

# RAJSI CHEMISTRY POINT, JAIPUR

## Major Test Paper (JRF/NET December-2018)

### PART-A

1. A circular wire has a diameter of 14 cm. If it is cut and a square is made of the wire then what is the area of the square formed ?

- (a) 144 sq. cm      (b) 49 sq. cm      (c) 196 sq. cm      (d) 121 sq. cm

2. Ram does  $\frac{1}{4}$ th of a job in 6 days and Rahim does the remaining part in 12 days. In how Many days Ram and Rahim working together can complete the whole work ?

- (a) 8 days 16 hours      (b) 9 days 14 hours      (c) 7 days      (d) 8 day 5 hours

3. In how many ways a committee of 5 members can be formed from 6 executives and 5 Technicians consisting of 3 executives and 2 technicians ?

- (a) 120      (b) 200      (c) 150      (d) 300

4. A wall clock gains 5 seconds in 3 minutes. It was properly set at 7 O' clock in the morning, if in the same day the clock indicates a time of 4 : 15 pm, then what is the truetime ?

- (a) 3 : 48 pm      (b) 4 : 10 pm      (c) 4 pm      (d) 3 : 55 pm

5. On a cloth a shopkeeper gives 52% discount to Ram and to Hari he gives Successive discount of 30% and 30% respectively. The customer getting better discount is?

- (a) Ram      (b) Hari      (c) both equal      (d) can't be determined

6. Income Ratio of A, B,C, D are,  $A : B = 1 : 2$  ;  $B : C = 2 : 3$  ;  $C : D = 3 : 4$  , and difference of income of A and D is 3,000 Rs. What is the income of C.

- (a) 3,000 Rs      (b) 24,00 Rs      (c) 36,00 Rs      (d) 2,000 Rs

7. If  $x + \frac{1}{x} = 2$ , then what is the value of  $x^{13} + \frac{1}{x^{13}}$

- (a) 0      (b) 1      (c) 2      (d) 13

8. Two cylinders have radius in the ratio 3 : 1 and heights in the ratio 1 : 3. Ratio of their volumes is

- (a) 1: 3      (b) 2: 1      (c) 3 : 1      (d) 1 : 4

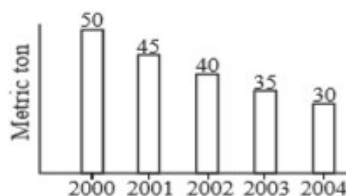
9. Statements (i) all A are B (ii) all B are C (iii) all C are D (iv) all D are E

Conclusions (i) all C are B (ii) all D are C (iii) Some E are A.

Now based on the statements find out which conclusions is right

- (a) only (i)      (b) (i) and (ii)      (c) only (iii)      (d) none

10. Wheat production of a country over a number of years is shown. Which year recorded highest percent reduction in production over the previous year ?



- (a) 2001      (b) 2002      (c) 2003      (d) 2004

11. Consider a circle of radius  $r$ . Fit the largest possible square inside it and the largest possible circle inside the square. What is the radius of the innermost circle?

- (a)  $\frac{r}{\sqrt{2}}$       (b)  $\frac{\pi r}{\sqrt{2}}$       (c)  $\frac{r}{2\pi\sqrt{2}}$       (d)  $\frac{r}{2}$

12. If in a certain code, 'do' is coded as '35' and 'her' is coded as '50'

What will be the code for 'him' ?

- (a) 62      (b) 51      (c) 45      (d) 55

13. In a class of 180 students where number, of boys are half of the number of girls, Arun is Ranked 134th from the top. If there are 18 girls after of Arun, then number of boy after Arun is

- (a) 30      (b) 28      (c) 25      (d) 24

14. Find unit digit of

$$(4928)^{121} - (2129)^{122} - (2^4)^{162} = ?$$

- (a) 2      (b) 1      (c) 5      (d) 7

15. An advertisement in 'The Hindu' says-'learn a foreign language course to get a high paid job' based on this statement conclude which one is true.

(i) Those who learn foreign language course get high paid job.

(ii) Only foreign language course can provide a high paid job

- (a) only (i) follows      (b) Only (ii) follows      (c) both follows      (d) None follows

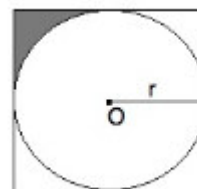
16. In an examination, 35% of total students failed in Hindi, 45% failed in English and 20% in both find the percentage of those who passed in both the subjects?

- (a) 60%      (b) 40%      (c) 30%      (d) 20%

17. If every side of a triangle is doubled, the area of the new triangle is  $k$  times the area of the old one.  $k$  is equal to

- (a)  $\sqrt{2}$       (b) 2      (c) 3      (d) 4

18. Find the shaded area if  $r=7$



- (a)  $7\pi$       (b)  $49(1-\pi/2)$       (c)  $7(1-\pi/4)$       (d)  $49(1-\pi/4)$

19. 17, 32, 19, 29, 21, 26, 23, ?

- (a) 25      (b) 23      (c) 25      (d) 29

20. Pankaj and Suresh lies on specific days.

Pankaj lies on Friday, Saturday and Sunday but he is honest on all other days. Suresh

lies on Tuesday, Wednesday and Thursdays but the truth on all other days.

On what day of the week would they both say "Tomorrow, I will lie."?

- (a) Sunday      (b) Friday      (c) Thursday      (d) Monday

## PART-B

1. For the electronic configuration  $1s^2 2s^2 2p^4$ , two of the possible term symbols are  $^1S$  and  $^3P$ . The remaining term is:

- a)  $^1D$                       b)  $^1F$                       c)  $^3D$                       d)  $^3F$

2. For one of the element various successive ionization enthalpies are given below:

IE	1st	2nd	3rd	4th	5th
-	577.5	1810	2750	11580	14820

The element is:

- a) P                              b) Mg                              c) Si                              d) Al

3. The electronegativities of H and Cl are 2.1 and 3.0 respectively. The correct statement about the nature of HCl is:

- a) 17% covalent      b) 17% ionic      c) 50% ionic      d) 100% covalent

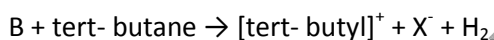
4. What is the term symbol of  $N^{2+}$  with electron configuration  $1\sigma_g^2 1\sigma_u^2 1\pi_u^3 2\sigma_g^2$ ?

- (a)  $^2\Pi_u$       (b)  $^1\Sigma_g^+$       (c)  $^1\Sigma_g^-$       (d)  $^2\Pi_g$

5. The pair of symmetry points group that are associate with only polar molecules is:

- a)  $C_{2v}, D_{\infty h}$       b)  $C_{3v}, C_{2h}$       c)  $D_{2h}, T_d$       d)  $C_{2v}, C_{\infty v}$

6.  $A + SbF_5 \rightarrow B$



Then A is

- (a) HCl                      (b) HF                      (c) HBr                      (d) HI

7.  $[Cp_2Fe]^+$  (ferrocinium cation) is given in coloured and paramagnetic. The colour arises due to

- (a)  $\sigma \rightarrow \sigma^*$       (b)  $\pi \rightarrow \pi^*$       (c) LMCT      (d) MLCT

8. The experimental magnetic moment of  $K_3[Fe(CN)_6]$  is  $2.3\mu_B$  and is attributable to the

- (a) spin-only value of a low-spin Fe      (b) spin-only value of a high-spin Fe  
(c) low-spin Fe with orbital contribution      (d) high-spin Fe with orbital contribution

9. 20 mL of 0.01M HCl is titrated with 10 mL of 0.01 M  $Ca(OH)_2$ . The pH of the solution at  $25^\circ C$  is

- (a) Less than 7      (b) More than 7      (c) Equal to 7      (d) Cannot predict

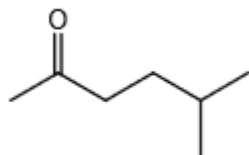
10. Identify correct statement for mercury as an environment pollutant

- (A) carbanionic biomethylation converts it to  $MeHg^+$   
(B) thiol group of cysteine has strong affinity for mercury  
(C) mercury containing industrial catalyst release caused minimata disease

The correct answer is

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

11. The  $m/z$  value of the detectable fragment formed by McLafferty like rearrangement of the following compound in mass spectrometer is



- (a) 43      (b) 58      (c) 72      (d) 49

12. A potassium salt 'A' reacts with dil. HCl to produce a colourless gas. This colourless gas turns lime water milky and the excess of this gas destroys milkiness. The compound

'A' is:

- (a) KCl                      (b)  $K_2SO_4$                       (c)  $KNO_3$                       (d)  $K_2CO_3$

13. The reaction between red phosphorous and  $NaClO_2$  yield hypophosphoric acid. The molecular formula of hypophosphoric acid is

- (a)  $H_5P_3O_{10}$                       (b)  $H_4P_2O_7$                       (c)  $H_3PO_4$                       (d)  $H_4P_2O_6$

14. Identify the correct statement

When the ligand donot sterically control the coordination geometry then

- (a) 4 coordinate complexes of Cu(I) is square planar geometry  
 (b) 4 coordinate complex of Pd (II) is tetrahedral geometry  
 (c) 4 coordinate complex of Zn(II) is square planar geometry  
 (d) 4 coordinate complex of Zn(II) is tetrahedral geometry

15. Trimeric phosphozenes are usually planer but can be forced out of this geometry. In

Contrast benzene derivatives are strictly planar. This is due to

- (a) more diffuse nature of d-orbitals  
 (b) more diffuse nature of p-orbital  
 (c) strong  $\pi\pi$ -  $\pi\pi$  bonding in phosphazenes in non-planar structure  
 (d) weak  $\pi\pi$ -  $d\pi$  bonding in phosphazenes in planar structure

