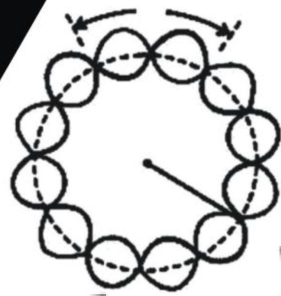


Chapter 20

ATOMIC SPECTRA

TOPICAL MULTIPLE CHOICE QUESTIONS

Topic 20.1:

Atomic Spectra

(1) The branch of physics which deals with the investigation of wavelength and intensities of electromagnetic radiation emitted or absorbed by atoms is called:

(a) electrography **(b)** spectrography
(c) spectroscopy **(d)** tomography

(2) There are ____________ basic types of spectra

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

(3) Which of the following is an example of continuous spectra?

(a) black body radiation spectrum **(b)** molecular spectrum
(c) atomic spectrum **(d)** none of these

(4) Which of the following is an example of band spectra?

(a) black body radiation spectrum **(b)** molecular spectrum
(c) atomic spectrum **(d)** none of these

(5) Balmer series contains the wavelength given by the formula:

(a) $\frac{1}{\lambda} = R_H\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$ **(b)** $\frac{1}{\lambda} = R_H\left[\frac{1}{2^2} - \frac{1}{n^2}\right]$
(c) $\frac{1}{\lambda} = R_H\left[\frac{1}{3^2} - \frac{1}{n^2}\right]$ **(d)** $\frac{1}{\lambda} = R_H\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$

(6) Paschen series contains the wavelength in the :

(a) visible region **(b)** ultraviolet region
(c) infrared region **(d)** none of these

(7) The atomic spectra are the examples of

(a) atomic spectra **(b)** line spectra
(c) continuous spectra **(d)** band spectra

(8) To get the better results from diffraction grating usually we use

(a) microscope **(b)** electron microscope
(c) spectrometer **(d)** compound microscope

(9) The Rydberg constant is equal to

(a) 1.0974×10^{7} m^{-1} **(b)** 1.0974×10^{-7} m^{-1}
(c) 1.0974×10^{9} m^{-1} **(d)** 6.63×10^{14} m^{-1}

(10) The dimension of Rydberg constant

(a) $[ML^{-1}]$ **(b)** $[L^{-1}]$
(c) $[MLT^{-1}]$ **(d)** $[LT^{-1}]$

(11) Pfund series contains the wavelength given by the formula:

(a) $\frac{1}{\lambda} = R_H\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$ **(b)** $\frac{1}{\lambda} = R_H\left[\frac{1}{5^2} - \frac{1}{n^2}\right]$
(c) $\frac{1}{\lambda} = R_H\left[\frac{1}{3^2} - \frac{1}{n^2}\right]$ **(d)** $\frac{1}{\lambda} = R_H\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$

(12) The Balmer series contain wavelengths in the __________ of the hydrogen spectrum.
(a) visible portion **(b)** infrared portion
(c) ultra violet portion **(d)** all of these

(13) Which of the following has the simplest spectrum
(a) oxygen **(b)** hydrogen
(c) nitrogen **(d)**neon

(14) The radiation having the wavelength shorter than violet is called
(a) x-rays radiation **(b)** infra red radiation
(c) gamma rays **(d)** ultraviolet radiation

(15) The radiation having the wavelength longer than red is called
(a) x-rays radiation **(b)** ultraviolet
(c) infra red radiation **(d)** visible radiation

(16) Bracket series is obtained when all the transition of electrons terminate at
(a) first orbit **(b)** second orbit
(c) third orbit **(d)** fourth orbit

(17) Balmer series is obtained when all the transition of electrons terminate at
(a) first orbit **(b)** second orbit
(c) third orbit **(d)** fourth orbit

(18) Lyman series contains the wavelength given by the formula:
(a) $\frac{1}{\lambda} = R_H\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$ **(b)** $\frac{1}{\lambda} = R_H\left[\frac{1}{5^2} - \frac{1}{n^2}\right]$
(c) $\frac{1}{\lambda} = R_H\left[\frac{1}{3^2} - \frac{1}{n^2}\right]$ **(d)** $\frac{1}{\lambda} = R_H\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$

PAST PAPER MCQS

(19) An electron in H-atom is excited from grouped state to n=4, how many spectral lines are possible in this case? GRW-2019 (G-I)
(a) 3 **(b)** 4
(c) 5 **(d)** 6

(20) Balmer series lies in the region of electromagnetic spectrum GRW-2019 (G-II)
(a) infra-red **(b)** visible
(c) ultraviolet **(d)** far infrared

(21) The shortest wavelength in Lyman series RWP-2013 (G-I), GRW-2022 (G-II)
(a) $\frac{2}{3}R_H$ **(b)** $\frac{4}{9}R_H$
(c) $\frac{1}{R_H}$ **(d)** R_H

(22) First spectral series of hydrogen atom was discovered by
DGK-2017 (G-I), DGK-2022 (G-I)
(a) Lyman **(b)** Rydberg
(c) Balmer **(d)** Paschen

(23) Balmer Series lies in the region of Electromagnetic: BWP-2019 (G-II), MTN-2022 (G-I)
(a) Infrared **(b)** Far Infrared

(c) Ultraviolet **(d)** Visible

(24) The relation for Balmer Series is written as: **MTN-2019 (G-I)**

(a) $\frac{1}{\lambda}=R_H\left(\frac{1}{2^2}-\frac{1}{n^2}\right)$ **(b)** $\frac{1}{\lambda}=R_H\left(\frac{1}{3^2}-\frac{1}{n^2}\right)$

(c) $\frac{1}{\lambda}=R_H\left(\frac{1}{4^2}-\frac{1}{n^2}\right)$ **(d)** $\frac{1}{\lambda}=R_H\left(\frac{1}{5^2}-\frac{1}{n^2}\right)$

(25) Paschen series is obtained when all transition of electron terminate on **FSD-2022 (G-II)**

(a) n = 1 **(b)** n = 2

(c) n = 3 **(d)** n = 4

ENTRY TEST MCQS

(26) Which is an example of continuous spectra?

