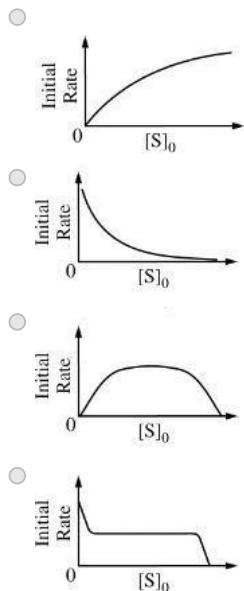
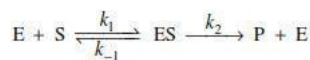


SECTION 1 - SECTION 1

Question No.1

The mechanism shown below has been proposed for the enzyme-catalyzed hydrolysis of certain biochemical compounds (substrates), where ES is an enzyme-substrate complex. Given a fixed amount of enzyme, E , which of the following could be the plot of the initial rate of the production of product, P , when using varying initial concentrations of substrate, $[S]_0$?



Question No.2

The Hamiltonian operator for a particle in a one-dimensional box, whose potential is zero inside the box and infinite outside the box, is

- ☐ $\hat{H} = \frac{-\hbar^2}{2m} \frac{d^2}{dx^2} + \frac{1}{2} kx^2$
- ☐ $\hat{H} = \frac{-\hbar^2}{2m} \frac{d^2}{dx^2}$
- ☐ $\hat{H} = \frac{-\hbar^2}{2mR^2} \frac{d^2}{d\theta^2} + \frac{\alpha\theta}{\pi}$
- ☐ $\hat{H} = \frac{-\hbar^2}{2m} \left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2} \right) - \frac{Ze^2}{r}$

Question No.3

The molecule that possesses S_4 symmetry element is

- ☐ ethylene
- ☐ 1,3-butadiene
- ☐ benzene
- ☐ allene

Question No.4

The spectroscopic ground state term symbols for the octahedral aqua complexes of Mn(II), Cr(III) and Cu(II), respectively, are

- ☐ 2H , 4F and 2D
- ☐ 2H , 2H and 2D
- ☐ 6S , 4F and 2D
- ☐ 6S , 4F and 2P

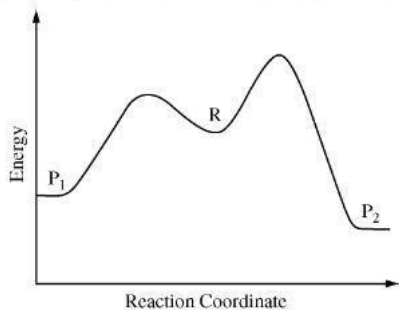
Question No.5

Which mode of expression the concentration of a solution remains independent of temp.

- ☐ Normality
- ☐ Formality
- ☐ Molality
- ☐ Molarity

Question No.6

A reactant, R , can produce either of two products, P_1 or P_2 , with competing pathways, as illustrated in the reaction profile shown below.

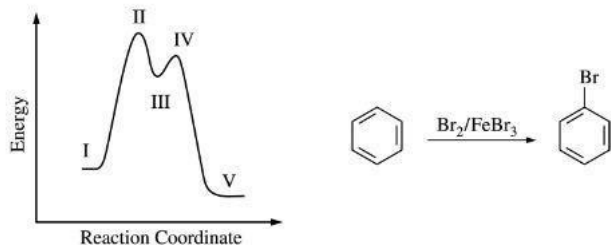


If the reaction is carried out at low temperature, which of the following best indicates the preferred product and the type of control?

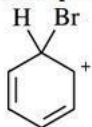
- ☐ P_2 & Kinetic
- ☐ P_1 & Thermodynamic
- ☐ P_1 & Kinetic
- ☐ P_2 & Thermodynamics

Question No.7

The reaction energy diagram for the electrophilic bromination of benzene with Br_2 and $FeBr_3$ is shown below.



Which position on the diagram corresponds to the species shown below?



- ☐ IV
- ☐ III
- ☐ I
- ☐ II

Question No.8

Hypochlorous acid is

- ☐ $HClO$
- ☐ $HClO_3$
- ☐ $HClO_2$
- ☐ $HClO_4$

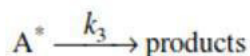
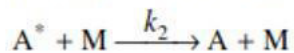
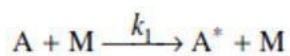
Question No.9

The solubility of silver chloride in water at 298.15 K is $0.00179 \text{ g litre}^{-1}$. The solubility product will be:

- ☐ $156 \times 10^{-10} \text{ mol}^2\text{dm}^{-6}$
- ☐ $1.56 \times 10^{-10} \text{ mol}^2\text{dm}^{-6}$
- ☐ $15.6 \times 10^{-12} \text{ mol}^2\text{dm}^{-6}$
- ☐ $1.56 \times 10^{-9} \text{ mol}^2\text{dm}^{-6}$

Question No.10

The gas-phase reaction $A \rightarrow \text{products}$ is postulated to proceed by the mechanism shown below, in which A^* is an activated A molecule and M is a chemically inert gas.



Assuming the steady-state approximation for A^* , this mechanism yields the rate equation

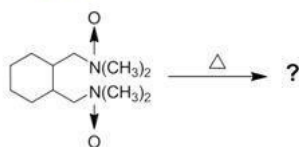
$$\text{rate} = \frac{k_1 k_3 [M][A]}{k_3 + k_2 [M]}.$$

Which of the following is NOT consistent with this mechanism?

