

Knowing your destiny is half of your journey  
& for rest to cover join us.

## INSTRUCTION

1. This Booklet contains 120 MCQ. you are required to answer any 15 question from section A, any 35 question from section B and any 25 question from section C.
2. Each question in section A & B carries 2 marks and section C question carry 4 marks each respectively.
3. There will be 25% negative marking for each wrong answer.
4. Use of calculator & Mobile is not permitted.



**CSIR NET JUNE 2017 EXAM**



CHEMICAL SCIENCE:Mock Test:01

**CSIR NET - SET - GATE - TIFR**

**SECTION A**

1. A ate grapes and pineapple; B ate grapes and oranges; C ate oranges, pineapple and apple; D ate grapes, apple and pineapple. After taking fruits, B and C fell sick. In the light of the above facts, it can be said that the cause of sickness was:

- A. Apple
- B. Pineapple
- C. Grapes
- D. Oranges

2. A person X was driving in a place where all roads ran either north-south or east-west, forming a grid. Roads are at a distance of 1 km from each other in a parallel. He started at the intersection of two roads, drove 3 km north, 3 km west and 4 km south. Which further route could bring him back to his starting point, if the same route is not repeated?

- A. 3 km east, then 2 km south
- B. 3 km east, then 1 km north
- C. 1 km north, then 2 km west
- D. 3 km south, then 1 km north

3. Five people A, B, C, D and E are seated about a round table. Every chair is spaced equidistant from adjacent chairs.

- (i) C is seated next to A
  - (ii) A is seated two seats from D
  - (iii) B is not seated next to A
- On the basis of above information, which of the following must be true?

- 1. D is seated next to B
- 2. E is seated next to A
- 3. D and C are separated by two seats

Select the correct answer using the code given below:

- A. 1 only
- B. 1 and 2 only
- C. 3 only
- D. Neither 1 nor 2 nor 3

4. There are five hobby clubs in a college — photography, yachting, chess, electronics and gardening. The gardening group meets every second day, the electronics group meets every third day, the chess group meets every fourth day, the yachting group meets every fifth day and the photography group meets every sixth day. How many times do all the five groups meet on the same day within 180 days?

- A. 5
- B. 18
- C. 10
- D. 3

5. There are some nectar-filled flowers on a tree and some bees are hovering on it. If one bee lands on each flower, one bee will be left out. If two bees land on each flower, one flower will be left out. The number of flowers and bees respectively are:

- A. 2 and 4
- B. 3 and 2
- C. 3 and 4
- D. 4 and 3

6. There are five persons in a group — P, Q, R, S and T. The group has one doctor, one lawyer and one artist. P and S are unmarried students. T is a man married to one of the group members. Q is the brother of P and is neither doctor nor artist. R is not doctor.

Who is the doctor?

- A. T
- B. P
- C. Q

D. R

7. There is an order of 19000 quantity of a particular product from a customer. The firm produces 1000 quantity of that product per out of which 5% are unfit for sale. In how many days will the order be completed?

A. 18

B. 19

C. 20

D. 22

8. A class starts at 11:00 am and lasts till 2:27 pm. Four periods of equal duration are held during this interval. After every period, a rest of 5 minutes is given to the students. The exact duration of each period is:

A. 48 minutes

B. 50 minutes

C. 51 minutes

D. 53 minutes

9. 30g of sugar was mixed in 180 ml water in a vessel A, 40 g of sugar was mixed in 280 ml of water in vessel B and 20 g of sugar was mixed in 100 ml of water in vessel C. The solution in vessel B is

A. sweeter than that in C

B. sweeter than that in A

C. as sweet as that in C

D. less sweet than that in C

10. In aid of charity, every student in a class contributes as many rupees as the number of students in that class. With the additional contribution of Rs. 2 by one student only, the total collection is Rs. 443. Then how many students are there in the class?

A. 12

B. 21

C. 43

D. 45

11. Anita's mathematics test had 70 problems carrying equal marks i.e., 10 arithmetic, 30 algebra and 30 geometry. Although she answered 70% of the arithmetic, 40% of the algebra and 60% of the geometry problems correctly, she did not pass the test because she got less than 60% marks. The number of more questions she would have to answer correctly to earn a 60% passing marks is:

A. 1

B. 5

C. 7

D. 9

12. In a class, there are 18 very tall boys. If these constitute three-fourths of the boys and the total number of boys is two-thirds of the total number of students in the class, what is the number of girls in the class?

A. 6

B. 12

C. 18

D. 21

13. Consider the following statements:

1. Either A and B are of the same age or A is older than B

2. Either C and D are of the same age or D is older than C

3. B is older than C

Which of the following conclusions can be drawn from the above statements?

A.A is older than B

B. B and D are of the same age

C.D is older than C

D. A is older than C

**14.** The monthly average salary paid to all the employees of a company was Rs. 5000. The monthly average salary paid to male and female employees was Rs. 5200 and Rs. 4200 respectively. Then the percentage of males employed in the company is

A. 75%

B. 80%

C. 85%

D. 90%

**15.** Two numbers X and Y are respectively 20% and 28% less than a third number Z. By what percentage is the number Y less than the number X ?

A. 12%

B. 10%

C. 9%

D. 8%

**16.** A daily train is to be introduced between station A and station B starting from each end at 6 AM and the journey is to be completed in 42 hours. What is the number of trains needed in order to maintain the Shuttle Service?

A. 2

B. 3

C. 4

D. 7

**17.** A piece of tin is in the form of a rectangle having length 12 cm and width 8 cm. This is used to construct a closed cube. The side of the cube is:

A. 2 cm

B. 3 cm

C. 4 cm

D. 7 cm

**18.** A person climbs a hill in a straight path from point 'O' on the ground in the direction of north-east and reaches a point 'A' after travelling a distance of 5 km. Then, from the point 'A' he moves to point 'B' in the direction of north-west. Let the distance AB be 12 km. Now, how far is the person away from the starting point 'O'?

A. 7 km

B. 13 km

C. 17 km

D. 11 km

**19.** An agricultural field is in the form of a rectangle having length  $X_1$  meters and breadth  $X_2$  meters ( $X_1$  and  $X_2$  are variable). If  $X_1 + X_2 = 40$  meters, then the area of the agricultural field will not exceed which one of the following values?

A. 400 sq m

B. 300 sq m

C. 200 sq m

D. 80 sq m

**20.** The sum of the ages of 5 members comprising a family, 3 years ago was 80 years. The average age of the family today is the same as it was 3 years ago, because of an addition of a baby during the intervening period. How old is the baby ?