(a) Black body radiation **(b)** Molecular spectra

(c) Atomic spectra **(d)** None of these

(27) If electron jumps from n = 5 to n = 1 then number of emitted spectral lines will be?

(a) 6 **(b)** 10

(c) 4 **(d)** 8

(28) The ratio of the frequencies of the long wavelength limits of Lyman and Balmer series of hydrogen spectrum is

(a) 27 : 5 **(b)** 5 : 27

(c) 4 : 1 **(d)** 1 : 4

Topic 20.2:

Bohr's Model of the Hydrogen Atom

(29) According to Bohr's 2nd postulate, angular momentum of an electron in one of its allowed orbit is given by:

(a) mr= $\frac{nh}{2\pi}$ **(b)** mv= $\frac{nh}{2\pi}$

(c) mvr= $\frac{h}{2\pi}$ **(d)** mvr= $\frac{nh}{2\pi}$

(30) According to 3rd postulate of Bohr's theory:

(a) E_n-E_p=fλ **(b)** E_n-E_p=he

(c) E_n-E_p=hf **(d)** E_p-E_n=hf

(31) An expression for electrostatic force between the electron and the nucleus of hydrogen atom is given by:

(a) F_e=K $\frac{e^2}{r_n^2}$ **(b)** F_e=K $\frac{K^2e^2}{r_n^2}$

(c) F_e=K $\frac{Ke^2}{r_n^2}$ **(d)** F_e=K $\frac{ke}{r_n^2}$

(32) The radius of 1st Bohr's orbit for hydrogen atom is:

(a) 0.053m **(b)** 0.053mm

(c) 0.053nm **(d)** 0.053 μm

(33) 3A° is equal to:

(a) 3×10^{-8}m **(b)** 3×10^{-10}m
(c) 3×10^{-12}m **(d)** 3×10^{-14}m

(34) The velocity of moving electron in nth orbit is given by relation:

(a) $V_n = \frac{nh}{2\pi ke^2}$ **(b)** $V_n = \frac{n^2h^2}{2\pi^2ke^2}$
(c) $V_n = \frac{nh}{2\pi^2ke^2}$ **(d)** $V_n = \frac{2\pi ke^2}{nh}$

(35) The total energy of the electron in nth orbit of hydrogen atom around the nucleus is given by:

(a) $E_n = -\frac{1}{n^2}\left[\frac{2\pi^2k^2me^4}{h^2}\right]$ **(b)** $E_n = -\frac{1}{n^2}\left[\frac{h^2}{2\pi^2k^2me^4}\right]$
(c) $E = -\frac{1}{n^2}\left[\frac{2\pi kme^2}{h^2}\right]$ **(d)** $E = -\frac{1}{n^2}\left[\frac{h^2}{2\pi kme^2}\right]$

(36) The energy of the 4th orbit in hydrogen atom is:

(a) –2.5 eV **(b)** –3.50 eV
(c) –13.60 eV **(d)** –0.85 eV

(37) In the state n = ∞ of hydrogen atom, total energy of electron is:

(a) 5.2 eV **(b)** 9.8 eV
(c) zero **(d)** 10.5 eV

(38) Whenever an electron makes a transition, that is jump from higher energy state E_n to a lower state E_p then

(a)a photon of energy h/f is absorb **(b)** a photon of energy f/ h is emitted
(c) a photon of energy hf is emitted. **(d)** none of these

(39) If an electron jumps from lower to higher orbit, it will

(a) emit energy **(b)** either absorb or emit energy
(c) absorb energy **(d)** neither absorb nor emit energy

(40) The radius of the first Bohr orbit in hydrogen atom is

(a) 0.053×10^{-6} m **(b)** 0.053×10^{-12} m
(c) 0.053×10^{-9} m **(d)** 0.053×10^{-3} m

(41) The radius of the first orbit is r_1 = 0.053 nm, then the radius of 3rd orbit is

(a) 0.106 nm **(b)** 0.053 nm
(c) 0.212 nm **(d)** 0.477nm

(42) The energy required to remove the electron from the first orbit is called

(a) kinetic energy **(b)** potential energy
(c) ionization energy **(d)** excitation energy

(43) The value for ionization energy of hydrogen atom is

(a) 13.6MeV **(b)** 13.6keV
(c) 13.6μeV **(d)** 13.6eV

(44) The minimum potential through which external electron should be accelerated so that it can supply the requisite ionization energy is known as

(a) electric potential **(b)** gravitational potential
(c) ionization potential **(d)** all of these

