# Solved Example

**Ex.1** The mass charge ratio for $A^+$ ion is $1.97 \times 10^{-7}$ kg $C^{-1}$. Calculate the mass of A atom.

**Sol.** Given $\frac{m}{e} = 1.97 \times 10^{-7}$

(since $e = 1.602 \times 10^{-19}$ C) $\therefore m = 1.97 \times 10^{-7} \times 1.602 \times 10^{-19}$ kg

**$m = 3.16 \times 10^{-26}$ kg**

**Ex.2** Write down the numerical value of h and its unit

**Sol.** $h = 6.625 \times 10^{-27}$ erg sec $= 6.625 \times 10^{-34}$ joule sec

The unit of h = joule sec. or erg sec. $\left(\because h\nu = E \quad \therefore h = \frac{E}{\nu} = \frac{erg}{sec^{-1}}\right)$

**Ex.3** AIR service on Vividh Bharati is transmitted on 219 m band. What is its transmission frequency in Hertz ?

**Sol.** Given $\lambda = 219$ m Thus, $\nu = \frac{c}{\lambda}$

or $\nu = \frac{3.0 \times 10^8}{219} =$ **$1.37 \times 10^6$ Hz**

**Ex.4** The ionization energy of $He^+$ is $19.6 \times 10^{-18}$ J $atom^{-1}$. The energy of the first stationary state of $Li^{+2}$ will be :

[1] $84.2 \times 10^{-18}$ J/atom [2] $44.10 \times 10^{-18}$ J/atom [3] $63.2 \times 10^{-18}$ J/atom [4] $21.2 \times 10^{-18}$ J/atom

**Ans. [2]**

**Sol.** $E_1$ for $Li^{+2} = E_1$ for $H \times Z^2 = E_1$ for $H \times 9$

$E_1$ for $He^+ = E_1$ for $H \times Z^2_{He} = E_1$ for $H \times 4$

or $E_1$ for $Li^{+2} = \frac{9}{4}$ $E_1$ for $He^+ = 19.6 \times 10^{-18} \times \frac{9}{4}$ **$= 44.10 \times 10^{-18}$ J/atom**

**Ex.5** Atomic radius is of the order of $10^{-8}$ cm and nuclear radius is of the order of $10^{-13}$ cm. Calculate what fraction of atom is occupied by nucleus ?

**Sol.** Volume of nucleus $= \frac{4}{3}\pi r^3 = \frac{4}{3}\pi (10^{-13})^3$ cm$^3$

Volume of atom $= \frac{4}{3}\pi (10^{-8})^3$ cm$^3$

$$\frac{V_N}{V_{Atom}} = \frac{10^{-39}}{10^{-24}} = 10^{-15}$$

$V_{Nucleus} =$ **$10^{-15} \times V_{Atom}$**

**Ex.6** Which of the following set of quantum numbers are not permitted

(a) n = 3, *l* = 2, m = – 2, s = +1/2 (b) n = 3, *l* = 2, m = – 1, s = 0

(c) n = 2, *l* = 2, m = +1, s = – 1/2 (d) n = 2, *l* = 2, m = +1, s = – 1/2

**Sol.** (a) This set of quantum number is permitted.

(b) This set of quantum number is not permitted as value of 's' cannot be zero.

(c) This set of quantum number is not permitted as the value of '$l$' cannot be equal to 'n'.

(d) This set of quantum number is not permitted as the value of 'm' cannot be greater than '$l$'.

**Ex.7** Prove that $u_n = \sqrt{\left(\frac{Ze^2}{mr_n}\right)}$ where u is velocity of electron in a one electron atom of at. no. Z at a distance $r_n$ from the nucleus, m and e are mass and charge of electron.

**Sol.** Kinetic energy of electron = $\frac{1}{2}mu^2$

Also from Bohr's concept K.E. = $\frac{1}{2}\frac{Ze^2}{r_n}$ $\quad\therefore\ \frac{1}{2}mu^2 = \frac{1}{2}\frac{Ze^2}{r_n}$

$$v = \sqrt{\left(\frac{Ze^2}{mr_n}\right)}$$

**Ex.8** Calculate the number of proton emitted in 10 hours by a 60 W sodium lamp ($\lambda$ or photon = 5893 Å)

**Sol.** Energy emitted by sodium lamp in one sec.

= Watt × sec = 60 × 1 J

Energy of photon emitted = $\frac{hc}{\lambda}$

$$= \frac{6.626\times10^{-34}\times3\times10^{8}}{5893\times10^{-10}} = 3.37\times10^{-19}\ \text{J}$$

$\therefore$ No of photons emitted per sec. = $\frac{60}{3.37\times10^{-19}}$

$\therefore$ No. of photons emitted in 10 hours = $17.8\times10^{19}\times10\times60\times60$ = **$6.41\times10^{24}$**

**Ex.9** Find out the energy of H atom in first excitation state.The value of permittivity factor $4\pi\varepsilon_0 = 1.11264\times10^{-10}\ C^2N^{-1}m^{-2}$.

**Sol.** In M.K.S. system

$$E_n = -\frac{2\pi^2Z^2me^2}{(4\pi\varepsilon_0)^2n^2h^2} = \frac{2\times(3.14)^2\times(1)^2\times9.108\times10^{-31}\times(1.602\times10^{-19})^4}{(1.11264\times10^{-10})^2\times(2)^2\times(6.625\times10^{-34})^2} = \mathbf{5.443\times10^{-19}\ joule}$$

**Ex.10** The shortest wave length in H spectrum of Lymen series when $R_H = 109678\ cm^{-1}$ is

[1] 1002.7 Å [2] 1215.67 Å [3] 1127.30 Å [4] 911.7 Å

**Ans. [4]**

**Sol.** For Lymen series $n_1 = 1$

For shortest 'l' or Lymen series the energy difference in two levels showing transition should be maximum

(i.e. $n_2 = \infty$) $\quad \frac{1}{\lambda} = R_H \left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$

$= 109678 \qquad = 911.7 \times 10^{-8} \qquad = \mathbf{911.7\ Å}$

**Ex.11** Electromagnetic radiations of wavelength 242 nm is just sufficient to ionise sodium atom. Calculate the ionisation energy of sodium in kJ $mol^{-1}$.

**Sol.** Energy associated with a photon of 242 nm $= \frac{6.625\times10^{-34}\times3.0\times10^{8}}{242\times10^{-9}} = 8.21 \times 10^{-19}$ joule

$\because$ 1 atom of Na for ionisation requires $= 8.21 \times 10^{-19}$ J

$\therefore$ $6.023 \times 10^{23}$ atoms of Na for ionisation requires

$= 8.21 \times 10^{-19} \times 6.023 \times 10^{23}$

$= 49.45 \times 10^4$ J = **494.5 kJ $mol^{-1}$**

**Ex.12** How many electrons in a given atom can have the following quantum numbers

(a) n = 4, *l* = 2, m = 0 (b) n = 3

(c) n = 2, *l* = 1, m = – 1, s = + 1/2 (d) n = 4, *l* = 1

**Sol.** (a) *l* = 2 means d-subshell and m = 0 refer to $dz^2$ orbital

$\therefore$ Number of electrons are **2**.

(b) For n = 3, *l* = 0, 1, 2

| | | |
|---|---|---|
| *l* = 0 | m = 0 | 2 electrons |
| *l* = 1 | m = –1 | 6 electrons |
| *l* = 2 | m = –2, –1, 0, +1, +2 | 10 electrons |
| | Total electrons | 18 electrons |

Alternatively, number of electrons for any energy level is given by

$2n^2$ i.e. $2 \times 3^2 = 18$ electrons

(c) *l* = 1 refers to p-subshell, m = – 1 refers to $p_x$ or $p_y$ orbital whereas, s = + 1/2 indicate for only 1 electron.

(d) *l* = 1 refers to p-subshell which has three orbitals ($p_x$, $p_y$ and $p_z$) each having two electrons. Therefore , total number of electrons are **6**.

