

SECTION-A

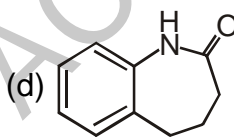
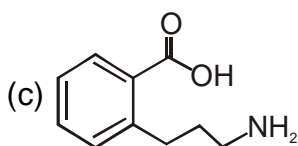
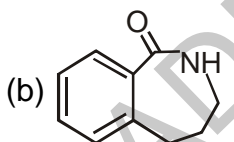
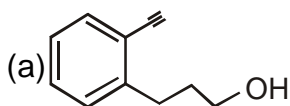
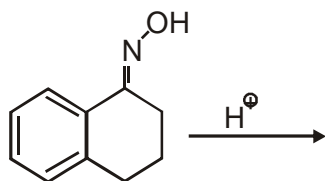
Q.1 The correct order of wavelength (λ_{\max}) of the halide to metal charge-transfer band of

$[Co(NH_3)_5Cl]^{2+}$ (I), $[Co(NH_3)_5Br]^{2+}$ (II) and $[Co(NH_3)_5I]^{2+}$ (III), is

- (a) III < II < I (b) I < II < III
(c) II < III < I (d) I < III < II

Correct Answer: (B)

Q.2 The major product formed in the following reaction is



Correct Answer: (D)

Q.3 For a reaction of the type $A + B \rightarrow$ products, the unit of the rate constant is $\text{mol L}^{-1} \text{s}^{-1}$.

- (a) 0 (b) 1
(c) 2 (d) 3

Correct Answer: (A)

Q.4 The correct option for the metal ion present in the active site of myoglobin, hemocyanin and vitamin B_{12} respectively is.

- (a) iron, iron and zinc (b) molybdenum, iron and copper
(c) iron, copper and cobalt (d) molybdenum, copper and cobalt

Correct Answer: (C)



Q.5 The thermodynamic criterion for spontaneity of a process in a system under constant volume and temperature and in the absence of any work other than expansion work (if any) is

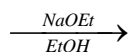
- (a) Change in entropy is positive (b) Change in enthalpy is negative
(c) Change in Helmholtz free energy is negative
(d) Change in Gibbs free energy is negative

Correct Answer: (C)

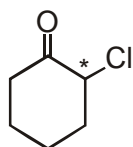
Q.6 For three non-coplanar vectors a, b and c, the expression a, (b x c) can be written as

- (a) (a x b). c (b) (a x b). (a x c)
(c) (a. b) x (a. c) (d) (a. b) x c

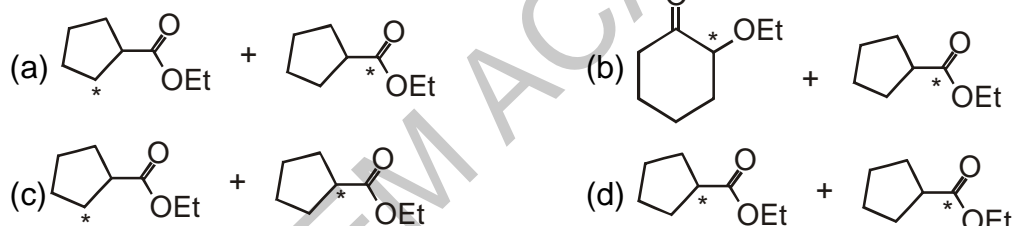
Correct Answer: (A)



Q.7 The correct option for the major products of the following reaction is



* Represents isotopically labeled carbon atom



Correct Answer: (C)

Q.8 The number of vibrational mode(s) of a carbon dioxide molecule that can be detected using infrared spectroscopy is

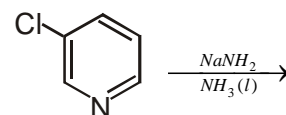
- (a) 1 (b) 2
(c) 3 (d) 4

Correct Answer: (B)

