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FOR GOD AND COUNTRY

ST. LAWRENCE HIGH SCHOOL

A JESUIT CHRISTIAN MINORITY INSTITUTION

1st TERM EXAMINATION – 2019

MODEL ANSWER

CLASS – XI

F.M.-70
DATE -05.08.19

SUBJECT – CHEMISTRY
DURATION – 3 Hours 15mins

GROUP-A (TOTAL MARKS-14)

MARKS – 1X14=14

1.1 Which of the following is iso-electronic?

(a) CO_2 and NO_2 (b) NO_2^- and CO_2 (c) N_2 and CO (d) SO_2 and CO_2

Ans.**(c) N_2 and CO**

1.2 Number of unpaired electrons in **Cr^{3+}**

(a) 3 (b) 2(c) 1 (d) 5

Ans.**(a) 3**

1.3 According to Bohr's theory, the angular momentum of an electron in 7^{th} orbit is-

(a) 2.5h/π (b) 25h/π(c) 1.0h/π (d) 3.5h/π

Ans. **(d) 3.5h/π**

1.4 The maximum number of orbitals present in the nth orbit-

(a) $2n^2$ b) n c) n^2 d) 2(2l+1)

Ans. **c)** n^2

1.5 Who modified Bohr's theory by introducing elliptical orbits for electron path?

(a) Rutherford (b) Thomson(c) Hund (d) Sommerfeld

Ans.**(d) Sommerfeld**

1.6 The strength which is independent on temperature-

(a) Normality (b) Molarity and mole fraction (c) Molality and mole fraction (d) Formality

Ans.**(c) Molality and mole fraction**

1.7 The energy of an electron in the nth Bohr orbit of hydrogen atom is-

(a) $13.6/n^4$ eV (b) $13.6/n^3$ eV (c) $13.6/n^2$ eV (d) 13.6/n eV

Ans.**(c) $13.6/n^2$ eV**

1.8 Which of the following ion is the largest in size among r_{ionic}, $r_{covalent}$, r_{VDW}, $r_{Metallic}$

(a) $r_{Metallic}$(b) r_{ionic}(c) $r_{covalent}$(d) r_{VDW}

Ans.**(d) r_{VDW}**

1.9 Which of the following is the correct order of the size of iodine species?

(a) $I^+ > I^- > I$ (b) $I^- > I > I^+$ (c) $I > I^- > I^+$ (d) $I > I^+ > I^-$

Ans.**(b) $I^- > I > I^+$**

1.10Which one is most basic among the following?

(a) Na_2O (b) Cs_2O (c) BaO (d) MgO

Ans.**(b) Cs_2O**

1.11 Among the following which one has the highest cation to anion ratio?

(a) CsI (b) CsF(c) LiF(d) NaF

Ans.**(b) CsF**

1.12 The pair of elements exhibiting diagonal relationship-

(a) Al and B (b) Be and Mg(c) B and Be(d) B and Si

Ans.**(d) B and Si**

1.13 In the periodic table the elements which can form coloured complexes belong to-

(a) f-block (b) s-block (c) p-block (d) d-block

Ans.**(d) d-block**

1.14 The electronegativity of the following elements increase in the order-

(a) C,N,Si,P (b) N,Si,C,P (c) Si,P,C,N (d) P,Si,N,C

Ans.**(c) Si,P,C,N**

TOTAL MARKS-56(GROUP-B, C, D, E)

GROUP – B

2. Answer the following questions. (Alternatives are to be noted): **MARKS -1X4=4**

2.1 Find the number of electrons present in **0.1g** of Fructose.

Ans. **$0.05xN_A$**

2.2 Why are electron gain enthalpy of **Be** and **Mg** are positive?

Ans. **Due to their stable electronic configuration, they don't want to accept additional electron.**

OR

Find the equivalent mass of **$KMnO_4$** in acidic medium?

Ans. **31.6**

2.3 Find the electronic configuration of the following: **Fe^{2+}** and **S^{2-}**

Ans. **Fe^{2+}: [Ar] $3d^6$ and S^{2-}: [Ne] $2s^2 2p^6$**

OR

Which group of the periodic table contains solid, liquid and gaseous elements? What are those elements?

Ans. **Group: 17**

2.4 Why is the 1^{st} electron affinity value of Cl has higher than that of F?

Ans. **Due to relatively less electron density and presence of vacant "d" orbital.**

GROUP-C

3. Answer the following questions. (Alternatives are to be noted): **MARKS -2X5=10**

3.1 If an electron is promoted from first orbit to the third orbit of a hydrogen atom, by how many times will the radius of the orbit be increased?

Ans. **9 times; $r_3 = 9xr_1$**

OR

Mention the name of the factors that affect the Electronegativity.

