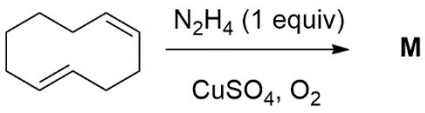
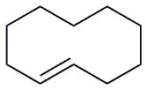
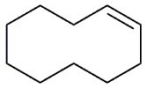
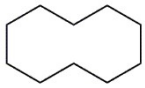
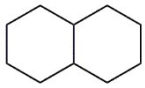
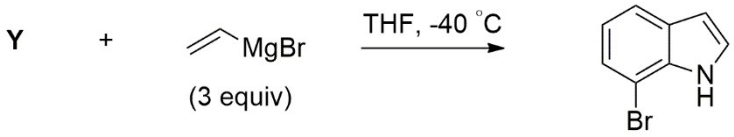
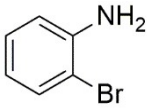
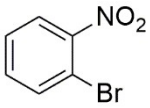
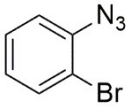
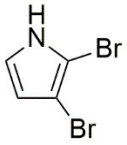
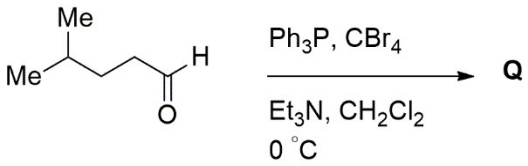
Q.11 – Q.35 Carry ONE mark Each

Q.11	The major product **M** formed in the following reaction is 
(A)	
(B)	
(C)	
(D)	

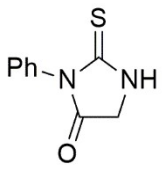
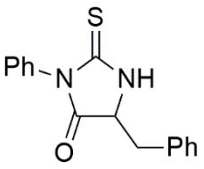
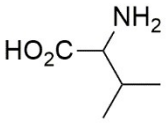
Dynamic Chemistry Point

Q.12	The starting material **Y** in the following reaction is
	
(A)	
(B)	
(C)	
(D)	

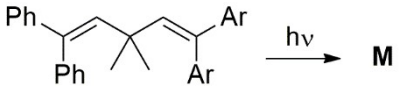
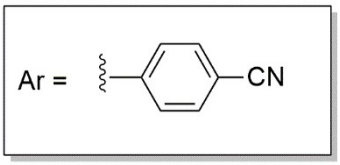
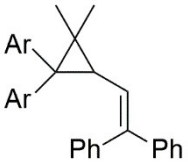
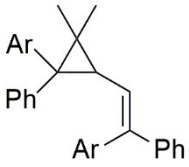
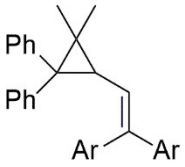
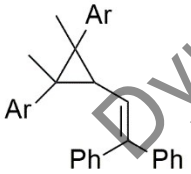
Dynamic Chemistry Point

Q.13	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

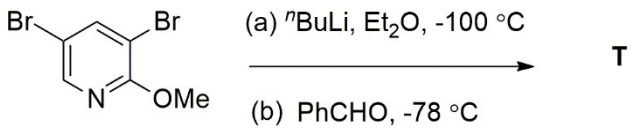
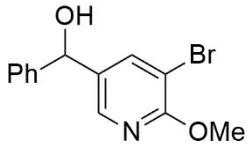
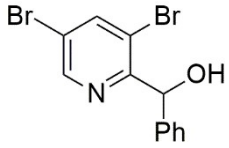
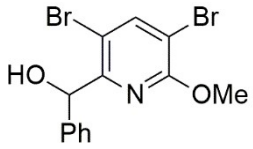
Dynamic Chemistry Point

Q.14	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
	M =  **N** =  **O** = 
(A)	glycine-phenylalanine-valine
(B)	valine-phenylalanine-glycine
(C)	glycine-tyrosine-valine
(D)	glycine-phenylalanine-alanine

Dynamic Chemistry Point

Q.15	The major product **M** in the following reaction is
	 
(A)	
(B)	
(C)	
(D)	

Dynamic Chemistry Point

Q.16	The major product **T** formed in the following reaction is
	
(A)	
(B)	
(C)	
(D)	

Dynamic Chemistry Point

Q.17	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
Q.18	The ν_{O-O} resonance Raman stretching frequency (cm^{-1}) of the coordinated dioxygen in *oxy-hemoglobin* and *oxy-hemocyanin* appears, respectively, nearly at
(A)	1136 and 744
(B)	1550 and 744
(C)	744 and 1136
(D)	744 and 1550