16. The shape of  $[ClF_4]^-$  and  $[ClF_2]^-$  ions is respectively.

- (a) see-saw and linear                      (b) see-saw and bent  
 (c) tetrahedral and linear                      (d) square planar and linear

17. Choose the correct order of ionic radius from given option

- (a)  $Ce^{+3} > Pr^{+3} > Dy^{+3} > Eu^{+3}$                       (b)  $Pr^{+3} > Dy^{+3} > Eu^{+3} > Ce^{+3}$   
 (c)  $Dy^{+3} > Eu^{+3} > Ce^{+3} > Pr^{+3}$                       (d)  $Ce^{+3} > Pr^{+3} > Eu^{+3} > Dy^{+3}$

18. The reaction of  $CrCl_3$  with liq.  $NH_3$  to give yellow  $[Cr(NH_3)_6]Cl_3$  often has low yield, since the reaction tends to stop with production of pink  $[Cr(NH_3)_5Cl]Cl_2$ . On addition of a small piece of Na metal to liq.  $NH_3$  yield of  $[Cr(NH_3)_6]Cl_3$

- (a) increases                      (b) decreases                      (c) remain constant                      (d) cannot predicted

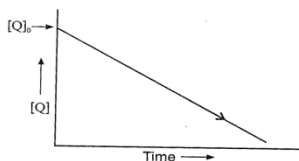
19. Which among the following statement is correct for  $F_3C-CF_2-CF_3$ ?

- (a) all C-F bond length are identical  
 (b) two C-F bond attached to middle carbon atom are longer as compared to other C-F bond at terminal carbon  
 (c) Two C-F bond attached to middle carbon atom are shorter as compared to other C-F bond at terminal carbon  
 (d) none of these

20. Match the Column-I with Column-II

Column-I	Column-II
(P) Feritin	(I) Electron transport
(Q) Vitamin B12	(II) Ionophore
(R) Cytochromes	(III) Oxygen transport
(S) Valinomycin	(IV) Nitrogen fixation
	(V) Organometallic enzyme
	(VI) Iron storage

- (a) P-VI, Q-IV, R-II, S-V (b) P-I, Q-III, R-VI, S-IV  
(c) P-III, Q-V, R-IV, S-VI (d) P-VI, Q-V, R-I, S-II
21. The incorrect statement among the following is  
(a) Mossbauer spectroscopy shows that the two Fe(III) ions in oxyhemerythrin are in different environment  
(b) Oxyhemerythrin is diamagnetic and EPR inactive  
(c) The blue color of oxyhemocyanin is due to LMCT  
(d) O<sub>2</sub> bind with hemerythrin in O<sub>2</sub><sup>-</sup> form whereas bind with hemocyanin in O<sub>2</sub><sup>-2</sup> form.
22. Consider the following statement(s)  
(I) Eu<sup>3+</sup> and Sm<sup>3+</sup> show abnormal magnetism  
(II) For Eu and Yb third ionisation energy is highest among lanthanoids  
(III) Actinoids show more variable oxidation states than lanthanoids  
(IV) Absorption peaks of actinoids is broader than lanthanoids.  
The correct answer is  
(a) I and II (b) III and IV (c) II, III and IV (d) all are correct
23. The complexes [Co(NH<sub>3</sub>)<sub>5</sub>X]<sup>2+</sup> have charge transfer to metal band. The complex would you expect to show higher wavelength of charge transfer band if X is  
(a) F<sup>-</sup> (b) Cl<sup>-</sup> (c) Br<sup>-</sup> (d) I<sup>-</sup>
24. Which of the following statement is not true regarding the carbene  
(a) Schrock carbene behaves like a phosphorus ylide in some of its reactions  
(b) The carbene carbon of Schrock carbene is nucleophilic in nature whereas metal is electron deficient.  
(c) The metal-carbon bond of Fischer carbene has a relatively high rotational barrier  
(d) The metal atom of Fischer carbene is relatively electron rich
25. The masses recorded when a substance is weighed 5 times are 10.8, 10.2, 10.6, 10.4 and 11 mg. The variance is closest to  
(a) 0.50 (b) 0.10 (c) 10.6 (d) 0.75
26. Which of the following molecules would not give pure rotational spectrum?  
H<sub>2</sub>, HCl, CO, CH<sub>3</sub>Cl, H<sub>2</sub>O (liq.), NH<sub>3</sub>, NH<sub>4</sub>Cl  
(a) H<sub>2</sub>, NH<sub>3</sub> (b) H<sub>2</sub>, NH<sub>4</sub>Cl, CO  
(c) H<sub>2</sub>, NH<sub>3</sub>, NH<sub>4</sub>Cl (d) H<sub>2</sub>, H<sub>2</sub>O (liq.), NH<sub>4</sub>Cl
27. The anions in Fluorite structure are present in  
(a) All Oh Voids (b) Half Oh Voids (c) Half Td Voids (d) All Td Voids
28. The order of increasing Bronsted acidity for the boron hydrides is  
(a) B<sub>5</sub>H<sub>9</sub> < B<sub>6</sub>H<sub>10</sub> < B<sub>10</sub>H<sub>14</sub> (b) B<sub>10</sub>H<sub>14</sub> < B<sub>5</sub>H<sub>9</sub> < B<sub>6</sub>H<sub>10</sub>  
(c) B<sub>6</sub>H<sub>10</sub> < B<sub>10</sub>H<sub>14</sub> < B<sub>5</sub>H<sub>9</sub> (d) B<sub>10</sub>H<sub>14</sub> < B<sub>6</sub>H<sub>10</sub> < B<sub>5</sub>H<sub>9</sub>
29. In the reaction,  
$$P + Q \rightarrow R + S$$
  
The time taken for 75% reaction of P is twice the time taken for 50% reaction of P. The concentration of Q varies with reaction time as shown in the figure. The overall order of the reaction is :

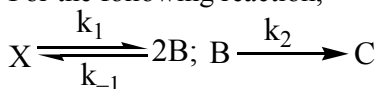


- (a) 2                      (b) 3                      (c) 0                      (d) 1

30. The rate constant for a first order reaction is  $6.909 \text{ min}^{-1}$ . Therefore, the time required in minutes for the participation of 75% of the initial reactant is:

- (a)  $\frac{2}{3} \log 2$                       (b)  $\frac{2}{3} \log 4$                       (c)  $\frac{3}{2} \log 2$                       (d)  $\frac{3}{2} \log 4$

31. For the following reaction,



$\frac{d[B]}{dt}$  is given by

- (a)  $k_1[A] - k_{-1}[B]^2 - 2k_2[B]$                       (b)  $2k_1[A] - k_{-1}[B]^2 - k_2[B]$   
 (c)  $\frac{1}{2}k_1[A] - \frac{1}{2}k_{-1}[B]^2 - k_2[B]$                       (d)  $2k_1[A] - 2k_{-1}[B]^{1/2} - k_2[B]$

32. A first order gaseous reaction is 25% complete in 30 minutes at  $227^\circ\text{C}$  and in 10 minutes at  $237^\circ\text{C}$ . The activation energy of the reaction is closest to ( $R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$ ),

- (a)  $27 \text{ kcal mol}^{-1}$                       (b)  $110 \text{ kcal mol}^{-1}$                       (c)  $55 \text{ kcal mol}^{-1}$                       (d)  $5.5 \text{ kcal mol}^{-1}$

33. The Nernst equation for the reaction  $A^{2+} + 2e \rightarrow B$ , in terms of the free energy change is,

- (a)  $\Delta G = \Delta G^0 + 2.303RT \ln \frac{[B]}{[A]}$                       (b)  $\Delta G = \Delta G^0 - 2.303RT \ln \frac{[B]}{[A]}$   
 (c)  $-\Delta G = -\Delta G^0 + 2.303RT \ln \frac{[B]}{[A]}$                       (d)  $\Delta G = -\Delta G^0 + 2.303RT \ln \frac{[B]}{[A]}$

34. If the concentration (c) is increased to 4 times its original value (c), the change in molar conductivity for strong electrolytes is (where b is Kohlrausch constant)

- (a) 0                      (b)  $b\sqrt{c}$                       (c)  $2b\sqrt{c}$                       (d)  $4b\sqrt{c}$

35. The correct expression for  $\left(\frac{\partial G}{\partial p}\right)_T =$

- (a) V                      (b) S                      (c) -S                      (d) -V

36. Which of the following relation is INCORRECT?

- (a)  $\left(\frac{\partial A}{\partial T}\right)_V = -S$                       (b)  $\left[\frac{\partial A}{\partial V}\right]_T = -P$                       (c)  $\left[\frac{\partial G}{\partial T}\right]_p = -S$                       (d)  $\left[\frac{\partial A}{\partial T}\right]_r = P$

37. Which of the following Maxwell's equation is NOT correct?

- (a)  $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial V}{\partial T}\right)_p$                       (b)  $\left(\frac{\partial T}{\partial V}\right) = -\left(\frac{\partial p}{\partial S}\right)_V$                       (c)  $\left(\frac{\partial V}{\partial p}\right)_s = \left(\frac{\partial T}{\partial S}\right)$                       (d)  $\left(\frac{\partial T}{\partial p}\right)_s = \left(\frac{\partial V}{\partial S}\right)_p$

38. The symmetric rotor among the following is:

- (A)  $\text{CH}_4$                       (B)  $\text{CH}_3\text{Cl}$   
 (C)  $\text{CH}_2\text{Cl}_2$                       (D)  $\text{CCl}_4$