Ans. **a) Size of the atom, b) Hybridization state, c) Oxidation state, d) Bond energy, bond length and bond order.**

3.2 Calculate the wavelength of the spectral line obtained in the spectrum of Li^{+2} ion when the transition takes place between two levels whose sum is **4** and the difference is **2.**

Ans. **Wavelength= $1.14x10^{-6}$ cm**

3.3 Why is the 1^{st} ionization energy of O is lower than that of N but the second ionization energy value shows the opposite trend?

Ans. **Hint: Half-filled and full-filled orbital stability.**

OR

Explain the Photoelectric effect.

Ans. **Hint: Definition, Mathematical explanation and Physical interpretation.**

3.4 Ionisation potential of hydrogen in $KJmol^{-1}$ unit is **1312.0**. What will be its value in unit of $eVatom^{-1}$? (**$1eV= 1.6X10^{-19}$ J**)

Ans. **$12.643x10^{42}$ $eVatom^{-1}$**

OR

Draw the shapes of d- orbitals.

Ans. **d- orbitals have double dumbbell shape. Draw their diagrams; d_{x2-y2}, d_{z2}, d_{xy}, d_{yz}, d_{zx}.**

3.5 First electron affinity of oxygen is negative but second electron affinity is positive-explain.

Ans. **Electronic repulsion between the existing electrons and the newly added electron.**

OR

The atomic mass of an element M is **'a'** and the formula of its oxide is **M_2O_3**. Show that the equivalent mass of the element is **(a/n)**.

Ans. **At S.T.P., 16n parts of O combines with 2a parts of M**

8 parts of O combines with (2ax8/16n) parts of M= (a/n)

GROUP-D

4. Answer the following questions. (Alternatives are to be noted): **MARKS-3X9=27**

4.1 According to de-Broglie, matter should exhibit dual behavior that is both particle and wave like properties. However, a cricket ball of mass **100g** doesn't move like a wave when it is thrown by a Bowler at a speed of **100Km/h**.Calculate the wavelength of the ball and explain why it doesn't show wave nature.

Ans. **Wavelength= h/mv= $6.626x10^{-34}$/(100x100x5/18) = 0.002384 m= 0.2384cm**

The hypothesis is applicable for microscopic particles but not for macroscopic particles.

OR

Account for the following:

(i) Chromium has electronic configuration $3d^5\ 4s^1$ and not $3d^4\ 4s^2$

Ans. **Hint: Exchange energy to attain higher stability for symmetrical orientation of electrons.**

(ii) What is the number of emission lines when the excited electron of H-atom in **n=7** drops to the ground state? 1.5x2= 3

Ans. **n (n-1)/2 ; 21**

4.2 Account for the following as stated:

(i) Which is more basic: **$Mg(OH)_2$ or $Al(OH)_3$**?

Ans. **$Mg(OH)_2$[Hint: Group 2 metals]**

(ii) Which is more stable: **Sn^{2+} or Sn^{4+}**?

Ans. **Sn^{2+}[Hint: Inert Pair effect]**

(iii) Which is more acidic: **P_2O_5 or SiO_2**?

Ans. **P_2O_5[Across the period acidic strength of oxides increases]**

3x1= 3

4.3 Suppose the human population of the world is **$3x10^{10}$**. If 100 molecules of sugar (**$C_{12}H_{22}O_{11}$**) are distributed per head. What is the total quantity of sugar required for distribution?

Ans. **$1.7037x10^{-9}$ g**

3x1= 3

OR

Write down the differences between the electronegativity and electron affinity.

Ans. **E.N.: External property, calculated in bonded state, doesn't have unit, factors are different**

Electronegativity: Internal property, calculated in isolated state, has unit, factors are different

4.4Derive the expression for angular momentum of Bohr electron from de-Broglie equation.

Ans.

Angular momentum of Bohr electron from de-Broglie equation

According to de-Broglie, a tiny particle like electron, revolving in a circular orbit must have wave character associated with it. Thus, for the wave (associated with the moving electron) to be completely in phase, the circumference of the orbit should be integral multiple of wavelength, λ.

$$2\pi r = n\lambda \text{ or, } \lambda = \frac{2\pi r}{n} \quad \ldots [1]$$

[where, r = radius of the orbit and n = an Integer]

Again from de-Broglie equation,

$$\lambda = \frac{h}{mv} \quad \ldots [2]$$

[where, m = mass of electron, v = velocity of electron.]

$$\frac{2\pi r}{n} = \frac{h}{mv} \text{ or, } mvr \text{ (angular momentum)} = \frac{nh}{2\pi}$$

This is the same relation as predicted by Bohr.

4.5 Write down the electronic configurations of the following:

$_{45}Rh$, $_{58}Ce$ and**$_{41}Nb$** 3X1=3

Ans. **$_{45}Rh$= [Kr] $4s^2 4p^6 4d^8 5s^1$**

$_{58}Ce$= [Xe] $5f^2 6s^2$

$_{41}Nb$= [Kr] $4d^4 5s^1$

4.6 Explain in brief the Planck's quantum theory. 3

Ans. **a) Each electron has a fixed amount of energy and energy comes in the form of energy packets or quanta.**

b) Energy is only transmitted during the absorption and emission of energy from lower to higher energy level and vice versa.

c) The energy of a moving electron is equal to the respective energy of the stationary orbit.