- ☐ When the partial pressure of M is very low, the reaction is second order overall.
- ☐ When the partial pressure of M is very high, the reaction is first order overall.
- ☐ When the partial pressure of M is very low, the rate is independent of the concentration of A.
- ☐ When the partial pressure of M is very high, the reaction is first order in A.

Question No.11

Identify the correct product.



- ☐
- ☐
- ☐
- ☐

Question No.12

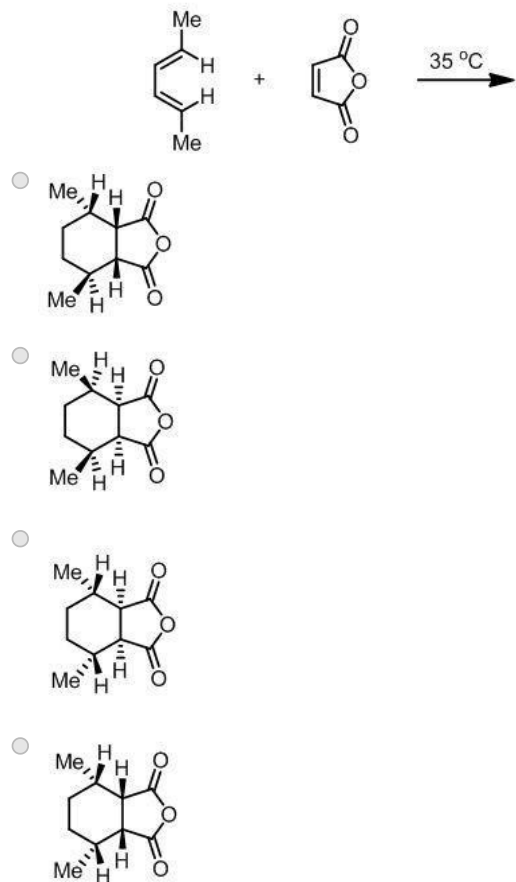
The Rydberg equation given below accurately predicts the UV-visible emission spectrum of the hydrogen atom. A form of the Rydberg equation may also be used to predict the UV-visible emission for all of the following EXCEPT

$$\bar{\nu} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

- ☐ hydride ion, H^-
- ☐ deuterium atom, D
- ☐ tritium atom, T
- ☐ helium cation, He^+

Question No.13

Predict the product of the following cycloaddition reaction



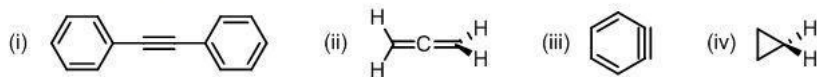
Question No.14

Which of the following experimental observations were explained by Planck's quantum theory?

- ☐ Blackbody radiation curves
- ☐ Temperature dependence of reaction rates
- ☐ Electron diffraction patterns
- ☐ Emission spectra of diatomic molecules

Question No.15

Which of the following has sp -hybridised carbon atom?



- ☐ (i) and (ii)
- ☐ (i) and (iii)

- ☐ (iii) and (iv)
- ☐ (i), (ii) and (iii)

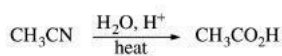
Question No.16

The difference between the angular momentum of two orbits of He^{2+} is $2h/\pi$. The energy of an electron present in the higher orbit is -1.51eV . Identify the lower orbit.

- ☐ 3
- ☐ 4
- ☐ 1
- ☐ 2

Question No.17

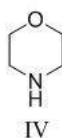
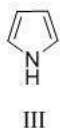
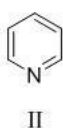
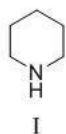
Which of the following best depicts the initial nucleophilic addition step in the acid-catalyzed hydrolysis of acetonitrile shown below?



- ☐
- ☐
- ☐
- ☐

Question No.18

The decreasing order of basicity of the following compounds is



- ☐ IV > III > II > I
- ☐ IV > I > III > II
- ☐ I > IV > II > III
- ☐ I > II > III > IV

Question No.19

A system that consists of a sample of nitrogen gas behaving as an ideal gas is compressed at a constant temperature. Which of the following is true about w (work) and q (heat transfer) for this process?

- ☐ $w > 0$, $q > 0$
- ☐ $w > 0$, $q < 0$
- ☐ $w < 0$, $q < 0$
- ☐ $w < 0$, $q > 0$

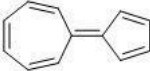
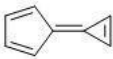
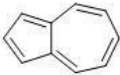
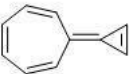
Question No.20

A buffer is made from equal concentrations of a weak acid and its conjugate base. Doubling the volume of the buffer solution by adding water has what effect on its pH ?

- ☐ It significantly decreases the pH .
- ☐ It significantly increases the pH
- ☐ It changes the pH asymptotically to the pK_a of the acid.
- ☐ It has little effect

Question No.21

Which of the following compound **doesn't have** dipole moment

- ☐ 
- ☐ 
- ☐ 
- ☐ 

Question No.22

A reaction has a negative (and approximately temperature independent) enthalpy change. It does not proceed spontaneously at room temperature (25°C). At which of the following temperatures is the reaction more likely to become spontaneous?

- ☐ 100°C
- ☐ -50°C
- ☐ 50°C
- ☐ 1000°C

Question No.23

When a certain metal is irradiated with radiation of frequency $5.5 \times 10^{14} \text{ s}^{-1}$, electrons are ejected. If the work function of the metal is $2.9 \times 10^{-19} \text{ J}$, which of the following expresses the kinetic energy (in joules) of the ejected electrons?