A. 6 months

B. 1 year

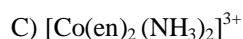
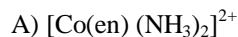


C. 2 years

D. 2 years and 6 months

**SECTION B**

21. Which of the following has an optical isomer?



22. Which of the following statements is not true?

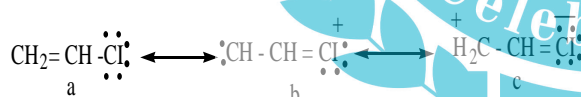
A)  $\text{MnCl}_4^{2-}$  ion has tetrahedral geometry and is paramagnetic

B)  $[\text{Mn}(\text{CN})_6]^{2-}$  ion has octahedral geometry and is paramagnetic

C)  $[\text{CuCl}_4]^{2-}$  has square planar geometry and is paramagnetic

D)  $[\text{Ni}(\text{Ph}_3\text{P})_2\text{Br}_2]$  has trigonal bipyramidal geometry and one unpaired electron

23. Vinyl halide is represented in the following resonating structures



The orders of stability of resonating structure are as follows:

A)  $a > b > c$

B)  $a > c > b$

C)  $a = b = c$

D) None of these

24. Which one of the following pairs consists of good oxidizing and a good reducing agent respectively?

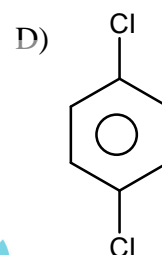
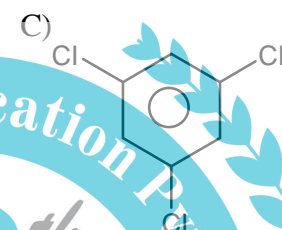
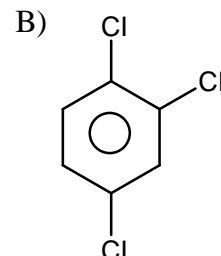
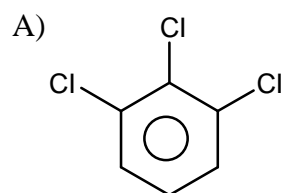
A) Ce(IV), Ln(III)

B) Ln(III), Eu(II)

C) Ce(IV), Eu(II)

D) Ln(III), Ce(III)

25. Which has maximum dipole moment?



26. Energy required when molecule excited from J to (J + 1) rotational energy state, is equal to:

A)  $2BJ(J+1)$

B)  $2BJ$

C)  $2B(J+1)$

D)  $2BJ(J-1)$

27. Zn in carbonic anhydrase is coordinated by three histidine and one water molecule. The reaction of  $\text{CO}_2$  with this enzyme is an example of

A) Electrophilic addition

B) Electron transfer

C) Nucleophilic addition

D) Electrophilic substitution

28. Point out the correct statements amongst the following:

A)  $[\text{Cu}(\text{CN})_4]^{3-}$  has tetrahedral geometry and  $dsp^2$  hybridization



B)  $[\text{Ni}(\text{CN})_6]^{4-}$  is octahedral and Ni has  $d^2sp^3$  hybridization

C)  $[\text{ZnBr}_4]^{2-}$  is tetrahedral and diamagnetic

D)  $[\text{Cr}(\text{NH}_3)_6]^{3+}$  has octahedral geometry and  $sp^3d^2$  hybridization

29.  $E_p$  for  $\text{Co}^{3+}$  is  $250 \text{ KJ mole}^{-1}$  and  $\Delta_0$  for the complex ion  $[\text{Co}(\text{CN})_6]^{3-}$  is  $345 \text{ KJ mole}^{-1}$ . Then the complex ion is

A) Paramagnetic

B) Diagonal magnetic

C) Ferromagnetic

D) None of these

30. The donor character of the following P(III) ligands in the synthesis of metal complex lie in the order.

A)  $\text{PF}_3 > \text{P}(\text{OCH}_3)_3 > \text{P}(\text{CH}_3)_3$

B)  $\text{P}(\text{CH}_3)_3 > \text{P}(\text{OCH}_3)_3 > \text{PF}_3$

C)  $\text{P}(\text{OCH}_3)_3 > \text{P}(\text{CH}_3)_3 > \text{PF}_3$

D)  $\text{PF}_3 > \text{P}(\text{OCH}_3)_3 > \text{P}(\text{CH}_3)_3$

31. Lanthanoid contraction is caused due to:

A) The same effective nuclear charge from Ce to Lu

B) The imperfect shielding on outer electrons by 4f electrons from the nuclear charge.

C) The appreciable shielding on outer electrons by 4f electrons from the nuclear charge.

D) The appreciable shielding on outer electrons by 5d electrons from the nuclear charge.

32. Which statement is NOT correct about complexes formed by the lanthanoids?

A) Hard donor ligands are favoured over soft donor ligands.

B) The 4f atomic orbitals do not play a significant part in metal – ligand bonding.

C) High coordination number are often observed.

D) Aqua ions are typically 6 – coordinate.

33. Which of the following chromatographic technique can analyze all types of sample?

A) Liquid chromatographic

B) Gas chromatographic

C) Super critical fluid chromatographic

D) High performance liquid chromatographic

34. Which compound would be expected to show intense IR absorption at  $1746 \text{ cm}^{-1}$ ?

A)  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$

B)  $\text{CH}_3\text{CO}_2\text{CH}_3$

C)  $\text{CH}_3\text{CH}_2\text{CCH}_3$

D)  $\text{CH}_3\text{CH}_2\text{SCH}_3$

35. The value of  $\Delta H_{\text{sol}}$  of  $\text{BaCl}_2(\text{s})$  and  $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}(\text{s})$  are  $-a \text{ kJ}$  and  $b \text{ kJ}$  respectively. The value of  $\Delta H_{\text{Hydration}}$  of  $\text{BaCl}_2(\text{s})$  is:

A)  $b - a$

B)  $a + b$

C)  $-a - b$

D)  $a - b$

36. If  $E_f$  and  $E_b$  are the activated energies of the forward and reverse reactions and the reaction is known to be exothermic, then

A)  $E_f < E_b$

B)  $E_f > E_b$

C)  $E_f = E_b$

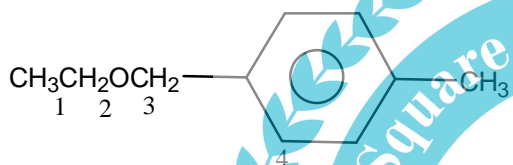
D) Data insufficient to predict



37. In water molecule which of the following matrices represent  $\sigma_v$  operation

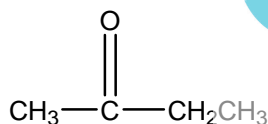
- A)  $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$   
 B)  $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$   
 C)  $\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$   
 D)  $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

38. Which of the following protons gives an NMR signal with the lowest chemical shift value (farthest up field)?



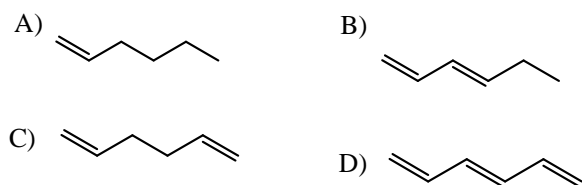
- A) 1  
 B) 2  
 C) 3  
 D) 4

39. Which of the following m/z values is the base peak for 2-butanone?



- A) 15  
 B) 29  
 C) 43  
 D) 57

40. Which of the following compounds exhibits the highest  $\lambda_{\max}$  in UV spectra?



41. In a compound  $XY_2O_4$ , oxide ions are arranged in CCP and cations X are present in octahedral voids. Cations Y are equally distributed between octahedral and tetrahedral voids. The fraction of the octahedral voids occupied in:

- A) 1/2  
 B) 1/4  
 C) 1/8  
 D) 1/6

42. A 100.0 mL dilute solution of  $Ag^+$  is electrolyzed for 15.0 minute with a current of 1.25 mA and the silver is removed completely. What is the initial  $[Ag^+]$ ?

