SOLVED EXAMPLE

Ex. 1 If an electron in H atom has an energy of –78.4 kcal/mol. The orbit in which the electron is present is :-

(A) 1^{st} **(B)** 2^{nd}
(C) 3^{rd} **(D)** 4^{th}

Sol. $E^n = \frac{-313.6}{n^2}\text{kcal / mol} \Rightarrow -78.4 = \frac{-313.6}{n^2}$

$\therefore$ n = 2

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

(A) n = 4 to n = 2 **(B)** n = 3 to n = 2
(C) n = 3 to n = 1 **(D)** n = 2 to n = 1

Sol. $\bar{v} = \frac{1}{\lambda} = \left(\frac{1}{2^2} - \frac{1}{4^2}\right)RZ^2 = \frac{3}{4}R$

In H–spectrum for the same $\bar{v}$ or λ as Z = 1, n = 1, $n_2 = 2$

So, **(D)** is the correct answer.

Ex. 3 Difference between n^{th} and $(n + 1)^{th}$ Bohr's radius of H–atom is equal to its $(n – 1)^{th}$ Bohr's radius. The value of n is :-

(A) 1 **(B)** 2
(C) 3 **(D)** 4

Sol. $r_n \propto n^2$

But $r_n + 1 – r_n = r_n – 1$

$(n + 1)^2 – n^2 = (n – 1)^2$

n = 4

So **(D)** is the correct answer

Ex. 4 The dissociation energy of H_2 is 430.53 kJ mol^{-1}. If H_2 is dissociated by illumination with radiation of wavelength 253.7 nm. The fraction of the radiant energy which will be converted into kinetic energy is given by :-

(A) 8.86% **(B)** 2.33%
(C) 1.3% **(D)** 90%

Sol. $\frac{hc}{\lambda} = \frac{430.53\times10^3}{6.023\times10^{23}} + \text{K.E.}$

$\text{K.E.} = \frac{6.626\times10^{-34}\times3\times10^8}{253.7\times10^{-9}} - \frac{430.53\times10^3}{6.023\times10^{23}}$

$= 6.9 \times 10^{-20}$

$\therefore \text{Fraction} = \frac{6.9\times10^{-20}}{7.83\times10^{-19}} = 0.088 = 8.86\%$

Ex. 5 Principal, azimuthal and magnetic quantum numbers are respectively related to :-

(A) size, orientation and shape
(B) size, shape and orientation
(C) shape, size and orientation
(D) none of these

Sol. Principal gives size, i.e. azimuthal gives shape and magnetic quantum number gives the orientation.

So, **(B)** is the correct answer.

Ex. 6 If the radius of 2^{nd} Bohr orbit of hydrogen atom is r_2. The radius of third Bohr orbit will be :-

(A) $\frac{4}{9}r_2$ **(B)** $4r_2$
(C) $\frac{9}{4}r_2$ **(D)** $9r_2$

Sol. $r = \frac{n^2h^2}{4\pi^2 mZe^2}$

$\therefore \frac{r_2}{r_3} = \frac{2^2}{3^2}$ $\therefore r_3 = \frac{9}{4}r_2$

So, **(C)** is the correct answer.

Ex. 7 Light of wavelength λ shines on a metal surface with intensity x and the metal emits Y electrons per second of average energy, Z. What will happen to Y and Z if x is doubled ?

(A) Y will be double and Z will become half
(B) Y will remain same and Z will be doubled
(C) Both Y and Z will be doubled
(D) Y will be doubled but Z will remain same

Sol. When intensity is doubled, number of electrons emitted per second is also doubled but average energy of photoelectrons emitted remains the same.

So, **(D)** is the correct answer.

Ex. 8 Which of the following is the ground state electronic configuration of nitrogen :-

(A) [↑↓] [↑↓] [↑ | ↑ | ↑]
(B) [↑↓] [↑↓] [↑ | ↓ | ↑]
(C) [↑↓] [↑↓] [↑ | ↓ | ↓]
(D) [↑↓] [↑↓] [↓ | ↓ | ↓]

Sol. In **(A)** and **(D)**, the unpaired electrons have spin in the same direction.

So, **(A)** and **(D)** are the correct answer.

Ex. 9 Select the wrong statement (s) from the following ?

(A) If the value of $\ell = 0$, the electron distribution is spherical

(B) The shape of the orbital is given by magnetic quantum number

(C) Angular momentum of 1s, 2s, 3s electrons are equal

(D) In an atom, all electrons travel with the same velocity

Sol. **(B)** is wrong because shape is given by azimuthal quantum number and magnetic quantum number tells the orientation. **(D)** is wrong because electrons in different shells travel with different velocities.

So, **(A)** and **(C)** are the correct answer.

Ex. 10 No. of wave in third Bohr's orbit of hydrogen is :-

(A) 3 **(B)** 6

(C) 9 **(D)** 12

Sol. Number of waves $= \dfrac{\text{Circumference}}{\text{Wavelength}}$

$$\frac{2\pi r}{\lambda} = \frac{2\pi r}{h/mv} = \frac{2\pi}{h}(mvr) = \frac{2\pi}{h} \times \frac{nh}{2\pi}$$

$\therefore$ n = 3

So, **(A)** is the correct answer.

Ex. 11 In the hydrogen atoms, the electrons are excited to the 5th energy level. The number of the lines that may appear in the spectrum will be :-

(A) 4 **(B)** 8

(C) 10 **(D)** 12

Sol. No. of lines produced for a jump from fifth orbit to 1st orbit is given by

$$= \frac{n(n-1)}{2} = \frac{5(5-1)}{2} = 10$$

So, **(C)** is the correct answer.

Ex. 12 Many elements have non-integral atomic masses because :-

(A) they have isotopes

(B) their isotopes have non-integral masses

(C) their isotopes have different masses

(D) the constituents, neutrons, protons and electrons combine to give rational masses

Sol. Non-integral atomic masses are due to isotopes which have different masses.

So, **(A)** and **(C)** are the correct answer.

Ex. 13 For the energy levels in an atom, which one of the following statement/s is/are correct ?

(A) There are seven principal electron energy levels

(B) The second principal energy level can have four sub-energy levels and contain a maximum of eight electrons

(C) The M energy level can have a maximum of 32 electrons.

(D) The 4s sub-energy level is at a lower energy than the 3d sub-energy level.

Sol. **(A)** and **(D)** are true. **(B)** is wrong because for n = 2, $\ell = 0, 1$ (two sub-energy levels). **(C)** is wrong because M shell means n = 3. Maximum electrons it can have $= 2n^2 = 2 \times 3^2 = 18$

So, **(A)** and **(D)** is the correct answer.

Ex. 14 Find the wavelength emitted during the transition of electron in between two levels of Li^{2+} ion whose sum is 5 and difference is 3.

Sol. Let the transition occurs between the level n_1 and n_2 and $n_2 > n_1$

Given that $n_1 + n_2 = 5$

$n_2 - n_1 = 3$

$\therefore$ $n_1 = 1$ and $n_2 = 4$

Therefore, $\dfrac{1}{\lambda} = R_h \times Z^2 \left[\dfrac{1}{(1)^2} - \dfrac{1}{(4)^2}\right]$

$$= 109678 \times (3)^2 \left[\frac{15}{16}\right]$$

$\therefore$ $\lambda = 1.08 \times 10^{-6}$ cm

Ex. 15 Find the wavelengths of the first line of He^+ ion spectral series whose interval with extreme lines is

$$\frac{1}{\lambda_1} - \frac{1}{\lambda_2} = 2.7451 \times 10^4 \text{ cm}^{-1}$$

Sol. Extreme lines means first and last

$$\frac{1}{\lambda_1} - \frac{1}{\lambda_2} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{\infty^2}\right] - RZ^2\left[\frac{1}{n_1^2} - \frac{1}{(n_1+1)^2}\right]$$

$$\text{or } \frac{1}{\lambda_1} - \frac{1}{\lambda_2} = \frac{RZ^2}{(n_1+1)^2}$$

$$2.7451 \times 10^4 = \frac{109677.76 \times 2^2}{(n_1+1)^2}$$

$(n_1 + 1) = 4$

$n_1 = 3$

Wavelength of first line,

$$\frac{1}{\lambda} = 109677.76 \times 2^2 \times \left[\frac{1}{3^2} - \frac{1}{4^2}\right]$$

$\lambda = 4689 \times 10^{-8}$ cm $= 4689$ Å

Ex. 16 The Lyman series of the hydrogen spectrum can be represented by the equation.

$$v = 3.2881 \times 10^{15}\ s^{-1}\left[\frac{1}{(1)^2} - \frac{1}{(n)^2}\right]$$

(where n = 2, 3,.....)

Calculate the maximum and minimum wavelength of lines in this series.

Sol. $$\bar{\nu} = \frac{1}{\lambda} = \frac{\nu}{c} = \frac{3.2881 \times 10^{15}}{3 \times 10^8}\ m^{-1}\left[\frac{1}{(1)^2} - \frac{1}{n^2}\right]$$

Wavelength is maximum $(\bar{\nu}_{min})$ when n is minimum so that $\frac{1}{n^2}$ is maximum

$$\therefore\ \bar{\nu}_{min} = \frac{1}{\lambda_{max}} = \frac{3.2881 \times 10^{15}}{3 \times 10^8}\left[\frac{1}{(1)^2} - \frac{1}{(2)^2}\right]$$

$$\therefore\ \lambda_{max} = \frac{3 \times 10^8}{3.2881 \times 10^{15}} \times \frac{4}{3}$$

$$= 1.2165 \times 10^{-7}\ m = 121.67\ nm$$

Wavelength is minimum $(\bar{\nu}_{max})$ when n is ∞

i.e. series converge

$$\therefore\ \nu_{max} = \frac{1}{\lambda_{min}} = \frac{3.2881 \times 10^{15}}{3 \times 10^8}$$

$$\therefore\ \lambda_{min} = 0.9124 \times 10^{-7} m\ 91.24\ nm$$

Ex. 17 Two hydrogen atoms collide head on and end up with zero kinetic energy. Each atom then emits a photon of wavelength 121.6 nm. Which transition leads to this wavelength ? How fast were the hydrogen atoms travelling before collision ?

