



ST. LAWRENCE HIGH SCHOOL
 A JESUIT CHRISTIAN MINORITY INSTITUTION
Model Answer of 1st TERM EXAMINATION – 2018
CLASS – XIA1
MODEL ANSWER

SUBJECT – CHEMISTRY
DURATION – 3 Hours 15mins

F.M.- 70
DATE -01.08.18

PART-B (TOTAL MARKS-14)

MARKS – 1X14=14

1.1 The position of both an electron and helium atom is known within 1.0 nm and the momentum of the electron is known within $50 \times 10^{-26} \text{ kgms}^{-1}$. The minimum uncertainty in the measurement of the momentum of the helium atom is-

- (a) 50 kgms^{-1} (b) 60 kgms^{-1} (c) $80 \times 10^{-26} \text{ kgms}^{-1}$ (d) $50 \times 10^{-26} \text{ kgms}^{-1}$

Ans. **(d) $50 \times 10^{-26} \text{ Kg ms}^{-1}$**

1.2 Which of the following pair of orbitals possess two nodal planes-

- (a) $p_{xy}, d_{x^2-y^2}$ (b) d_{xy}, d_{xz} (c) p_{xy}, d_{zx} (d) $d_z^2, d_{x^2-y^2}$

Ans. **(b) d_{xy}, d_{xz}**

1.3 Which of the following is not correct for an electronic distribution in the ground state-

- (a) $\text{Co}=[\text{Ar}]4s^23d^7$, (b) $\text{Ni}=[\text{Ar}]4s^23d^8$, (c) $\text{Cu}=[\text{Ar}]4s^23d^9$, (d) $\text{Zn}=[\text{Ar}]4s^23d^{10}$

Ans. **(c) $\text{Cu}=[\text{Ar}] 4s^23d^9$**

1.4 If electron, hydrogen, helium and neon nuclei are all moving with the velocity of light, then the wavelengths associated with these particles are in the order-

- (a) Electron>Hydrogen>Helium>Neon
 (b) Electron> Helium> Hydrogen >Neon
 (c) Electron<Hydrogen<Helium<Neon
 (d) Neon<Hydrogen<Helium<Electron

Ans. **(a) Electron>Hydrogen>Helium>Neon**

1.5 The maximum number of unpaired electron that can be present in d orbital-

- (a) 1 (b) 3 (c) 5 (d) 7

Ans. **(c) 5**

1.6 A transition metal X has a configuration $[\text{Ar}]3d^4$ in its +3 oxidation state. Its atomic number is –

- (a) 25 (b) 26. (c) 22 (d) 19

Ans. **(a) 25**

1.7 The electronic configuration of Gadolinium(atomic number 64) is-

- (a) $[\text{Xe}]4f^85d^96s^2$ (b) $[\text{Xe}]4f^75d^16s^2$ (c) $[\text{Xe}]4f^35d^56s^2$ (d) $[\text{Xe}]4f^65d^26s^2$

Ans. **(b) $[\text{Xe}]4f^75d^16s^2$**

1.8 The number of radial nodes of 3s and 2p orbitals are respectively-

(a) 2,0 (b) 0,2 (c) 1,2 (d) 2,1

Ans. (a) 2,0

1.9 The frequency corresponding to transition $n=2$ to $n=1$ in hydrogen atom is-

(a) 15.66×10^{10} Hz (b) 24.66×10^{14} Hz (c) 30.57×10^{14} Hz (d) 40.57×10^{24} Hz

Ans. (b) 24.66×10^{14} Hz

1.10 The mass of proton with a wavelength equal to 1.54×10^{-8} cm is-

(a) 0.8268×10^{-34} Kg (b) 1.2876×10^{-33} Kg (c) 1.4285×10^{-32} Kg (d) 1.8884×10^{-32} Kg

Ans. (c) 1.4285×10^{-32} Kg

1.11 Splitting of spectral lines under the influence of magnetic field is called-

(a) Zeeman Effect (b) Stark effect (c) Photoelectric effect (d) Compton effect

Ans. (a) Zeeman Effect

1.12 The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom-

(a) $\text{He}^+(n=2)$ (b) $\text{Li}^{2+}(n=2)$ (c) $\text{Li}^{2+}(n=3)$ (d) $\text{Be}^{3+}(n=2)$

Ans. (c) $\text{Li}^{2+}(n=3)$

1.13 The wavelength of radiation emitted, when in a hydrogen atom electron falls from infinity to stationary state 1, would be (Rydberg constant = $1.097 \times 10^7 \text{ m}^{-1}$)-

