

**CSIR-UGC-NET GATE CHEMISTRY**
GATE CHEMISTRY 2019**Q.1-Q. 5 carry ONE mark each.**

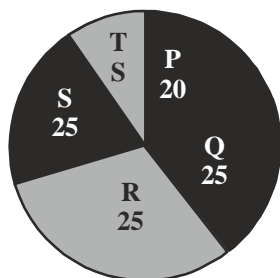
1. John Thomas, an _____ writer, passed away in 2018
(a) imminent (b) prominent (c) eminent (d) dominant
2. _____ I permitted him to leave, I would't have had any problem with him being absent,
_____ I?
(a) Had, wouldn't (b) Have, would (c) Had, would (d) Have, wouldn't
3. The sum and product of two integers are 26 and 165 respectively. The difference between these two integers is _____
(a) 2 (b) 3 (c) 4 (d) 6
4. The minister avoided any mention of the issue of women's reservation in the private sector. He was accused of _____ the issue.
(a) collaring (b) skirting (c) tying (d) belting
5. A worker noticed that the hour hand on the factory clock had moved by 225 degrees during her stay at the factory. For how long did she stay in the factor?
(a) 3.75 hours (b) 4 hours and 15 mins
(c) 8.5 hours (d) 7.5 hours

Q.6-Q. 10 carry TWO marks each.

6. Congo was named by Europeans. Congo's dictator Mobuto later changed the name of the country and the river to Zaire with the objective of Africanising names of persons and space. However, the name Zaire was a Portuguese alteration of *Nzadi o Nzere*, a local African term meaning 'River that swallows Rivers'. Zaire was the Portuguese name for the Congo river in the 16th and 17th centuries.
Which one of the following statements can be inferred from the paragraph above?
(a) Mobuto was not entirely successful in Africanising the name of his country
(b) The term *Nzadi o Nzere* was of Portuguese origin
(c) Mobuto's desire to Africanise names was prevented by the Portuguese
(d) As a dictator Mobuto ordered the Potuguese to alter the name of the river to Zaire
7. M and N had four children P, Q, R and S. Of them, only P and R were married. They had children X and Y respectively. If Y is a legitimate child of W, which one of the following statements is necessarily FALSE?
(a) M is the grandmother of Y (b) R is the father of Y
(c) W is the wife of R (d) W is the wife of P
8. A firm hires employees at five different skill levels, P, Q, R, S, T. The shares of employment at these skill levels of total employment in 2010 is given in the pie chart as shown. There were a total of 600 employees in 2010 and the total employment increased by 15% from 2010 to 2016. The total employment at skill levels P, Q and R remained unchanged during the period. If the employment at skill level S increased by 40% from 2010 to 2016. How many employees were there at skill level T in 2016?



Percentage share of skills in 2010

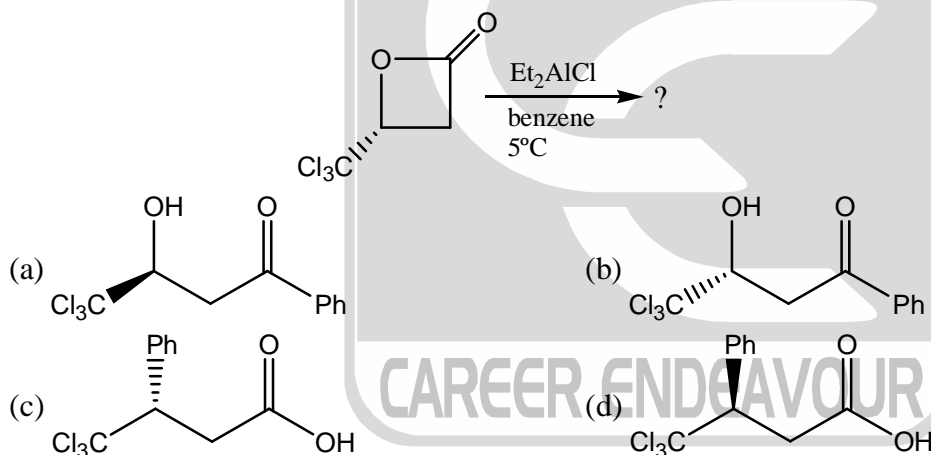


- (a) 30 (b) 35 (c) 60 (d) 72

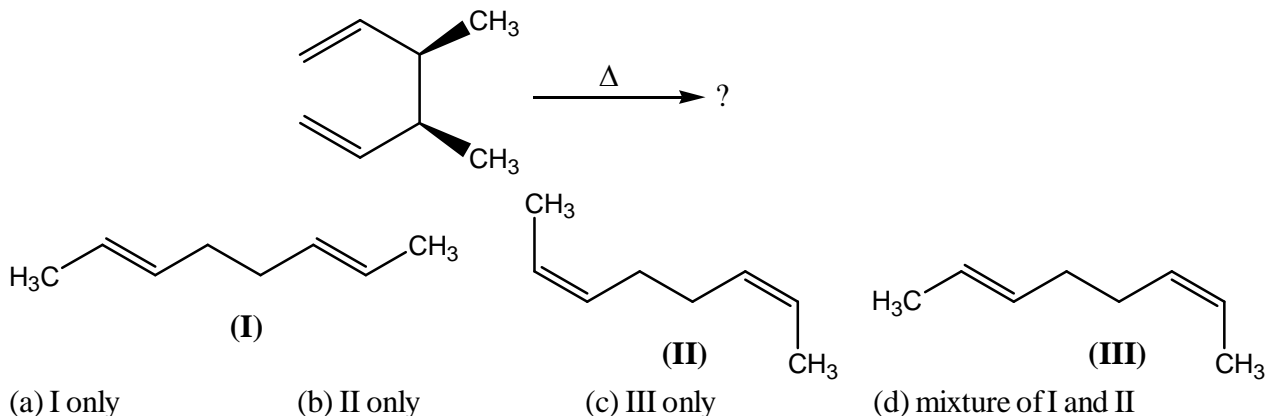
9. Under a certain legal system, prisoners are allowed to make one statement. If their statement turns out to be true then they are hanged. If the statement turns out to be false then they are shot. One prisoner made a statement and the judge had no option but to set him free. Which one of the following could be that statement?
 (a) I did not commit the crime (b) I committed the crime
 (c) I will be shot (d) You committed the crime
10. A person divided an amount of Rs. 100,000 into two parts and invested in two different schemes. In one he got 10% profit and in the other he got 12%. If the profit percentages are interchanged with these investments he would have got Rs. 120 less. Find the ratio between his investments in the two schemes.
 (a) 9 : 16 (b) 11 : 14 (c) 37 : 63 (d) 47 : 53

Q.1-Q.25 carry one mark each.

