Test Booklet Code & Serial No.
प्रश्नपत्रिका कोड व क्रमांक

B

Paper-II
CHEMICAL SCIENCE

Signature and Name of Invigilator

1. (Signature) .....

(Name) .....

2. (Signature) .....

(Name) .....

Seat No. | | | | | | | |

(In figures as in Admit Card)

Seat No. .....

(In words)

OMR Sheet No. | | | | | | | |

(To be filled by the Candidate)

SEP - 33221

Time Allowed : 2 Hours] **[Maximum Marks : 200**

Number of Pages in this Booklet : **36**

Number of Questions in this Booklet : **100**

Instructions for the Candidates

1. Write your Seat No. and OMR Sheet No. in the space provided on the top of this page.
2. This paper consists of **100** objective type questions. Each question will carry *two* marks. *All* questions of Paper II will be compulsory.
3. At the commencement of examination, the question booklet will be given to the student. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as follows :
   (*i*) To have access to the Question Booklet, tear off the paper seal on the edge of this 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 missing pages/questions or questions repeated or not in serial order or any other discrepancy should not be accepted and correct booklet should be obtained from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given. The same may please be noted.
   (*iii*) After this verification is over, the OMR Sheet Number should be entered on this Test Booklet.
4. Each question 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 : where (C) is the correct response.

   (A) (B) ● (D)

5. Your responses to the items are to be indicated in the **OMR Sheet given inside the Booklet only.** If you mark at any place other than in the circle in the OMR Sheet, it will not be evaluated.
6. Read instructions given inside carefully.
7. Rough Work is to be done at the end of this booklet.
8. If you write your Name, Seat Number, Phone Number or put any mark on any part of the OMR Sheet, except for the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, you will render yourself liable to disqualification.
9. You have to return original OMR Sheet to the invigilator at the end of the examination compulsorily and must not carry it with you outside the Examination Hall. You are, however, allowed to carry the Test Booklet and duplicate copy of OMR Sheet on conclusion of examination.
10. Use only Blue/Black Ball point pen.
11. Use of any calculator or log table, etc., is prohibited.
12. There is no negative marking for incorrect answers.

विद्यार्थ्यांसाठी महत्त्वाच्या सूचना

1. परिक्षार्थींनी आपला आसन क्रमांक या पृष्ठावरील वरच्या कोपऱ्यात लिहावा. तसेच आपणांस दिलेल्या उत्तरपत्रिकेचा क्रमांक त्याखाली लिहावा.
2. सदर प्रश्नपत्रिकेत 100 बहुपर्यायी प्रश्न आहेत. प्रत्येक प्रश्नास **दोन** गुण आहेत. या प्रश्नपत्रिकेतील **सर्व** प्रश्न सोडविणे अनिवार्य आहे.
3. परीक्षा सुरू झाल्यावर विद्यार्थ्याला प्रश्नपत्रिका दिली जाईल. सुरुवातीच्या 5 मिनीटांमध्ये आपण सदर प्रश्नपत्रिका उघडून खालील बाबी अवश्य तपासून पहाव्यात.
   (*i*) प्रश्नपत्रिका उघडण्यासाठी प्रश्नपत्रिकेवर लावलेले सील उघडावे. सील नसलेली किंवा सील उघडलेली प्रश्नपत्रिका स्विकारू नये.
   (*ii*) पहिल्या पृष्ठावर नमूद केल्याप्रमाणे प्रश्नपत्रिकेची एकूण पृष्ठे तसेच प्रश्नपत्रिकेतील एकूण प्रश्नांची संख्या पडताळून पहावी. पृष्ठे कमी असलेली/कमी प्रश्न असलेली/प्रश्नांचा चुकीचा क्रम असलेली किंवा इतर त्रुटी असलेली सदोष प्रश्नपत्रिका सुरुवातीच्या 5 मिनिटातच पर्यवेक्षकाला परत देऊन दुसरी प्रश्नपत्रिका मागवून घ्यावी. त्यानंतर प्रश्नपत्रिका बदलून मिळणार नाही तसेच वेळही वाढवून मिळणार नाही याची कृपया विद्यार्थ्यांनी नोंद घ्यावी.
   (*iii*) वरीलप्रमाणे सर्व पडताळून पाहिल्यानंतरच प्रश्नपत्रिकेवर ओ.एम.आर. उत्तरपत्रिकेचा नंबर लिहावा.
4. प्रत्येक प्रश्नासाठी (A), (B), (C) आणि (D) अशी चार विकल्प उत्तरे दिली आहेत. त्यातील योग्य उत्तराचा रकाना खाली दर्शविल्याप्रमाणे ठळकपणे काळा/निळा करावा.
   उदा. : जर (C) हे योग्य उत्तर असेल तर.

   (A) (B) ● (D)

5. या प्रश्नपत्रिकेतील प्रश्नांची उत्तरे **ओ.एम.आर. उत्तरपत्रिकेतच दर्शवावीत.** इतर ठिकाणी लिहिलेली उत्तरे तपासली जाणार नाहीत.
6. आत दिलेल्या सूचना काळजीपूर्वक वाचाव्यात.
7. प्रश्नपत्रिकेच्या शेवटी जोडलेल्या कोऱ्या पानावरच कच्चे काम करावे.
8. जर आपण ओ.एम.आर. वर नमूद केलेल्या ठिकाणा व्यतिरीक्त इतर कोठेही नाव, आसन क्रमांक, फोन नंबर किंवा ओळख पटेल अशी कोणतीही खूण केलेली आढळून आल्यास अथवा असभ्य भाषेचा वापर किंवा इतर गैरमार्गाचा अवलंब केल्यास विद्यार्थ्याला परीक्षेस अपात्र ठरविण्यात येईल.
9. परीक्षा संपल्यानंतर विद्यार्थ्याने मूळ ओ.एम.आर. उत्तरपत्रिका पर्यवेक्षकांकडे परत करणे आवश्यक आहे. तथापि, प्रश्नपत्रिका व ओ.एम.आर. उत्तरपत्रिकेची द्वितीय प्रत आपल्याबरोबर नेण्यास विद्यार्थ्यांना परवानगी आहे.
10. फक्त निळ्या किंवा काळ्या बॉल पेनचाच वापर करावा.
11. कॅलक्युलेटर किंवा लॉग टेबल वापरण्यास परवानगी नाही.
12. चुकीच्या उत्तरासाठी गुण कपात केली जाणार नाही.

Chemical Science
Paper II

Time Allowed : 120 Minutes] **[Maximum Marks : 200**

Note : This Paper contains **Hundred (100)** multiple choice questions. Each question carrying **Two (2)** marks. Attempt *All* questions.

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1. SF_4 reacts with $^{11}BF_3$ to form $[SF_3]$ $[^{11}BF_4]$. ^{19}F NMR of anion will exhibits (^{11}B = I = 3/2) :

   (A) Five equally spaced lines with equal intensity

   (B) A quartet with intensity 1 : 3 : 3 : 1

   (C) A quintet with intensity 1 : 4 : 6 : 4 : 1

   (D) Four equally spaced lines with equal intensity

2. Which statement about the trans-effect and the trans-influence is *correct* ?

   (A) trans effect is a ground state effect, whereas the trans-influence is an axcited state effect

   (B) both trans effect and trans-influence are ground state effects

   (C) rates of substitution are affected by the trans-effect but not by trans-influence

   (D) trans-influence is a ground state effect, whereas trans-effect is an excited state effect

3. The oxidising tendency of chlorine oxoanions ClO_4^-, ClO_3^-, ClO_2^- and ClO^- follows the order .....

   (A) $ClO_4^- \simeq ClO_3^- < ClO_2^- < ClO^-$

   (B) $ClO_4^- > ClO_3^- > ClO_2^- > ClO^-$

   (C) $ClO_4^- < ClO_3^- < ClO_2^- \simeq ClO^-$

   (D) $ClO_4^- < ClO_3^- \simeq ClO_2^- < ClO^-$

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4. Keeping all parameters the same if the standard deviation is doubled, variance would be :
   (A) halved (B) doubled
   (C) remain same (D) quadrupled

5. Molecular geometry of $XeOF_5^-$ is :
   (A) Trigonal bipyramid (B) Pentagonal pyramid
   (C) Octahedral (D) Square pyramidal

6. The only metal which forms nitride (M_3N) among group(1) elements is :
   (A) K (B) Na
   (C) Li (D) Rb

7. Among tetrahedral complexes of cobalt :
   (*i*) $[CoBr_2Cl_2]^-$
   (*ii*) $[CoBrCl_2(OH_2)]$ and
   (*iii*) [CoBr I (OH_2)Cl],
   the complex which shows optical isomers is/are :
   (A) (*ii*) only (B) (*i*) and (*iii*)
   (C) (*i*), (*ii*), (*iii*) (D) (*iii*) only

8. The rate law for substitution in square planar Pt(II) complexes contains two terms (Rate = k_1 [Pt L_3X] + k_2 [Pt L_3X] [Y] where [Pt L_3X] is the starting complex and Y is the entering group. The reason for the two-term law is :
   (A) there are competitive associative and dissociative pathways
   (B) there are two competing dissociative pathways
   (C) the solvent enters in the rate determining step and then two competing fast steps follow
   (D) the solvent competes with Y in the rate determining step

9. The symmetry elements of compound SiFClBrI are :
   (A) E, σh, (C_5) (B) E, (C_1)
   (C) E, $4C_3$, $3C_2$, $3S_4$, $6\sigma d$ (D) E, $C\infty$, $\infty \sigma v$, $(C\infty h)$

10. Ground Mülliken symbol of central metal ion in the complex $[FeCl_4]^{2-}$ is :
   (A) ^5D (B) ^5E_g
   (C) ^5E (D) ^6S

11. The compounds :

(*i*) $Na_2[Fe(CN)_5\ NO].2H_2O$ and

(*ii*) $Na_4[Fe(CN)_6]$ are differentiated by ^{57}Fe Mössbauer spectroscopy. (*i*) and (*ii*) will exhibit ..... Mössbauer lines.