Dynamic Chemistry Point

Q.19	The number of metal-metal bond(s), with $\sigma, \pi,$ and δ character, present in $[Mo_2(CH_3CO_2)_4]$ complex is(are), respectively,
(A)	1, 2, 1
(B)	1, 2, 0
(C)	1, 1, 0
(D)	1, 1, 1

Dynamic Chemistry Point

Q.20	$1s_A$ and $1s_B$ are the normalized eigenfunctions of two hydrogen atoms H_A and H_B, respectively. If $S = \langle 1s_A \vert 1s_B \rangle$, the option that is ALWAYS CORRECT is
(A)	$S = 1$
(B)	$S = 0$
(C)	S = imaginary constant
(D)	$0 \leq S \leq 1$
Q. 21	The pure vibrational spectrum of a hypothetical diatomic molecule shows three peaks with the following intensity at three different temperatures. Peak | Intensity (arbitrary unit) | 300 K | 600 K | 900 K 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

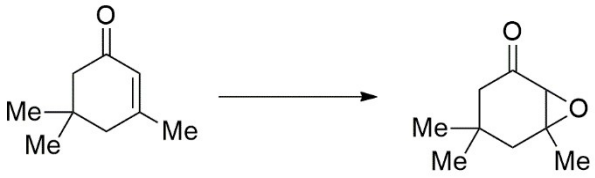
Dynamic Chemistry Point

Q.22	The point group of SF_6 is
(A)	D_{6h}
(B)	O_h
(C)	D_{6d}
(D)	C_{6v}
Q. 23	A point originally at $(1, 3, 5)$ was subjected to a symmetry operation $(\hat{O}_1)$ that shifted the point to $(-1, -3, 5)$. Subsequently, the point at $(-1, -3, 5)$ was subjected to another symmetry operation $(\hat{O}_2)$ that shifted this point to $(-1, -3, -5)$. The symmetry operators $\hat{O}_1$ and $\hat{O}_2$ are, respectively,
(A)	$\hat{C}_2(x)$ and $\hat{\sigma}(xy)$
(B)	$\hat{C}_2(z)$ and $\hat{\sigma}(xy)$
(C)	$\hat{\sigma}(xy)$ and $\hat{C}_2(z)$
(D)	$\hat{S}_1$ and $\hat{S}_2$

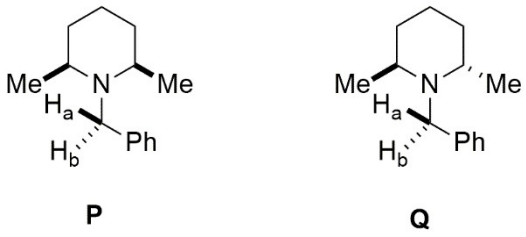
Dynamic Chemistry Point

Q. 24	Adsorption of a gas with pressure P on a solid obeys the Langmuir adsorption isotherm. For a fixed fractional coverage, the correct relation between *K* and P at a fixed temperature is [$K = k_a/k_b$, k_a and k_b are the rate constants for adsorption and desorption, respectively. Assume non-dissociative adsorption.]
(A)	$K \propto \mathrm{P}^{-1/2}$
(B)	$K \propto \mathrm{P}$
(C)	$K \propto \mathrm{P}^{-1}$
(D)	$K \propto \mathrm{P}^{1/2}$
Q. 25	The temperature dependence of the rate constant for a second-order chemical reaction obeys the Arrhenius equation. The SI unit of the 'pre-exponential factor' is
(A)	s^{-1}
(B)	$m^3\ mol^{-1}\ s^{-1}$
(C)	$mol\ m^{-3}\ s^{-1}$
(D)	$(m^3\ mol^{-1})^2\ s^{-1}$

Dynamic Chemistry Point

Q.26	The CORRECT reagent(s) for the given reaction is(are)
	
