compound given mass spectrum with relative intensities at M^+ and M^{+2} in the ratio of 1 : 1 ?

- (A) Bromo benzene
(B) Chloro benzene
(C) Iodo benzene
(D) Fluoro benzene



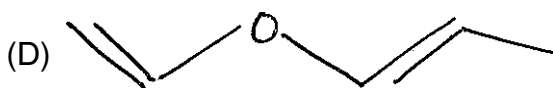
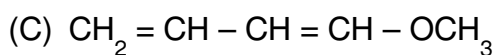
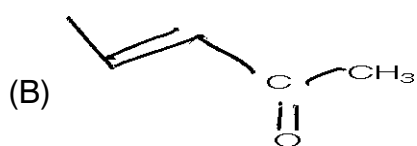
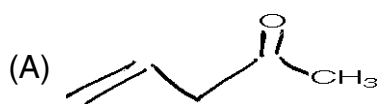
55. A compound with molecular formula C_5H_8O shows the following spectral data :

u.v. (E + OH) : λ_{max} 227 nm.

IR (k Br) : 1620 and 1670 cm^{-1} .

1H NMR ($CDCl_3$) : δ 2.0(d), 2.2(s), 5.3(d) and 5.7(q).

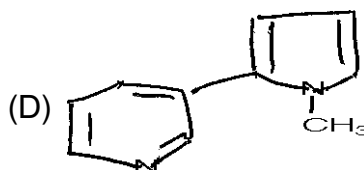
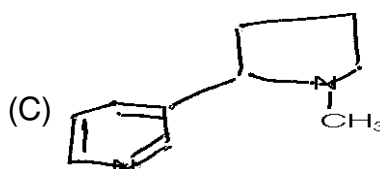
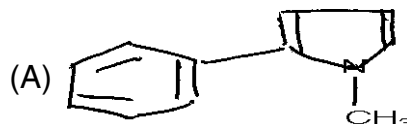
The structure of the compound is :



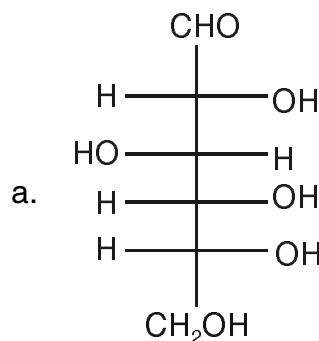
56. The reaction of singlet carbene and triplet carbene with cis-2-butene gives respectively.

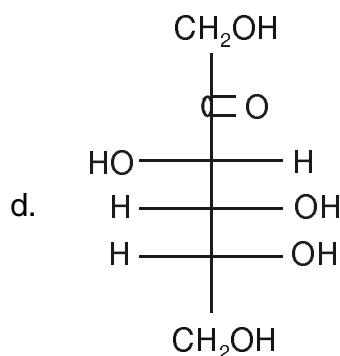
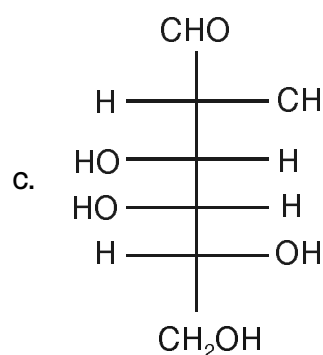
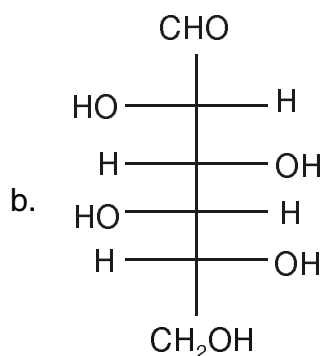
- (A) cis-product and racemic mixture
- (B) trans-product and racemic mixture
- (C) racemic mixture and cis-product
- (D) trans-product and cis-product

57. Identify the correct structure of natural product nicotine.



58. Considering the following monosaccharides which of the following statement is correct ?

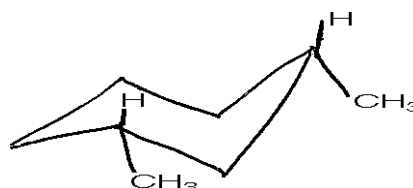




- i) a and c are C_4 epimers
- ii) a is D-glucose and d is D-mannose
- iii) a and d form same osazone
- iv) b is D-iodose and c is D-talose