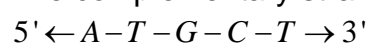
Q.9 Correct trend in the bond order is

- (a) $O_2^+ > O_2^{2-} > O_2^-$ (b) $O_2^- > O_2^+ > O_2^{2-}$
(c) $O_2^{2-} > O_2^- > O_2^+$ (d) $O_2^+ > O_2^- > O_2^{2-}$

Correct Answer: (D)

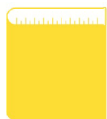


Q.10 The complementary strand for the following single strand of DNA is



- (a) 3' ← T-A-C-G-A → 5' (b) 3' ← A-T-G-C-T → 5'
(c) 5' ← T-A-C-G-A → 3' (d) 5' ← A-A-C-G-T → 3'

Correct Answer: (A & D)

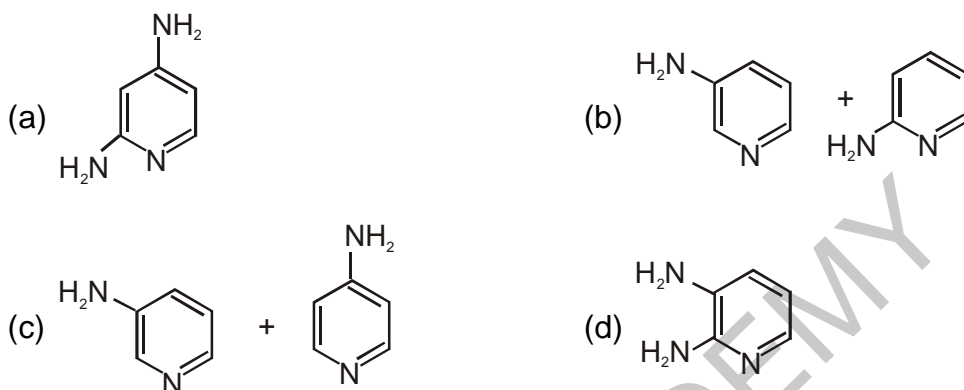


Q.11 The compound formed upon subjecting an aliphatic to Lassaigne's test is

- (a) NaNH_2 (b) NaNO_2
(c) NaCN (d) NaN_3

Correct Answer: (C)

Q.12 The correct option for the product(s) of the following reaction is



Correct Answer: (C)

Q.13 The total number of degree of freedom of an HBr molecule that is constrained to translate along a straight line but does not have any constraints for its rotation and vibration is

- (a) 6 (b) 5
(c) 4 (d) 3

Correct Answer: (C)

Q.14 Among the following compound the one having the lowest boiling point is

- (a) SnCl_4 (b) GeCl_4
(c) SiCl_4 (d) CCl_4

Correct Answer: (C)

Q.15 The correct statement regarding the observed magnetic properties of NO , O_2 , B_2 and C_2 in their ground state is

- (a) NO , B_2 and C_2 are paramagnetic (b) B_2 , O_2 and NO are paramagnetic
(c) O_2 , C_2 and NO are paramagnetic (d) O_2 , B_2 and C_2 are paramagnetic

Correct Answer: (B)



Q.16 According to the kinetic of gases, the ratio of the root mean square velocity of molecular oxygen and molecule hydrogen at 300 K is

- (a) 1 : 1 (b) $1:2\sqrt{2}$
(c) 1 : 4 (d) 1 : 16

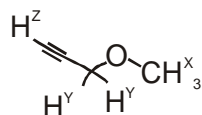
Correct Answer(C)

Q.17 In quantitative inorganic analysis of metal ions, the ion which precipitates as sulfide in the presence of H_2S in warm dilute HCl is

- (a) Cr^{3+} (b) Al^{3+}
(c) Co^{2+} (d) Bi^{3+}

Correct Answer: (D)

Q.18 In 1H NMR spectrum of the given molecule, the correct order of chemical shifts of the labelled protons (H^X , H^Y , H^Z)