(A)	H_2O_2, NaOH
(B)	
(C)	DIBAL-H, then *m*CPBA
(D)	SO_3·pyridine, Me_2SO

Dynamic Chemistry Point

Q.27	The CORRECT statement(s) about the ^1H NMR spectra of compounds **P** and **Q** is(are)  **P** **Q**
(A)	**P** shows a sharp singlet at $\delta = 3.70$ ppm (for H_a and H_b)
(B)	**Q** shows a sharp singlet at $\delta = 3.70$ ppm (for H_a and H_b)
(C)	**P** shows a AB-quartet centered at $\delta = 3.63$ ppm (for H_a and H_b)
(D)	**Q** shows a AB-quartet centered at $\delta = 3.63$ ppm (for H_a and H_b)
Q.28	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 isomorphic with CsI_3 and the oxidation state of Tl is +3
(D)	Both TlBr and TlCl have CsCl structure

Dynamic Chemistry Point

Q.29	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

Dynamic Chemistry Point

Q.30 Match the CORRECT option(s) from column **A** with column **B** according to the metal centre present in the active site of metalloenzyme.

A		**B**	
P	Cu	**I**	B_{12}-coenzyme
Q	Mo	**II**	Carboxypeptidase
R	Co	**III**	Nitrate reductase
S	Zn	**IV**	Cytochrome P-450
		V	Tyrosinase

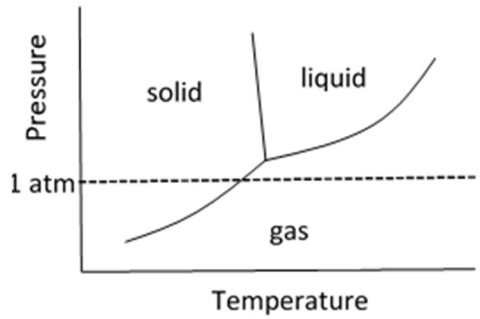
(A) **P-V**, **Q-III**, **R-I**, **S-II**

(B) **P-IV**, **Q-II**, **R-I**, **S-III**

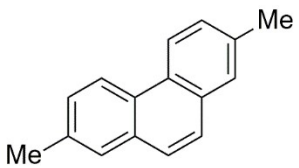
(C) **P-II**, **Q-IV**, **R-V**, **S-III**

(D) **P-V**, **Q-III**, **R-II**, **S-IV**

Dynamic Chemistry Point

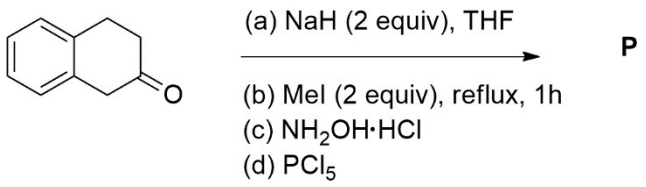
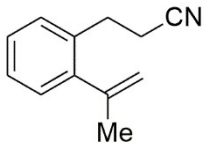
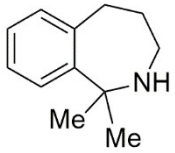
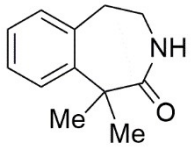
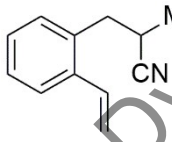
Q. 31	The CORRECT statement(s) about the following phase diagram for a hypothetical pure substance **X** is(are) 
(A)	The molar volume of solid **X** is less than the molar volume of liquid **X**
(B)	**X** does not have a normal boiling point
(C)	The melting point of **X** decreases with increase in pressure
(D)	On increasing the pressure of the gas isothermally, it is impossible to reach solid phase before reaching liquid phase
Q. 32	The parameter(s) fixed for each system in a canonical ensemble is(are)
(A)	temperature
(B)	pressure
(C)	volume
(D)	composition

Dynamic Chemistry Point

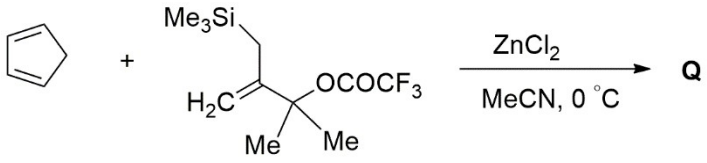
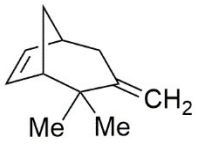
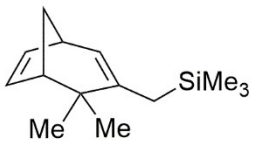
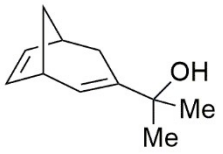
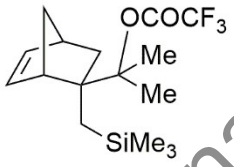
Q.33	The number of peaks exhibited by **T** in its broadband proton decoupled ^{13}C NMR spectrum recorded at 25 °C in $CDCl_3$ is
	 **T**
Q.34	The diffraction angle (in degree, rounded off to one decimal place) of (321) sets of plane of a metal with atomic radius 0.125 nm, and adopting BCC structure is (Given: the order of reflection is 1 and the wavelength of X-ray is 0.0771 nm)
Q. 35	For the angular momentum operator $\hat{L}$ and the spherical harmonics $Y_{lm}(\theta, \phi)$, $\left(\hat{L}_x^2 + \hat{L}_y^2\right) Y_{21}(\theta, \phi) = n\,\hbar^2\, Y_{21}(\theta, \phi)$. The value of n is