(45) In Bohr orbit which of the following have the specific amount of energies

(a) free electrons **(b)**orbital electrons
(c) holes **(d)**orbital holes

(46) The speed of electron in the second Bohr orbit

(a) $2.19 \times 10^8 ms^{-1}$ (b) $1.095 \times 10^6 ms^{-1}$
(c) $1.92 \times 10^6 ms^{-1}$ (d) $13.6 \times 10^7 ms^{-1}$

(47) The energy of the 3rd orbit of the hydrogen atom is
(a) –2.5eV (b) –0.85eV
(c) –1.5eV (d) –4.9 eV

(48) When electron jumps from n^{th} to the p^{th} orbit in an hydrogen atom then the wavelength of the emitted radiation is given by
(a) $\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$ (b) $\frac{1}{\lambda} = \frac{1}{R_H}\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$
(c) $\frac{1}{\lambda} = R_H\left[\frac{1}{n^2} - \frac{1}{p^2}\right]$ (d) $\frac{1}{\lambda} = \frac{1}{R_H}\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$

(49) The electric P.E of an electron in an orbit at a distance of r_n from the positive charge
(a) $\frac{Ke^2}{r_n^{\ 2}}$ (b) $\frac{Ke}{r_n^{\ 2}}$
(c) $-\frac{Ke^2}{r_n}$ (d) $\frac{Ke^2}{r_n}$

PAST PAPER MCQS

(50) The numerical value of Rydberg's constant is: **LHR-2019 (G-II)**
(a) 1.0974×10^7 (b) 1.0974×10^{-7}
(c) 1.0974×10^{14} (d) 1.0974×10^{-14}

(51) Radius of first bohr orbit of hydrogen atom is: **LHR-2021 (G-I)**
(a) 0.053 nm (b) 0.053 mm
(c) 0.053 μm (d) 0.053 m

(52) The value of Rydberg constant is: **LHR-2021 (G-II)**
(a) $1.0974 \times 10^7 m^{-1}$ (b) $6.02 \times 10^{-34} m^{-1}$
(c) $3 \times 10^8 m^{-1}$ (d) $1.6 \times 10^{19} m^{-1}$

(53) Rydberg constant is given unit of.
MIRPUR (AJK) 2017, GRW-2022 (G-I), SGD-2022 (G-I)
(a) kg^{-1} (b) m^{-1}
(c) s^{-1} (d) Js

(54) The energy of electron in ground state of hydrogen atom is –13.6 eV, then its energy is fourth orbit is **SWL-2017**
(a) –3.4 eV (b) –0.85 eV
(c) –54.4 eV (d) –13.6 eV

(55) The quantized radius of first Bohr orbit of Hydrogen atom is. **DGK-2022 (G-II)**
(a) 0.053 nm (b) 0.053 m
(c) 0.0053 nm (d) 0.53 nm

(56) The equation of Ryberg's constant is **BWP-2022 (G-II)**
(a) $R_H = \frac{hc}{m_o}$ (b) $R_H = \frac{E_o}{hc}$
(c) $R_H = \frac{E_o}{\lambda}$ (d) $R_H = \frac{1}{\lambda}$

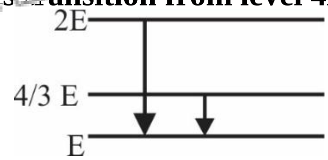
(57) The velocity of moving electron in in different orbit is: **FSD-2022 (G-I)**

(a) $V_n = \frac{nh}{2\pi ke^2}$ (b) $V_n = \frac{n^2h^2}{2\pi^2 ke^2}$

(c) $V_n = \frac{nh}{2\pi^2 ke^2}$ (d) $V_n = \frac{2\pi ke^2}{nh}$

ENTRY TEST MCQS

(58) The following fig indicates the energy levels of a certain atom. When the system moves from 2 E level to E a photon of wavelength λ is emitted. The wavelength of photon produced during its transition from level 4E/3 to level E is.



(a) $\frac{\lambda}{3}$ (b) $\frac{3\lambda}{4}$

(c) $\frac{4\lambda}{3}$ (d) 3λ

(59) Radii are quantized, then the $r_1 : r_2 : r_3$ will be?

(a) 1 : 2 : 3 (b) 1 : 4 : 9

(c) 1 : 3 : 5 (d) 1 : 1 : 1

Topic 20.3:

Inner Shell Transition and Characteristics of X-Rays

(60) The emission of photons by a metal when electrons are incident is called:

(a) Compton effect (b) diffraction

(c) x-rays production (d) all of these

(61) X-rays are

(a) electromagnetic waves (b) longitudinal waves

(c) transverse waves (d) complex waves

(62) X-rays are electromagnetic waves having wavelength:

(a) 10^{-6}m (b) 10^{-8}m

(c) 10^{-10}m (d) 10^{-12}m

(63) Which of the following phenomena can be studied with x-rays:

(a) Compton effect (b) photoelectric effect

(c) pair production (d) all of these

(64) An x-ray photon produced due to transition of electron from M-shell to K-shell is called:

(a) K_α (b) K_β

(c) K_γ (d) none of these

(65) Which of the following radiation can burn the human skin?

