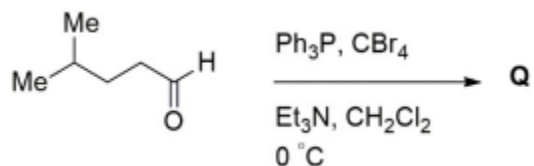
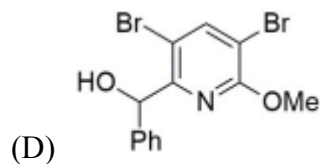
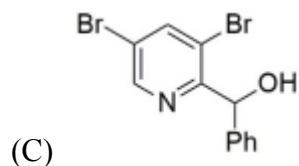
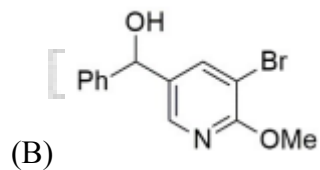
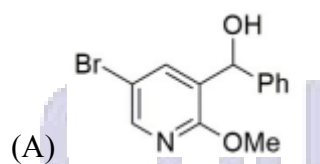
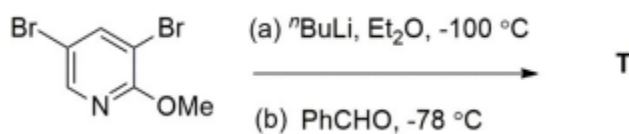


Q1) The major product in the given reaction is Q. The mass spectrum of Q shows { [M] = molecular ion peak }

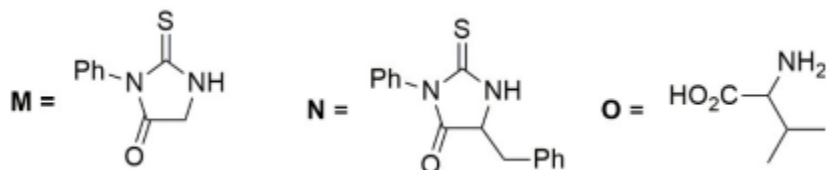


- (A) [M], [M+2] and [M+4] with relative intensity of 1:2:1
 (B) [M] and [M+2] with relative intensity of 1:1
 (C) [M], [M+2] and [M+4] with relative intensity of 1:3:1
 (D) [M] and [M+2] with relative intensity of 2:1

Q2) The major product T formed in the following reaction is



Q3) A tripeptide on treatment with PhNCS (pH = 8.0) followed by heating with dilute HCl afforded a cyclic compound M and a dipeptide. The dipeptide on treatment with PhNCS (pH = 8.0) followed by heating with dilute HCl afforded a cyclic compound N and an acyclic compound O. The CORRECT sequence (from N- to C-terminus) of the tripeptide is



- (A) glycine-phenylalanine-valine
- (B) valine-phenylalanine-glycine
- (C) glycine-tyrosine-valine
- (D) glycine-phenylalanine-alanine

Q4) In differential thermal analysis (DTA)

- (A) the temperature differences between the sample and reference are measured as a function of temperature
- (B) the differences in heat flow into the reference and sample are measured as a function of temperature
- (C) the change in the mass of the sample is measured as a function of temperature
- (D) the glass transition is observed as a sharp peak

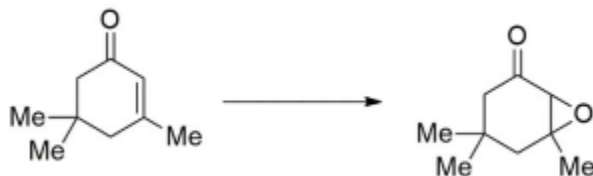
Q5) The pure vibrational spectrum of a hypothetical diatomic molecule shows three peaks with the following intensity at three different temperatures.

Peak	Intensity (Arbitrary Unit)		
	300K	600K	900K
I	1.0	1.0	1.0
II	0.1	0.1	0.1
III	0.02	0.04	0.06

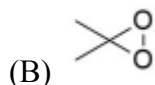
The CORRECT statement is

- (A) Peak I appears at the lowest energy
- (B) Peak II appears at the lowest energy
- (C) Peak III appears at the lowest energy
- (D) Peak I appears at the highest energy

Q6) The CORRECT reagent(s) for the given reaction is(are)



(A) H_2O_2 , NaOH



(C) DIBAL-H, then *m*CPBA

(D) $\text{SO}_3 \cdot \text{pyridine}$, Me_2SO

Q7) The CORRECT statement(s) about thallium halides is(are)

(A) TlF is highly soluble in water whereas other Tl-halides are sparingly soluble