**Ex.13** Calculate the longest wavelength which can remove the electron from I Bohr's orbit. Given $E_1 = 13.6$ eV.

**Sol.** The photon capable of removing electron from I Bohr's orbit must possess energy

$= 13.6$ eV

$= 13.6 \times 1.602 \times 10^{-19}$ J $= 21.787 \times 10^{-19}$ J

$\because$ $E = \frac{hc}{\lambda}$ ; $21.787 \times 10^{-19} = \frac{6.625\times10^{-34}\times3.0\times10^{8}}{\lambda}$

$\therefore$ $\lambda = 912.24 \times 10^{-10}$ m **= 912.24 Å**

**Ex.14** Naturally occurring boron consists of two isotopes whose atomic weights are 10.01 and 11.01. The atomic weight of natural boron is 10.81. Calculate the percentage of each isotope in natural boron

**Sol.** Let the percentage of isotope with atomic wt. 10.01 = x

$\therefore$ Percentage of isotope with atomic wt. 11.01 = 100 – x

Average atomic wt. = $\frac{m_1x_1 + m_2X_2}{x_1 + x_2}$

or Average atomic wt. = $\frac{x \times 10.01 + (100 - x) \times 11.01}{100}$

$10.81 = \frac{x \times 10.01 + (100 - x) \times 11.01}{100} = 20$

$\therefore$ % of isotope with atomic wt. 10.01 = **20**

% of isotope with atomic wt. 11.01 = 100 – x = **80**

**Ex.15** What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition n = 4 to n = 2 of $He^+$ spectrum ?

**Sol.** For $He^+$, $\frac{1}{\lambda} = R_H Z^2 \left[\frac{1}{2^2} - \frac{1}{4^2}\right]$

For H, $\frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

Since $\lambda$ is same

$\therefore$ $Z^2 \left[\frac{1}{2^2} - \frac{1}{4^2}\right] = \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\because$ Z = 2

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

$\therefore$ $n_1 = \mathbf{1}$ and $n_2 = \mathbf{2}$

**Ex.16** The ionization energy of H-atom is 13.6 eV. The ionization energy of $Li^{+2}$ ion will be

[1] 54.4 eV [2] 122.4 eV [3] 13.6 eV [4] 27.2 eV **Ans. [2]**

**Sol.** $E_1$ for $Li^{+2}$ $= E_1$ for H $\times Z^2$ [for Li, Z = 3]

$= 13.6 \times 9$

$=$ **122.4 eV**

**Ex.17** Calculate momentum of radiations of wavelength 0.33 nm.

**Sol.** We have $\lambda = \frac{h}{mu}$ $\therefore$ $mu = \frac{h}{\lambda}$

$= \frac{6.625 \times 10^{-34}}{0.33 \times 10^{-9}} = 2.01 \times 10^{-24}$ kgmsec$^{-1}$

**Ex.18** On the basis of Heisenberg's uncertainty principle, show that the electron cannot exist within the nucleus.

**Sol.** Radius of the nucleus is of the order of $10^{-13}$ cm and thus uncertainty in position of electron, i.e., ($\Delta x$), if it is within the nucleus will be $10^{-13}$ cm.

Now $\Delta x.\Delta u \geq \frac{h}{4\pi m}$

$\therefore$ $\Delta u = \frac{6.626\times10^{-27}}{4\times3.14\times9.108\times10^{-28}\times10^{-13}}$

$= 5.79 \times 10^{12}$ cm/sec

i.e., order of velocity of electron will be 100 times greater than the velocity of light which is impossible. Thus, possibility of electron to exist is nucleus is zero.

**Ex.19** Oxygen consists of isotopes of $O^{16}$, $O^{17}$ and $O^{18}$ and carbon consists of isotopes of $C^{12}$ and $C^{13}$. How many types of $CO_2$ molecule can be formed ? Also report their mol, wt.

**Sol.** Total no. of molecules of $CO_2$ = 12

[1] $C^{12}O^{16}O^{16}$ Mol. wt. = 44

[2] $C^{12}O^{17}O^{17}$ = 46

[3] $C^{12}O^{18}O^{18}$ = 48

[4] $C^{12}O^{16}O^{17}$ = 45

[5] $C^{12}O^{16}O^{18}$ = 46

[6] $C^{12}O^{17}O^{18}$ = 47

Similarly six molecules with $C^{13}$ isotopes.

**Ex.20** The atomic masses of two isotopes of O are 15.9936 and 17.0036. Calculate in each atom

[1] No. of neutrons [2] No. of protons [3] No. of electrons [4] Mass no.

**Ans. [1]**

**Sol.**

| | **I** isotope of O | **II** isotope of O |
|---|---|---|
| Atomic masses are | 15.9936 | 17.0036 |
| $\therefore$ Mass no. are | **16** | **17** (Integer values) |
| $\therefore$ No of neutrons | = 16 – 8 = **8** | 17 – 8 = **9** |
| and no. of electrons | **= 8** | **= 8** |

Mass no. – At no. = No. of neutrons

# Exercise # 1

**Q.1** An atom of an element contains the number of electrons equal to :

[1] Atomic mass [2] Atomic number [3] Equivalent weight [4] Electron affinity

**Q.2** If a neutral atom changes to cation its :

[1] atomic size decreases [2] atomic number decreases

[3] atomic size increase [4] atomic number increases

**Q.3** The K.E. of an electron in first Bohr's orbit of H-atom is 13.6 eV. Total energy of first orbit is :

[1] $-\frac{1}{2} \times 13.6$ eV [2] – 13.6 eV [3] $2 \times 13.6$ eV [4] $\frac{1}{2} \times 13.6$ eV

**Q.4** Which of the following radioactive isotope of carbon is used for the calculate of life period of a planet ?

[1] ${}^{12}_{6}C$ [2] ${}^{13}_{6}C$ [3] ${}^{14}_{6}C$ [4] ${}^{16}_{6}C$

**Q.5** The shape of p-orbital is :

[1] Elliptical [2] spherical [3] dumb-bell [4] None of these

**Q.6** ${}_{6}C^{11}$ and ${}_{5}B^{11}$ are called :

[1] Nuclear isomers [2] Isobars [3] Isotopes [4] Fission products

**Q.7** No two electrons of an atom can have same :

[1] principle quantum number [2] azimuthal quantum number

[3] set of four quantum numbers [4] magnetic quantum number

**Q.8** Correct set of four quantum numbers for the valence (outermost) electron of rubidium (Z = 37) is :

[1] 5, 0, 0 + 1/2 [2] 5, 1, 0, + 1/2 [3] 5, 1, 1, + 1/2 [4] 6, 0, 0, + 1/2

**Q.9** Which of the following formula represents the K.E. of an electron in $n^{th}$ Bohr's orbit of H-atom ?

[1] $\frac{Rhc}{n^2}$ [2] $-\frac{Rhc}{n^2}$ [3] $-\frac{2Rhc}{n^2}$ [4] $\frac{2Rhc}{n^2}$

**Q.10** The number of electrons arranged in an orbital is :

[1] One [2] Two [3] Three [4] Four

**Q.11** The frequency of a radiobulletin is 600 kilocycles. What is the wavelength of the signal ?

[1] 100 m [2] 250 m [3] 500 m [4] 600 m

**Q.12** The energy of electron in excited H-atom is – 3.4 eV. What is the angular momentum of electron ?

[1] $\frac{h}{\pi}$ [2] $\frac{h}{2\pi}$ [3] $\frac{2h}{\pi}$ [4] $\frac{3h}{\pi}$

**Q.13** What is the frequency of the electron in an orbit of radius r, if its velocity is v ?

[1] $\frac{2\pi r}{v}$ [2] $2\pi rv$ [3] $\frac{vr}{2\pi}$ [4] $\frac{v}{2\pi r}$

**Q.14** How many spectral lines will be obtained by the various transitions when an electron comes from excited state n = 5 to its original state ?

[1] 20 [2] 5 [3] 4 [4] 10

**Q.15** Principal, azimuthal and magnetic quantum numbers are respectively related to :

[1] size, shape and orientation [2] shape, size and orientation

[3] size, orientation and shape [4] None of these

**Q.16** Bohr's model of the atom can explain :

[1] The spectrum of H-atom only

[2] The spectrum of hydrogen molecule

[3] The spectrum of atom or ion containing one electron only

[4] The solar spectrum

**Q.17** The electromagnetic radiation with highest wavelength is :

[1] Ultraviolet [2] Radio waves [3] X-rays [4] Infra red

**Q.18** The angular momentum of electron in Bohr's orbit is J. What will be the K.E. of that Bohr's orbit ?

[1] $\frac{1}{2}\frac{Jv}{r}$ [2] $\frac{Jv}{r}$ [3] $\frac{J^2}{2m}$ [4] $\frac{J^2}{2\pi}$

**Q.19** The electronic configuration of $H^-$ is :

[1] $1s^0$ [2] $1s^1$ [3] $1s^2$ [4] $1s^1\,2s^1$

**Q.20** The wavelength of first line of Balmer series of H-atom is – (R = Rydberg's constant)

[1] $\frac{36}{5R}$ [2] $\frac{36R}{5}$ [3] $\frac{5R}{36}$ [4] $\frac{5}{36R}$

**Q.21** The excitation energy of an electron from second orbit to third orbit of an atom with + Ze nuclear charge is 47.2 eV. If the energy of H-atom in lowest energy state is – 13.6 eV. What will be the value of Z ?