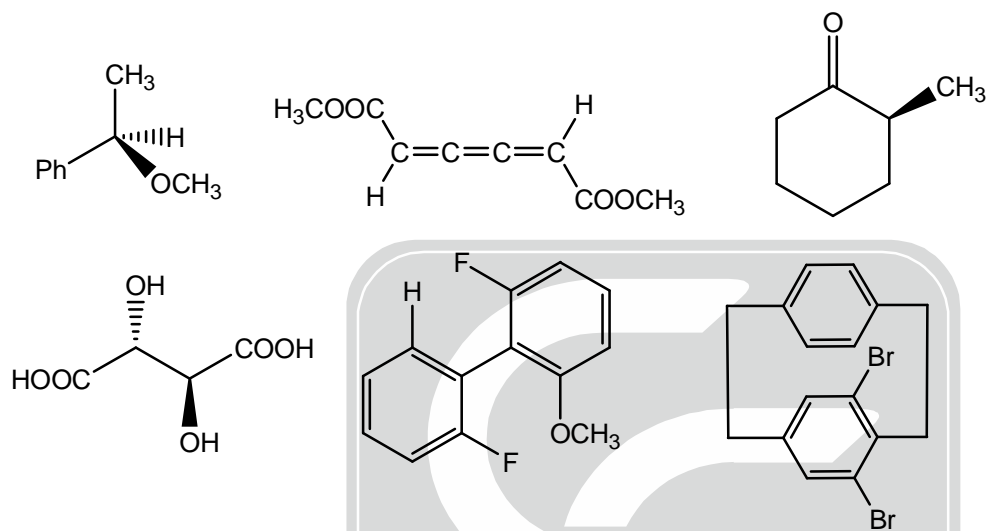
1. The major product formed in the following reaction is



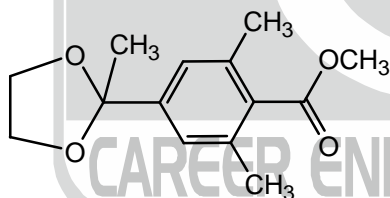
2. Among the following carbon allotropes, the one with discrete molecular structure is
 (a) Diamond (b) α -Graphite (c) β -Graphite (d) Fullerene
3. The product (s) formed in the following reaction is(are)



4. Micelle formation is accompanied by the
 (a) decrease in overall entropy due to ordering
 (b) increase in overall entropy mostly due to increase in solvent entropy
 (c) increase in overall entropy mostly due to increase in solute entropy
 (d) increase in overall entropy and decrease in enthalpy
5. On heating a sample of 25 mg hydrated compound (molecular weight = 250 g/mol) in thermogravimetric analysis, 16 mg of dehydrated compound remains. The number of water molecules lost per molecule of hydrated compound is _____
 (Molecular weight of water = 18 g/mol)
6. Among the following compounds, the number of compounds that DO NOT exhibit optical activity at room temperature is _____

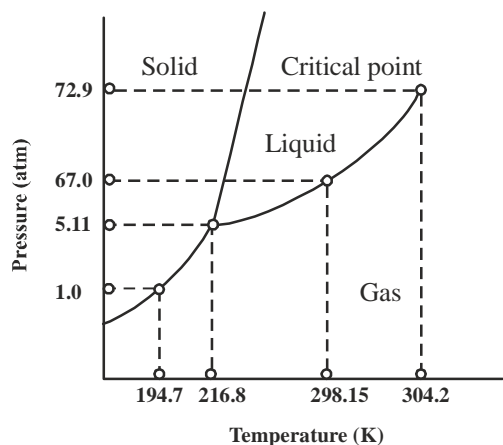


7. The number of ^1H NMR signals observed for the following compound is _____

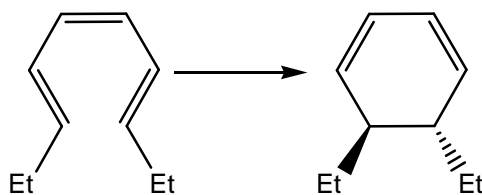


8. The INCORRECT statement about the solid-state structure of CsCl and CaF_2 is
 (a) Cations in both sides exhibit coordination number 8
 (b) CsCl has bcc type structure and CaF_2 has cubic close pack structure
 (c) Radius ratio for Cs/Cl and Ca/F is 0.93 and 0.73, respectively
 (d) Both exhibit close pack structure
9. The number of CO stretching bands in IR spectrum of trigonal bipyramidal $\text{cis-M}(\text{CO})_3\text{L}_2$ is _____
 (M = metal and L = monodentate ligand)