(B) TlF adopts a distorted NaCl structure

(C) TlI_3 is isomorphous with CsI_3 and the oxidation state of Tl is +3

(D) Both TlBr and TlCl have CsCl structure

Q8) The CORRECT statement(s) about the spectral line broadening in atomic spectra is(are)

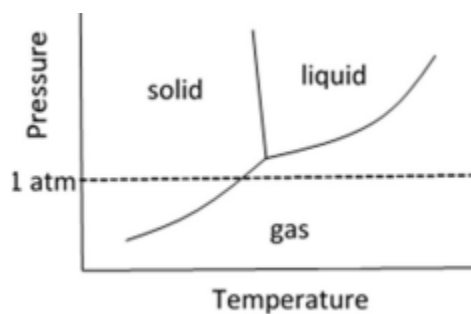
(A) The collision between atoms causes broadening of the spectral line

(B) Shorter the lifetime of the excited state, the broader is the line width

(C) Doppler broadening is more pronounced as the flame temperature increases

(D) In flame and plasma, the natural line broadening exceeds the collisional line broadening

Q9) The CORRECT statement(s) about the following phase diagram for a hypothetical pure substance X is(are)

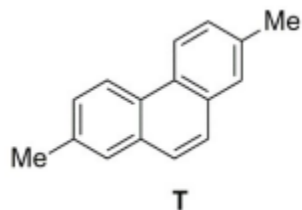


(A) The molar volume of solid X is less than the molar volume of liquid X

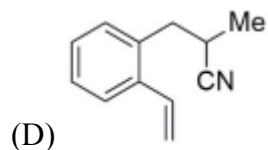
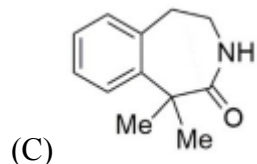
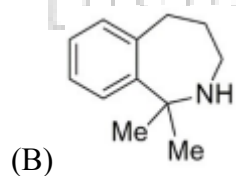
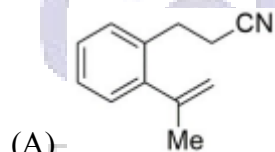
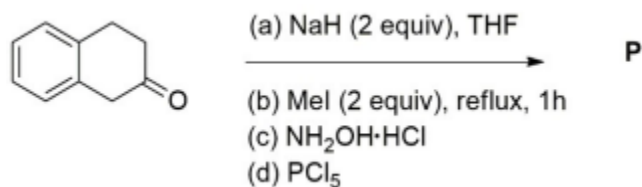
(B) X does not have a normal boiling point

- (C) The melting point of X decreases with increase in pressure
 (D) On increasing the pressure of the gas isothermally, it is impossible to reach solid phase before reaching liquid phase

Q10) The number of peaks exhibited by T in its broadband proton decoupled ^{13}C NMR spectrum recorded at 25°C in CDCl_3 is