(a) infrared (b) infrasonic

(c) x-rays (d) ultrasonic

(66) The penetrating power of x-rays depends on

(a) applied voltage (b) frequency

(c) energy (d) all of these

(67) The rest mass of x-ray photon is

(a) infinite (b) 9×10^{-31}kg

(c) 1.67×10^{-27}kg (d) zero

(68) x-rays were discovered in 1895 by
(a) Einstein **(b)** Becquerel
(c) Curie **(d)** Wilhem Conrad Roetgen

(69) The photons emitted in inner shell transition are called
(a) characteristics of beta rays **(b)** characteristics of gamma rays
(c) characteristics of x-rays **(d)** all of these

(70) In heavy atoms the electrons are assumed to be arranged in
(a) elliptical shells **(b)**concentric shell
(c) rectangular shells **(d)**parabolic shells

(71) Which of the following shell is closest to the nucleus
(a) K-shell **(b)** L-shell
(c) M-shell **(d)** none of these

(72) The inner shell electrons of an atom are
(a) loosely bound **(b)** tightly bound
(c) neither tightly nor loosely **(d)** none of these

(73) The energy required for the displacement of inner shell electrons from their normal state is
(a) very large **(b)** very small
(c) not required **(d)** none of these

(74) After excitation, when an atom returns to its normal state, photons emit
(a) large amount of energy **(b)** very small amount of energy
(c) no energy **(d)** equal to energy absorbed

(75) The transition of inner shell electrons in heavy atoms gives rise to the emission of
(a) x-rays **(b)** high energy photons
(c) both a and b **(d)** none of these

(76) During production of x-rays, when the cathode is heated by the filament it emits
(a) protons **(b)** electrons
(c) neutrons **(d)** all of these

(77) The characteristics x-rays appear as discrete lines on a
(a) discrete spectrum **(b)** continuous spectrum.
(c) band spectrum **(d)** all of these

(78) The continuous x-ray spectrum is due to an effect known as
(a) bremsstrahlung radiation **(b)** breaking radiation
(c) both a and b **(d)** none of these

(79) X-rays can penetrate through a material upto
(a) several centimeters **(b)** few centimeters
(c) few meters **(d)** few Km

(80) X-rays are affected by
(a) electric field **(b)** magnetic field
(c) both a and b **(d)** neither a nor b

(81) The target metal in x-ray tube is made of
(a) aluminium **(b)** gold
(c) tungsten. **(d)** silver

(82) The elements which allow greater amount of incident x-rays to pass through them are
(a) oxygen **(b)** hydrogen
(c) carbon **(d)** all of these

(83) X-rays can cause
(a) cancer **(b)** damage the living tissues
(c) both a and b **(d)** none of these

(84) Density differences of the order of __________ can be detected by the CAT-scanners
(a) 2% **(b)** 1%
(c) 10% **(d)** 100%

(85) In continuous x-ray spectrum when the electrons lose all their K.E in the first collision, the K.E is expressed as
(a) $K.E = hf_{min}$ **(b)** $K.E = h\lambda_{max}$
(c) $K.E = hf_{max}$ **(d)** $K.E = h\lambda_{min}$

(86) The quality of x-rays depends upon
(a) filament of current **(b)** material of the target
(c) accelerating voltage **(d)** both b and c

(87) CAT stands for:
(a) computerized axial tomography **(b)** computerized automatic treatment
(c) computerized accelerated tomography **(d)** none of these

(88) One widely used system is computerized axial tomography is called:
(a) bremsstrahlung **(b)** continuous spectrum
(c) CAT-Scanner **(d)** computer

PAST PAPER MCQS

(89) X-ray diffraction reveals that these are **SGD-2017 (G-I)**
(a) particle type **(b)** wave type
(c) both wave and particle **(d)** none of above

(90) X-rays are electromagnetic radiations having wavelength in the range **SGD-2017 (G-II)**
(a) 10^{-10}m **(b)** 10^{-12}m
(c) 10^{-8}m **(d)** 10^{-6}m

(91) Production of X-rays is the reverse process of. **SGD-2022 (G-II)**
(a) photoelectric effect **(b)** Compton effect
(c) annihilation **(d)** pair production

(92) Photons emitted in the inner shell transition are. **BWP-2022 (G-I)**
(a) Continuous X-rays **(b)** Gamma Rays
(c) Characteristic x-rays **(d)** Energetic X-rays

ENTRY TEST MCQS

(93) In an X-rays tube, the intensity of the emitted X-rays beam is increased by
(a) Increasing the target potential **(b)** Decreasing the filament current.
(c) Increasing the filament current **(d)** Decreasing the target potential.

(94) Mosley's law relates the frequencies of line X-rays with the following characteristics of the target element?
(a) Its density **(b)** Its atomic weight
(c) Its atomic number **(d)** Inter planer spacing of the atomic planes

Topic 20.4:

Uncertainty Within the Atom

(95) The size of the nucleus of an atom (i.e diameter of the nucleus) is of the order of:
(a) 10^{-10}m **(b)** 10^{-12}m
(c) 10^{-14}m **(d)** 10^{-16}m

(96) The maximum uncertainty in the measurement of position of an electron inside the nucleus is of the order of:
(a) 10^{-8}m **(b)** 10^{-12}m
(c) 10^{-14}m **(d)** 10^{-16}m

(97) The radius of hydrogen is about
(a) 1.67×10^{-19} m **(b)** 7.3×10^{-10} m
(c) 6.7×10^{-11} m **(d)** 5×10^{-11} m

(98) The speed of electrons in atom is
(a) less than speed of light **(b)** greater than speed of light
(c) equal to speed of light **(d)** none of these

ENTRY TEST MCQS

(99) The speed of electrons in atom is
(a) Less than speed of light **(b)** Greater than speed of light
(c) Equal to speed of light **(d)** None of these