(A) a doublet in (*i*) and (*ii*)

(B) a doublet in (*i*) and singlet in (*ii*)

(C) a singlet in (*i*) and (*ii*)

(D) a singlet in (*i*) and doublet in (*ii*)

12. The order of basicity of phosphines is :

(A) $PEt_3 > PMe_3 > PPh_3 > P(OMe)_3 > P(OPh)_3$

(B) $PEt_3 < PMe_3 < PPh_3 < P(OMe)_3 < P(OPh)_3$

(C) $PEt_3 > PMe_3 \simeq P(OMe)_3 > PPh_3 \simeq P(OPh)_3$

(D) $PEt_3 \simeq PMe_3 > PPh_3 \simeq P(OPh)_3 > P(OMe)_3$

13. How many significant figures should be presented for the answer of the following calculation ?

$$\frac{2.2 \times 3.233 \times 1.67}{3.01}$$

(A) 3 (B) 2

(C) 4 (D) 5

14. The filler gas used in hollow cathode lamps of Atomic Absorption spectrometer is :

(A) N_2 (B) Ar

(C) Air (D) He

15. Alkene metathesis reactions catalyzed by metal-carbene complexes proceeds by the formation of the intermediate :

(A) Metallocene (B) Metallocarboborane

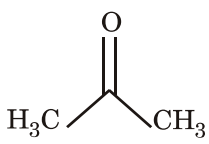
(C) Metallocyclobutane (D) Metallocyclopropane

16. The ground state term symbol of Tb^{3+} is :

(A) $^7F_6$ (B) $^7F_0$

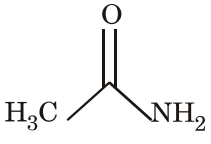
(C) $^2F_{5/2}$ (D) $^2F_{7/2}$

17. The correct order of polarity of the following functional groups is :


(I)

$H_3C - OH$

(II)


(III)

$H_3C - CH_2 - C \equiv N$

(IV)

(A) I < II < III < IV

(B) I < IV < III < II

(C) IV < III < I < II

(D) III < IV < II < I

18. Within the HSAB principle, a hard acid :

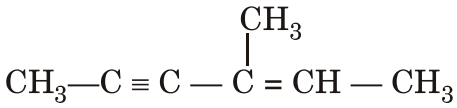
(A) Is not very polarizable

(B) Has a low charge density

(C) Shows a preference for soft base

(D) Shows a preference for donor atoms of lower electronegativity

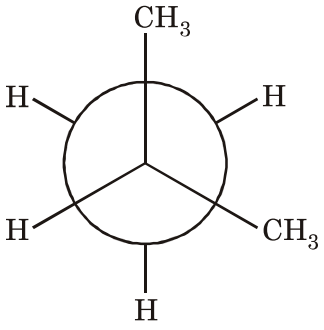
19. The correct IUPAC name of the following compound is :

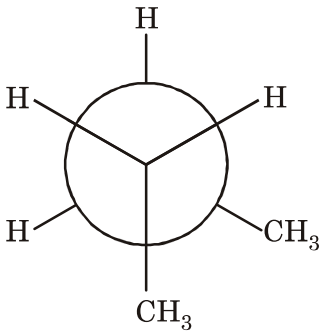


(A) 4–Methyl–4–hexen–2–yne (B) 4–Methyl–2–hexen–4–yne

(C) 3–Methyl–4–hexen–2–yne (D) 3–Methyl–2–hexen–4–yne

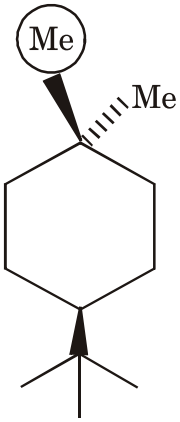
20. The correct statement for the following structures is that they are :

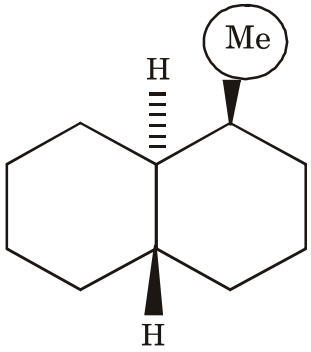


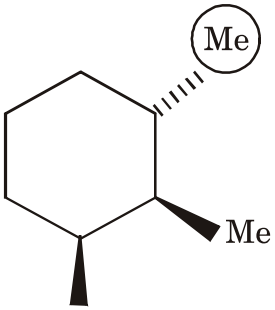


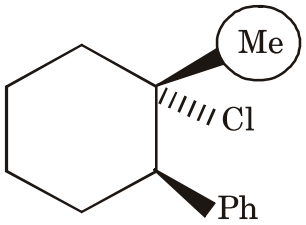
(A) Not isomers
(B) Conformational isomers
(C) Enantiomers
(D) Structural isomers

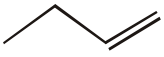
21. In the most stable conformation the molecule having the circled Me group equatorial is :

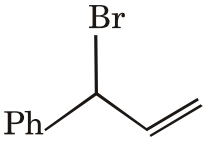
(A)


(B)


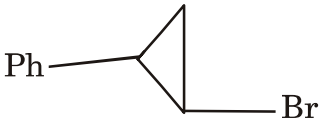
(C)


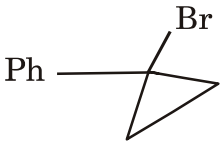
(D)


22. The major product in the radical bromination of Ph  with NBS, heat is :

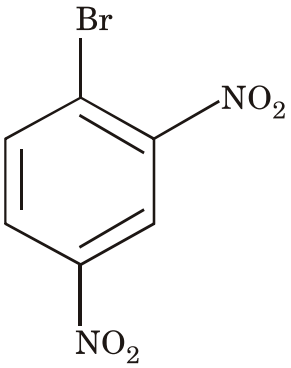
(A) 

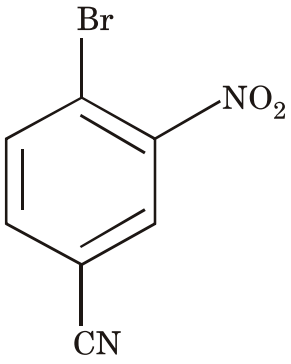
(B) 

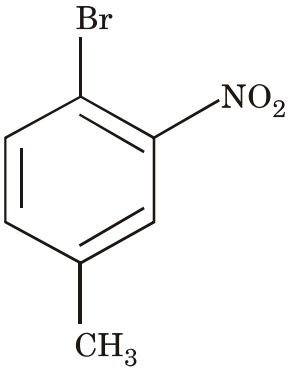
(C) 

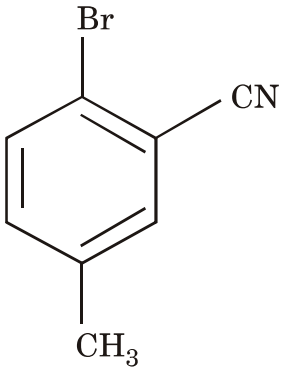
(D) 

23. Which among the following react fastest with NaOMe ?

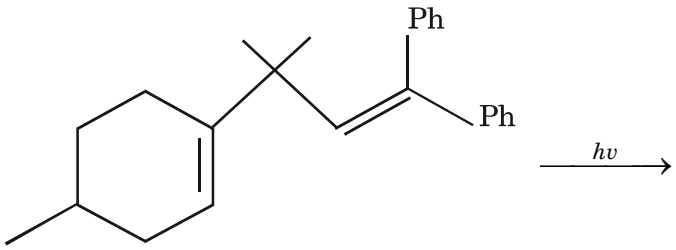
(A) 

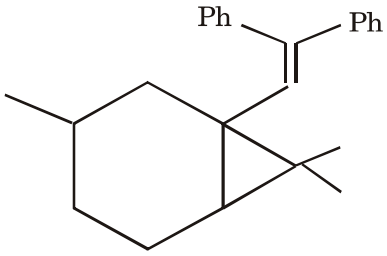
(B) 

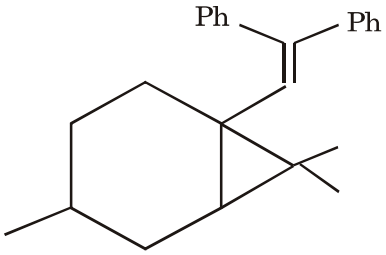
(C) 

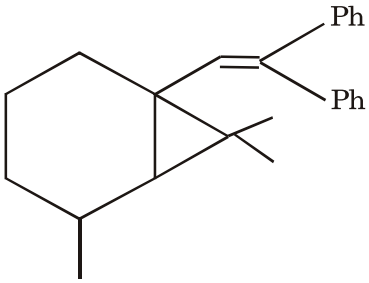
(D) 

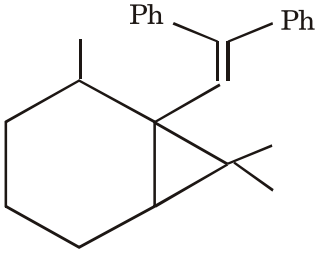
24. The major product of the following reaction is :



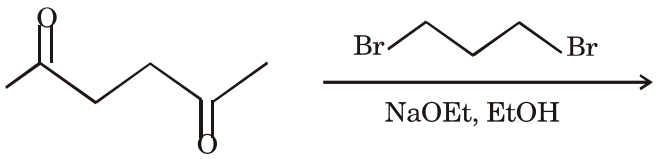
(A)