Q11) The major product P obtained in the following reaction sequence is



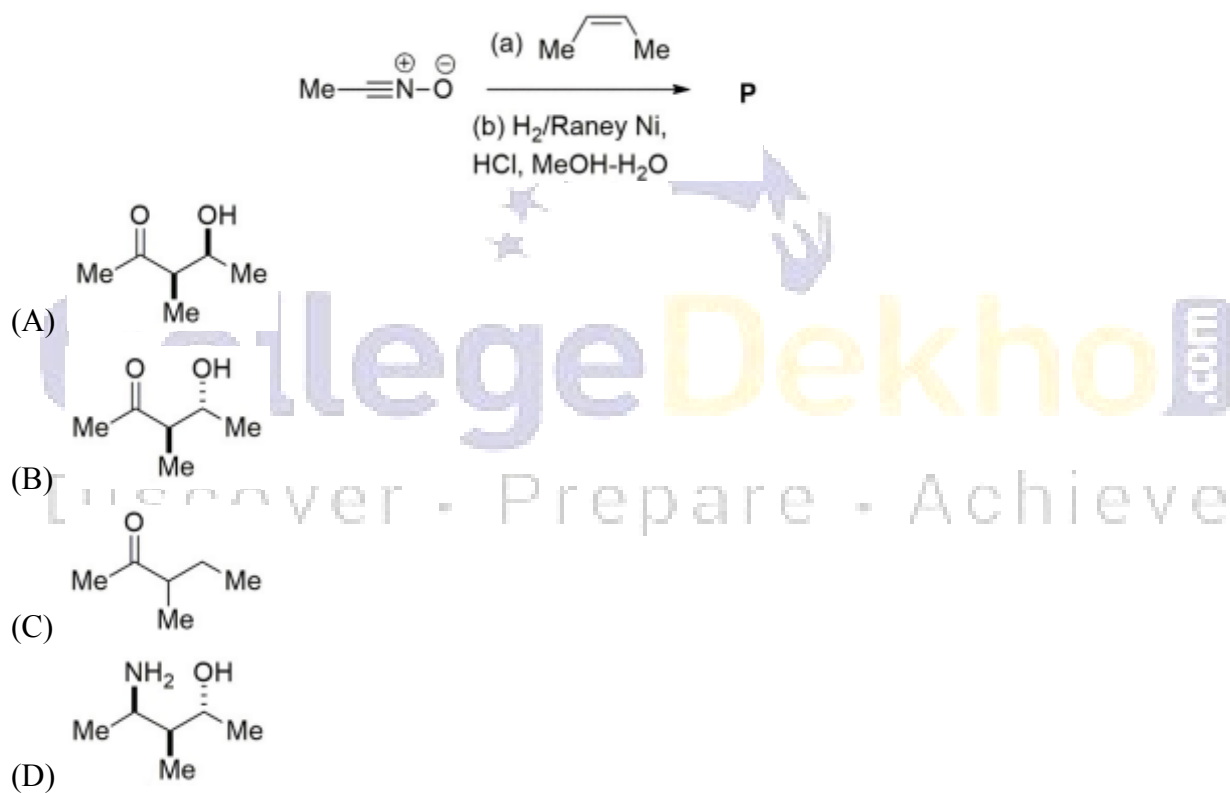
Q12) The parameter(s) fixed for each system in a canonical ensemble is(are)

- (A) temperature
- (B) pressure
- (C) volume
- (D) composition

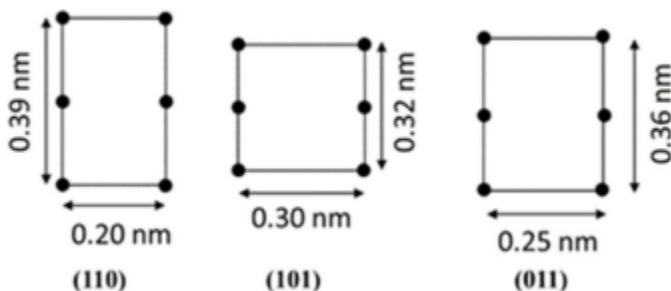
Q13) The diffraction angle (in degree, rounded off to one decimal place) of (321) sets of plane of a metal with atomic radius 0.125 nm, and adopting BCC structure is

(Given: the order of reflection is 1 and the wavelength of X-ray is 0.0771 nm)

Q14) The major product P in the reaction sequence is



Q15) Three different crystallographic planes of a unit cell of a metal are given below (solid circles represent atom). The crystal system of the unit cell is