Dynamic Chemistry Point

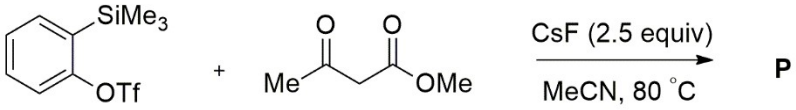
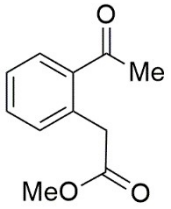
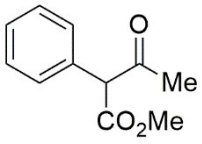
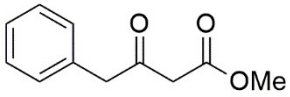
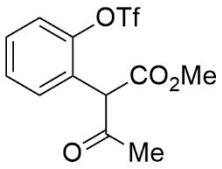
Q.26 – Q.55 Carry TWO marks Each

Q.36	The major product **P** obtained in the following reaction sequence is 
(A)	
(B)	
(C)	
(D)	

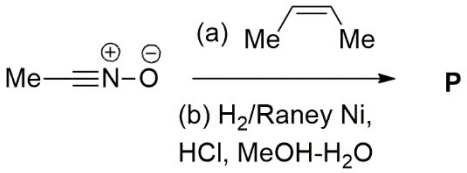
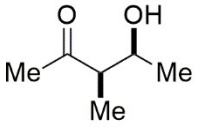
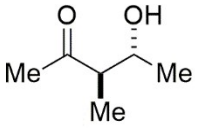
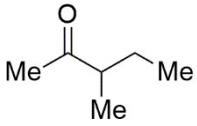
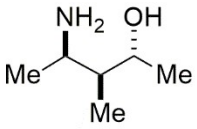
Dynamic Chemistry Point

Q.37	The major product **Q** in the given reaction is 
(A)	
(B)	
(C)	
(D)	

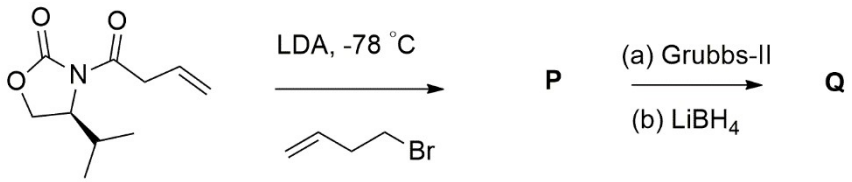
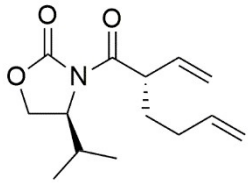
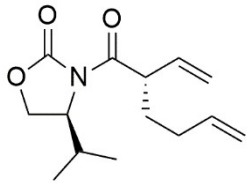
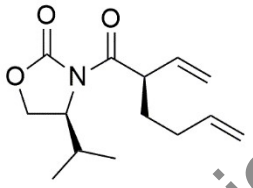
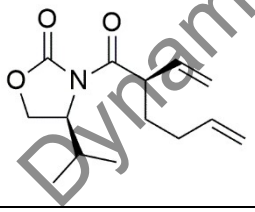
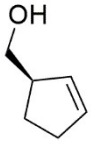
Dynamic Chemistry Point

Q.38	The major product **P** in the following reaction is 
(A)	
(B)	
(C)	
(D)	