- A)  $2.32 \times 10^{-1}$   
 B)  $2.32 \times 10^{-4}$   
 C)  $2.32 \times 10^{-3}$   
 D)  $1.16 \times 10^{-4}$

43. Laser light scattering of Polymeric solutions is done to find out the following of Polymers

- A. Mass  
 B. Density  
 C. Particle sizes  
 D. Inherent viscosity

44. Which of the following function are acceptable in quantum mechanics?

- A)  $\tan x$ ; for  $0 \leq x \leq \frac{x}{2}$   
 B)  $\operatorname{cosec} x$ ; for  $0 \leq x \leq \frac{x}{2}$   
 C)  $\cos x + \sin x$ ; for  $0 \leq x \leq \frac{x}{2}$   
 D) None of these

45. The normalised wave function for the particle in a one-dimensional box is:

A)  $\Psi = \sqrt{\frac{2}{a}} \cdot \sin \frac{n\pi x}{a}$

B)  $\Psi = \sqrt{\frac{a}{2}} \cdot \sin \frac{n\pi x}{a}$

C)  $\Psi = a \sin \frac{n\pi x}{2a}$

D)  $\Psi = a^2 \cos \frac{n\pi x}{2a}$

46. At any temperature T, the entropy of a solid substance ( $S_T$ ) given by the expression

A)  $C_p dT$

B)  $\int_0^T \frac{C_p dT}{T}$

C)  $C_p / T$

D)  $\frac{C_p - C_v}{T}$

47. Select the correct statements.

I. For an electron, the spin quantum number is  $s = \frac{1}{2}$

II. The energy of the electron decreases as the value of n increases.

III. The spin magnetic quantum number is  $m_s = s, s - 1, \dots, -s$ ; for an electron,  $m_s = +\frac{1}{2}, -\frac{1}{2}$

- A) I and II  
 B) II and III  
 C) I and III  
 D) I, II and III

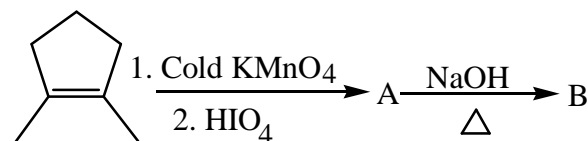
48. Arrange in increasing  $pK_a$

- a)  $O_2N - CH_2 - COOH$   
 b)  $HOOC - CH_2 - COOH$   
 c)  $CH_3 - CH_2 - COOH$

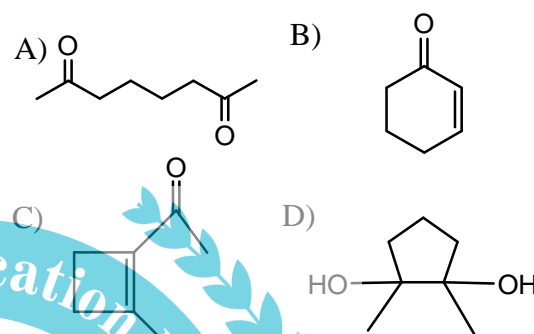
- A)  $a < b < c$   
 B)  $c < b < a$   
 C)  $b < a < c$

D)  $b < c < a$

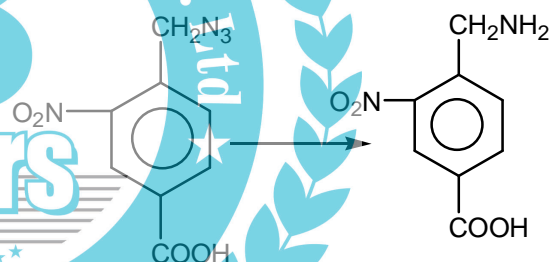
49. Consider the following sequence of reaction:



The product B is:

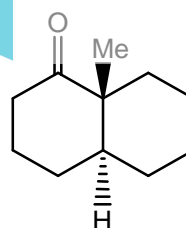


50. The reagent of the given transformation is:



- A)  $NaBH_4$   
 B)  $LiAlH_4$   
 C) DIBAL  
 D) All of these

51. The configuration at the two asymmetric centres (C - 1 and C - 6) in the molecular given below are

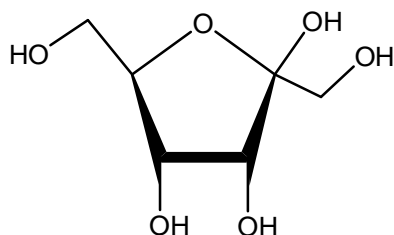


- A) 1R, 6R  
 B) 1R, 6S  
 C) 1S, 6S



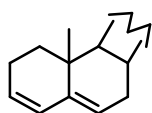
D) 1S, 6R

52. Which description fit the following sugar best?



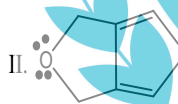
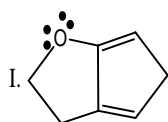
- A) Ketose, furanose,  $\alpha$   
 B) Ketose, furanose,  $\beta$   
 C) Aldose, pyranose,  $\beta$   
 D) Aldose, pyranose,  $\alpha$

53. What is the calculated  $\lambda_{\max}$  for



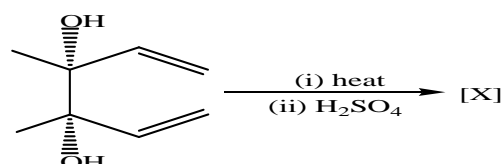
- A) 234 nm  
 B) 229 nm  
 C) 239 nm  
 D) 217 nm

54. Rank in the order of increasing rate in a Diels-Alder reaction.

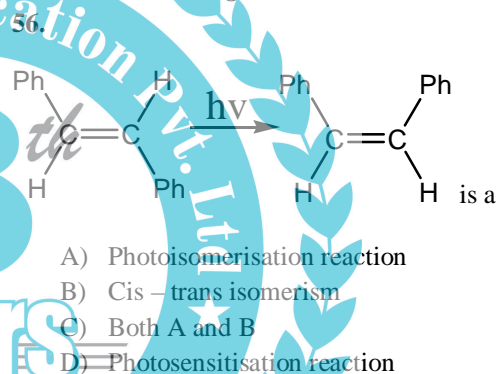
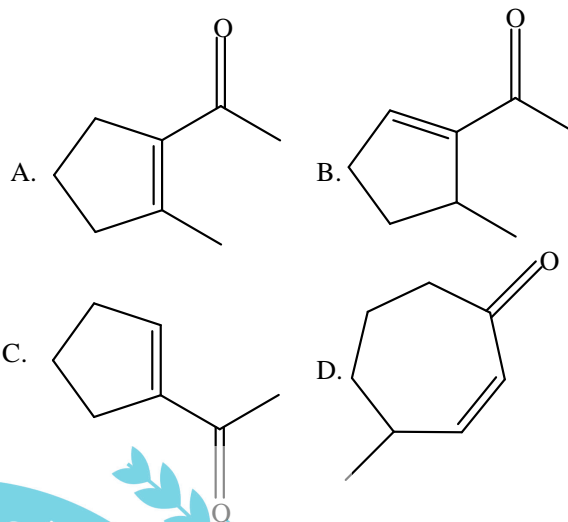


- A. II < I < III  
 B. II < III < I  
 C. III < I < II  
 D. III < II < I

55. In the reaction



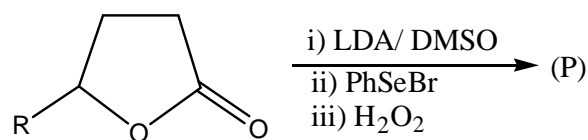
The major product [X] is :

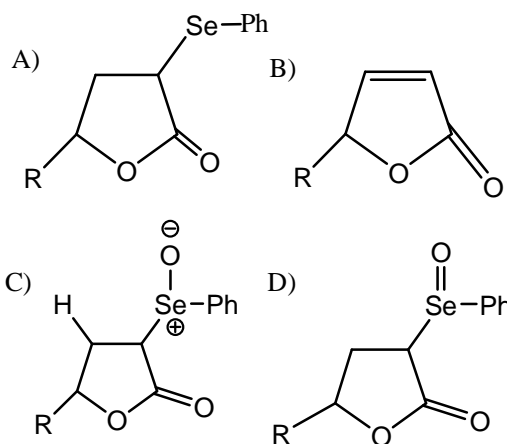


Which of the following orders is correct for heat of combustion of these isomers?