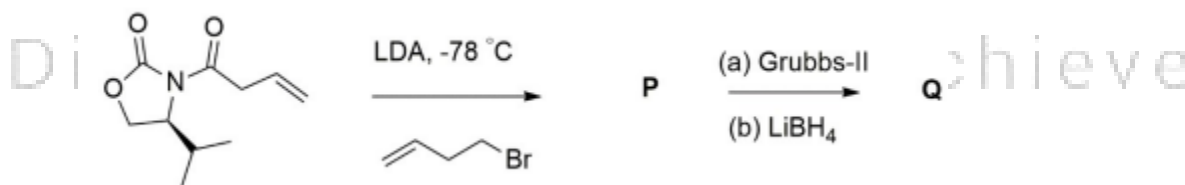


- (A) triclinic
- (B) monoclinic
- (C) tetragonal
- (D) orthorhombic

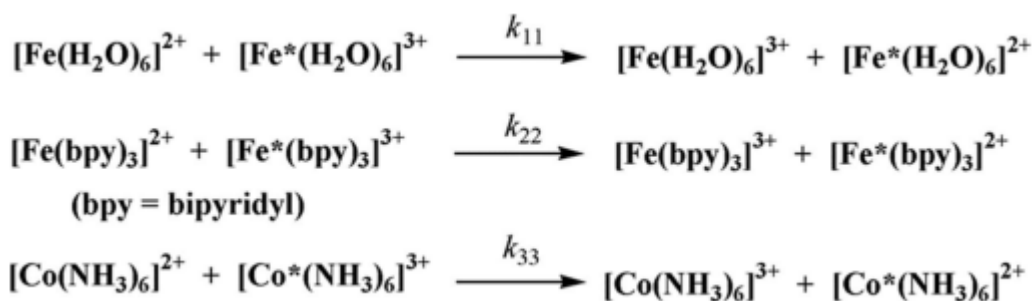
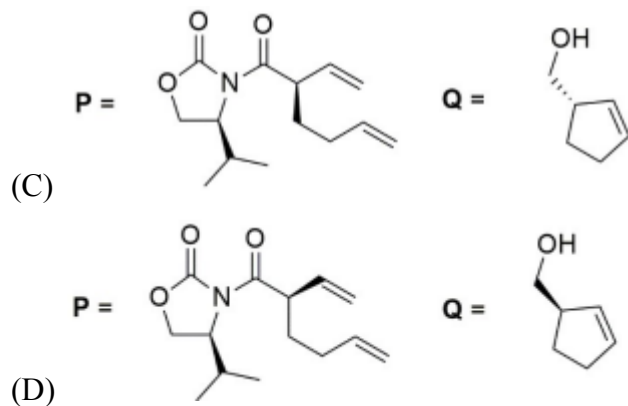
Q16) The number of $V_{s=0}$ stretching vibration band(s) observed in the IR spectrum of the high-spin $[Mn(dms)_6]^{3+}$ complex (dms: dimethylsulfoxide) is

- (A) only one
- (B) two with intensity ratio 1:2
- (C) two with intensity ratio 1:1
- (D) six with intensity ratio 1:1:1:1:1:1

Q17) The major products P and Q in the following reaction sequence are



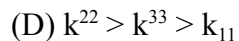
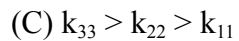
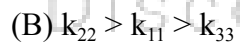
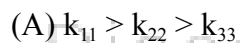
- (A) (B)



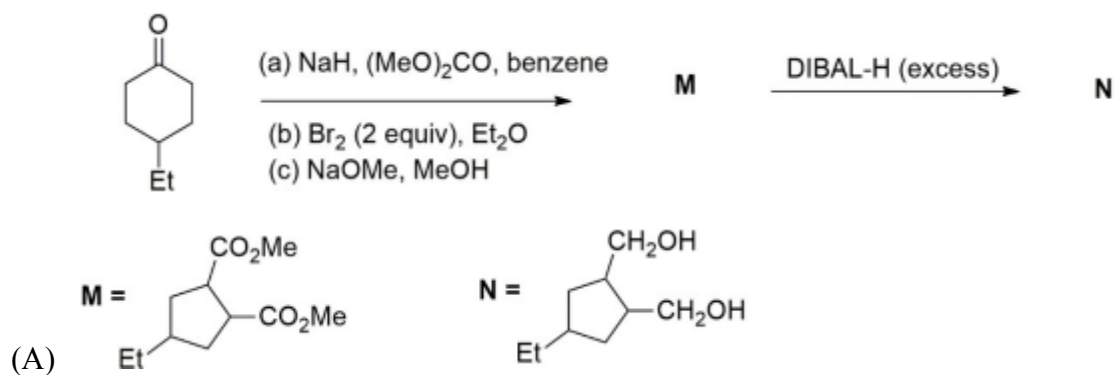
Q18)

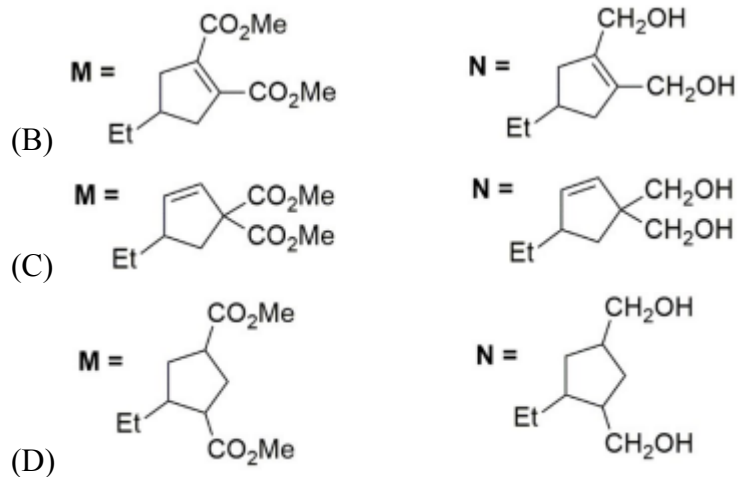
*indicates a radioactive isotope

The rate constants in the given self-exchange electron transfer reactions at a certain temperature follow