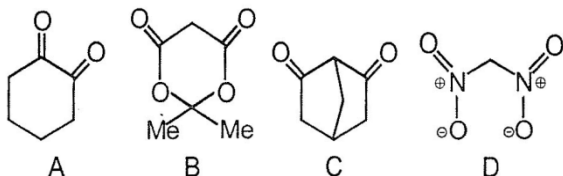
39. According to Huckel theory, the  $\pi$  electron density on the corner carbon atom in propenyl cation  $(\text{CH}_2\text{HCH}_2)^+$  is (in units of electronic charge) (a)  $\frac{1}{2}$  (b)

$\frac{1}{\sqrt{2}}$  (c) 1 (d) 2

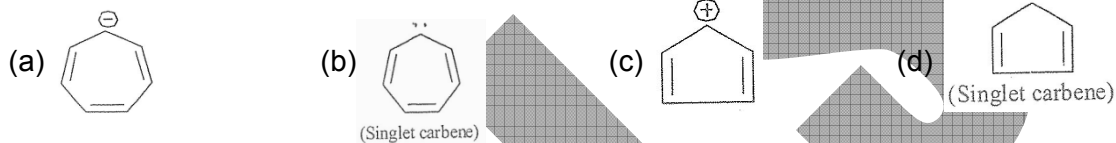
40. The value of commutator  $[x, p_x^2]$  is given by

(a)  $2i$  (b)  $2ih$   
(c)  $2ihx$  (d)  $2ihp_x$

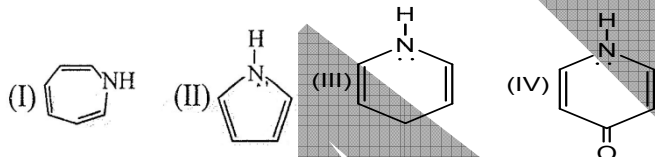
41. Arrange the given carbon acids in the increasing order of acidic strength



42. Which of the following is aromatic?

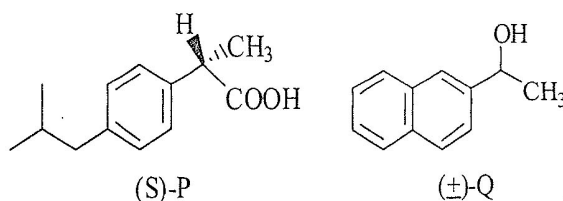


43. Write the correct basicity order of the following compounds.



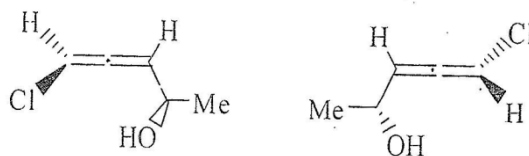
(a) I > III > IV > II (b) I > III > II > IV  
(c) I > IV > III > IV (d) II > III > IV > I

44. Esterification of the acid P with the alcohol Q will give



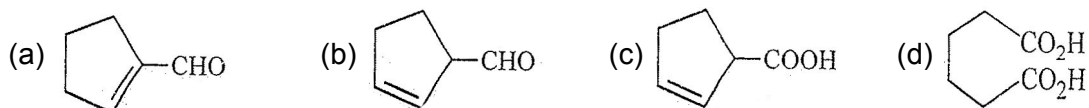
(a) only one enantiomer (b) a mixture of diastereomers  
(c) a mixture of enantiomers (d) only one diastereomer

45. The correct relation between the following compounds is

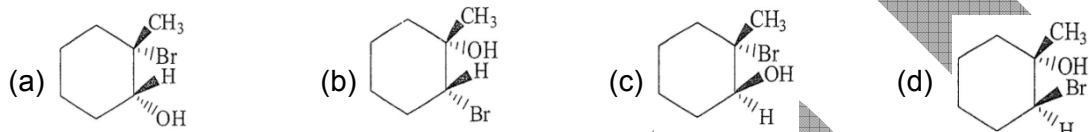
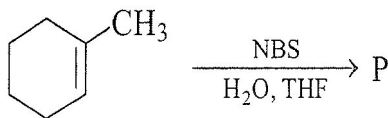


(a) Enantiomers (b) Diastereomers  
(c) Homomers (identical) (d) Constitutional isomers

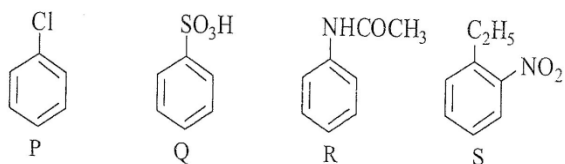
46. Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound E. Compound E on further treatment with aqueous KOH yields compound F. Compound F is



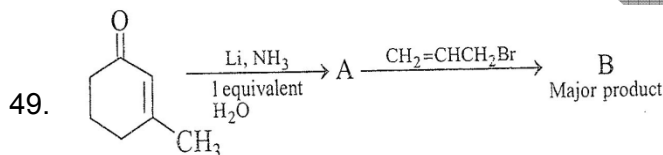
47. Major product of the given reaction is



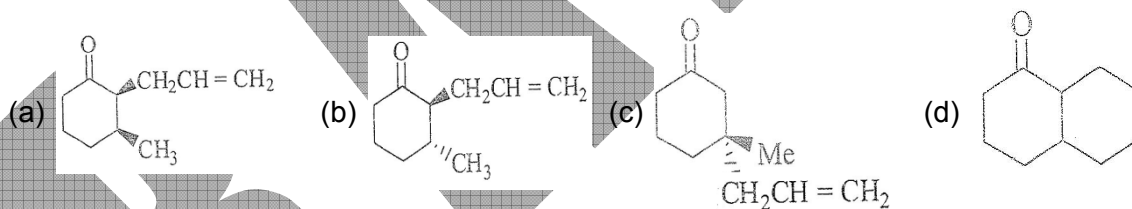
48. The decreasing order of electrophilic nitration of the following compounds will follow the trend



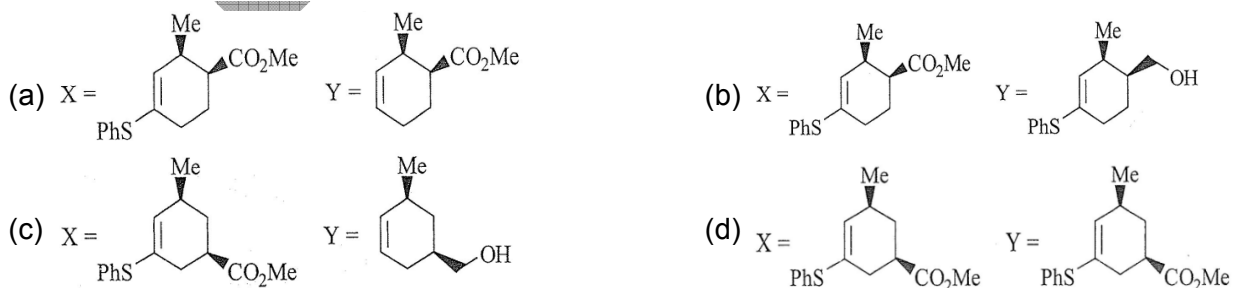
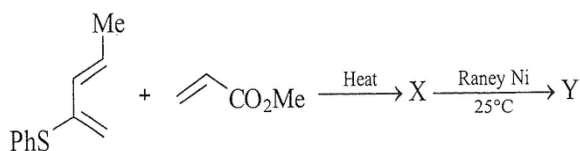
- (a) S > R > P > Q  
(b) R > S > P > Q  
(c) R > P > S > Q  
(d) P > S > R > Q



B is:



50. The major product X and Y formed in the following reaction sequence are





## PART-C

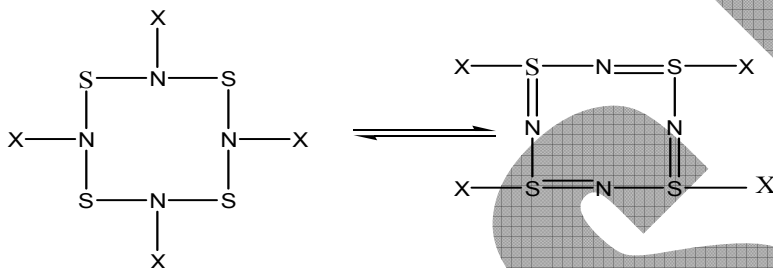
51. In a magnetic field of strength 2.349 T, the resonance frequency of  $^{15}\text{N}$  nuclei is 10.13MHz. The resonance frequency of  $^{15}\text{N}$  in a magnet of 11.745T is ?

- (a) 2.06 MHz    (b) 50.65 Hz    (c) 50.65 MHz    (d) 18.64 MHz

52. Which of the following types of silicate represents the mineral  $\text{Mg}_3(\text{OH})_2[\text{Si}_4\text{O}_{10}]$  ?

- (a) Linear silicate    (b) Cyclic silicate    (c) 3-D-silicate    (d) Sheet silicate

53. Correct order of substituent ( $\text{X} = \text{F}, \text{Cl}, \text{Br}, \text{H}$ ) for equilibrium constant of following reaction is



- (a)  $\text{H} > \text{Br} > \text{Cl} > \text{F}$     (b)  $\text{F} > \text{Cl} > \text{Br} > \text{H}$     (c)  $\text{F} > \text{Cl} > \text{H} > \text{Br}$     (d)  $\text{H} > \text{F} > \text{Cl} > \text{Br}$

54. The crystal of  $\text{KCoF}_3$  show three absorption bands in its absorption spectrum at  $7150\text{ cm}^{-1}$ ,  $15200\text{ cm}^{-1}$  and  $19200\text{ cm}^{-1}$ . In this compound  $\text{Co}^{2+}$  ion is surrounded octahedrally by six  $\text{F}^-$  ligands. The magnitude of CFSE is ( $\text{cm}^{-1}$ ).