Sol. Wavelength is emitted in UV region and thus $n_1 = 1$

For H atom $= \frac{1}{\lambda} = R_H\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$

$$\therefore\ \frac{1}{121.6 \times 10^{-9}} = 1.097 \times 10^7\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$$

∴ n = 2

Also the energy released is due to collision and all the kinetic energy is released in form of photon.

$$\therefore\ \frac{1}{2}mv^2 = \frac{hc}{\lambda}$$

$$\therefore\ \frac{1}{2} \times 1.67 \times 10^{-27} \times v^2 = \frac{6.625 \times 10^{-34} \times 3 \times 10^8}{121.6 \times 10^{-9}}$$

$$\therefore\ v = 4.43 \times 10^4\ m/sec$$

Ex. 18 When certain metal was irradiated with light frequency 0.4×10^{13} Hz the photo electrons emitted had twice the kinetic energy as did photo electrons emitted when the same metal was irradiated with light frequency 1.0×10^{13} Hz. Calculate threshold frequency (ν_0) for the metal.

Sol. $h\nu = h\nu_0 + KE$

$KE_1 = h(\nu_1 - \nu_0)$

$$KE_2 = h(\nu_2 - \nu_0) = \frac{KE_1}{2}$$

$$\therefore\ \frac{\nu_2 - \nu_0}{\nu_1 - \nu_0} = \frac{1}{2} \Rightarrow \frac{1.0 \times 10^{13} - \nu_0}{0.4 \times 10^{13} - \nu_0} = \frac{1}{2}$$

$\Rightarrow \nu_0 = 1.6 \times 10^{13}$ Hz

Ex. 19 An electron beam can undergo difraction by crystals. Through what potential should a beam of electrons be accelerated so that its wavelength becomes equal to 1.0 Å.

Sol. For an electron

$\frac{1}{2}mv^2 = eV$ where V is accelerating potential

$$\lambda = \frac{h}{mv}$$

$$\therefore\ \frac{1}{2}m\left(\frac{h}{m\lambda}\right)^2 = eV$$

$$\therefore\ V = \frac{1}{2} \times \frac{h^2}{m\lambda^2 e}$$

$$= \frac{1 \times (6.625 \times 10^{-34})^2}{2 \times 9.108 \times 10^{-31} \times (1.0 \times 10^{-10})^2 \times 1.602 \times 10^{-19}}$$

= 150.40 volt

Ex. 20 The angular momentum of an electron in a Bohr's orbit of H-atom is 4.2178×10^{-34} kgm²/sec. Calculate the wavelength of the spectral line emitted when electrons falls from this level to next lower level.

Sol. $$mvr = \frac{nh}{2\pi}$$

$$\frac{nh}{2\pi} = 4.2178 \times 10^{-34}$$

$$n = \frac{4.2178 \times 10^{-34} \times 2 \times 3.14}{6.625 \times 10^{-34}} = 4$$

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

The wavelength for transition from n = 4 to n = 3

$$\frac{1}{\lambda} = 109678\left[\frac{1}{3^2} - \frac{1}{4^2}\right]$$

$\lambda = 1.8 \times 10^{-4}$ cm.

Ex. 21 Find the energy in kJ per mole of electronic charge accelerated by a potential of 2 volt.

Sol. Energy in joules = charge in coulombs × potential difference in volt

$= 1.6 \times 10^{-19} \times 6.02 \times 10^{23} \times 2 = 19.264 \times 10^4$ J or 192.264 kJ

Ex. 22 Which hydrogen like ionic species has wavelength difference between the first line of Balmer and first line of Lyman series equal to 59.3×10^{-9} m ? Neglect the reduced mass effect.

Sol. Wave number of first Balmer line of an species with atomic number Z is given by

$$\bar{v}' = RZ^2\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5RZ^2}{36}$$

Similarly wave number of $\bar{v}$ of first Lyman line is given by

$$\bar{v} = RZ^2\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3}{4}RZ^2 \;;\; \bar{v} = \frac{1}{\lambda} \text{ and } \bar{v}' = \frac{1}{\lambda'}$$

$$\therefore \quad \lambda' - \lambda = \frac{36}{5RZ^2} - \frac{4}{3RZ^2} = \frac{1}{RZ^2}\left[\frac{36}{5} - \frac{4}{3}\right] = \frac{88}{15RZ^2}$$

$$\therefore \quad Z^2 = \frac{88}{59.3 \times 10^{-9} \times 15 \times 1.097 \times 10^7} = 9 \text{ or } Z = 3$$

$\therefore$ Ionic species is Li^{2+}

Ex. 23 **(i)** What is highest frequency photon that can be emitted from hydrogen atom ? What is wavelength of this photon ?

(ii) Find the longest wavelength transition in the Paschen series of Be^{3+}.

(iii) Find the ratio of the wavelength of first and the ultimate line of Balmer series of He^+ ?

Sol. **(i)** Highest frequency photon is emitted when electron comes from infinity to 1st energy level.

$$E = -\frac{13.6Z^2}{1^2} = -13.6 \text{ eV}$$

or, $13.6 \times 1.6 \times 10^{-19}$ Joule $= 2.176 \times 10^{-18}$ Joule

$E = h\nu$

$$\therefore \quad \nu = \frac{E}{h} = \frac{2.176 \times 10^{-18}\text{ J}}{6.626 \times 10^{-34}\text{ Js}} = 0.328 \times 10^{16} \text{ Hz}$$

$$\nu = \frac{c}{\lambda}$$

$$\therefore \lambda = \frac{3 \times 10^8}{0.328 \times 10^{16}} = 9.146 \times 10^{-8} \text{ m}$$

(ii) $\bar{v} = R_H \times Z^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

For He ; Z = 4 ; For Paschen series $n_1 = 3$

For longest wavelength $n_2 = 4$

$$\frac{1}{\lambda} = 109678 \times (4)^2 \times \left[\frac{1}{3^2} - \frac{1}{4^2}\right]$$

$$= 109678 \times 16 \times \left[\frac{1}{9} - \frac{1}{16}\right] = 109678 \times 16 \times \frac{7}{144}$$

$\lambda = 1172.20$ Å

(iii) Wave number of first line of Balmer,

$$\bar{v}_1 = RZ^2\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5 \times 4R}{36} = \frac{5R}{9}$$

$\therefore$ Wavelength of first line of Balmer $= \frac{9}{5R}$

Wave number of ultimate line of Balmer,

$$\bar{v}_2 = RZ^2\left[\frac{1}{2^2} - \frac{1}{\infty}\right] = \frac{4R}{4} = R$$

$\therefore$ Wavelength of ultimate line of Balmer $= \frac{1}{R}$

$\therefore$ Ratio $= \frac{9}{5}$

Ex. 24 The kinetic energy of an electron in H like atom is 6.04 eV. Find the area of the third Bohr orbit to which this electron belongs. Also report the atom.

Sol. K.E. = 6.04 in 3rd orbit

E_{total} = K.E. + P.E. = K.E. – 2 × K.E.

$\Rightarrow$ –K.E. = – 6.04 eV

E_1 for H = –13.6 eV and not for any orbit E = – 6.04 eV for H atom. Thus, atom for which K.E. is given is other than H.

E_n H like atom $= E_{nH} \times Z^2$

$$\frac{E_1}{n^2} \times Z^2 \Rightarrow 6.04 = \frac{13.6}{3^2} \times Z^2$$

$Z^2 = 3.99 \approx 4 \Rightarrow Z = 2$

$\therefore$ The atom is $He^+ \Rightarrow r_n = 0.529 \times \frac{n^2}{Z} = 0.529 \times \frac{3^2}{2} = 2.3805$ Å

Area, $\pi r^2 = \frac{22}{7} \times \left(2.3805 \times 10^{-8}\right)^2 = 17.8 \times 10^{-16}$ cm²

Ex. 25 What are the frequency and wavelength of a photon emitted during a transition from n = 5 state to the n = 2 state in the hydrogen atom ?

Sol. Since $n_i = 5$ and $n_f = 2$, this transition gives rise to a spectral line in the visible region of the Balmer series.

$$\Delta E = 2.18 \times 10^{-18}\text{ J}\left[\frac{1}{5^2} - \frac{1}{2^2}\right] = -4.58 \times 10^{-19}\text{ J}$$

It is an emission energy

The frequency of the photon (taking energy in terms of magnitude) is given by

$$\nu = \frac{\Delta E}{h} = \frac{4.58 \times 10^{-19}\text{ J}}{6.626 \times 10^{-34}\text{ Js}} = 6.91 \times 10^{14}\text{ Hz}$$

$$\lambda = \frac{c}{\nu} = \frac{3.0 \times 10^8\text{ ms}^{-1}}{6.91 \times 10^{14}\text{ Hz}} = 434 \text{ nm}$$

Exercise # 1 — SINGLE OBJECTIVE — NEET LEVEL

1. A neutral atom (Atomic no. > 1) consists of
(A) Only protons
(B) Neutrons + protons
(C) Neutrons + electrons
(D) Neutron + proton + electron

2. The nucleus of the atom consists of
(A) Proton and neutron
(B) Proton and electron
(C) Neutron and electron
(D) Proton, neutron and electron

3. The size of nucleus is of the order of
(A) 10^{-12} m **(B)** 10^{-8} m
(C) 10^{-15} m **(D)** 10^{-10} m

4. Positive ions are formed from the neutral atom by the
(A) Increase of nuclear charge
(B) Gain of protons
(C) Loss of electrons
(D) Loss of protons

5. The electron is
(A) α-ray particle **(B)** β-ray particle
(C) Hydrogen ion **(D)** Positron

6. The number of electrons in an atom of an element is equal to its
(A) Atomic weight **(B)** Atomic number
(C) Equivalent weight **(D)** Electron affinity

7. The nucleus of the element having atomic number 25 and atomic weight 55 will contain
(A) 25 protons and 30 neutrons
(B) 25 neutrons and 30 protons
(C) 55 protons
(D) 55 neutrons