- ☐ $\frac{h(5.5 \times 10^{14} \text{ s}^{-1})}{(2.9 \times 10^{-19} \text{ J})}$
- ☐ $h(5.5 \times 10^{14} \text{ s}^{-1}) + (2.9 \times 10^{-19} \text{ J})$
- ☐ $(2.9 \times 10^{-19} \text{ J}) - h(5.5 \times 10^{14} \text{ s}^{-1})$
- ☐ $h(5.5 \times 10^{14} \text{ s}^{-1}) - (2.9 \times 10^{-19} \text{ J})$

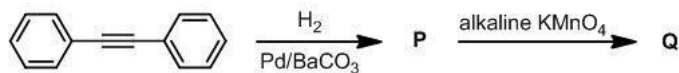
Question No.24

An enantiomerically pure acid is treated with a racemic mixture of an alcohol having one chiral carbon. The ester formed will be

- ☐ Meso compound
- ☐ Racemic mixture
- ☐ Pure enantiomer
- ☐ Diastereomer

Question No.25

Predict the products (**P** and **Q**) of the following reaction sequence



- ☐ **P** = c1ccccc1/C=C/c2ccccc2 **Q** = c1ccccc1C=O
- ☐ **P** = c1ccccc1/C=C/c2ccccc2 **Q** = c1ccccc1C=O
- ☐ **P** = c1ccccc1/C=C/c2ccccc2 **Q** = c1ccccc1C(=O)O
- ☐ **P** = c1ccccc1/C=C/c2ccccc2 **Q** = c1ccccc1C(=O)O

Question No.26

The first ionisation potential of Na, Mg, Al and Si follow the order

- ☐ Na = Mg = Al > Si
- ☐ Na < Mg < Al < Si
- ☐ Na > Mg > Al > Si
- ☐ Na < Mg > Al < Si

Question No.27

According to Nernst equation, the potential of an electrode changes by 59.2 mV whenever the ratio of the oxidized and the reduced species changes by a factor of 10 at 25 °C. What would be the corresponding change in the electrode potential if the experiment is carried out at 30 °C?

- ☐ 59.2 mV
- ☐ 60.2 mV
- ☐ 71.0 mV
- ☐ 5.92 mV

Question No.28

Which of the following is classified as a conjugate acid-base pair?

- ☐ HCl/NaOH
- ☐ H₃O⁺/H₂O
- ☐ H⁺/Cl⁻
- ☐ O₂/H₂O

Question No.29

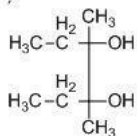
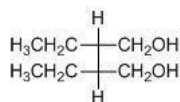
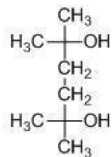
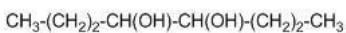
The biological functions of cytochrome P450 and myoglobin are, respectively

- ☐ O₂ storage and electron carrier
- ☐ electron carrier and O₂ transport
- ☐ O₂ transport and O₂ storage
- ☐ Oxidation of alkene and O₂ storage

Question No.30

A diol C₈H₁₈O₂ doesn't react with HIO₄. Its ¹H NMR consists of three singlets at δ1.2 (12H), δ1.6 (4H) and δ2.0 (2H). What is the structure of diol.

- ☐


☐

☐

☐


Question No.31

The anhydride of $\text{Ba}(\text{OH})_2$ is

- ☐ BaO
- ☐ Ba
- ☐ BaO_2
- ☐ BaOH

Question No.32

Which of the following statements about nuclear binding energies is NOT true?

- ☐ Nuclear binding energies have about the same magnitude as chemical bond energies.
- ☐ Nuclei have slightly less mass than the sum of their component nucleons.
- ☐ The nuclei of heavy elements have more neutrons than protons in order to provide sufficient binding energy to hold the nuclei together
- ☐ Binding energy per nucleon reaches a maximum for ^{56}Fe .

Question No.33

Redox enzyme catalysis involves the cyclic oxidation and reduction of metal ions that have at least two stable positive oxidation states. Which of the following groups of metals could be found at the active site of redox enzymes?

- ☐ Na, Ba, Al
- ☐ Cu, Fe, Co
- ☐ Zn, Ca, Ga
- ☐ Sr, Ga, Mg

Question No.34

For the reaction of pyridine as Lewis base and BX_3 ($\text{X} = \text{F}, \text{Cl}, \text{Br}$) as Lewis acid, the order of stability of the adducts is

- ☐ $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$
- ☐ $\text{BBr}_3 < \text{BF}_3 < \text{BCl}_3$
- ☐ $\text{BF}_3 < \text{BBr}_3 < \text{BCl}_3$
- ☐ $\text{BBr}_3 < \text{BCl}_3 < \text{BF}_3$

Question No.35

An impure sample of K_2O was analyzed by precipitating the potassium as the insoluble tetraphenyl borate salt, $\text{KB}(\text{C}_6\text{H}_5)_4$. The precipitate, $\text{KB}(\text{C}_6\text{H}_5)_4$ had a mass of 1.57 g. The mass of K_2O in the original sample is obtained from which of the following? (Molar masses: $\text{KB}(\text{C}_6\text{H}_5)_4 = 358.3\text{g}$ and $\text{K}_2\text{O} = 94.2\text{g}$)

