2020
(CBCS)
(6th Semester)
CHEMISTRY
ELEVENTH PAPER (CHEM/6/CC/363)
(Physical chemistry-III)

1. Choose the correct answer from below:

i) According to Grotthus-Draper's law photochemical reaction takes place by
- a)   Reflection of Photons
- b)   Absorption of Photons
- c)   Transmission of Photons
- d)   None of the above

ii) Photosensitized reaction involves the transfer of energy from
- a)   Triplet to singlet
- b)   Singlet to singlet
- c)   Triplet to Triplet
- d)   None of the above

iii) Quantum yield equal to one indicates that
- a)   One molecule reacts per a photon
- b)   No molecules react
- c)   More than one molecules react per a photon
- d)   None of the above

iv) Photochemistry involves the interaction of matter with
- a)   UV and Visible
- b)   UV and X-Ray
- c)   Visible and Infrared
- d)   Visible and Micro wave

v) The primary process of HI dissociation involves
- a) $H + HI \rightarrow H_2 + I$
- b) $HI + h\nu \rightarrow H + I$
- c) $I + HI \rightarrow I_2 + H$
- d)   None of the above

vi) The potential energy (V) of particle in one dimensional box is taken as V = ? inside the box and V = ? outside the box

- a) $V = 0 \; ; V = \infty$
- b) $V = \infty \; ; V = 0$
- c) $V = 0 \; ; V = 0$
- d) $V = \infty \; ; V = \infty$

vii) The wave functions ψm and ψn are said to be orthogonal, if their eigen values λ_m and λ_n satisfy one of the following conditions

    a) $\lambda_m = \lambda_n$
    b) $\lambda_m \neq \lambda_n$
    c) $\lambda_m < \lambda_n$
    d)   None of the above

viii) The wave function in quantum mechanics represents

    a)   A state of the system
    b)   Shape of the system
    c)   Quantum numbers
    d)   None of the above

ix) When the particle is present in the potential box the energy of lowest level corresponds

    a) $n = 0$
    b) $n = 1$
    c) $n = 2$
    d) $n = 3$

x) Consider a one dimentional box of length 'a' the probability of finding the particle (P) inside the box must satisfy

    a) $P = 0$
    b) $P = 1$
    c) $P = \frac{1}{2}$
    d) $P = \infty$

xi) Partition function may be stated as the ratio of total number of molecules to the number of molecules in the zeroth level. Then at absolute zero, the expected partition function is

    a)   0
    b)   1
    c)   Between 0 and 1
    d)   None of the above

xii) Degenerate energy levels associated with each rotational energy level can be expressed as

    a) $2J + 1$
    b) $J + 1$
    c) $\Pi (J + 2)$
    d)   None of the above

xiii) The unit of partition function is

    a)   metre/second
    b)   mol/L
    c) Kg/m^3
    d)   None of the above

xiv) The rotational partition function for heteronuclear linear molecule can be given by
- a) $Q = 8\pi^2 IkT/h^2$
- b) $Q = 8h^2 IkT/\pi^2$
- c) $Q = 8\pi I^2 kT/h^2$
- d) $Q = 8\pi Ik^2 T/h^2$

xv) The vibrational energy of diatomic molecule is given by
- a) $E_v = (\upsilon + 1/2)h\upsilon_0$
- b) $E_v = (\upsilon + 1)h\upsilon_0$
- c) $E_v = (\upsilon + 1/3)h\upsilon_0$
- d) None of the above

xvi) HCl and DCl (Where H is protium, D is deuterium) show different rotational spectra. This is because
- a) HCl and DCl have different electron cloud around their centres
- b) HCl and DCl have different dipole moment
- c) HCl and DCl have different moment of inertia
- d) None of the above

xvii) In vibrational-Rotational energy change, P-Branch line arises when the change in rotational energy (J) corresponds
- a) $\Delta J = -1$
- b) $\Delta J = +1$
- c) $\Delta J = 0$
- d) None of the above