8. If W is atomic weight and N is the atomic number of an element, then
(A) Number of e^{-1} = W – N
(B) Number of $_0n^1$ = W – N
(C) Number of $_1H^1$ = W – N
(D) Number of $_0n^1$ = N

9. The total number of neutrons in dipositive zinc ions with mass number 70 is
(A) 34 **(B)** 40
(C) 36 **(D)** 38

10. Which of the following are isoelectronic with one another
(A) Na^+ and Ne **(B)** K^+ and O
(C) Ne and O **(D)** Na^+ and K^+

11. The number of electrons in one molecule of CO_2 are
(A) 22 **(B)** 44
(C) 66 **(D)** 88

12. Chlorine atom differs from chloride ion in the number of
(A) Proton
(B) Neutron
(C) Electrons
(D) Protons and electrons

13. CO has same electrons as or the ion that is isoelectronic with CO is
(A) N_2^+ **(B)** CN^-
(C) O_2^+ **(D)** O_2^-

14. The mass of an atom is constituted mainly by
(A) Neutron and neutrino
(B) Neutron and electron
(C) Neutron and proton
(D) Proton and electron

15. The atomic number of an element represents
(A) Number of neutrons in the nucleus
(B) Number of protons in the nucleus
(C) Atomic weight of element
(D) Valency of element

16. An atom has 26 electrons and its atomic weight is 56. The number of neutrons in the nucleus of the atom will be
(A) 26 **(B)** 30
(C) 36 **(D)** 56

17. The most probable radius (in pm) for finding the electron in He^+ is
(A) 0.0 **(B)** 52.9
(C) 26.5 **(D)** 105.8

18. The number of unpaired electrons in the Fe^{2+} ion is
(A) 0 **(B)** 4
(C) 6 **(D)** 3

19. A sodium cation has different number of electrons from

(A) O^{2-} **(B)** F^{-}

(C) Li^{+} **(D)** Al^{3+}

20. An atom which has lost one electron would be

(A) Negatively charged

(B) Positively charged

(C) Electrically neutral

(D) Carry double positive charge

21. Rutherford's experiment on scattering of particles showed for the first time that the atom has

(A) Electrons **(B)** Protons

(C) Nucleus **(D)** Neutrons

22. Rutherford's scattering experiment is related to the size of the

(A) Nucleus **(B)** Atom

(C) Electron **(D)** Neutron

23. Rutherford's alpha particle scattering experiment eventually led to the conclusion that

(A) Mass and energy are related

(B) Electrons occupy space around the nucleus

(C) Neutrons are buried deep in the nucleus

(D) The point of impact with matter can be precisely determined

24. Bohr's model can explain

(A) The spectrum of hydrogen atom only

(B) Spectrum of atom or ion containing one electron only

(C) The spectrum of hydrogen molecule

(D) The solar spectrum

25. When atoms are bombarded with alpha particles, only a few in million suffer deflection, others pass out undeflected. This is because

(A) The force of repulsion on the moving alpha particle is small

(B) The force of attraction on the alpha particle to the oppositely charged electrons is very small

(C) There is only one nucleus and large number of electrons

(D) The nucleus occupies much smaller volume compared to the volume of the atom

26. Positronium consists of an electron and a positron (a particle which has the same mass as an electron, but opposite charge) orbiting round their common centre of mass. Calculate the value of the Rydberg constant for this system.

(A) $R_{\infty} / 4$ **(B)** $R_{\infty} / 2$

(C) $2R_{\infty}$ **(D)** R_{∞}

27. When α-particles are sent through a thin metal foil, most of them go straight through the foil because (one or more are correct)

(A) Alpha particles are much heavier than electrons

(B) Alpha particles are positively charged

(C) Most part of the atom is empty space

(D) Alpha particles move with high velocity

28. When an electron jumps from L to K shell

(A) Energy is absorbed

(B) Energy is released

(C) Energy is sometimes absorbed and sometimes released

(D) Energy is neither absorbed nor released

29. When beryllium is bombarded with α-particles, extremely penetrating radiations which cannot be deflected by electrical or magnetic field are given out. These are

(A) A beam of protons **(B)** α -rays

(C) A beam of neutrons **(D)** X-rays

30. Which one of the following is not the characteristic of Planck's quantum theory of radiation

(A) The energy is not absorbed or emitted in whole number or multiple of quantum

(B) Radiation is associated with energy

(C) Radiation energy is not emitted or absorbed conti- nuously but in the form of small packets called quanta

(D) This magnitude of energy associated with a quantum is proportional to the frequency

31. The spectrum of is expected to be similar to

(A) H **(B)** Li^{+}

(C) Na **(D)** He^{+}

32. Energy of orbit

(A) Increases as we move away from nucleus

(B) Decreases as we move away from nucleus

(C) Remains same as we move away from nucleus

(D) None of these

33. Bohr model of an atom could not account for

(A) Emission spectrum

(B) Absorption spectrum

(C) Line spectrum of hydrogen

(D) Fine spectrum

34. Existence of positively charged nucleus was established by

(A) Positive ray analysis

(B) α-ray scattering experiments

(C) X-ray analysis

(D) Discharge tube experiments

35. Electron occupies the available orbital singly before pairing in any one orbital occurs, it is
(A) Pauli's exclusion principle
(B) Hund's Rule
(C) Heisenberg's principle
(B) Prout's hypothesis

36. The wavelength of a spectral line for an electronic transition is inversely related to
(A) The number of electrons undergoing the transition
(B) The nuclear charge of the atom
(C) The difference in the energy of the energy levels involved in the transition
(D) The velocity of the electron undergoing the transition

37. When an electron drops from a higher energy level to a low energy level, then
(A) Energy is emitted
(B) Energy is absorbed
(C) Atomic number increases
(D) Atomic number decreases

38. Davisson and Germer's experiment showed that
(A) β-particles are electrons
(B) Electrons come from nucleus
(C) Electrons show wave nature
(D) None of the above

39. When an electron jumps from lower to higher orbit, its energy
(A) Increases (B) Decreases
(C) Remains the same (D) None of these

40. Experimental evidence for the existence of the atomic nucleus comes from
(A) Millikan's oil drop experiment
(B) Atomic emission spectroscopy
(C) The magnetic bending of cathode rays
(D) Alpha scattering by a thin metal foil

41. De broglie equation describes the relationship of wavelength associated with the motion of an electron and its
(A) Mass (B) Energy
(C) Momentum (D) Charge

42. The wave nature of an electron was first given by
(A) De-Broglie (B) Heisenberg
(C) Mosley (D) Sommerfield

43. Among the following for which one mathematical expression $\lambda = \frac{h}{p}$ stands
(A) De Broglie equation (B) Einstein equation
(C) Uncertainty equation (D) Bohr equation

44. Which one of the following explains light both as a stream of particles and as wave motion
(A) Diffraction (B) $\lambda = h/p$
(C) Interference (D) Photoelectric effect

45. In which one of the following pairs of experimental observations and phenomenon does the experimental observation correctly account for phenomenon

Experimental observation	Phenomenon
(A) X-ray spectra	Charge on the nucleus
(B) α-particle scattering	Quantized electron orbit
(C) Emission spectra	The quantization of energy
(D) The photoelectric effect	The nuclear atom

46. Be's 4th electron will have four quantum numbers

	n	l	m	s
(A)	1	0	0	+1/2
(B)	1	1	+1	+1/2
(C)	2	0	0	- 1/2
(D)	2	1	0	+1/2

47. The quantum number which specifies the location of an electron as well as energy is
(A) Principal quantum number
(B) Azimuthal quantum number
(C) Spin quantum number
(D) Magnetic quantum number

48. The shape of an orbital is given by the quantum number
(A) n (B) l
(C) m (D) s

49. In a given atom no two electrons can have the same values for all the four quantum numbers. This is called
(A) Hund's rule
(B) Aufbau's principle
(C) Uncertainty principle
(D) Pauli's exclusion principle

50. Nitrogen has the electronic configuration $1s^2, 2s^2\, 2p_x^1\, 2p_y^1\, 2p_z^1$ and not $1s^2, 2s^2\, 2p_x^2\, 2p_y^1\, 2p_z^0$ which is determined by
(A) Aufbau's principle
(B) Pauli's exclusion principle
(C) Hund's rule
(D) Uncertainty principle

51. Which one of the following configuration represents a noble gas

(A) $1s^2, 2s^2 2p^6, 3s^2$

(B) $1s^2, 2s^2 2p^6, 3s^1$

(C) $1s^2, 2s^2 2p^6$

(D) $1s^2, 2s^2 sp^6, 3s^2 3p^6, 4s^2$

52. The electronic configuration of silver atom in ground state is

(A) $[Kr]3d^{10} 4s^1$ (B) $[Xe]4f^{14} 5d^{10} 6s^1$

(C) $[Kr]4d^{10} 5s^1$ (D) $[Kr]4d^9 5s^2$

53. Principal, azimuthal and magnetic quantum numbers are respectively related to

(A) Size, shape and orientation

(B) Shape, size and orientation

(C) Size, orientation and shape

(D) None of the above

54. Correct set of four quantum numbers for valence electron of rubidium (Z = 37) is

(A) $5, 0, 0, +\frac{1}{2}$ (B) $5, 1, 0, +\frac{1}{2}$

(C) $5, 1, 1, +\frac{1}{2}$ (D) $6, 0, 0, +\frac{1}{2}$

55. The correct ground state electronic configuration of chromium atom is

(A) $[Ar]3d^5 4s^1$ (B) $[Ar]3d^4 4s^2$

(C) $[AR]3d^6 4s^0$ (D) $[Ar]4d^5 4s^1$

56. 2p orbitals have

(A) $n = 1, l = 2$ (B) $n = 1, l = 0$

(C) $n = 2, l = 1$ (D) $n = 2, l = 0$

57. Electronic configuration of H^- is

(A) $1s^0$ (B) $1s^1$

(C) $1s^2$ (D) $1s^1, 2s^2$

58. The quantum numbers for the outermost electron of an element are given below as

$n = 2, l = 0, m = 0, s = +\frac{1}{2}$. The atoms is

(A) Lithium (B) Beryllium

(C) Hydrogen (D) Boron

59. Principal quantum number of an atom represents

(A) Size of the orbital

(B) Spin angular momentum

(C) Orbital angular momentum

(D) Space orientation of the orbital

60. An element has the electronic configuration $1s^2, 2s^2 2p^6, 3s^2 3p^2$. Its valency electrons are

(A) 6 (B) 2

(C) 3 (D) 4

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. A photon of energy hν is absorbed by a free electron of a metal having work function w < hν. Then :
(A) The electron is sure to come out
(B) The electron is sure to come out with a kinetic energy (hν – w)
(C) Either the electron does not come out or it comes with a kinetic energy (hν – w)
(D) It may come out with a kinetic energy less than (hν – w)

