

TEST SERIES CSIR-NET/JRF Dec. 2017

BOOKLET SERIES **E**

Full Length Test – 2

Paper Code **01**

Test Type: **TEST SERIES**

CHEMICAL SCIENCES

Duration: 3:00 Hours

Date: 09-12-2017

Maximum Marks: 200

Read the following instructions carefully:

* Single Paper Test is divided into three Parts.

Part - A: This part shall carry 20 questions. The candidate shall be required to answer any 15 questions. Each question shall be of 2 marks.

Part - B: This part shall contain 40 questions. The candidate shall be required to answer any 35 questions. Each question shall be of 2 Marks.

Part - C: This part shall contain 60 questions. The candidate shall be required to answer any 25 questions. Each question shall be of 4 marks.

* Darken the appropriate bubbles with HB pencil/Ball Pen to write your answer.

* There will be negative marking @25% for each wrong answer.

* The candidates shall be allowed to carry the Question Paper Booklet after completion of the exam.

* For rough work, blank sheet is attached at the end of test booklet.



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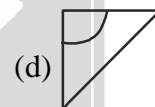
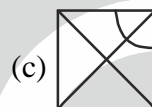
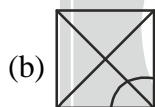
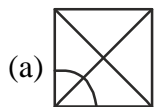
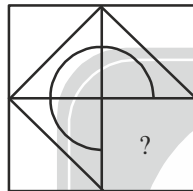


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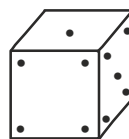
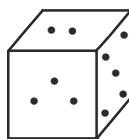


PART-A

- A man earns Rs. 20 on the first day and spends Rs. 15 on the next day. He again earns Rs. 20 on the third day and spends Rs. 15 on the fourth day. If he continues to save like this, how soon will he have Rs. 60 in hand?
(a) on 17th day (b) On 27th day (c) On 30th day (d) On 40th day
- The average age of students of a class is 15.8 years. The average age of boys in the class is 16.4 years and that of the girls is 15.4 years. The ratio of the number of boys to the number of girls in the class is
(a) 1 : 2 (b) 2 : 3 (c) 3 : 4 (d) 3 : 5
- The age of father 10 years ago was thrice the age of his son. Ten years hence, father's age will be twice that of his son. The ratio of their present ages is
(a) 5 : 2 (b) 7 : 3 (c) 9 : 2 (d) 13 : 4
- In a fraction, if numerator is increased by 40% and denominator is increased by 80% then what fraction of the original is the new fraction?
(a) $\frac{1}{2}$ (b) $\frac{7}{9}$ (c) $\frac{7}{18}$ (d) data inadequate
- In the following figure, a part of the figure is missing. Find out the missing figure

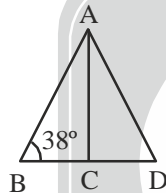


- Some articles were bought at 6 for Rs. 5 and sold at 5 for Rs. 6. Gain percent is
(a) 30% (b) $33\frac{1}{3}\%$ (c) 35% (d) 44%
- In a school, 10% of the boys are same in number as $\frac{1}{4}$ th of the girls. What is the ratio of boys to girls in that school?
(a) 3 : 2 (b) 5 : 2 (c) 2 : 1 (d) 4 : 3
- 3 pumps, working 8 hours a day, can empty a tank in 2 days. How many hours a day must 4 pumps work to empty the tank in 1 day?
(a) 9 (b) 10 (c) 11 (d) 12
- If A can do $\frac{1}{4}$ of a work in 3 days and B can do $\frac{1}{6}$ of the same work in 4 days. How much will A get if both work together and are paid Rs. 180 in all?
(a) Rs. 36 (b) Rs. 60 (c) Rs. 108 (d) Rs. 120
- What is the number of dots on the face, opposite to the face that contains 2 dots

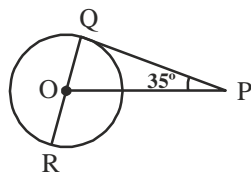


- (a) 1 (b) 3 (c) 4 (d) 6

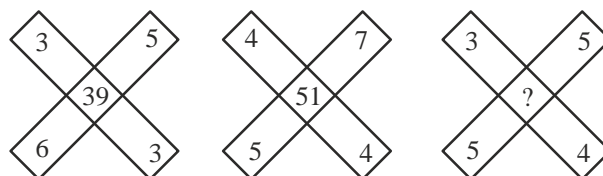
11. Walking $\frac{6}{7}$ th of his usual speed, a man is 12 minutes too late. The usual time taken by him to cover that distance is
 (a) 1 hour (b) 1 hour 12 min
 (c) 1 hour 15 min (d) 1 hour 20 min
12. The area of the largest triangle that can be inscribed in a semi-circle of radius r is
 (a) r^2 (b) $2r^2$ (c) r^3 (d) $2r^3$
13. If the radius of a circle is diminished by 10% then its area is diminished by
 (a) 10% (b) 19% (c) 20% (d) 36%
14. 12 spheres of the same size are made from melting a solid cylinder of 16 cm. Diameter and 2 cm height. The diameter of each sphere is
 (a) $\sqrt{3}$ cm (b) 2 cm (c) 3 cm (d) 4 cm
15. How many times in a day, are the hands of a clock in straight line but opposite in direction?
 (a) 20 (b) 22 (c) 24 (d) 48
16. In this figure $\angle B = 38^\circ$, $AC = BC$ and $AD = CD$ then find $\angle D$



- (a) 26° (b) 28° (c) 38° (d) 52°
17. A box contains 5 green, 4 yellow and 3 white marbles. Three marbles are drawn at random. What is the probability that they are not of the same colour
 (a) $\frac{3}{44}$ (b) $\frac{3}{55}$ (c) $\frac{52}{55}$ (d) $\frac{41}{44}$
18. 'Sailor' is related to 'Ship' in the same way as 'Lawyer' is related to
 (a) legal (b) law (c) court (d) ruling
19. In the following figure PQ is tangent and QOR is the diameter of circle, if $\angle QPO = 35^\circ$ then $\angle POR$ is equal to



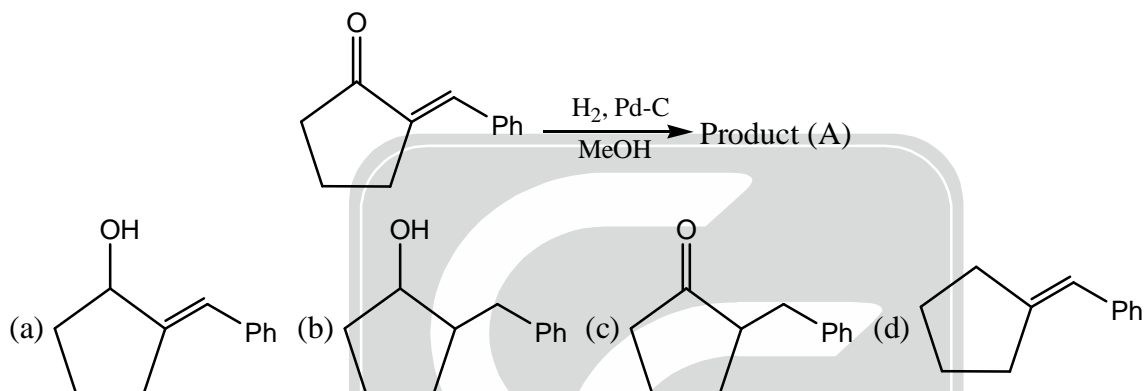
- (a) 125° (b) 120° (c) 70° (d) 115°
20. Which number will come in place of '?'



- (a) 35 (b) 37 (c) 45 (d) 47

PART-B

21. The geometry and coordination number for $[\text{UO}_2][\text{MeCO}_2]_2 \cdot 2\text{H}_2\text{O}$ complex is
 (a) octahedral and 6 (b) hexagonal bipyramidal and 8
 (c) square antiprismatic and 8 (d) pentagonal bipyramidal and 7
22. A possible geometry for an eight coordinate complex ML_8 might be a hexagonal bipyramidal. For this geometry. Assuming low spin, which of following configuration expected to show Jahn-Teller distortion?
 (a) d^1, d^2, d^4, d^9 (b) d^4, d^9 (c) d^1, d^3, d^5, d^7 (d) d^1, d^4, d^5, d^7
23. The pair of Ln^{3+} that show strongest luminiscence is
 (a) La^{3+} and Gd^{3+} (b) Lu^{3+} and Gd^{3+} (c) Eu^{3+} and Tb^{3+} (d) Sm^{3+} and Ce^{3+}
24. BiCl_3 on hydrolysis produces a white turbidity due to formation of
 (a) $\text{Bi}(\text{OH})_3$ (b) BiOCl (c) $\text{BiCl}_2(\text{OH})$ (d) $\text{Bi}(\text{OH})_2\text{Cl}$
25. The major product 'A' formed in the following reaction,

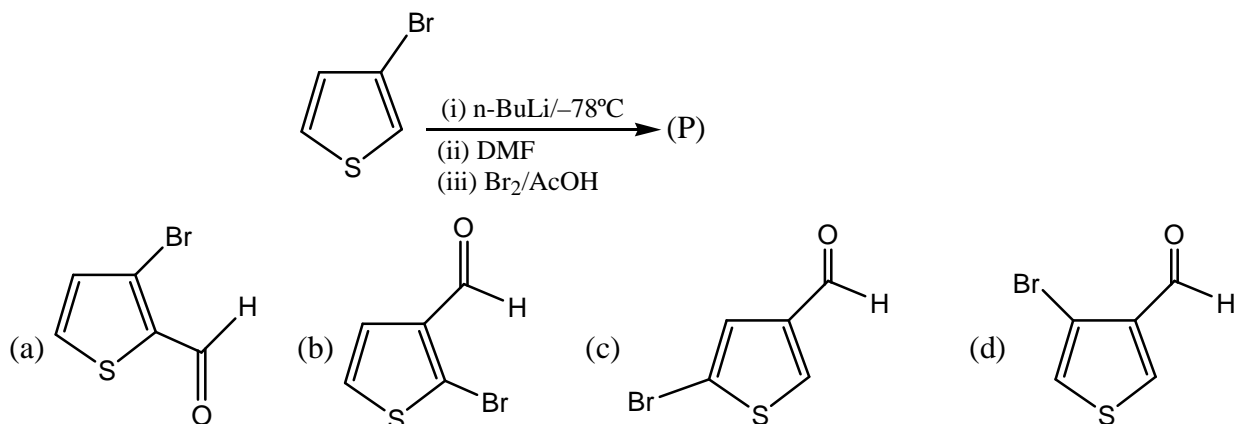


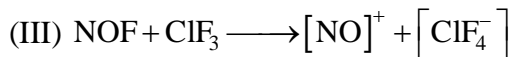
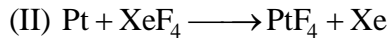
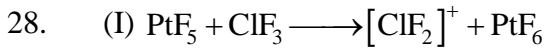
26. Consider the statement

- (1) The degeneracy of an hydrogenic orbital having energy $-\frac{R_H hc}{25}$ is 25 (If spin is involved)
- (2) The degeneracy of a particle confined to move in 3D cubic box having energy $\frac{27h^2}{8ml^2}$ is 1.
- (3) The degeneracy of a particle rotating with energy $\frac{6h^2}{\mu r^2}$ is 7.

Which of the following statement(s) is false?

- (a) 1, 2 (b) 2, 3 (c) 1, 3 (d) 3 only
27. The major product (P) is

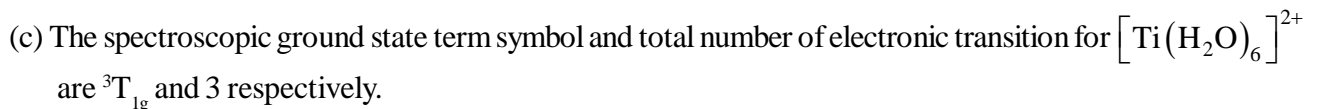
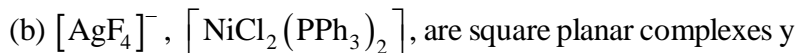
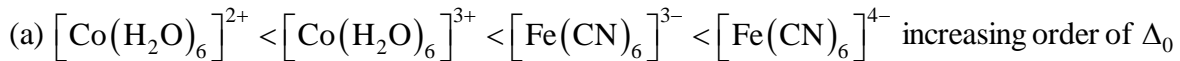




Identify the correct statement about above reaction

- (a) I is correct, PtF_5 behave as base
 (b) II is correct, XeF_4 behave as acid
 (c) III is correct, NOF behave as acid
 (d) I, II, III are correct, and in II, Pt behave as acid.