- (a) $H^Z > H^Y > H^X$ (b) $H^Z > H^Y > H^X$
(c) $H^X > H^Y > H^Z$ (d) $H^Y > H^X > H^Z$

Correct Answer: (D)

Q.19 The correct option for the number of bending modes of vibration in each of H_2O , S_2 and DO_2 molecules, respectively, is

- (a) 1, 2 and 2 (b) 2, 2 and 1
(c) 2, 1, and 2 (d) 1, 2 and 1

Correct Answer: (D)

Q.20 Among the following the correct statement is

- (a) The density follows the order $Cs > Rb > Li > Na$.
(b) The solubility in water follows the order $Cs_2CO_3 > K_2CO_3 > Na_2CO_3 > Li_2CO_3$
(c) The first ionization potential follows the order, $Li > K > Na > Cs$
(d) The melting point follows the order, $MgCl_2 > BeCl_2 > CaCl_2 > SrCl_2$

Correct Answer: (B)



Q.21 The ratio of the nearest neighbour atomic distances in body-centered cubic (bcc) and face-centered cubic (fcc) crystals with the same unit cell edge length is

(a) $\sqrt{\frac{2}{2}}$

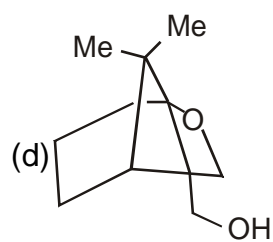
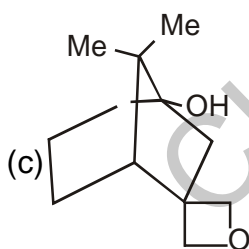
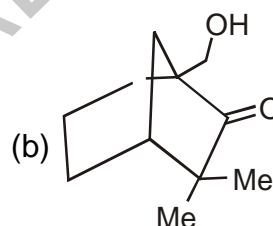
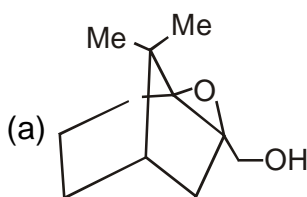
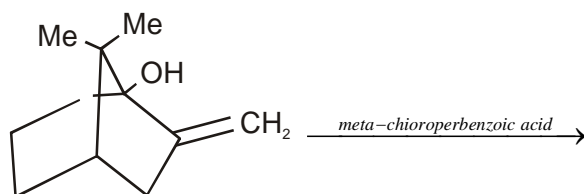
(b) $\sqrt{\frac{3}{2}}$

(c) $\frac{1}{\sqrt{2}}$

(d) $\frac{1}{2}$

Correct Answer: (B)

Q.22 The major product of the following reaction is



Correct Answer: (B)

Q.23 The function $f(x) = xe^{-x^2}$ has a minimum at

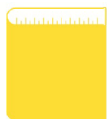
(a) $x = \sqrt{2}$

(b) $x = -\sqrt{2}$

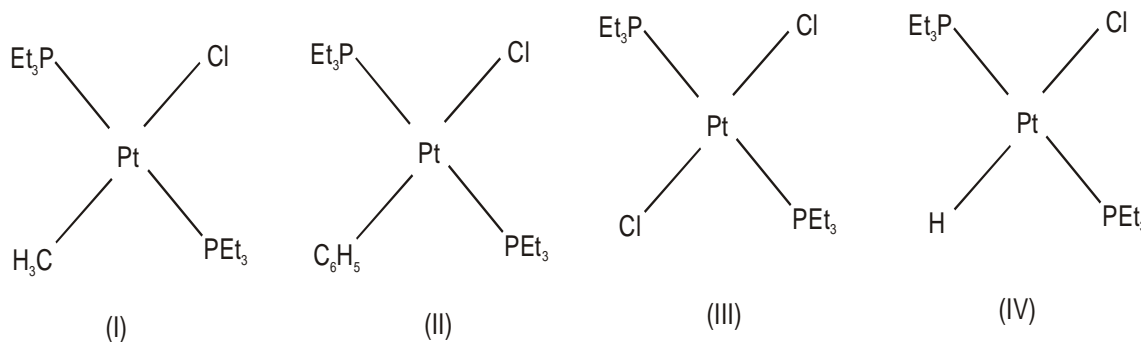
(c) $x = \frac{1}{\sqrt{2}}$

(d) $x = -\frac{1}{\sqrt{2}}$

Correct Answer: (D)