2. Light of wavelength λ falls on metal having work function hc/λ_0. Photoelectric effect will take place only if :
(A) $\lambda \geq \lambda_0$ (B) $\lambda \geq 2\lambda_0$
(C) $\lambda \leq \lambda_0$ (D) $\lambda \leq \lambda_0/2$

3. A bulb of 40 W is producing a light of wavelength 620 nm with 80% of efficiency then the number of photons emitted by the bulb in 20 seconds are (1eV = 1.6×10^{-19} J, hc = 12400 eV Å)
(A) 2×10^{18} (B) 10^{18}
(C) 10^{21} (D) 2×10^{21}

4. If the value of $E_n = -78.4$ kcal/mole, the order of the orbit in hydrogen atom is :
(A) 4 (B) 3
(C) 2 (D) 1

5. Correct order of radius of the Ist orbit of H, He^+, Li^{2+}, Be^{3+} is :
(A) $H > He^+ > Li^{2+} > Be^{3+}$
(B) $Be^{3+} > Li^{2+} > He^+ > H$
(C) $He^+ > Be^{3+} > Li^{2+} > H$
(D) $He^+ > H > Li^{2+} > Be^{3+}$

6. What is likely to be orbit number for a circular orbit of diameter 20 nm of the hydrogen atom :
(A) 10 (B) 14
(C) 12 (D) 16

7. Which is the correct relationship :
(A) E_1 of H = 1/2 E_2 of He^+ = 1/3 E_3 of Li^{2+} = 1/4 E_4 of Be^{3+}
(B) $E_1(H) = E_2(He^+) = E_3(Li^{2+}) = E_4(Be^{3+})$
(C) $E_1(H) = 2E_2(He^+) = 3E_3(Li^{2+}) = 4E_4(Be^{3+})$
(D) No relation

8. If velocity of an electron in I orbit of H atom is V, what will be the velocity of electron in 3rd orbit of Li^{+2}
(A) V (B) V/3
(C) 3 V (D) 9 V

9. In a certain electronic transition in the hydrogen atoms from an initial state (1) to a final state (2), the difference in the orbital radius $(r_1 - r_2)$ is 24 times the first Bohr radius. Identify the transition.
(A) $5 \to 1$ (B) $25 \to 1$
(C) $8 \to 3$ (D) $6 \to 5$

10. The species which has its fifth ionisation potential equal to 340 V is
(A) B^+ (B) C^+
(C) B (D) C

11. Choose the correct relations on the basis of Bohr's theory.
(A) Velocity of electron $\propto n$
(B) Frequency of revolution $\propto \frac{1}{n^2}$
(C) Radius of orbit $\propto n^2 Z$
(D) Electrostatic force on electron $\propto \frac{1}{n^4}$

12. **S1 :** Potential energy of the two opposite charge system increases with the decrease in distance.
S2 : When an electron make transition from higher orbit to lower orbit it's kinetic energy increases.
S3 : When an electron make transtition from lower energy to higher energy state its potential energy increases.
S4 : 11eV photon can free an electron from the 1st excited state of He^+ -ion.
(A) T T T T (B) F T T F
(C) T F F T (D) F F F F

13. **S1 :** Bohr model is applicable for Be^{2+} ion.
S2 : Total energy coming out of any light source is integral multiple of energy of one photon.
S3 : Number of waves present in unit length is wave number.
S4 : e/m ratio in cathode ray experiment is independent of the nature of the gas.
(A) F F T T (B) T T F F
(C) F T T T (D) T F F F

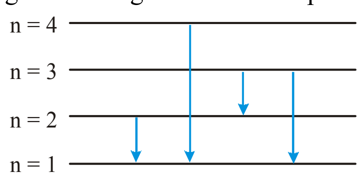
14. Match the following
(A) Energy of ground state of He^+
(i) + 6.04 eV
(B) Potential energy of I orbit of H-atom
(ii) –27.2 eV
(C) Kinetic energy of II excited state of He^+
(iii) 54.4 V
(D) Ionisation potential of He^+
(iv) – 54.4 eV
(A) A – (i), B – (ii), C – (iii), D – (iv)
(B) A – (iv), B – (iii), C – (ii), D – (i)
(C) A – (iv), B – (ii), C – (i), D – (iii)
(D) A – (ii), B – (iii), C – (i), D – (iv)

15. The wavelength of a spectral line for an electronic transition is inversely proportional to :
(A) number of electrons undergoing transition
(B) the nuclear charge of the atom
(C) the velocity of an electron undergoing transition
(D) the difference in the energy involved in the transition

16. Total no. of lines in Lyman series of H spectrum will be (where n = no. of orbits)
(A) n (B) n – 1
(C) n – 2 (D) n (n + 1)

17. The energy of hydrogen atom in its ground state is –13.6 eV. The energy of the level corresponding to n = 5 is:
(A) –0.54 eV (B) –5.40 eV
(C) –0.85 eV (D) –2.72 eV

18. Suppose that a hypothetical atom gives a red, green, blue and violet line spectrum . Which jump according to figure would give off the red spectral line.



(A) $3 \to 1$ (B) $2 \to 1$
(C) $4 \to 1$ (D) $3 \to 2$

19. The difference between the wave number of 1st line of Balmer series and last line of paschen series for Li^{2+} ion is :
(A) $\frac{R}{36}$ (B) $\frac{5R}{36}$
(C) 4R (D) $\frac{R}{4}$

20. The spectrum of He^{+} is expected to be similar to that of :
(A) Li^{2+} (B) He
(C) H (D) Na

21. No. of visible lines when an electron returns from 5th orbit upto ground state in H spectrum :
(A) 5 (B) 4
(C) 3 (D) 10

22. In a sample of H-atom electrons make transition from 5th excited state upto ground state, producing all possible types of photons, then number of lines in infrared region are
(A) 4 (B) 5
(C) 6 (D) 3

23. In H-atom, if 'x' is the radius of the first Bohr orbit, de Broglie wavelength of an electron in 3rd orbit is :
(A) $3\pi x$ (B) $6\pi x$
(C) $\frac{9x}{2}$ (D) $\frac{x}{2}$

24. What possibly can be the ratio of the de Broglie wavelengths for two electrons each having zero initial energy and accelerated through 50 volts and 200 volts ?
(A) 3 : 10 (B) 10 : 3
(C) 1 : 2 (D) 2 : 1

25. The approximate wavelength associated with a gold-ball weighing 200 g and moving at a speed of 5 m/hr is of the order of
(A) 10^{-1} m (B) 10^{-20} m
(C) 10^{-30} m (D) 10^{-40} m

26. The wavelength of a charged particle ________ the square root of the potential difference through which it is accelerated :
(A) is inversely proportional to
(B) is directly proportional to
(C) is independent of
(D) is unrelated with

27. The uncertainty in the momentum of an electron is 1.0×10^{-5} kg m s^{-1} . The uncertainty in its position will be: ($h = 6.626 \times 10^{-34}$ Js)
(A) 1.05×10^{-28} m (B) 1.05×10^{-26} m
(C) 5.27×10^{-30} m (D) 5.25×10^{-28} m

28. An α-particle is accelerated through a potential difference of V volts from rest. The de-Broglie's wavelength associated with it is
(A) $\sqrt{\frac{150}{V}}$ Å (B) $\frac{0.286}{\sqrt{V}}$ Å
(C) $\frac{0.101}{\sqrt{V}}$ Å (D) $\frac{0.983}{\sqrt{V}}$ Å

29. de-Broglie wavelength of electron in second orbit of Li^{2+} ion will be equal to de-Broglie of wavelength of electron in
(A) n = 3 of H-atom (B) n = 4 of C^{5+} ion
(C) n = 6 of Be^{3+} ion (D) n = 3 of He^{+} ion

30. The total spin resulting from a d^7 configuration is :
(A) 1 (B) 2
(C) 5/2 (D) 3/2

31. Which of the following ions has the maximum number of unpaired d-electrons?
(A) Zn^{2+} (B) Fe^{2+}
(C) Ni^{3+} (D) Cu^{+}

32. The orbital with zero orbital angular momentum is :
(A) s (B) p
(C) d (D) f

33. Which of the following is electronic configuration of Cu^{2+} (Z = 29) ?
(A) $[Ar]4s^1 3d^8$ (B) $[Ar]4s^2 3d^{10} 4p^1$
(C) $[Ar]4s^1 3d^{10}$ (D) $[Ar] 3d^9$

34. Spin magnetic moment of X^{n+} (Z = 26) is $\sqrt{24}$ B.M. Hence number of unpaired electrons and value of n respectively are :
(A) 4, 2 (B) 2, 4
(C) 3, 1 (D) 0, 2

35. Consider the ground state of Cr atom (Z = 24). The numbers of electrons with the azimuthal quantum numbers, ℓ = 1 and 2 are, respectively :
(A) 16 and 5 (B) 12 and 5
(C) 16 and 4 (D) 12 and 4

36. Given is the electronic configuration of element X :

K	L	M	N
2	8	11	2

The number of electrons present with ℓ = 2 in an atom of element X is :
(A) 3 (B) 6
(C) 5 (D) 4