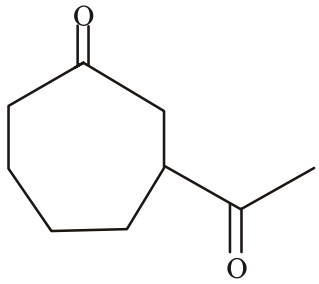
(B)


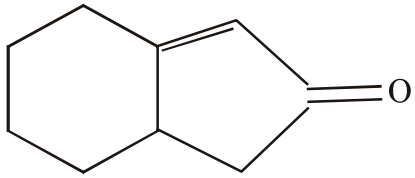
(C)


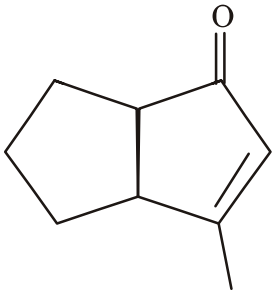
(D)


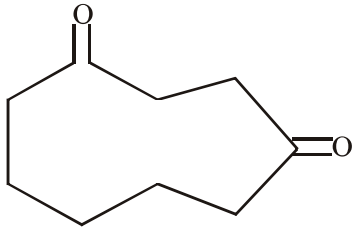
25. The major product of the following reaction is :



(A) 

(B) 

(C) 

(D) 

26. Which one among the following arrows is the correct representation of resonance ?

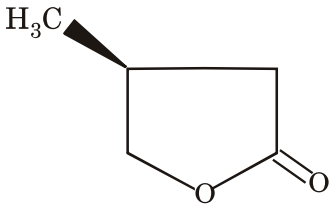
(A) 

(B)

(C)

(D) 

27. The number of signals expected for the following compound in ^{1}H–NMR is :



(A) 08

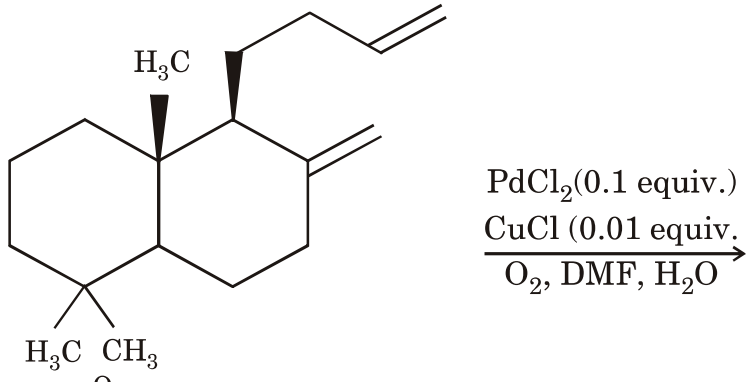
(B) 03

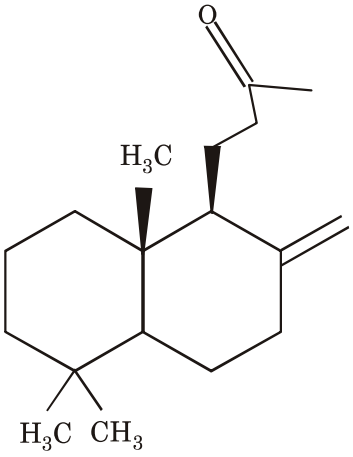
(C) 06

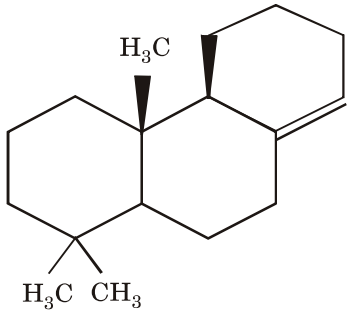
(D) 05

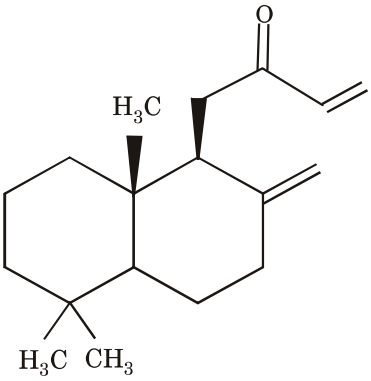
28. The methyl carbon of the acetone-d_6 appears in the ^{13}C–NMR as :
    (A) quintet (1 : 2 : 3 : 2 : 1)
    (B) sextet (1 : 5 : 10 : 10 : 5 : 1)
    (C) septet (1 : 3 : 6 : 7 : 6 : 3 : 1)
    (D) septet (1 : 6 : 15 : 20 : 15 : 6 : 1)

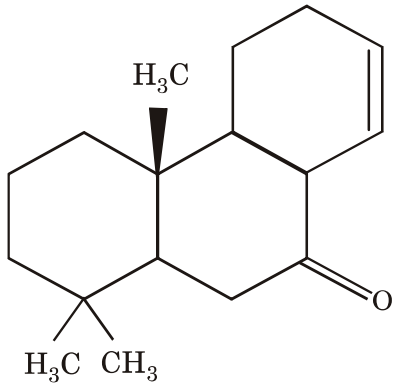
29. The major product of the following reaction is :



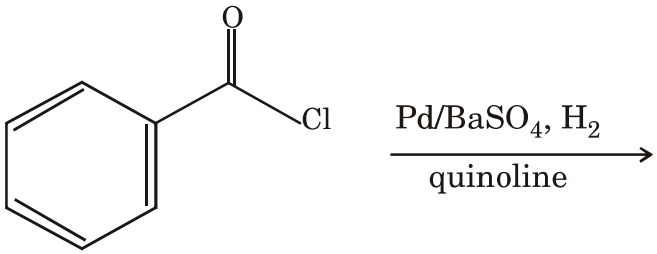
(A)


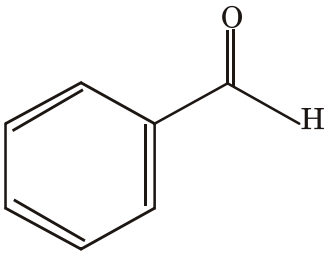
(B)


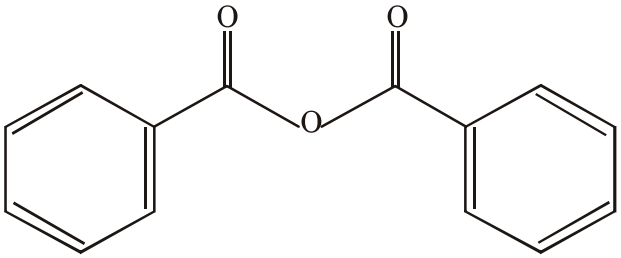
(C)


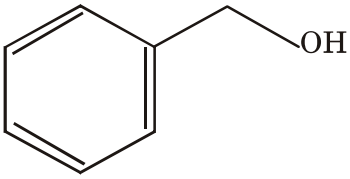
(D)


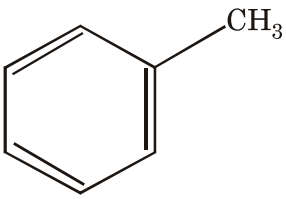
30. The major product of the following reaction is :



(A) 

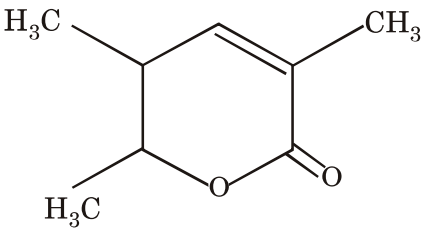
(B) 

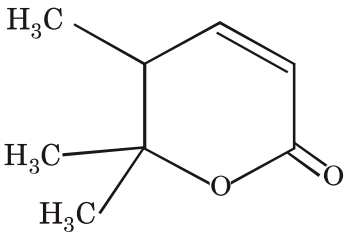
(C) 

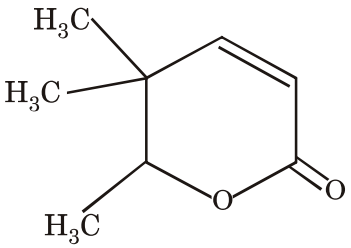
(D) 

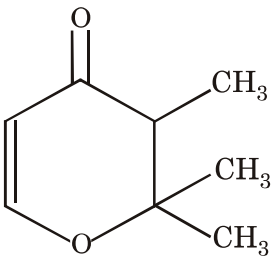
31. An organic compound with molecular formula $C_8H_{12}O_2$ exhibit the following spectral data IR : 1720 cm^{-1}; ^{1}H-NMR : δ 6.95 (d, J = 8.5 Hz, 1H) 5.9 (d, J = 8.5 Hz, 1H), 4.53 (q, J = 6Hz, 1H) 1.41 (d, J = 6Hz, 3H), 1.20 (S, 3H), 1.15 (S, 3H).