10. Consider the following phase diagram of CO_2 (not to scale). At equilibrium, the INCORRECT statement is

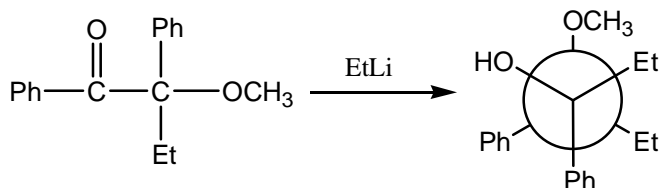


- (a) At 200K, on increasing the pressure from 1 to 50 atm, CO_2 gas condenses to liquid
 (b) It is not possible to obtain liquid CO_2 from gaseous CO_2 below 5.11 atm
 (c) Both liquid and gas phase of CO_2 coexist at 298.15 K and 67 atm
 (d) With increasing pressure, the melting point of solid CO_2 increases.
11. In a 400 MHz ^1H NMR spectrometer, a proton resonates at 1560 Hz higher than that of tetramethylsilane. The chemical shift value of this proton is _____ ppm. (Round off to one decimal places). (Chemical shift of tetramethylsilane is fixed at zero ppm)
12. The Δ_0 value of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is 8500 cm^{-1} . The Δ_0 values of $[\text{NiCl}_6]^{4-}$ and $[\text{Ni}(\text{NH}_3)_6]^{2+}$ compared to $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ are
 (a) higher and lower, respectively (b) lower and higher, respectively
 (c) higher in both complex ions (d) lower in both complex ions
13. Consider a system of three identical and distinguishable non-interacting particles and three available non-degenerate single particle energy levels having energies 0, ε and 2ε . The system is in contact with a heat bath of temperature T(K). A total energy of 2ε is shared by these three particles. The number of ways the particles can be distributed is _____
14. In Freundlich isotherm, a linear relationship is obtained in the plot of (θ = surface coverage and p = partial pressure of the gas)
 (a) θ vs p (b) $\ln(\theta)$ vs $\ln(p)$ (c) $\ln(\theta)$ vs (p) (d) θ vs $\ln(p)$
15. Consider a two-state system at thermal equilibrium having energies 0 and $2k_B T$ for which the degenerates are 1 and 2, respectively. The value of the partition function at the same absolute temperature T is _____ (Round off to two decimal places). (k_B is the Boltzmann constant)
16. The Woodward-Hoffmann condition to bring out the following transformation is

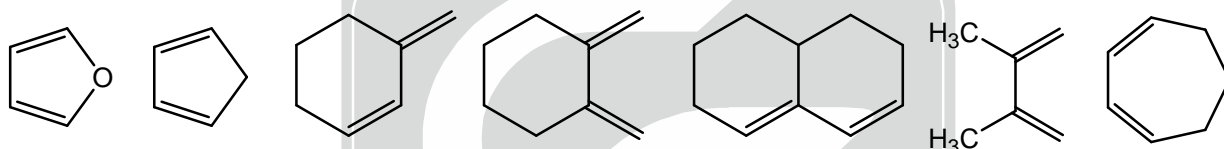


- (a) Δ , conrotatory (b) Δ , disrotatory (c) $h\nu$, disrotatory (d) $h\nu$, conrotatory

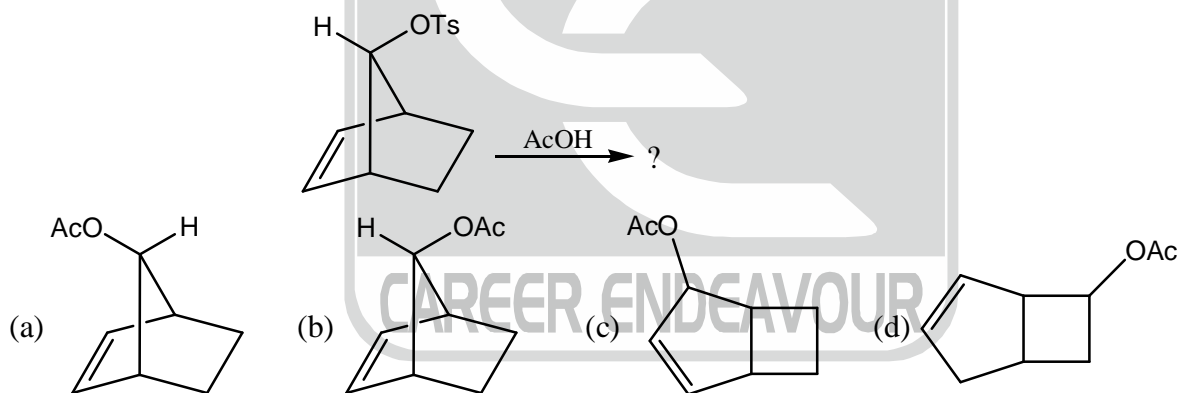
17. Gas phase bond length and dipole moment of a compound (MX) is 3 \AA and 10.8 D , respectively. The ionic character in gas phase MX is _____%. (Round off to one decimal place).
($1\text{ D} = 3.336 \times 10^{-30}\text{ C m}$)
18. The INCORRECT statement about the silicones is
(a) They are thermally unstable because of the Si-C bond
(b) They are insoluble in water
(c) They are organosilicon polymers
(d) They have stable silica-like skeleton ($-\text{Si}-\text{O}-\text{Si}-\text{O}-\text{Si}-$)
19. The entropy change for the melting of 'x' moles of ice (heat of fusion is 80 cal g^{-1}) at 273 K and 1 atm pressure is 28.80 cal K^{-1} . The value of 'x' is _____ (Round off to two decimal places)
(Molecular weight of water = 18 g/mol)
20. In the following reaction, the stereochemistry of the major product is predicted by the



- (a) Cram's model
(b) Cram's chelation model
(c) Felkin model
(d) Felkin-Anh model
21. The number of following diene(s) that undergo Diels-Alder reaction with methyl acrylate is _____