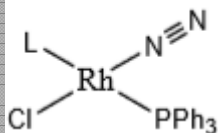
- (a)  $6440\text{ cm}^{-1}$     (b)  $5720\text{ cm}^{-1}$     (c)  $21690\text{ cm}^{-1}$     (d)  $9640\text{ cm}^{-1}$

55. The rate of electron transfer in the following reaction is rapid because



- (a) It is an inner sphere reaction  
 (b) It is an outer sphere reaction  
 (c) Electron transfer takes place from  $\pi^*$  of  $[\text{Ru}(\text{NH}_3)_6]^{+2}$  to  $\pi^*$  of  $[\text{Ru}(\text{NH}_3)_6]^{+3}$  without any transfer of any energy.  
 (d) Electron transfer takes place from  $\sigma^*$  of  $[\text{Ru}(\text{NH}_3)_6]^{+2}$  to  $\sigma^*$  of  $[\text{Ru}(\text{NH}_3)_6]^{+3}$  without any Transfer of any energy.

56.  $\text{L} =$  (a)  $\text{PPh}_3$     (b)  $\text{PMe}_3$     (c)  $\text{PF}_3$     (d)  $\text{P}(\text{OMe})_3$   
 (1)    (2)    (3)    (4)



Arrange the dinitrogen complex in order of their increasing N-N bond length

- (a)  $1 > 2 > 3 > 4$     (b)  $2 > 1 > 4 > 3$     (c)  $4 > 2 > 1 > 3$     (d)  $3 > 4 > 1 > 2$

57. When a reduced cytochrome transfer an electron from its  $\text{Fe}(\text{II})$  to the bound  $\text{O}_2$

- (a) the bond order of  $\text{O}_2$  is reduced by one and  $\nu_{\text{O}_2}$  decreases  
 (b) A metal bound super oxide is formed and  $\nu_{\text{O}_2}$  decreases  
 (c) A metal bound super oxide is formed and  $\nu_{\text{O}_2}$  increases  
 (d) the bond order of  $\text{O}_2$  is reduced by one and  $\nu_{\text{O}_2}$  increases

58. The correct combination of isolobal relationship are

- (A)  $OC = Mo(CO)_5 \leftrightarrow OC = CH_2$   
 (B)  $Cp(CO)_2Mo \equiv CR \leftrightarrow$  Acetylene  
 (C)  $\{CpRh(CO)\}_2(\mu-CH_2) \leftrightarrow$  Cyclopropane

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

59. The symmetry operation  $S_6^2$  brings some molecule in an orientation that can also be obtained by performing

- (a) Inversion centre      (b) A two-fold axis of symmetry  
 (c) A three fold axis of symmetry      (d) A six-fold axis of symmetry

60. Correct order of rates of exchange of coordinated and solvent  $H_2O$  is

- (a)  $[Os(H_2O)_6]^{+2} > [Ru(H_2O)_6]^{+2} > [Fe(H_2O)_6]^{+2} > [Zn(H_2O)_6]^{+2}$   
 (b)  $[Fe(H_2O)_6]^{+2} > [Zn(H_2O)_6]^{+2} > [Ru(H_2O)_6]^{+2} > [Os(H_2O)_6]^{+2}$   
 (c)  $[Zn(H_2O)_6]^{+2} > [Fe(H_2O)_6]^{+2} > [Ru(H_2O)_6]^{+2} > [Os(H_2O)_6]^{+2}$   
 (d)  $[Fe(H_2O)_6]^{+2} > [Zn(H_2O)_6]^{+2} > [Os(H_2O)_6]^{+2} > [Ru(H_2O)_6]^{+2}$

61.

Match the complexes with correct IR stretching frequency of  $\nu(CO) \text{ cm}^{-1}$

**Complexes**       **$\nu(CO) \text{ cm}^{-1}$**

(I)  $[(dien)Mn(CO)_3]^+$       (A) 2090

(II)  $[Mn(CO)_6]^+$       (B) 1960

(III)  $[(en)Mn(CO)_4]^+$       (C) 2000

(IV)  $[(MeH_2N)Mn(CO)_5]^+$       (D) 2043

(a) I-A, II-B, III-D, IV-C

(b) I-B, II-A, III-C, IV-D

(c) I-A, II-B, III-C, IV-D

(d) I-D, II-A, III-C, IV-B

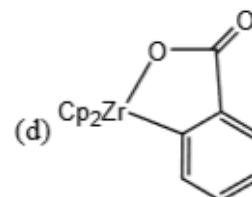
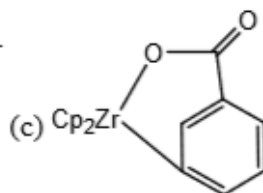
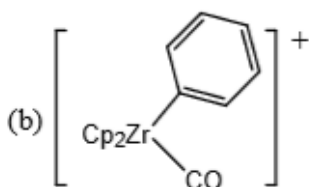
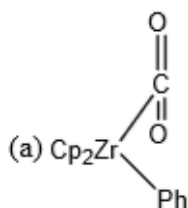
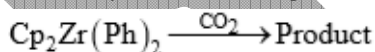
62. Predict the order of reactivity of the following in oxidative addition reaction of HCl

A-  $IrCl(CO)(PPh_3)_2$       B-  $IrCl(CO)(PMe_3)_2$

C-  $IrMe(CO)(PMe_3)_2$       D-  $IrPh(CO)(PMe_3)_2$

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

63. Predict the product of the given chemical reaction

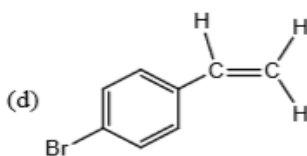
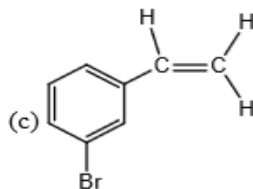
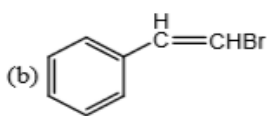
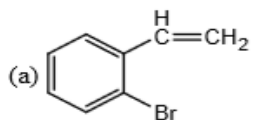


64. An organic compound (molecular formula  $C_8H_7Br$ ) yields a primary alcohol on hydroboration and gives the following spectral data :

UV:  $\lambda_{max} 282(\epsilon_{max} 450)$

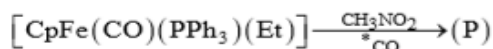
IR :  $\nu_{max} 3033(w), 1646(m), 1602(m), 1582(w), 870(s), 770(s), 710(m)$

$^1\text{H NMR}$ :  $\delta 5.14$      $\delta 5.70$      $\delta 6.70$      $\delta 7.26-7.38$   
 Integration    1    :    1    :    1    :    4

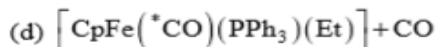
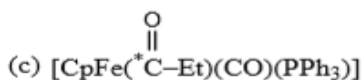
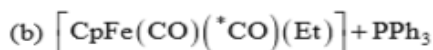
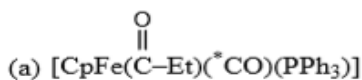


65. The solution  $^{31}\text{P}$  NMR spectrum of a mixture of isomers of the square planar complex  $[\text{Pt}(\text{SCN})_2(\text{Ph}_2\text{PCH}_2\text{PPh}_2)_2]$  shows two singlet and two doublet at 228K. The number of possible isomer for complex  $[\text{Pt}(\text{SCN})_2(\text{Ph}_2\text{PCH}_2\text{PPh}_2)_2]$  is  
 (a) 1    (b) 2    (c) 3    (d) 4

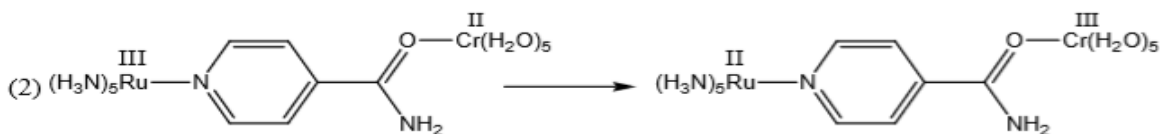
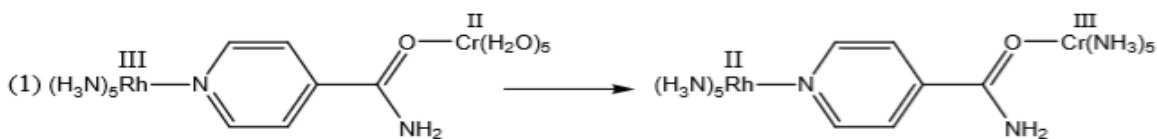
- 66 Predict the product of the given chemical reaction



The major product (P) in the above reaction



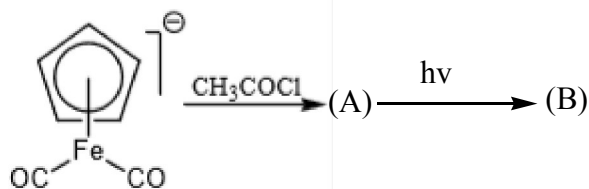
67. Give the answer on the basis of given reactions,  
 Consider the following electron transfer reactions