☐

$$\frac{(358.3)}{(1.57)(94.2)}$$

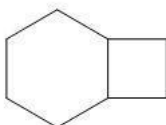
☐ $\frac{(1.57)(94.2)}{(358.3)}$

☐ $\frac{2(1.57)(94.2)}{(358.3)}$

☐ $\frac{(1.57)(94.2)}{2(358.3)}$

Question No.36

IUPAC nomenclature of the following compound is



- ☐ Bicyclo [6.2.0] octane
- ☐ Bicyclo [4.2.2] octane
- ☐ Bicyclo [4.2.0] octane
- ☐ Bicyclo [5.2.2] octane

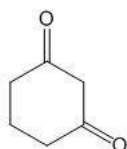
Question No.37

$11.2 \times 10^3 \text{ m}^3$ of a gas at STP requires 104.6 J to raise its temperature by 10 degree. The C_v for the gas is:

- ☐ 10.46 J/deg/mole
- ☐ 9.4 J/deg/mole
- ☐ 20.92 J/deg/mole
- ☐ Zero

Question No.38

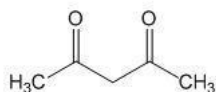
The correct order of the acidity for the following compounds is



(A)



(B)



(C)

- ☐ B > A > C
- ☐ C > B > A
- ☐ B > C > A
- ☐ C > A > B

Question No.39

When ferric oxide, Fe_2O_3 , is dissolved in 6 M HNO_3 , which iron-containing species predominates in solution?

- ☐ $\text{Fe}(\text{H}_2\text{O})_6^{3+}$
- ☐ $\text{Fe}(\text{OH})_4^-$
- ☐ $\text{Fe}(\text{OH})_3$
- ☐ $\text{Fe}(\text{H}_2\text{O})_6^{2+}$

Question No.40

Aspartic acid shows:

- ☐ pK_{a1} and pK_{a2}
- ☐ pK_{a1}
- ☐ pK_{a1} , pK_{a2} , and pK_{a3}

☐ pKa₂

Question No.41

Which of the following procedures tend(s) to minimize the influence of random errors on measured results?

- I. Signal averaging
 - II. Use of internal standards
 - III. Averaging the results from multiple samples
- ☐ I only
- ☐ II only
- ☐ I and III only
- ☐ III only

Question No.42

Which of the following are Lewis acids?

- ☐ PH₃ and BCl₃
- ☐ BCl₃ and AlCl₃
- ☐ PH₃ and SiCl₄
- ☐ AlCl₃ and SiCl₄

Question No.43

Considering 0.1 M aqueous solutions of each of the following, which solution has the lowest H⁺?

- ☐ Na₂S
- ☐ NaCl
- ☐ Na₃PO₄
- ☐ Na₂CO₃

Question No.44

The solid-state structures of the principal allotropes of elemental boron are made up of which of the following structural units?

- ☐ B₁₂ icosahedra
- ☐ B₈ cubes
- ☐ B₆ octahedra
- ☐ B₄ tetrahedra

Question No.45

Which of the following must be true about a binary liquid mixture that obeys Raoult's law?

- I. The partial pressure of each component at equilibrium is proportional to its mole fraction in the liquid mixture.
 - II. The volume of the mixture is equal to the sum of the volumes of each component before mixing.
 - III. Intermolecular interactions in the mixture are identical to intermolecular interactions in the pure components.
- ☐ III only
- ☐ I, II, and III
- ☐ I and III only
- ☐ II and III only

Question No.46

If one proton is released on showering alpha particles on ${}^7\text{N}^{14}$, then which of the following will be formed?

- ☐ 817
- ☐ 818
- ☐ 918
- ☐ 917

Question No.47

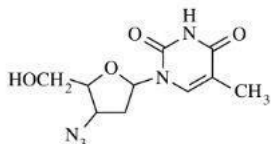
System A and system B below are identical closed systems that undergo a change of state from the same initial conditions (P_1, V_1, T_1) to the same final conditions (P_2, V_2, T_2) , but by a different process. What are ΔU and q for the change in state for system B?

System A	Adiabatic	Work = 300J
System B	Nonadiabatic	Work = 200J

- ☐ $\Delta U(\text{J})=0, q(\text{J})=-300$
- ☐ $\Delta U(\text{J})=-300, q(\text{J})=-100$
- ☐ $\Delta U(\text{J})=-300, q(\text{J})=0$
- ☐ $\Delta U(\text{J})=-100, q(\text{J})=-100$

Question No.48

The compound shown below is AZT, a drug used in the treatment of acquired immune deficiency syndrome (AIDS).



What is the total number of stereoisomers for this compound?

- ☐ 4
- ☐ 8
- ☐ 6
- ☐ 2

Question No.49

An organic compound has a distribution coefficient, K_p , of 2.00 between an ether and water. If 10.0 g of the compound is dissolved in 100 mL of water that is then extracted twice with 100 mL portions of the ether, what fraction of the compound remains in the water? ($K_p = \frac{C_{\text{ether}}}{C_{\text{water}}}$)

- ☐ 0.250
- ☐ 0.500
- ☐ 0.111
- ☐ 0.200

Question No.50

pH of 0.001N sodium hydroxide solution at 25 °C is

- ☐ 11
- ☐ 4
- ☐ 3
- ☐ 12

Question No.51

Of the following solutions, which will have the highest ionic strength? (Assume complete dissociation.)

- ☐ 0.050 M CaCl_2
- ☐ 0.050 M AlCl_3
- ☐ 0.100 M NaCl
- ☐ 0.100 M HCl

Question No.52

Which of the following must be true if the wavefunction $\psi(x)$ is normalized?