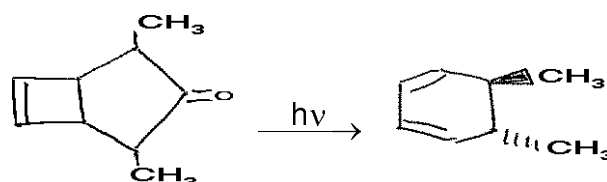
- (A) (i) and (iii) (B) (ii) and (iii)
(C) (i) and (ii) (D) (iii) and (iv)

59. The name of the following compound is



- (A) a, e - cis - 1, 3-dimethyl cyclohexane
(B) e, e - cis - 1, 3-dimethyl cyclohexane
(C) a, e - trans - 1, 3-dimethyl cyclohexane
(D) e, e - trans - 1, 3-dimethyl cyclohexane

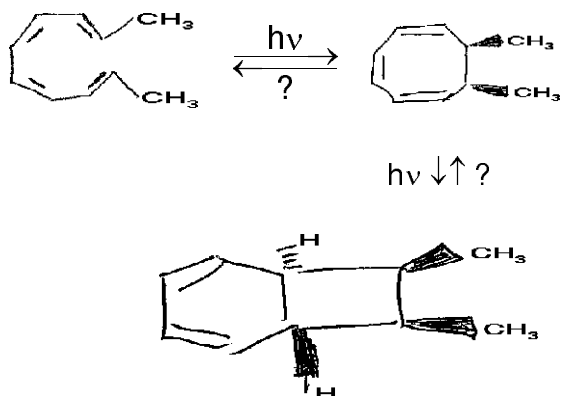
60. In the following photo chemical concerted reaction the product formed by



- (A) Norrish I type cleavage followed by 6π -disrotatory electro cyclisation
(B) Norrish I type cleavage followed by 6π -conrotatory electro cyclisation
(C) Norrish II type cleavage followed by 6π -disrotatory electro cyclisation
(D) Norrish II type cleavage followed by 6π -conrotatory electro cyclisation