37. The orbital angular momentum of an electron in 2s-orbital is :
(A) $+\frac{1}{2}\frac{h}{2\pi}$ (B) zero
(C) $\frac{h}{2\pi}$ (D) $\sqrt{2}\frac{h}{2\pi}$

38. The possible value of ℓ and m for the last electron in the Cl^- ion are :
(A) 1 and 2 (B) 2 and + 1
(C) 3 and – 1 (D) 1 and – 1

39. For an electron, with n = 3 has only one radial node. The orbital angular momentum of the electron will be
(A) 0 (B) $\sqrt{6}\frac{h}{2\pi}$
(C) $\sqrt{2}\frac{h}{2\pi}$ (D) $3\left(\frac{h}{2\pi}\right)$

40. The possible set of quantum no. for the unpaired electron of chlorine is :

	n	ℓ	m
	n	ℓ	m
(A)	2	1	0
(B)	2	1	1
(C)	3	1	1
(D)	3	0	0

41. Which of the following statement(s) is (are) correct?
(A) The electronic configuration of Cr is $[Ar] (3d)^5 (4s)^1$. (Atomic number of Cr = 24)
(B) The magnetic quantum number may have positive values.
(C) In silver atom, 21 electrons have a spin of one type and 26 of the opposite type. (Atomic number of Ag = 47)
(D) None of these

42. Which of the following atoms and ions are isoelectronic i.e. have the same number of electrons with the neon atom
(A) F^- (B) Oxygen atom
(C) Mg (D) N^-

43. Atoms consists of protons, neutrons and electrons. If the mass of neutrons and electrons were made half and two times respectively to their actual masses, then the atomic mass of $_6C^{12}$
(A) Will remain approximately the same
(B) Will become approximately two times
(C) Will remain approximately half
(D) Will be reduced by 25%

44. The increasing order (lowest first) for the values of e/m (charge/mass) for
(A) e, p, n, α (B) n, p, e, α
(C) n, p, α, e (D) n, α, p, e

45. The electronic configuration of a dipositive metal M^{2+} is 2, 8, 14 and its atomic weight is 56 a.m.u. The number of neutrons in its nuclei would be
(A) 30 (B) 32
(C) 34 (D) 42

46. The ratio of the energy of a photon of 2000Å wavelength radiation to that of 4000Å radiation is
(A) 1/4 (B) 4
(C) 1/2 (D) 2

47. Discovery of the nucleus of an atom was due to the experiment carried out by
(A) Bohr (B) Mosley
(C) Rutherford (D) Thomson

48. In a Bohr's model of atom when an electron jumps from n = 1 to n = 3, how much energy will be emitted absorbed
(A) 2.15×10^{-11} erg (B) 0.1911×10^{-10} erg
(C) 2.389×10^{-12} erg (D) 0.239×10^{-10} erg

49. The nucleus of an atom can be assumed to be spherical. The radius of the nucleus of mass number A is given by $1.25 \times 10^{-13} \times A^{1/3}$cm Radius of atom is one $\mathring{A}$. If the mass number is 64, then the fraction of the atomic volume that is occupied by the nucleus is

(A) 1.0×10^{-3} (B) 5.0×10^{-5}
(C) 2.5×10^{-2} (D) 1.25×10^{-13}

50. The energy of an electron in the first Bohr orbit of H atom is -13.6eV . The possible energy value(s) of the excited state(s) for electrons in Bohr orbits to hydrogen is(are)

(A) –3.4eV (B) –4.2eV
(C) –6.8eV (D) +6.8eV

51. The energy of the electron in the first orbit of He^+ is -871.6×10^{-20} J . The energy of the electron in the first orbit of hydrogen would be

(A) -871.6×10^{-20} J (B) -435.8×10^{-20} J
(C) -217.9×10^{-20} J (D) -108.9×10^{-20} J

52. The total number of valence electrons in 4.2 gm of N_3^- ion is (N_A is the Avogadro's number)

(A) 1.6 N_A (B) 3.2 N_A
(C) 2.1 N_A (D) 4.2 N_A

53. The Bohr orbit radius for the hydrogen atom (n = 1) is approximately 0.530Å . The radius for the first excited state (n = 2) orbit is

(A) 0.13Å (B) 1.06Å
(C) 4.77Å (D) 2.12Å

54. The frequency of a wave of light is $12 \times 10^{14} s^{-1}$. The wave number associated with this light is

(A) 5×10^{-7} m (B) $4 \times 10^{-8} cm^{-1}$
(C) $2 \times 10^{-7} m^{-1}$ (D) $4 \times 10^{4} cm^{-1}$

55. The series limit for Balmer series of H-spectra is

(A) 3800 (B) 4200
(C) 3646 (D) 4000

56. The ionization energy of hydrogen atom is -13.6 eV. The energy required to excite the electron in a hydrogen atom from the ground state to the first excited state is (Avogadro's constant = 6.022×10^{23})

(A) 1.69×10^{-20} J (B) 1.69×10^{-23} J
(C) 1.69×10^{23} J (D) 1.69×10^{25} J

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1.

Column I	Column II
(A) Cathode rays	(p) Helium nuclei
(B) Dumb-bell	(q) Uncertainty principle
(C) Alpha particles	(r) Electromagnetic radiation
(D) Moseley	(s) p-orbital
(E) Heisenberg	(t) Atomic number
(F) X-rays	(u) Electrons

2. Frequency = f, Time period = T, Energy of n^{th} orbit = E_n, radius of n^{th} orbit = r_n, Atomic number = Z, Orbit number = n

Column I	Column II
(A) f	(p) n^3
(B) T	(q) Z^2
(C) E_n	(r) $\frac{1}{n^2}$
(D) $\frac{1}{r_n}$	(s) Z

3.

Column I	Column II
(A) Lyman series	(p) maximum number of spectral line observed = 6
(B) Balmer series	(q) maximum number of spectral line observed = 2
(C) In a sample of H-atom for 5 upto 2 transition	(r) 2^{nd} line has wave number $\frac{8R}{9}$
(D) In a single isolated H-atom for 3 upto 1 transition	(s) 2^{nd} line has wave number $\frac{3R}{16}$
	(t) Total number of spectral line is 10.

4.

Column I	Column II
(A) Aufbau principle	(p) Line spectrum in visible region
(B) de broglie	(q) Maximum multiplicity of electron
(C) Angular momentum	(r) Photon
(D) Hund's rule	(s) $\lambda = h/(mv)$
(E) Balmer series	(t) Electronic configuration
(F) Planck's law	(u) mvr

Exercise # 3 PART - 2 ASSERTION & REASONING

Each question has 5 choices **(A)**, **(B)**, **(C)**, **(D)** and **(E)** out of which only one is correct.

(A) Assertion is true, Reason is true and Reason is correct explanation for Assertion.

(B) Assertion is true, Reason is true and Reason is not correct explanation for Assertion.

(C) Assertion is true, Reason is false.

(D) Assertion is false, Reason is true.

(E) Both Assertion and Reason are false.

1. **Assertion :** Specific charge of α-particle is twice to that of proton.
Reason : Specific charge is given by e/m.

2. **Assertion :** For n = 3, ℓ may be 0, 1 and 2 and 'm' may be 0, ± 1 and ± 2.
Reason : For each value of n, there are 0 to (n – 1) possible values of ℓ; for each value of ℓ, there are 0 to ± ℓ values of m.

3. **Assertion :** If the potential difference applied to an electron is made 4 times, the de Broglie wavelength associated is halved. Initial kinetic energy of electron was zero.
Reason : On making potential difference 4 times, velocity is doubled and hence λ is halved.

4. **Assertion :** Wave number of a spectral line for an electronic transition is quantised.
Reason : Wave number is directly proportional to the velocity of electron undergoing the transition.

5. **Assertion :** Humphry series discovered in H-atomic spectra has lowest energy radiations among all series.
Reason : Lowest state for this series is $n_1 = 6$.

6. **Assertion :** A photon of energy 12 eV can break three molecules of A_2 into atoms which has bond dissociation energy of 4 eV/molecule.
Reason : Total energy is conserved and interaction is always one to one between photon and molecule.

7. **Assertion :** Thomson's analysis of cathode ray experiment led him to conclude that electrons were fundamental particles.
Reason : e/m ratio for particles in cathode rays was found to be independent of the nature of the gas taken in the tube.

8. **Assertion :** e/m ratio in case of anode ray experiment is different for different gases.
Reason : The ion of gases formed after the ejection of electron are different if gas is different.

9. **Assertion :** Spin quantum number can have the value +1/2 or -1/2.
Reason : (+) sign here signifies the wave function.

10. **Assertion :** Total number of orbitals associated with principal quantum number n = 3 is 6.
Reason : Number of orbitals in a shell equals to 2n.

11. **Assertion :** Energy of the orbitals increases as
1s < 2s = 2p < 3s = 3p < 3d < 4s = 4p
= 4d = 4f < ......
Reason : Energy of the electron depends completely on principal quantum number.

12. **Assertion :** Splitting of the spectral lines in the presence of magnetic field is known as stark effect.
Reason : Line spectrum is simplest for hydrogen atom.

13. **Assertion :** Thomson's atomic model is known as 'raisin pudding' model.
Reason : The atom is visualized as a pudding of positive charge with electrons (raisins) embedded in it.

14. **Assertion :** Atomic orbital in an atom is designated by n, l, m and s .
Reason : These are helpful in designating electron present in an orbital.

15. **Assertion :** The transition of electrons $n_3 \rightarrow n_2$ in H atom will emit greater energy than $n_4 \rightarrow n_3$.
Reason : n_3 and n_2 are closer to nucleus tan n_4.

16. **Assertion :** Cathode rays are a stream of α-particles.
Reason : They are generated under high pressure and high voltage.

17. **Assertion :** In case of isoelectronic ions the ionic size increases with the increase in atomic number.
Reason : The greater the attraction of nucleus, greater is the ionic radius.