29. Consider the correct statement among the following



(d) Arphos is an pentadentate ligand

30. Consider the correct statement(s) among the following

(1) The enthalpies of hydration for Na^+ , K^+ and Rb^+ are -296 , -321 and -404 kJ mol^{-1} , respectively

(2) The pyroxene $\text{CaMgSi}_2\text{O}_6$ and $\text{CaFeSi}_2\text{O}_6$ are isomorphous

(3) The carbide ThC_2 liberate C_2H_2 and C_2H_6 when treated with water

(4) The structure of SNF_3 is planar

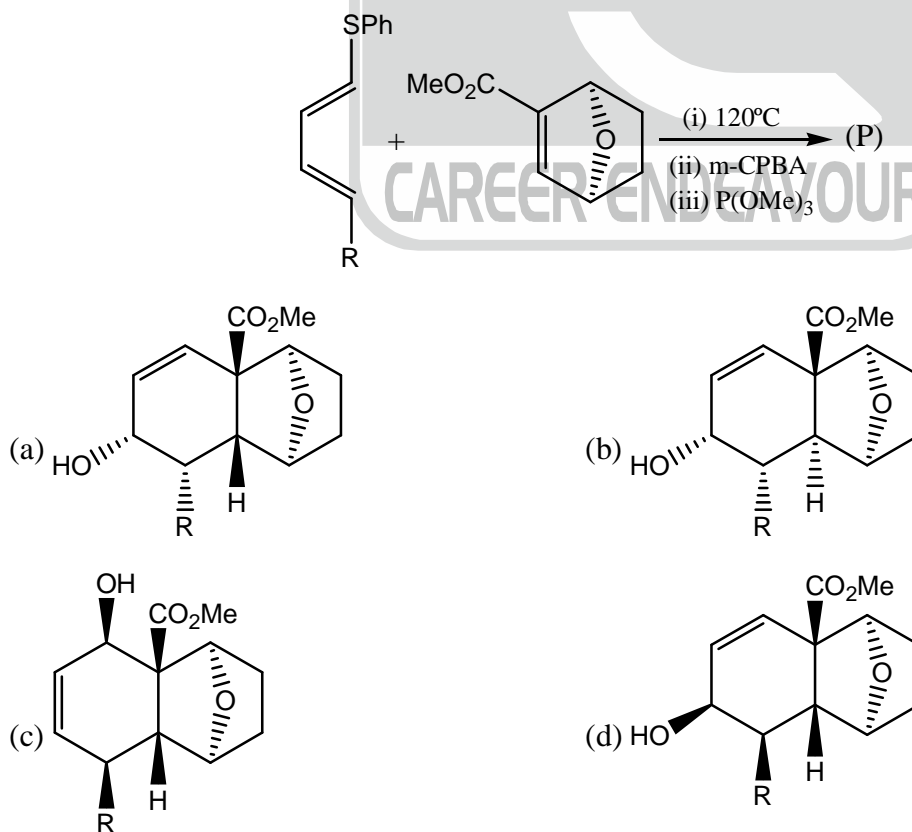
(a) 1 and 2

(b) 2 and 3

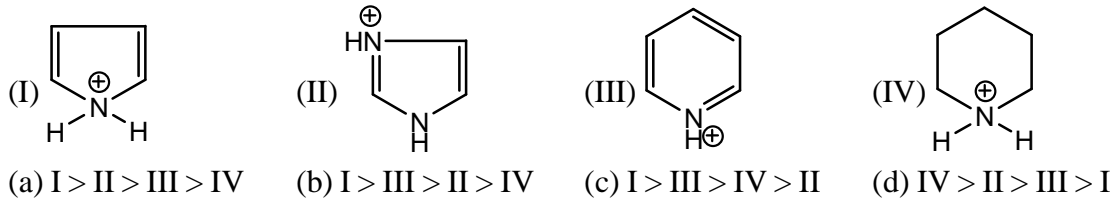
(c) 1, 2 and 4

(d) 1 and 4

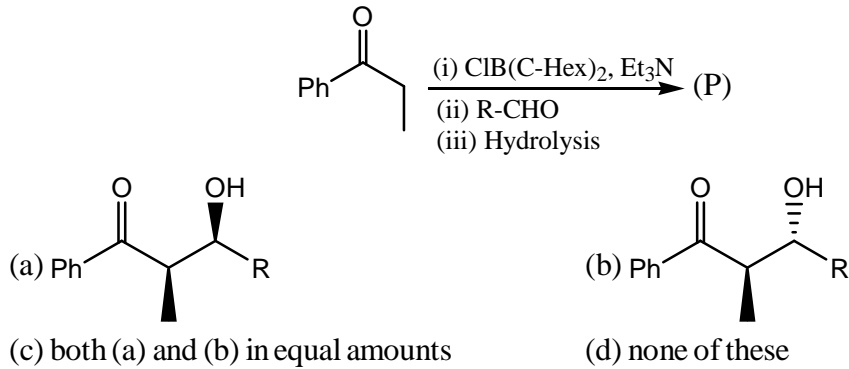
31. The major product (P) is



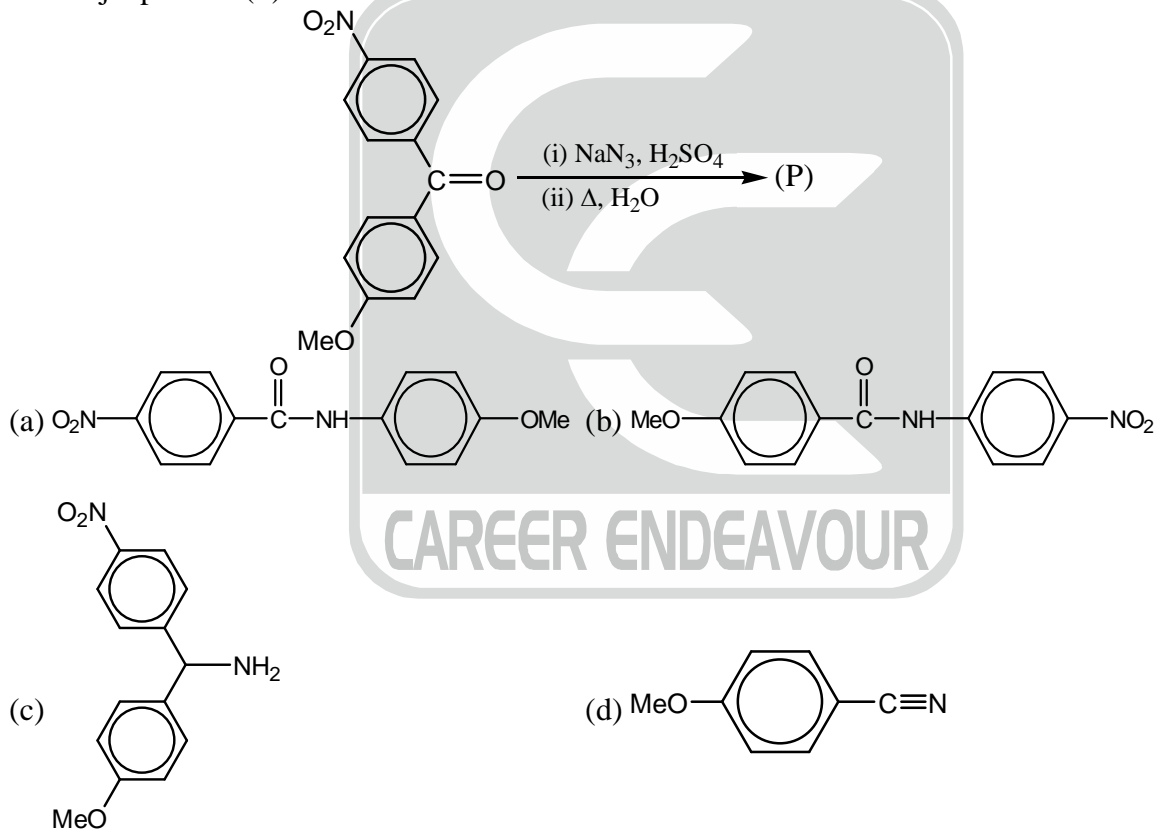
32. The correct order of pK_a values of the following compounds

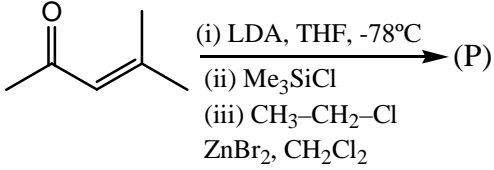


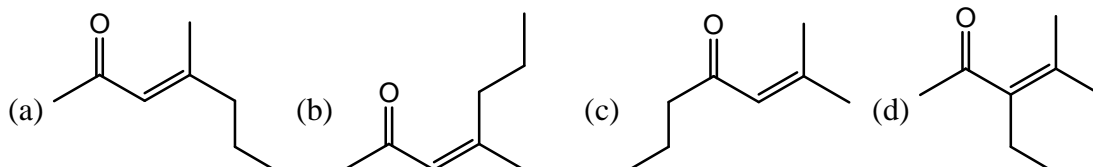
33. The major product (P) is



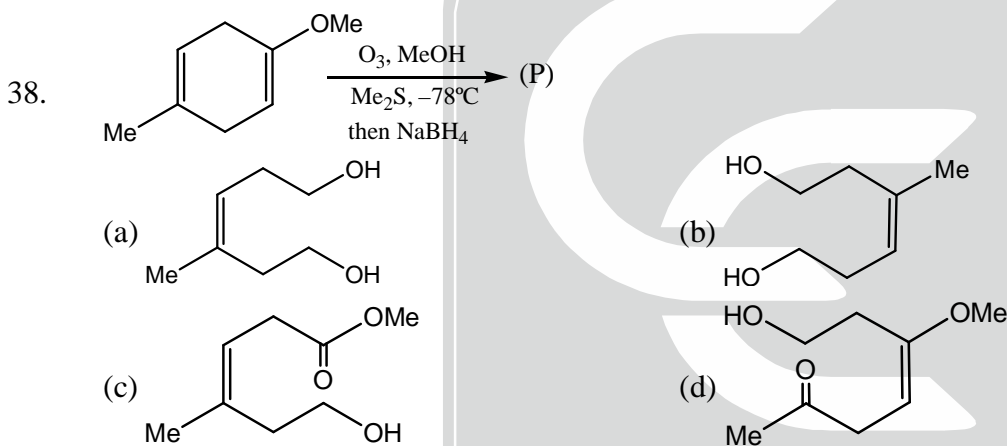
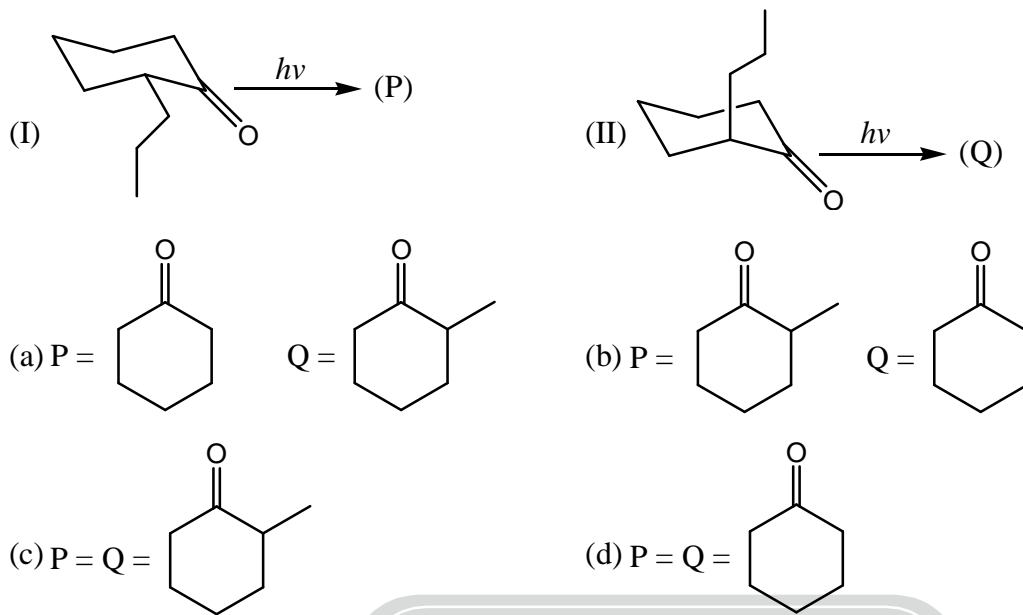
34. The major product (P) is



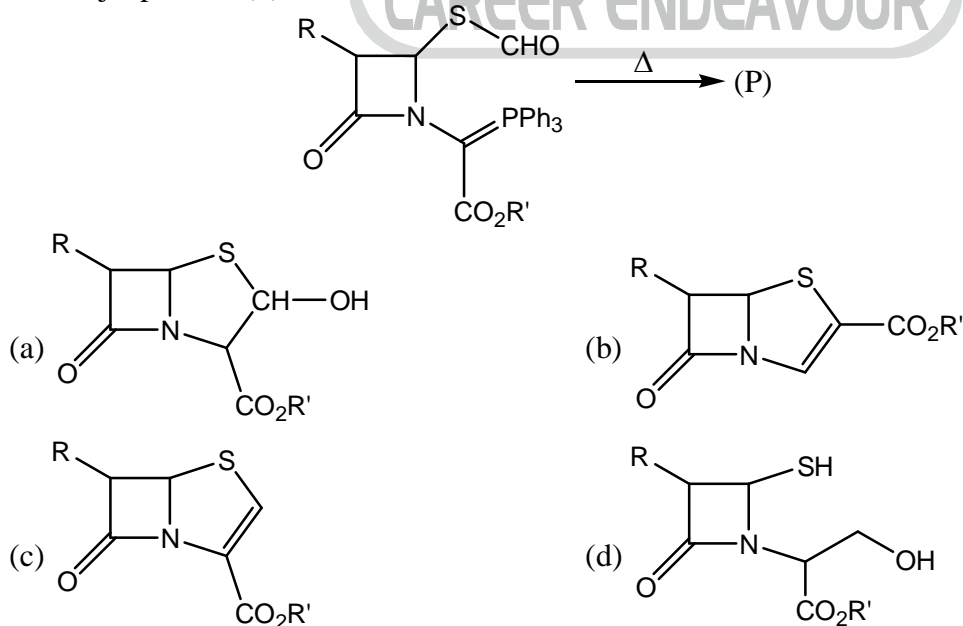
35. 