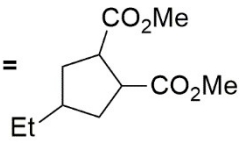
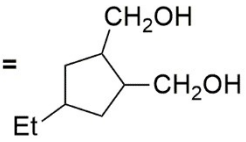
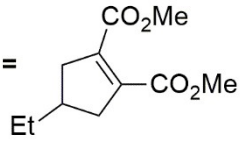
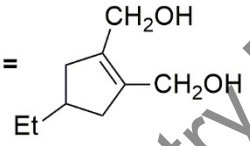
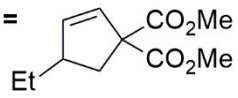
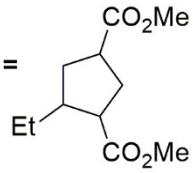
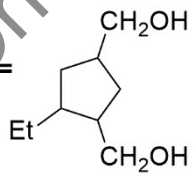
Dynamic Chemistry Point

Q.39	The major product **P** in the reaction sequence is 
(A)	
(B)	
(C)	
(D)	

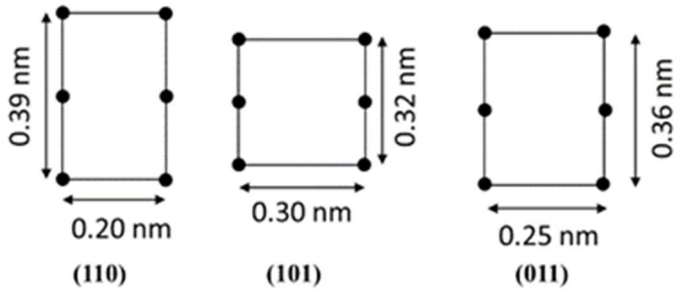
Dynamic Chemistry Point

Q.40	The major products **P** and **Q** in the following reaction sequence are 
(A)	**P =**  **Q =** 
(B)	**P =**  **Q =** 
(C)	**P =**  **Q =** 
(D)	**P =**  **Q =** 

Dynamic Chemistry Point

Q.41	The major products **M** and **N** in the given reaction sequence are 
(A)	**M =**  **N =** 
(B)	**M =**  **N =** 
(C)	**M =**  **N =** 
(D)	**M =**  **N =** 

Dynamic Chemistry Point

Q.42	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
Q.43	The number of equivalents of H_2S gas released from the active site of *rubredoxin*, *2-iron ferredoxin,* and *4-iron ferredoxin* when treated with mineral acid, respectively, are
(A)	4, 6, 8
(B)	0, 2, 4
(C)	1, 2, 4
(D)	0, 2, 3

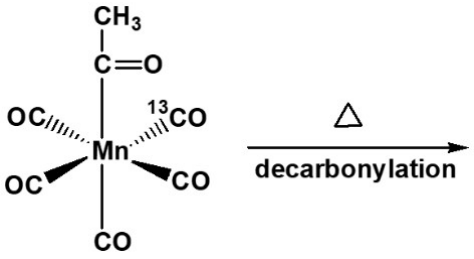
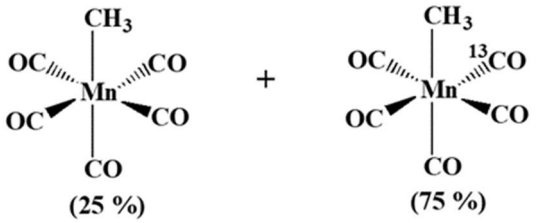
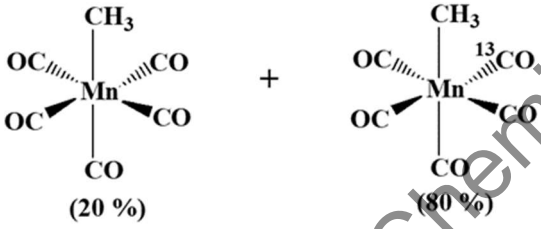
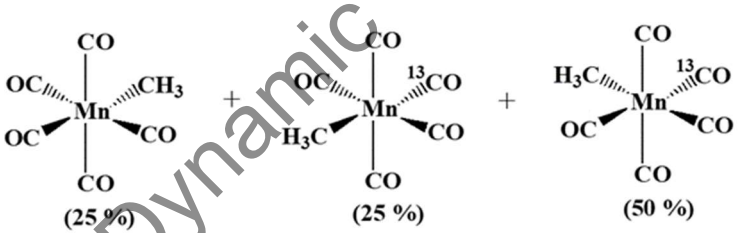
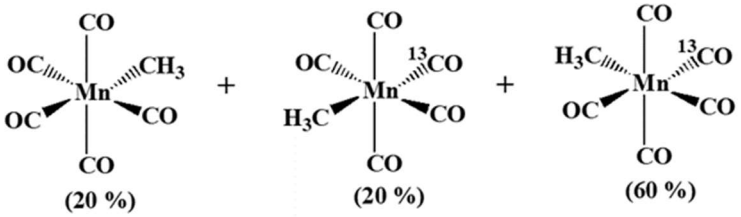
Dynamic Chemistry Point