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. The frequency of radiation emitted when the electron falls from n = 4 to n = 1 in a hydrogen atom will be)Given ionisation energy of H = 2.18×10^{-18} J and h = 6.625×10^{-34} Js) **[CBSE AIPMT 2004]**

(A) $1.54 \times 10^{15}\ s^{-1}$ **(B)** $1.03 \times 10^{15}\ s^{-1}$
(C) $3.08 \times 10^{15}\ s^{-1}$ **(D)** $2.00 \times 10^{15}\ s^{-1}$

2. The energy of second Bohr orbit of the hydrogen atom is –328 kJ mol^{-1}, hence the energy of fourth Bohr orbit would be **[CBSE AIPMT 2005]**

(A) –41 kJ mol^{-1} **(B)** –1312 kJ mol^{-1}
(C) –164 kJ mol^{-1} **(D)** –82 kJ mol^{-1}

3. Given, the mass of electron is 9.11×10^{-31} kg, Planck's constatn is 6.626×10^{-34} Js, the uncertainty involved in the measurement of velocity within a distance of 0.1 Å is **[CBSE AIPMT 2006]**

(A) $5.79 \times 10^{6}\ ms^{-1}$ **(B)** $5.79 \times 10^{7}\ ms^{-1}$
(C) $5.79 \times 10^{8}\ ms^{-1}$ **(D)** $5.79 \times 10^{5}\ ms^{-1}$

4. The orientation of an atomic orbital is governed by **[CBSE AIPMT 2007]**

(A) azimuthal quantum number
(B) spin quantum number
(C) magnetic quantum number
(D) principal quantum number

5. Consider the following sets of quantum number.

	n	l	m	s
(i)	3	0	0	+1/2
(ii)	2	2	1	+1/2
(iii)	4	3	–2	–1/2
(iv)	1	0	–1	–1/2
(v)	3	2	3	+1/2

Which of the following sets of quantum number is not possible ? **[CBSE AIPMT 2007]**

(A) (ii), (iii) and (iv) **(B)** (i), (ii), (iii) and (iv)
(C) (ii), (iv) and (v) **(D)** (i) and (iii)

6. If uncertainty in position and momentum are equal, then uncertainty in velocity is **[CBSE AIPMT 2008]**

(A) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$ **(B)** $\sqrt{\frac{h}{2\pi}}$

(C) $\frac{1}{m}\sqrt{\frac{h}{\pi}}$ **(D)** $\sqrt{\frac{h}{\pi}}$

7. The measurement of the electrons position is associated with an uncertainty in momentum, which is equal to 1×10^{-18} gcm s^{-1}, The uncertainty in electron velocity is (mass of an electron is 9×10^{-28} g) **[CBSE AIPMT 2008]**

(A) 1×10^{9} cm s^{-1} **(B)** 1×10^{6} cm s^{-1}
(C) 1×10^{5} cm s^{-1} **(D)** 1×10^{11} cm s^{-1}

8. Maximum number of electrons in a subshell of an atom is determined by the following **[CBSE AIPMT 2009]**

(A) 4 / +2 **(B)** 2 / + 1
(C) 4 / – 2 **(D)** $2n^2$

9. The energy absorbed by each molecule (A_2) of a substance is 4.4×10^{-19} J and bond energy per molecule is 4.0×10^{-19} J. The kinetic energy of the molecule per atom will be **[CBSE AIPMT 2009]**

(A) 2.0×10^{-20} J **(B)** 2.2×10^{-19} J
(C) 2.0×10^{-19} J **(D)** 4.0×10^{-20} J

10. Which of the following is not permissible arrangement of electrons in an atom ? **[CBSE AIPMT 2009]**

(A) n = 4, l = 0, m = 0, s = – 1/2
(B) n = 5, l = 3, m = 0, s = + 1/2
(C) n = 3, l = 2, m = – 3, s = – 1/2
(D) n = 3, l = 2, m = – 2, s = – 1/2

11. If n = 6, the correct sequence for filling of electrons will be **[CBSE AIPMT 2011]**

(A) ns → (n – 1)d → (n – 2)f → np
(B) ns → (n – 2)f → np → (n – 1)d
(C) ns → np → (n – 1)d → (n – 2)f
(D) ns → (n – 2)f → (n – 1)d → np

12. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelenths, i.e. λ_1 and λ_2 will be **[CBSE AIPMT 2011]**

(A) $\lambda_1 = 2\lambda_2$ **(B)** $\lambda_1 = 4\lambda_2$

(C) $\lambda_1 = \frac{1}{2}\lambda_2$ **(D)** $\lambda_1 = \lambda_2$

13. The correct set of four quantum numbers for the valence electron of rubidium atom (at. no. = 37) is **[CBSE AIPMT 2012]**

(A) $5, 1, 1, +\frac{1}{2}$ **(B)** $6, 0, 0, +\frac{1}{2}$

(C) $5, 0, 0, +\frac{1}{2}$ **(D)** $5, 1, 0, +\frac{1}{2}$

14. Maximum number of electrons in a subshell with l = 3 and n = 4 is

(A) 14 **(B)** 16
(C) 10 **(D)** 12

15. What is the maximum numbers of electrons that can be associated with the folowing set of quantum number ?

n = 3, l = 1 and = – 1 **[NEET 2013]**

(A) 10 **(B)** 6
(C) 4 **(D)** 2

16. The value of Planck's constant is 6.63×10^{-34}Js. The speed of light is 3×10^{17} nm s^{-1}. Which value is closest to the wavelength in nanometer of a quantum of light with frequency of 6×10^{15} s^{-1} ? **[NEET 2013]**

(A) 10 **(B)** 25
(C) 50 **(D)** 75

17. Calculate the energy in joule corresponding to light of wavelenth 45 nm (Planck's constant, h = 6.63 × 10–34 Js; speed of light c = 3 × 108 ms^{-1}).

[CBSE AIPMT 2014]

(A) 6.67×10^{15} **(B)** 6.67×10^{11}
(C) 4.42×10^{-15} **(D)** 4.42×10^{-18}

18. What is the maximum number of orbitals that can be identified with the following quantum number?

n = 3, l = 1, and $m_l = 0$ **[CBSE AIPMT 2014]**

(A) 1 **(B)** 2
(C) 3 **(D)** 4

19. The angular momentum of electrons in d orbital is equal to

(A) $\sqrt{6}h$ **(B)** $\sqrt{2}h$
(C) $2\sqrt{3}h$ **(D)** 0 h

20. The number of d-electrons in Fe^{2+} (Z = 26) is not equal to the number of electrons in which one of the following? **[CBSE AIPMT 2015]**

(A) s-electrons in Mg (Z = 12)
(B) p-electrons in Cl (Z = 17)
(C) d-electrons in Fe (Z = 26)
(D) p-electrons in Ne (Z = 10)

21. Which is the correct order of increasing energy of the listed orbitals in the atom of titanium ?

[CBSE AIPMT 2015]

(A) 3s 4s 3p 3d **(B)** 4s 3s 3p 3d
(C) 3s sp 3d 4s **(D)** 3s sp 4s 3d

22. How many electrons can fit in the orbital for which n = 3 and l = 1? **[NEET 2016, Phase II]**

(A) 2 **(B)** 6
(C) 10 **(D)** 14

23. Two electrons occupying the same orbital are distinguished by **[NEET 2016, Phase I]**

(A) Magnetic quantum number
(B) Azimuthal quantum number
(C) Spin quantum number
(D) Principal quantum number

24. Which one is the wrong statement? **[NEET 2017]**

(A) de-Broglie's wavelength is given by

$$\lambda = \frac{h}{mv}, \text{ where}$$

m = mass of the particle,
v = group velocity of the particle

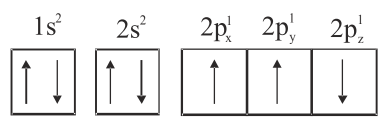
(B) The uncertainty principle is $\Delta E \times \Delta t \geq h / 4\pi$

(C) Half-filled and fully filled orbitals have greater stability due to greater exchange energy greater symmetry and more balanced arrangement

(D) The energy of 2s-orbital is less than the energy of 2p-orbital in case of hydrogen like atoms

25. Which one is a wrong statement ? **[NEET 2018]**

(A) The electronic configuration of N atom



(B) An orbital is designated by three quantum numbers while an electron in an atom is designated by four quantum numbers.

(C) Total orbital angular momentum of electron in 's' orbital is equal to zero.

(D) The value of m for d_z2 is zero.

26. Match the metal ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code: **[NEET 2018]**

Column I	Column II
a. Co^{3+}	i. $\sqrt{8}$ B.M.
b. Cr^{3+}	ii . $\sqrt{35}$ B.M
c. Fe^{3+}	iii. $\sqrt{3}$ B.M
d. Ni^{2+}	iv. $\sqrt{24}$ B.M
	v. $\sqrt{15}$ B.M

	a	b	c	d
(A)	iv	i	ii	iii
(B)	i	ii	iii	iv
(C)	iv	v	ii	i
(D)	iii	v	i	ii

Exercise # 4 PART - 2 PREVIOUS YEAR (AIIMS)

1. The quantum number m of a free gaseous atom is associated with
(A) the effective volume of the orbital
(B) the shape of the orbital
(C) the spatial orientation of the orbital
(D) the energy of the orbital in the absence of a magnetic field. [2003]

2. For principle quantum number n = 4, the total number of orbitals having $l = 3$ is
(A) 3 (B) 7
(C) 5 (D) 9 [2004]

3. The most probable radius (in pm) for finding the electron in He^+ is
(A) 0.0 (B) 52.9
(C) 26.5 (D) 105.8 [2005]

4. The isoelectronic pair is [2005]
(A) Cl_2O, ICl_2^- (B) ICl_2^-O, ClO_2
(C) IF_2^+, I_3^- (D) ClO_2^-, ClF_2^+

5. $^{238}_{92}U$ emits 8 α-particles and 6 β-particles.The neutron/proton ratio in the product nucleus is
(A) 60/41 (B) 61/40
(C) 62/41 (D) 61/42
[2005]

6. α-particles can be detected using
(A) thin aluminium sheet (B) barium sulphate
(C) zinc sulphide screen (D) gold foil
[2005, 2015]