- A) I > II > III  
 B) III > II > I  
 C) II > III > I  
 D) I > III > II

58. The product of the reaction is:





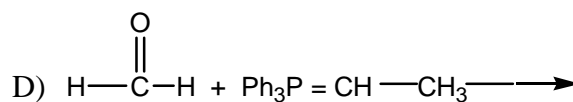
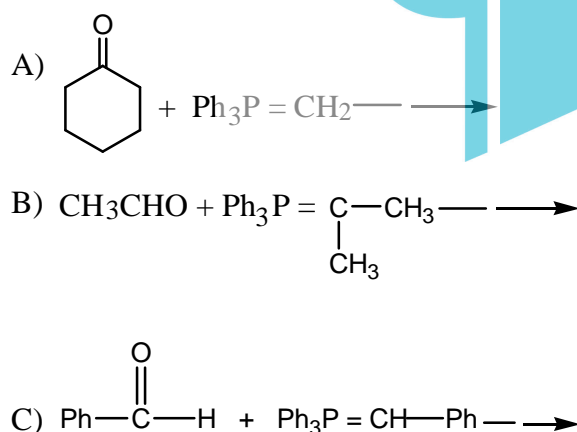
59. Arrange acidity of given alcohols in decreasing order:

1. 4-nitro-1-butanol
2. 2-nitro-1-butanol
3. 3-nitro-1-butanol
4. 1-butanol

Select the correct answer from the codes given below:

- A) 1,2,4,3
- B) 1,2,3,4
- C) 2,3,1,4
- D) 2,3,4,1

60. In which of the following reactions, two products will be formed other than phosphonium ylide ( $\text{POPh}_3$ )



### SECTION C

61. Match List - I (lanthanide ion) and List - II (magnetic moment) and select the correct answer using the codes given below:

List - I	List - II
P. $\text{Er}^{3+}$	1. 7.6 BM
Q. $\text{Gd}^{3+}$	2. 9.6 BM
R. $\text{Tm}^{3+}$	3. 2.83 BM
S. $\text{Pm}^{3+}$	4. 7.94 BM
	5. 3.68 BM

- A) P-2, Q-4, R-1, S-3
- B) P-5, Q-2, R-3, S-4
- C) P-4, Q-2, R-3, S-1
- D) P-5, Q-2, R-3, S-1

62.  $\text{CeI}_2$  has metallic luster. It is explained by formulating it as:

- A)  $\text{Ce(III)}, 2f^7, e^-$
- B)  $\text{Ce(II)}, 2f^7$
- C)  $\text{Ce(IV)}, 2f^7, 2e^-$
- D) None of the above.

63. In a spectrophotometric experiment, 84.9% of the incident light is absorbed by the solution under investigation. If the solution is of concentration  $0.069 \text{ mol dm}^{-3}$ , and the path length of the cell is 12.5 mm, the molar absorption coefficient of the solution is:

- A.  $2.24 \text{ mol}^{-1} \text{ dm}^{-3} \text{ cm}^{-1}$
- B.  $0.0824 \text{ mol}^{-1} \text{ dm}^{-3} \text{ cm}^{-1}$
- C.  $0.824 \text{ mol}^{-1} \text{ dm}^{-3} \text{ cm}^{-1}$
- D.  $1.21 \text{ mol}^{-1} \text{ dm}^{-3} \text{ cm}^{-1}$

64. In liquid HF solution following reaction proceeds:



The role of  $AsF_5$  is:

- A.Reducing Agent,  $F^-$  acceptor
- B.Oxidizing agent,  $F^-$  acceptor
- C.Oxidizing agent,  $F^-$  donor
- D.Reducing agent,  $F^-$  donor

65. Atoms  ${}_7X^A$ ,  ${}_8Y^B$ , and  ${}_9Z^{17}$  are such that  ${}_8Y$  is an isobar of  ${}_7X$  and atom  ${}_9Z^{17}$  is isotone of  ${}_8Y$ . Mass no. of X and no. of neutrons in Y are respectively.

- A) 8, 8
- B) 17, 7
- C) 9, 8
- D) 16, 8.

66. In a potentiometric titration, the end point is characterised by

- A)  $\frac{dE}{dV} = 0, \frac{d^2E}{dV^2} = 0$
- B)  $\frac{dE}{dV} \neq 0, \frac{d^2E}{dV^2} = 0$
- C)  $\frac{dE}{dV} = 0, \frac{d^2E}{dV^2} \neq 0$
- D)  $\frac{dE}{dV} \neq 0, \frac{d^2E}{dV^2} \neq 0$

Where E is the emf of the titration cell and V is the volume of the titrant added.

67. Red  $\beta$  - ketoenolate complex of Ni (II) are diamagnetic the red turns bluish green in presence of water and become paramagnetic. Which of the following structure formed during the reaction?

- A) Tetrahedral
- B) Square planner
- C) Octahedral
- D) Dodecahedral

68. The ligand field bands of lanthanide complexes are generally sharper than those of transition metal complexes because:

A) Transitions are allowed for lanthanide complexes

B) Intensity of the bands are higher for lanthanide complexes

C) f - orbitals have higher energy than d - orbitals

D) f - orbitals, compared to d - orbitals, interact less effectively with ligands.

69. John - Teller distortion can be found in these complex:

- A) Ti (III), Cu (II), HsFe(III)
- B) Cu (I), Ni (II), HsFe (III)
- C) Cu (II), LsFe (III), Ti (III)
- D) LsFe (III), Mn(II), Cu(I)

70. Match List-I (The metalloenzymes) with List - II (The metal present in the enzyme) and select the correct answer using the codes given below the lists:

List - I	List - II
I. Caroxypeptidase	P. Fe
II. Cytochrome	Q. Cu
III. Nitrogenase	R. Zn
IV. Ascorbate oxidase	S. Mo

- A) I - R, II - Q, III - P, IV - S
- B) I - P, II - R, III - S, IV - Q
- C) I - S, II - Q, III - R, IV - P
- D) I - R, II - P, III - S, IV - Q

71. The  $^{19}F$  NMR spectrum of  $PCl_2F_3$  (I for  $^{31}P = \frac{1}{2}$ , I for  $^{19}F = \frac{1}{2}$ ) shows:-

- A) Two triples and two doublets
- B) Two triplet and one doublet
- C) Two doublet and one triplet
- D) Three triplet and one doublet

72. The mass spectrum of an unknown compound has a molecular ion peak with a relative abundance of 43.27% and an  $M + 1$  peak with a relative abundance of 3.81%. How many carbon atoms are in the compound?

- A) 8  
B) 4  
C) 6  
D) 2

73.  $[NiL_5]$  (where L is neutral) types of compounds can have trigonal bipyramidal (tbp) and square pyramidal (sp) geometries. Which one of the following is correct about magnetic properties of these types of geometries?

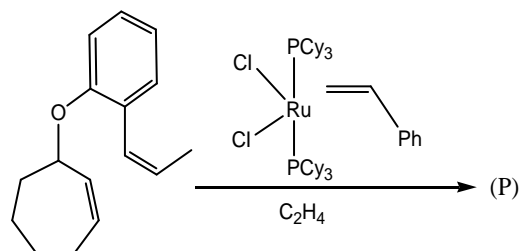
- A)  $[NiL_5]$  with sp geometry is paramagnetic only  
B)  $[NiL_5]$  with tbp geometry is paramagnetic only  
C)  $[NiL_5]$  with tbp and sp geometries is diamagnetic  
D)  $[NiL_5]$  with tbp and sp geometries is paramagnetic.