36. Which among the following gives negative Tollen's test and will not form osazone with phenylhydrazine
 (a) D-Galactose (b) Maltose (c) D-fructose (d) Sucrose
37. In the following reaction the products (P) and (Q) are

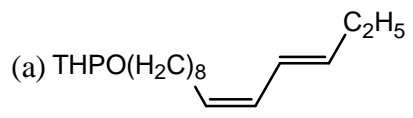
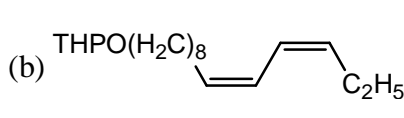
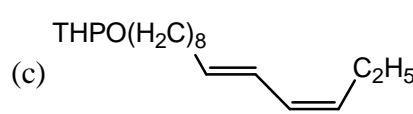
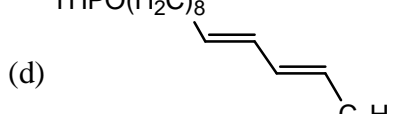


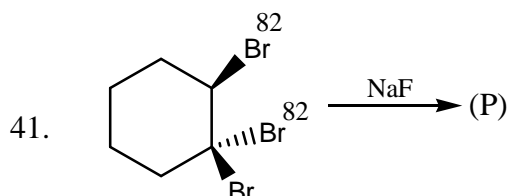
39. The major product (P) is



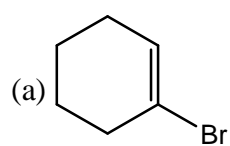
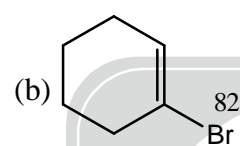
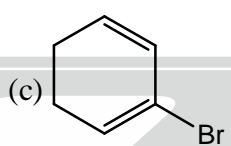
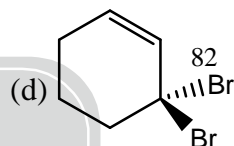


The major product (X) in the above reaction is

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



The major product (P) in the above reaction is

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

42. Which of the following pairs of complexes shows labile and inert complexes respectively

- (a) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ (b) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
 (c) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ (d) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$

43. If the temperature is halved and the mass of the gaseous molecule is double. The rms speed of the molecular will change by a factor of

- (a) 1 (b) 2 (c) 1/4 (d) 1/2

44. The selection rules for the appearance of R branch in the rotational vibrational absorption spectra of a diatomic molecule with in rigid rotor-harmonic oscillator model are

- (a) $\Delta v = \pm 1$ and $\Delta J = \pm 1$ (b) $\Delta v = +1$ and $\Delta J = +1$
 (c) $\Delta v = +1$ and $\Delta J = -1$ (d) $\Delta v = -1$ and $\Delta J = -1$

45. The $J = 0 \rightarrow 1$ rotational transition of $^1\text{H}^{37}\text{Cl}$ occurs at 700 GHz. Assuming the molecule to be a rigid rotor the $J = 5 \rightarrow 6$ transition occurs at

- (a) 140 cm^{-1} (b) 4200 cm^{-1} (c) 240 cm^{-1} (d) 180 cm^{-1}

46. Consider N particles at a temperature T, Pressure P, volume V and chemical potential μ having energy E. The parameters that are kept constant for a Grand canonical ensemble are

- (a) V, T, N (b) V, T, μ (c) V, E, N (d) N, P, T

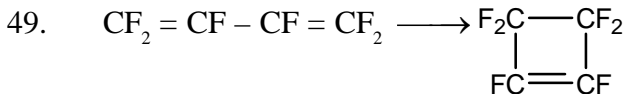
47. The molecular formulae of the fragments of a molecule in its mass spectrum are given below.

- (P) $\text{C}_4\text{H}_5\text{Cl}$ (Q) $\text{C}_{10}\text{H}_9\text{NO}_2$ (R) C_7H_7 (S) $\text{C}_3\text{H}_5\text{Cl}$

Assign the incorrect statement for the above fragments

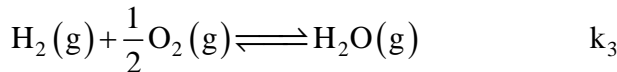
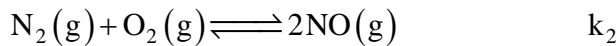
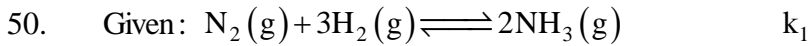
- (a) Fragment P is a cation and it is even electron species.
 (b) Fragment Q is a radical cation and it is odd electron species.
 (c) Fragment R is a cation and it is odd mass species.
 (d) Fragment S is a cation and it is even mass species.

48. Gas A and B are mixed in a container. The condition at which ΔG_{mix} is minimum
 (a) $n_A > n_B$ (b) $x_A < x_B$ (c) $n_A = n_B$ (d) $n_A = 1 \text{ mol}, n_B = 2 \text{ mol}$



For this reaction, $\Delta H = -49 \text{ kJ mol}^{-1}$ and $\Delta S = -40.2 \text{ J mol}^{-1} \text{ K}^{-1}$. The temperature upto which the forward reaction is spontaneous

- (a) 1492°C (b) 946°C (c) 1219°C (d) 1080°C



The equilibrium constant for $2\text{NH}_3(\text{g}) + \frac{5}{2}\text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g}) + 3\text{H}_2\text{O}(\text{g})$

- (a) $k_1 k_2 k_3$ (b) $\frac{k_1 k_2}{k_3}$ (c) $\frac{k_1 k_3^2}{k_2}$ (d) $\frac{k_2 k_3^3}{k_1}$

51. Migration current in polarographic experiment can be taken care of by
 (a) allowing the solution to come at rest (b) increasing the rate of flow of mercury
 (c) decreasing the temperature (d) none of these

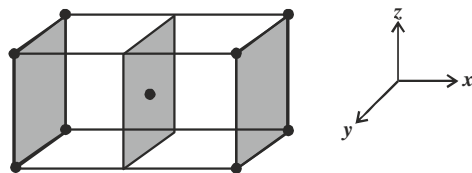
52. Consider a first order reaction, $\text{A} \rightarrow \text{P}$ with half life of 20 mins. If reaction was carried out with 4M of 'A' initially, then the concentration of product in units of mole litre⁻¹ after 3.6×10^3 sec from the start of the reaction will be

- (a) 0.5 (b) 2.5 (c) 3.0 (d) 3.5

53. The Langmuir theory of adsorption is more applicable at
 (a) low pressure and high temperature (b) low pressure and low temperature
 (c) high pressure and low temperature (d) high pressure and high temperature

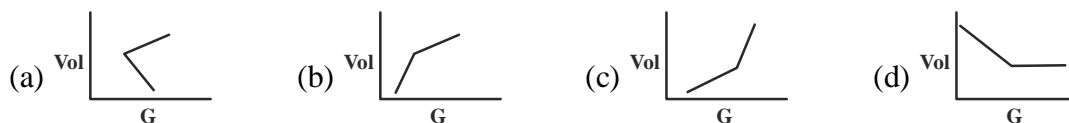
54. The value of Mark-Houwink exponent for which viscosity average molar mass and mass average molar mass become equal is
 (a) 0 (b) 0.5 (c) 1 (d) none

55. The miller indices of the following planes (in a BCC lattice)

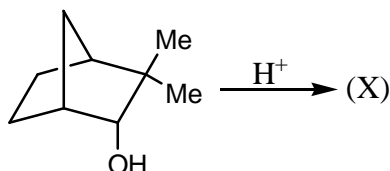


- is
 (a) (100) (b) (200) (c) (010) (d) (020)

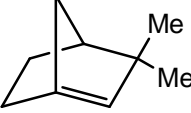
56. Benzoic acid is titrated against NaOH conductometrically, graphical representation will be

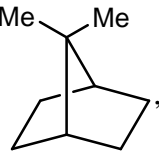


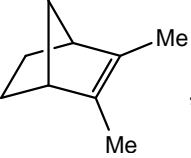
57. The alcohol campherolol on treatment with acid, afforded product 'X'



For product (X), which of the following statement is correct.

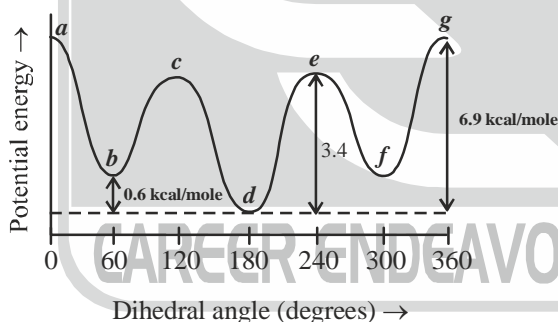
(a) X is  and exhibits 9 ^{13}C NMR signals in its spectrum

(b) X is  , and exhibits 4 ^{13}C NMR signals in its spectrum

(c) X is  , and exhibits 5 ^{13}C NMR signals in its spectrum

(d) X is  , and exhibits 8 ^{13}C NMR signals in its spectrum.