Q.24 The correct trend in the rate of substitution of Cl⁻ by pyridine in the following complexes is



(a) III < II < I < IV

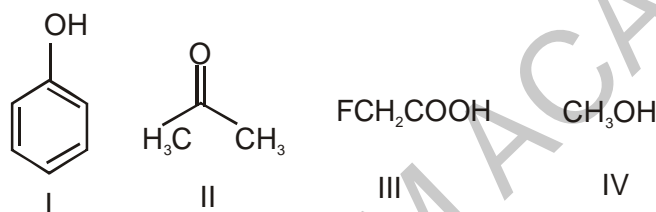
(b) II < III < I < IV

(c) I < II < III < IV

(d) III < II < IV < I

Correct Answer (A)

Q.25 The increasing of acidity of the given molecules in aqueous media is



(a) IV < I < II < III

(b) II < I < IV < III

(c) II < IV < I < III

(d) IV < II < I < III

Correct Answer (C)

Q.26 The observed magnetic moments of octahedral Mn³⁺, Fe³⁺ and Co³⁺ complexes are 4.95, 6.06 and 0.00 BM, respectively. The correct option for the electronic configuration of Mn³⁺, Fe³⁺ and Co³⁺ metal ions in these complexes, respectively is

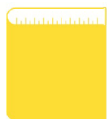
(a) $t_{2g}^4 e_g^1$, $t_{2g}^3 e_g^2$ and $t_{2g}^4 e_g^2$

(b) $t_{2g}^3 e_g^1$, $t_{2g}^5 e_g^0$ and $t_{2g}^6 e_g^0$

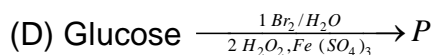
(c) $t_{2g}^3 e_g^1$, $t_{2g}^3 e_g^2$ and $t_{2g}^6 e_g^0$

(d) $t_{2g}^3 e_g^1$, $t_{2g}^3 e_g^2$ and $t_{2g}^4 e_g^2$

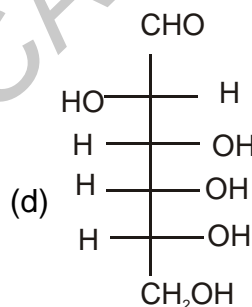
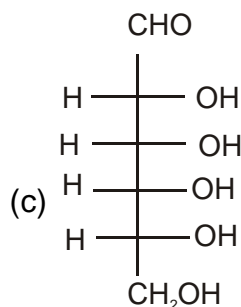
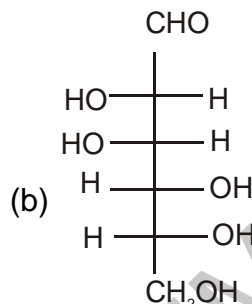
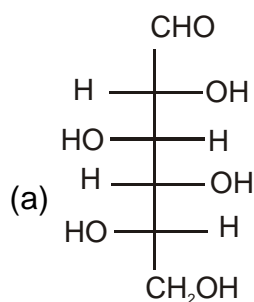
Correct Answer (C)



Q.27 In the following reaction of (D)-Glucose, a parallel P is formed.