Q.44	The number of $\nu_{S=O}$ stretching vibration band(s) observed in the IR spectrum of the high-spin $[Mn(dmso)_6]^{3+}$ complex (dmso: 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

Dynamic Chemistry Point

Q.45	$[Fe(H_2O)_6]^{2+} + [Fe^*(H_2O)_6]^{3+} \xrightarrow{k_{11}} [Fe(H_2O)_6]^{3+} + [Fe^*(H_2O)_6]^{2+}$ $[Fe(bpy)_3]^{2+} + [Fe^*(bpy)_3]^{3+} \xrightarrow{k_{22}} [Fe(bpy)_3]^{3+} + [Fe^*(bpy)_3]^{2+}$ **(bpy = bipyridyl)** $[Co(NH_3)_6]^{2+} + [Co^*(NH_3)_6]^{3+} \xrightarrow{k_{33}} [Co(NH_3)_6]^{3+} + [Co^*(NH_3)_6]^{2+}$ *indicates a radioactive isotope The rate constants in the given self-exchange electron transfer reactions at a certain temperature follow
(A)	$k_{11} > k_{22} > k_{33}$
(B)	$k_{22} > k_{11} > k_{33}$
(C)	$k_{33} > k_{22} > k_{11}$
(D)	$k_{22} > k_{33} > k_{11}$

Dynamic Chemistry Point

Q.46	The CORRECT distribution of the products in the following reaction is 
(A)	
(B)	
(C)	
(D)	

Dynamic Chemistry Point

Q.47	The addition of $K_4[Fe(CN)_6]$ to a neutral aqueous solution of the cationic species of a metal produces a brown precipitate that is insoluble in dilute acid. The cationic species is
(A)	Fe^{3+}
(B)	UO_2^{2+}
(C)	Th^{4+}
(D)	Cu^{2+}
Q.48	The electronic spectrum of a Ni(II) octahedral complex shows four *d-d* bands, labelled as **P**, **Q**, **R**, and **S**. Match the bands corresponding to the transitions.

	λ_{max}, nm (ε, $M^{-1}cm^{-1}$)		**Transitions**
P	1000 (50)	**I**	$^3A_{2g}(F) \rightarrow {}^3T_{1g}(P)$
Q	770 (8)	**II**	$^3A_{2g}(F) \rightarrow {}^3T_{1g}(F)$
R	630 (55)	**III**	$^3A_{2g}(F) \rightarrow {}^3T_{2g}(F)$
S	375 (110)	**IV**	$^3A_{2g}(F) \rightarrow {}^1E_g(D)$

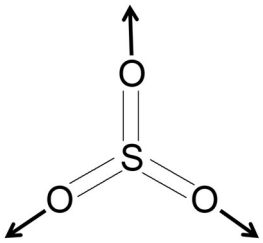
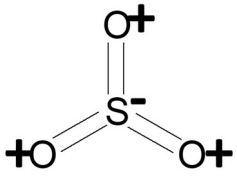
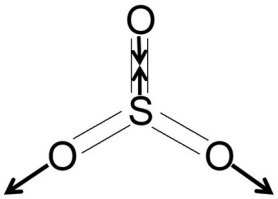
(A)	**P-IV**, **Q-III**, **R-II**, **S-I**
(B)	**P-III**, **Q-IV**, **R-II**, **S-I**
(C)	**P-II**, **Q-IV**, **R-I**, **S-III**
(D)	**P-I**, **Q-IV**, **R-II**, **S-III**

Dynamic Chemistry Point

Q.49	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. SiH_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

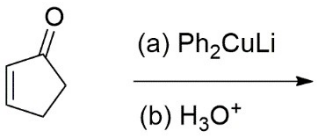
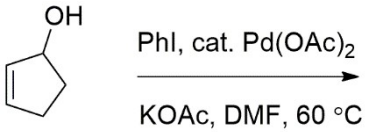
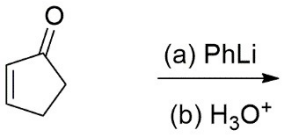
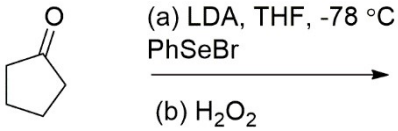
Dynamic Chemistry Point