4.7 Mention the limitations of Rutherford's atomic model and the rectifications made by Niels Bohr. 3

Ans. **Limitations of Rutherford's atomic model:**

a) The shape of the orbit of moving electrons is circular only.

b) The model doesn't tell about the magnitude of the quantity like radius of the circular path, speed of the electrons and their energy.

c) The radiation that emitted by moving electron is expected to be "continuous" in nature. But the spectra obtained from atoms are line spectra or discontinuous in nature.

d) The model can't justify the stability of an atom from the point of view of electromagnetism.

Rectifications made by Niels Bohr:

a) The single electron of a hydrogen atom moves in a circular path (called orbit) around its nucleus.

b) The energy of a moving electron is quantized within a particular orbit and the orbits are known as the stationary orbits.

OR

State and explain Pauli's exclusion principle. 3

Ans. **No two electrons in a particular orbital can have the same set of all four quantum numbers. Proper explanation by taking any atomic species and drawing its sub-orbits depicting different orbitals.**

4.8 What is diagonal relationship? Name two transuranic elements. 2+1=3

Ans. **Diagonal relationship: Some elements of certain groups in the second period show similarity in properties with the diagonally opposite elements of the third period and such similarity in properties is referred to as diagonal relationship.**

Transuranic elements: **Np_{93} and Pu_{94}**

OR

Comment on each of the following statements:

(1) The ionic mobilities of the alkali metal ions in aqueous solution are

$Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

Ans. **Size of the ions in the aquated state.**

(2) What is meant by effective nuclear charge? 2+1=3

Ans. **Due to screening effect, the valence shell electrons do not experience the complete charge of the nucleus. The actual nuclear charge experienced by the valence shell electrons is called the effective nuclear charge.**

4.9 Mention the factors controlling electronegativity of an element. Mention the names of different scales for measuring electronegativity of an element. 2+1=3

Ans. **Factors: a) size of the atom, b) Oxidation state, c) hybridization state and d) bond length, bond dissociation energy and bond order,**

Scales: a) Pauling scale, b) Mulliken-Jaffy scale and c) Allred-Rochow scale.

GROUP- E

5. Answer the following questions. (Alternatives are to be noted): **MARKS- 5X3=15**

5.1 (i) The uncertainty in the position and velocity of a particle are 10^{-10} **m** and $5.27X10^{-24}$ ms^{-1} respectively. Calculate the mass of the particle.

Ans. **0.1Kg**

(ii) Calculate the shortest and longest wavelengths in Lyman series of hydrogen spectrum.

Ans. **Shortestwavelength: $911x10^{-8}$ cm**

Longestwavelength: $1215x\ 10^{-8}$ cm

(iii) Find the number of neutrons present in $5x10^{-4}$ mol of ^{14}C isotope.

Ans. $2.4088x10^{21}$

2+2+1=5

5.2 Elements A,B and C have atomic numbers **(Z-2),Z** and **(Z+1)** respectively. Of these B is an inert gas element.

(i) Which one of these has the highest electronegativity?

(ii) Which one of these has the highest ionisation potential?

(iii) What is the formula of the compound produced by the combination of A and C?

(iv) What is the nature of the bond in this compound? 5

Ans. **i) A, ii) B, iii) C_2A, iv) Ionic or electrovalent bond**

5.3 (i) Both K and Cu atoms have $4s^1$ electron in their outermost shells, yet Cu has higher ionization enthalpy than K-Why?

Ans. **Hint: Due to presence of "d" electrons having relatively lower shielding effect, the effective nuclear charge being felt by the valence electron has higher value than K.**

(ii) Li_2CO_3, inspite of being an alkali metal carbonate, is sparingly soluble in water like $MgCO_3$---- explain.

Ans. **Hint: Ionic potential, i.e. higher polarizing power of Li^+ than Mg^{2+}**

(iii) What do you understand by negative value of electron-gain enthalpy of an element?

Ans. **The element wants to accept an additional electron.** 2+2+1=5

OR

(i) If uncertainties in position and momentum of a moving object are same, find the uncertainty in its velocity.

Ans. **ΔV is greater than equal to $(V/4\pi)$, i.e. the uncertainty in velocity is so large that its velocity is uncertain.**

(ii) Show that the sum of energies for the transition from **n=3** to **n=2** and from **n=2** to **n=1** is equal to the transition energy from **n=3** to **n=1** in case of a H-atom.

Ans. $E_{3-2} + E_{2-1} = E_{3-1}$

Are the wavelength and frequencies of the emitted spectrum also additive as their energies are?

Ans. wavelength is not an additive property but frequency is an additive property like energy.

2+2+1=5