(a) 406 nm, (b) 192 nm (c) 91 nm, (d) 9.1×10^{-8} nm

Ans. (c) 91 nm

1.14 In Bohr's model, atomic radius of the first orbit is γ , the radius of the third orbit is-

(a) $\gamma/3$ (b) γ (c) 3γ (d) 9γ

Ans. (d) 9γ

2. Answer the following questions. (Alternatives are to be noted) :

MARKS: 1X4=4

2.1 Find the angular momentum of 2p electron.

Ans. $\sqrt{2} h/2\pi$

2.2 Find the ionization energy of Li^{2+} ion.

Ans. $13.6 \times (z)^2 = 13.6 \times 3^2 = 122.4 \text{ eV}$

2.3 Find the normality of a 3M sulphuric acid solution

Ans. 6N

2.4 Find the equivalent weight of sulphuric acid when 20g of NaOH completely consumes 98g of the acid.

Ans. 49

GROUP-A

1. Answer the following questions. (Alternatives are to be noted):

MARKS: 2X5=10

1.a) Explain Hund's rule of maximum multiplicity with suitable example.

Ans. The pairing of electrons in the orbitals within the same sub-shell does not take place until the orbitals are singly filled-up and singly occupied orbitals must have all the electrons with parallel spin. Refer any standard text book for explanation.

Or, **Molarity is dependent on temperature. Why?**

Ans. Molarity doesn't depend on temperature, as the mass of both the solute and solvents are considered to determine the value of Molarity.

1. b) **State the physical significance of wave function.**

Ans. **Physical significance of Wave function:**

The probability of finding any particle described by a specific wave function ψ at a given point and time is proportional to the value of ψ^2

Or, **What is radial probability distribution plot?**

Ans. Radial distribution curve gives an idea about the electron density at a radial distance from the nucleus. The value of $4\pi r^2\psi^2$ (Radial probability density function) becomes zero at a nodal point, also known as radial node. It is plotted on a graph as $4\pi r^2\psi^2$ vs r .

1. d) **What is Bohr correspondence principal?**

Ans. **Bohr Correspondence Rule:**

The correspondence principle states that the behavior of systems described by theory of quantum mechanics reproduces classical physics in the limit of large quantum numbers. In other words, it says that for large orbits and for large energies, quantum calculations must agree with classical calculations.

Or

Write the value of magnetic quantum numbers for a h-subshell.

Ans. **For 'h' subshell:**

(-) 5 to (+) 5-Magnetic Quantum numbers

1. e) **Arrange in order of energy in a H-atom: 1s,2s,2p,3s,3p,3d**

Ans. For hydrogen atom:

$1s=2s=2p=3s=3p=3d$

2. **Answer the following questions. (Alternatives are to be noted):**

MARKS: 3X9=27

2.a (i) **What is Heisenberg uncertainty rule?**

Ans. It is impossible to measure simultaneously both the position and the velocity i.e., momentum of a sub-atomic particle like electron accurately at any particular moment.

Brief explanation with proper equation.

(ii) **The orbital angular momentum of an electron in the 3p subshell is..... $h/2\pi$**

Ans. Angular momentum of 3p subshell: $\sqrt{2}h/2\pi$

Or

(i) **If the uncertainty in position is zero, then the uncertainty in momentum is.....**

Ans. Infinite

(ii) **The orbital described by $n=3, l=2, m=0$ stands for:**

a) d_{xy} b) d_{xz} c) d_{z^2} d) $d_{x^2-y^2}$

Ans. d_{z^2} Orbital

b. (i) **What is the exchange energy?**

Exchange Energy: It is the amount of energy released when two or more electrons with the same spin exchange their positions in the degenerate orbitals of a subshell.

ii) **What do you mean by degenerate orbitals?**

Degenerate Orbital: Orbitals having equal amount of energy levels and that can easily be interchanged by a rotating through a particular angle are called degenerate orbitals. (Degeneracy can only be seen in the absence of approaching ligands.)

c. (i) **Which one will have a higher magnetic moment, Cu(II) and Mn(II)?**

Mn(II); Because it has 5 (Five) unpaired electrons.

(ii) **AB compound has magnetic moment of 1.73 BM. Provided that the B atom is present in a cationic state, find the formula of the fluoride of B in this state.**

Ans. B contains 2 (Two) unpaired electrons. Therefore the probable formula: BF_2

Or

(i) **What is Pauli's exclusion rule?**

Pauli's exclusion Principle: No two electrons in an atom have the same set of values for all the four quantum numbers.