74. The increasing order of wavelength of absorption for the complex ions:

- I.  $[Cr(NH_3)_6]^{3+}$   
II.  $[CrCl_6]^{3-}$   
III.  $[Cr(OH_2)_6]^{3+}$   
IV.  $[Cr(CN)_6]^{3-}$  IS:

- A)  $IV < II < I < III$   
B)  $IV < III < II < I$   
C)  $IV < I < III < II$   
D)  $II < III < I < IV$

75.



P is:



76. Arrange the following in order of decreasing boiling point:

- I) n - Butane  
II) n - Butanol  
III) n - Butyl chloride  
IV) Isobutane

- A)  $IV > III > II > I$   
B)  $IV > II > III > I$

C) I > II > III > IV

D) II > III > I > IV

77. Match list I with II and select the correct answer using the codes given below the lists

List I (Equiv. conductance at 1024 dilution)	List II (Formula)
P. 229	1. $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$
Q. 97	2. $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
R. 404	3. $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$
S. 523	4. $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$

A) P – 3, Q – 1, R – 2, S – 4

B) P – 1, Q – 4, R – 3, S – 2

C) P – 1, Q – 3, R – 4, S – 2,

D) P – 3, Q – 2, R – 1, S – 4.

78. The spin – only magnetic moment (in B.M.) value of  $[\text{FeF}_6]^{3-}$  and  $[\text{Co}(\text{CN})_5(\text{H}_2\text{O})]^{3-}$  respectively are:

A) 0 and 1.73

B) 5.92 and 1.73

C) 4.47 and 1.73

D) 5.92 and 3.87

79. Match list I with list II and select the correct answer:

List I (species)	List II (O – N – O angle)
I. $\text{NO}_2^+$	P. $180^\circ$
II. $\text{NO}_2$	Q. $132^\circ$
III. $\text{NO}_2^-$	R. $120^\circ$
IV. $\text{NO}_3^-$	S. $115^\circ$
	T. $109^\circ$

A) I – T, II – S, III – R, IV – Q

B) I – T, II – Q, III – S, IV – R

C) I – P, II – Q, III – S, IV – R

D) I – P, II – S, III – R, IV – Q.

80. Which oxidation states correctly represent the usual range exhibited by the stated metal?

A) Ce; + 3 and + 4

B) Th; + 2 and + 4

C) Pu; + 3, + 4, + 5 and +6

D) U; +2, +3 and +4

81. According to collision theory, most molecular collisions don't lead to reaction. Which of the following are necessary for collisions to successfully lead to reaction?

1. The total kinetic energy of the collision must be greater than some minimum value.

2. A catalyst must be present at the collision.

3. The colliding particles must be properly oriented in space when they collide.

A) 1, 2 and 3

B) 1 only

C) 1 and 3

D) 2 and 3

82. With regard to kinetics, which of the following statements is (are) false?

I) The rate constant (k) can be affected by change in temperature.

II) The addition of a catalyst lowers the activation energy barrier by changing the overall thermodynamics of reaction.

III) Increasing the temperature decreases the activation energy barrier

A) II, III and IV

B) I, II and III

C) II and III

D) I and IV

83. Find the mean deviation from the following data.

Weight (g)	15.11	15.38	15.32	15.36	15.23
Deviation	0.17	0.10	0.04	0.08	0.05

A) 1.88

B) 0.188



- C) 18.8  
D) 0.088

84. Select the correct statements:

I: Spectroscopic transition are changes in populations of quantized energy levels of a system involving the absorption, emission, or scattering of electromagnetic radiation,  $\Delta E = h\nu$ .

II. Degenerates levels are of different energies.

III. The photoelectric effect is the ejection of electrons from metals when they are exposed to ultraviolet radiation:  $\frac{1}{2} m_e v^2 = h\nu - \Phi$ , where  $\Phi$  is the work function, the energy required to remove an electron from the metal to infinity.

- A) I and II  
B) II and III  
C) I and III  
D) I, II and III

85. Select the correct statements:

I. Perturbation theory is a technique that supplies approximate solution to the Schrodinger equation and in which the Hamiltonian for the problem is expressed as a sum of simpler Hamiltonians.

II. In classical physics, radiation is described in terms of an oscillating electromagnetic disturbance that travels through vacuum at a constant speed  $c = \lambda\nu$ .

III. A black body is an object that emits and absorbs all frequencies of radiation uniformly.

- A) I and II  
B) II and III  
C) I and III  
D) I, II and III

86. Match List – I with List – II and select the correct answer using the codes given below the lists:

List – I	List – II
P) $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$	1. $C_{3v}$
Q) $\text{Fe}_2(\text{CO})_9$	2. $D_{3h}$
R) Eclipsed ferrocene	3. $O_h$
	4. $D_{3d}$
	5. $D_{5h}$
	6. $D_{4h}$

- A) P – 3, Q – 2, R – 5  
B) P – 6, Q – 4, R – 5  
C) P – 6, Q – 2, R – 5  
D) P – 3, Q – 6, R – 4

87. The character table of  $C_{3v}$  point group is provided below, along with an additional reducible representation,  $\Gamma$

	E	$2C_3$	$3\sigma_v$
$A_1$	1	1	1
$A_2$	1	1	-1
E	2	-1	0
$\Gamma$	6	0	2

$\Gamma$  is given by

- A)  $A_1 + A_2 + 2E$   
B)  $2A_1 + 2E$   
C)  $2A_2 + 2E$   
D)  $2A_1 + 2A_2 + E$

88. Select the correct statements:

I. The Hamiltonian operator is the operator for the total energy of a system,  $\hat{H}\Psi = E\Psi$  and is the sum of the operators for kinetic energy and potential energy.

II. There are five unpaired electrons in  $(n - 1) d$  suborbitals in  $\text{Fe}^{3+}$ .

III. The expectation value of an operator is  $\langle \Omega \rangle = \int \Psi^* \hat{\Omega} \Psi dt$ .

- A) I and II  
B) II and III  
C) I and III  
D) I, II and III

89. The population of  $J^{\text{th}}$  rotational level N is given by  $N_J = N_0 (2J + 1) e^{-[j(j+1)B]/kT}$ . The J value of rotational level with maximum population ( $J_{\text{max}}$ ) is given by:

- A)  $\frac{(2kT)}{B} - 1$   
 $\sqrt{2}$

B)  $\frac{\sqrt{2kT/B}-1}{2}$

C)  $\frac{kT}{B}$

D)  $\frac{B}{kT}$

90. Iron crystallizes in a bcc system with a lattice parameter of 2.861 Å. Calculate the density of iron in the bcc system (Atomic weight of Fe = 56,  $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$ ).

A) 7.92 g mL<sup>-1</sup>

B) 8.96 g mL<sup>-1</sup>

C) 2.78 g mL<sup>-1</sup>

D) 6.72 g mL<sup>-1</sup>

91. What is the molecular mass (M) of a compound that has a concentration  $w = 1$ . An osmotic pressure of  $\Pi = 0.20 \text{ atm}$  at  $T = 300 \text{ K}$ ?