Correct statement about above reaction is

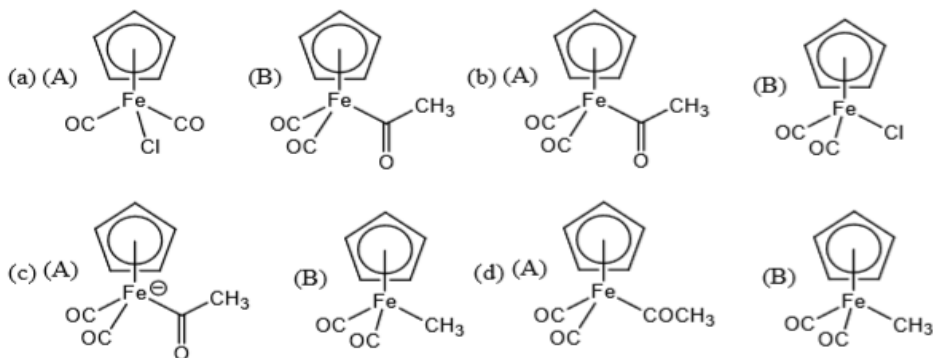
- (a) rate of I is faster than II    (b) rate of II is faster than I  
 (c) both I and II occurs at same rate    (d) can not be predicted

- 68 for the given reaction

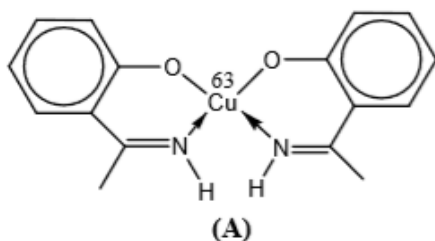


The major product (A) and (B) in the above reaction are (given the compound (B) have

no IR band near  $1700-1600\text{ cm}^{-1}$ )



69. For a complex A, NH proton affect the EPR spectrum. The total number of hyperfine lines an intensity pattern (experimentally one bench) in the EPR spectrum of A



- (a) 60, 1 : 2 : 1 : 2 : 4 : 2 : 3 : 6 : 3 : 2 : 4 : 2 : 1 : 2 : 1  
 (b) 44, 1 : 2 : 3 : 4 : 5 : 6 : 5 : 4 : 3 : 2 : 1  
 (c) 15, 1 : 2 : 3 : 4 : 4 : 3 : 2 : 1  
 (d) 11, 1 : 2 : 3 : 4 : 5 : 4 : 3 : 2 : 1

70. Consider the statement(s)

- (I) The most destabilised orbital in crystal field splitting of pentagonal bipyramidal complexes is  $d_{z^2}$  whereas  $dxz$  and  $dyz$  is most stabilised in square pyramidal complexes.  
 (II) The total number of microstates for  $3p^1 3d^1$  configuration is 60.  
 (III) The splitting of H term in tetrahedral field is  $T_1$ ,  $T_2$  and  $A_2$ .  
 (IV)  ${}^3A_{2g}$  is ground state for  $d^2$  tetrahedral complex.

The correct statements are

- (a) I and II      (b) II and III      (c) I, II and IV      (d) II, III and IV

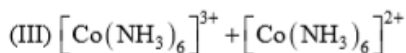
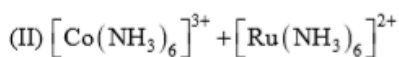
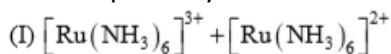
71. Consider the following statement(s)

- (I) Many actinoids oxides are non-stoichiometric whereas few lanthanoids oxides are Non-stoichiometric  
 (II)  $\text{Ln}^{2+}$  complexes are strong reducing agents  
 (III) In solid states, salts of  $\text{UO}_2^{2+}$  contain linear cation.  
 (IV) Thorium form iodides of formulae  $\text{ThI}_3$ ,  $\text{ThI}_2$  both show metallic conductivity

The correct answer is

- (a) I and II      (b) II and III      (c) II, III and IV      (d) all are correct

72. The relative values of the rate constant ( $k/\text{dm}^3\text{mol}^{-1}\text{s}^{-1}$ ) for the following electron transfer reaction in aqueous solution respectively are



(a) (I)  $10^{-8}$ , (II)  $10^{-2}$ , (III)  $10^4$

(b) (I)  $10^4$ , (II)  $10^{-2}$ , (III)  $10^{-8}$

(c) (I)  $10^{-2}$ , (II)  $10^{-8}$ , (III)  $10^4$

(d) (I)  $10^4$ , (II)  $10^{-8}$ , (III)  $10^{-2}$

73. Consider the correct statement

(A) The colour of trans-  $[\text{Co}(\text{en})_2\text{F}_2]^+$  is more instance than those of cis-  $[\text{Co}(\text{en})_2\text{F}_2]^+$

(B) The colour of trans-  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$  is more instance than those of trans-  $[\text{Co}(\text{en})_2\text{F}_2]^+$

(C) The number of d-d band observed in electronic spectrum of an octahedral Cr(III) complex is two

(D) Red crystalline  $[\text{NiCl}_2(\text{PPh}_2\text{CH}_2\text{Ph})_2]$  is paramagnetic

74. If s-p intermixing is not considered then which of followings characteristics is changed in  $\text{C}_2$ ?

(A) Number of electron in gerade molecular orbitals

(B) Bond order

(C) Magnetic behaviour

(D) Dipole moment Correct answer is/are

(a) A and B (b) A and C (c) B and C (d) C and D

75. Find out the structure of following high nuclearity carbonyl cluster

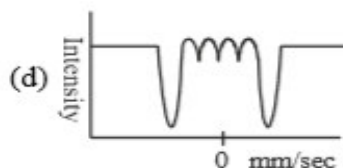
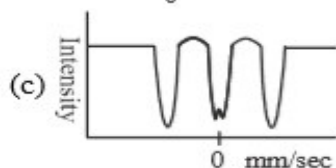
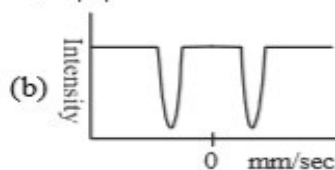
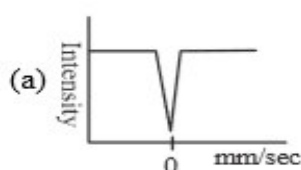
$[\text{Ru}_6(\text{CO})_{17}\text{C}]$ ,  $[\text{Os}_5(\text{CO})_{15}\text{C}]$  and  $[\text{Fe}_4(\text{CO})_{12}\text{C}]^{-2}$ , respectively

(a) closo, nido, nido (b) closo, nido, arachno

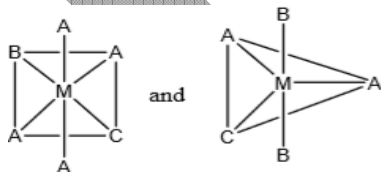
(c) arachno, nido, closo (d) nido, closo, arachno

76. Give the answer

The correct Mossbauer spectrum for ferredoxins ( $\text{Fe}_4\text{S}_4$ ) in oxidised form is



77. The point group symmetry for the following structures



are respectively

(a)  $\text{C}_s$  and  $\text{C}_{2v}$

(b)  $\text{C}_s$  and  $\text{C}_s$

(c)  $\text{D}_{4h}$  and  $\text{C}_{2v}$

(d)  $\text{C}_{4v}$  and  $\text{C}_{2v}$

78. The ratio of population of first rotationally excited level with  $J = 1$  respect to ground state rotational state ( $J = 0$ ) for  $\text{CO}_2$  molecule is {if  $kT = 2000 \text{ cm}^{-1}$ , the separation between  $J = 1$  and  $J = 0$  (in energy) =  $16.8 \times 10^{-24} \text{ J}$ ,  $h = 7 \times 10^{-34} \text{ J-s}$ ,  $C = 3 \times 10^{10} \text{ cm/s}$ }

- (a)  $3e^{(-1.74 \times 10^{-49})}$                       (b)  $3e^{(-3.52 \times 10^{-49})}$                       (c)  $3e^{(-4 \times 10^{-4})}$                       (d)  $3e^{(-2 \times 10^{-4})}$

79. For enzyme catalyzed reaction, a Lineweaver – Burk plot gave the following data:

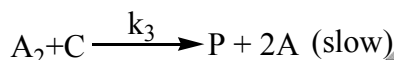
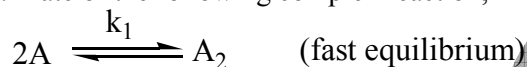
Slope = 40s

Intercept =  $4 \text{ (mmol dm}^{-3} \text{ s}^{-1})^{-1}$ .

If the initial concentration of enzyme is  $2.5 \times 10^{-9} \text{ mol dm}^{-3}$ , what is the catalytic efficiency (in  $\text{dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ ) of the reaction?

