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# Jars Education

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Time : 1 Hour 15 Minute

## STD 11 Science Chemistry
## Chapter Based Test

Total Marks : 40

## SECTION A

* **Choose The Right Answer From The Given Options.[1 Marks Each]** **[6]**

1. Isotopes have same____but different____.
   (A) Atomic number, mass number.
   (B) Mass number, atomic number.
   (C) Number of neutrons, atomic number.
   (D) None of these.
2. For an element (Z = 25), how many electrons are present in the "N" shell in its ground state?
   (A) 13 (B) 2 (C) 15 (D) 3
3. Mass number is __________.
   (A) The sum of the total number of protons and neutrons present in the nucleus of an atom.
   (B) The electrons present in the outermost shell of an atom.
   (C) An atom of each element having a definite combining capacity.
   (D) The total number of protons present in the nucleus of an atom.
4. When an electron do transition from n = 4 to n = 2, the emitted line of spectrum will be:
   (A) First line of Lyman series.
   (B) Second line of Balmer series.
   (C) First line of Paschen series.
   (D) Second line of Paschen series.
5. The atomic number of an element is 32 and mass number 55. Calculate the number of neutrons?
   (A) 23 (B) 32 (C) 21 (D) 25
6. Thomson's atomic model concluded that _____ is the constituent particle of all kinds of atoms.
   (A) Electron (B) Protron (C) Neutron (D) None of these

* **Answer The Following Questions In One Sentence.[1 Marks Each]** **[5]**

7. The electronic configuration of N (7) is $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$ and not $1s^2\ 2s^2\ 2p_x^2\ 2p_y^1$.Why?
8. How does the intensity of the spectral line vary with wavelength?
9. Which quantum number specifies the shape of an orbital?
10. How many radial and angular nodes are present in 2p-orbital.
11. Write the number of electrons present in mole of $N^{3-}$ ion.

## SECTION B

* **Given Section consists of questions of 2 marks each.** **[6]**

1. What is the lowest value of n that allows g orbitals to exist?

2. In photoelectric effect experiment, irradiation of a metal with light of frequency $5 \times 10^{20}$ $s^{-1}$ yields electrons with maximum K.E. = $6.63 \times 10^{-14}$J. Calculate $v_0$(threshold frequency) for the metal.

3. A proton is moving with kinetic energy $5 \times 10^{-27}$J. What is the velocity of the proton?

## SECTION C

*** Given Section consists of questions of 3 marks each. [9]**

1. A bulb emits light of wavelength $4500 \text{Å}$. The bulb is rated as 150 watt and 8% energy is emitted as light. How many photons are emitted by the bulb per second?
   [h = $6.626 \times 10^{-34}$Js]

2. Hydrogen atom has only one electron, so mutual repulsion between electrons is absent. However, in multielectron atoms mutual repulsion between the electrons is significant. How does this affect the energy of an electron in the orbitals of the same principal quantum number in multielectron atoms?

3. Similar to electron diffraction, neutron diffraction microscope is also used for the determination of the structure of molecules. If the wavelength used here is 800pm, calculate the characteristic velocity associated with the neutron.

## SECTION D

*** Case study based questions [4]**

1. Read the passage given below and answer the following questions from (i) to (v).
   The first concreteexplanation for the phenomenon of the blackbody radiation was given byMax Planck in 1900.An ideal body, which emits and absorbs radiations of allfrequencies uniformly, is called a black bodyand the radiation emitted by such a body is called black body radiation. Max Planck arrived at a satisfactory relationshipbymaking an assumption that absorption andemmission of radiation arises from oscillatori.e., atoms in the wall of black body.He suggested that atoms andmolecules could emit or absorb energy onlyin discrete quantities and not in a continuousmanner. He gave the name quantum to thesmallest quantity of energy that can be emitted or absorbed in the form of electromagnetic radiation. The energy (E) of aquantum of radiation is proportionalto its frequency (ν) and is expressed byequation .
   $E = h\upsilon$.
   The proportionality constant, ‘h’ is knownas Planck’s constant and has the value$6.626 \times 10^{-34}$ Js.In 1887, H. Hertz performed a very interestingexperiment in which electrons (or electriccurrent) were ejected when certain metals (forexample potassium, rubidium, caesium etc.)were exposed to a beam of light. The phenomenon is calledPhotoelectric effect. The results observed inthis experiment were:
    1. The electrons are ejected from the metalsurface as soon as the beam of light strikesthe surface, i.e., there is no time lagbetween the striking of light beam and theejection of electrons from the metal surface.
    2. The number of electrons ejected is proportional to the intensity or brightness of light.
    3. For each metal, there is a characteristicminimum frequency,ν0(also known asthreshold frequency) below which photoelectric effect is not observed. At afrequency $\nu > \nu_0$, the ejected electrons comeout with certain kinetic energy.