(ii) **State Aufbau rule.**

Aufbau Rule: In an electronic system electrons are being added progressively to the various orbitals in order of increasing energy level starting with the orbital of lower energy.

d. (i) **Give the definition of orbital.**

Ans. Orbital is a 3-dimensional region in the space where the probability of finding an electron is the maximum.

(ii) **Explain why ferrous salts rapidly oxidizes to ferric ones in the laboratory.**

To gain half-filled orbital stability (electronic configuration has to be given)

(iii) **What is Spin multiplicity?**

Spin multiplicity: In spectroscopy and quantum chemistry, the multiplicity of an energy level is defined as $(2S+1)$, where S is the total spin angular momentum. The values 1, 2, 3 corresponds to singlet, doublet and triplet respectively.

e. (i) **What is space quantisation?**

Space Quantization: It corresponds to an atom in a magnetic field whose quantum states correspond to a limited number of possible angles between the directions of the angular momentum and magnetic intensity.

(ii) **Find the exchange energy of a d^5 configuration.**

Exchange energy of d^5 is 5C_2 i.e., $5! / 3! \times 2! = 10$

(iii) **Find the total energy of a H electron if the potential energy is X.**

Ans. $X/2$

Or

(i) **The number of spectral lines formed when an electron deexcites from the 5th to 1st shell is....**

Ans. Number of spectral lines: $n(n-1)/2 = 10$

(ii) Write the electronic configuration of Gadolinium (atomic number=64)

Ans. $[\text{Xe}]_{54} 4f^7 5d^1 6s^2$

f. (i) Find the wavelength of the radiation released when an electron returns to its ground state from the 4th state is.....nm

Ans. $(16/15) \times 1/R_z^2$

(ii) Find the number of electrons in 6.3kg of oxalic acid (Molecular weight=126g/mol)

Ans. $58 \times (6.3/126) \times 6.023 \times 10^{23}$

g. (i) Find the molarity of the solution formed by dissolving 4.9g of sulphuric acid in 200ml of water.

Ans. 0.025M

What is Formality?

Formality: When one gram formula mass amount of a substance remains dissolved in 1 L solution, then the strength of the solution is known as 1 formal.

h. What is equivalent weight?

Equivalent weight: It is defined as the number of parts by mass of the element which combines with 1.008 parts by mass of hydrogen or 8 parts by mass of oxygen or 35.5 parts by mass of chlorine or can displace the same amount of hydrogen, oxygen or chlorine respectively from their compounds.

What is empirical formula?

Empirical Formula: A formula giving the proportions of the elements present in a compound but not the actual numbers or arrangement of atoms.

eg. The empirical formula of glucose is (CH_2O)

What is a Limiting reagent?

Limiting agent: The chemical reagent in a chemical reaction is the substance that is totally consumed when the chemical reaction is completed. The amount of product formed is limited by this reagent, since the reaction cannot continue without it.

i. Find the weight of phosphoric acid which is required to completely neutralize 5.8g of $\text{Mg}(\text{OH})_2$.

Ans. 9.8g of Phosphoric acid

Q.3 Answer the following questions. (Alternatives are to be noted): MARKS: 5X3=15

3. a) A nitrogen containing compound is heated to give out ammonia gas which was passed through 20ml of 0.1M HCl. The residual acid was neutralized by 5ml 0.1M NaOH solution. Find the weight of Nitrogen present in the sample.

Ans. 0.007g

b) i) State De-Broglie equation.

De Broglie equation: It is an equation used to describe the wave properties of matter, specifically, the wave nature of the electron: $\lambda = h/mv$, where λ is the wavelength, h is the Planck's constant, m , is the mass of a particle, moving at a velocity v .

➤ **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 .

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

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


Again from de-Broglie equation,

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

[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.



i)

Prove Bohr hypothesis of angular momentum quantisation from Der-Broglie hypothesis.

iii) What is a nodal Plane?

Nodal Plane: A nodal plane is a plane in which the probability of finding an electron is zero.

c) 5g of an unknown metal carbonate requires 4.9g of sulphuric acid for complete reaction. If the metal is trivalent, find the molecular mass of the carbonate.

Ans. 100g

Find the equivalent weight of oxalic acid hydrate and KMnO_4 in acidic media.

Ans. Equivalent weight of oxalic acid = $126/2 = 63$

Equivalent of $\text{KMnO}_4 = 158/5 = 31.67$