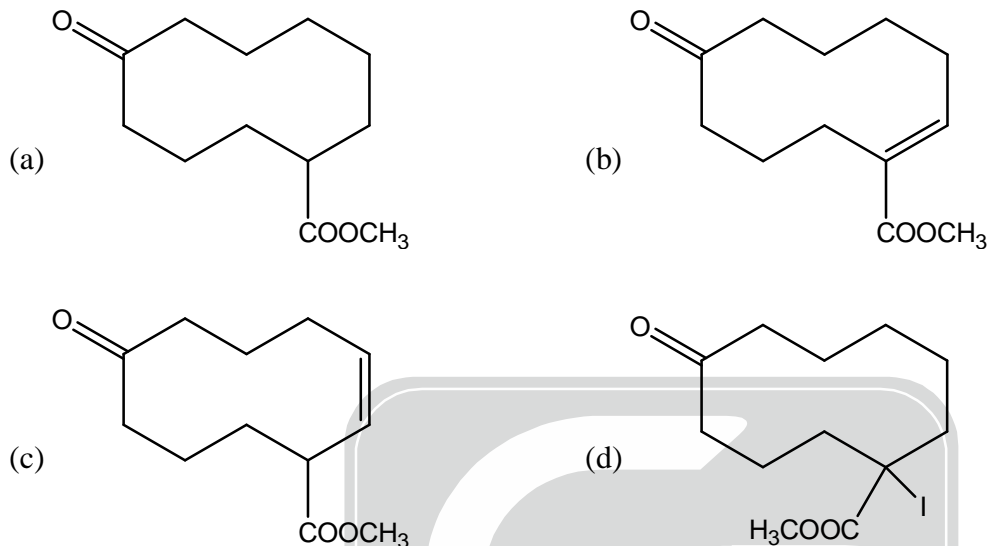
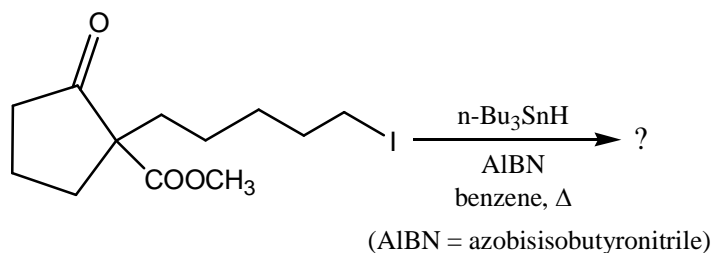


22. The major product formed in the following reaction is



23. An ideal gas occupies an unknown volume V liters (L) at a pressure of 12 atm . The gas is expanded isothermally against a constant external pressure of 2 atm so that its final volume becomes 3 L . The work involved for this expansion process is _____ cal. (Round off to two decimal places).
(Gas constant $R = 0.082\text{ L atm mol}^{-1}\text{ K}^{-1} = 2\text{ cal mol}^{-1}\text{ K}^{-1}$)
24. The total number of α and β particles emitted in the following radioactive decay is _____
$${}_{92}^{238}\text{U} \longrightarrow {}_{82}^{210}\text{Pb}$$
25. The INCORRECT statement about the interhalogen compound ICl_3 is
(a) It exists as a dimer
(b) Geometry around the iodine is tetrahedral in solid-state
(c) It decomposes as ICl and Cl_2 in gas-phase
(d) Liquid ICl_3 conducts electricity

26. The major product formed in the following reaction is



27. Match the metalloproteins with their respective functions

P	Ferritin	I	Electron transfer
Q	Rubredoxin	II	Acid – base catalysis
R	Cobalamin	III	Metal storage
S	Carbonic anhydrase	IV	Methyl transfer

(a) P-III; Q-II; R-I; S-IV
(c) P-IV; Q-I; R-III; S-II

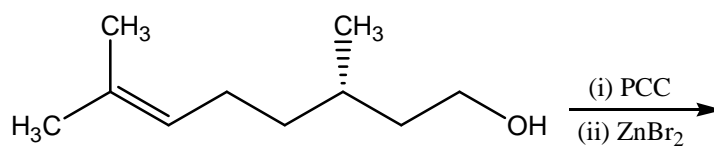
(b) P-III; Q-I; R-IV; S-II
(d) P-IV; Q-II; R-I; S-III

28. The correct molecular representation of $W(Cp)_2(CO)_2$ is

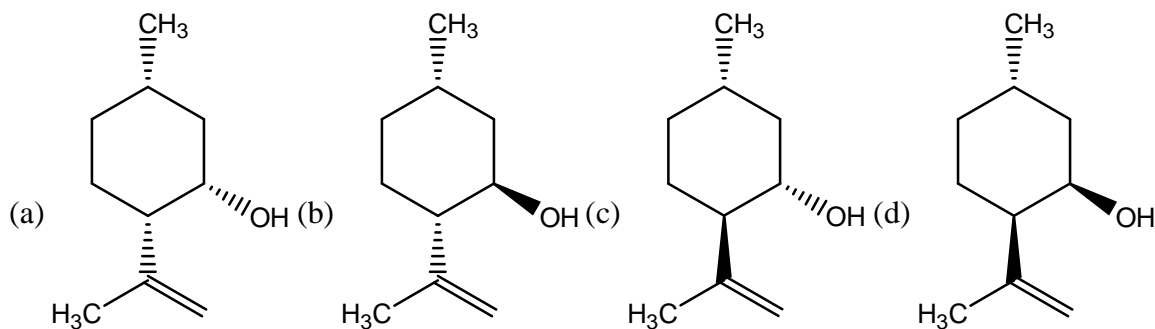
(Cp = cyclopentadienyl)



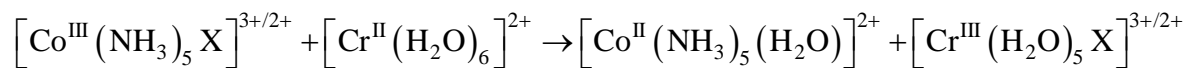
29. The major product formed in the following reaction is



(PCC = pyridinium chlorochromate)



30. The rate of the following redox reaction is slowest when X is



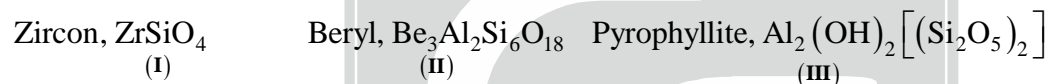
- (a) H_2O (b) NH_3 (c) Cl^- (d) N_3^-

31. If $\langle \alpha | \hat{S}_x \hat{S}_y - \hat{S}_y \hat{S}_x | \alpha \rangle = i\hbar^2 a$, where \hat{S}_x and \hat{S}_y are spin angular momentum operators and $|\alpha\rangle$ is spin up eigen function, then the value of a is _____ (Round off to one decimal place)