Topic 20.5:

Laser

(100) Laser is the acronym for:
(a) light amplification by slow energy radiation
(b) light amplification by simple energy radiation
(c) light amplification by stimulated emission of radiation
(d) light amplification by solar energy radiation

(101) Most common type of laser is
(a) solid laser **(b)** liquid laser
(c) gas laser **(d)** solid, liquid and gas laser

(102) In laser beam all the photons:
(a) have different energy **(b)** have the same energy
(c) have different frequency **(d)** have same charge

(103) For laser production radiation must be
(a) coherent **(b)** non-coherent
(c) intense **(d)** both a & c

(104) Laser can be produced by creating:
(a) meta stable state **(b)** population inversion
(c) assembly of photons **(d)** all of these

(105) The excited states in which the life time of an electron is of the order of 10^{-3} sec are called:
(a) metastable state **(b)** normal state
(c) ground state **(d)** none of these

(106) The most common type of lasers used in physics laboratories are:
(a) neon laser **(b)** argon laser
(c) helium neon laser **(d)** none of these

(107) Helium-neon laser, discharge tube contains helium:
(a) 10% **(b)** 15%
(c) 25% **(d)** 85%

(108) To study the laser, which of the following process must be understood
(a) population inversion **(b)** stimulated emission
(c) both a and b **(d)** none of these

(109) Lasers are used to produce
(a)intense beam of light **(b)** unidirectional beam of light
(c) monochromatic beam of light **(d)** all of these

(110) The process in which the higher state has a greater population than the lower energy state is called
(a)population inversion **(b)** normal population
(c)induced population **(d)** none of these

(111) Laser beam can be used to generate
(a) four dimensional image **(b)** three dimensional image
(c) one dimensional image **(d)** all of these

(112) Laser can be used
(a) for welding **(b)** for inducing fusion reactions
(c) for telecommunications along optical fibers **(d)** all of these

PAST PAPER MCQS

(113) Metastable state is ______ than normal excited state. GRW-2019 (G-I)
(a) 10^{-5} times larger **(b)** 10^{-8} times smaller
(c) 10^{-3} times smaller **(d)** 10^{5} times larger

(114) An electron can reside in the meta stable state for about: FSD-2019 (G-I)
(a) 10^{3}s **(b)** 10^{-8}s
(c) 10^{8}s **(d)** 10^{-3}s

(115) For holography we use DGK-2017 (G-II)
(a) X-rays **(b)** laser
(c) γ-rays **(d)** β-rays

(116) Normally electron can reside in excited state for about: BWP-2017 (G-I)
(a) 10^{-3}s **(b)** 10^{-8}s
(c) 10^{-6}s **(d)** 10^{8}s

(117) Laser bean can be used in. MTN-2022 (G-II)
(a) holography **(b)** x-ray machine
(c) fission **(d)** solid structure study

(118) In population inversion, atoms can reside in metastable state for________. MTN-2022 (G-II)
(a) 10^{-10}sec **(b)** 10^{-3}sec
(c) 10^{-8}sec **(d)** 10^{-12}sec

ENTRY TEST MCQS

(119) The ratio of life time of metastable excited state to the normal state is
(a) $1:10^{5}$ **(b)** $1:10^{4}$
(c) $10^{5}:1$ **(d)** $1:10^{6}$

(120) Laser are classified into:
(a) Solid laser **(b)** Liquid laser
(c) Gas laser **(d)** Solid, Liquid and gas laser

ANSWER KEYS

(Topical Multiple Choice Questions)

1	C	21	C	41	D	61	A	81	C	101	C
2	D	22	C	42	C	62	C	82	D	102	B
3	A	23	D	43	D	63	A	83	C	103	D
4	B	24	A	44	C	64	B	84	B	104	B
5	B	25	A	45	B	65	C	85	C	105	A
6	C	26	A	46	D	66	D	86	D	106	C
7	B	27	B	47	C	67	D	87	A	107	D
8	C	28	A	48	A	68	D	88	C	108	C
9	A	29	D	49	C	69	C	89	A	109	D
10	B	30	C	50	A	70	B	90	A	110	A
11	B	31	A	51	A	71	A	91	A	111	B
12	A	32	C	52	A	72	B	92	C	112	D
13	B	33	B	53	B	73	A	93	C	113	D
14	D	34	D	54	B	74	D	94	C	114	B
15	C	35	A	55	A	75	C	95	C	115	B
16	D	36	D	56	B	76	B	96	C	116	B
17	B	37	C	57	D	77	B	97	D	117	A
18	A	38	C	58	D	78	C	98	A	118	C
19	D	39	C	59	B	79	A	99	A	119	C
20	B	40	C	60	C	80	D	100	C	120	D

KIPS TOPICAL SHORT QUESTIONS

20.1 ATOMIC SPECTRA

(1) What is meant by spectroscopy?

Ans: The branch which deals with the study of spectra formed by the emission or absorption of radiation by atoms of the elements. It includes the study of spectra produced by the atoms.

Generally, there are three types of spectra which are given below:-

(i) Continuous spectra
(ii) Band spectra
(iii) Discrete or line spectra i.e. atomic spectra.

(2) Define Continuous Spectrum and give its example.

Ans: **Continuous Spectrum:** "The spectrum in which wavelength of electromagnetic radiation has continuous values to give rise to intensity of radiation is called continuous spectrum."