58. Consider the potential energy diagram for reaction about the $C_{(2)}-C_{(3)}$ bond in n-butane



The energy difference between partially eclipsed and skew conformation in kcal/mole is

- (a) 2.8 (b) 2.9 (c) 3 (d) 5.4

59. Which of the following complex do not follow 18 electron rule.

- (a) $Fe_3(CO)_{12}$ (b) $Mn_2(CO)_{10}$ (c) $[Cp_2Co]^+$ (d) $[Re(CO)_5]$

60. The structure of $Tc(\eta^3-B_3H_{10})(CO)_3$ is

- (a) Arachno (b) Nido (c) Closo (d) Hypho

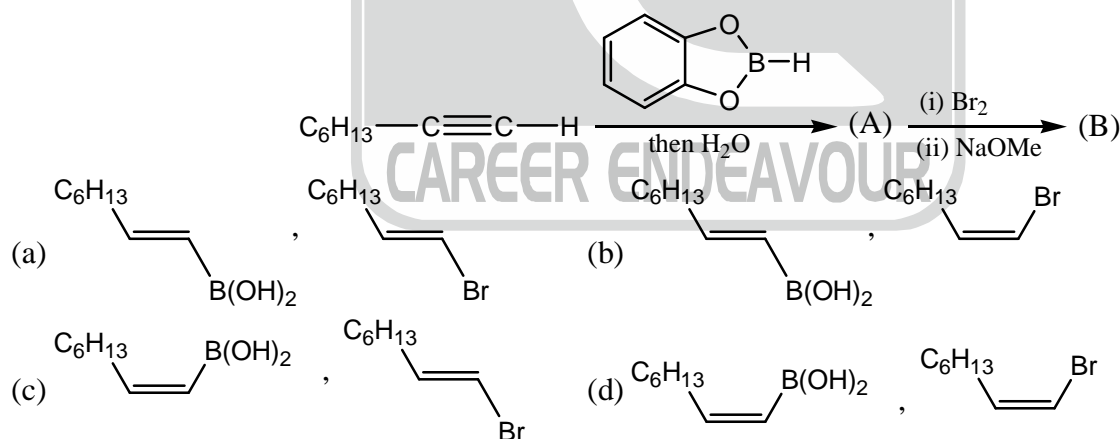
PART-C

61. Consider the correct statement(s) from following?
 (I) Thorium forms iodide of formula ThI_2 , ThI_3 and ThI_4 having Th(IV) in all iodides
 (II) In solid state, salts of $[\text{UO}_2]^{2+}$ contain linear cation. This cation has colour due to LMCT
 (III) Stability of Lanthanoid dihalide with respect to disproportionation into LnX_3 and Ln is greatest for X = I (Iodine)
 (IV) Reaction of NaOR with UCl_4 leads to monomeric $\text{U}(\text{OR})_4$ complexes when R group is very bulky.
 The correct answer is
 (a) I, II, III, IV (b) II, III, IV (c) I, II, III (d) I, II

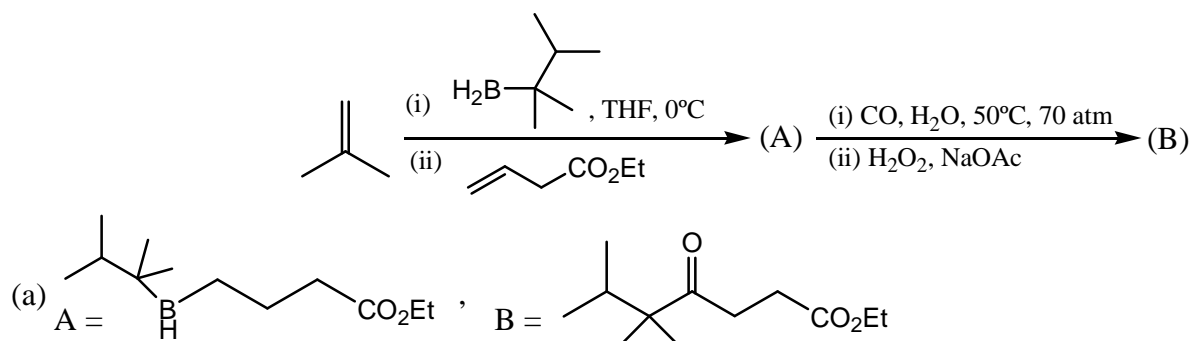
62. Consider the true statement(s) from following?
 (I) Electrical resistivity of metal-graphite compound increases with increase in temperature
 (II) Reactivity of alkali metal graphite decrease with decrease in ionization energy of graphite ($\text{Li} > \text{Na} > \text{K} > \text{Rb} > \text{Cs}$, reactivity order)
 (III) Under controlled condition hydrolysis of alkali metal graphite produces hydrocarbon such as C_2H_2 .
 (IV) In alkali metal graphite, graphite layers remain intact but are stacked vertically inABAB.... fashion
 The correct statement is
 (a) I, II, III, IV (b) II, III, IV (c) I, II, III (d) I, II

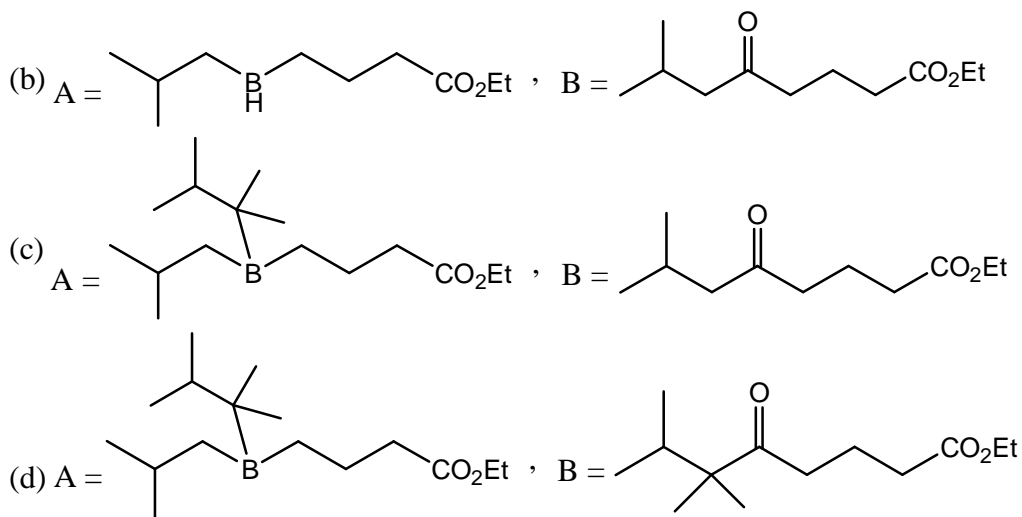
63. Consider the true statement(s) from the following
 (I) $[\text{Mn}(\text{CO})_6]^+ > [\text{Cr}(\text{CO})_6] > [\text{V}(\text{CO})_6]^- > [\text{Ti}(\text{CO})_6]^{2-} \rightarrow$ energy for LMCT
 (II) $\text{RuO}_4^{2-} > \text{FeO}_4^{2-} > \text{MnO}_4^{3-} > \text{CrO}_4^{4-} \rightarrow \Delta_t$
 (III) $\text{FeO}_4^{2-} > \text{MnO}_4^{3-} > \text{CrO}_4^{4-} \rightarrow$ wavelength for LMCT
 (IV) $\text{FeO}_4^{2-} < \text{MnO}_4^{3-} < \text{CrO}_4^{4-} \rightarrow$ energy for LMCT
 (a) III, IV (b) I, II, IV (c) II, III, IV (d) I, II, III, IV

64. Products 'A' and 'B' in the following reaction are, respectively

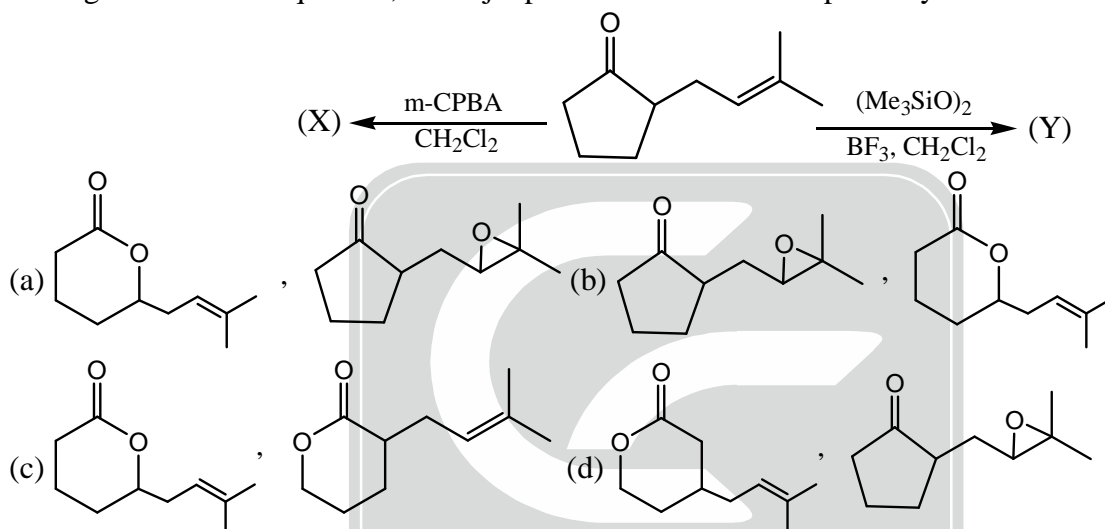


65. Major product A and B formed in the given reaction sequence are, respectively





66. In the given reaction sequence, the major products X and Y are respectively



67. Consider the correct statement

- (a) The geometry of InCl_5^{2-} is trigonal bipyramidal
 (b) $\text{As} > \text{Se} > \text{Br}$, correct order of ionisation energy
 (c) I_2Cl_6 is fully planar species
 (d) $\text{LiF} < \text{LiCl} < \text{LiBr}$, correct order of melting point.

68. Treatment of an aqueous solution of NiCl_2 with $\text{H}_2\text{NCHPhCHPhNH}_2$ give a blue complex (A) ($\mu_{\text{eff}} = 3.30 \mu\text{B}$). Which loose H_2O on heating to form a yellow diamagnetic compound (B). The geometry of compound (A) & (B) and number of isomer in (A) respectively are

- (a) square planar, square planar and 2
 (b) octahedral, tetrahedral and 2
 (c) octahedral, square planar and 3
 (d) square planar, octahedral and 3

69. Identify the correct statement among following

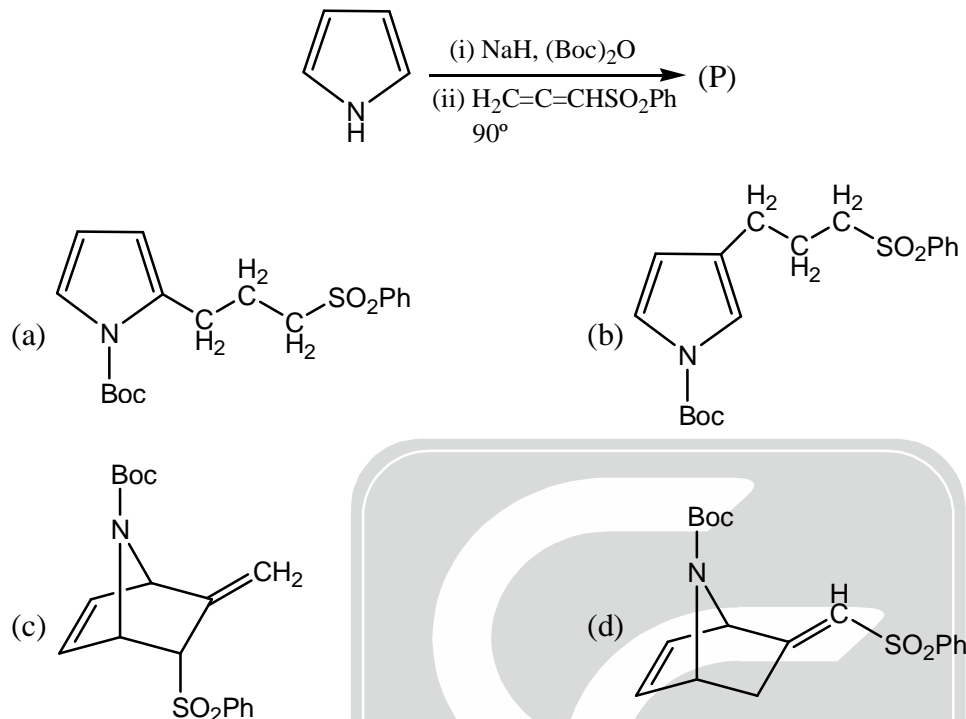
- (a) The room temperature magnetic moment of $[\text{CoI}_4]^{2-}$ (e.g. $5.01 \mu_{\text{B}}$ for the $[\text{Et}_4\text{N}]^+$ salt) is larger than that of salt of $[\text{CoCl}_4]^{2-}$
 (b) The first charge transfer band for $[\text{MnO}_4]^-$ occurs at 22940 cm^{-1} and that for $[\text{MnO}_4]^{2-}$ at 18320 cm^{-1}
 (c) The electronic spectrum of $[\text{Ni}(\text{DMSO})_6]^{2+}$ exhibits two absorption band
 (d) $\text{F}^- < \text{H}_2\text{O} < \text{NH}_3 < \text{en} < \text{CN}^- < \text{I}^-$, decreasing order of nephelauxetic effect.