The kineticenergies of these electrons increase withthe increase of frequency of the light used.

The particle nature of light posed a dilemmafor scientists. Theonly way to resolve the dilemma was to acceptthe idea that light possesses both particle andwave-like properties, i.e., light has dualbehaviour. Depending on the experiment, wefind that light behaves either as a wave or as astream of particles. Whenever radiationinteracts with matter, it displays particle likeproperties in contrast to the wavelike properties (interference and diffraction), whichit exhibits when it propagates. This conceptwas totally alien to the way the scientiststhought about matter and radiation and it tookthem a long time to become convincedof itsvalidity.

The study of emission or absorption spectra is referred to as spectroscopy.The emission spectra of atoms inthe gas phase, on the other hand, do not showa continuous spread of wavelength from redto violet, rather they emit light only at specificwavelengths with dark spaces between them.Such spectra are called line spectra or atomicspectra.The Swedishspectroscopist, Johannes Rydberg, noted that

all series of lines in the hydrogen spectrumcould be described by the following expression:

$$\bar{v} = 109,677\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)cm^{-1}$$

The value 109,677 $cm^{-1}$ is called theRydberg constant for hydrogen. The first fiveseries of lines that correspond to $n_1$= 1, 2, 3,4, 5 are known as Lyman, Balmer, Paschen,Bracket and Pfund series, respectively.Neils Bohr (1913) was the first to explainquantitatively the general features of thestructure of hydrogen atom and its spectrum.He used Planck’s concept of quantisation ofenergy. Though the theory is not the modernquantum mechanics, it can still be used to rationalize many points in the atomic structureand spectra. Bohr’s model for hydrogen atomis based on the following postulates:

1. The electron in the hydrogen atom canmove around the nucleus in a circular pathof fixed radius and energy. These paths arecalled orbits, stationary states or allowedenergy states. These orbits are arrangedconcentrically around the nucleus.
2. The energy of an electron in the orbit doesnot change with time. However, theelectron will move from a lower stationarystate to a higher stationary state whenrequired amount of energy is absorbedby the electron or energy is emitted when electron moves from higher stationarystate to lower stationary state. The energychange does not takeplace in a continuous manner.
3. The frequency of radiation absorbed oremitted when transition occurs between two stationary states that differ in energyby $\triangle E$, is given by:

$$v = \frac{\triangle E}{h} = \frac{E_2 - E_1}{h}$$

Where E1 and E2 are the energies of the lower and higher allowed energy statesrespectively. This expression is commonly known as Bohr’s frequency rule.

4. The angular momentum of an electron isquantised. In a given stationary state itcan be expressed as in equation

$$m_e vr = n.\frac{h}{2\pi} n = 1, 2, 3.....$$

i. The first concrete explanation for the phenomenon of the black body radiation was given by ….in 1900.
   a. Max Planck
   b. De Broglie
   c. Albert Einstein,
   d. Niels Bohr

ii. Which of the following equation is Planck's equation?

a. $E= mc^2$
b. $E = h\upsilon$
c. $E= hc^2$
d. $E= vc^2$.

iii. What is nature of light?

a. Wave
b. Particle
c. Wave and Particle
d. None of above

iv. The value .... is called theRydberg constant for hydrogen.

a. $109{,}674 cm^{-1}$
b. $109{,}675 cm^{-1}$
c. $109{,}676 cm^{-1}$
d. $109{,}677 cm^{-1}$

v. ...was the first to explain quantitatively the general features of the structure of hydrogen atom and its spectrum.

a. Max Planck
b. De Broglie
c. Albert Einstein,
d. Niels Bohr

## SECTION E

*** Given Section consists of questions of 5 marks each. [10]**

1. i. How many electrons will present in sub-shell having spin quantum number value of $-\frac{1}{2}$ for n = 4?

ii. Which of the following transition will have minimum wavelength and why?
$n_4 \rightarrow n_1$, $n_4 \rightarrow n_2$, $n_2 \rightarrow n_1$.

iii. Give the number of radial nodes for 3s and 2p orbitals.

2. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition n = 4 to n = 2 of $He^+$ spectrum?

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