A)  $M = 576 \text{ g/mol}$

B)  $M = 3876 \text{ g/mol}$

C)  $M = 147 \text{ g/mol}$

D)  $M = 9818 \text{ g/mol}$

92. Which of the following may be used to define chemical potential: -

1)  $\left(\frac{\partial G}{\partial n_i}\right)_{T, P, n_j}$

2)  $\left(\frac{\partial A}{\partial n_i}\right)_{T, V, n_j}$

3)  $\left(\frac{\partial H}{\partial n_i}\right)_{S, P, n_j}$

4)  $\left(\frac{\partial E}{\partial n_i}\right)_{S, V, n_j ; i \neq j}$

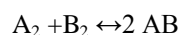
A) 1 only

B) 2 only

C) 3 only

D) 1, 2, 3 and 4

93. Two compartments X and Y are separated by an impermeable partition P. In the compartment X, the following reaction is going on in a solvent S. while the compartment Y contains only the solvent S:



Contains of both the compartments are continuously and vigorously stirred. After the reaction in the compartment X has reached equilibrium, the concentrations of  $A_2$ ,  $B_2$  and AB are measured and the equilibrium constant calculated. Then the partition is quickly removed. After waiting for a very long time, all the concentrations are measured again, and the new value of the equilibrium constant calculated. What is the most appropriate statement you can make about the result of this experiment? Assume that the chemicals are behaving ideally and the temperature is kept constant.



A) The concentrations of all the chemicals and the equilibrium constant will be less than their values before the partitions was removed.

B) After removing the partitions, the concentrations of  $A_2$  and  $B_2$  will increase, and that of AB will decrease.

C) After removing the partition, the concentrations of  $A_2$  and  $B_2$  will decrease, and that of AB will increase.

D) After removing the partition, the concentrations of all the chemical will decrease.

94. An ensemble of quantum harmonic oscillators is kept at a finite temperature  $T = \frac{1}{k_B \beta}$ ; the partition

function of a single oscillator with energy levels  $(n + \frac{1}{2}) h\omega$  is given by:

A)  $Z = \frac{e^{-\beta h\omega/2}}{1 - e^{-\beta h\omega}}$

B)  $Z = \frac{e^{-\beta h\omega/2}}{1 + e^{-\beta h\omega}}$

C)  $Z = \frac{1}{1 - e^{-\beta h\omega}}$

D)  $Z = \frac{1}{1 + e^{-\beta h\omega}}$

95. A linear polyatomic molecule has one or more degenerate modes of vibration. If these are counted as a single vibration, then equation  $B_v = B_e - \sum_i \alpha_i (v_i + \frac{1}{2})$  for the rotational constant  $B_v$  becomes

A)  $B_v = B_e - \sum_i \alpha_i (V_i - d_i/2)$

B)  $B_v = B_e - \sum_i \alpha_i (V_i + d_i/2)$

C) Both A and B

D) None of these

96. Which of the following is/are true for physical adsorption ?

I. Extent of adsorption increases with pressure increase.

II. It requires large activation energy.

III. It can be easily reversed.

IV. It is preferred at high temperature.

A. I and III

B. I and II

C. III and IV

D. II and III

97. For  $[\text{CoI}_4]^-$  (I),  $[\text{Co}(\text{Br}_4)]^-$  (II) and  $[\text{CoCl}_4]^-$  (III), the ligand to metal charge transfer bands increase in energy in the order:

A) I < III < II

B) I < II < III

C) III < II < I

D) II < I < III

98. Calculate the equilibrium constant for the reaction  $\text{Fe}^{2+} + \text{Ce}^{4+} \rightleftharpoons \text{Fe}^{3+} + \text{Ce}^{3+}$ .

Given that:  $E^\circ_{\text{Ce}^{4+}/\text{Ce}^{3+}} = 1.44 \text{ V}$ ,

$$E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.68 \text{ V}.$$

A)  $7.6 \times 10^{11}$

B)  $7.6 \times 10^{10}$

C)  $7.6 \times 10^{12}$

D)  $7.6 \times 10^9$

99. Based on the molecular terms symbols of various 'd' electron systems, which of the following are expected not to show less than three electronic transitions:

A.  $d^4, d^9$

B.  $d^2, d^7$

C.  $d^6, d^8$

D.  $d^3, d^1$

100. The rate constant, the activation energy and Arrhenius parameter of a chemical reaction at  $25^\circ \text{C}$

are  $3.0 \times 10^{-4} \text{ sec}^{-1}$ ,  $104.4 \text{ kJ mol}^{-1}$  and  $6.0 \times 10^4 \text{ sec}^{-1}$  respectively. The value of the rate constant as  $T \rightarrow \infty$  is:

A)  $2 \times 10^{18} \text{ sec}^{-1}$

B)  $6.0 \times 10^4 \text{ sec}^{-1}$

C) Infinity

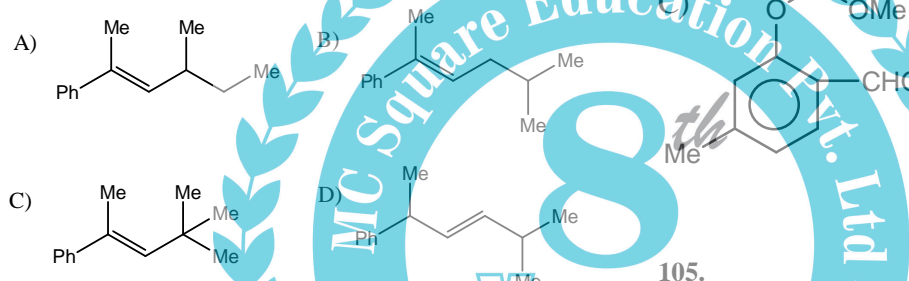
D)  $3.6 \times 10^{30} \text{ sec}^{-1}$

101. The correct stability order of the following resonance structure is:

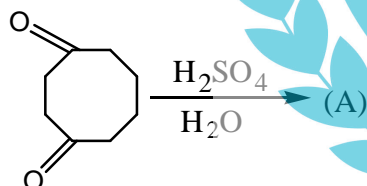
- I)  $\text{H}_2\text{C} = \overset{+}{\text{N}} = \overset{-}{\text{N}}$   
 II)  $\text{H}_2\overset{+}{\text{C}} - \overset{-}{\text{N}} = \overset{-}{\text{N}}$   
 III)  $\text{H}_2\overset{-}{\text{C}} - \overset{+}{\text{N}} \equiv \overset{-}{\text{N}}$   
 IV)  $\text{H}_2\overset{-}{\text{C}} - \overset{+}{\text{N}} = \overset{+}{\text{N}}$

- A) I > II > IV > III  
 B) I > III > II > IV  
 C) II > I > III > IV  
 D) III > I > IV > II

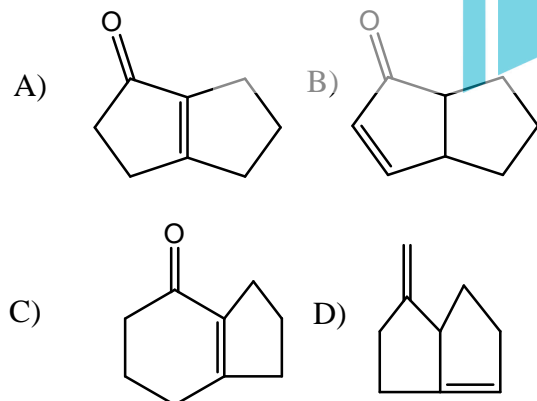
102. An optically active aromatic alkene ( $\text{C}_{13}\text{H}_{18}$ ) on ozonolysis gives acetophenone as one of the products. What is the structure of the alkene?