Among the following compounds, the one which will give the same product (P) under identical reaction conditions is



Correct Answer (B)

Q.28. The correct option having one complex from each of the following pairs which is more reaction towards the oxidative addition reaction by hydrogen molecule is

Pair 1 : $\text{IrCl}(\text{PMe}_3)_3$ (I) and $\text{IrCl}(\text{CO})(\text{PMe}_3)_2$ (II)

Pair 2 : $\text{IrCl}(\text{CO})(\text{PPh}_3)_2$ (III) and $\text{IrCl}_3(\text{PPh}_3)$ (IV)

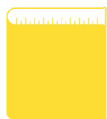
(a) (I) and (III)

(b) (I) and (IV)

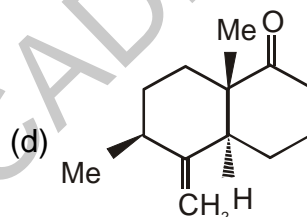
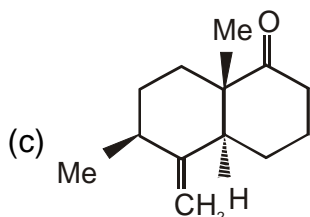
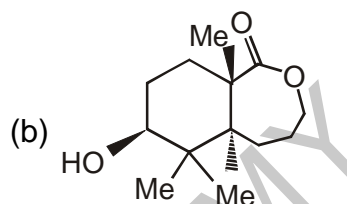
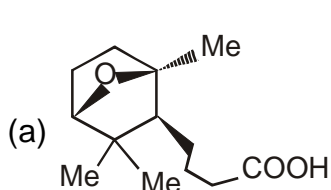
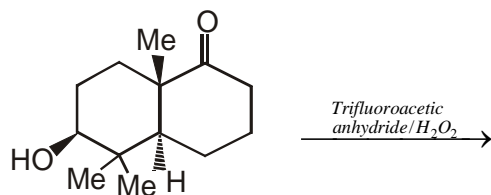
(c) (II) and (III)

(d) (II) and (IV)

Correct Answer (A)



Q.29 The major product of the following reaction is



Correct Answer (A*)

Q.30 The half-life of the chemical reaction $A \rightarrow \text{Product}$, for initial reactant concentration of 0.1 and 0.4 mol L⁻¹ are 200 and 50 s, respectively. The order of the reaction is

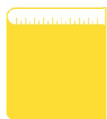
- (a) 0 (b) 1
(c) 2 (d) 3

SECTION -B

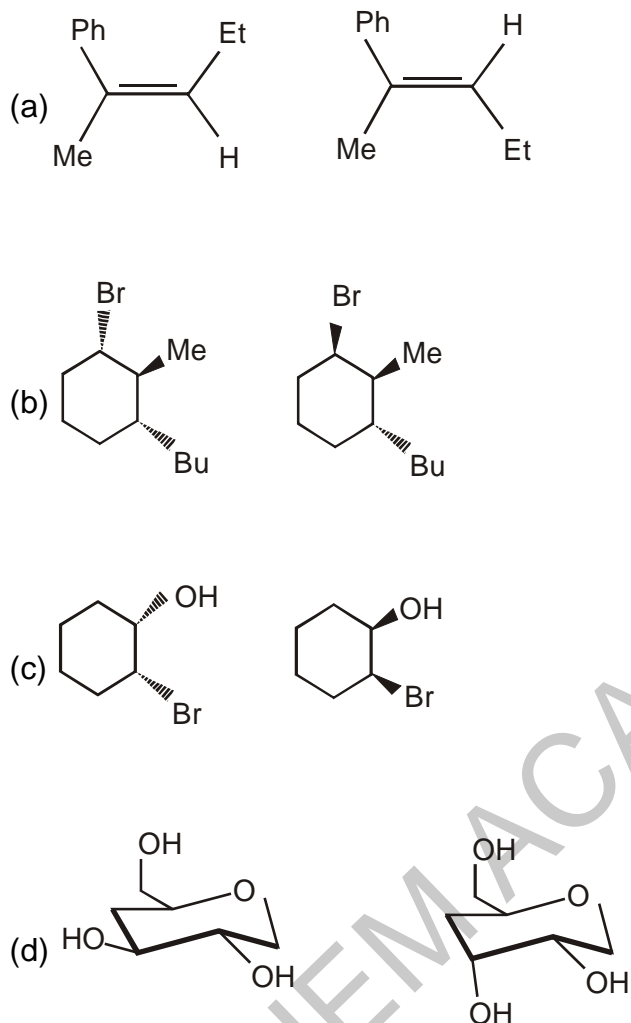
Q.1 The unit of the constant 'a' in van der Waals equation of state of a real gas can be expressed as