Example: Black body radiation spectrum is an example of continuous spectrum.

(3) List the colours of line spectra of an excited hydrogen atom.

Ans: The colours of line spectra of an excited hydrogen atom are "red, blue green, blue and violet."

(4) Find the shortest wavelength of Balmer's series.

Ans: Equation for wavelength of Balmer's series is

$$\frac{1}{\lambda} = R_H\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$$

For shortest wavelength

$$n = \infty$$

$$\frac{1}{\lambda_{\min}} = 1.0974\times10^7\left(\frac{1}{4} - \frac{1}{\infty^2}\right)$$

$$\frac{1}{\lambda_{\min}} = \frac{1.0974\times10^7}{4}$$

$$\frac{1}{\lambda_{\min}} = 0.27435\times10^7$$

$$\lambda_{\min} = \frac{1}{0.27435\times10^7}$$

$$\lambda_{\min} = 3.64\times10^{-7}\,m$$

(5) In which region of the electromagnetic spectrum does the following series fall Lyman series, Balmer series and Paschen series ?

Ans: **(i)** LYMAN SERIES (ultraviolet region)
(ii) BALMER SERIES (visible region)
(iii) PASCHEN SERIES (infrared region)

(6) Describe the types of spectra and give its example.

Ans: In General there are three types of spectra called

(i) Continuous spectra e.g. Black body radiation spectrum.
(ii) Band spectra e.g. Molecular Spectra.

(iii) Discrete or line spectra e.g. Atomic spectra.

(7) Differentiate between Line spectrum and band spectrum

Ans:

LINE SPECTRUM	BAND SPECTRUM
Line spectra are also called atomic spectra because the lines represent wavelengths radiated from atoms when electrons change from one energy level to another.  Line spectrum	Band spectra is the name given to groups of lines so closely spaced that each group appears to be a band, e.g., nitrogen spectrum.  Band spectrum

PAST PAPER SHORT QUESTIONS

(8) What is meant by a line spectrum? Explain, how line spectrum can be used for the identification of elements. **LHR-2017 (G-I), BWP-2017 (G-I)**

(9) Explain the term of spectroscopy. **MTN-2019 (G-I), MTN-2022 (G-I)**

(10) Find the shortest wavelength of radiation in Balmer series. **LHR-2022 (G-II)**

(11) Calculate the longest wavelength of radiation for Paschen series. **FSD-2022 (G-I)**

20. 2 BOHR'S MODEL OF THE HYDROGEN ATOM

(12) What is meant by ionization and excitation energy?

Ans: Ionization Energy

The energy required to remove an electron from an isolated gaseous atom.

Excitation Energy

The amount of energy required to raise an electron from its ground state to any of the higher allowed state.

It is equal to the difference in energy of ground state and excited state.

(13) The electron in a hydrogen atom requires energy of 10.2 eV for excitation. A photon and an electron of 10.5 eV energy are incident on the atom. Which one of them may excite the atom?

Ans: The photon may excite the atom, if its energy is equal to excitation energy of atom i.e 10.2 eV. Hence, in this case, it can not excite the atom.

But, electron may lose some part of its energy and causes to excite the atom.

(14) Differentiate an orbital electron from a free electron.

Ans: Free electron can have any amount of energy and orbital electron have specific energy. Which is given by the relation $E_n = -\frac{E_o}{n^2}$

Where E_o = 13.6 eV and n = 1, 2, 3,…….

(15) Write any two postulates of Bohr's model of H-atom.

Ans: Postulate I:

An electron, bound to the nucleus in an atom, can move around the nucleus in certain circular orbits without radiating energy. These orbits are called the discrete stationary states of the atom.

Postulate II:

Only those stationary orbits are allowed for which orbital angular momentum is equal to an integral-multiple of $h/2\pi$ i.e.

$$mvr = \frac{nh}{2\pi} \quad \text{-------------} (1)$$

where n = 1, 2, 3 and n is called the principal quantum number, m and v are the mass and velocity of the orbiting electron respectively, and h being Planck's constant.

(16) What is meant by excitation and ionization potential?

Ans: The P.D applied to accelerated the electron from lower energy state to higher energy state for the required excitation energy is called excitation potential

Ionization Potential

The P.D required to accelerated an electron, such that it may ionize the atom.

PAST PAPER SHORT QUESTIONS

(17) Define excitation energy and ionization energy? **LHR-2019 (G-I)**

(18) Bohr's theory of hydrogen atom is based upon several assumptions. Do any of these assumptions contradict classical physics? **GRW-2019 (G-I)**

(19) Write down postulates of Bohr's model of Hydrogen **GRW-2019 (G-II)**

(20) Can the electron in the ground state of hydrogen absorb a photon of energy 13.6 eV and greater than 13.6 eV? **MIRPUR (AJK) 2017, DGK-2017 (G-II), FSD-2022 (G-I)**

(21) Is energy conserved when an atom emits a photon of light? **SWL-2017, DGK-2017 (G-I)**

(22) State any two postulates of Bohr's atomic model. **BWP-2019 (G-II)**

(23) How can the spectrum of Hydrogen contain so many lines when Hydrogen contain one electron? **MTN-2022 (G-II)**

(24) Calculate the energy of electron in 4^{th} orbit of Hydrogen Atom (in ev). **BWP-2022 (G-I)**

20.3 INNER SHELL TRANSITION AND CHARACTERISTIC X-RAYS

(25) Why do solids given rise to a continuous spectrum while hot gases give rise to line spectrum?