[1] 4 [2] 5 [3] 6 [4] 7

**Q.22** The statement 'It is not possible to estimate accurately the position and momentum of an electron simultaneously is associated with :

[1] Heisenberg's uncertainty principle [2] De-Broglie's principle

[3] Pauli's uncertainty principle [4] Aufbau principle

**Q.23** K, L and M shells of an atom contain 2, 8 and 6 electrons respectively. Total number of s-electrons in this element are :

[1] 6 [2] 5 [3] 7 [4] 10

**Q.24** When $\alpha$-particle are passed through thin metal foil, most of the particles pass-through straight because :

[1] $\alpha$-particles are lighter than electrons [2] $\alpha$-particles are positively charged

[3] Most of the part of atom is empty [4] $\alpha$-particles move with high speed

**Q.25** The increasing order (lowest first) for the value of e/m (charge/mass) for :

[1] e, p, n, $\alpha$ [2] n, p, e, $\alpha$ [3] n, p, $\alpha$, e [4] n, $\alpha$, p, e

**Q.26** The electron of H-atom transits from n = 1 to n = 4 by absorbing energy. If the energy of n = 1 state is $-21.8 \times 10^{-19}$ Joule then its energy in n = 4 state will be :

[1] $-21.8 \times 10^{-19}$ Joule [2] $-5.45 \times 10^{-19}$ Joule

[3] $-2.725 \times 10^{-19}$ Joule [4] $-1.362 \times 10^{-19}$ Joule

**Q.27** The wavelength of first line of Lymen series is 1216 Å. What is the wave length of last line ?

[1] 3648 Å [2] 608 Å [3] 912 Å [4] 2432 Å

**Q.28** Energy of orbit :

[1] Increases as we move away from nucleus

[2] Decreases as we move away from nucleus

[3] Remains same as we move away from nucleus

[4] None of these

**Q.29** Which electronic level would allow the hydrogen atom to absorb a photon but not to emit a photon ?

[1] 3s [2] 2p [3] 2s [4] 1s

**Q.30** The electronic configuration of a diapositive metal $M^{2+}$ is, 2, 8, 14 and its atomic weight is 56 amu. The number of neutrons in its nuclei would be :

[1] 30 [2] 32 [3] 34 [4] 42

**Q.31** The electrostatic force of attraction between the electron of first Bohr's orbit of H-atom and it nucleus is :

[1] $10 \times 10^{-3}$ dyne [2] $8 \times 10^{-3}$ dyne [3] $8 \times 10^{-4}$ dyne [4] $10 \times 10^{-4}$ dyne

**Q.32** de' Broglie equation tells about :

[1] the relation between electron and nucleus [2] the relation between electron and proton

[3] the relation between electron and neutron [4] electrons' dual nature of wave and particle

**Q.33** When an electron jumps from L to K shell :

[1] energy is absorbed

[2] energy is released

[3] energy is sometimes released and sometimes absorbed

[4] energy is neither absorbed nor released

**Q.34** Helium atom is two times heavier than a hydrogen molecule. At 298 K, the average kinetic energy of helium atom is :

[1] two times that of hydrogen molecule [2] same as that of hydrogen molecule

[3] four times that of hydrogen molecule [4] half that of hydrogen molecule

**Q.35** Positronium is the name given to an atom like combination formed between :

[1] A positron and a proton [2] A positron and a neutron

[3] A positron and $\alpha$-particle [4] A positron and an electron

**Q.36** The potential energies of first, second and third Bohr's orbits of $He^+$ cation are $E_1$, $E_2$ and $E_3$. The correct sequence of these energies is :

[1] $E_1 > E_2 > E_3$ [2] $E_1 = E_2 > E_3$ [3] $E_1 = E_2 = E_3$ [4] $E_3 > E_2 > E_1$

**Q.37** The circumference of first Bohr's orbit of hydrogen atom is how many times the circumference of second Bohr's orbit of $He^+$ ?

[1] two times [2] half [3] equal [4] none of these

**Q.38** The sum of the number of neutrons and protons in the isotopes of hydrogen is :

[1] 6 [2] 5 [3] 4 [4] 3

**Q.39** According to Sommerfeld, the numbers of circular and elliptical suborbits in $n^{th}$ Bohr's orbit are respectively :

[1] 1 and (n – 1) [2] (n – 1) and 1 [3] 2 and (n – 1) [4] (n – 2) and 1

**Q.40** According to Pauli's exclusion principle :

[1] No two electrons can have the same energy in an orbital

[2] No two electrons can have the parallel spin in an orbital

[3] As far as possible the electrons fill in different orbitals

[4] Electron try to occupy the orbital of lower energy

**Q.41** The mass of a cricket ball is 0.21 kg. If the order of uncertainty in position is 100 pm then uncertainty in its velocity will be :

[1] $3.5 \times 10^{-24}$ m/sec [2] $6.02 \times 10^{23}$ m/sec [3] $6.602 \times 10^{-27}$ m/sec [4] $2.5 \times 10^{-24}$ m/sec

**Q.42** The molecular weight of an oxide of nitrogen is 30. The number of electrons present in one molecule of this compound is :

[1] 15 [2] 30 [3] $6.02 \times 10^{23} \times 15$ [4] $6.02 \times 10^{23} \times 30$

**Q.43** Which of the following are isoelectronic with one another :

[1] $Na^+$ and Ne [2] $K^+$ and O [3] Ne and O [4] $Na^+$ and $K^+$

**Q.44** Which of the following statements is false ?

[1] $(n + \ell)$ rule arranges the orbitals in increasing order of energy

[2] Wavelength of a particle is inversely proportional to its momentum

[3] Aufbau's principle was given a scientist named Aufbau

[4] Velocity of all types of electromagnetic radiation is same

**Q.45** The electron with highest energy is :

[1] in nucleus [2] in ground state

[3] in first excited state [4] At infinite distance from the nucleus

**Q.46** Electron density in the region between 1s and 2s- orbital is :

[1] high [2] low [3] zero [4] None of these

**Q.47** If the radius of first orbit of H-atom is 5 pm, the radius of third orbit $Li^{2+}$ will be :

[1] 106 pm [2] 23 pm [3] 32 pm [4] 15 pm

**Q.48** If the Rydberg constant is R then the energy of electron in ground state of H-atom will be :

[1] $-\frac{ch}{R}$ [2] – Rch [3] $-\frac{Rc}{h}$ [4] – R/ch

**Q.49** In which of the following planes of s-orbitals, the probability of finding the electrons is not zero ?

(a) xy plane (b) yz plane (c) along the x axis (d) xyz plane

Correct answer is :

[1] (a) and (d) only [2] (b) and (c) only [3] (d) only [4] (a) and (c) only

**Q.50** The number of neutrons in the tritium nucleus is :

[1] 1 [2] 2 [3] 3 [4] 4



## Answer Key

| Qus. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ans. | 2 | 1 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 1 | 4 | 4 | 1 | 3 | 2 | 1 | 3 | 1 |
| Qus. | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| Ans. | 2 | 1 | 1 | 3 | 4 | 4 | 3 | 1 | 4 | 1 | 2 | 4 | 2 | 2 | 4 | 4 | 2 | 1 | 1 | 2 |
| Qus. | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | | | | | | | | | | |
| Ans. | 4 | 1 | 1 | 3 | 4 | 3 | 4 | 2 | 3 | 2 | | | | | | | | | | |

# Exercise # 2

**Q.1** An atom has an atomic weight of W and atomic number N then :

[1] Number of electrons = W – N [2] Number of protons = W – N

[3] Number of neutrons = W – N [4] Number of neutrons = N

**Q.2** When an electron of charge e and mass m moves with velocity v about the nuclear charge Ze in the circular orbit of radius r, then the potential energy of the electron in given by :

[1] $Ze^2/r$ [2] $-Ze^2/r$ [3] $Ze^2/r^2$ [4] $mv^2/r$

**Q.3** The number of electrons shared by each atom of nitrogen in nitrogen molecule is :

[1] 2 [2] 6 [3] 3 [4] 4

**Q.4** If uncertainty in position of electron is zero, then the uncertainty in its momentum would be :

[1] Zero [2] $h/2\pi$ [3] $3h/2\pi$ [4] Infinity

**Q.5** It is known that atoms contain protons, neutrons and electrons. If the mass of neutron is assumed to be half of its original value whereas that of electron is assumed to be twice to this original value. The atomic mass of $_6C^{12}$ will be :

[1] Twice [2] 75% less [3] 25% less [4] One half of its original value

**Q.6** If the energy of an electron in hydrogen atom is given by expression, $-1312/n^2$ kJ $mol^{-1}$, then the energy required to excite the electron from ground state to second orbit is :