- (a)  $10^5$                       (b)  $10^6$                       (c)  $10^7$                       (d)  $10^4$

80. The overall rate of the following complex reaction,



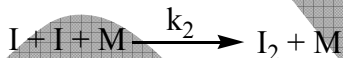
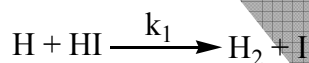
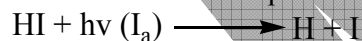
by steady state approximation would be:

- (a)  $K_1K_2k_3 [A]^3[B]$                       (b)  $K_2K_1k_3 [A][B]^3$   
 (c)  $K_1K_2k_3 [A][B]^2$                       (d)  $K_1K_2k_3 [A][B]$

81. The Arrhenius parameters for the thermal decomposition  $\text{NOCl}$ ,  $2\text{NOCl(g)} \rightarrow 2\text{NO(g)} + \text{Cl}_2\text{(g)}$ , are  $A = 1013 \text{ M}^{-1} \text{ s}^{-1}$ ,  $E_a = 105 \text{ kJ mol}^{-1}$  and  $RT = 2.5 \text{ kJ mol}^{-1}$ . The enthalpy (in  $\text{kJ mol}^{-1}$ ) of the activated complex will be

- (a) 110                      (b) 105                      (c) 102.5                      (d) 100

82. Photochemical decomposition of HI takes place with the following mechanism



hydrogen (H) and iodine (I) atoms as intermediates, the rate of removal of HI is

- (a)  $I_a/2$                       (b)  $I_a$                       (c)  $2I_a$                       (d)  $I_a^2$

83. The standard reduction potential at 298K for single electrodes are given below:

Electrode	Electrode Potential (Volt)
$\text{Mg}^{2+} / \text{Mg}$	-2.34
$\text{Zn}^{2+} / \text{Zn}$	-0.76
$\text{Fe}^{2+} / \text{Fe}$	-0.44

From this we can infer that

- (a) Zn can reduce both  $\text{Mg}^{2+}$  and  $\text{Fe}^{2+}$   
 (b) Fe can reduce both  $\text{Mg}^{2+}$  and  $\text{Zn}^{2+}$   
 (c) Mg can reduce both  $\text{Zn}^{2+}$  and  $\text{Fe}^{2+}$   
 (d) Mg can reduce  $\text{Zn}^{2+}$  but not  $\text{Fe}^{2+}$

84. Main assumption(s) involved in the derivation of Debye-Huckel equation is (are) the validity of

- (a) Only Poisson equation                      (b) Poisson equation and Boltzmann distribution  
 (c) Poisson equation, Boltzmann distribution and  $|\pm Z e \phi| \gg k_B T$   
 (d) Poisson equation Boltzmann distribution and  $|\pm Z e \phi| \ll k_B T$

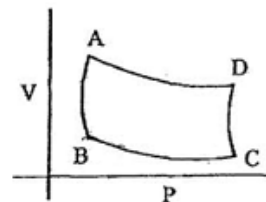
Considering

85. The equilibrium constant for an electrochemical reaction,  
 $2\text{Fe}^{3+} + \text{Sn}^{2+} \rightleftharpoons \text{Fe}^{2+} + \text{Sn}^{4+}$   
 is [ $E^0(\text{Fe}^{3+}/\text{Fe}^{2+}) = 0.75\text{V}$ ,  $E^0(\text{Sn}^{4+}/\text{Sn}^{2+}) = 0.15\text{V}$ ,  $(2.303RT/F) = 0.06\text{V}$ ]  
 (a)  $10^{10}$  (b)  $10^{20}$  (c)  $10^{30}$  (d)  $10^{40}$
86. Electrolysis of an aqueous solution of 1.0 M NaOH results in  
 (a) Na at the cathode and  $\text{O}_2$  at the anode  
 (b)  $\text{H}_2$  at the cathode and  $\text{O}_2$  at the anode  
 (c) Na and  $\text{H}_2$  at the cathode, and  $\text{O}_2$  at the anode  
 (d)  $\text{O}_2$  at the cathode and  $\text{H}_2$  at the anode
87. The fugacity of a gas depends on pressure and the compressibility factor  $Z (= p\bar{V}.RT)$  through the relation ( $\bar{V}$  is the molar volume)

$$f = p \cdot \exp \left[ \int_0^p \frac{Z-1}{p} dp \right]$$

For the gases at temperature T and upto moderate pressure, this equation shows that

- (a)  $f < p$ , if  $T \rightarrow 0$  (b)  $f < p$ , if  $T \rightarrow \infty$   
 (c)  $f > p$ , if  $T \rightarrow 0$  (d)  $f = p$ , if  $T \rightarrow 0$
88. Given the following two relations,  $x_1 d\mu_1 + x_2 d\mu_2 = 0$  (A)  
 and  $x_1 d\bar{V}_1 + x_2 d\bar{V}_2 = 0$  (B)  
 for a binary liquid mixture at constant temperature and pressure, the true statement is that,  
 (a) Both the relations are correct  
 (b) Relation A is correct, but B is not  
 (c) Relation B is correct, but A is not  
 (d) Both A and B are INCORRECT, Except for very dilute solutions
89. The value of  $\Delta U - \Delta H$  for the relation  $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{C}(\text{s}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}(\text{g})$  is:  
 (a)  $-3RT$  (b)  $+3RT$   
 (c)  $+RT$  (d)  $-RT$
90. The figure below describes how a Carnot engine works. It starts from the adiabatic compression step denoted by:



- (a) AB (b) BC (c) DC (d) AD
91. If the displacement vectors of all atoms in cis-butadiene are taken as the basis vectors, the characters of the reducible representation of  $E_1$ ,  $C_2$ ,  $\sigma_v$  (molecular plane) and  $\sigma_v'$  are:

$C_{2v}$	E	$C_2$	$\sigma_v$	$\sigma_v'$
NUS	10	0	10	0
$X(R)$	3	-1	1	1
	30	0	10	0

- (A) 30, 10, 30, 0 (B) 30, 0, 10, 0 (C) 30, 20, 0, 0 (D) 30, 0, 20, 0

92. Character table of  $C_{2v}$  point group is

$C_{2v}$	E	$C_2$	$\sigma_v$	$\sigma_v'$	
$A_1$	1	1	1	1	z
$A_2$	1	1	-1	-1	-
$B_1$	1	-1	1	-1	x
$B_2$	1	-1	-1	1	y

If the initial and states belong to  $A_1$  and  $B_1$  irreducible representations respectively the allowed electronic transition from  $A_1$  to  $B_1$  is

- (A) z-polarised (B) y-polarised  
(B) x-polarised (D) x, z-polarised

93. The character table of  $C_{2v}$  point group is given below in cis-butadiene molecule the vibrational modes belonging to  $A_2$  irreducible representation are IR inactive. The remaining IR active modes are:

$C_{2v}$	E	$C_2$	$\sigma_v$	$\sigma_v'$	
$A_1$	1	1	1	1	$z^2, x^2, y^2, z$
$A_2$	1	1	-1	-1	$R_x, xy$
$B_1$	1	-1	1	-1	$x, R_y, xy$
$B_2$	1	-1	-1	1	$y, R_z, yz$

- (a)  $7A_1 + 5B_1 + 8B_2$  (b)  $9A_1 + 9B_1 + 7B_2$   
(c)  $7A_1 + 3B_1 + 7B_2$  (d)  $9A_1 + 3B_1 + 8B_2$

94. The probability of finding the particle in a dimensional box of length 'L' in the region between  $L/4$  and  $3L/4$  for quantum number  $n = 1$  is:

- (a)  $\frac{1}{2}$  (b)  $\frac{1}{2} + \frac{1}{\pi}$  (c)  $\frac{1}{2} - \frac{1}{\pi}$  (d)  $\frac{2}{3}$

95. A polymer sample has the following composition

No of molecules	Molecular weight
10	2000
50	4000
40	8000

The Poly-Dispersity Index (PDI) of the polymer is

- (A) 760/670 (B) 787/675 (C) 760/600 (D) 800/670

96. For HCl molecule  $\omega = 2989.7 \text{ cm}^{-1}$  and  $\omega x_e = 52.05 \text{ cm}^{-1}$ , where  $\omega$  = equilibrium vibrational frequency and  $x_e$  = anharmonicity constant. The zero point energy under anharmonic potential of HCl and DCl is

- (a) 1495 and 1057 (b) 1443 and 1021  
(c) 1495 and 2113 (d) 1443 and 2041

97. Bromine has two isotopes  $^{79}\text{Br}$  and  $^{80}\text{Br}$ , each have 50% abundant, In the mass spectrum of tribromomethane ( $\text{CHBr}_3$ ), the highest mass peaks are at  $m/z = 250, 251, 252$  and  $253$ . The ratio of the intensities of these peaks is:

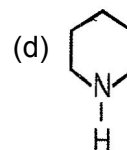
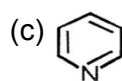
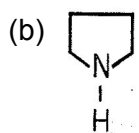
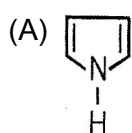
- (a) 2:3:3:2 (b) 1:1:1:1 (c) 1:3:3:1 (d) 1:2:2:1

98. The multiplicity of the signal in  $^{31}\text{P}$  NMR spectrum of  $\text{PF}_2\text{D}_2$  is (If  $J_{\text{PD}} > J_{\text{PF}}$ )

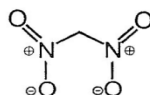
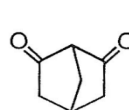
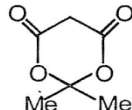
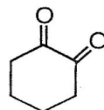
- (a) Triplet of doublet with intensity ratio 1:2:1  
(b) Doublet of quintet with intensity ratio 1:2:3:2:1  
(c) Quintet of doublet with equal intensity of 1:2:3:2:1  
(d) Doublet of quintet with intensity ratio 1:4:6:4:1



99. Which of the following is the strongest base in water?



100. Arrange the given carbon acids in the increasing order of acidic strength

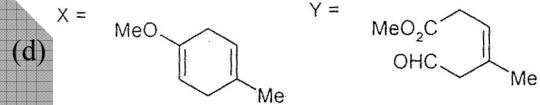
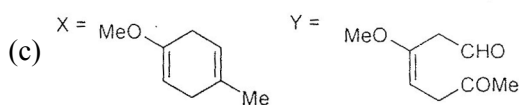
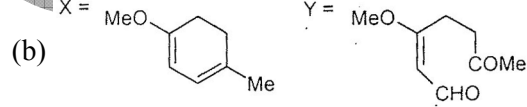
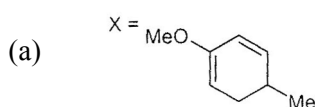
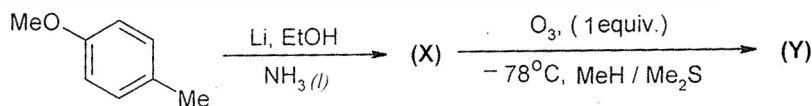