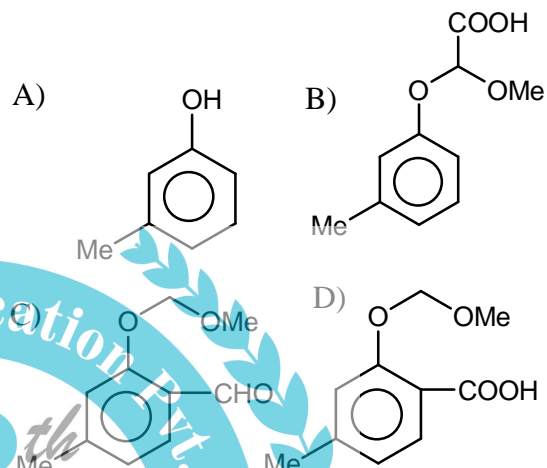
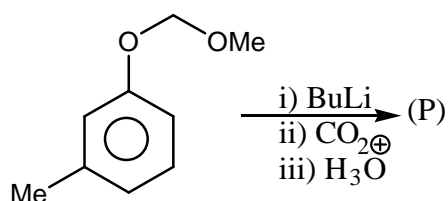
103. This is an example of an intramolecular aldol reaction:



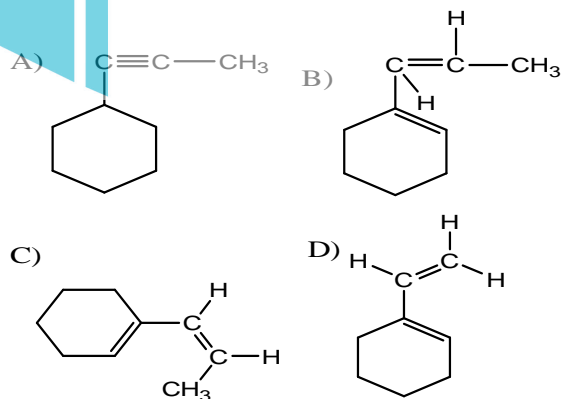
Product (A) is:



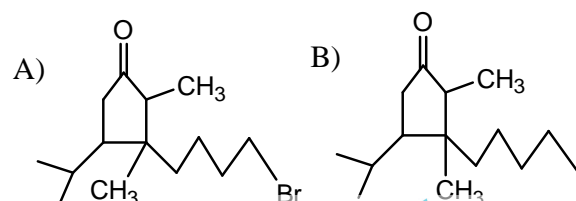
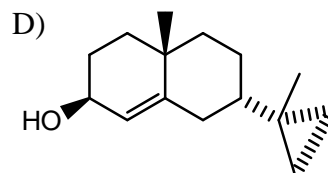
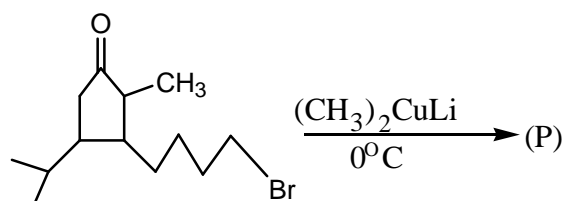
104. Product (P) of the reaction is:



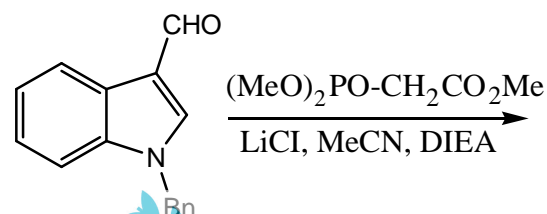
Product (B) is:



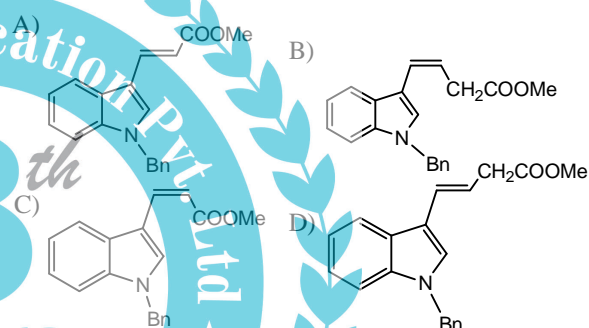
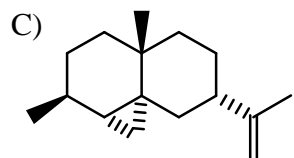
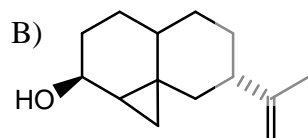
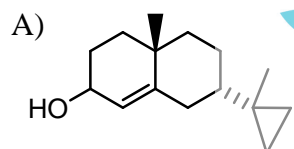
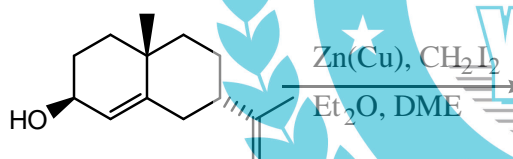
106. The product of the reaction is:



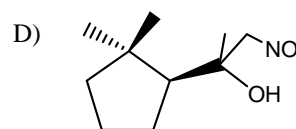
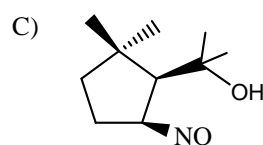
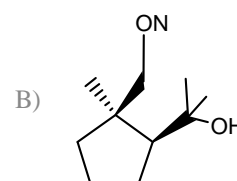
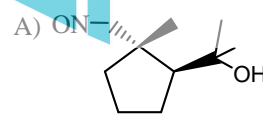
108.



107.

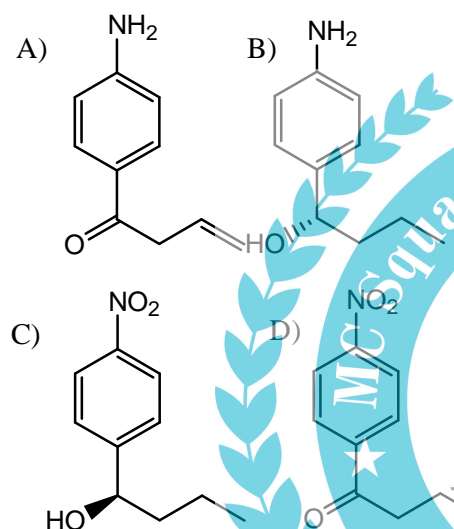
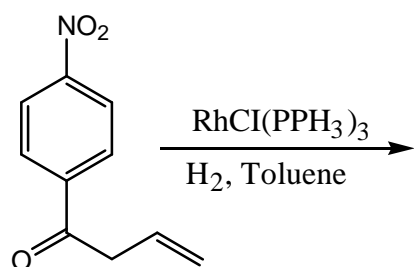


109. Identify the product formed in the following reaction:

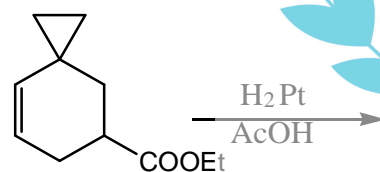




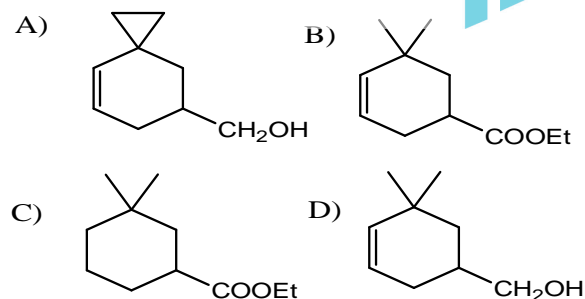
110. The major product formed in the following reaction is:



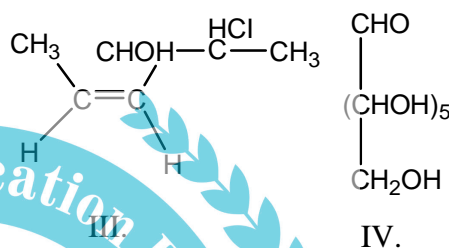
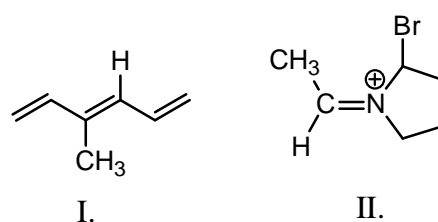
111.