The correct structure of the compound is :

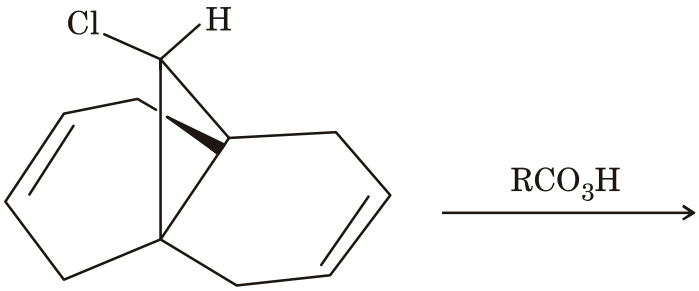
(A) 

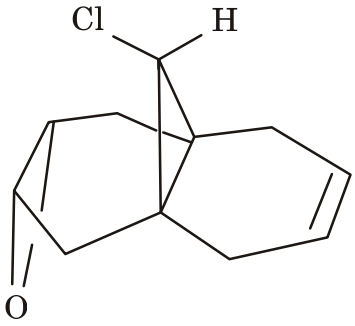
(B) 

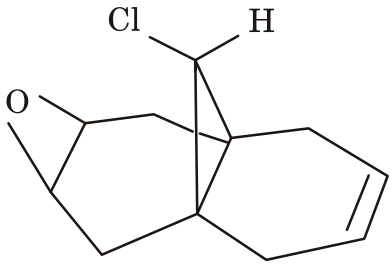
(C) 

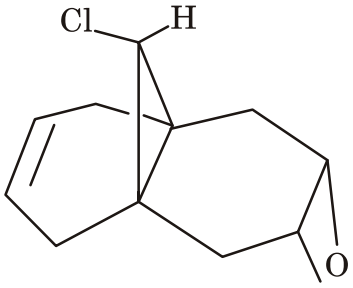
(D) 

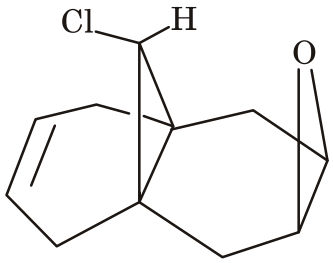
32. The major product of the following reaction is :



(A)


(B)


(C)


(D)


33. Which of the following molecule has enantiotopic protons ?

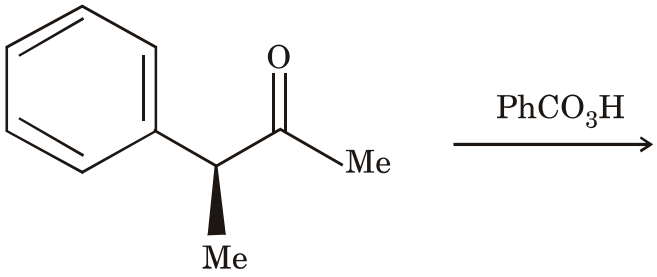
(A) Butane

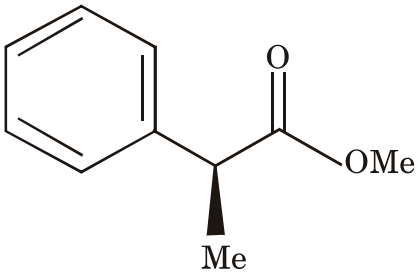
(B) Cyclopropane

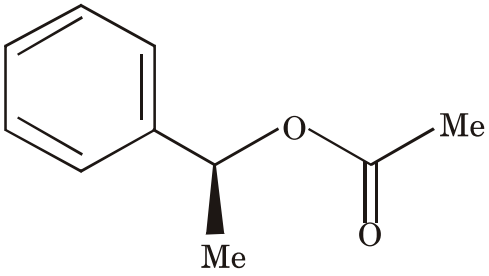
(C) Ethane

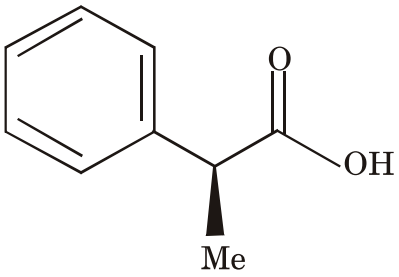
(D) Propane

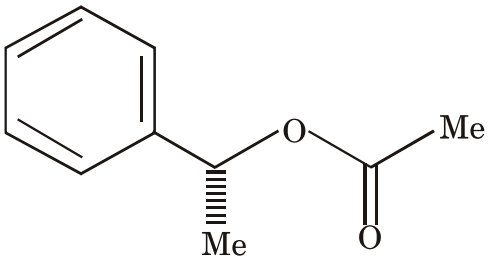
34. The major product of the following reaction is :



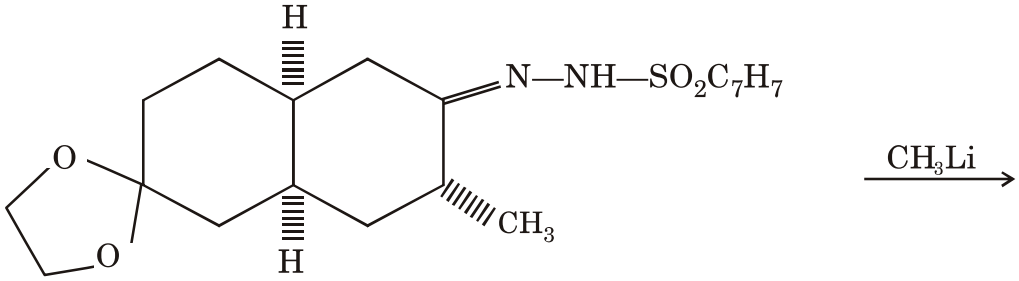
(A) 

(B) 

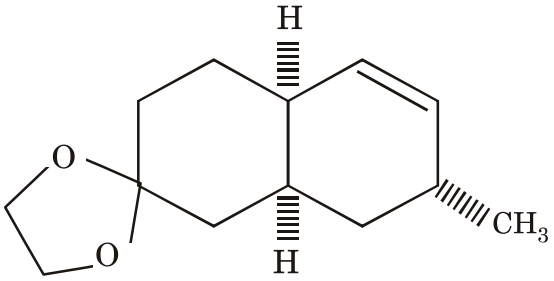
(C) 

(D) 

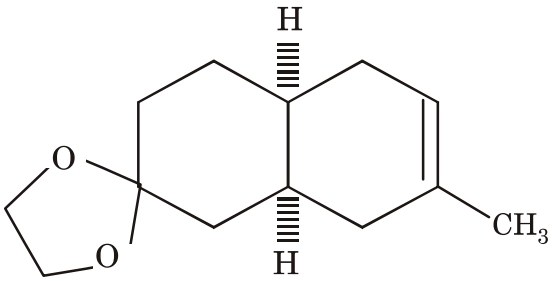
35. The major product of the following reaction is :



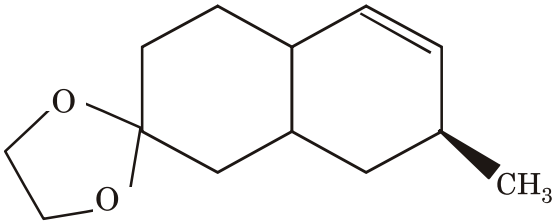
(A)



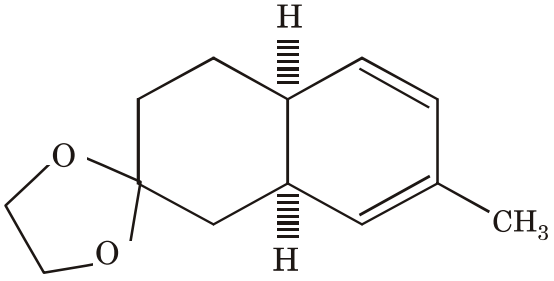
(B)



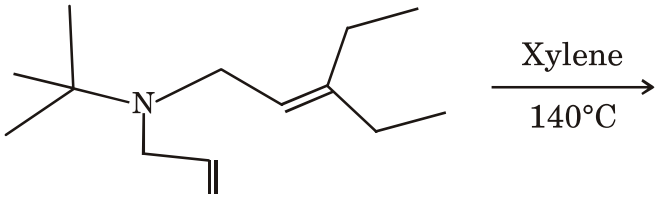
(C)

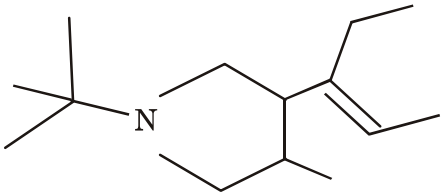


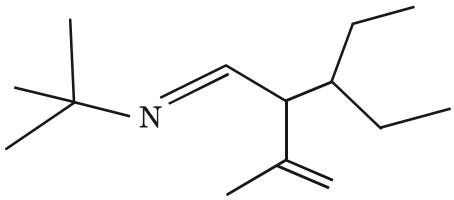
(D)

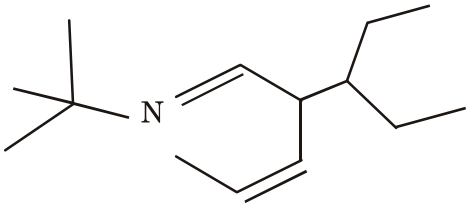


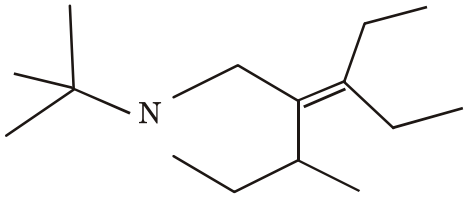
36. The major product of the following reaction is :



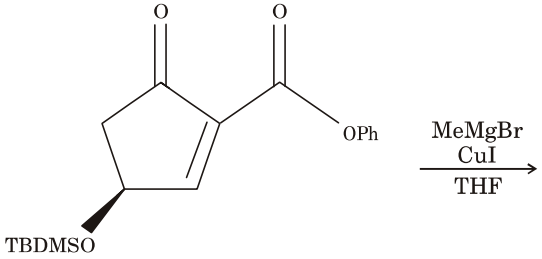
(A) 

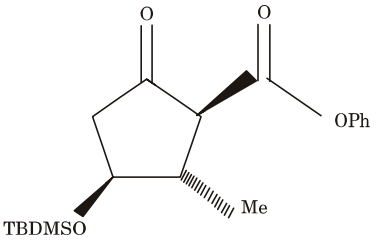
(B) 