32. Among the following compounds, a normal spinel is

- (a) MgFe_2O_4 (b) ZnFe_2O_4 (c) CoFe_2O_4 (d) CuFe_2O_4

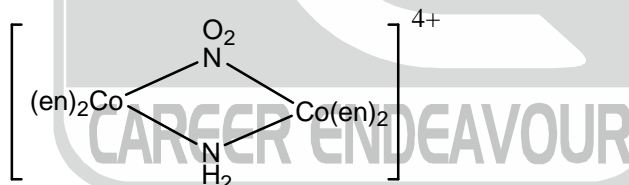
33. Following are the examples of silicate minerals



The correct structural description of the minerals is

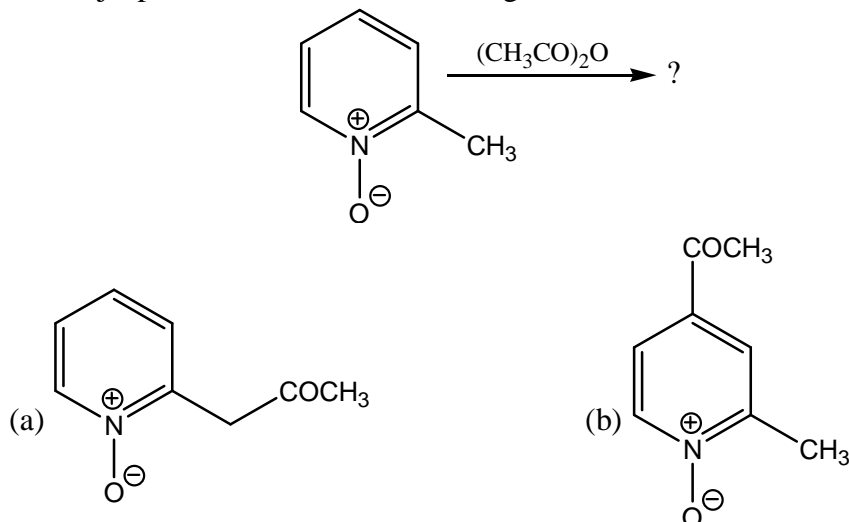
- (a) **I**-Ortho silicate, **II**-Cyclic silicate and **III**-Sheet silicate
 (b) **I**-Ortho silicate, **II**-Sheet silicate and **III**-Cyclic silicate
 (c) **I**-Cyclo silicate, **II**-Sheet silicate and **III**-Ortho silicate
 (d) **I**-Sheet silicate, **II**-Ortho silicate and **III**-Cyclic silicate

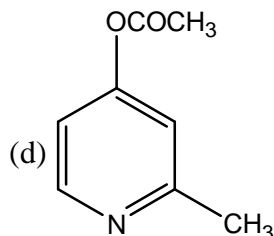
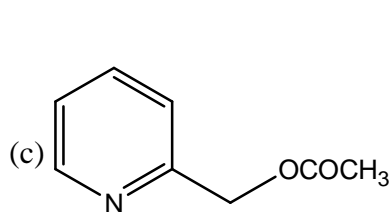
34. The number of possible optically active isomer(s) for the following complex is



en = ethylenediamine

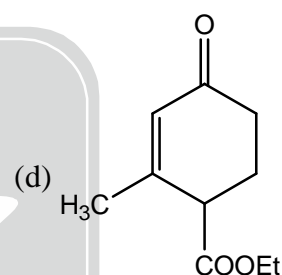
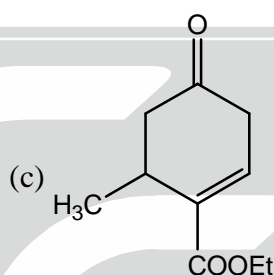
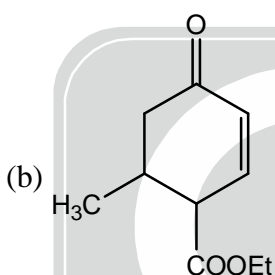
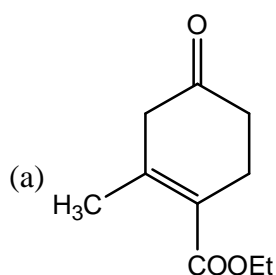
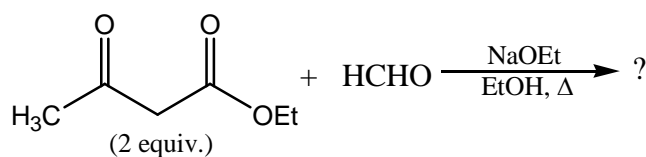
35. The major product formed in the following reaction is



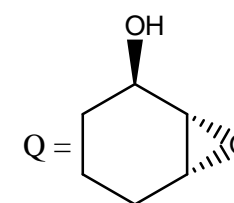
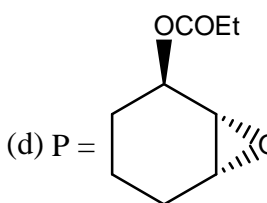
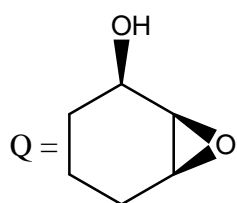
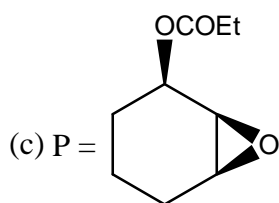
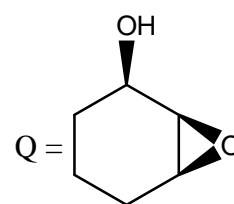
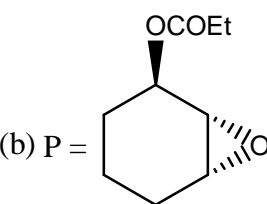
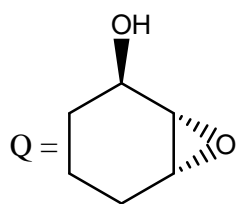
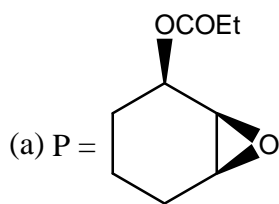
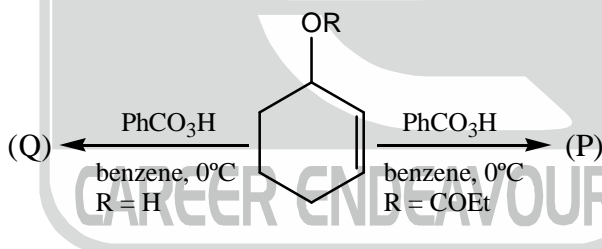


Q.36-Q.65 carry TWO marks each.