- ☐ $\psi^*(x)\psi(x) = 0$
- ☐ $\psi^*(x)\psi(x) = 1$
- ☐ $\int_{-\infty}^{+\infty} \psi^*(x)\psi(x)dx = 0$

☐ $\int_{-\infty}^{+\infty} \psi^*(x)\psi(x)dx = 1$

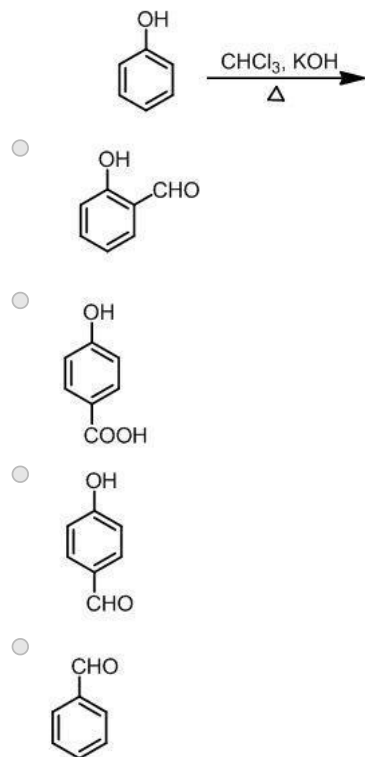
Question No.53

Which of the following dimethylcyclobutane is chiral?

- ☐ *trans*-1,2-dimethylcyclobutane
- ☐ *cis*-1,2-dimethylcyclobutane
- ☐ *trans*-1,3-dimethylcyclobutane
- ☐ *cis*-1,3-dimethylcyclobutane

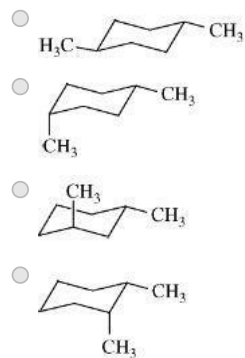
Question No.54

Predict the correct product of the following reaction



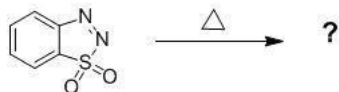
Question No.55

Of the following isomers, which is the most thermodynamically stable?



Question No.56

Identify the product



- ☐
- ☐
- ☐
- ☐

Question No.57

For the reaction $A + B \rightarrow C + D$ carried

out at constant temperature, the initial rates of reaction given above were found experimentally. The rate law of this reaction, expressed as a function of reactant concentrations, is

[A]/M	[B]/M	Initial rate / 10^{-4} M s^{-1}
0.10	0.30	1.5
0.20	0.30	3.0
0.20	0.60	12.0

- ☐ rate = $k[A][B]^2$
- ☐ rate = $k[A]^2[B]$
- ☐ rate = $k([A] + [B])$
- ☐ rate = $k[A][B]$

Question No.58

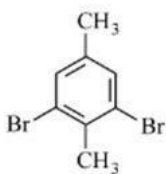
How many carbon signals will appear in the ^{13}C -DEPT-135 spectrum of camphor?

- ☐ 5
- ☐ 7
- ☐ 6
- ☐ 4

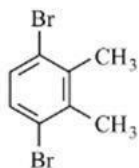
Question No.59

The proton NMR spectrum of an aromatic compound, $\text{C}_8\text{H}_8\text{Br}_2$, includes two methyl singlets. Its proton-decoupled ^{13}C -NMR spectrum displays a total of six peaks. Of the following, which structure best fits these data?

- ☐
- ☐
- ☐

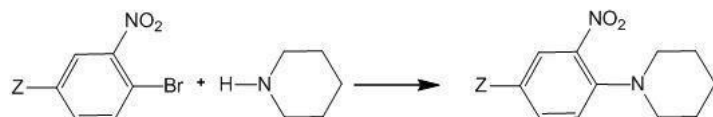


☐



Question No.60

The correct order of the rate constants for the following series of reactions ($Z = \text{CF}_3/\text{CH}_3/\text{OCH}_3$) is

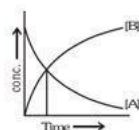


- ☐ $\text{CF}_3 > \text{CH}_3 > \text{OCH}_3$
- ☐ $\text{CF}_3 > \text{OCH}_3 > \text{CH}_3$
- ☐ $\text{OCH}_3 > \text{CF}_3 > \text{CH}_3$
- ☐ $\text{CH}_3 > \text{OCH}_3 > \text{CF}_3$

Question No.61

The accompanying figure depicts the change in concentration of species A and B for the reaction

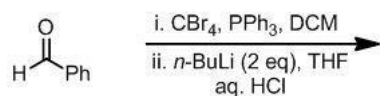
$\text{A} \rightarrow \text{B}$ as a function of time the point of intersection of the two curves represents.



- ☐ $t_{2/3}$
- ☐ $t_{1/2}$
- ☐ $t_{3/4}$
- ☐ indicates equilibrium

Question No.62

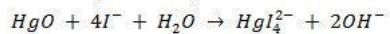
What is the expected product of the following reaction



- ☐ $\text{Ph}-\text{C}\equiv\text{Cl}$
- ☐ $\text{Ph}-\text{C}\equiv\text{H}$
- ☐ $\text{Ph}-\text{C}\equiv\text{Ph}$
- ☐ $\text{Ph}-\text{C}\equiv\text{Br}$

Question No.63

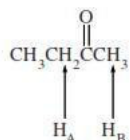
A 0.217 g sample of HgO (molar mass = 217g) reacts with excess iodide ions according to the reaction shown below. Titration of the resulting solution requires how many mL of 0.10 M HCl to reach equivalence point?