[1] 328 kJ/mol [2] 656 kJ/mol [3] 984 kJ/mol [4] 1312 kJ/mol

**Q.7** Krypton ($_{36}Kr$) has the electronic configuration ($_{18}Ar$) $4s^2\ 3d^{10}\ 4p^6$. The $37^{th}$ electron will go into which of the following sub levels :

[1] 4f [2] 4d [3] 3p [4] 5s

**Q.8** Which of the following statements is false :

[1] The energy of red photon is more than the energy of violet photon

[2] The momentum of photon is inversely proportional to its wave length

[3] The energy of a photon is inversely proportional to its wave length

[4] The particle nature of electromagnetic radiations is able to explain the photoelectric effect

**Q.9** Calculate the de-Broglie wave length of the electron in the ground state of hydrogen atom, given that its kinetic energy is 13.6 eV : ($1eV = 1.602 \times 10^{-19}$ J)

[1] $3.328 \times 10^{-10}$ m [2] $2.338 \times 10^{-10}$ m [3] $3.328 \times 10^{10}$ m [4] $2.338 \times 10$ m

**Q.10** Which of the following pair having same number of orbitals :

(a) N, O (b) O, F (c) Na, K (d) S, Cl

The correct answer is :

[1] a, b, c [2] b, c, d [3] c, d, a [4] a, b, d

**Q.11** The speed of a proton is one hundredth of the speed of light in vacuum. What is its de-Broglie wavelength ? Assume that one mole of protons has a mass equal to one gram [$h = 6.626 \times 10^{-27}$ erg sec] :

[1] $13.31 \times 10^{-3}$ Å [2] $1.33 \times 10^{-3}$ Å [3] $13.13 \times 10^{-2}$ Å [4] $1.31 \times 10^{-2}$ Å

**Q.12** The value of charge on the oil droplets experimentally observed were $-1.6 \times 10^{-19}$ and $-4 \times 10^{-19}$ coulomb. The value of the electronic charge, indicated by these results is :

[1] $1.6 \times 10^{-19}$ [2] $-2.4 \times 10^{-19}$ [3] $-4 \times 10^{-19}$ [4] $-0.8 \times 10^{-19}$

**Q.13** The ratio of ionization energy of H and $Be^{+3}$ is :

[1] 1 : 1 [2] 1 : 3 [3] 1 : 9 [4] 1 : 16

**Q.14** Hydrogen spectrum consists of :

[1] An intense line [2] Six series of lines [3] Three series of lines [4] Four series of lines

**Q.15** Which of the following salt has isoelectronic cation and anion :

[1] KF [2] NaCl [3] $SrCl_2$ [4] $MgF_2$

**Q.16** Which set of quantum numbers is possible for the last electron of $Mg^+$ ion :

[1] n = 3, $l$ = 2, m = 0, s = + $\frac{1}{2}$ [2] n = 2, $l$ = 3, m = 0, s = + $\frac{1}{2}$

[3] n = 1, $l$ = 0, m = 0, s = + $\frac{1}{2}$ [4] n = 3, $l$ = 0, m = 0, s = + $\frac{1}{2}$

**Q.17** The discovery of neutron became very late because :

[1] Neutrons are present in nucleus [2] Neutrons are fundamental particles

[3] Neutrons are charge less [4] All

**Q.18** If $E_1$, $E_2$ and $E_3$ represent respectively the kinetic energies of an electron, an alpha particle and a proton each having same de Broglie wavelength then :

[1] $E_1 > E_3 > E_2$ [2] $E_2 > E_3 > E_1$ [3] $E_1 > E_2 > E_3$ [4] $E_1 = E_2 = E_3$

**Q.19** The value of : [2p(energy) – 1s(energy)] for H-atom would be :

[1] 10.2 eV [2] 13.6 eV [3] 3.4 eV [4] None of these

**Q.20** In hydrogen atom, If an electron jumps from n = 6 to n = 2, how many possible spectral lines are obtained :

[1] 15 [2] 10 [3] 6 [4] 12

**Q.21** If Hund's rule is followed, magnetic moment of $Fe^{2+}$, $Mn^+$ and Cr all having 24 electrons will be in order :

[1] $Fe^{2+} < Mn^+ < Cr$ [2] $Fe^{2+} < Cr = Mn^+$ [3] $Fe^{2+} = Mn^+ < Cr$ [4] $Mn^{2+} = Cr < Fe^{2+}$

**Q.22** The speed of the electron in the 1st orbit of the hydrogen atom in the ground state is–

[1] c/1.37 [2] c/1370 [3] c/13.7 [4] c/137

**Q.23** Five ionization energy values in kJ $mol^{-1}$ are 834, 869, 1008, 1170, 376 shows :

[1] Successive ionization energies for the element of atomic number 5

[2] The first ionization energies for successive elements in Groups 5, 6, 7, 0 and 1

[3] The first ionization energies for elements with atomic number 1–5

[4] Successive ionization energies for transition element with 4 electron in the d-subshell

**Q.24** If n and l are respectively the principal and azimuthal quantum numbers, then the expression for calculating the total number of electrons in any energy level is :

[1] $\sum_{l=0}^{l=n} 2(2l+1)$ [2] $\sum_{l=1}^{l=n-1} 2(2l+1)$ [3] $\sum_{l=0}^{l=n+1} 2(2l+1)$ [4] $\sum_{l=0}^{l=n-1} 2(2l+1)$

**Q.25** If $10^{-17}$J of light energy is needed by the interior of human eye to see an object. The photons of green light ($\lambda$ = 550 nm) needed to see the object are :

[1] 27 [2] 28 [3] 29 [4] 30

**Q.26** The potential energy of the electron present in the ground state of $Li^{2+}$ ion is represent by :

[1] $+\frac{3e^2}{4\pi\varepsilon_0 r}$ [2] $-\frac{3e}{4\pi\varepsilon_0 r}$ [3] $-\frac{3e^2}{4\pi\varepsilon_0 r}$ [4] None of these

**Q.27** For the energy levels in an atom which one of the following statements is correct :

[1] The 4s sub-energy level is at a higher energy than the 3d sub-energy level

[2] The second principal energy level can have four orbitals and contain a maximum of 8 electrons

[3] The M-energy level can have maximum of 32 electrons

[4] None of these

**Q.28** 13.5 g of Aluminium when changes to $Al^{+3}$ ion in solution, will lose :

[1] $18.0 \times 10^{23}$ electrons [2] $6.022 \times 10^{23}$ electrons

[3] $3.01 \times 10^{23}$ electrons [4] $9.1 \times 10^{23}$ electrons

**Q.29** Assume that the nucleus of the F-atom is a sphere of radius $5 \times 10^{-13}$ cm. What is the density of matter in F–nucleus :

[1] $6.02 \times 10^{11}$ g/ml [2] $6.02 \times 10^{13}$ g/ml [3] $6.02 \times 10^{18}$ g/ml [4] None

**Q.30** The ionization energy of a hydrogen atom is 13.6eV. The energy of the third-lowest electronic level in doubly ionized lithium (Z = 3) is :

[1] –28.7 eV [2] –54.4 eV [3] –122.4 eV [4] –13.6 eV

**Q.31** Assuming the nucleus and an atom 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. The atomic radius of atom is 1Å. If the mass number is 64, the fraction of the atomic volume that is occupied by the nucleus is :

[1] $1.25 \times 10^{-13}$ [2] $2.50 \times 10^{-13}$ [3] $5 \times 10^{-5}$ [4] None

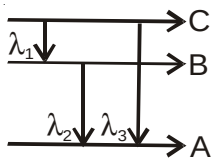
**Q.32** An electron in a hydrogen atom in its ground state absorbs 1.50 times as much energy as the minimum required for it to escape from the atom. What is the wavelength of the emitted electron :

[1] 4.70 Å [2] 4.70 nm [3] 9.4 Å [4] 9.40 nm

**Q.33** For an electron in a hydrogen atom, the wave function, $\psi$ is proportional to exp–$(r/a_0)$, where $a_0$ is the Bohr's radius. What is the ratio of the probability of finding the electron at the nucleus to the probability of finding it at $a_0$.