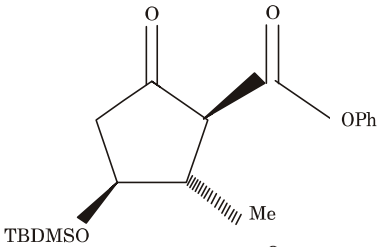
(C) 

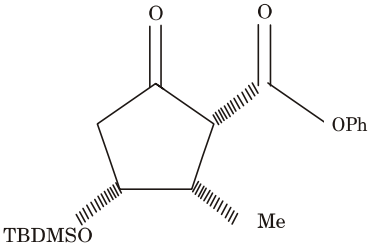
(D) 

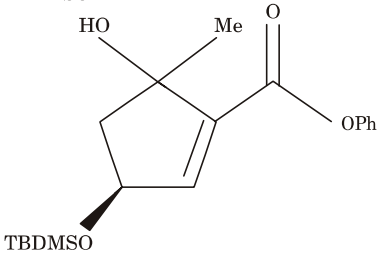
37. The major product of the following reaction is :



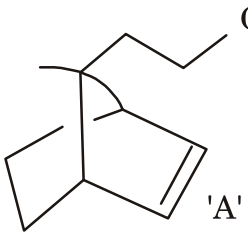
(A) 

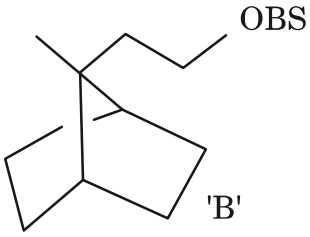
(B) 

(C) 

(D) 

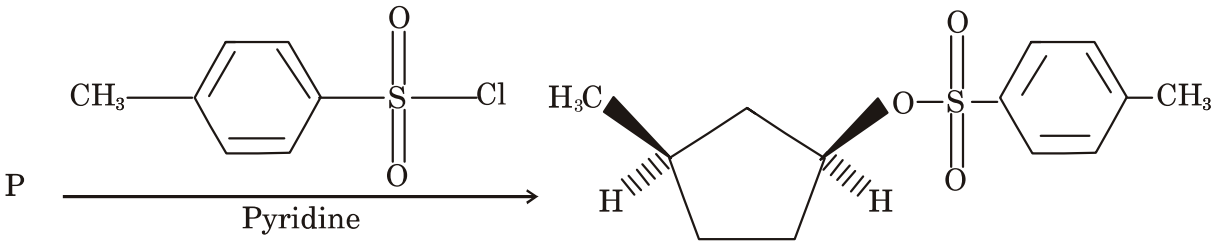
38. Compound A, at 25°C undergoes acetolysis 140000 times faster than compound B. Select the reason for this behaviour :



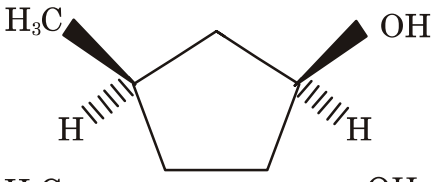
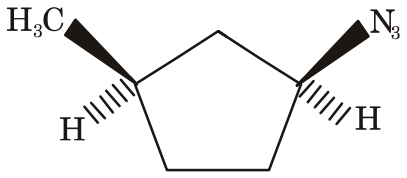


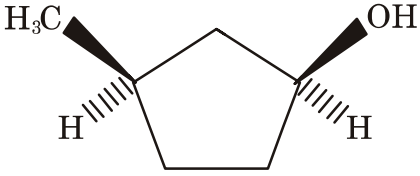
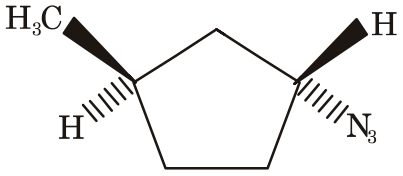
(A) Anchimeric assistance
(B) Inductive effect
(C) Fields effect
(D) Resonance effect

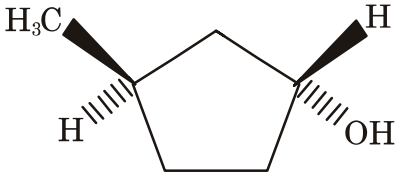
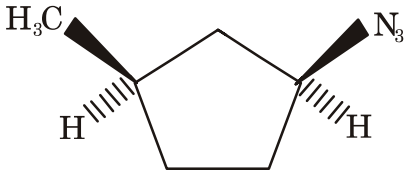
39. The reactant 'P' and product 'Q' in the following reaction are :

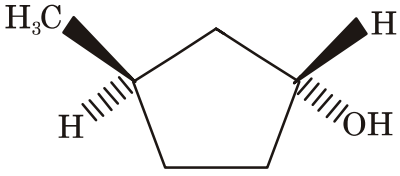
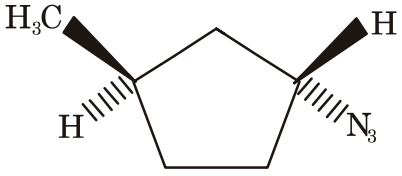


$\xrightarrow[EtOH/H_2O]{NaN_3}$ Q

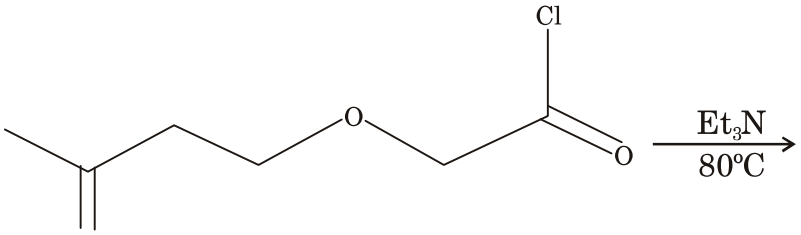
(A) P =  , Q = 

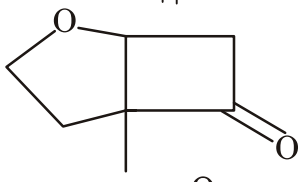
(B) P =  , Q = 

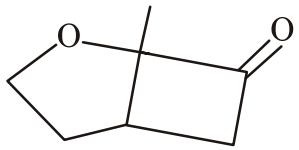
(C) P =  , Q = 

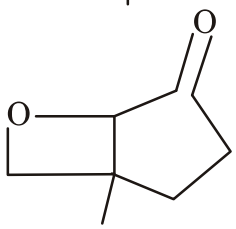
(D) P =  , Q = 

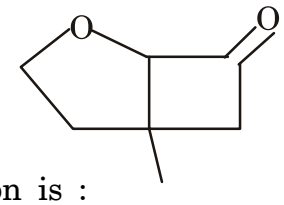
40. The major product of the following reaction is :



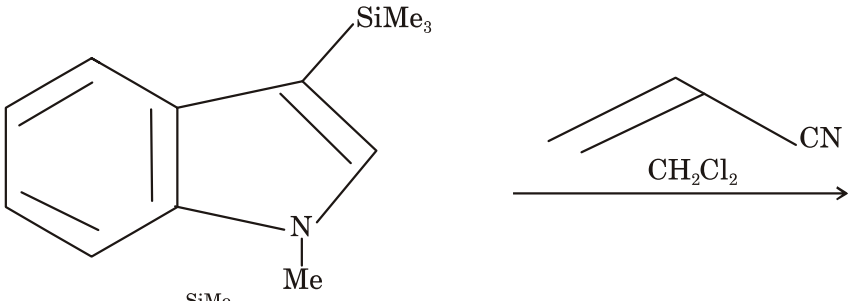
(A) 

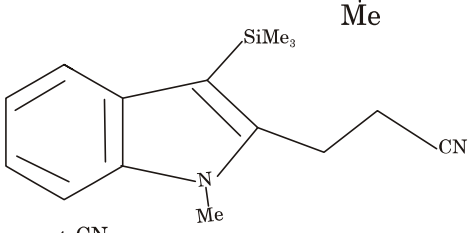
(B) 

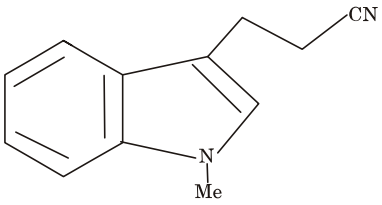
(C) 

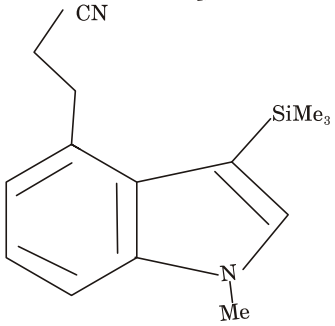
(D) 

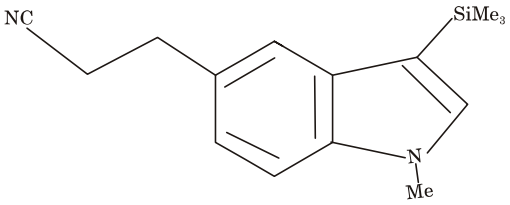
41. The major product of the following reaction is :



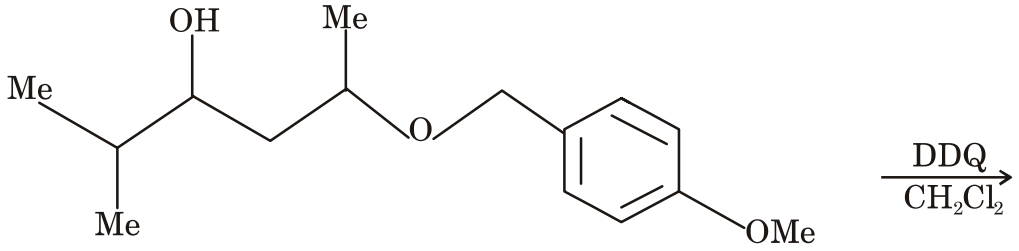
(A) 