- ☐ 10 mL
- ☐ 1.0 mL
- ☐ 20 mL
- ☐ 50 mL

Question No.64

Which of the following gives the multiplicities of the signals for the protons designated H_A and H_B in the 1H NMR spectrum of the compound shown below?



- ☐ Quartet Triplet
- ☐ Triplet Doublet
- ☐ Quartet Singlet
- ☐ Septet Singlet

Question No.65

Number of rings present in the following molecule



- ☐ 3
- ☐ 5
- ☐ 6
- ☐ 4

Question No.66

The number of bridging ligand(s) and metal metal bond(s) present in the complex $[Ru_2(\eta^5-Cp)_2(CO)_2(Ph_2PCH_2PPh_2)]$ (obeys 18-electron rule) respectively are

- ☐ 3 and 1
- ☐ 0 and 1
- ☐ 1 and 2
- ☐ 2 and 1

Question No.67

Of the following substances, which is likely to have the largest value of the coefficient a in the van der Waals equation of state for real gases shown below?

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

- ☐ CH_4
- ☐ H_2
- ☐ N_2
- ☐ NH_3

Question No.68

The number of d-d bands in the electronic spectra of octahedral Cr(III) complex is expected to be

- ☐ one
- ☐ four
- ☐ three
- ☐ two

Question No.69

An artificial soft drink contains 11.0 g/L of tartaric acid $C_4H_6O_6$, and 20 g/L of its potassium salt $C_4H_5O_6K$. What is the pH of the drink? (Given: K_a tartaric acid = 1.0×10^{-3})

- ☐ 5.21
- ☐ 4.24
- ☐ 3.82
- ☐ 3.16

Question No.70

Which of the following reactions is best classified as an oxidative addition?

- ☐ $[Cr(CO)_6] + Br^- \rightarrow [Cr(CO)_5Br]^- + CO$
- ☐ $[PtH(CH_3)\{P(C_6H_5)_3\}_2] + P(C_6H_5)_3 \rightarrow [Pt\{P(C_6H_5)_3\}_3] + CH_4$
- ☐ $[Pt(NH_3)Cl_3]^- + NH_3 \rightarrow [Pt(NH_3)_2Cl_2] + Cl^-$
- ☐ $[Pt\{P(C_2H_5)_3\}_2HCl] + HCl \rightarrow [Pt\{P(C_2H_5)_3\}_2(H)_2Cl_2]$

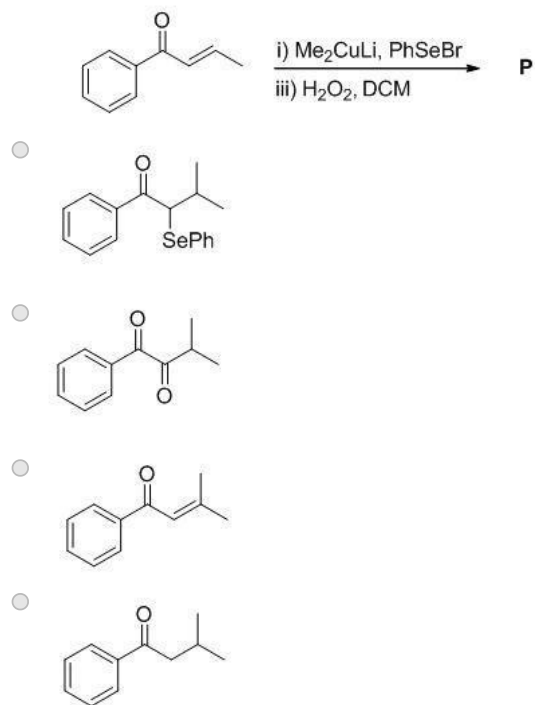
Question No.71

The degeneracy of the rotational energy level with $J = 4$ for a heterodiatomic molecule is:

- ☐ 9
- ☐ 7
- ☐ 8
- ☐ 4

Question No.72

Predict the product (P) for the following reaction



Question No.73

Which is the right decreasing order of nucleophilicity?

- ☐ $\text{CH}\equiv\text{C}^- > \text{NH}_2^- > \text{CH}_3\text{-CH}_2^- > \text{OH}^-$
- ☐ $\text{CH}_3\text{-CH}_2^- > \text{NH}_2^- > \text{CH}\equiv\text{C}^- > \text{OH}^-$
- ☐ $\text{NH}_2^- > \text{CH}\equiv\text{C}^- > \text{OH}^- > \text{CH}_3\text{-CH}_2^-$
- ☐ $\text{OH}^- > \text{NH}_2^- > \text{CH}\equiv\text{C}^- > \text{CH}_3\text{-CH}_2^-$

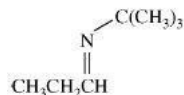
Question No.74

In the complex $[\text{Ni}(\text{H}_2\text{O})_2(\text{NH}_3)_4]^{+2}$ the magnetic moment (μ) of Ni is

- ☐ 2.83 BM
- ☐ 1.73 BM
- ☐ 3.87 BM
- ☐ Zero

Question No.75

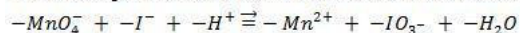
Which of the following procedures gives the compound shown below?