[1] e [2] $e^2$ [3] $1/e^2$ [4] Zero

**Q.34** Energy levels A, B, C of a certain atom corresponds to increasing values of energy, i.e., $E_A < E_B < E_C$. If $\lambda_1$, $\lambda_2$ and $\lambda_3$ are the wavelengths of radiations corresponding to the transitions C to B, B to A and C to A respectively, which of the following statement is correct :



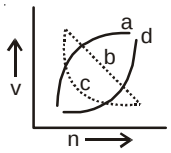

[1] $\lambda_3 = \lambda_1 + \lambda_2$ [2] $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1 + \lambda_2}$ [3] $\lambda_1 + \lambda_2 + \lambda_3 = 0$ [4] $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

**Q.35** The energy difference between two electronic states is 46.12 kcal/mole. What will be the frequency of the light emitted when an electron drops from the higher to the lower energy state (Planck constant = $9.52 \times 10^{-14}$ kcal sec mole$^{-1}$)

[1] $4.84 \times 10^{15}$ cycles sec$^{-1}$ [2] $4.84 \times 10^{-5}$ cycles sec$^{-1}$

[3] $4.84 \times 10^{-12}$ cycles sec$^{-1}$ [4] $4.84 \times 10^{14}$ cycles sec$^{-1}$

**Q.36** Which of the following curves may represent the speed of the electron in a hydrogen atom as a function of the principal quantum number n :




[1] a [2] b [3] c [4] d

**Q.37** The uncertainty in the position of an electron (mass $9.1 \times 10^{-28}$ gm) moving with a velocity of $3 \times 10^4$ cm sec$^{-1}$, Accurate upto 0.011% will be :

[1] 1.92 cm [2] 7.68 cm [3] 0.175 cm [4] 3.84 cm

**Q.38** A–1 kW radio transmitter operates at a frequency of 880 Hz. How many photons per second does it emit :

[1] $1.71 \times 10^{21}$ [2] $1.71 \times 10^{33}$ [3] $6.02 \times 10^{23}$ [4] $2.85 \times 10^{26}$

**Q.39** Two particles A and B are in motion. It the wavelength associated with the particle A is $5.0 \times 10^{-8}$ m, the wavelength of particle B having momentum half of A is :

[1] $2.5 \times 10^{-8}$ m [2] $1.25 \times 10^{-8}$ m [3] $1.0 \times 10^{-7}$ m [4] $1.0 \times 10^{-8}$ m

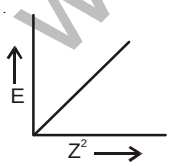
**Q.40** A particle A moving with a certain velocity has de Broglie wavelength of 1 Å. If particle B has mass 25% of that A and velocity 75% of that of A, the de Broglie wavelength of B will be approximately :

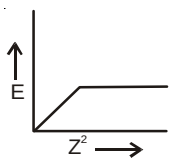
[1] 1 Å [2] 5.3 Å [3] 3 Å [4] 0.2 Å

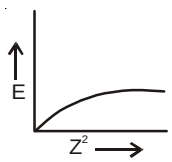
**Q.41** Energy required to pull out an electron from 1$^{st}$ orbit of hydrogen atom to infinity is 100 units. The amount of energy needed to pull out the electron from 2nd orbit to infinity is :

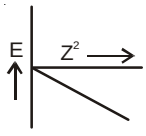
[1] 50 units [2] 100 units [3] 25 units [4] Zero

**Q.42** The graphical representation of energy of $e^-$ and atomic number is :

[1] 


[2] 


[3] 


[4] 


**Q.43** At atom has x energy level then total number of lines in its spectrum are :

[1] 1 + 2 + 3 ..... (x + 1)

[2] 1 + 2 + 3 ..... $(x)^2$

[3] 1 + 2 + 3 ..... (x – 1)

[4] (x + 1) (x + 2) (x + 4)

**Q.44** Which of the following statementsis wrong :

[1] Kinetic energy of an electron is halfof the magnitude of its potential energy

[2] Kietic energy of an electron is negative of total energy of electron

[3] Energy of an electron decreases with increases in the value of principal quantum number

[4] All of these

**Q.45** If each hydrogen atom is excited by giving 8.4eV energy, then the number of spectral lines emitted is equal to:

[1] none [2] 2 [3] 3 [4] 4

**Q.46** The orbital cylindrically symmetrical about x-axis is :

[1] $p_z$ [2] $p_y$ [3] $p_x$ [4] $d_{xz}$

**Q.47** Which of the d-orbital lies in the xy-plane :

[1] $d_{xz}$ only [2] $d_{xy}$ only [3] $d_{x^2-y^2}$ only [4] $d_{xy}$ & $d_{x^2-y^2}$ only

**Q.48** The probability of finding an electron residing in a $p_x$ orbital is zero in the :

[1] xy plane [2] yz plane [3] y direction [4] z direction

**Q.49** If the series limit of wavelength of the Lyman series for the hydrogen atoms is 912Å, then the series limit of wavelength for the Balmer series of the hydrogen atom is :

[1] 912 Å [2] 912 × 2 Å [3] 912 × 4 Å [4] 912/2 Å

**Q.50** An element of atomic weight Z consist of two isotopes of mass number Z – 1 and Z + 2. Percentage of abundanc of the heavier isotope is :

[1] 25 [2] $33\frac{1}{3}$ [3] $66\frac{2}{3}$ [4] 75



## Answer Key

| Qus. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ans. | 3 | 2 | 2 | 4 | 3 | 3 | 4 | 1 | 1 | 4 | 2 | 1 | 4 | 2 | 4 | 4 | 3 | 4 | 1 | 2 |
| Qus. | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| Ans. | 2 | 4 | 2 | 4 | 2 | 3 | 3 | 4 | 2 | 4 | 1 | 1 | 4 | 2 | 4 | 3 | 3 | 2 | 3 | 2 |
| Qus. | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | | | | | | | | | | |
| Ans. | 3 | 4 | 3 | 3 | 1 | 3 | 3 | 2 | 3 | 2 | | | | | | | | | | |

# Exercise # 3

**Q.1** From the given sets of quantum numbers the one that is inconsistent with the theory is : **[IIT-Scr. 1994]**

[1] n = 3, $l$ = 2, m = – 3, s = + 1/2 [2] n = 4, $l$ = 3, n = 3, s = + 1/2

[3] n = 2, $l$ = 1, m = 0, s = – 1/2 [4] n = 4, $l$ = 3, m = 2, s = + 1/2

**Q.2** The size of nucleus is measured in : **[CPMT 1994]**

[1] amu [2] Angstrom [3] Fermi [4] cm

**Q.3** The total number of electrons present in all the p-orbitals of bromine are : **[MP PET 1994]**

[1] Five [2] Eighteen [3] Seventeen [4] Thirty five

**Q.4** When an electron revolves in a stationary orbit then : **[MP PET 1994]**

[1] It absorbs energy [2] It gains kinetic energy

[3] It emits radiation [4] Its energy remains constant

**Q.5** The total number of valence electrons in 4.2 gm of $N_3^-$ ion is ($N_A$ is the Avogadro's number) : **[CBSE 1994]**

[1] 1.6 $N_A$ [2] 3.2 $N_A$ [3] 2.1 $N_A$ [4] 4.2 $N_A$

**Q.6** If n = 3, then the value of '$\ell$' which is incorrect : **[CPMT 1994]**

[1] 0 [2] 1 [3] 2 [4] 3

**Q.7** Chlorine atom differs from chloride ion in the number of : **[MP PET 1995]**

[1] Proton [2] Neutron [3] Electrons [4] Protons and electrons

**Q.8** The uncertainty in the position of an electron (mass = $9.1 \times 10^{-28}$ g) moving with a velocity of $3.0 \times 10^4$ cm $s^{-1}$ accurate upto 0.001% will be (use $\frac{h}{4\pi}$ in the uncertainty expression, where h = $6.62 \times 10^{-27}$ erg-s)

[1] 1.92 cm [2] 7.68 cm [3] 5.76 cm [4] 3.84 cm **[CBSE 1995]**

**Q.9** A 3p orbital has : **[IIT 1995]**

[1] Two spherical nodes [2] Two non-spherical nodes

[3] One spherical and one non-spherical nodes [4] One spherical and two non-spherical nodes

**Q.10** Zeeman effect refers to the : **[AFMC 1995]**

[1] Splitting up of the lines in an emission spectrum in a magnetic field

[2] Splitting up to the lines in an emission spectrum in the presence of an external electrostatic field

[3] Emission of electrons from metals when light falls upon them

[4] Random scattering of light by colloidal particles

**Q.11** For n = 3 energy level, the number of possible orbitals are : **[MP PMT 1995]**

[1] 1 [2] 3 [3] 4 [4] 9

**Q.12** The orbital angular momentum of an electron in 2s orbital is : **[IIT 1996]**

[1] $+\frac{1}{2} \cdot \frac{h}{2\pi}$ [2] Zero [3] $\frac{h}{2\pi}$ [4] $\sqrt{2} \cdot \frac{h}{2\pi}$