36. In the EPR spectrum of a methyl radical, the number of lines and their relative intensities, respectively are
 (a) 1 and 1 (b) 3 and 1 : 2 : 1 (c) 4 and 1 : 2 : 2 : 1 (d) 4 and 1 : 3 : 3 : 1
37. The major product formed in the following reaction is



38. In the following reactions, the major product (P) and (Q) are



39. The normal boiling point of a compound (X) is 350 K (heat of vaporization, $\Delta_{\text{vap}}H = 30 \text{ kJ mol}^{-1}$). The pressure required to boil 'X' at 300K is _____ Torr. (Round off to two decimal places)

(Ignore the temperature variation of $\Delta_{\text{vap}}H$; Gas constant $R = 8.31 \text{ J mol}^{-1}\text{K}^{-1}$ and $1 \text{ atm} = 760 \text{ Torr}$)

40. Suppose the wave function of a one dimensional system is

$$\psi = \sin(kx)\exp(3ikx)$$

In an experiment measuring the momentum of the system, one of the expected outcomes is

- (a) 0 (b) $\hbar k$ (c) $2\hbar k$ (d) $3\hbar k$
41. The specific rotation of optically pure (R)-2-bromobutane is -112.00 . A given sample of 2-bromobutane exhibited a specific rotation of -82.88 . The percentage of (S)-(+)-enantiomer present in the sample is _____
42. The product obtained in the reaction of $\text{Mn}_2(\text{CO})_{10}$ with Br_2 is
(a) $\text{Mn}(\text{CO})_5\text{Br}$ (b) $\text{Mn}_2(\text{CO})_8\text{Br}_2$ (c) $\text{Mn}(\text{CO})_4\text{Br}_2$ (d) $\text{Mn}_2(\text{CO})_9\text{Br}$

43. A particle in one dimensional box of length $2a$ with potential energy

$$V = \begin{cases} 0 & |x| < a \\ \infty & |x| > a \end{cases}$$

is perturbed by the potential $V' = ex \text{ eV}$, where c is a constant. The first order correction to the first excited state of the system is _____ $\times c \text{ eV}$.

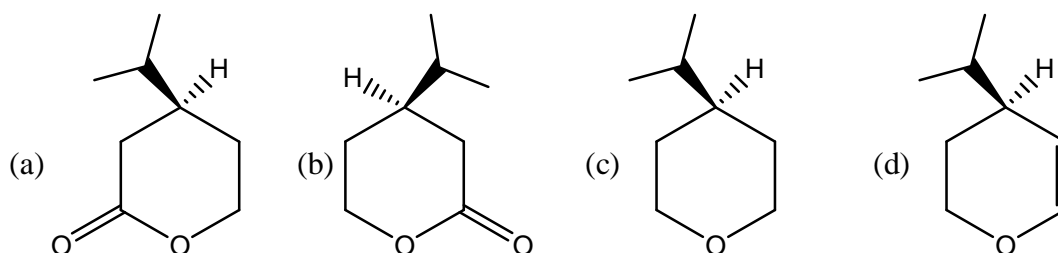
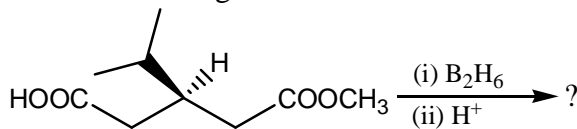
44. For a bimolecular gas phase reaction, $P + Q \longrightarrow R$, the pre-exponential factor is $1 \times 10^{13} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$. The standard entropy of activation at 25°C is _____ $\text{JK}^{-1}\text{mol}^{-1}$. (Round off to two decimal points).

(The standard concentration $c^0 = 1 \text{ mol dm}^{-3}$, Planck constant $h = 6.62 \times 10^{-34} \text{ J s}$, Boltzmann constant $k_B = 1.38 \times 10^{-23} \text{ JK}^{-1}$, Gas constant $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$)

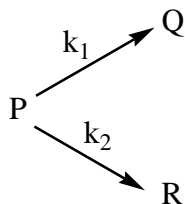
45. The experimentally observed magnetic moment values, which match well with the spin-only values for the pair of aqueous ions is

(Atomic number: Cr = 24, Co = 27, Gd = 64, Tb = 65, Dy = 66 and Lu = 71)

- (a) Cr(III) and Gd(III) (b) Co(II) and Gd(III)
(c) Cr(III) and Dy(III) (d) Lu(III) and Tb(III)
46. The major product formed in the following reaction is