Q. 50	The CORRECT statement regarding the following three normal modes of vibration of SO_3 is

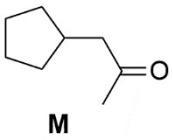
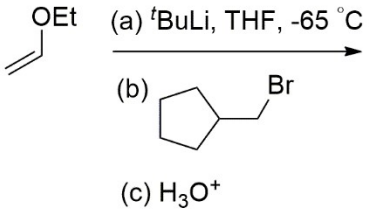
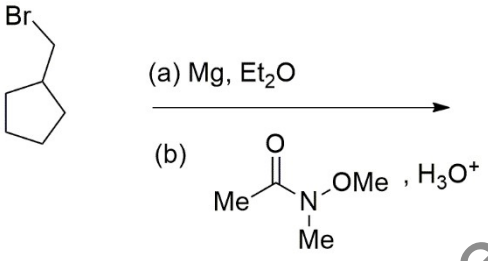
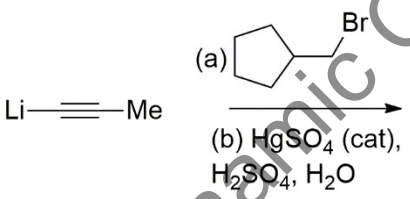
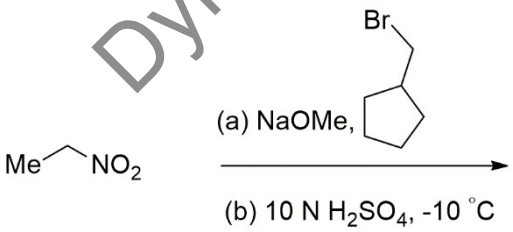
(I)	(II)	(III)
	 ‘+’ and ‘−’ indicate out-of-plane motion	

(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

Dynamic Chemistry Point

Q.51	The reaction(s) that yield(s) 3-phenylcyclopentanone as the major product is(are)
(A)	
(B)	
(C)	
(D)	

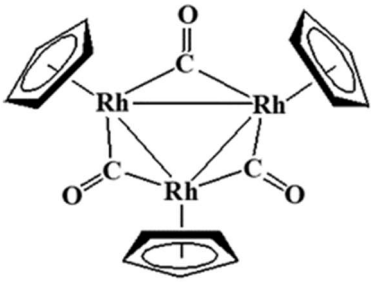
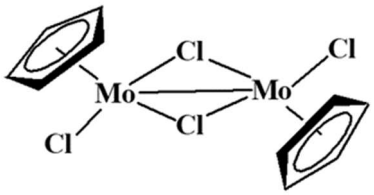
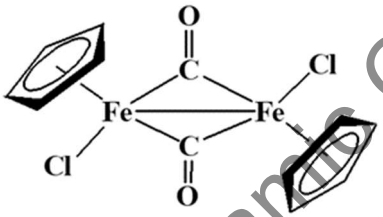
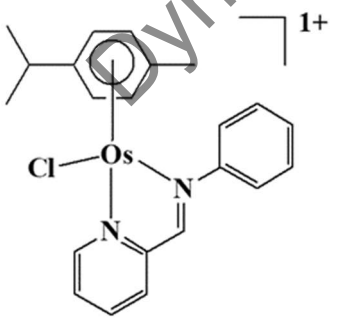
Dynamic Chemistry Point

Q.52	The reaction(s) that yield(s) **M** as the major product is(are)  **M**
(A)	
(B)	
(C)	
(D)	

Dynamic Chemistry Point

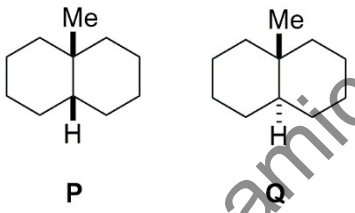
Q.53	The CORRECT statement(s) regarding $B_{10}H_{14}$ is(are)
(A)	Brønsted acidity of $B_{10}H_{14}$ is higher than that of B_5H_9
(B)	Structurally $B_{10}H_{14}$ is a *closo*-borane
(C)	The metal-promoted fusion of $B_5H_8^-$ produces $B_{10}H_{14}$
(D)	Both $B_{10}H_{14}$ and $B_{10}H_{12}(SEt_2)_2$ have the same number of valence electrons
Q.54	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