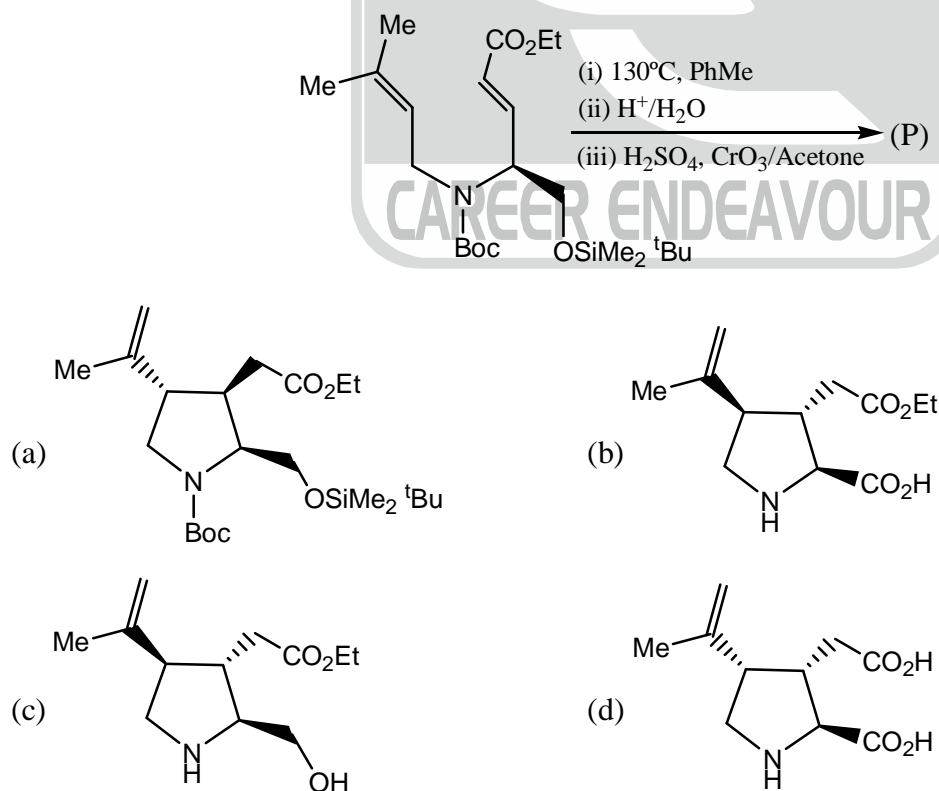
70. Identify the fast dissociation rate constant (k_s^{-1}) of CO, cis to those ligand in given complexes follow the order (reaction proceed via square pyramidal transition state)

- (1) $\text{Cr}(\text{CO})_6$ (2) $\text{Cr}(\text{CO})_5(\text{PPh}_3)$ (3) $[\text{Cr}(\text{CO})_5\text{Cl}]^-$ (4) $[\text{Cr}(\text{CO})_5\text{Br}]^-$ (5) $[\text{Cr}(\text{CO})_5\text{I}]^-$
 (a) $2 > 5 > 4 > 1 > 3$ (b) $1 > 2 > 3 > 4 > 5$
 (c) $2 > 4 > 5 > 3 > 1$ (d) $3 > 4 > 5 > 2 > 1$

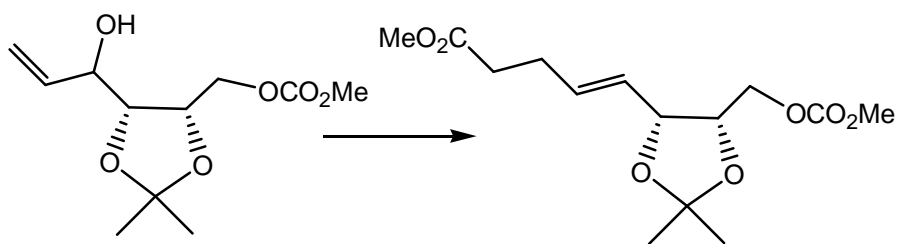
71. The major product (P) is



72. The major product (P) is



73. Suggest a suitable reagents for the following conversion



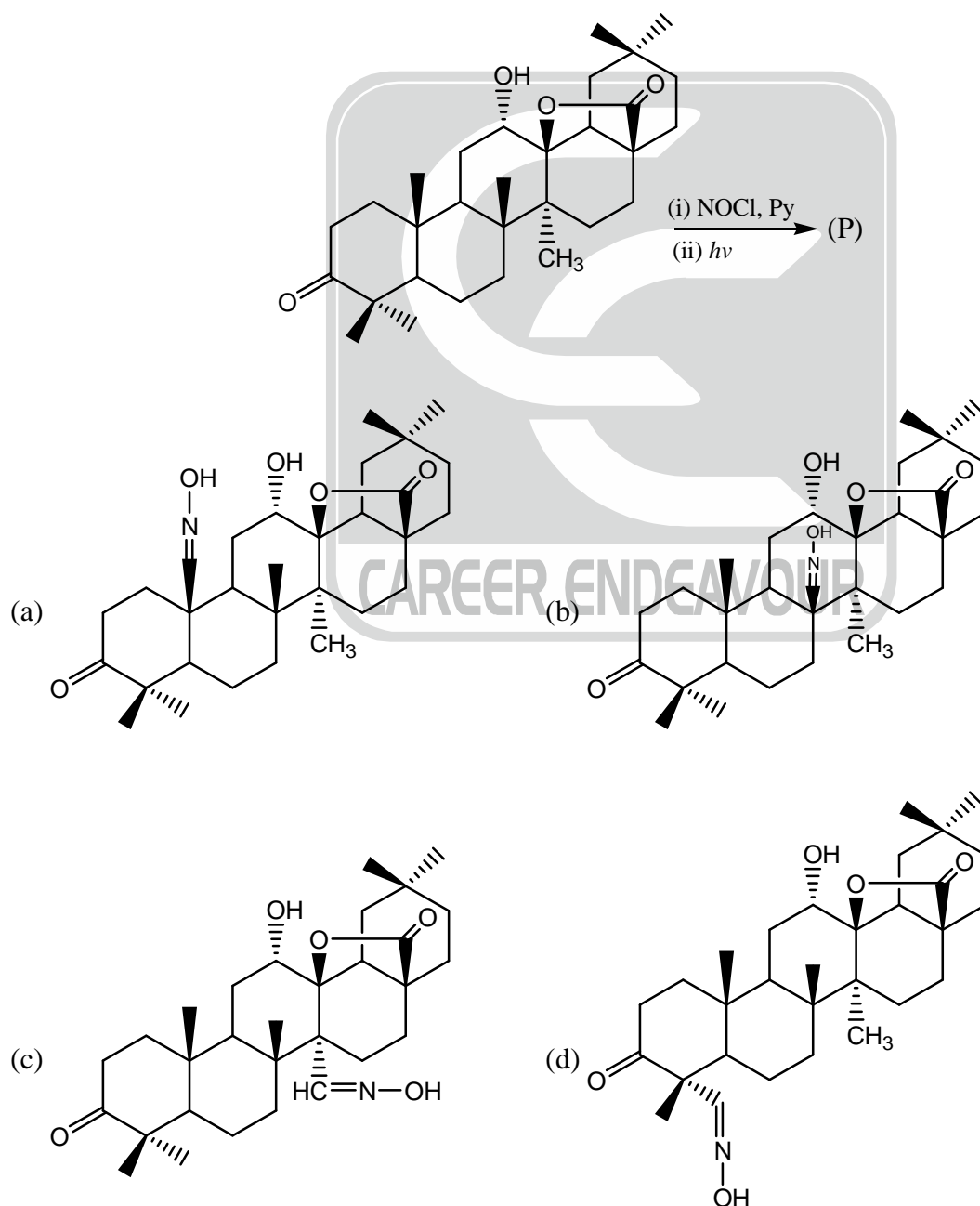
(a) $\text{H}_3\text{C}-\text{C}(\text{OMe})_3 \mid \text{H}^+$ then Δ and [3,3]-S.T.R.

(b) $\text{H}_3\text{C}-\text{C}(\text{OMe})_3 \mid \text{H}^+$ then Δ and [2,3]-S.T.R.

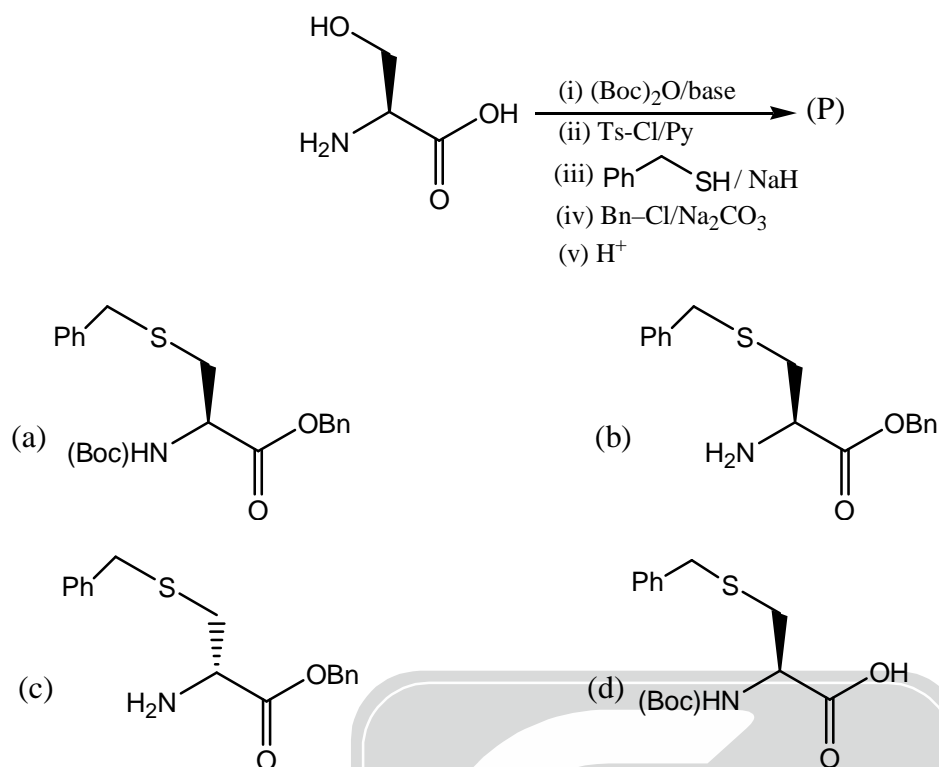
(c) $\text{Et}-\text{C}(\text{OMe})_3 \mid \text{H}^+$ then Δ and [3,3]-S.T.R.

(d) $[\text{Et}-\text{C}(\text{OMe})_3 \mid \text{H}^+$ then Δ and [2,3]-S.T.R.]

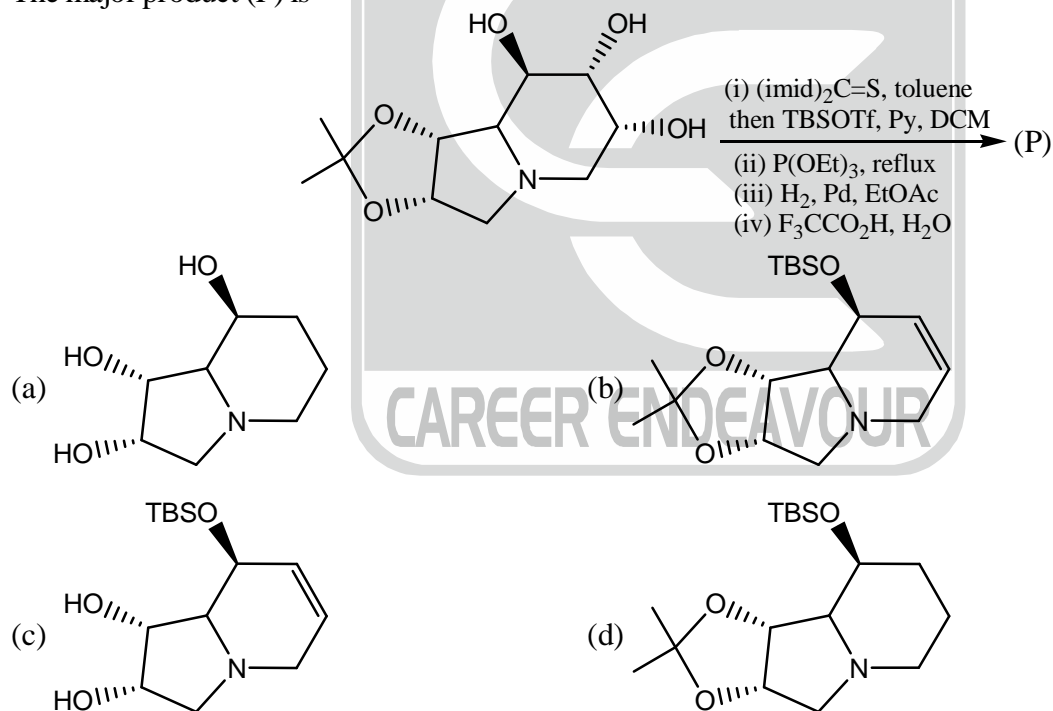
74. The major product (P) is



75. The major product (P) is



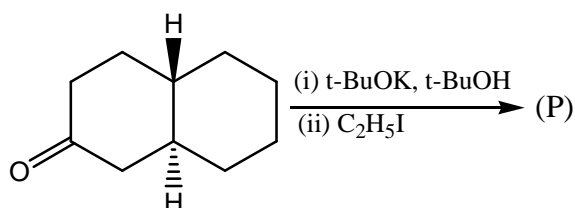
76. The major product (P) is

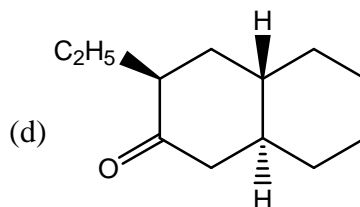
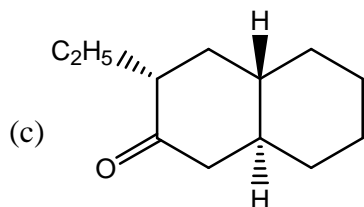
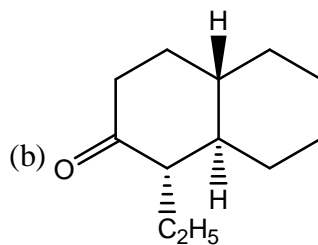
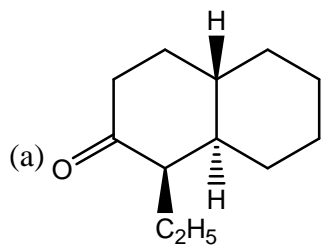