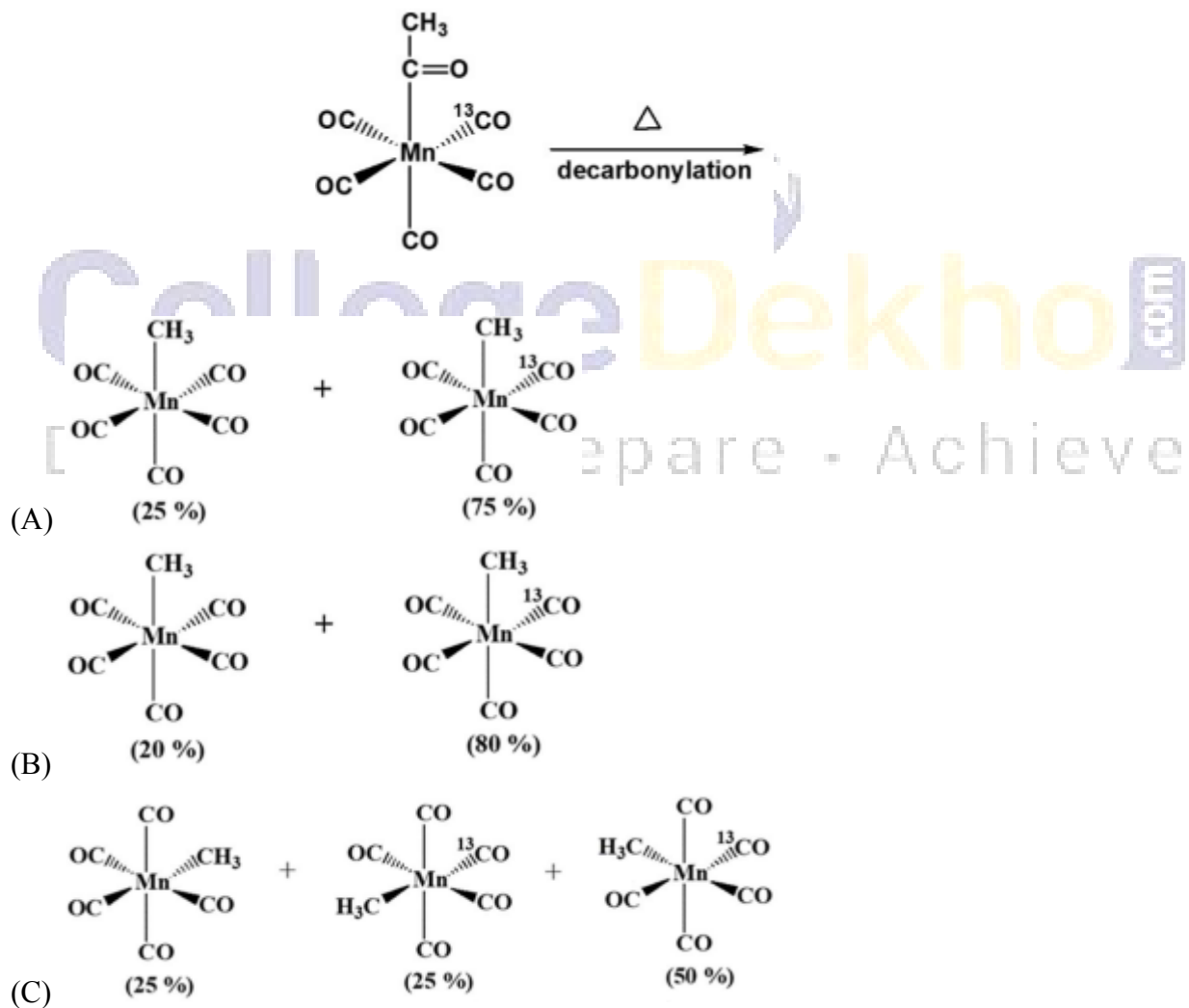


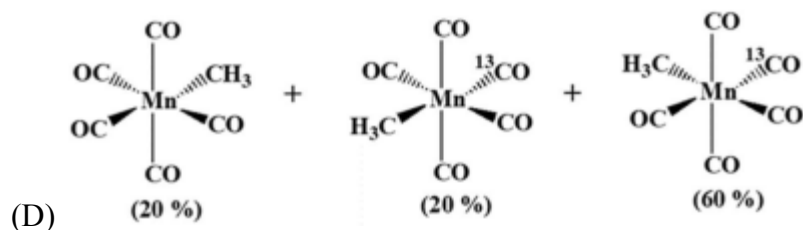
Q19) The major products M and N in the given reaction sequence are