- (a) m⁶ Pa mol⁻¹ (b) m⁶ J mol⁻²
(c) m³ Pa mol⁻² (d) m³ J mol⁻²

Correct Answer (A, D)



Q.2 The diastereomeric pair(s) among the following option(s) is/are



Correct Answer (A, B, D)

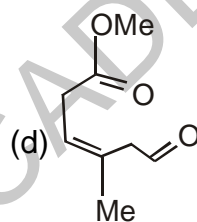
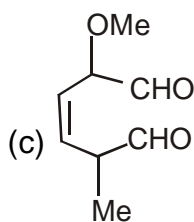
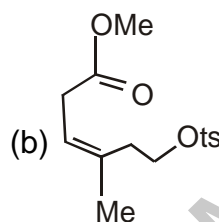
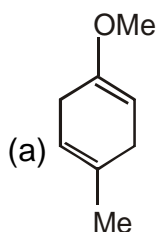
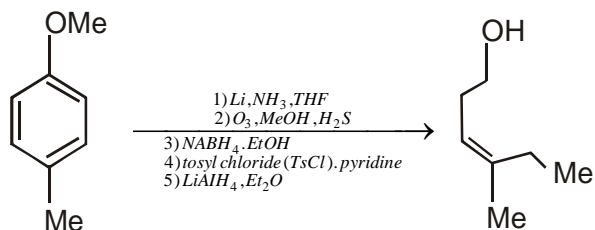
Q.3 The true statement(s) regarding the carbonic anhydrase enzyme is/are

- (a) It is involved in peptide bond cleavage.
- (b) Redox inactive Zn^{2+} ion is involved in the catalytic activity of this enzyme.
- (c) Activated $M.OH_2$ ($m = \text{metal ion}$) acts as the nucleophile in the enzyme.
- (d) The metal ion is coordinated to the side chain of histidine residues.

Correct Answer (B,C,D)



Q.4 The compound(s) formed as intermediate(s) in the following reaction sequence is/are



Correct Answer (A,B,D)

Q.5 Among the following microwave active molecule(s) is are

(a) trans-dichloroethene

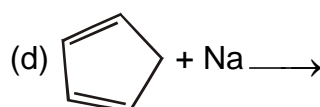
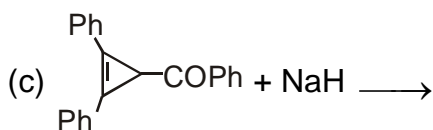
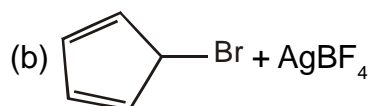
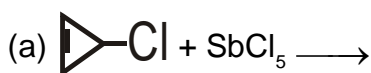
(b) 1, 2-dinitrobenzene

(c) 3-methylphenol

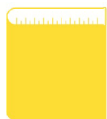
(d) para-aminophenol

Correct Answer (B,C,D)

Q.6 The reaction(s) that result(s) in the formation of aromatic species is/are



Correct Answer (A, D)



- Q.7** The correct statement(s) about NO_2 , NO_2^+ and CO_2 is/are
- (a) Both NO_2 and CO_2 are paramagnetic
 - (b) NO_2 is paramagnetic and NO_2^+ is diamagnetic.
 - (c) Both CO_2 and NO_2^+ have linear geometry.
 - (d) CO_2 and NO_2^+ are isoelectronic.