Ans: In solids, atoms are placed very close to each other. Due to this closeness, their energy levels overlapped and form energy bands. Since these levels now do not possess discrete values. Thus when transition takes place between such levels, radiation emitted possess different energies, thus it form continuous spectrum. While in gases atoms are far apart. Thus they possess discrete energy levels. Hence radiations emitted from gaseous sample are discrete which is called line spectrum.

(26) What are x-rays? Give some properties of x-rays.

Ans: X-rays are electromagnetic waves of much shorter wavelength about 10^{-10}m.

Properties:

(i) X-rays are not affected by electric and magnetic fields.

(ii) Frequency of x-rays is greater than ultraviolet radiation.

(iii) Straight-line propagation.

X- rays exhibits the phenomenon of

- Reflection.
- Refraction.
- Interference.
- Diffraction (by NaCl crystal)
- Polarization.
- Pass through certain opaque materials.
- Ionization.

(27) Write a note on CAT scanner.

Ans: In the recent past, several vastly improved X-ray techniques have been developed. One widely used system is computerized axial topography; the corresponding instrument is called CAT-Scanner.

Density differences of the order of one percent can be detected with CAT-Scan. Tumors and other anomalies that are not detected by older techniques, but now detected by CAT-Scanner.

(28) How does a K_α X-ray differ from a K_β X-ray?

Ans: Suppose that one of the electrons in the K shell is removed, thereby producing a vacancy or hole in that shell. The electron from the L shell jumps to occupy the hole in the K shell, thereby emitting a photon of energy $hf_{k\alpha}$ called the k_α X-ray given by

$hf_{k\alpha} = E_L - E_K$ …..

It is also possible that the electron from the M shell might also jump to occupy the hole in the K shell. The photons emitted are Kβ X-ray with energies.

$hf_{k\beta} = E_M - E_K$

These photons give rise to K_β X- ray and so on.

(29) What is difference between bremsstrahlung radiation and characteristic x-rays, in production?

Ans: Basically, Bremsstrahlung radiation is produced due to slowing down of charged particles like electron, and characteristic X-rays are produced due to inner shell transitions in heavy atoms.

(30) What happen when an electron loses all of its energy in X-ray?

Ans: X-ray photon in the continuous spectrum of X-rays is produced such that

"Energy of X-ray photon = Initial Energy of electron"

This happens when electron loses all of its energy in one encounter.

Otherwise continuous X-rays' photons are produced when an electron loses all of its energy in a number of encounters.

(31) What is biological effects of X-Rays?

Ans: X-rays cause damage to living tissue. As X-ray photons are absorbed in tissues, they break molecular bonds and create highly reactive free radicals (such as H and OH), which in turn can disturb the molecular structure of the proteins and especially the genetic material. Young and rapidly growing cells are particularly susceptible; hence X-rays are useful for selective destruction of cancer cells.

On the other hand a cell may be damaged by radiation but survive, continue dividing and produce generation of defective cells. Thus X-rays can cause cancer. Even when the organism itself shows no apparent damage, excessive radiation exposure can cause changes in their productive system that will affect the organism's offspring.

PAST PAPER SHORT QUESTIONS

(32) Write two properties of X-rays. **SGD-2017 (G-I)**

(33) How K_α and K_β X-rays are emitted? **FSD-2019**

(34) What is meant by CAT-Scanner? **SWL-2019, MTN-2022 (G-II)**

20.4 UNCERTAINTY WITHIN THE ATOM

(35) What is meant by the statement, that an electron may exist with in the atom but may not exist within the nucleus?

Ans.

Existence of electron with in nucleus	Existence of electron with in atom
For the existence of electron with in nucleus Δx must be taken equal to size of nucleus which is nearly 10^{-14} m so putting $\Delta x = 10^{-14} m$ $h = 6.63\times10^{-34} Js$ $m = 9.1\times10^{-31} kg$ Hence: $\Delta v = \frac{h}{m\Delta x} = \frac{6.63\times10^{-34}}{9.1\times10^{-31}\times10^{-14}}$ $\Delta x = 7.3\times10^{10} m/s$ Which is greater than speed of light 3×10^8 m/s but it is not possible for material particle to have speed greater than speed of light. Therefore we can say that electron can not exist with in nucleus.	For the existence of electron with in atom Δx must be taken equal to size of atom which is nearly 5×10^{-11} m so putting $\Delta x = 5\times10^{11} m$ $h = 6.63\times10^{-34} Js$ $m = 9.1\times10^{-31} kg$ Hence: $\Delta v = \frac{h}{m\Delta v} = \frac{6.63\times10^{-34}}{9.1\times10^{-31}\times5\times10^{-11}}$ $\Delta v = 1.46\times10^{7} m/s$ Which is less than speed of light 3 x 10^8m/s this is possible for an electron and thus electron may exist with in an atom.

PAST PAPER SHORT QUESTIONS

(36) Is energy conserved when an atom emits a photon of light? **GRW-2022 (G-I), RWP-2022 (G-II)**

(37) Find the speed of electron in the first Bohr orbit. **RWP-2022 (G-II)**

20.5 LASER

(38) Meta stable state is different from normal excited state. How?