Q20) The CORRECT distribution of the products in the following reaction is





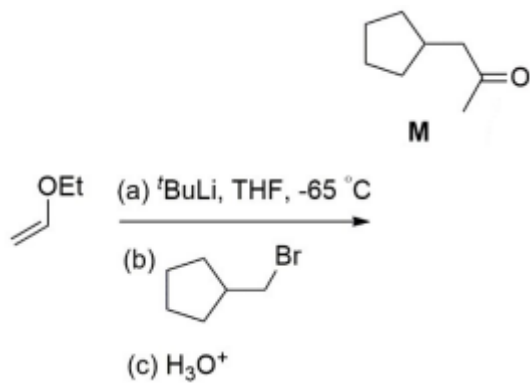
Q21) In the following table, the left column represents the rigid-rotor type and the right column shows a set of molecules.

P. Symmetric rotor (oblate)	1. S_iH_4
Q. Symmetric rotor (prolate)	2. CH_3Cl
R. Spherical rotor	3. C_6H_6
S. Asymmetric rotor	4. CH_3OH
	5. CO_2

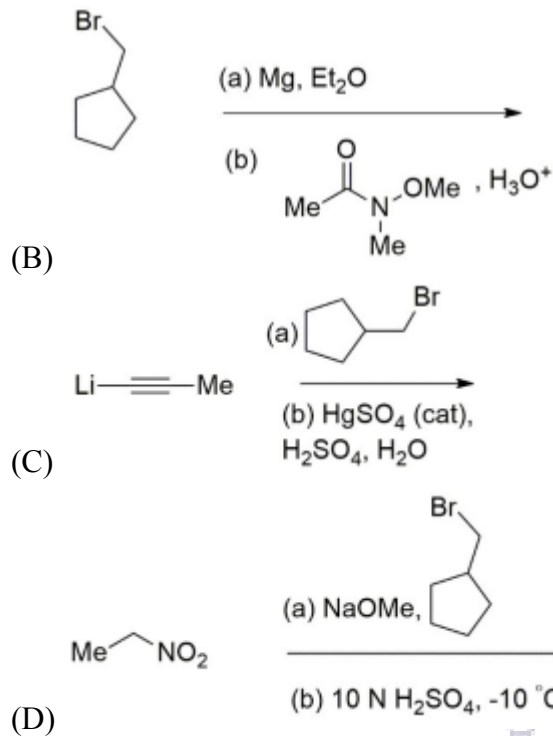
The CORRECT match is

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

Q22) The reaction(s) that yield(s) M as the major product is(are)



(A)



Q23) The CORRECT statement regarding the following three normal modes of vibration of SO_3 is

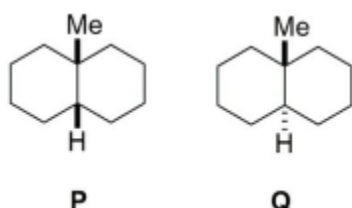
(I)	(II)	(III)
	<p>'+' and '-' indicate out-of-plane motion</p>	

- (A) (I) and (II) are infrared active while (III) is infrared inactive
- (B) (I) is infrared inactive while (II) and (III) are infrared active
- (C) (I) and (III) are infrared inactive while (II) is infrared active
- (D) None of the modes are infrared active since SO_3 has zero dipole moment

Q24) The radius of gyration (in nm, rounded off to one decimal place), for three dimensional random coil linear polyethylene of molecular weight 8,40,000 is

[Given: CC bond length = 0.154 nm]

Q25) The difference between the number of Gauche-butane interactions present in P and Q is

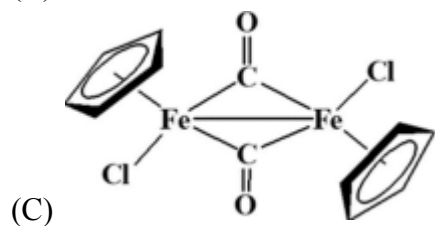
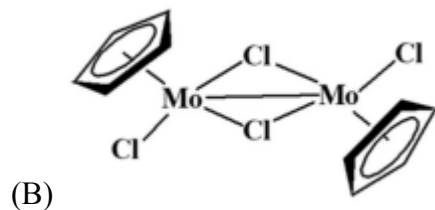
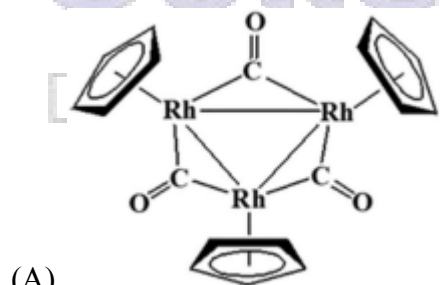