61. Mention the type of rotation for electrocyclic cyclisation under photochemical condition for the following.

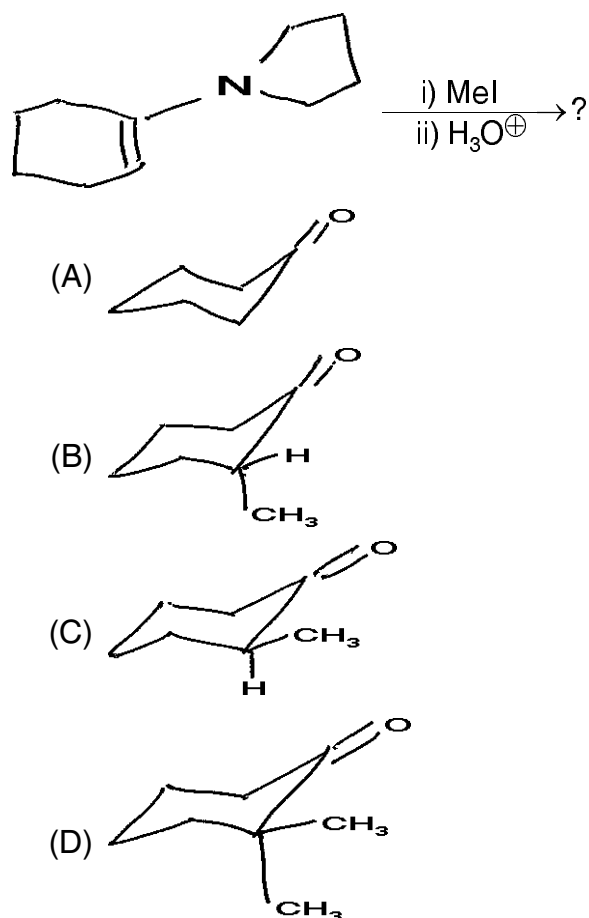


- (A) dis and con
(B) dis and dis
(C) con and dis
(D) con and con

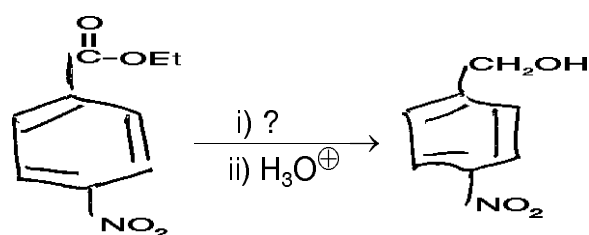
62. Deprotection of benzyl ethers can be effectively done by

- (A) Lithium aluminium hydride
(B) DCC
(C) Catalytic hydrogenation
(D) Tributyl tin hydride

63. Identify the product for the following :



64.

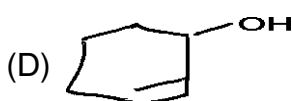
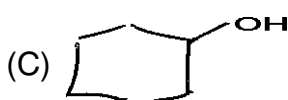


The above transformation can be achieved easily by

- (A) Catalytic hydrogenation
(B) Lithium aluminium hydride
(C) Sodium hydride
(D) Sodium in liquid ammonia



65. Acid catalysed dehydration of cis - 1, 2-cyclohexane diol exclusively yields.



66. For the formation of the following products, the possible intermediates respectively are

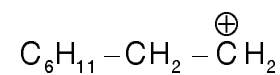
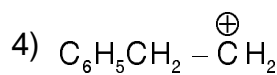
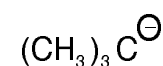
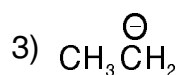
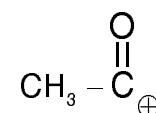
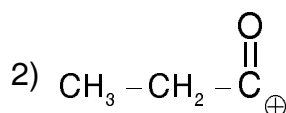
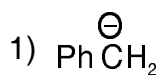


- (A) Carbene; benzyne
 (B) Nitrene ; benzyne
 (C) Carbene ; nitrene
 (D) Benzyne ; nitrene

67. Which one is more stable among the following pairs of the ions ?

a

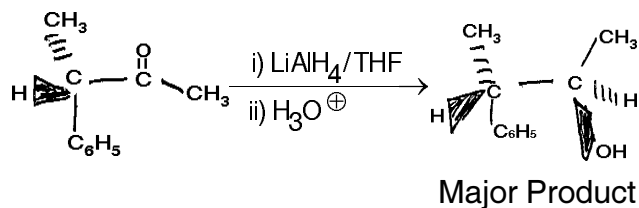
b



1 2 3 4

- (A) a b b a
 (B) b a a b
 (C) a b a a
 (D) a a b b

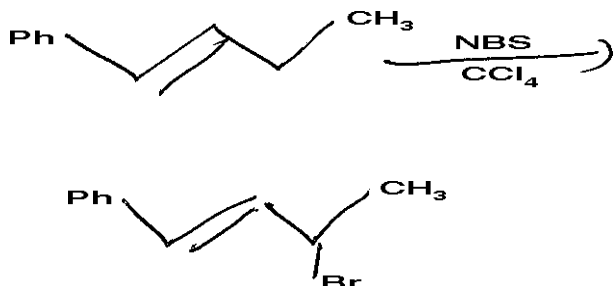
68. The following reaction is



- (A) Diastereo selective
 (B) Enantio selective
 (C) Chemo selective
 (D) Regio selective

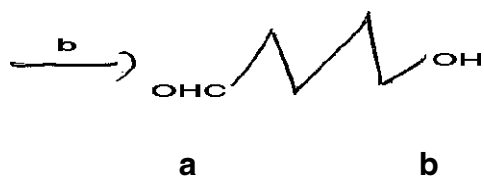
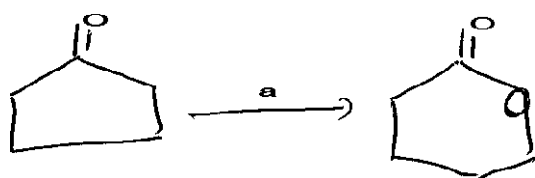