(B) 

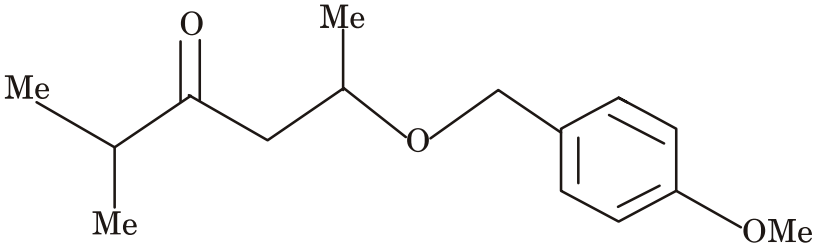
(C) 

(D) 

42. The major product in the following reaction is :



(A)



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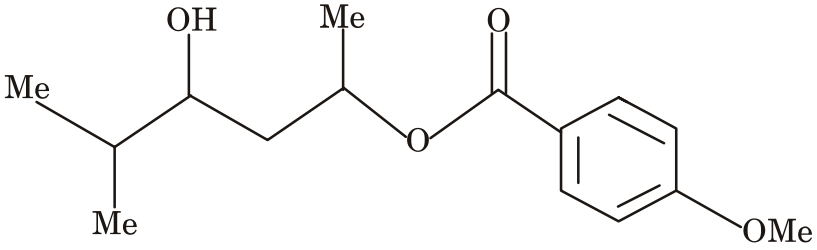
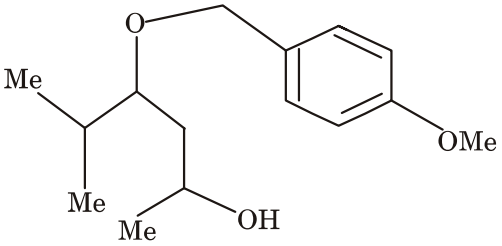
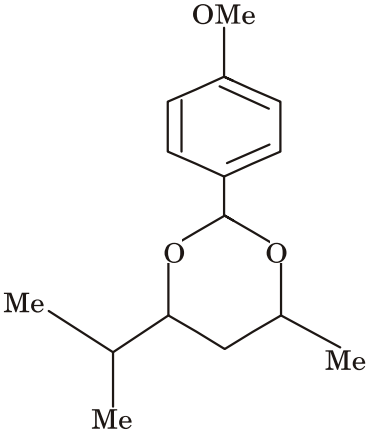


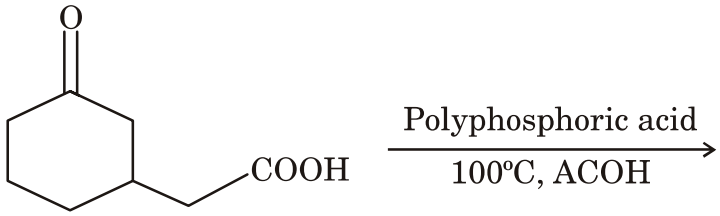
(C)

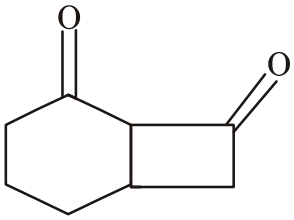


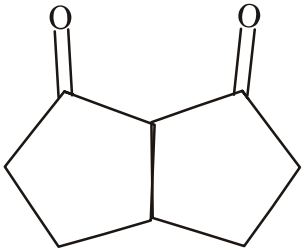
(D)

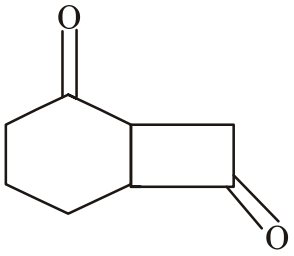


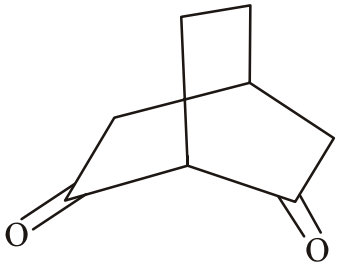
43. The major product of the following reaction is :



(A) 

(B) 

(C) 

(D) 

44. The correct match of the natural product in column II with class in column I is :

Column I	**Column II**
(*a*) Vitamin	(*i*) Glycogen
(*b*) Terpene	(*ii*) Nicotine
(*c*) Polysaccharide	(*iii*) Ascorbic acid
(*d*) Alkaloid	(*iv*) Carvone

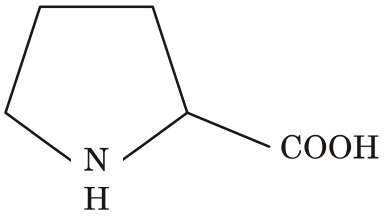
(A) (*a*—*iv*) (*b*—*iii*) (*c*—*i*) (*d*—*ii*)

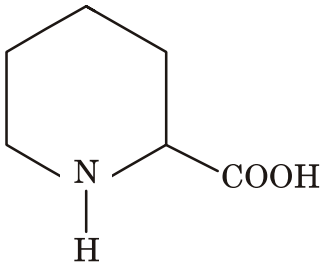
(B) (*a*—*i*) (*b*—*iv*) (*c*—*iii*) (*d*—*ii*)

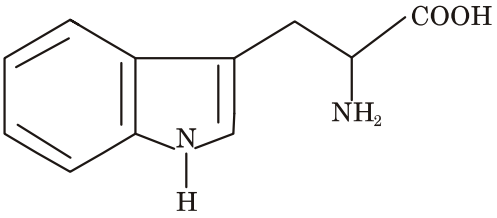
(C) (*a*—*iii*) (*b*—*ii*) (*c*—*i*) (*d*—*iv*)

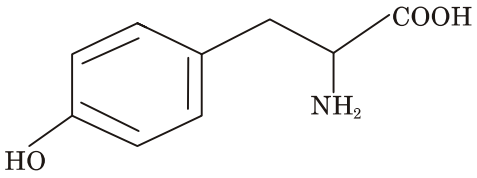
(D) (*a*—*iii*) (*b*—*iv*) (*c*—*i*) (*d*—*ii*)

45. Which of the following is not a natural amino acid ?

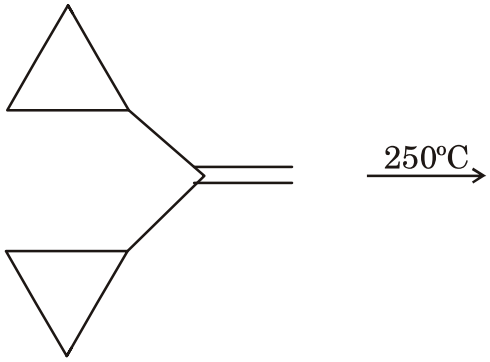
(A) 

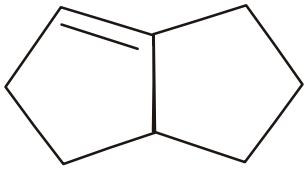
(B) 

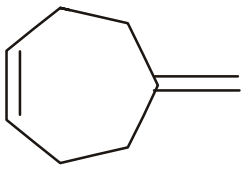
(C) 

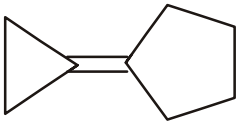
(D) 

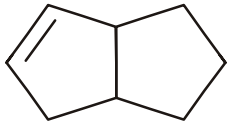
46. The major product of the following reaction is :



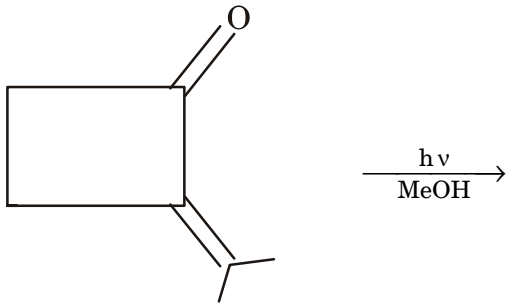
(A) 

(B) 

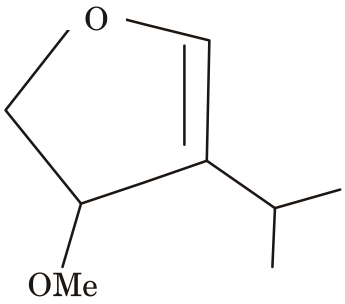
(C) 

(D) 

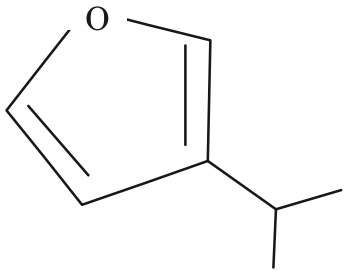
47. The major product in the following reaction is :



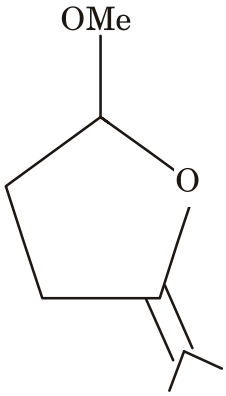
(A)



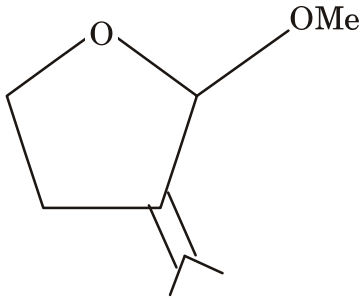
(B)