7. The de Broglie wavelength associated with a ball of mass 1 kg having kinetic energy 0.5 J is
(A) 6.626×10^{-37} m (B) 13.20×10^{-34} m
(C) 10.38×10^{-21} m (D) 6.626×10^{-34} Å
[2006]

8. X-rays are emitted during
(A) α, n reaction (B) K-capture
(C) n, α reaction (D) β-emission
[2007]

9. Which of the following fadioisotopes is used as anticancerous ?
(A) Na-24 (B) C-14
(C) U-235 (D) Co-60
[2007]

10. Decay constant of a radioactive substance is 69.3 sec^{-1}, find $t_{1/16}$ of the same substance.
(A) 4×10^{-2} sec (B) 2×10^{-2} sec
(C) 1×10^{-2} sec (D) None of these
[2007]

11. In the ground state of Cu^+, the number of shells occupied, subshells occupied, filled orbitals and unpaired electrons respectively are
(A) 4, 8, 15, 0 (B) 3, 6, 15, 1
(C) 3, 6, 14, 0 (D) 4, 7, 14, 2
[2010]

12. Assume that you are travelling at a speed of 90 km/h in a small car with a mass of 1050 kg. If the uncertainty in the velocity of the car is 1% (Δv = 0.9 kmk/h), what is the uncertainty (in meters) in the position of the car ?
(A) $\Delta x \geq 1 \times 10^{-35}$ m (B) $\Delta x \geq 2 \times 10^{-37}$ m
(C) $\Delta x \geq 2 \times 10^{-36}$ m (D) $\Delta x \geq 4 \times 10^{-38}$ m
[2010]

13. Smallest wavelength occurs for
(A) Lyman series (B) Balmer series
(C) Paschen series (D) Brackett series
[2011]

14. Which of the following is wrong for Bohr model ?
(A) It establishes stability of atom.
(B) It is inconsistent with Heisenberg uncertainty principle.
(C) It explains the concept of spectral lines for hydrogen like species.
(D) Electrons behave as particle and wave
[2011]

15. Threshold frequency of a metal is 5×10^{13} s^{-1} upon which 1×10^{14} s^{-1} frequency light is focused. Then the maximum kinetic energy of emitted electron is

(A) 3.3×10^{-21} **(B)** 3.3×10^{-20}
(C) 6.6×10^{-21} **(D)** 6.6×10^{-20}

[2012]

16. In Bohr's orbit, $\frac{nh}{2\pi}$ indicates

(A) momentum **(B)** kinetic energy
(C) potential energy **(D)** angular momentum

[2012]

17. A particle is moving 3 times faster than the speed of electron. If the ratio of wavelength of particle and electron is 1.8×10^{-4}, then particle is

(A) neutron **(B)** α-particle
(C) deuteron **(D)** tritium

[2013]

18. Which of the following pairs represents isotones ?

(A) ${}^{77}_{33}As, {}^{78}_{34}Se$ **(B)** ${}^{195}_{78}pt, {}^{190}_{76}Os$
(C) ${}^{108}_{47}Ag, {}^{112}_{48}Cd$ **(D)** ${}^{178}_{72}Hf, {}^{137}_{56}Ba$

[2014]

19. Which of the following arrangements is possible ?

	n	l	m	s
(A)	5	2	2	$+\frac{1}{2}$
(B)	2	2	0	$-\frac{1}{2}$
(C)	3	–2	1	$+\frac{1}{2}$
(D)	0	0	1	$+\frac{1}{2}$

[2015]

20. According to Bohr's thery, which of the following correctly represents the variation of energy and radius of an electron in n^{th} orbit of H-atom?

(A) $E_n \propto \frac{1}{n^2}, r \propto \frac{1}{n^2}$ **(B)** $E_n \propto \frac{1}{n^2}, r \propto n^2$

(C) $E_n \propto n^2, r \propto n^2$ **(D)** $E_n \propto n, r \propto \frac{1}{n}$

[2016]

21. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter-orbit jumps of the electron for Bohr orbits in an atom of hydrogen **[2017]**

(A) $5 \rightarrow 2$ **(B)** $4 \rightarrow 1$
(C) $2 \rightarrow 5$ **(D)** $3 \rightarrow 2$

22. Wave length of particular transition for H atom is 400 nm. What can be wavelength of He^+ for same transition : **[2018]**

(A) 400 nm **(B)** 100 nm
(C) 1600 nm **(D)** 200 nm

ASSERTION AND REASON

In each of the following questions, two statement are given one is assertion and the other is reason. Examine the statement carefully and mark the correct answer according to the instruction given below

(A) If both the assertion and reason are true and reason explains the assertion
(B) If both the assertion and reason are true but reason does not explain the assertion
(C) If assertion is true but reason is false
(D) If assertion is false but reason in true
(E) Both assertion & reason are false

23. **Assertion :** ${}^{22}_{11}Na$ emits a positron given ${}^{22}_{12}Mg$.

Reason : In β^+ emission, neutron is transformed into proton. **[2003]**

24. **Assertion :** The free gaseous Cr atom has six unpaired electrons.

Reason : Half - filled s orbital has greater stability.

[2004]

25. **Assertion :** Nuclear binding energy per nucleon is in the order - ${}^{9}_{4}Be > {}^{7}_{3}Li > {}^{4}_{2}He$.

Reason : Binding energy per nucleon increases linearly with difference in number of neutrons and protons. **[2004]**

26. **Assertion :** The position of an element in periodic table after emission of one α and two β-particles remains unchanged.

Reason : Emission of one α and two β-particles give isotope of the element which acquires same position in periodic table. **[2007, 2010]**

27. **Assertion :** The quantized energy of an electron is largely determined by its principal quantum number.

Reason : The principal quantum number, n is a measure of the most probable distance of finding the electron around the nucleus. **[2008]**

28. **Assertion :** The nuclear isomers are the atoms with the same atomic number and same mass number, but with different radioactive properties.

Reason : The nucleus in the excited state will evidently have a different half-life as compared to that in the ground state. **[2010]**

29. **Assertion :** Bohr model fails in case of multielectron species.

Reason : It does not mention electron-electron interactions. **[2012]**

30. **Assertion :** The spectrum of He^+ is expected to be similar to that of hydrogen.

Reason : He^+ is also one electron system.

[2012]

31. **Assertion :** Number of radial and angular nodes for 3p-orbital are 1, 1 respectively.

Reason : Number of radial and angular nodes depends only on principal quantum number.

[2013]

32. **Assertion :** For Balmer series of hydrogen spectrum, the value $n_1 = 2$ and $n_2 = 3, 4, 5....$.

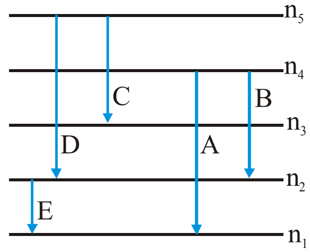
Reason : The value of n_2 for a line in Balmer series of hydrogen spectrum having the highest wavelength is 6. **[2015]**

33. **Assertion :** The radius of the first orbit of hydrogen atom is 0.529Å. **[2017]**

Reason : Radius of each circular orbit (r_n) - 0.529Å (n^2/Z), where n = 1, 2, 3 and Z = atomic number.

MOCK TEST

1. For a hypothetical H like atom which follows Bohr's model, some spectral lines were observed as shown. If it is known that line 'E' belongs to the visible region, then the lies possibly belonging to ultra violet region will be (n_1 is not necessarily ground state)
[Assume for this atom, no spectral series shows overlaps with other series in the emmission spectrum]



(A) B and D **(B)** D only **(C)** C only **(D)** A only

2. The number of photons emitted in 10 hours by a 60 W sodium lamp (λ of photon = 6000 Å)
(A) 6.50×10^{24} **(B)** 6.40×10^{23} **(C)** 8.40×10^{23} **(D)** 3.40×10^{23}

3. Ratio of frequency of revolution of electron in the 2nd excited state of He^+ and 2nd state of hydrogen is.

(A) $\frac{32}{27}$ **(B)** $\frac{27}{32}$ **(C)** 1/54 **(D)** 27/2

4. A proton accelerated from rest through a potential difference of 'V' volts has a wavelength λ associated with it. An alpha particle in order to have the same wavelength must be accelerated from rest through a potential difference of

(A) V volt **(B)** 4V volt **(C)** 2V volt **(D)** $\frac{V}{8}$ volt

5. If the wave number of 1st line of Balmer series of H-atom is 'x' then the wave number of 1st line of lyman series of the He^+ ion will be

(A) $\frac{36x}{5}$ **(B)** $\frac{12x}{5}$ **(C)** $\frac{108x}{5}$ **(D)** x

6. Consider the ground state of Cr atom (Z = 24). The number of electrons with the azimuthal quantum numbers, λ = 1 and 2 are, respectively :
(A) 16 and 5 **(B)** 12 and 5 **(C)** 16 and 4 **(D)** 12 and 4

7. 4000 Å photon is used to break the iodine molecule, then the % of energy converted to the K.E. of iodine atoms if bond dissociation energy of I_2 molecule is 246.5 kJ/mol
(A) 8% **(B)** 12% **(C)** 17% **(D)** 25%

8. Radius of 3rd orbnit of Li^{2+} ion is 'x' cm then de-broglie wavelength of electrons in the 1st orbit is

(A) $\frac{2\pi x}{3}$ cm **(B)** $6\pi x$ cm **(C)** $3\pi x$ cm **(D)** $\frac{2\pi x}{6}$ cm

9. When an electron makes a transition from (n + 1) state to n state, the frequency of emitted radiation is related to n according to (n > > 1)
(A) $\nu \propto n^{-3}$ **(B)** $\nu \propto \nu n^2$ **(C)** $\nu \propto n^3$ **(D)** $\nu \propto n^{2/3}$

10. If uncertainty in momentum is twice the uncertainty in position of an electron then uncertainty in velocity is :

$[\hbar = \frac{h}{2\pi}]$

(A) $\frac{1}{2m}\sqrt{\hbar}$ **(B)** $\frac{h}{4\pi m}$ **(C)** $\frac{1}{4m}\sqrt{h}$ **(D)** $\frac{1}{m}\sqrt{\hbar}$