69. The suitable catalyst for the following transformation is



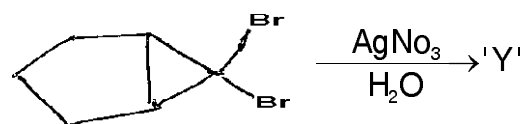
- (A) Benzoyl peroxide
- (B) Hydrogen peroxide
- (C) m-chloro for benzoic acid
- (D) Sodium ethoxide

70. Identify the appropriate reagents a and b for the following transformation.



- (A) m-cl-perbenzoic acid ; acid hydrolysis
- (B) Hydrogen peroxide ; DIBAL – H
- (C) Lead acetate ; acid hydrolysis
- (D) m-cl-perbenzoic acid ; DIBAL – H

71. The reagent 'X' required and the major product 'Y' formed in the following reaction sequence are :

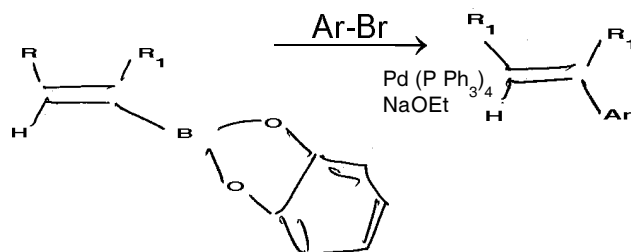


X

Y

- (A) $\text{CH}_2\text{Br}_2 / t\text{-BuO}^\ominus \text{k}^\oplus$
- (B) $\text{CH}_2\text{Br}_2 / t\text{-BuO}^\ominus \text{k}^\oplus$
- (C) $\text{CHBr}_3 / t\text{-BuO}^\ominus \text{k}^\oplus$
- (D) $\text{CHBr}_3 / t\text{-BuO}^\ominus \text{k}^\oplus$

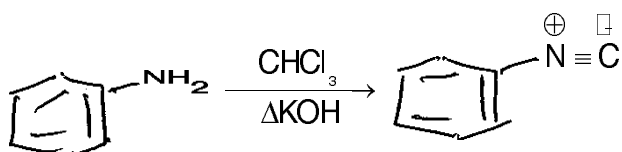
72. The following reaction is known as



- (A) Negishi coupling
- (B) Heck coupling
- (C) Suzuki coupling
- (D) Stelle coupling

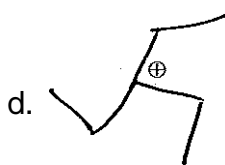
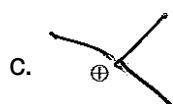


73. In the following conversion which intermediate is involved ?



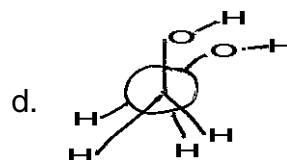
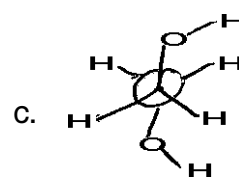
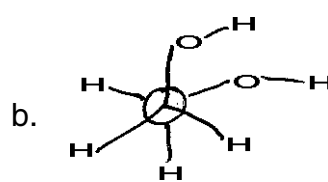
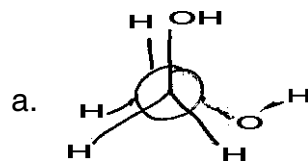
- (A) Carbene
- (B) Carbocation
- (C) Carbanion
- (D) Benzyne

74. Arrange the following carbocations in decreasing order of stability.



- (A) $c > a > b > d$
- (B) $d < b < a < c$
- (C) $a < b < c < d$
- (D) $a > b > c > d$

75. Arrange the following conformers with increasing order of stability.



- (A) $b > c > a > d$
- (B) $d < a < c < b$
- (C) $a < b < c < d$
- (D) $b < a < c < d$



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Space for Rough Work