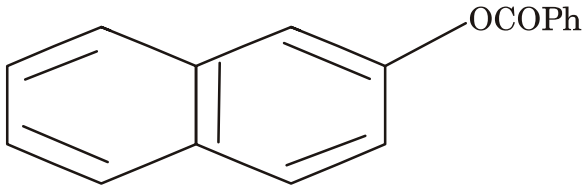
(C)

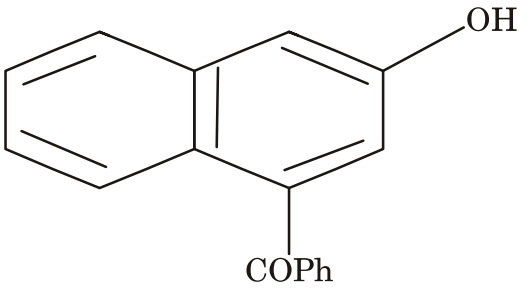


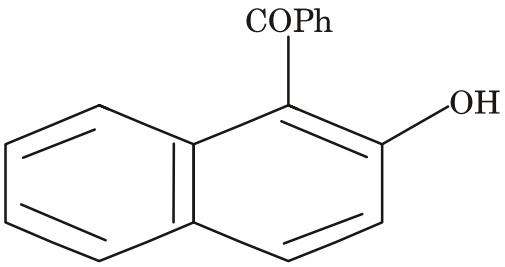
(D)

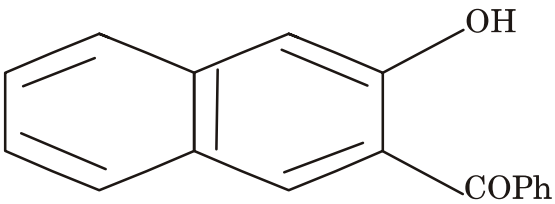


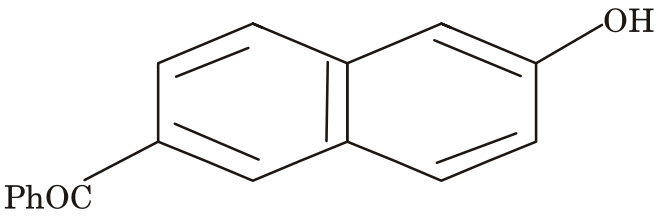
48. The major product in the following reaction is :



(A) 

(B) 

(C) 

(D) 

49. When 10 mL of 0.1M NaOH is added to 10 mL of 0.1M HCl, pH of the solution will be :

(A) 2 (B) 7

(C) 0 (D) 14

50. Activation energy (E_a) and the enthalpy of the reaction (ΔH) are 134 kJ/mol and –234 kJ respectively for the following gas phase reaction :

$$CO + NO_2 \rightarrow CO_2 + NO_2$$

The activation energy for the reaction $CO_2 + NO_2 \rightarrow CO + NO_2$ is :

(A) 100 kJ/mol (B) –134 kJ/mol

(C) 368 kJ/mol (D) 184 kJ/mol

51. The rate (ν) of reaction catalyzed by a suitable enzyme is given by the Michaelis-Menton equation as

$$\nu = \frac{V_{max}[s]}{K_M + [s]}$$

where [s] is the substrate concentration K_M is Michaelis-Menton constant. Which of the following is *correct* ?

(A) Unit of K_M is $dm^3.mol^{-1}$ $time^{-1}$

(B) Unit of K_M is $mol.dm^{-3}$

(C) When $K_M = [s]$; $\nu = V_{max}$

(D) at low substrate concentrations ν varies exponentially with $[s]$

52. A compound contains two types of atoms X and Y. It crystallizes in a cubic lattice with atom X at the corners of the unit cell and Y at the body centre. The simplest possible formula of this compound is :

(A) X_2Y (B) X_4Y

(C) XY (D) XY_4

53. How many initiator fragments are present in a polymer chain formed by coupling termination in addition polymerization ?

(A) 1 (B) 2

(C) 3 (D) 0

54. Based on tacticity, the polymer is divided into ..... types.

(A) Two (B) Four

(C) Three (D) Five

55. Step reaction polymerization proceeds by :

(A) Addition polymerization

(B) Condensation polymerization

(C) Anionic polymerization

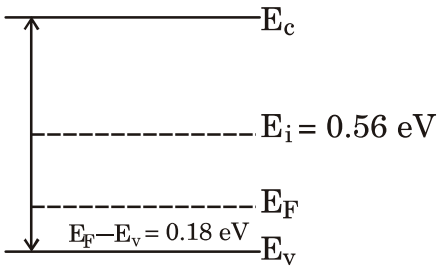
(D) Cationic polymerization

56. The polydispersity index of a polymer is given by the ratio of :

(A) $\bar{M}v / \bar{M}w$ (B) $\bar{M}w / \bar{M}z$

(C) $\bar{M}w / \bar{M}n$ (D) $\bar{M}n / \bar{M}w$

57. The diagram given below is of silicon crystal at 300 K.



From the diagram it can be inferred that :

(A) The Fermi level is 0.38 eV below the intrinsic level of conduction E_i

(B) The semiconductor is a *p*-type material

(C) The semiconductor is a *n*-type material

(D) $E_c - E_v = 0.56$ eV

58. At 445°C, K_c for the following equilibrium reaction

$$2HI\ (g) \rightleftharpoons I_2(g) + H_2(g)$$

A mixture of H_2, I_2 and HI are present in a closed vessel at 445°C at the following concentrations :

$$[HI] = 2.0\ M;\ [H_2] = 0.50\ M\ [I_2] = 0.010\ M.$$

Which of the following is *correct* about K_c, the reaction quotent ?

(A) $Q_c = K_c$; the system is in equilibrium

(B) $Q_c < K_c$; more H_2 & I_2 will form

(C) $Q_c < K_c$; more HI will form

(D) $Q_c > K_c$; more H_2 & I_2 will form

59. In a canonical ensemble, a system X of fixed volume is in contact with a large reservoir Y, then :

(A) X can exchange only energy with Y

(B) X can exchange only particles with Y

(C) X can exchange neither energy nor particles with Y

(D) X can exchange both energy and particles with Y

60. According to Fermi-Dirac the statistics following assumption is made :

(A) the particles are distinguishable and any number of particles may occupy the same energy level

(B) the particles are indistinguishable and any number of particles may occupy a given energy level

(C) the particles are indistinguishable but only one particle may occupy a given energy level

(D) the particles are distinguishable and only one particle may occupy a given energy level

61. The ratio of the energy of the electron in the ground state of hydrogen atom to that of the electron in the first excited state of Be^{3+} is :

(A) 1 : 4 (B) 1 : 8

(C) 2 : 9 (D) 1 : 16

62. Which among the following nuclei are fissile ?

(I) ^{233}U

(II) ^{238}U

(III) ^{239}Pu

(IV) ^{235}U

(A) (I) and (II) (B) (II) and (III)

(C) (I), (III) and (IV) (D) (II), (III) and (IV)

63. Which detector works on the principle of ionization of gas molecules ?

(A) Semiconductor detector (B) Scintillation counter

(C) GM counter (D) Surface barrier detector

64. As radioactivity is a random phenomenon, the error in measuring activity in CPM can be reduced by :
    (A) Measuring the activity for a longer period of time
    (B) Measuring the activity for a short period of time
    (C) Measuring the activity by increasing the current
    (D) Measuring the activity at intermittent time intervals

65. A proton is 1836 times heavier than an electron. The ratio of the de Broglie wavelengths, λ_e / λ_p is :
    (A) $1 : (1836)^2$ (B) $(1836)^{1/2} : 1$
    (C) $1836 : 1$ (D) $(1836)^2 : 1$

66. An electron and a proton are accelerated through the same potential. The ratio of their de Broglie wavelengths, λ_e / λ_p is :
    (A) $\left(m_p / m_e \right)^{1/2}$ (B) $\left(m_e / m_p \right)$
    (C) m_p / m_e (D) $\left(m_p / m_e \right)^2$

67. The energy of a particle in a three-dimensional box of equal side lengths is given as :

$$E = \frac{h^2}{8ma^2}\left(\frac{n^2}{x} + \frac{n^2}{y} + \frac{n^2}{z}\right)$$

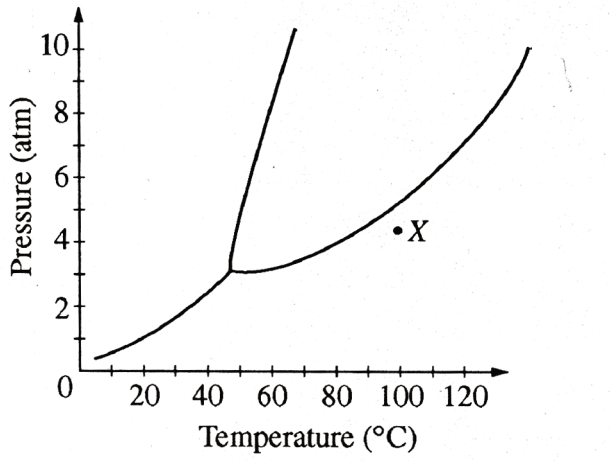
    The degeneracy of energy for the levels $n_x\ n_y\ n_z$ = 1, 1, 1, 2, 1, 1 and 3, 2, 1 respectively are :
    (A) 3, 4, 6 (B) 1, 1, 1
    (C) 1, 3, 6 (D) 1, 3, 3

68. The ionization energy of hydrogen atom is 13.6 eV; the ionization energy for the ground state of Li^{2+} is approximately :
    (A) 27.2 eV (B) 40.8 eV
    (C) 54.4 eV (D) 122.4 eV

69. Most of the light re-emitted at the same wavelength as the incident light is called as :

(A) Raman scattering
(B) Rayleigh scattering
(C) Anti-Stokes scattering
(D) Stokes scattering

70. Given below is the phase diagram of a pure substance



The substance at the conditions represented by the point 'X' is cooled to 30°C, keeping the pressure constant. In this process, the phase of the substance :

(A) Changes from gas to liquid
(B) Changes from gas to liquid to solid
(C) Remains as liquid
(D) Remains as solid

71. Both the vapour pressure at 25°C and normal boiling point of toluene are higher than that of water, which of the following explains these observations ?