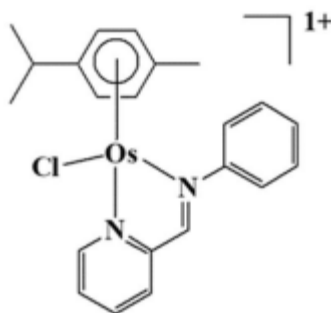
Q26) The CORRECT statement(s) about the Group-I metals is(are)

- (A) Reactivity of Group-I metals with water decreases down the group
- (B) Among the Group-I metals, Li spontaneously reacts with N_2 to give a red-brown layer-structured material
- (C) Thermal stability of Group-I metal peroxides increases down the group
- (D) All the Group-I metal halide are high-melting colorless crystalline solids

Q27) The compound(s) that satisfies/satisfy the 18-electron rule is(are)

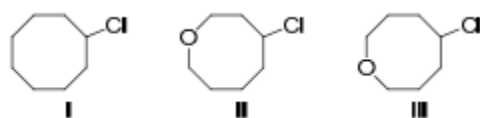
(Atomic number of Os = 76, Rh = 45, Mo = 42, and Fe = 26)





(D)

Q28) The correct order of the rate of solvolysis for the following chlorides in acetic acid is



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

Q29) The correct order of stability for the following conformations of cyclohexane is



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

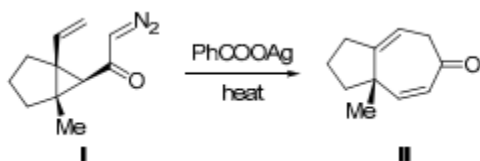
Q30) Amongst the following, the metal carbonyl species having the highest ν_{CO} stretching frequency is

- (A) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$
 (B) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
 (C) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
 (D) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

Q31) MnCr_2O_4 is

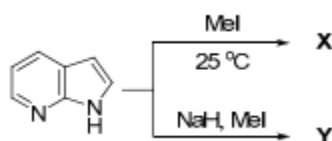
- (A) normal spinel with total CFSE of $-15.5 Dq$
 (B) inverse spinel with total CFSE of $-15.5 Dq$
 (C) normal spinel with total CFSE of $-24 Dq$
 (D) inverse spinel with total CFSE of $-24 Dq$

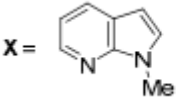
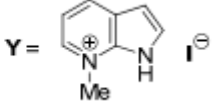
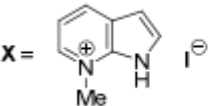
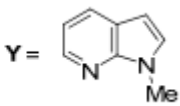
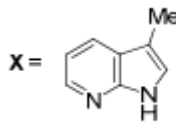
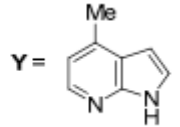
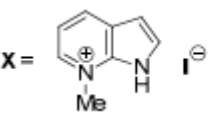
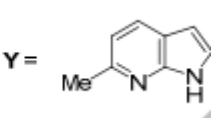
Q32) Formation of the ketone II from the diazoketone I involves



- (A) generation of carbene and a [2,3]-sigmatropic rearrangement
- (B) generation of carbene and an electrocyclic ring closing reaction
- (C) generation of ketene and a [2+2] cycloaddition
- (D) generation of ketene and a [3,3]-sigmatropic rearrangement

Q33) The major products X and Y formed in the following reactions are

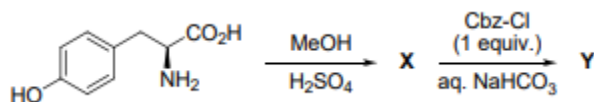


- (A) $\text{X} =$  $\text{Y} =$ 
- (B) $\text{X} =$  $\text{Y} =$ 
- (C) $\text{X} =$  $\text{Y} =$ 
- (D) $\text{X} =$  $\text{Y} =$ 

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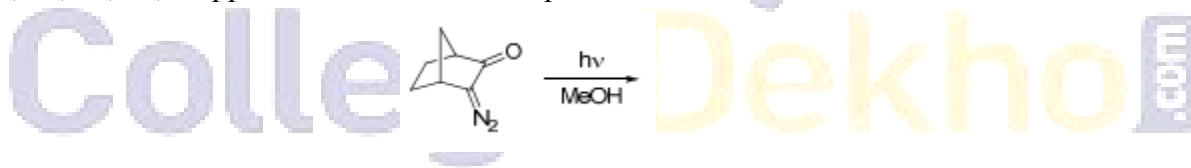
Prepare - Achieve