**Q.13** Which statement is not correct for n = 5, m = 3 : **[CPMT 1996]**

[1] $l$ = 4 [2] $l$ = 0, 1, 2, 3 ; s = + 1/2

[3] $l$ = 3 [4] All are correct

**Q.14** $1s^2$, $2s^2$ $2p^5$ $3s^2$ shows configuration of : **[CPMT 1996]**

[1] $Al^{+3}$ in ground state [2] Ne in excited state

[3] $Mg^{+1}$ in excited stated [4] All are correct

**Q.15** In a Bohr's model of atom when an electron jumps from n = 1 to n = 3, how much energy will be emitted or absorbed : **[CBSE 1996]**

[1] $2.15 \times 10^{-11}$ ergs [2] $0.1911 \times 10^{-10}$ ergs [3] $2.389 \times 10^{-12}$ ergs [4] $0.239 \times 10^{-10}$ ergs

**Q.16** The shape of an orbital is given by the quantum number : **[MP PMT 1996]**

[1] n [2] $l$ [3] m [4] s

**Q.17** Which of the following metal ions will have maximum number of unpaired electrons : **[CPMT 1996]**

[1] $Fe^{+2}$ [2] $Co^{+2}$ [3] $Ni^{+2}$ [4] $Mn^{+2}$

**Q.18** The maximum probability of finding an electron in the $d_{xy}$ orbital is : **[MT PET 1996]**

[1] Along the x-axis [2] Along the y-axis

[3] At an angle of 45º from the x and y-axes [4] At an angle of 90º from the x and y-axes

**Q.19** CO has same electrons as or the ion that is isoelectronic with CO is : **[CBSE 1997]**

[1] $N_2^+$ [2] $CN^-$ [3] $O_2^+$ [4] $O^-_2$

**Q.20** The total number of orbital in an energy level designated by principal quantum number n, is equal to :

[1] 2n [2] $2n^2$ [3] n [4] $n^2$ **[AIIMS 1997]**

**Q.21** Which electronic level would allow the hydrogen atom to absorb a photon but not to emit a photon :

[1] 3s [2] 2p [3] 2s [4] 1s **[CPMT 1997]**

**Q.22** An electron has principal quantum number 3. The number of its : **[MT PET 1997]**

(i) subshells and (ii) orbitals would be respectively

[1] 3 and 5 [2] 3 and 7 [3] 3 and 9 [4] 2 and 5

**Q.23** Aufbau principle is not satisfied by : **[MP PMT 1997]**

[1] Cr and Cl [2] Cu and Ag [3] Cr and Mg [4] Cu and Na

**Q.24** The first use of quantum theory to explain the structure of atom was made by : **[IIT 1997]**

[1] Heisenberg [2] Bohr [3] Planck [4] Einstein

**Q.25** Five valence electrons of $_{15}P$ are labelled as $\underset{3s}{\boxed{AB}}$ $\underset{3p}{\boxed{X|Y|Z}}$. If the spin quantum number of B and Z is + 1/2, the group of electrons with three of the quantum number same are : **[JIPMER 1997]**

[1] Ab, XYZ, BY [2] AB [3] XYZ, AZ [4] AB, XYZ

**Q.26** In an element going away from nucleus, the energy of particle : **[RPMT 1997]**

[1] Decreases [2] Unchanged [3] Increases [4] None of these

**Q.27** In neutral atom, which particles are equivalent : **[RPMT 1997]**

[1] $p^+$, $e^+$ [2] $e^-$, $e^+$ [3] $e^-$, $p^+$ [4] $p^+$, $n^0$

**Q.28** If n + *l* = 6, then total possible number of subshells would be : **[RPMT 1997]**

[1] 3 [2] 4 [3] 2 [4] 5

**Q.29** The configuration $1s^2\ 2s^2\ 2p^5\ 3s^1$ shows : **[AIIMS 1997]**

[1] Ground state of fluorine atom [2] Excited state of fluorine atom

[3] Excited state of neon atom [4] Excited state of ion $O_2^-$ ion

**Q.30** The electron configuration of gadolinium (atomic no. 64) is : **[CBSE 1997]**

[1] [Xe] $4f^8\ 5d^9\ 6s^2$ [2] [Xe] $4f^7\ 5d^1\ 6s^2$ [3] [Xe] $4f^3\ 5d^5\ 6s^2$ [4] [Xe] $4f^6\ 5d^2\ 6s^2$

**Q.31** If electron falls from n = 3 to n = 2, then emitted energy is : **[AFMC 1997]**

[1] 10.2 eV [2] 12.09 eV [3] 1.9 eV [4] 0.65 eV

**Q.32** Number of protons, neutrons and electrons in the element $_{89}X^{231}$ is : **[AFMC 1997]**

[1] 89, 231, 89 [2] 89, 89, 242 [3] 89, 142, 89 [4] 89, 71, 89

**Q.33** In the ground state configuration of $Cr_{24}$ how many orbitals are present having paired and unpaired electrons :

[1] 10 [2] 12 [3] 15 [4] 16 **[RPMT 1997]**

**Q.34** Discoverer of positron : **[RPMT 1997]**

[1] Paulling [2] Anderson [3] Yukawa [4] Segre

**Q.35** Which of the following species not contains neurtrons : **[RPMT 1997]**

[1] H [2] $Li^{+2}$ [3] C [4] O

**Q.36** The energy of an electron in the first Bohr orbit of H atom is – 13.6 eV. The possible energy value of the first excited state for electrons in Bohr orbits to hydrogen is (are) : **[IIT 1998]**

[1] – 3.4 eV [2] – 4.2 eV [3] – 6.8 eV [4] + 6.8 eV

**Q.37** The energy of an electron in the first orbit of $He^+$ is $-871.6 \times 10^{-20}$ J. The energy of the electron in the first orbit of hydrogen would be : **[Roorkee 1998]**

[1] $-871.6 \times 10^{-20}$ J [2] $-435.8 \times 10^{-20}$ J [3] $-217.9 \times 10^{-20}$ J [4] $-108.9 \times 10^{-20}$ J

**Q.38** The position of both an electron and a helium atom is known within 1.0 nm and the momentum of the electron is known within $50 \times 10^{-26}$ kg $ms^{-1}$. The minimum uncertainty in the measurement of the momentum of the helium atom is : **[CBSE 1998]**

[1] 50 kg $ms^{-1}$ [2] 60 kg $ms^{-1}$ [3] $80 \times 10^{-26}$ kg $ms^{-1}$ [4] $50 \times 10^{-26}$ kg $ms^{-1}$

**Q.39** The Bohr orbit radius for the hydrogen atom (n = 1) is approximately 0.530 A. The radius for the first excited state (n = 2) orbit is : **[CBSE 1998]**

[1] 0.13 Å [2] 1.06 Å [3] 4.77 Å [4] 2.12 Å

**Q.40** Which of the following explain the sequence of filling the electrons in different orbitals : **[AIIMS 1998]**

[1] Hund's rule [2] Octet rule [3] Aufbau principle [4] All of these

**Q.41** Number of orbitals having paired electrons for gaseous Fe are : **[RPMT 1998]**

[1] 4 [2] 11 [3] 15 [4] 19

**Q.42** [Ar] $3d^6$ is the configuration of the following ion : **[RPMT 1998]**

[1] $Fe^{+2}$ [2] $Ti^{+3}$ [3] $Co^{+2}$ [4] $Cr^{+3}$

**Q.43** Which triad of quantum number [n, *l*, m] is not applicable for 3d-electron : **[RPMT 1998]**

[1] 3, 2, 0 [2] 3, 1 –1 [3] 3, 2, – 2 [4] 3, 2, +1

**Q.44** Which of the following configuration follows the Hund's rule : **[RPMT 1998]**

[1] [He] 2s: ↑↓ 2p: ↑ ↑ ☐ [2] [He] 2s: ↑↓ 2p: ↑↓ ↑ ☐

[3] [He] 2s: ↑↓ 2p: ↑ ↑↓ ☐ [4] [He] 2s: ↑↓ 2p: ↓ ↑ ☐

**Q.45** The ratio of radii of 3rd and 2nd Bohr's orbit of hydrogen atom is : **[RPMT 1998]**

[1] 3 : 2 [2] 4 : 9 [3] 9 : 4 [4] 9 : 1

**Q.46** The four quantum number for the valence shell electron or last electron of sodium is : **[MP PMT 1999]**

[1] n = 2, $\ell$ = 1, m = – 1, s = – 1/2 [2] n = 3, $\ell$ = 0, m = 0, s = + 1/2

[3] n = 3, $\ell$ = 2, m = – 2, s = – 1/2 [4] n = 3, $\ell$ = 2, m = 2, s = + 1/2