(A) Liquids with higher vapour pressures typically have higher boiling points
(B) Toluene has a higher molar mass than water
(C) Toluene has a lower heat of vaporization than water
(D) The density of toluene vapour is greater than that of water vapour

72. P-Jump and T-Jump methods are used to study the kinetics of fast reactions. Which of the following is *correct* ?

(A) P-jump method can be used for reactions for which $\Delta V = 0$

(B) T-jump method can be used for reactions for which $\Delta H = 0$

(C) Ionic reactions cannot be studied by P-jump method

(D) P-jump method can be used to study the reactions for which $\Delta V \neq 0$

73. Which of the following is *correct* ?

(I) CMC of an anionic surfactant is higher than that of a non-ionic surfactant of the same chain length

(II) CMC of an anionic surfactant is lower than that of a non-ionic surfactant of the same chain length

(III) CMC of an ionic surfactant decreases in presence of small quantity of added electrolyte

(IV) CMC of an ionic surfactant increases in presence of small quantity of added electrolyte

(A) (I) and (II) (B) (I) and (III)

(C) (II) and (III) (D) (III) and (IV)

74. Which of the following are directly related to surface tension phenomena ?

(I) Spherical shapes of droplets in the absence of external forces

(II) A sail boat in water

(III) A needle floating in water

(IV) Water rising in the xylem of plants

(A) (I) and (II) (B) (I), (II) and (III)

(C) (I), (III) and (IV) (D) (II), (III) and (IV)

75. The overall chemical reaction of photosynthesis is best described as .....

(A) an exothermic reaction that breaks down sugar

(B) an endothermic reaction that breaks down sugar

(C) an exothermic reaction that forms sugar

(D) an endothermic reaction that forms sugar

76. In the electrolysis of an aqueous solution of HBr, of the following products are formed :

(A) O_2 at the cathode, H_2 at the anode

(B) H_2 at the cathode, Br_2 at the anode

(C) OH^- at the cathode, HOBr at the anode

(D) Br_3^- at the cathode, $HBrO_4$ at the anode

77. Thermonuclear reactions are responsible for energy production in :

(A) Nuclear reactors (B) Atom bombs

(C) Volcanoes (D) Stars

78. For the adsorption of N_2 on activated carbon at 77 K :

(A) $\Delta H = 0; \quad \Delta S < 0$

(B) $\Delta H < 0; \quad \Delta S < 0$

(C) $\Delta H > 0; \quad \Delta S < 0$

(D) $\Delta H = 0; \quad \Delta S = 0$

79. For the reaction $A \rightarrow P$, the graph of 1/[A] as a function of time is linear, what is the reaction order in A ?

(A) Zeroth (B) First

(C) Second (D) Half

80. A compound formed by element X and Y crystallizes in cubic structure in which atoms of 'X' are at the corners while that of 'Y' are at the face centre. The formula of the compound is :

(A) 3XY (B) X_3Y

(C) XY_3 (D) X_8Y_6

81. The magnetic moment of potassium salt of $[Fe(CN)_6]^{3-}$ is 2.3 μB. Choose the *correct* statement from the following :
    (A) It is spin only value of one unpaired electron
    (B) It is spin only value between one and two unpaired electron
    (C) The increase in magnetic moment because of ferromagnetic coupling
    (D) The increase in magnetic moment because of spin-orbit coupling

82. According to Wade's rules, the structures of $B_{10}C_2H_{12}$ and $B_{10}H_{12}(SEt_2)_2$ are respectively :
    (A) nido and closo
    (B) closo and nido
    (C) closo and arachno
    (D) nido and arachno

83. The geometry of $[IF_7]^-$ is :
    (A) capped octahedron
    (B) cube
    (C) trigonal prismatic
    (D) pentagonal bipyramidal

84. A complex that possess ^5D ground term symbol for its metal ion is :
    (A) $[Mn(CN)_6]^{3-}$
    (B) $[Cr(H_2O)_6]^{2+}$
    (C) $[Fe(CN)_6]^{4-}$
    (D) $[Co(H_2O)_6]^{2+}$

85. The magnetic moment of the complex $[Mn(NCS)_6]^{4-}$ is 6.06 μB. Its electronic configuration is :
    (A) $t_{2g}^{\ 5}\ e_g^{\ 0}$
    (B) $t_{2g}^{\ 3}\ e_g^{\ 2}$
    (C) $t_2^{\ 3}\ e^2$
    (D) $t_{2g}^{\ 2}\ e_g^{\ 3}$

86. Mülliken symbol(s) possible for 'G' term in octahedral ligand field is/are :
    (A) A_{1g}
    (B) T_{2g}, E_g
    (C) A_{1g}, E_g, T_{1g}, T_{2g}
    (D) A_{2g}, T_{2g}, T_{1g}

87. For metal olefin complexes :
    (*i*) $[PtCl_3(C_2F_4)]^-$ and
    (*ii*) $[PtCl_3(C_2H_4)]^-$
    Which of the following statements is *correct* ?
    (A) Carbon-carbon bond length is same in both (*i*) and (*ii*)
    (B) Carbon-carbon bond length in (*ii*) is smaller than (*i*)
    (C) Carbon-carbon bond length in (*i*) is smaller than (*ii*)
    (D) Olefin coordinates to Pt in a η^1 mode

88. X-band EPR spectrum of CH_2OH radical will show ..... lines.

(A) 6 (B) 3

(C) 2 (D) 5

89. *n*-type of semiconductor(s) among Fe_2O_3, FeO, FeS, CuI and Cu_2O is/are :

(A) FeO, FeS and Fe_2O_3

(B) CuI and Cu_2O

(C) Fe_2O_3, FeO and Cu_2O

(D) Fe_2O_3 only

90. Oxygen molecule binds as a hydroperoxide ligand to the metal ion in :

(A) Oxyhemoglobin (B) Oxyhemocyanin

(C) Oxyhemerythrin (D) Oxymyoglobin

91. The spin state and oxidation state of iron in deoxyhemerythrin and oxyhemerythrin respectively are :

(A) high spin iron (II) and high spin iron (III)

(B) low spin iron (II) and low spin iron (III)

(C) high spin iron (II) and low spin iron (III)

(D) low spin iron (II) and high spin iron (III)

92. In Ziegler-Natta catalyst titanium acts as a :

(A) Lewis base (B) Neutral

(C) Lewis acid (D) Bronsted base

93. The correct order of Rh–C bond lengths in the complexes

(*i*) $Rh(CO)\ Cl(PPh_3)_2$

(*ii*) $Rh(CO)\ Cl(PEt_3)_2$ and

(*iii*) $Rh(CO)\ Cl\{P(C_6H_5)_3\}_2$

will be :

(A) (*i*) > (*ii*) > (*iii*) (B) (*iii*) > (*i*) > (*ii*)

(C) (*iii*) > (*ii*) > (*i*) (D) (*ii*) > (*i*) > (*iii*)

94. The point group of phosphorus pentafluoride is :

(A) C_5h (B) C_3h

(C) D_3h (D) D_5h

95. Which among the following beryllium alkyl compounds are stable ?

(*i*) $Be(Me)_2$

(*ii*) $Be(Et)_2$

(*iii*) $Be(B\mu^t)_2$

(*iv*) $BeCH_2\ (B\mu^t)_2$

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

96. Operational, Personal and Instrumental errors are types of :

(A) determinate errors
(B) indeterminate errors
(C) additive errors
(D) proportional errors

97. The kinetics of the isomerization of cis to trans - $[Mo(CO)_4(PEt_3)_2]$ can be followed by IR spectroscopy. Which of the following regions of the IR spectrum would you focus on to monitor the reaction ?

(A) 3500 – 3000 cm^{-1}
(B) 2000 – 1800 cm^{-1}
(C) 1600 – 1400 cm^{-1}
(D) 1200 – 800 cm^{-1}

98. In a base catalyzed substitution of Cl^- by OH^- in $[Co(NH_3)_5Cl]^{2+}$ under strongly basic conditions the first step in the mechanism will be :

(A) substitution of Cl^- by OH^-
(B) dissociation of Cl^- to give five coordinate intermediate
(C) association of OH^- to give a seven coordinate intermediate
(D) Conversion of an ammine ligand to amido ligand

99. The crystal field stabilization energy (CFSE) of an octahedral Ti^{3+} complex is 20,100 cm^{-1}. CFSE of its tetrahedral complex will be :

(A) 10,050 cm^{-1}
(B) 20,100 cm^{-1}
(C) 8933 cm^{-1}
(D) 11,187 cm^{-1}

100. The reactions of $[PtCl_4]^{2-}$ with NH_3 (reaction I) and of $[PtCl_4]^{2-}$ with $[NO_2]^-$ followed by NH_3 (reaction II) are ways of forming :

(A) I : cis $[PtCl_2(NH_3)_2]$; II : cis $[PtCl_2(NH_3)(NO_2)]^-$
(B) I : trans $[PtCl_2(NH_3)_2]$; II : trans $[PtCl_2(NH_3)(NO_2)]^-$
(C) I : cis $[PtCl_2(NH_3)_2]$; II : trans $[PtCl_2NH_3(NO_2)]^-$
(D) I : trans $[PtCl_2(NH_3)_2]$; II : cis $[PtCl_2NH_3(NO_2)]^-$

ROUGH WORK