- ☐ $\text{CH}_3\text{CH}_2\text{CHO} + (\text{CH}_3)_3\text{CNH}_2 \xrightarrow{\text{H}^+}$
- ☐ $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \xrightarrow[2. \text{NaOH}]{1. (\text{CH}_3)_3\text{CNH}_2}$
- ☐ $\text{CH}_3\text{CH}_2\text{C}\equiv\text{N} \xrightarrow[2. \text{H}_3\text{O}^+]{1. (\text{CH}_3)_3\text{CMgBr}}$
- ☐ $\text{CH}_3\text{CH}_2\text{MgBr} \xrightarrow[2. \text{H}_3\text{O}^+]{1. (\text{CH}_3)_3\text{CCN}}$

Question No.76

When the equation shown below is balanced, which of the following is true?



- ☐ The $\text{MnO}_4^- : \text{Mn}^{2+}$ ratio is 3:1
- ☐ The $\text{I}^- : \text{IO}_3^-$ ratio is 3: 1.
- ☐ The $\text{H}^+ : \text{I}^-$ ratio is 2: 1.
- ☐ The $\text{I}^- : \text{IO}_3^-$ ratio is 3: 1.

Question No.77

The correct order of the rate of substitution of the H_2O ligand in the high-spin octahedral aquo complexes $[\text{M}(\text{H}_2\text{O})_6]^{2+}$ of the metal ions are

- ☐ $\text{Ni}^{2+} \text{ Cr}^{2+} \text{ Fe}^{2+}$
- ☐ $\text{Cr}^{2+} \text{ Fe}^{2+} \text{ Ni}^{2+}$
- ☐ $\text{Fe}^{2+} \text{ Ni}^{2+} \text{ Cr}^{2+}$
- ☐ $\text{Ni}^{2+} \text{ Fe}^{2+} \text{ Cr}^{2+}$

Question No.78

The metal complex that exhibits a triplet as well as a doublet in its ^{31}P NMR spectrum is

- ☐ $\text{trans-}[\text{IrCl}(\text{CO})(\text{PPh}_3)_2]$
- ☐




- ☐ *mer*- $[\text{IrCl}_3(\text{PPh}_3)_3]$
- ☐ *fac*- $[\text{IrCl}_3(\text{PPh}_3)_3]$

Question No.79

According to Hückel molecular orbital theory, the secular equation below can be used to find possible energy levels of the π -electrons in

$$\begin{vmatrix} \alpha - E & \beta & 0 & 0 \\ \beta & \alpha - E & \beta & 0 \\ 0 & \beta & \alpha - E & \beta \\ 0 & 0 & \beta & \alpha - E \end{vmatrix} = 0$$

- ☐ $\text{HC} \equiv \text{C} - \text{CH}_2\text{CH}_3$
- ☐ 
- ☐ $\text{H}_2\text{C} = \text{CH} - \text{CH} = \text{CH}_2$
- ☐ $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

Question No.80

The strongest base in liquid ammonia is

- ☐ NH_4^+
- ☐ NH_2^-
- ☐ N_2H_4
- ☐ NH_3

Question No.81

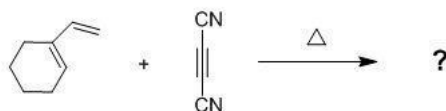
For EDTA titrations, the analyte solution and the titrant solution are both buffered at the same pH for which of the following reasons?

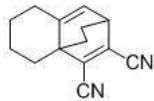
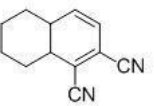
- The conditional formation constant is affected by pH .
- The fraction of EDTA in the fully deprotonated Y^{4-} form varies with pH .
- When EDTA reacts to form a metal complex, H^+ is a product in most cases.

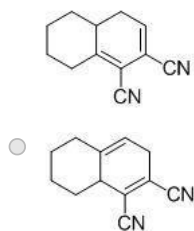
- ☐ I and III only
- ☐ I and II only
- ☐ I, II, and III
- ☐ II and III only

Question No.82

Which of the following is the most likely product of the Diel's Alder reaction.



- ☐ 
- ☐ 
- ☐



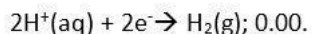
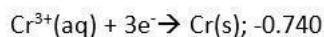
Question No.83

A radioactive isotope, which is used in diagnostic imaging, has a half-life of 6.0 hours. If a quantity of this isotope has an activity of 150 μCi when it is delivered to a hospital, how much activity will remain 24 hours after delivery? (μCi =microcuries)

- ☐ 9.4 μCi
- ☐ 19 μCi
- ☐ 150 μCi
- ☐ 38 μCi

Question No.84

At 298 K, the standard reduction potentials for the following half reactions are given as:



The strongest reducing agent is:

- ☐ Cr(s)
- ☐ $\text{Fe}^{2+}(\text{aq})$
- ☐ $\text{H}_2(\text{g})$
- ☐ Zn(s)

Question No.85

Pick the molecule, which has a zero dipole moment

- ☐ (E)-1,2-Dibromoethene
- ☐ 1,2-Dibromoethane
- ☐ (Z)-1,2-Dibromoethene
- ☐ 1,1-Dibromomethane

Question No.86

Phthalic acid, $(\text{COOH})\text{C}_6\text{H}_4(\text{COOH})$, is a weak, diprotic acid with dissociation constants below