**Q.47** Heaviest particle is : **[MP PET 1999]**

[1] Meson [2] Neutron [3] Proton [4] Electron

**Q.48** Which is correct statement about proton : **[MP PET 1999]**

[1] Proton is nucleus of deuterium [2] Proton is ionized hydrogen molecule

[3] Proton is ionized hydrogen atom [4] Proton is $\alpha$-particle

**Q.49** The energy of an electron in $n^{th}$ orbit of hydrogen atom is : **[MP PET 1999]**

[1] $-\frac{13.6}{n^4}$ eV [2] $-\frac{13.6}{n^3}$ eV [3] $-\frac{13.6}{n^2}$ eV [4] $-\frac{13.6}{n}$ eV

**Q.50** If wavelength of photon is $2.2 \times 10^{-11}$ m, h = $6.8 \times 10^{-34}$ Js, then momentum of photon is : **[MP PET 1999]**

[1] $3 \times 10^{-23}$ Kg $ms^{-1}$ [2] $3.33 \times 10^{22}$ Kg $ms^{-1}$

[3] $1.452 \times 10^{-44}$ kg $ms^{-1}$ [4] $6.89 \times 10^{43}$ kg $ms^{-1}$

**Q.51** The electrons identified by quantum number n and *l* **[IIT 1999]**

(i) n = 4, *l* = 1 (ii) n = 4, *l* = 0 (iii) n = 3, *l* = 2 (iv) n = 3, *l* = 1

can be placed in order of increasing energy from the lowest to highest, as :

[1] (iv) < (ii) < (iii) < (i) [2] (ii) < (iv) < (i) < (iii)

[3] (i) < (iii) < (ii) < (iv) [4] (iii) < (i) < (iv) < (ii)

**Q.52** Ground state electron configuration of nitrogen atom can be represent by : **[IIT 1999]**

[1] ↑↓ ↑↓ ↑ ↑ ↑ [2] ↑↓ ↑↓ ↑ ↓ ↑ [3] ↑↓ ↑↓ ↑ ↓ ↓ [4] None of these

**Q.53** Which of the following has more unpaired d-electron : **[CBSE 1999]**

[1] $Zn^+$ [2] $Fe^{2+}$ [3] $Ni^{3+}$ [4] $Cu^+$

**Q.54** The uncertainty in momentum of an electron is $1 \times 10^{-5}$ kg-m/s. The uncertainty in its position will be : **[CBSE 1999]**

[1] $1.05 \times 10^{-28}$ m [2] $1.05 \times 10^{-26}$ m [3] $5.27 \times 10^{-30}$ m [4] $5.25 \times 10^{-28}$ m

**Q.55** The de-Broglie wavelength of a particle with mass 1g and velocity 100 m/s is : **[CBSE 1999]**

[1] $6.63 \times 10^{-33}$ m [2] $6.63 \times 10^{-34}$ m [3] $6.63 \times 10^{-35}$ m [4] $6.65 \times 10^{-35}$ m

**Q.56** Which of the following set of quantum numbers belong to highest energy : **[CPMT 1999]**

[1] n = 4, $l$ = 0, m = 0, s = + $\frac{1}{2}$ [2] n = 3, $l$ = 0, m = 0, s = + $\frac{1}{2}$

[3] n = 3, $l$ = 1, m = 1, s = + $\frac{1}{2}$ [4] n = 3, $l$ = 2, m = 1, s = + $\frac{1}{2}$

**Q.57** Which of the following are isoelectronic species : **[CPMT 1999]**

I – $CH^+_3$, II – $NH_2^-$, III – $NH^+_4$, IV – $NH_3$

[1] I, II, III [2] II, III, IV [3] I, II, IV [4] I and II

**Q.58** Which quantum number will determine the shape of the subshell : **[CPMT 1999]**

[1] Principal quantum number [2] Azimuthal quantum number

[3] Magnetic quantum number [4] Spin quantum number

**Q.59** A metal in its di positive state has the electronic configuration 2, 8, 14 and has the atomic weight equal to 56. Number of neutrons in its nucleus would be : **[RPMT 1999]**

[1] 30 [2] 32 [3] 34 [4] 28

**Q.60** Which set of quantum number for an electron of an atom is not possible : **[RPMT 1999]**

[1] n = 1, $l$ = 0, m = 0, s = + $\frac{1}{2}$ [2] n = 1, $l$ = 1, m = 1, s = + $\frac{1}{2}$

[3] n = 1, $l$ = 0, m = 0, s = – $\frac{1}{2}$ [4] n = 2, $l$ = 1, m = – 1, s = + $\frac{1}{2}$

**Q.61** Outer electronic configuration of the element of atomic number 24 is : **[RPMT 1999]**

[1] $3s^2\ 3p^6\ 3d^5\ 4s^1$ [2] $3s^2\ 3p^6\ 3d^4\ 4s^2$ [3] $3s^2\ 3p^6\ 3d^6$ [4] None

**Q.62** The basis of three unpaired electrons in the configuration of nitrogen is : **[RPMT 1999]**

[1] Aufbau principle [2] Pauli's principle [3] Hund's principle [4] Uncertainty principle

**Q.63** Correct order of size is : **[RPMT 1999]**

[1] $I > I^+ > I^-$ [2] $I > I^- > I^+$ [3] $I^- > I > I^+$ [4] $I^+ > I > I^-$

**Q.64** Which is not electromagnetic radiation : **[RPMT 2000]**

[1] Infrared rays [2] X–ray [3] Cathode rays [4] Gamma rays

**Q.65** Which of the following pair of orbitals posses two nodal planes : **[RPMT 2000]**

[1] $p_{xy}$, $d_{x^2-y^2}$ [2] $d_{xy}$, $d_{zx}$ [3] $p_{yz}$, $d_{zx}$ [4] $d_{z^2}$ , $d_{x^2-y^2}$

**Q.66** The mass of a neutron is of the order of : **[RPMT 2000]**

[1] $10^{-23}$ kg [2] $10^{-24}$ kg [3] $10^{-26}$ kg [4] $10^{-27}$ kg

**Q.67** Smallest cation is : **[RPMT 2000]**

[1] $Na^+$ [2] $Mg^{2+}$ [3] $Ca^{2+}$ [4] $Al^{3+}$

**Q.68** Electron enters the sub-shell for which (n + *l*) value is minium. This is enunciated as : **[RPMT 2000]**

[1] Hund's rule [2] Aufbau principle

[3] Heisenberg uncertainty principle [4] Pauli's exclusion principle

**Q.69** The minium real charge on any particle which can exist is : **[RPMT 2000]**

[1] $1.6 \times 10^{-19}$ coulomb [2] $1.6 \times 10^{-10}$ coulomb

[3] $4.8 \times 10^{-10}$ coulomb [4] Zero

**Q.70** Which sub-shell is not permissible : **[RPMT 2000]**

[1] 2d [2] 4f [3] 6p [4] 3s

**Q.71** Sub-shell designated by azimuthal quantum number *l* = 3 can have maximum number of electrons :

[1] 14 [2] 6 [3] 10 [4] 0 **[RPMT 2000]**

**Q.72** Quantum number n = 3, *l* = 2, m = + 2 shows how many orbitals : **[CPMT 2001]**

[1] 1 [2] 2 [3] 3 [4] 4

**Q.73** Which is isoelectronic with sulphide ion : **[RPMT 2001]**

[1] Cl [2] Ne [3] Ar [4] Kr

**Q.74** Ground state electronic configuration of nitrogen is : **[RPMT 2001]**

[1] $1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$ [2] $1s^2, 2s^2, 2px^2, 2p_y^1$

[3] $1s^2, 2s^2, 2p_x^2, 2p_z^1$ [4] $1s^2, 2s^2, 2p_x^3$

**Q.75** In the Bohr's orbit, what is the ratio of total kinetic energy and total energy of electron : **[RPMT 2002]**

[1] – 1 [2] – 2 [3] 1 [4] + 2

**Q.76** Rutherford $\alpha$-particle dispersion experiment concludes : **[RPMT 2002]**

[1] All positive ions are deposited at small part [2] All negative ions are deposited at small part

[3] Protons moves around the electrons [4] Neutrons are charged particles

**Q.77** Which of the following element outermost orbit's last electron has magnetic quantum number m = 0 ?

[1] Na [2] O [3] Cl [4] N **[RPMT 2002]**

**Q.78** The value of Planck's constant is $6.63 \times 10^{-34}$ Js. The velocity of light is $3.0 \times 10^8$ m $s^{-1}$. Which value is closest to the wavelength in nanometers of a quantum of light with frequency of $8 \times 10^{15}$ $s^{-1}$ ? **[CPMT 2003]**

[1] $5 \times 10^{-18}$ [2] $4 \times 10^1$ [3] $3 \times 10^7$ [4] $2 \times 10^{-25}$