77. In the following compounds, which one is resolvable?

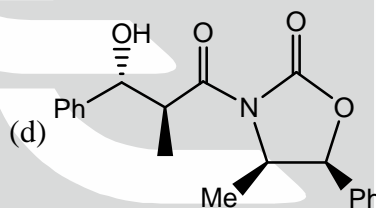
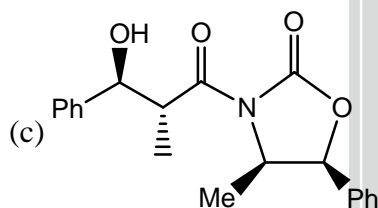
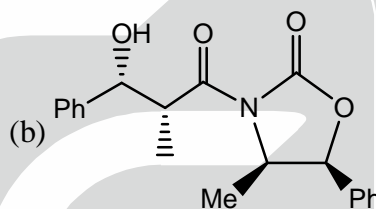
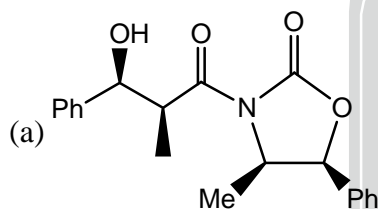
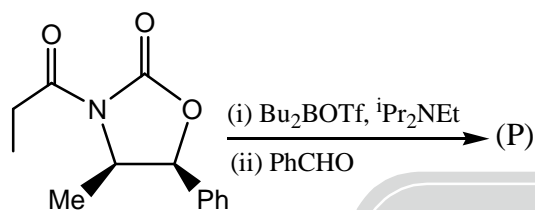
- (a) cis 1, 2-dimethyl cyclohexane (b) cis 1, 3-dimethyl cyclohexane
 (c) trans 1, 4-dimethyl cyclohexane (d) trans 1, 2-dimethyl cyclohexane

78. The major product (P) is

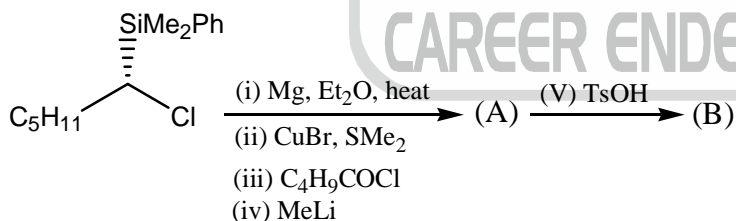




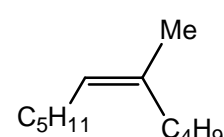
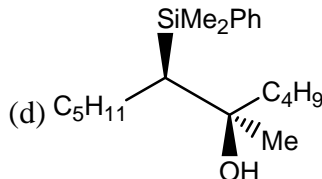
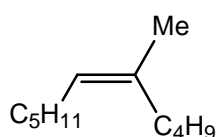
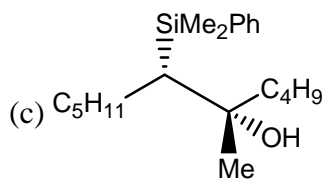
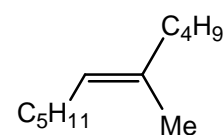
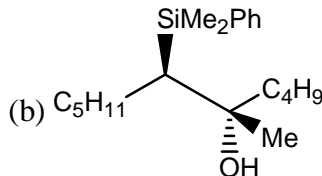
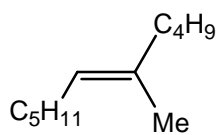
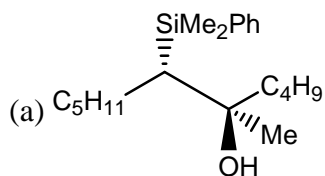
79. The major product (P) is



80.

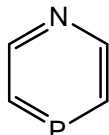


The major product (A) and (B) are respectively



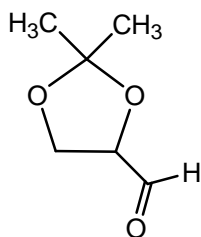
81. Which of the following statements about hemoglobin is not true
 (a) There is a H-bonding between an imidazole N–H of a histidine and bound O_2 group.
 (b) In the deoxy form, the Fe(II) atom is in the high spin state and out of the heme plane in the direction of the histidine group.
 (c) The dioxygen unit is bound in a bent fashion similar to the η^2 – superoxo type.
 (d) Hemoglobin an $\alpha_2\beta_2$ heterotetramer that binds O_2 co-operatively, is found in red blood cells.
82. The enzyme nitrogenase catalyze the activation and reduction of dinotrogen to ammonia, the nitrogenase are composed of two metalloproteins which are commonly referred to as the Fe protein and the MFe (M = Mo, V and Fe) co-factor. The Fe-protein commonly in the nitrogenase is
 (a) Fe_2S_2 (b) Fe_4S_4 (c) dimer of Fe_4S_4 (d) Fe_3S_4

83. Which is correct for reaction with



- (a) BF_3 and $B(CH_3)_3$ both will add to 'N'
 (b) BF_3 and $B(CH_3)_3$ both will add to 'P'
 (c) BF_3 will add to 'N' while $B(CH_3)_3$ will add to 'P'
 (d) BF_3 will add to 'P' while $B(CH_3)_3$ will add to 'N'.
84. In the first excited state ($^x P_{1/2}$) of chlorine lies at energy of 200 cm^{-1} above the ground state ($^x P_{3/2}$). The fraction of chlorine atoms in the first excited state at $k_B T = 210\text{ cm}^{-1}$ is close to
 (a) $\frac{1}{1+e}$ (b) $\frac{1}{1+4e}$ (c) $\frac{1}{1+2e}$ (d) $\frac{1}{2+e}$
85. The rotational constant of ^{16}O is 10 cm^{-1} . The wave number of incident radiation in a Raman spectrometer is 20891 cm^{-1} . What is the wave number of second scattered stokes line (in cm^{-1}) and second anti-stokes line (in cm^{-1}) is
 (a) 21071 cm^{-1} , 20711 cm^{-1} (b) 20791 cm^{-1} , 20991 cm^{-1}
 (c) 20711 cm^{-1} , 21071 cm^{-1} (d) 20971 cm^{-1} , 20811 cm^{-1}
86. A metal (atomic weight = 26.08) crystallises in the cubic system with $a = 4.05\text{ \AA}$. Its density is 2.7 g cm^{-3} . The radius of the atom of the metal is
 (a) 1.4 \AA (b) 2.4 \AA (c) 3.4 \AA (d) none
87. The vibrational frequency of homo-nuclear diatomic molecule is ν . The temperature at which the population of the first excited state will be $\frac{1}{4}$ that of the ground state is given by [degeneracy of ground = 1 and degeneracy of excited state = 3]
 (a) $\frac{3h\nu}{2k_B \ln 2}$ (b) $\frac{3h\nu}{k_B \ln 2}$ (c) $\frac{h\nu}{3k_B \ln 4}$ (d) $\frac{h\nu}{2k_B \ln 2}$
88. What will be the number of hyperfine lines and intensity ratio for NH_2 radical? Given that Hyperfine coupling constant due to nitrogen and hydrogen are 2.5 mT and 1.25 mT respectively.
 (a) Seven 1:2:2:2:2:2:1 (b) Nine 1:2:1:1:2:1:1:2:1
 (c) Seven 1:2:3:4:3:2:1 (d) Nine 1:2:3:4:5:4:3:2:1
89. Which is the incorrect statement
 (a) Mossbauer source for iron-57Fe can be prepared by electron capture reaction of cobalt-57
 (b) Both Iron-57 and Sn-119, gives six lines in Mossbauer spectrum in magnetic splitting
 (c) Both Iron-57 and Sn-119, gives six lines in Mossbauer spectrum in quadrupole splitting
 (d) Both Iron-57 and Sn-119, shows opposite effect of S-electron density on Isomer shift

90. Number of signals in proton and carbon NMR of the above molecule will be

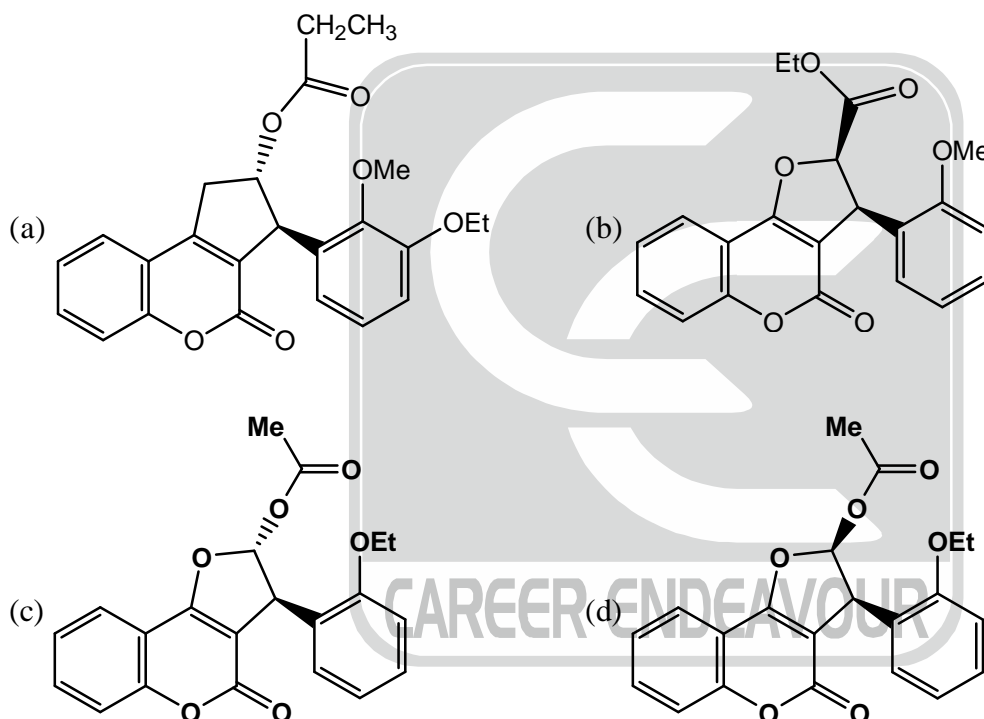


- (a) Five and five (b) Five and six (c) Six and Six (d) Three and five

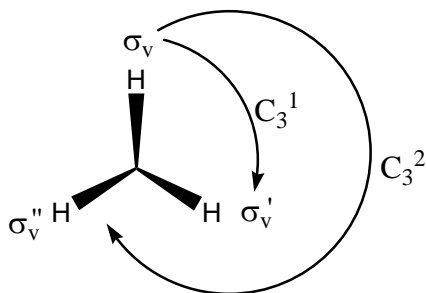
91. A compound with molecular formula $C_{21}H_{18}O_6$ shows following spectral data. IR(KBr) $1647, 1734\text{ cm}^{-1}$. $^1\text{H NMR}$ (300 MHz, CDCl_3) ^1H 1.35 (t, 3H, $J = 7.2\text{ Hz}$), 3.81 (s, 3H), 4.31-4.37 (q, 2H), 5.09 (d, 1H, $J = 5.1\text{ Hz}$), 5.20 (d, 1H, $J = 5.1\text{ Hz}$), 6.90-6.95 (m, 2H), 7.10 (d, 1H, $J = 7.2\text{ Hz}$), 7.26-7.43 (m, 3H), 7.58-7.64 (m, 1H), 7.79 (d, 1H, $J = 7.2\text{ Hz}$).