Q34) The major products X and Y formed in the following reaction sequence are



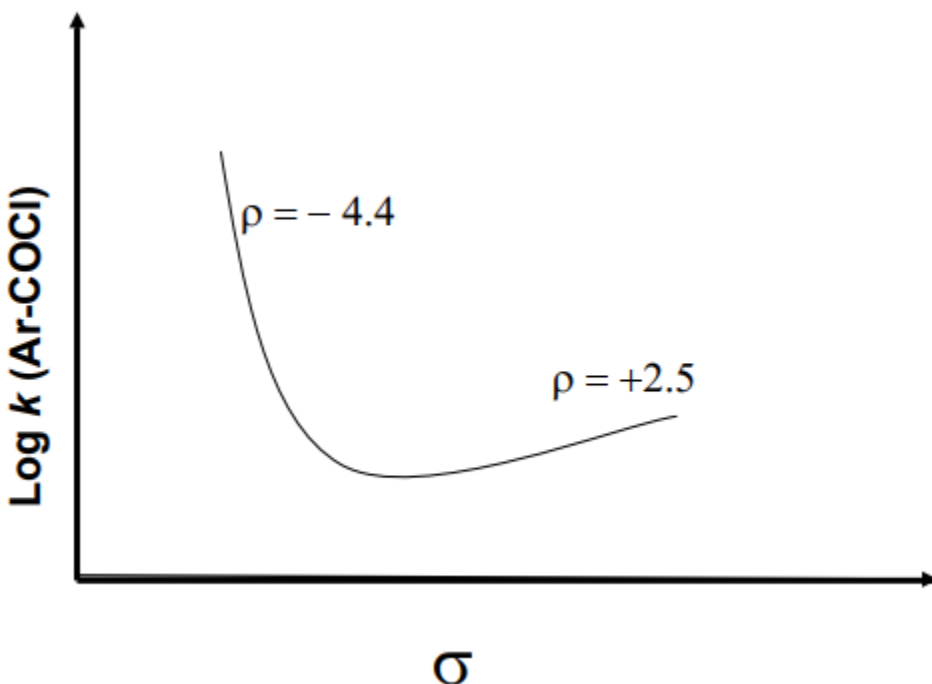
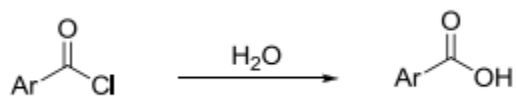
- (A) X = Y =
- (B) X = Y =
- (C) X = Y =
- (D) X = Y =

Q35) The product of the following reaction gave 6 line ^{13}C NMR spectrum with peaks at δ 175, 52, 50, 46, 37, 33 ppm. The structure of the product is



- (A)
- (B)
- (C)
- (D)

Q36) Shown below is a Hammett plot obtained for the reaction



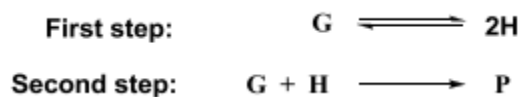
The change in slope of the plot indicates that

- (A) the reaction does not follow linear free energy relationship
- (B) electrons are being withdrawn from the transition state in the mechanism
- (C) electrons are being donated to the transition state in the mechanism
- (D) the mechanism of the reaction is changing

Q37) A disaccharide that will not give Benedict's test and will not form osazone is

- (A) maltose
- (B) lactose
- (C) cellobiose
- (D) sucrose

Q38) For a reaction involving two steps given below



assume that the first step attains equilibrium rapidly. The rate of formation of P is proportional to

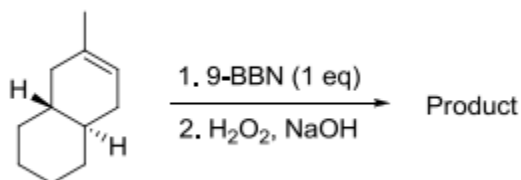
- (A) $[\text{G}]^{1/2}$

- (B) [G]
- (C) [G]²
- (D) [G]^{3/2}

Q39) Among the following donors, the one that forms most stable adduct with the Lewis acid B(CH₃)₃ is

- (A) 4-methylpyridine
- (B) 2,6-dimethylpyridine
- (C) 4-nitropyridine
- (D) 2,6-di-*tert*-butylpyridine

Q40) Identify the product from the following reaction



(9-BBN = 9-Borabicyclo[3•3•1]nonane)

- (A)
- (B)
- (C)
- (D)