Dynamic Chemistry Point

Q. 55	The compound(s) that satisfies/satisfy the 18-electron rule is(are) (Atomic number of Os = 76, Rh = 45, Mo = 42, and Fe = 26)
(A)	
(B)	
(C)	
(D)	

Dynamic Chemistry Point

Q.56	For three operators $\hat{A}$, $\hat{B}$, and $\hat{C}$, $\left[\hat{A},\left[\hat{B},\hat{C}\right]\right]+\left[\hat{B},\left[\hat{C},\hat{A}\right]\right]$ =
(A)	$\left[\hat{C},\left[\hat{A},\hat{B}\right]\right]$
(B)	$\left[\hat{C},\left[\hat{B},\hat{A}\right]\right]$
(C)	$\left[\left[\hat{B},\hat{A}\right],\hat{C}\right]$
(D)	$\left[\left[\hat{A},\hat{B}\right],\hat{C}\right]$

Q. 57	The difference between the number of Gauche-butane interactions present in **P** and **Q** is  **P** **Q**
Q.58	The calculated magnetic moment (in BM, rounded off to two decimal places) of a Ce^{3+} complex is

Dynamic Chemistry Point

Q.59	The state of the electron in a He^+ ion is described by the following normalized wavefunction, $\Psi(r,\theta.\phi) = \sqrt{\frac{3}{8}}\, R_{21}(r)Y_{10}(\theta,\phi) - i\sqrt{\frac{7}{16}}R_{10}(r)Y_{00}(\theta,\phi) + xR_{32}(r)Y_{20}(\theta,\phi).$ Here, R_{nl} and Y_{lm} represent the radial and angular components of the eigenfunctions of He^+ ion, respectively, and x is an unknown constant. If the energy of the ion is measured in the above state, the probability (rounded off to two decimal places) of obtaining the energy of $-\frac{2}{9}$ atomic unit is
Q.60	A certain wavefunction for the hydrogen-like atom is given by $\Psi(r,\theta,\phi) = \frac{2^{\frac{1}{2}}}{81\,\pi^{\frac{1}{2}}} \left(\frac{Z}{a_0}\right)^{5/2} \left(6 - \frac{Zr}{a_0}\right) r\, e^{-Zr/3a_0} \cos\theta\ .$ The number of node(s) in this wavefunction is

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Q. 61	EMF of the following cell Cu | $CuSO_4$(aq, 1.0 mol/kg) | Hg_2SO_4(s) | Hg(l) | Pt at 25 °C and 1 bar is 0.36 V. The value of the mean activity coefficient (rounded off to three decimal places) of $CuSO_4$ at 25 °C and 1 bar is [Given: Standard electrode potential values at 25 °C for $Cu^{2+} + 2e^- \rightarrow Cu$ and $Hg_2SO_4 + 2e^- \rightarrow 2Hg + SO_4^{2-}$ are 0.34 V and 0.62 V, respectively. Consider: RT/F at 25 °C = 0.0256 V]

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Q. 62	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: C–C bond length = 0.154 nm]
Q. 63	The activation energy of the elementary gas-phase reaction $O_3 + NO \rightarrow NO_2 + O_2$ is 10.5 kJ mol^{-1}. The value of the standard enthalpy of activation (rounded off to two decimal places in kJ mol^{-1}) at 25 °C is [Given: R is 8.314 J mol^{-1} K^{-1}]
Q. 64	In a collection of molecules, each molecule has two non-degenerate energy levels that are separated by 5000 cm^{-1}. On measuring the population at a particular temperature, it was found that the ground state population is 10 times that of the upper state. The temperature (in K, rounded off to the nearest integer) of measurement is [Given: Value of the Boltzmann constant = 0.695 cm^{-1} K^{-1}]
Q. 65	The change in entropy of the surroundings (in J K^{-1}, rounded off to two decimal places) to convert 1 mol of supercooled water at 263 K to ice at 263 K at 1 bar is [Consider: $\Delta_{fus}H°$ at 273 K = 6.0 kJ mol^{-1}, and the molar heat capacity of water is higher than that of ice by 37.0 J K^{-1} mol^{-1} in the temperature range of 263 K to 273 K]

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