Product is:



112. Arrange the following compounds in decreasing order for stereogenic centres.



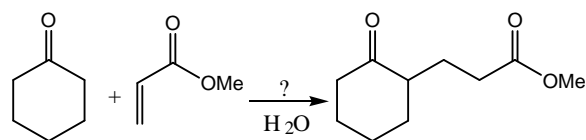
Select the correct answer from the codes given below:

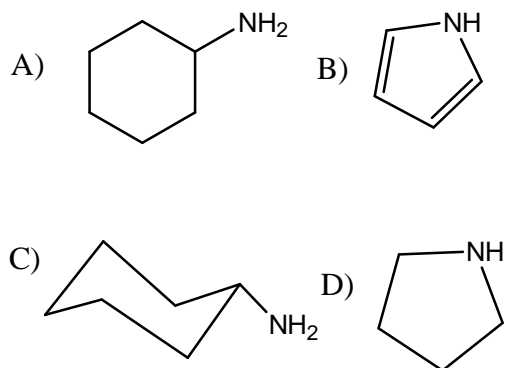
- A) I > II > III > IV  
 B) IV > III > II > I  
 C) IV > III > I > II  
 D) I > III > IV > II

113. In an absorption cell, the transmittance of 0.1 M solution of a substance 'X' is 80% and that of 0.1 M solution of another substance 'Y' is 60% at a given wavelength. The transmittance of a solution that is simultaneously 0.1 M in 'X' and 0.1 M in 'Y' will be.

- A) 70%                      B) 80%  
 C) 58%                      D) 48%

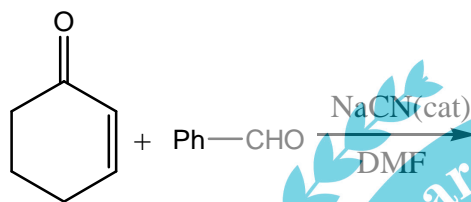
114. Which of the following reagents is best suited for the following reactions?



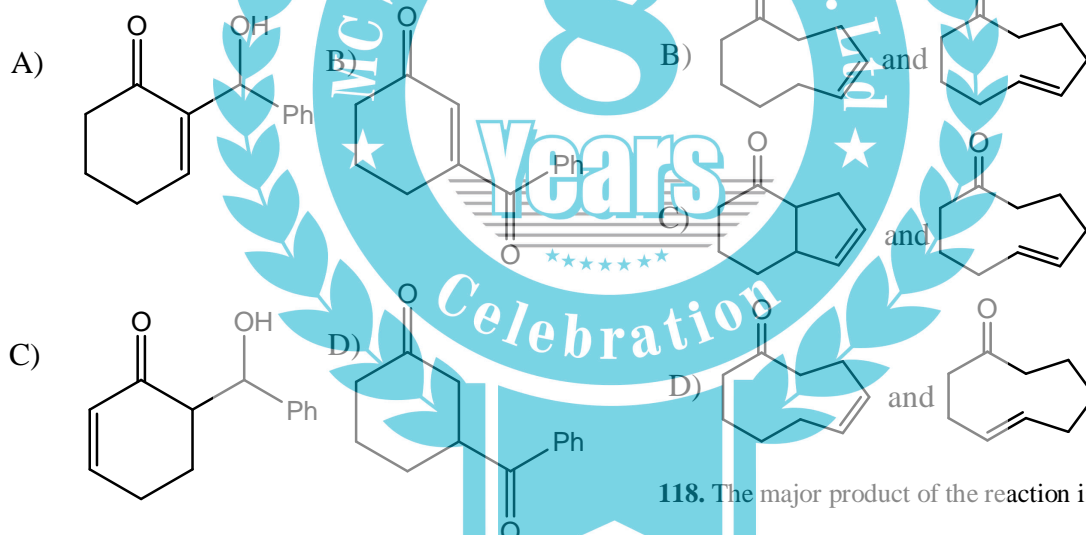


1. Cis – trans isomerism
  2. Photo isomerism
  3. Intramolecular energy transfer
- A) 1 and 2  
B) 1 and 3  
C) Only 1  
D) 1, 2 and 3.

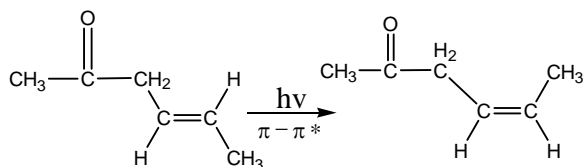
115. In the following reaction:



The major product [X] is:

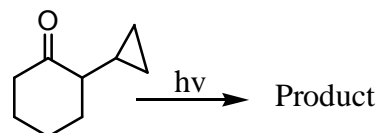


116.



Is an example of:

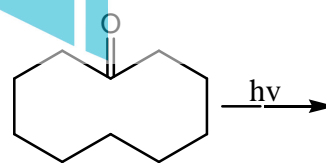
117.

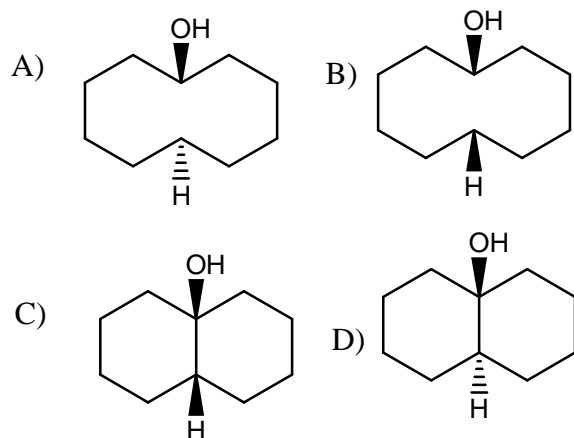


The product is:

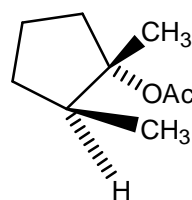


118. The major product of the reaction is:

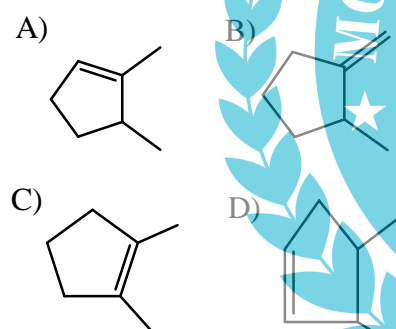




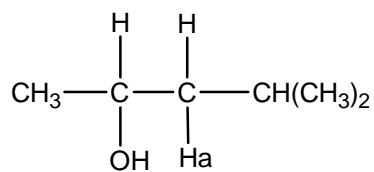
119.



Which of the following product cannot be obtained by this reaction.



120. How many lines are given by 'H<sub>a</sub>' proton in the <sup>1</sup>H-NMR spectrum of the compounds?



- A) 8 lines  
B) 6 lines  
C) 4 lines  
D) 2 lines