11. The energy required to dislodge electron from excited isolated H-atom, $IE_1 = 13.6\ eV$ is

(A) $=13.6\,eV$ **(B)** $>13.6\,eV$ **(C)** <13.6 and $>3.4\,eV$ **(D)** $\leq 3.4\,eV$

12. The number of nodal planes in a p_x is

(A) One **(B)** Two **(C)** Three **(D)** Zero

13. The third line in Balmer series corresponds to an electronic transition between which Bohr's orbits in hydrogen

(A) $5 \rightarrow 3$ **(B)** $5 \rightarrow 2$ **(C)** $4 \rightarrow 3$ **(D)** $4 \rightarrow 2$

14. Which of the following has maximum number of unpaired electron (atomic number of Fe 26)

(A) Fe **(B)** Fe (II) **(C)** Fe (III) **(D)** Fe (IV)

15. The frequency of one of the lines in Paschen series of hydrogen atom is 2.340×10^{11} Hz. The quantum number n_2 which produces this transition is

(A) 6 **(B)** 5 **(C)** 4 **(D)** 3

16. Which of the following electron transition in a hydrogen atom will require the largest amount of energy

(A) From n = 1 to n =2 **(B)** From n = 2 to n = 3 **(C)** From $n = \infty$ to n = 1 **(D)** From n = 3 to n = 5

17. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter-orbit jumps of the electron for Bohr orbits in an atom of hydrogen

(A) $3 \rightarrow 2$ **(B)** $5 \rightarrow 2$ **(C)** $4 \rightarrow 1$ **(D)** $2 \rightarrow 5$

18. The value of Planck's constant is 6.63×10^{-34} Js. The velocity of light is $3.0 \times 10^{8}\ ms^{-1}$. Which value is closest to the wavelength in nanometres of a quantum of light with frequency of $8 \times 10^{15} s^{-1}$

(A) 3×10^{7} **(B)** 2×10^{-25} **(C)** 5×10^{-18} **(D)** 4×10^{1}

19. As electron moves away from the nucleus, its potential energy

(A) Increases **(B)** Decreases **(C)** Remains constant **(D)** None of these

20. If n and ℓ are respectively the principal and azimuthal quantum numbers, then the expression for calculating the total number of electrons in any orbit is -

(A) $\sum_{\ell=1}^{\ell=n} 2(2\ell+1)$ **(B)** $\sum_{\ell=1}^{\ell=n-1} 2(2\ell+1)$ **(C)** $\sum_{\ell=0}^{\ell=n+1} 2(2\ell+1)$ **(D)** $\sum_{\ell=0}^{\ell=n-1} 2(2\ell+1)$

21. Uncertainty in position is twice the uncertainty in momentum. Uncertainty in velocity is :

(A) $\sqrt{\frac{h}{\pi}}$ **(B)** $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$ **(C)** $\frac{1}{2m}\sqrt{\hbar}$ **(D)** $\frac{h}{4\pi}$

22. For which orbital angular probability distribution is maximum at an angle of 45° to the axial direction-

(A) $d_{x^2-y^2}$ **(B)** d_{z^2} **(C)** d_{xy} **(D)** P_x

23. The wave number of electromagnetic radiation emitted during the transition of electron in between two levels of Li^{2+} ion having sum of the principal quantum numbers 4 and difference is 2, will be : (R_H = Rydberg constant)

(A) 3.5 R_H **(B)** 4 R_H **(C)** 8 R_H **(D)** $\frac{8}{9} R_H$

24. Consider an electron in the n^{th} orbit of a hydrogen atom in the Bohr model. The circumference of the orbit can be expressed in terms of the de Broglie wavelength λ of the electron as :

(A) $(0.529)\, n\lambda$ **(B)** $\sqrt{n}\,\lambda$ **(C)** $(13.6)\,\lambda$ **(D)** $n\lambda$

MATRIX-MATCH TYPE

25. Match the following :
P_n = potential energy, E_n = total energy
f = frequency, Z = atomic number
V_n = velocity in n^{th} orbit
T_n = time period in n^{th} orbit

Column - I	Column - II
(A) $E_n \,\alpha\, r^y$, y = ?	**(p)** 1/2
(B) E_n / P_n	**(q)** 1
(C) $\frac{1}{f_n^{-x}}\, \alpha, z\ \ x = ?$	**(r)** 2
(D) $(V_n \times T_n)^t \,\alpha\, r_n$, t = ?	**(s)** – 1

26. Match the following :

List - I	List - II
(A) n = 6 $\rightarrow$ n = 3 (In H-atom)	**(p)** 10 lines in the spectrum
(B) n = 7 $\rightarrow$ n = 3 (In H-atom)	**(q)** Spectral lines in visible region
(C) n = 5 $\rightarrow$ n = 2 (In H-atom)	**(r)** 6 lines in the spectrum
(D) n = 6 $\rightarrow$ n = 2 (In H-atom)	**(s)** Spectral lines in infrared region

ASSERTION AND REASON TYPE

Each question has 5 choices **(A)**, **(B)**, **(C)**, **(D)** and **(E)** out of which only one is correct.
(A) Assertion is true, Reason is true and Reason is correct explanation for Assertion.
(B) Assertion is true, Reason is true and Reason is not correct explanation for Assertion.
(C) Assertion is true, Reason is false.
(D) Assertion is false, Reason is true.
(E) Both Assertion and Reason are false.

27. **Assertion :** The position of an electron can be determined exactly with the help of an electron microscope.
Reason : The product of uncertainty in the measurement of its momentum and the uncertainty in the measurement of the position cannot be less than a finite limit.

28. **Assertion :** A spectral line will be seen for a $2p_x - 2p_y$ transition.
Reason : Energy is released in the form of wave of light when the electron drops from $2p_x - 2p_y$ orbital.

29. **Assertion :** The cation energy of an electron is largely determined by its principal quantum number.
Reason : The principal quantum number n is a measure of the most probable distance of finding the electron around the nucleus.

30. **Assertion :** Nuclide $^{30}Al_{13}$ is less stable than $^{40}Ca_{20}$
Reason : Nuclides having odd number of protons and neutrons are generally unstable

ANSWER KEY

EXERCISE - 1

1. D	**2.** A	**3.** C	**4.** C	**5.** B	**6.** B	**7.** A	**8.** B	**9.** B	**10.** A	**11.** A	**12.** C	**13.** B
14. C	**15.** B	**16.** B	**17.** C	**18.** B	**19.** C	**20.** C	**21.** C	**22.** A	**23.** B	**24.** B	**25.** D	**26.** B
27. C	**28.** B	**29.** C	**30.** A	**31.** B	**32.** A	**33.** D	**34.** B	**35.** B	**36.** C	**37.** A	**38.** C	**39.** A
40. D	**41.** C	**42.** A	**43.** A	**44.** B	**45.** C	**46.** C	**47.** A	**48.** B	**49.** D	**50.** C	**51.** C	**52.** C
53. A	**54.** A	**55.** A	**56.** C	**57.** C	**58.** A	**59.** A	**60.** D					

EXERCISE - 2

1. D	**2.** C	**3.** D	**4.** C	**5.** A	**6.** B	**7.** B	**8.** A	**9.** A	**10.** C	**11.** D	**12.** B	**13.** C
14. C	**15.** D	**16.** B	**17.** A	**18.** D	**19.** D	**20.** A	**21.** C	**22.** C	**23.** B	**24.** D	**25.** C	**26.** A
27. C	**28.** C	**29.** B	**30.** D	**31.** B	**32.** A	**33.** D	**34.** A	**35.** B	**36.** A	**37.** B	**38.** D	**39.** C
40. C	**51.** A	**42.** A	**43** D	**44.** D	**45.** A	**46.** D	**47.** C	**48.** B	**49.** D	**50.** A	**51.** C	**52.** A
53. D	**54.** D	**55.** C	**56.** B									

EXERCISE - 3 : PART - 1

1. A → (u), B → (s), C → (p), D → (t), E → (q), F → (r)

2. A → (q), B → (p), C → (q, r), D → (r, s)

3. A → (r), B → (s), C → (p), D → (q)

4. A → (t), B → (s), C → (u), D → (q), E → (p), F → (r)

PART - II

1. D	**2.** A	**3.** A	**4.** C	**5.** A	**6.** D	**7.** A	**8.** A	**9.** C	**10.** E	**11.** C	**12.** D	**13.** A
14. D	**15.** B	**16.** E	**17.** E									

EXERCISE - 4 : PART - 1

1. C	**2.** D	**3.** A	**4.** C	**5.** D	**6.** A	**7.** A	**8.** A	**9.** A	**10.** C	**11.** D	**12.** A	**13.** C
14. A	**15.** D	**16.** C	**17.** D	**18.** A	**19.** A	**20.** B	**21.** C	**22.** A	**23.** C	**24.** D	**25.** A	**26.** C

PART - 2

1. C	**2.** B	**3.** C	**4.** D	**5.** C	**6.** C	**7.** A	**8.** B	**9.** D	**10.** A	**11.** C	**12.** B	**13.** A
14. D	**15.** B	**16.** D	**17.** A	**18.** A	**19.** A	**20.** B	**21.** A	**22.** B	**23.** D	**24.** C	**25.** D	**26.** A
27. A	**28.** A	**29.** B	**30.** A	**31.** C	**32.** C	**33.** A						

MOCK TEST

1. D	**2.** A	**3.** A	**4.** D	**5.** C	**6.** B	**7.** C	**8.** A	**9.** A	**10.** D	**11.** D	**12.** A	**13.** B
14. C	**15.** B	**16.** A	**17.** A	**18.** D	**19.** A	**20.** D	**21.** C	**22.** C	**23.** C	**24.** D		

25. A → (s), B → (p), C → (p), D → (q)

26. A → (r, s), B → (p, s), C → (q, r), D → p, q)

27. E **28.** E **29.** A **30.** A