xviii) The electronic spectroscopy is also called
- a) Visible and ultraviolet spectroscopy
- b) Visible and NMR spectroscopy
- c) Rotation and vibrational spectroscopy
- d) Mass spectroscopy

xix) Molecule which can be studied by microwave spectroscopy is
- a) H_2
- b) N_2
- c) Cl_2
- d) CO

xx) The energy change in molecular spectroscopy is in the order
- a) $E_{Vibrational} > E_{Rotational} > E_{Electronic}$
- b) $E_{Electronic} > E_{Vibrational} > E_{Rotational}$
- c) $E_{Rotational} > E_{Electronic} > E_{Vibrational}$
- d) None of the above

xxi) The relation between entropy change and EMF can be given as
- a) $\Delta S = n\left(\frac{\delta E}{\delta T}\right)$
- b) $\Delta S = nF\left(\frac{\delta E}{\delta T}\right)$
- c) $\Delta S = nF\left(\frac{\delta E}{\delta T}\right)p$
- d) None of the above

xxii) Which of the following relations corresponds to zero liquid junction potential
(T_a and T_c are transport number of anion and cation respectively)

      a) $T_a > T_c$
      b) $T_a < T_c$
      c) $T_a = T_c$
      d)   None of the above

xxiii) pH can be determined by hydrogen electrode by using the formula

      a)   pH = E_{cell} / 0.0591
      b)   pH = E_{cell} / 0.2
      c)   pH = E_{cell} / 0.691
      d)   None of the above

xxiv) The standard electrode potential of standard hydrogen electrode is taken as

      a)   One
      b)   Zero
      c)   0.25
      d)   None of the above

xxv) The reaction is said to be feasible if

      a) E^0_{cell} =+ ve
      b) E^0_{cell} =$-$ ve
      c) E^0_{cell} =Zero
      d)   None of the above

2. Fill in the blanks

i) For an electronic transition in a molecule ($\sigma \to \sigma^*$, $\pi \to \pi^*$, $n \to \sigma^*$ and $n \to \sigma^*$) the highest energy is involved in_____

ii) In an electronic transition if the promoted electron have a spin parallel to its original partner this is called excited _____

iii) In photochemical reaction the energy of radiations of wavelength 2000 to 8000 A^0 varies from ___to _____ kcal per mole

iv) The phenomenon of ejection of electrons from the surface of metal is known as _____ effect

v) According to plank's radiation law enegy of photon is given as _____

vi) Heat capacity at constant pressure is represented as _____

vii) Probability of macrostate is equal to the number of_____corresponding to that macrostate

viii) According to boltzmann distribution law each particle of the molecular system is _____ from other

ix) The value of partition function is _____ at absolute zero

x) The number of modes of viration for linear molecule can be determined by the formula _____

xi) Among the molecules CO_2, HCl and O_2 the infrared active molecule is _____

xii) Spectral lines produced by transition from v = 1 to higher level is called _____

xiii) Quinhydrone is an equimolar concentration of quinone and _____

xiv) The relationship between free energy change and EMF is given as _____

xv) The sum of transport number of cation (t_+) and transport number of anion (t_-) is equal to _____

Answer key (The correct answer is given in bold letter)

1. Choose the correct answer from below:

   i) According to Grotthus-Draper's law photochemical reaction takes place by
      b) **Absorption of Photons**
   ii) Photosensitized reaction involves the transfer of energy from
      c) **Triplet to Triplet**
   iii) Quantum yield equal to one indicates that
      a) **One molecule reacts per a photon**
   iv) Photochemistry involves the interaction of matter with
      a) **UV and Visible**
   v) The primary process of HI dissociation involves
      b) **HI + hν→ H + I**
   Vi) The potential energy (V) of particle in one dimensional box is taken as V = ?inside the box and V = ? outside the box