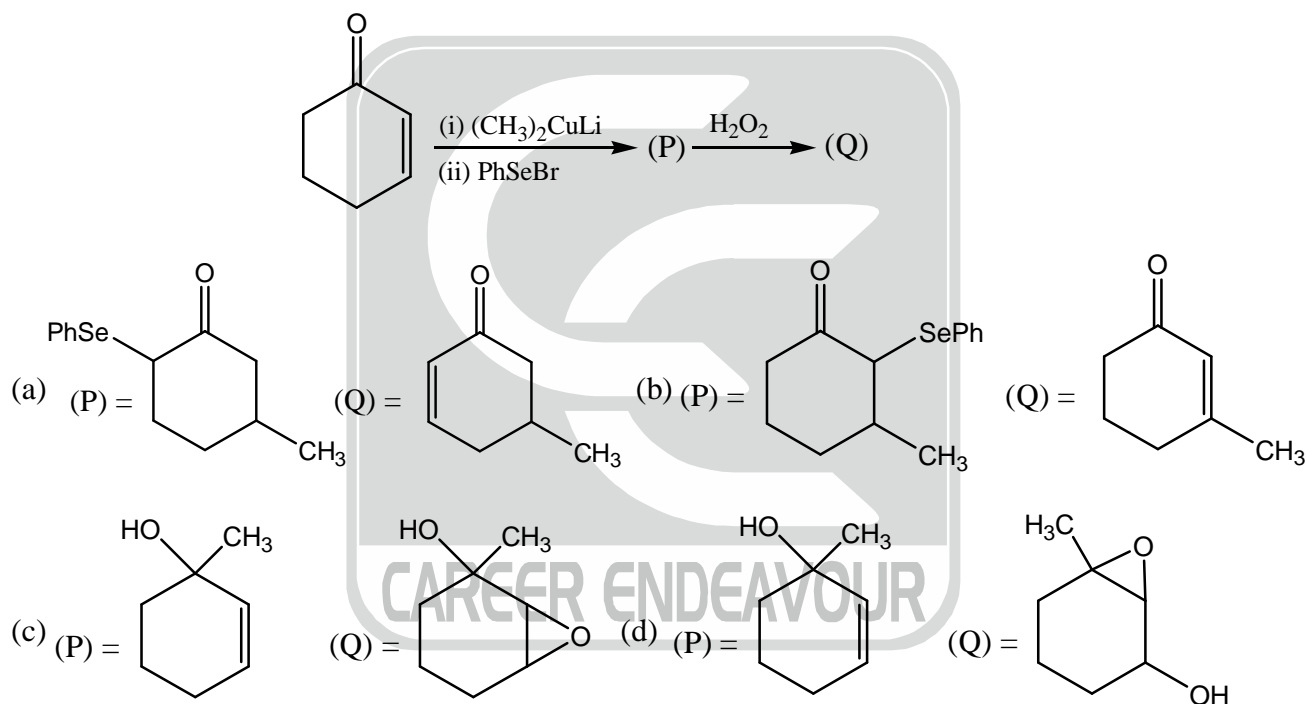
47. Consider the following two parallel irreversible first order reaction at temperature T,



where k_1 and k_2 are the rate constants and their values are 5×10^{-2} and $15 \times 10^{-2} \text{ min}^{-1}$, respectively, at temperature T. If the initial concentration of the reactant (P) is 4 mol L^{-1} , then the concentration of product (R) after 10 min of reaction is _____ mol L^{-1} . (Round off to two decimal places)
(Assume only P is present at the beginning of the reaction)

48. Consider a two dimensional harmonic oscillator with angular frequency $\omega_x = 2\omega_y = 6.5 \times 10^{14} \text{ rad s}^{-1}$. The wavelength of x polarized light required for the excitation of a particle from its ground state to the next allowed excited state is _____ $\times 10^{-6} \text{ m}$. (Round off to one decimal places).
(Speed of light, $c = 3.0 \times 10^8 \text{ m s}^{-1}$)

49. In the following reaction sequence, the products P and Q are

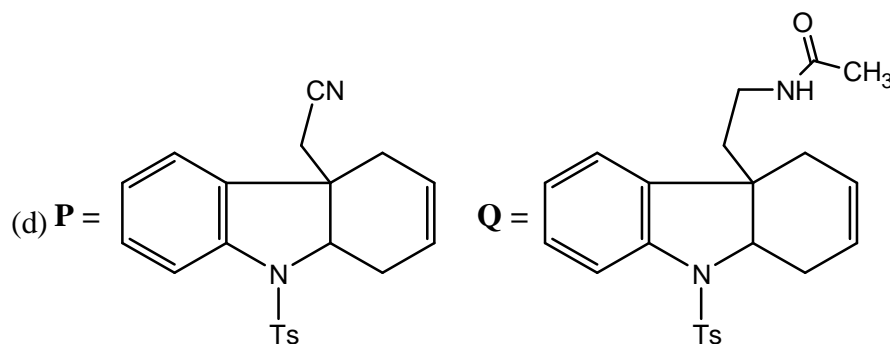
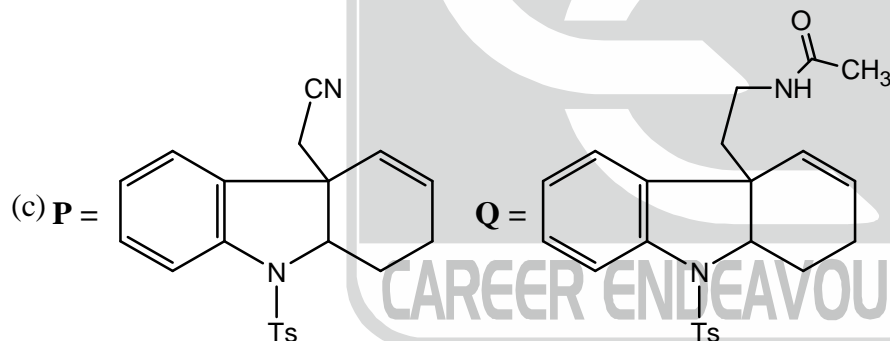
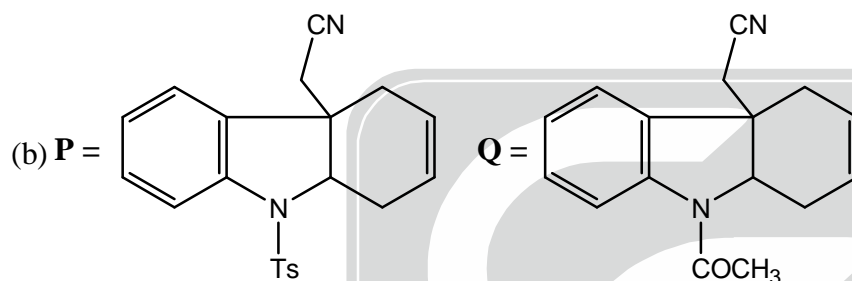
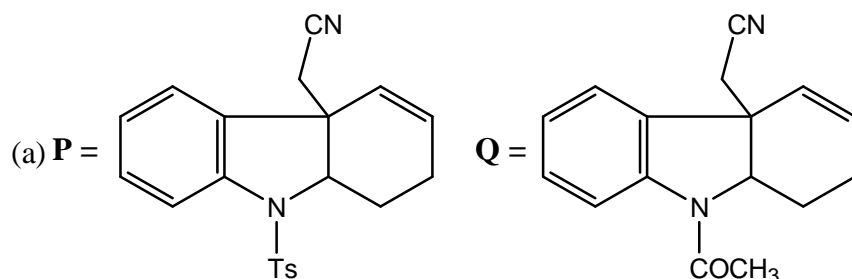
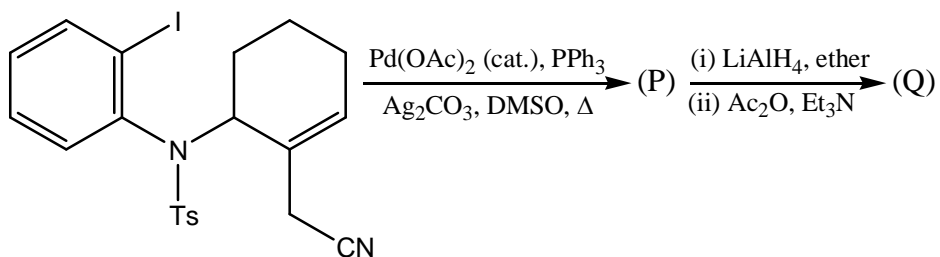