The pH of an aqueous solution of potassium acid phthalate, $(\text{COOH})\text{C}_6\text{H}_4(\text{COO}^-\text{K}^+)$, is closest to

$$\text{p}K_{\text{a}1} = 2.95$$

$$\text{p}K_{\text{a}2} = 6.79$$

- ☐ 7.00
- ☐ 4.87
- ☐ 6.79
- ☐ 9.74

Question No.87

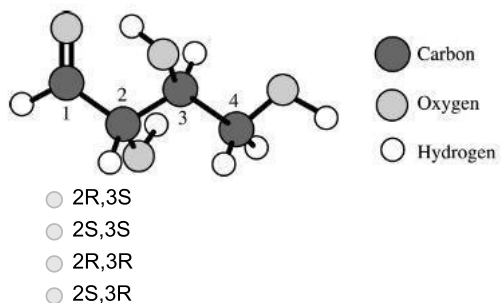
If $\psi(r)$ is the wavefunction for a 1s electron, the average distance from the nucleus for the electron is equal to

- ☐ $\psi^*(x)\psi(x) = 0$
- ☐ $\int_{-\infty}^{+\infty} \psi^*(x)\psi(x)dx = 1$
- ☐ $\psi^*(x)\psi(x) = 1$
- ☐

$$\int_{-\infty}^{+\infty} \psi^*(x)\psi(x)dx = 0$$

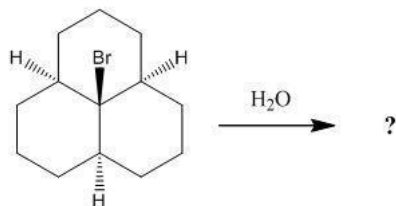
Question No.88

What is the stereochemistry of the carbohydrate structure shown below?



Question No.89

The mechanism and the product formed in the following reaction, respectively, are



- ☐ S_N^2
☐ S_N^2
☐ S_N^1
☐ S_N^1

Question No.90

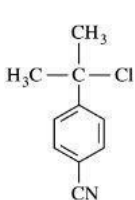
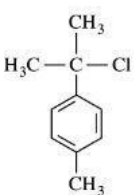
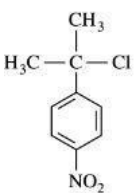
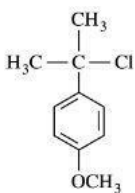
In the vibrational-rotational spectrum of diatomic molecule, the R-branch of the spectrum is the result of which of the following transitions?

- ☐ $\Delta J=1; \Delta v=1$
☐ $\Delta J=2; \Delta v=0$
☐ $\Delta J=1; \Delta v=0$
☐ $\Delta J=0; \Delta v=0$

Question No.91

Of the following compounds, which has the fastest S_N1 reaction rate with H_2O in acetone?

- ☐



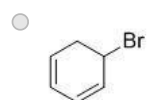
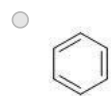
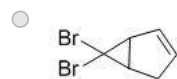
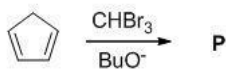
Question No.92

"Phosphorescence" is represented as

- ☐ $S_1 \rightarrow S_0 + h\nu$
- ☐ $T_1 \rightarrow S_0 + h\nu$
- ☐ $T_1 \rightarrow S_0 + \Delta$
- ☐ $S_1 \rightarrow T_1 + \Delta$

Question No.93

Identify the correct product (P)





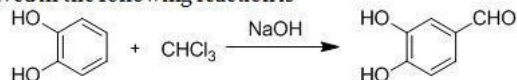
Question No.94

Octahedral high-spin Ni(II) complexes and tetrahedral Ni(II) complexes have magnetic moments values

- ☐ both in the range of 2.9-3.4 μ_B
- ☐ both up to 4.1 μ_B
- ☐ up to 4.1 μ_B and in the range of 2.9-3.4 μ_B respectively
- ☐ in the range of 2.9-3.4 μ_B and up to 4.1 μ_B respectively

Question No.95

Intermediate involved in the following reaction is



- ☐ CCl_3
- ☐ CCl_4
- ☐ CH_2Cl_2
- ☐ CCl_2

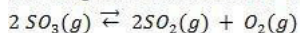
Question No.96

Which of the following is an n-type semiconductor?

- ☐ Silicon carbide
- ☐ Silicon
- ☐ Arsenic-doped silicon
- ☐ Diamond

Question No.97

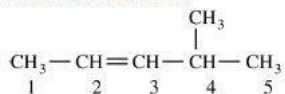
The K_p for the reaction shown above is 0.26 at $1,000^\circ\text{C}$ and 40.8 at $1,300^\circ\text{C}$. Which of the following combinations of ΔH and ΔS are most plausible for this reaction at these temperatures?



- ☐ $\Delta H < 0, \Delta S > 0$
- ☐ $\Delta H = 0, \Delta S = 0$
- ☐ $\Delta H > 0, \Delta S < 0$
- ☐ $\Delta H > 0, \Delta S > 0$

Question No.98

In the compound shown below, which hydrogen is most easily abstracted in a free radical bromination reaction?



- ☐ 1
- ☐ 3
- ☐ 4
- ☐ 2

Question No.99

What is the maximum number of phases that can be at equilibrium with each other in a three- component mixture?

- ☐ 5
- ☐ 2
- ☐ 4
- ☐ 3

Question No.100

The ground state electronic configuration of C_2 using all electrons is

- ☐ $\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \sigma_{2p}^2 \Pi_{2p}^2$
- ☐ $\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \Pi_{2p}^4$
- ☐ $\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \Pi_{2p}^2 \sigma_{2p}^1 \sigma_{2p}^{*1}$
- ☐ $\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \sigma_{2p}^2 \sigma_{2p}^{*2}$