      a) **V = 0 ; V = ∞**

   Vii) The wave functionsψm and ψn are said to be orthogonal, if their eigen values λ_m and $\lambda_n$satisfy one of the following conditions

      b) **$\lambda_m \neq \lambda_n$**

   viii) The wave function in quantum mechanics represents
      a) **A state of the system**
   ix) When the particle is present in the potential box the energy of lowest level corresponds
      b) **n =1**
   x) Consider a a one dimentional box of length 'a' the probability of finding the particle (P) inside the box must satisfy

    b)   **P = 1**

xi) Partition function may be stated as the ratio of total number of molecules to the number of molecules in the zeroth level. Then at absolute zero, the expected partition function is

    b)   **1**

Xii) Degenerate energy levels associated with each rotational energy level can be expressed as

    a) $2J + 1$

xiii) The unit of partition function is

    d)   **None of the above**

xiv) The rotational partition function for heteronuclear linear molecule can be given by

    a) $Q = 8\pi^2 I kT/h^2$

xv) The vibrational energy of diatomic molecule is given by

    a) $E_v = (v + 1/2)h\nu_0$

xvi) HCl and DCl (Where H is protium, D is deuterium) show different rotational spectra. This is because

    c)   **HCl and DCl have different moment of** inertia

xvii) In vibrational-Rotational energy change, P-Branch line arises when the change in rotational energy (J) corresponds

    a) $\Delta J = -1$

xviii) The electronic spectroscopy is also called

    a)   **Visible and ultraviolet spectroscopy**

xix) Molecule which can be studied by microwave spectroscopy is

    d)   **CO**

xx) The energy change in molecular spectroscopy is in the order

    b) $E_{Electronic} > E_{Vibrational} > E_{Rotational}$

xxi) The relation between entropy change and EMF can be given as**c)** $\Delta S = nF\left(\frac{\delta E}{\delta T}\right)p$

xxii) Which of the following relations corresponds to zero liquid junction potential (T_a and T_c are transport number of anion and cation respectively)

    c) $T_a = T_c$

       xxiii) pH can be determined by hydrogen electrode by using the formula

          a)   **pH = E$_{cell}$ / 0.0591**

       xxiv) The standard electrode potential of standard hydrogen electrode is taken as

          b)   **Zero**

       xxv) The reaction is said to be feasible if

          a)   **E$^{0}_{cell}$ =+ ve**

2. Fill in the blanks

i) For an electronic transition in a molecule ($\sigma \to \sigma^*$, $\pi \to \pi^*$, $n \to \sigma^*$ and $n \to \sigma^*$) the highest energy is involved in **$\sigma \to \sigma^*$**

ii) In an electronic transition if the promoted electron have a spin parallel to its original partner this is called excited **triplet state**

iii) In photochemical reaction the energy of radiations of wavelength 2000 to 8000 A^{0} varies from **23 to 230** kcal per mole

iv) The phenomenon of ejection of electrons from the surface of metal is known as **photoelectric**effect

v) According to plank's radiation law enegy of photon is given as **E = hν**

vi) Heat capacity at constant pressure is represented as **C$_p$**

vii) Probability of macrostate is equal to the number of **microstate** corresponding to that macrostate

viii) According to boltzmann distribution law each particle of the molecular system is **distinguishable** from other

ix) The value of partition function is **unity/one/1** at absolute zero

x) The number of modes of viration for linear molecule can be determined by the formula **3n-5**

xi) Among the molecules CO_2, HCl and O_2 the infrared active molecule is **HCl**

xii) Spectral lines produced by transition from v = 1 to higher level is called **hot bands**

xiii) Quinhydrone is an equimolar concentration of quinone and **hydroquinone**

xiv) The relationship between free energy change and EMF is given as **$-\Delta$ G = nFE$_{cell}$**

xv) The sum of transport number of cation (t$_+$) and transport number of anion (t$_–$) is equal to **one/1**