$^{13}\text{C NMR}$ (75 MHz, CDCl_3) ^{13}C 14.1, 21.1, 50.2, 62.2, 89.3, 104.8, 112.1, 117.0, 123.1, 124.1, 127.0, 129.8, 132.9, 136.6, 137.7, 155.4, 159.3, 166.4, 168.8

Element C, 68.85; H, 4.95 %. Found C, 68.75; H, 5.07%. The correct structure of the compound is



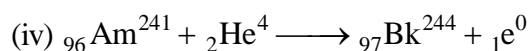
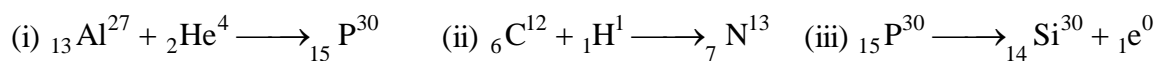
92. In C_{3v} point group, NH_3 molecule has the following symmetry operations, $E, C_3^1, C_3^2, \sigma_v, \sigma'_v, \sigma''_v$



The similarity transformation of C_3^1 with respect to E, C_3^1 and C_3^2 are respectively

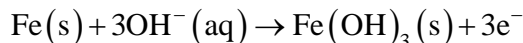
- (a) E, C_3^1 and C_3^2 (b) C_3^1, C_3^2 and E
 (c) C_3^1, E and C_3^2 (d) none

93. The nuclear reaction accompanied with emission of neutron(s) are



- (a) only (i) (b) (i) and (iv) (c) (ii) and (iv) (d) Only (iii)

94. K_{sp} of $\text{Fe}(\text{COH})_3(\text{s})$ is 10^{-38} . If $\text{Fe}|\text{Fe}^{3+} = 0.036\text{V}$ then calculate the potential of following reaction



taking $0.0591 \approx 0.06$

- (a) 0.724 V (b) -0.724 V (c) 0.796 (d) -0.796

95. For the cell, $\text{Mg}|\text{Mg}^{2+}(0.01\text{M})||\text{pH} = 1, \text{H}^+|\text{Pt}(\text{H}_2), E_{\text{cell}}^0 = 2.37\text{V}$

(a) $E_{\text{cell}} = 2.37 + \frac{0.0591}{2}\text{V}$ (b) $E_{\text{cell}} = 2.37 + 0.0591\text{V}$

- (c) $E_{\text{cell}} = 2.37\text{V}$ (d) none of these

96. Observe the following electronic transition of a diatomic molecule.



The allowed transitions are

- (a) (A) and (C) only (b) (B) and (D) only (c) (A), (B) and (C) only (d) (A), (C) and (D) only

97. Match the following Column-A with Column-B

Column-A

- (1) UV spectroscopy
(2) AAS
(3) Gas chromatography
(4) Fluorescence and phosphorescence spectrophotometry

Column-B

- (P) Xenon flash lamp
(Q) Thermal conductivity detector
(R) Hollow cathode lamp
(S) Deuterium discharge lamp

- (a) 1-S, 2-Q, 3-P, 4-R (b) 1-S, 2-R, 3-Q, 4-P
(c) 1-Q, 2-R, 3-S, 4-P (d) 1-Q, 2-P, 3-S, 4-R

98. $\psi = N r(6 - Zr)e^{-Zr/3} \cos \theta$, is a proposed hydrogenic wavefunction, where Z = atomic number, r = radial distance from the nucleus, θ = azimuthal angle, N is a constant. The **CORRECT** statement about ψ is

- (1) $\psi = 0$ in the xy-plane
(2) one nodal plane are present in ψ
(3) two radial node are present in ψ
(4) one angular node are present in ψ
(5) the size of the orbital increases with increase in atomic number
(a) 1, 2, 4 (b) 1, 2, 3, 4 (c) 1, 2, 4, 5 (d) 1, 2, 3, 4, 5

99. Suppose ψ_1 and ψ_2 , are two hybrid orbitals:

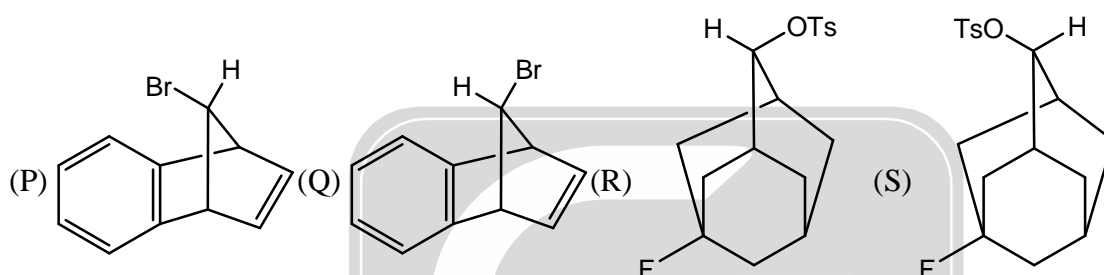
$$\psi_1 = 0.12\psi_{3s} + 0.63\psi_{3p_x} + 0.77\psi_{3p_y} \quad \text{and} \quad \psi_2 = 0.12\psi_{3s} - 0.63\psi_{3p_x} - 0.77\psi_{3p_y}$$

The angle (in degrees) between them is

- (a) 170 - 180 (b) 140-150 (c) 190-200 (d) 150-160



100. For a particle confined in a 1-D box of length a , find the location where wavefunction is $\frac{1}{2}$ of its maximum value in its lowest energy level
- (a) $x = \frac{a}{2}$ (b) $x = \frac{a}{6}$ (c) $x = \frac{a}{18}$ (d) $x = \frac{a}{3}$
101. The masses recorded when a substance is weighed 4 times are 15.8, 15.4, 15.6 and 16.0 mg. The variance (square of the standard deviation) is closest to
- (a) 0.02 (b) 0.05 (c) 0.10 (d) 0.20
102. An aqueous mixed solution of NaCl and HCl is exactly neutralized by an aqueous NaOH solution. The number of components in the final mixture is
- (a) 1 (b) 2 (c) 3 (d) 4
103. Which of the following statement is true about rate of acetolysis of compound P, Q, R and S

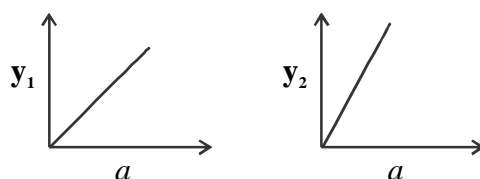


- (a) $P > Q$ and $S > R$ (b) $Q > P$ and $R > S$ (c) $P > Q$ and $R > S$ (d) $P \sim Q$ and $S \sim R$
104. Consider the statement
- (1) If ground stationary state of a harmonic oscillator is given by $\psi_0 = e^{-zx^2}$. Z should increase with decrease in mass.
- (2) For the particle in box problem in $(0, \ell)$ the value of $\langle x^3 \rangle$ in the $n \rightarrow \infty$ limit would be $\frac{L^3}{6}$
- The true statement is
- (a) 1 (b) 2 (c) 1 and 2 (d) None of these

105. Using the expression for the compressibility factor z of a vanderwall gas as $Z = 1 + \left[b - \frac{a}{RT} \right] \frac{P}{RT}$.

The fugacity coefficient for the gas is

- (a) $P e^{\left(b - \frac{a}{RT} \right) \frac{P}{RT}}$ (b) $P e^{-\left(b - \frac{a}{RT} \right) \frac{P}{RT}}$ (c) $e^{\left(b - \frac{a}{RT} \right) \frac{P}{RT}}$ (d) $e^{-\left(b - \frac{a}{RT} \right) \frac{P}{RT}}$
106. Consider the following graphs for a zero order reaction



The terms y_1 and y_2 are respectively.

- (a) half life time and \log (half life time) (b) quarter life time and \log (quarter life time)
- (c) quarter life time and half life time (d) half life time and quarter life time.

107. Consider the following

| Number of molecules | Molar mass |
|---------------------|------------|
| 10 | 1000 |
| 20 | 2000 |
| 20 | 7000 |

The polydispersity index P.D.I is

- (a) 0.535/361 (b) 5.35/361 (c) 53.5/361 (d) 535/361

108. The character table of T_d point group is

Character Table of the T_d Point Group

| T_d | E | $8C_3$ | $3C_2$ | $6S_4$ | $6\sigma_d$ | $h = 24$ | |
|-------|-----|--------|--------|--------|-------------|-------------------|---------------------------------|
| A_1 | 1 | 1 | 1 | 1 | 1 | | $x^2 + y^2 + z^2$ |
| A_2 | 1 | 1 | 1 | -1 | -1 | | |
| E | 2 | -1 | 2 | 0 | 0 | | $(2z^2 - x^2 - y^2, x^2 - y^2)$ |
| T_1 | 3 | 0 | -1 | 1 | -1 | (R_x, R_y, R_z) | |
| T_2 | 3 | 0 | -1 | -1 | 1 | (x, y, z) | (xy, xz, yz) |

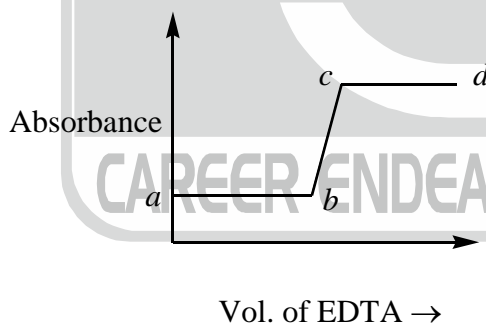
the normal modes of vibration are

- (a) $A_1 + 2T_2$ (b) $A_1 + E + T_2$ (c) $A_1 + E + 2T_2$ (d) $E + 2T_2$

109. Which one of the following is correct when an ideal gas is expanded adiabatically

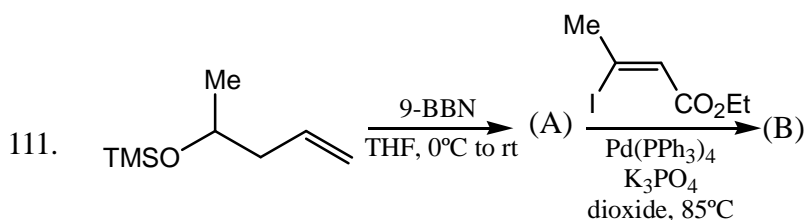
- (a) $q = 0, w = nC_v dT, \Delta U = nC_v dT, dT = -ve$
 (b) $q = 0, w = 0, \Delta U = nC_v dT, dT = -ve$
 (c) $q = 0, w = nC_v dT, \Delta U = nC_v dT, dT = +ve$
 (d) $q = 0, w = nC_v dT, \Delta U = 0, dT = +ve$

110. The spectrophotometric response for the titration of a mixture of M^+ and A^{2+} ions against EDTA is as follow

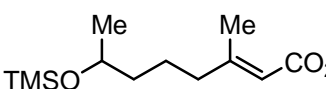
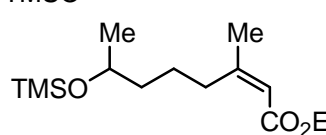
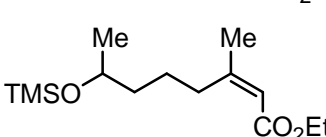
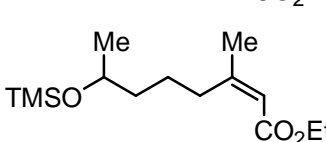


The correct statement is

- (a) Volume ab represents A^{2+} and volume bc represent M^+
 (b) Volume ab represents M^+ and volume bc represents A^{2+}
 (c) Volume ab represents M^+ and volume bc represent excess of EDTA
 (d) Volume ab represents M^+ and volume bc represent deficiency of EDTA



The major product (B) and the name of reaction is

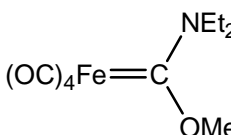
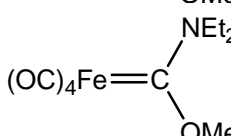
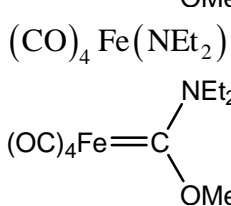
- (a)  , hydroboration-oxidation followed by Suzuki coupling.
- (b)  , hydroboration-oxidation followed by Suzuki coupling.
- (c)  , hydroboration-oxidation followed by Heck reaction.
- (d)  , hydroboration reaction followed by Suzuki coupling.

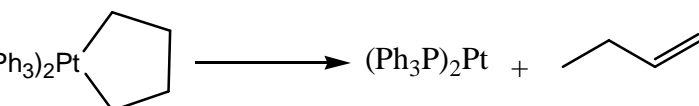
112. $\text{Mn}_2(\text{CO})_{10} \xrightarrow{\text{Na-Hg}} (\text{A}) \xrightarrow{\text{CH}_2=\text{CHCH}_2\text{Br}} (\text{B}) \xrightarrow{\Delta} (\text{C})$
The major product (C) and ^1H NMR spectrum at room temperature are

- (a)  , 3 signals
- (b)  , 3 signals
- (c)  , 3 signals
- (d)  , 2 signals.