50. Character table of point groups D_8 is given below

D_8	E	$2C_8$	$2C_4$	$2C_8^3$	C_2	$4C'_2$	$4C''_2$
A_1	a	1	1	1	1	1	1
A_2	b	1	1	1	1	h	i
B_1	c	-1	1	-1	1	1	j
B_2	d	-1	1	-1	1	-1	1
E_1	e	$\sqrt{2}$	0	$-\sqrt{2}$	-2	0	0
E_2	f	0	-2	0	k	0	0
E_3	g	$-\sqrt{2}$	0	$\sqrt{2}$	-2	0	0

The value of $(a+b+c+d+e+f+g+h+i+j+k)$ is equal to _____

51. In the following reaction sequence, the products P and Q are

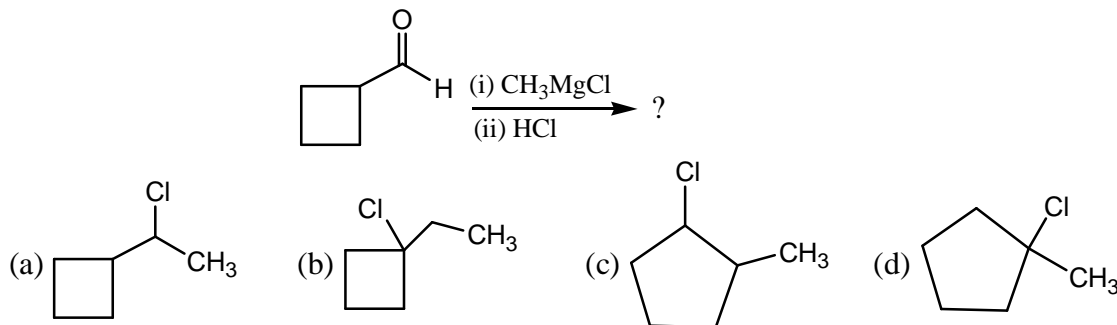


52. A complex is composed of one chromium ion, three bromides and six water molecules. Upon addition of excess AgNO_3 , 1.0 g aqueous solution of the complex gave 0.94 g of AgBr . The molecular formula of the complex is

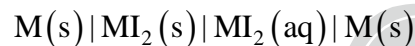
(Atomic weight: Cr = 52, Br = 80, Ag = 108, O = 16 and H = 1)

- (a) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Br}_3$ (b) $[\text{Cr}(\text{H}_2\text{O})_5\text{Br}]\text{Br}_2 \cdot \text{H}_2\text{O}$
 (c) $[\text{Cr}(\text{H}_2\text{O})_4\text{Br}_2]\text{Br} \cdot 2\text{H}_2\text{O}$ (d) $[\text{Cr}(\text{H}_2\text{O})_3\text{Br}_3] \cdot 3\text{H}_2\text{O}$

53. The major product formed in the following reaction is



54. Consider the electrochemical cell



where 'M' is a metal. At 298K, the standard reduction potentials are

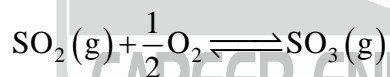
$E_{\text{M}^{2+}(\text{aq})/\text{M}(\text{s})}^0 = -0.12 \text{ V}$, $E_{\text{M}\text{I}_2(\text{s})/\text{M}(\text{s})}^0 = -0.36 \text{ V}$ and the temperature coefficient is

$\left(\frac{\partial E_{\text{cell}}^0}{\partial T}\right)_p = 1.5 \times 10^{-4} \text{ VK}^{-1}$. At this temperature the standard enthalpy change for the overall cell reaction,

$\Delta_r H^0$, is _____ kJ mol^{-1} . (Round off to two decimal places)

(Faraday constant $F = 96500 \text{ C mol}^{-1}$)

55. Consider the following equilibrium,



At 298K, the standard molar Gibbs energies of formation, $\Delta_f G^0$, of $\text{SO}_2(\text{g})$ and $\text{SO}_3(\text{g})$ are -300 and -371 kJ mol^{-1} , respectively. The value of the equilibrium constant, K_p , at this temperature is _____ $\times 10^{10}$.

(Round off to the nearest integer)

(Gas constant $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$)