(a)  $A < B < D < C$   
(c)  $C < B < D < A$

(b)  $D < C < B < A$   
(d)  $C < A < B < D$

**Linked answer questions 101 & 102**

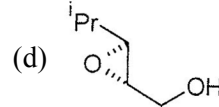
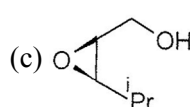
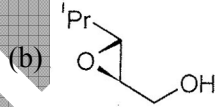
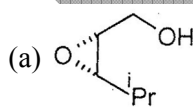
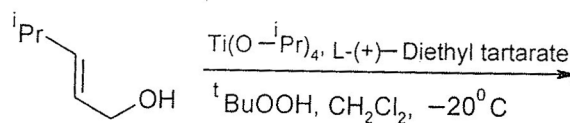
101. The major products X and Y formed in the following reaction sequence are:



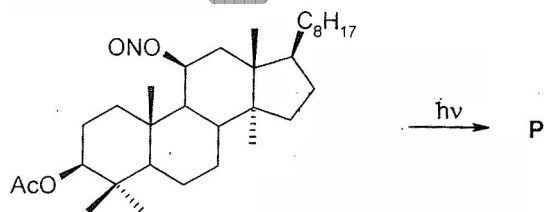
102. The reagent for selective reproduction of an aldehyde group in Y obtained in above reaction is

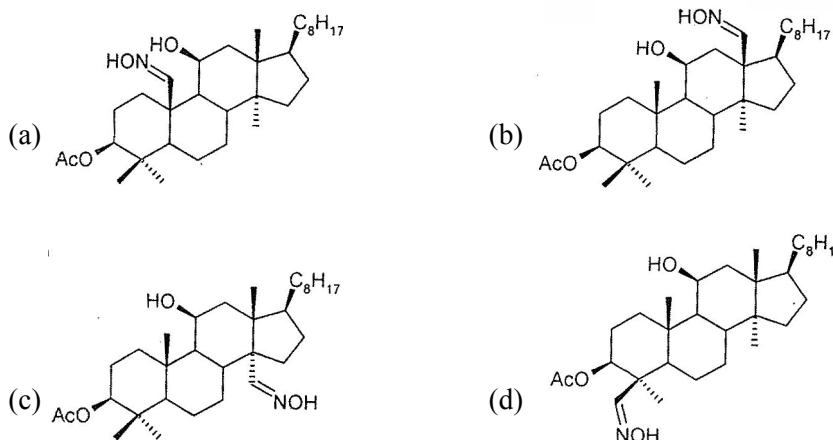
- (a)  $H_2 (Ph_3P)_3RhCl$   
(b)  $((H_3C)_2CHCH_2)_2AlH$   
(c)  $Na(CH_3COO)_3BH$   
(d)  $LiAlH_4$

103. The major product of the following reaction is:

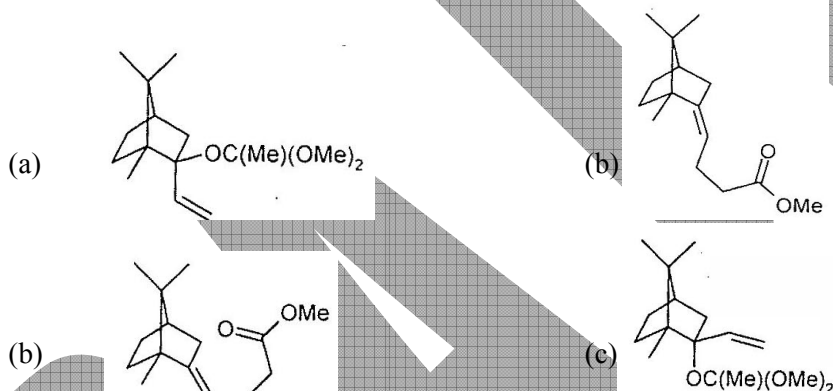
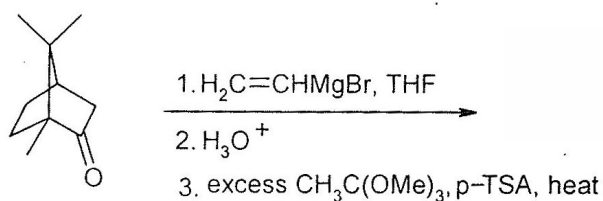


104. Identify the product from the following reaction

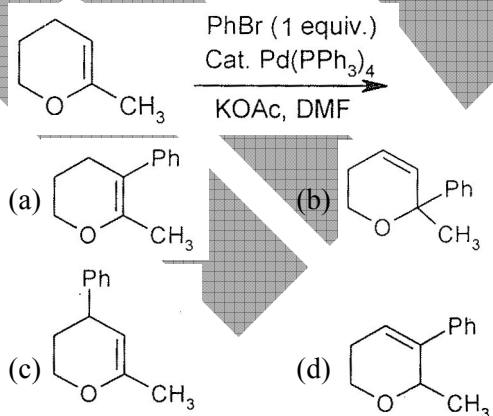




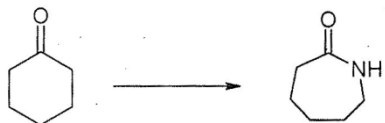
105. In the reaction given below, identify the product



106. The major product formed in the following reaction is



107. The following synthetic transformation can be achieved using



Reagents:

(p) (i)  $\text{NH}_2\text{OH} / \text{H}^+$ , (ii)  $\text{H}_2\text{SO}_4$

(q)  $\text{HN}_3/\text{H}^+$

(r) (i)  $\text{NH}_2\text{OH} / \text{H}^+$  (ii)  $\text{NaOH}$

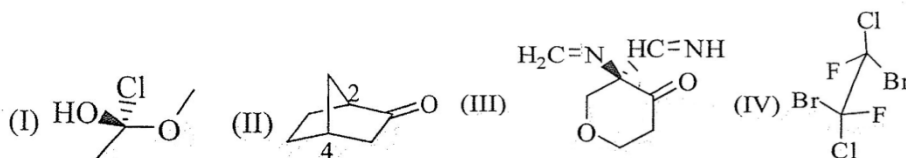
(a) (p) only

(b) (p) and (q)

(c) (q) and (r)

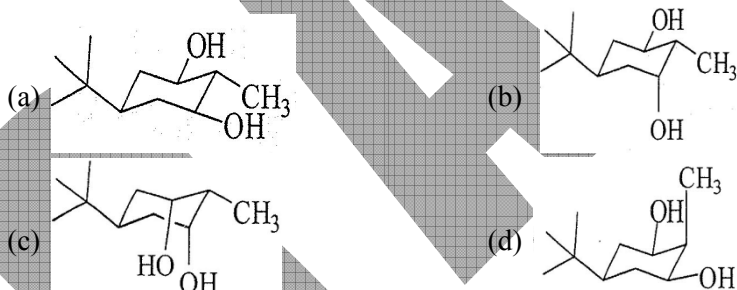
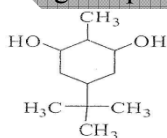
(d) (r) only

108. What is the absolute configuration of the following molecules? (NS – the molecule has no centre) Note: For the purpose of this question only, the order of stereocenters is not specified; i.e., R, S = S,R.

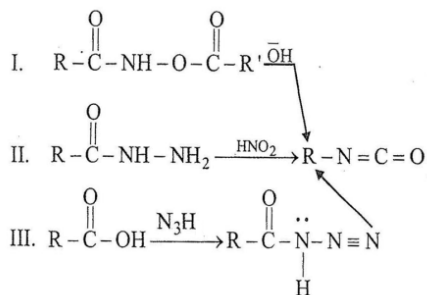


- |     | I | II  | III | IV  |
|-----|---|-----|-----|-----|
| (a) | R | R,S | R   | NS  |
| (b) | R | R,R | S   | R,R |
| (c) | R | R,S | NS  | NS  |
| (d) | R | S,R | R   | R,S |

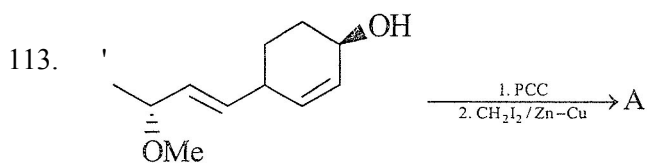
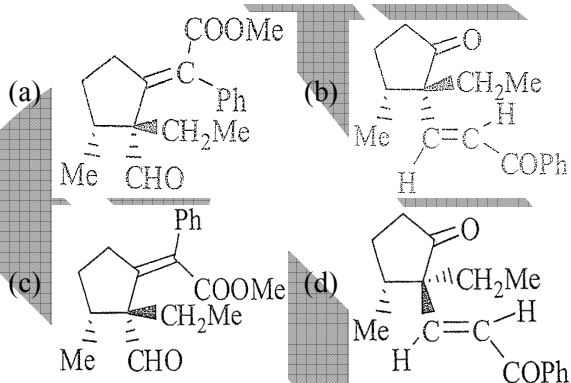
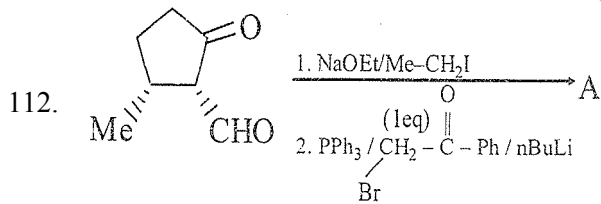
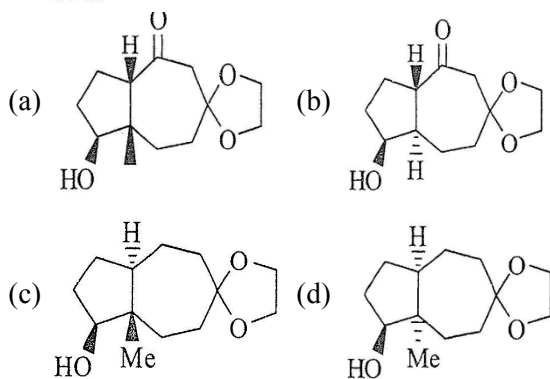
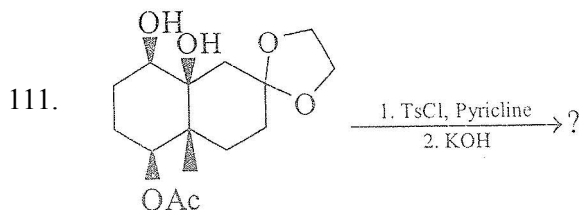
109. The optically active stereoisomer of the following compound is