**Q.79** The orbital angular momentum for an electron revolving in an orbit is given by $\sqrt{l(l+1)} \cdot \frac{h}{2\pi}$. This momentum for an s-electron will be given by : **[AIEEE 2003]**

[1] $\sqrt{2}.\frac{h}{2\pi}$ [2] $+\frac{1}{2}.\frac{h}{2\pi}$ [3] zero [4] $\frac{h}{2\pi}$

**Q.80** The number of d-electrons retained in $Fe^{2+}$ (At. no. of Fe = 26) ion is : **[AIEEE 2003]**

[1] 6 [2] 3 [3] 4 [4] 5

**Q.81** The de Broglie wavelength of a tennis ball of mass 60 g moving with a velocity of 10 metres per second is approximately : **[AIEEE 2003]**

[1] $10^{-25}$ metres [2] $10^{-33}$ metres [3] $10^{-31}$ metres [4] $10^{-16}$ metres

**Q.82** 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 ? **[AIEEE 2003]**

[1] $2 \rightarrow 5$ [2] $3 \rightarrow 2$ [3] $5 \rightarrow 2$ [4] $4 \rightarrow 1$

**Q.83** Which of the following sets of quantum number is correct for an electron in 4f orbital ? **[AIEEE 2004]**

[1] n = 3, $l$ = 2, m = – 2, s = + $\frac{1}{2}$ [2] n = 4, $l$ = 4, m = – 4, s = – $\frac{1}{2}$

[3] n = 4, $l$ = 3, m = + 1, s = + $\frac{1}{2}$ [4] n = 4, $l$ = 3, m = + 4, s = + $\frac{1}{2}$

**Q.84** consider the ground state of Cr atom (Z = 24). The numbers of electrons with the azimuthal quantum numbers, $l$ = 1 and 2 are, respectively : **[AIEEE 2004]**

[1] 16 and 5 [2] 12 and 5 [3] 16 and 4 [4] 12 and 4

**Q.85** The wavelength of the radiation emitted, when in a hydrogen atom electron falls from infinity to stationary state 1, would be (Rydberg constant = $1.097 \times 10^7\ m^{-1}$) : **[AIEEE 2004]**

[1] $9.1 \times 10^{-8}$ nm [2] 192 nm [3] 406 nm [4] 91 nm

**Q.86** Which one of the following sets of ions represents the collection of isoelectronic species ? **[AIEEE 2004]**

[1] $Na^+$, $Mg^{2+}$, $Al^{3+}$, $Cl^-$ [2] $Na^+$, $Ca^{2+}$, $Sc^{3+}$, $F^-$

[3] $K^+$, $Cl^-$, $Mg^{2+}$, $Sc^{3+}$ [4] $K^+$, $Ca^{2+}$, $Sc^{3+}$, $Cl^-$

**Q.87** Consider the following nuclear relations : **[AIEEE 2004]**

$^{238}_{92}M \rightarrow ^{x}_{y}N + 2\,^{4}_{2}He$ $\qquad$ $^{x}_{y}N \rightarrow ^{A}_{B}L + 2\beta^+$

The number of neutrons in the element L is :

[1] 146 [2] 144 [3] 140 [4] 142

**Q.88** Which of the following have same radius as hydrogen n = 1 : **[IIT Scr. 2004]**

[1] $He^+$, n = 2 [2] $Be^{+3}$, n = 2 [3] $Li^{+2}$, n =2 [4] $Li^{+2}$, n = 3

**Q.89** The ratio of charge and mass would be greater for - **[BHU 2005]**

[1] Proton [2] Electron [3] Neutron [4] Alpha

**Q.90** Magnitude of K.E. in an orbit is eaual to - **[BCECE 2005]**

[1] Half of the potential energy [2] Twice of the potential energy

[3] One fourth of the potential energy [4] None of these

**Q.91** Number of neutron in $C^{12}$ is - **[BCECE 2005]**

[1] 6 [2] 7 [3] 8 [4] 9

**Q.92** The most probable radius (in pm) for finding the electron in $He^+$ is - **[AIIMS 2005]**

[1] 0.0 [2] 52.9 [3] 26.5 [4] 105.8

**Q.93** 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 PMT 2005]**

[1] –41 kJ $mol^{-1}$ [2] –1312 kJ $mol^{-1}$ [3] –164 kJ $mol^{-1}$ [4] –82 kJ $mol^{-1}$

**Q.94** What is the packet of energy called **[AFMC 2005]**

[1] Electron [2] Photon [3] Positron [4] Proton

**Q.95** A metal surface is exposed to solar radiations **[DPMT 2005]**

[1] The emitted electrons have energy less than a maximum value of energy depending upon frequency of incident radiations

[2] The emitted electrons have energy less than maximum value of energy depending upon intensity of incident radiation

[3] The emitted electrons have zero energy

[4] The emitted electrons have energy equal to energy of photons of incident light

**Q.96** Which of the following transitions have minimum wavelength **[DPMT 2005]**

[1] $n_4 \longrightarrow n_1$ [2] $n_2 \longrightarrow n_1$ [3] $n_4 \longrightarrow n_2$ [4] $n_3 \longrightarrow n_1$

**Q.97** For an electron if the uncertainty in velocity is $\Delta v$, the uncertainty in its position ($\Delta x$) is given by - **[DPMT 2005]**

[1] $\frac{hm}{4\pi\Delta v}$ [2] $\frac{4\pi}{hm\Delta v}$ [3] $\frac{h}{4\pi m\Delta v}$ [4] $\frac{4\pi m}{h.\Delta v}$

**Q.98** Orbital is - **[DPMT 2005]**

[1] Circular path around the nucleus in which the electron revolves

[2] Space around the nucleus where the probability of finding the electron is maximum

[3] Amplitude of electrons wave

[4] None of these

**Q.99** If magnetic quantum number of a given atom represented by –3, then what will be its principle quantum number **[BHU 2005]**

[1] 2 [2] 3 [3] 4 [4] 5

**Q.100** The total number of orbitals in an energy level designated by principal quantum number n is equal to - **[J & K CET 2005]**

[1] 2n [2] $2n^2$ [3] n [4] $n^2$

**Q.101** The number of radial nodes of 3s and 2p orbitals are respectively - **[IIT-JEE 2005]**

[1] 2, 0 [2] 0, 2 [3] 1, 2 [4] 2, 1

**Q.102** Number of unpaired electrons in $Mn^{4+}$ is - **[DPMT 2005]**

[1] 3 [2] 5 [3] 6 [4] 4

**Q.103** Which of the following sequence is correct as per Aufbau principle **[DPMT 2005]**

[1] 3s < 3d < 4s < 4p [2] 1s < 2p < 4s < 3d

[3] 2s < 5s < 4p < 5d [4] 2s < 2p < 3d < 3p

**Q.104** Electronic configuration of deuterium atom is - **[J&K CET 2005]**

[1] $1s^1$ [2] $2s^2$ [3] $2s^1$ [4] $1s^2$

**Q.105** According to Bohr's theory, the angular momentum of an electron is $5^{th}$ orbit is - **[AIEEE 2006]**

[1] 1.0 h/π [2] 10 h/π [3] 2.5 h/π [4] 25h/π

**Q.106** Uncertainty in the position of an electron (mass = $9.1 \times 10^{-31}$ kg) moving with a velocity 300 $ms^{-1}$, accurate upto 0.001 %, will be - **[AIEEE 2006]**

[1] $5.76 \times 10^{-2}$m [2] $1.92 \times 10^{-2}$m [3] $3.84 \times 10^{-2}$m [4] $19.2 \times 10^{-2}$m

($h = 6.63 \times 10^{-34}$ Js)

**Q.107** Which one of the following sets of ions represents a collection of isoelectronic species ? **[AIEEE 2006]**

[1] $Ba^{2+}$, $Sr^{2+}$, $K^+$, $Ca^{2+}$ [2] $N^{3-}$, $O^{2-}$, $F^-$, $S^{2-}$

[3] $Li^+$, $Na^+$, $Mg^{2+}$, $Ca^{2+}$ [4] $K^+$, $Cl^-$, $Ca^{2+}$, $Sc^{3+}$

**Q.108** Which of the following sets of quantum numbers represents the highest energy of an atom ? **[AIEEE 2007]**

[1] n = 4, *l* = 0, m = 0, $s = +\frac{1}{2}$ [2] n = 3, *l* = 0, m = 0, $s = +\frac{1}{2}$

[3] n = 3, *l* = 1, m = 0, $s = +\frac{1}{2}$ [4] n = 3, *l* = 2, m = 0, $s = +\frac{1}{2}$



## Answer Key

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