113. $\text{Fe}(\text{CO})_5 \xrightarrow[\text{(ii) Me}_3\text{O}^+]{\text{(i) LiNEt}_2} (\text{P})$

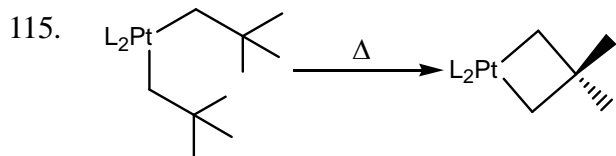
The major product (P) and the nature of product in the above reaction are, respectively

- (a)  and Schrock carbene
- (b)  and Fischer carbene
- (c) $(\text{CO})_4\text{Fe}(\text{NEt}_2)(\text{OMe})$ and Schrock carbene
- (d)  and Grubb's catalyst.

114.  $\longrightarrow (\text{Ph}_3\text{P})_2\text{Pt} + \text{CH}_2=\text{CHCH}_2\text{CH}_2\text{CH}_3$

The mechanism involves in the formation of the product

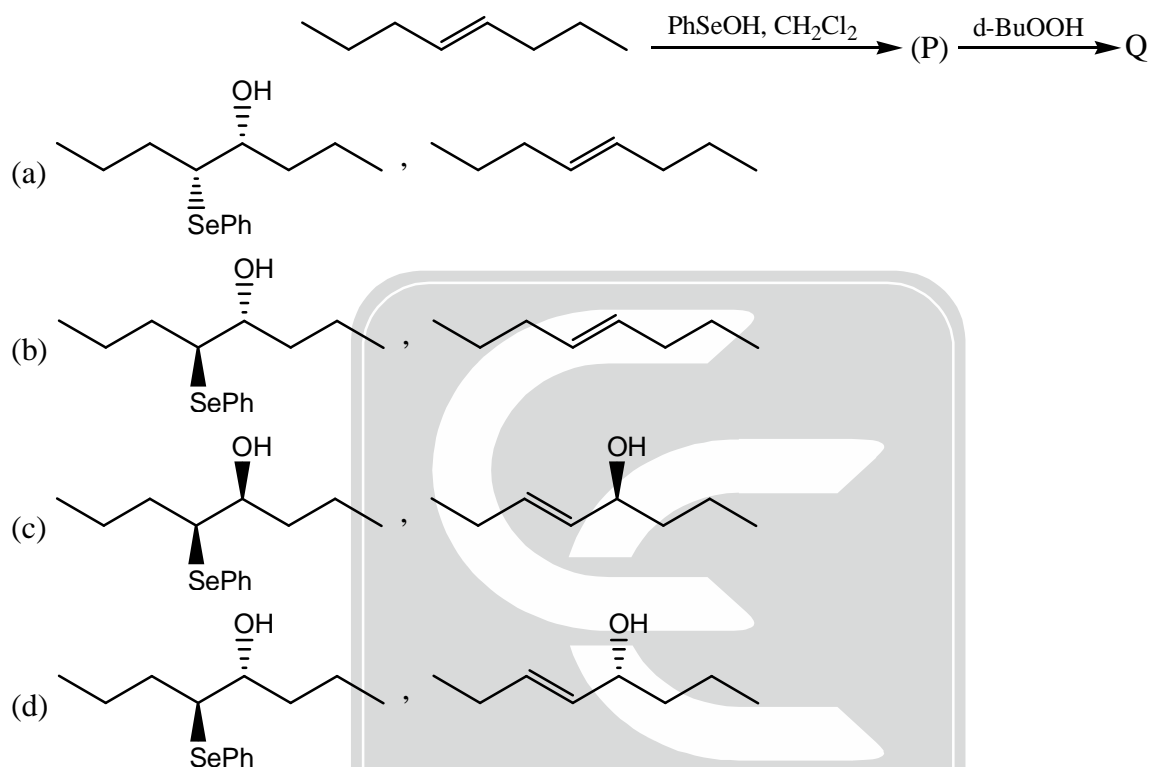
- (a) oxidative addition followed by β -elimination
- (b) β -elimination followed by oxidative addition
- (c) β -elimination followed by reductive elimination
- (d) reductive elimination followed by migratory insertion



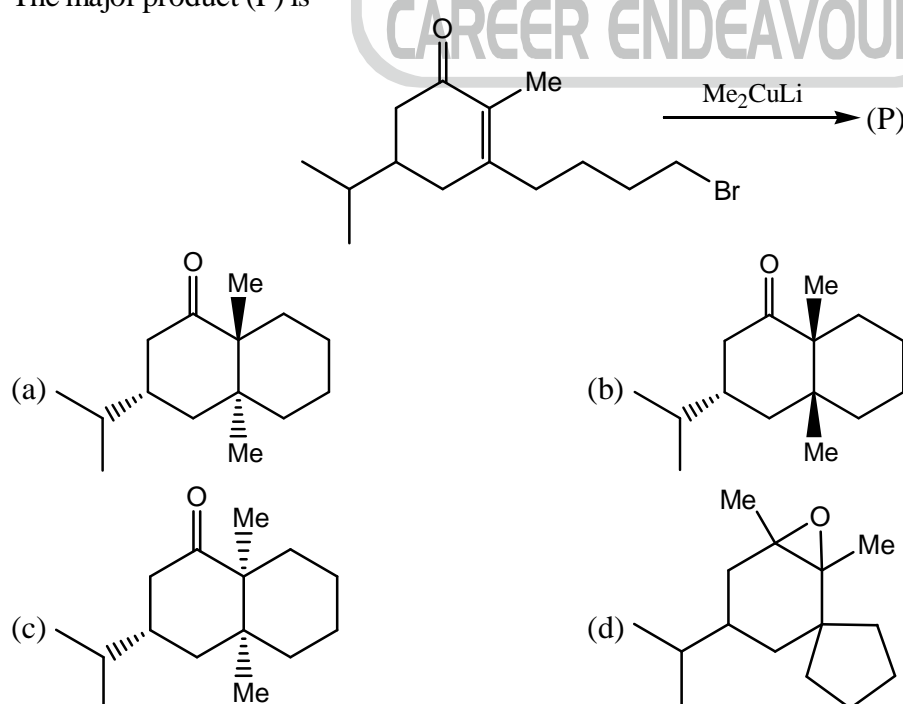
The major product formed in this reaction is

- (a) γ elimination followed by β -elimination
 (b) γ elimination followed by reductive elimination
 (c) reductive elimination followed by β -elimination
 (d) γ -elimination followed by migratory insertion

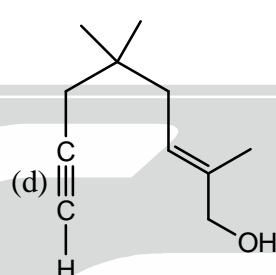
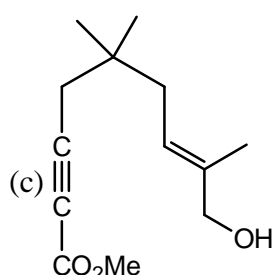
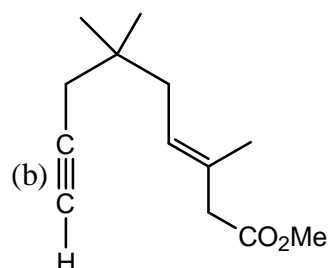
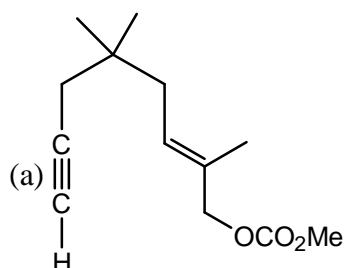
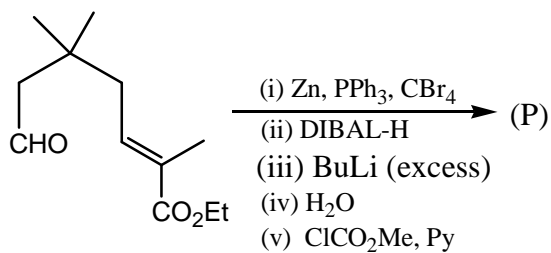
116. The products P and Q formed in the reaction given below are



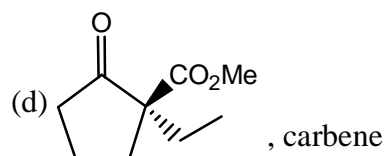
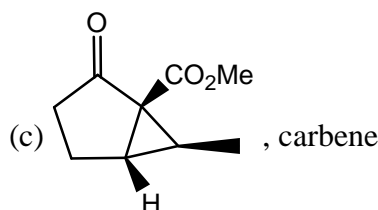
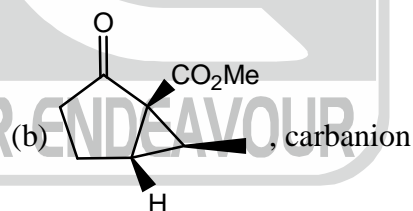
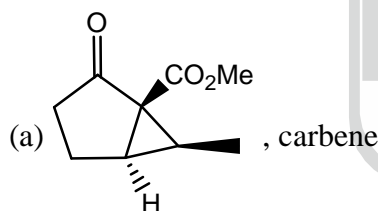
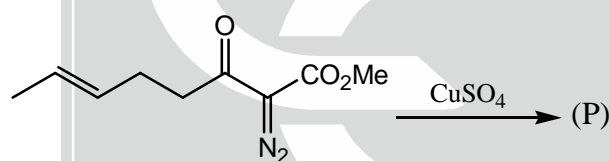
117. The major product (P) is



118. The major product (P) is



119. The major product (P) is



120. One mole of helium is mixed with 2 mole of neon, both at the same temperature and pressure. What is ΔS_{mix} for this process if total volume remains constant.

- (a) $9.136 JK^{-1}$ (b) $6.743 JK^{-1}$ (c) $15.897 JK^{-1}$ (d) $2.393 JK^{-1}$

All the very Best for NET "17th Dec. 2017" Exam

Space for rough work



CHEMICAL SCIENCES
TEST SERIES-E
[FULL LENGTH TEST-2]

Date : 09-12-2017

ANSWER KEY**PART-A**

| | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (b) | 3. (b) | 4. (b) | 5. (d) | 6. (d) | 7. (b) |
| 8. (d) | 9. (d) | 10. (a) | 11. (b) | 12. (a) | 13. (b) | 14. (d) |
| 15. (b) | 16. (b) | 17. (a) | 18. (c) | 19. (a) | 20. (b) | |

PART-B

| | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 21. (b) | 22. (c) | 23. (c) | 24. (b) | 25. (c) | 26. (d) | 27. (c) |
| 28. (d) | 29. (c) | 30. (b) | 31. (d) | 32. (d) | 33. (b) | 34. (a) |
| 35. (c) | 36. (d) | 37. (d) | 38. (c) | 39. (c) | 40. (b) | 41. (a) |
| 42. (c) | 43. (d) | 44. (b) | 45. (a) | 46. (b) | 47. (d) | 48. (c) |
| 49. (d) | 50. (d) | 51. (d) | 52. (d) | 53. (a) | 54. (c) | 55. (c) |
| 56. (b) | 57. (c) | 58. (a) | 59. (d) | 60. (a) | | |

PART-C

| | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|
| 61. (a) | 62. (d) | 63. (d) | 64. (b) | 65. (c) | 66. (b) | 67. (c) |
| 68. (c) | 69. (a) | 70. (d) | 71. (c) | 72. (d) | 73. (a) | 74. (c) |
| 75. (b) | 76. (a) | 77. (d) | 78. (d) | 79. (b) | 80. (c) | 81. (c) |
| 82. (c) | 83. (c) | 84. (c) | 85. (c) | 86. (a) | 87. (a) | 88. (a) |
| 89. (c) | 90. (b) | 91. (b) | 92. (d) | 93. (b) | 94. (c) | 95. (c) |
| 96. (b) | 97. (b) | 98. (a) | 99. (a) | 100. (b) | 101. (b) | 102. (b) |
| 103. (a) | 104. (d) | 105. (c) | 106. (d) | 107. (d) | 108. (c) | 109. (a) |
| 110. (a) | 111. (d) | 112. (d) | 113. (b) | 114. (c) | 115. (b) | 116. (d) |
| 117. (b) | 118. (a) | 119. (c) | 120. (c) | | | |

All the very Best for NET "17th Dec. 2017" Exam



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