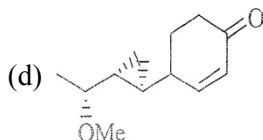
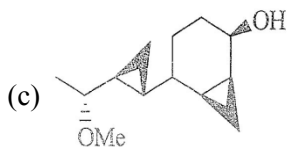
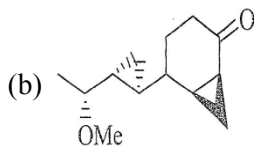
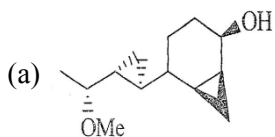
110. The following group of reaction very closely related to Hofmann involve the formation of an isocyanate, name them



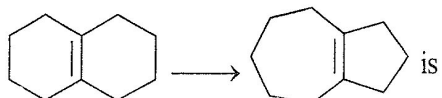
- (a) (I) Schmidt (II) Curtius (III) Lossen  
 (b) (I) Lossen (II) Curtius (III) Schmidt  
 (c) (I) Curtius (II) Lossen (III) Schmidt  
 (d) (I) Schmidt (II) Lossen (III) Curtius



What is the major product A?

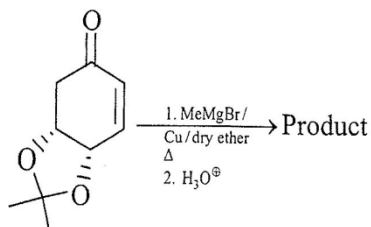


114. The most appropriate sequence of the reactions for carrying out the following conversion



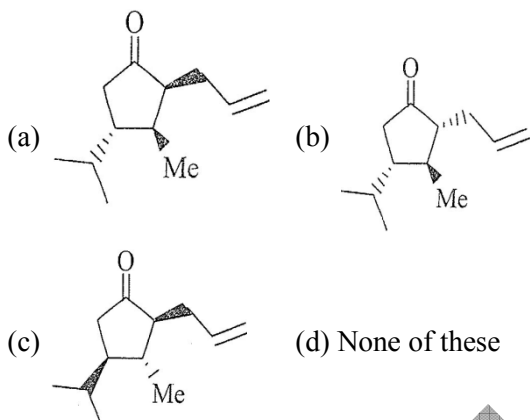
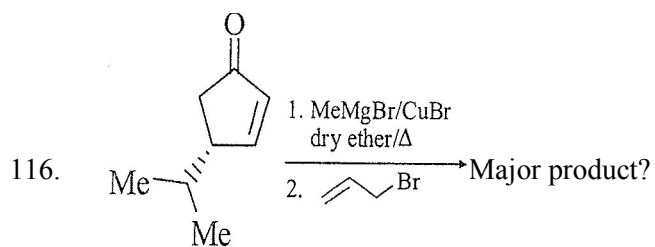
- (a) (i) peracid  
(ii)  $H^+$  (iii) Zn/dil.HCl
- (b) (i) Alkaline  $KMnO_4$   
(ii)  $NaIO_4$  (iii)  $N_2H_4/KOH$
- (c) (i) Alkaline  $KMnO_4$   
(ii)  $H^+$  (iii) Zn/dil.HCl
- (d) (i)  $O_3/Me_2S$   
(ii)  $NaOEt$  (iii)  $N_2H_4/KOH$

115.

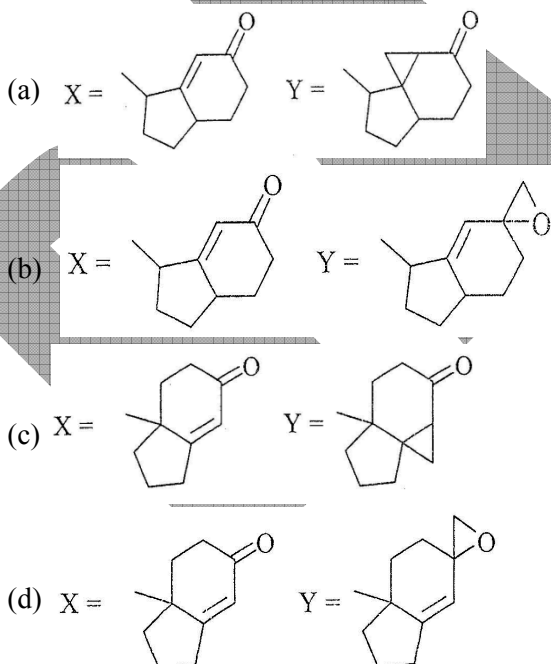
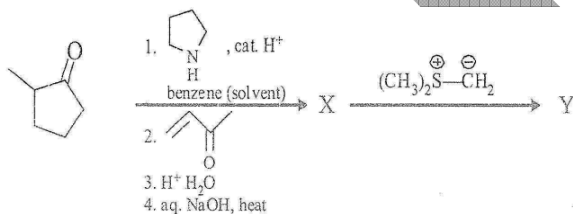


What is the major product and its selectivity of formation?

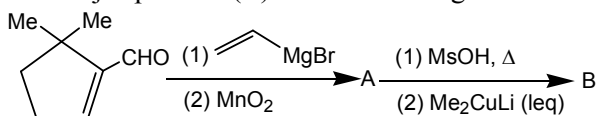
- (a) and regioselectivity
- (b) and regioselectivity and chemoselectivity both
- (c) and regioselectivity and stereoselectivity both
- (d) and stereoselectivity and chemoselectivity both

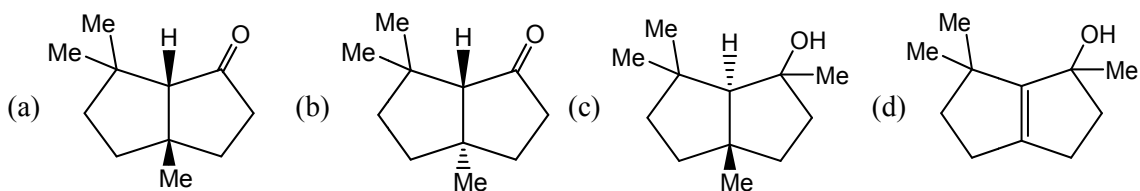


117. The major products X and Y formed in the following synthetic scheme, are

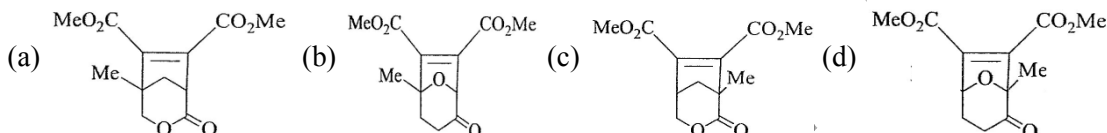
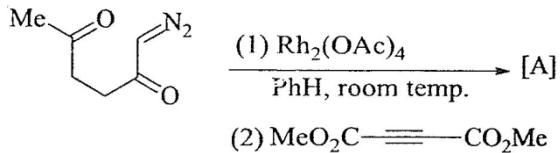


118. The major product (B) in the following reactions sequence

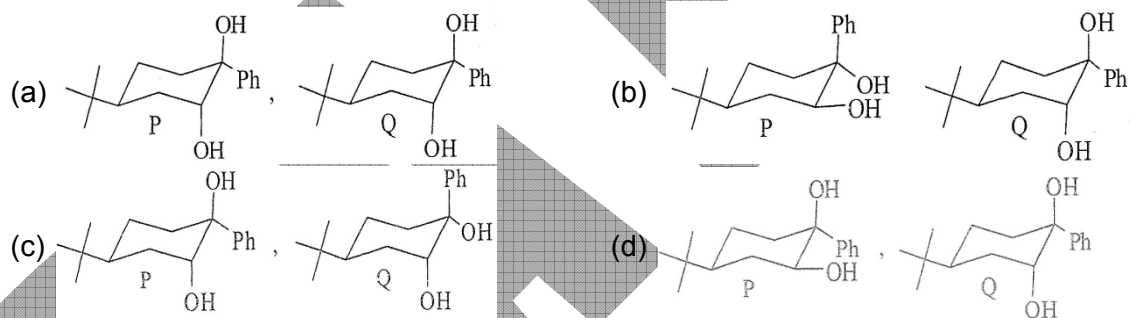
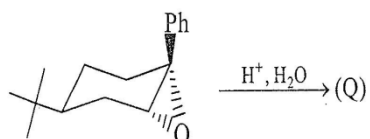
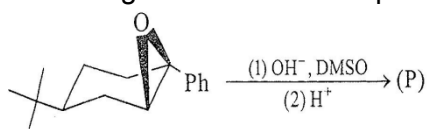




119. Give the major product [A] is



120. For the given reactions the product P and Q are,



\*\*\*\*\*End of the Test Paper\*\*\*\*\*

**RAJSI**