Correct Answer (B, C, D)

- Q.8** The correct statement(s) among the following is/are
- (a) Secondary structure of a polypeptide describes the number and type amino acid residues.
 - (b) Uracil is pyrimidine nucleobase.
 - (c) Natural fatty acids have odd number of carbon atoms.
 - (d) Reaction of (D)-glucose with Ca(OH)_2 gives a product mixture containing (D) - fructose, (D)-mannose and (D)-glucose.

Correct Answer (B,D)

- Q.9** The eigenvalue(s) of the matrix $\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$
- (A) -1 (B) 1
(C) 2 (D) 3

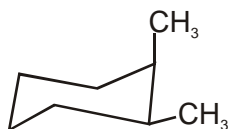
Correct Answer (A,D)

- Q.10** The true statement(s) regarding the brown ring test carried out in the laboratory for the detection of NO_3^- is/are
- (a) Brown ring is due to the formation of the iron nitrosyl complex.
 - (b) Concentrated nitric acid is used for the test.
 - (c) The complex formed in the reaction is $[\text{Fe(CN)}_5\text{NO}]^{2-}$
 - (d) The brown colored complex is paramagnetic in nature.

Correct Answer (A,B,D)

Section C

- Q.1** The number of gauche-butane interaction(s) in the following compound is _____.



Correct Answer (3)

- Q.2** The bond order of N_2^+ ion is _____ (Round off to one decimal place)

Correct Answer (2.5)



Q.3 The value of n for the complex $[\text{Fe}(\text{CO})_4(\text{SiMe}_3)]^n$ satisfying the 18-electron rule is

Correct Answer (-1)

Q.4 (R)-2-methyl-1-butanol has a specific rotation of $+13.5^\circ$. The specific rotation of 2-methyl-1-butanol containing 40% of the (S) - enantiomer is _____ $^\circ$. (Round off to one decimal place)

Correct Answer (2.7)

Q.5 In the structure of P_4O_{10} , the number of P-O-P bond(s) is _____.

Correct Answer (6)

Q.6 One liter of a buffer solution contains 0.004 mole of acetic acid ($\text{pK}_a = 4.76$) and 0.4 mole of sodium acetate. the pH of the solution is _____. (Round off to two decimal places)

Correct Answer (6.76)

Q.7 The limiting molar conductivity of La^{3+} and Cl^- ions in aqueous medium at 298 K are 209.10×10^{-4} and $76.35 \times 10^{-4} \text{ Sm}^2\text{mol}^{-1}$, respectively. the number of Cl^- in an infinitely dilute aqueous solution of LaCl_3 at 298 K is _____. (Round off to two decimal places.)

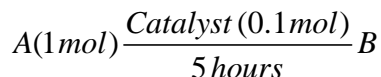
Correct Answer (0.52)

Q.8 One liter of an aqueous urea solution contains 6 g of urea. The osmotic pressure of the solution at 300 K (assuming an ideal behaviour) is _____ kPa. (Round off to one decimal place)

[Given: Molecular weight of urea is 60, gas constant (R) is $8.3 \text{ J K}^{-1} \text{ mol}^{-1}$]

Correct Answer:(249.4)

Q.9 The turnover frequency (TOF) for the catalytic reaction,



with 90% yield of the product is _____ hour^{-1} . (Round off to the nearest integer)

Correct Answer:(18)

Q.10 The ionization energy of hydrogen atom is 13.6 eV and the first ionization energy of sodium atom is 5.1 eV. The effective nuclear charge experienced by the valence electron of sodium atom is _____. (Round off to one decimal place)

Correct Answer:(7.033)



Q.11 A radioactive sample decays to 10% of its initial amount in 4600 minutes. The rate constant of this process is _____ hour⁻¹ (Round off to two decimal places)

Correct Answer:(0.03)

Q.12 Given that the radius of the first Bohr orbit of hydrogen atom is 53 pm, the radius of its third Bohr orbit is _____ pm. (Round off to the nearest integer)

Correct Answer:(477)

Q.13 Assume that the reaction of MeMgBr with ethylacetate proceeds with 100% conversion to give tert-butanol. The volume of 0.2 M solution of MeMgBr required to convert 10 mL of a 0.025 M solution of ethylacetate to tert-butanol is _____ mL. (Round off to one decimal place)