Normal Excited state	Metastable state
⇒ A higher energy state in which electron can stay for short time ⇒ Shifting of electron to excited is easy. ⇒ Here, electron can stay for 10^{-8}s.	⇒ Higher energy state in which electron remains more than usual time. ⇒ Shifting of electron to metastable state is difficult ⇒ Here, electron can stay for 10^{-3}s.

(39) Why does laser usually emit a single colour light?

Ans: Laser is obtained when an electron in higher energy level E_2 is stimulated to jump to lower energy level E_1. Thus a photon of energy hf = $E_2 - E_1$ is emitted. In leasing medium of LASER, the transition occurs between the same two levels in every atom. Thus, every atom emits the photon of same energy and colour. Thus single colour light is emitted.

(40) Explain what is difference between laser light and light from incandescent light.

Ans:

Laser Light	Incandescent Light
(1) Laser light is monochromatic i.e. consists of one wavelength.	**(1)** The ordinary light from incandescent body has a number of wave lengths.
(2) Laser light is coherent i.e light waves are in same phase.	**(2)** Ordinary light has no phase coherent i.e. waves are out of phase.
(3) The laser light moves in the same direction.	**(3)** This light is emitted in all directions. **(4)** This light is emitted in all directions.
(4) The laser light is produced due to stimulated emission of radiation.	**(5)** This light is produced due to spontaneous emission of light.
(5) Laser light is more intense than	**(6)** Its intensity is less.

ordinary light.	

(41) What are different kinds of lasers?

Ans: Kinds of Lasers:

There are different types of lasers whose power varies from milli watts to megawatts. Lasers are classified into three major kinds according to their light magnifying substances (or medium)

(i) Solids Lasers:

In solid lasers, a fluorescent crystal, such as that of a ruby glass or a semiconductor is used as light amplifying substance.

(ii) Liquid Lasers:

In liquid lasers, a dye dissolved in methanol or a similar liquid is used.

(iii) Gas Lasers:

In gas lasers, a gas or a mixture of gases is used as light magnifying substance (or medium). For example, helium-neon, argon ion and carbon dioxide gas lasers are most widely used as gas lasers.

(42) How does a metastable state differ from a normal excited state of an atom

Ans: Metastable state is a higher energy state in which electrons remain longer than usual. A metastable state is an excited state in which an excited electron can stay for longer time as compared to ordinary excited state. Hence, electron can take comparatively longer time to de-excite (fall to lower state) from metastable state. Also the transition of electron from or to the metastable state is more difficult as compared to other excited state.

(43) What is spontaneous Emission?

Ans: When the incident photon is absorbed by an atom in the ground state with the energy E_1, the atom is raised with energy E_2. This process is called stimulated absorption or induced absorption. Once in the excited state, two things can happen to the atom.

(i) It may decay by spontaneous emission in which the atom emits a photon of energy $hf = E_2 - E_1$ in any arbitrary direction.

(ii) The other way in the excited state is to decay by stimulated emission

(44) What is stimulated emission?

Ans: It is defined as "a process to speed up atomic transitions to lower levels". In this case, the incident photon of energy $hf = E_2 - E_1$ induces and atom to decay by emitting a photon that travels in the direction of the incident photon. For each incident photon we will have two photons going in the same direction, thus an amplified and unidirectional coherent beam is produced.

(45) What is LASER principle?

Ans: The basic principle is to produce stimulated emission. For this purpose atoms are excited by some means. But, their de-excitation is done with the help of an incident photon. This photon emits another photon of its own kind and so on.

(46) Define normal population and population inversion.

Ans: Normal Population:

Normal population is a state in which number of atoms in ground state are larger as compared to excited state.

Population Inversion:

Population inversion is a state in which number of atoms in ground state are less as compared to excited state.

(47) Write down the two uses of LASER.

Ans:

(i) The narrow intense beam of laser can be used to destroy tissue in a localized area. Tiny organelles with a living cell have been destroyed by using laser to study how the absence of that organelle affects the behavior of the cell.

(ii) The intense heat produced in small area by a laser beam is also used for welding, machining metals and for drilling tiny holes in hard materials.

PAST PAPER SHORT QUESTIONS

(48) What are the advantages of laser over ordinary light?
LHR-2021 (G-I), MTN-2022 (G-I), DGK-2022 (G-I), BWP-2022 (G-I)

(49) What is Helium-Neon Laser? **LHR-2021 (G-I)**

(50) Write down any two uses of laser in medicine. **SGD-2017 (G-II), LHR-2022 (G-I)**

(51) What do we mean when we say that the atom is excited?
SGD-2017 (G-I & G-II), DGK-2017 (G-II), LHR-2021 (G-II), LHR-2022 (G-I, II), GRW-2022 (G-I), RWP-2022 (G-I)

(52) Explain why laser action could not occur without population inversion between atomic levels? **MIRPUR (AJK) 2017**

(53) Write two uses of LASER in medicine. **DGK-2017 (G-I)**

(54) Distinguish between stimulated and spontaneous motion. **DGK-2022 (G-I)**

(55) Explain why laser action cannot occur without population inversion between atomic levels? **DGK-2022 (G-II)**

(56) Write any two uses of leaser in medicine and industry. **DGK-2022 (G-II)**

(57) Differentiate between normal population and population inversion of atomic energy state with figures. **BWP-2022 (G-II)**

(58) Can x-rays photon be reflected, refracted, diffracted and polarized just like other wave? Explain. **BWP-2022 (G-II)**

(59) Explain bremsstrahlung in x-rays spectrum. **FSD-2022 (G-II)**