Correct Answer:(2.5)

Q.14 A first order reflection of X-ray from {220} plane of copper crystal is observed at a glancing angle of 22°. The wavelength of the X-ray used is _____ pm. (Round off to one decimal place)

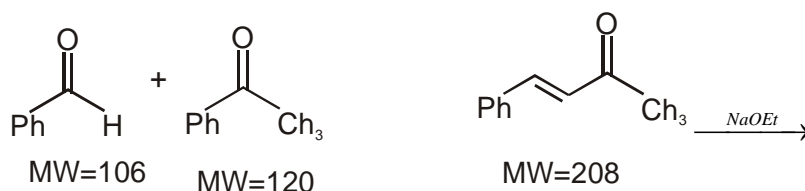
[Given Copper forms fcc crystal with unit cell edge length of 361 pm.]

Correct Answer:(95.6)

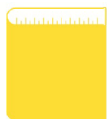
Q.15 The collision flux of a monoatomic gas on copper surface is $3.0 \times 10^{18} \text{ m}^{-2} \text{ s}^{-1}$. Note that copper surface forms a square lattice with lattice constant of 210 pm. If the sticking coefficient of the atom with copper is 1.0, the time taken by the gas to form a complete monolayer on the surface is _____ s. (Round off to one decimal place)

Correct Answer (7.5*)

Q.16 5.3 g of benzaldehyde was reacted with an excess of acetophenone to produce 5.2 g of the enone product as per the reaction shown below. The yield of the reaction is _____ % (Round off to the nearest integer)



Correct Answer (50)



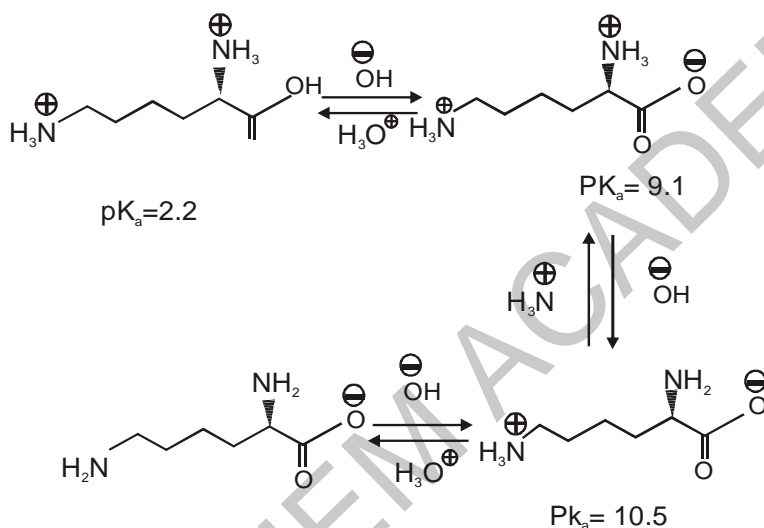
Q.17 One mole of an ideal gas is subjected to an isothermal increase in pressure from 100 kPa to 1000 kPa at 300 K. The change in Gibbs free energy of the system is _____ kJ mol⁻¹.

(Round off to one decimal place)

[given : Gas constant (R) = 8.3 J K⁻¹ mol⁻¹]

Correct Answer (5.7)

Q.18 Based on the information given below, the isoelectric point (pI) of lysine is _____
(Round off to one decimal place)



Correct Answer (1.12)

Q.19 Number of vertices in an icosahedral cluso-borane is _____

Correct Answer (12)

Q.20 The magnetic field strength required to excite an isolated proton to its higher spin state with an electromagnetic radiation of 300 MHz is _____ Tesla (T). (Round off to decimal places)

[Magnetogyric ratio of proton is 26.75 x 10⁷ rad T⁻¹ s⁻¹]

Correct Answer (1.12)