CHEMISTRY

NCERT - NCERT CHEMISTRY(HINGLISH)

STRUCTURE OF ATOM

Solved Example

1. calculate the number of protons, neutrons and electrons in $._{35}^{85}Br$

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2. The number of electrons,protons, neutron in a species are 18, $16$and 16 respectively. Assigns proper symbols

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3. the vividh bharati station of All india Radio, Delhi , broadcasts on a frequency of 1,368 kHz (kilo hertz). Calculate the wavelength of the electromagnetic radiation emitted by

transmitter . Which part of the electromagnetic spectrum does it belong to

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4. the wavelegth range of the visible spectrum extends from violet (400 nm) to red (750 nm). Express these wavelengths in frequencies (Hz) . (1nm =$10^{-9}m$)

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5. Calculate (a) Wavenumber and (b) frequency of yellow radiation having wavelength $5800A^{\circ}$.

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6. calculate energy of one mole of photons of radiation whose frequency is $5 \times 10^{14} hz$

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7. A 100 watt bulb emits monochromatic light of wavelength 400 nm. Calculate the number of photons emitted per second by the bulb.

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8. When electromagnetic radiaiton of wavelength $300nm$ falls on the surface of sodium electrons are emitted with a kinetic enegry of $1.68 \times 10^5 Jmol^-$. What is the minimum enegry needed to remove an

electorn from sodium?

Strategy: The minimum enegry required to remove an electron from target metal is called work function W_0 of the metal. It can be calculated from Eq., provided we know the energy of the incident photon and kinetic enegry of a single photoelectorn.

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9. The threshold frequency v_0 for a metal is $7 \times 10^{14} s^{-1}$. Calculate the kinetic energy of

an electron emitted when radiation of frequency $v = 1.0 \times 10^{15} s^{-1}$ hits the metal .

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10. 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?

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11. calculate the energy assoclated with the first orbit of He^{+} . What is the radius of this orbit?

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12. what will be the wavelength of a ball of mass 0.1 kg moving with a velocity of $10ms^{-1}$?

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13. The mass fo an electron is $9.1 \times 10^{-31} kg$. If its K.E. is $3.0 \times 10^{25} J$. Calculate its wavelength .

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14. calculate the mass of a photon with wavelength 3.6 A

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15. A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 Ã.... What is the uncertainty involved in the measurement of its velocity ?

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16. A golf ball has a mass of $40g$ and a speed of $45m/s$. If the speed can be measured

within accuracy of 2%, calculate the uncertainty in the position.

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17. what is the total number of orbitals associated with the principal quartum number n= 3?

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18. using s, p, d notations describe the orbtal with the following quantum numbers .

(a) n = 2 l=1, (b) n = 4 , l = 0, (c) n= 5 , l=3 , (d) n = 3 , l = 2

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Exercise

1. (i) Calculate the number of electrons which will together weigh one gram .

(ii) Calculate the mass and charge on one mole of electrons .

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2. (i) Calculate the total number of electrons present in 1 mole of methane .

(ii) Find (a) the total number and (b) the total mass of neutrons in 7 mg of $._{}^{14}C$. (Assume that mass of a neutron $= 1.675 \times 10^{-27} g$)

(iii) Find (a) the total number of protons and (b) the total mass of protons in $32mg$ of NH_3

at $STP.$ (mass of proton $= 1.672 \times 10^{-27} g$)

Will the answer change if the temperature and pressure are changed ?

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3. how many neutrons and protons are there in the following nuclei ?

$_{6}^{13}C, _{8}^{16}O, _{12}^{24}Mg, _{26}^{56}Fe, _{38}^{88}Sr$

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4. Write the complete symbol for the atom with the given atomic number (Z) and atomic mass (A).

a. $Z = 17, A = 35,$

b. $Z = 92, A = 233,$

c. $Z = 4, A = 9$

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5. Yellow light emitted from a sodium lamp has a wavelength (λ) of $580nm$. Calculate the

frequency (ν). Wave number and energy of yellow light photon .

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6. Find energy of each of the photons which

a. correspond to light of frequency $3 \times 10^{15} Hz$.

b. have wavelength of $0.50 Å$.

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7. Calculate the wavelength, frequency, and wave number of a light wave whose period is $2.0 \times 10^{-10} s$.

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8. what is the number of photons of light with a wavelength of 4000 pm that provide 1 J of energy ?

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9. A photon of wavelength $4 \times 10^{-7} m$ strikes on metal surface , the work function of the metal being $2.13 eV$ Calculate :

(i) the energy of the photon (ev)

(ii) the kinetic energy fo the emission and the velocity of the photoelectron $\left(1 eV = 1,6020 \times 10^{-19} J\right)$,

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10. Electromagnetic radiation of wavelength 242 nm is just sufficient to ionise a sodium

atom. Calculate the energy corresponding to this wavelength and the ionisation potential of Na.

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11. A 25 watt bulb emits monochromatic yellow light of wavelength of 0.57μ m. Calculate the rate of emission of quanta per second .

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12. Electrons are emitted with zero velocity from a metal surface when it is exposed to radiation of wavelength 6800 Å . Calculate threshold frequency (v_0) and work function (W_0) of the metal.

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13. what is the wavelength of light emitted when the electron in a hydrogen atom

undergoes transition from an energy level with n=4 to and energy level with n=2 ?

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14. How much energy is required to ionise a H - atom if the electron occupies $n = 5$ orbit ? Compare your answer with the ionization energy of H-atom (energy required to remove the electron from nth orbit).

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15. What is the maximum number of emission lines when the excited electron of a H atom in $n = 6$ drop to the ground state?

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16. a. The energy associated with the first orbit in the hydrogen atom is $-2.18 \times 10^{-18} J \text{atom}^{-1}$. What is the energy associated with the fifth orbit?

b. Calculate the radius of Bohr's fifth orbit for hydrogen atom.

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17. Calculate the wave number for the longest wavelength transition in the Balmer series of atomic hydrogen . $\left(R_H = 109677 cm^{-1}\right)$.

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18. What is the energy in joules required to shift the electron of the hydrogen atom from the first Bohr orbit to the fifth Bohr orbit ?

And what is the wavelength of the light emitted when the electron returns to the ground state ? The ground state electron energy is -218×10^{-11} erg.

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19. What is the energy in joules required to shift the elertcon of the hydrogen atom from the first Bohr orbit to the fifth Bohr orbit ? And what is the wavelenght of the light emitted when the electron returns to the

ground state ? The ground state electron energy is -218×10^{-11} erg.

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20. Calculate the wavelength of an electron moving with a velocity of $2.05 \times 10^{7} ms^{-1}$.

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21. The mass of an electron is $9.1 \times 10^{-31} kg$. If its K.E. is $3.0 \times 10^{25} J$. Calculate its

wavelength .

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22. Which of the following are isoelectronic species, i.e., those having the same number of electrons:

$Na^{\oplus}, K^{\oplus}, Mg^{2+}, Ca^{2+}, S^{2-}, Ar$

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23. i. Write the electronic configurations of the following ions:

a. H^{Θ}, b. $Na^{\oplus}$, c. O^{2-}, d. F^{Θ}

ii. What are the atomic numbers of elements whose outermost electrons are represented by

a. $3s^1$, b. $2p^3$, c. $3p^5$?

iii. Which atoms are indicated by the following configurations?

a. $[He]2s^1$, b. $[Ne]3s^23p^3$, c. $[Ar]4s^23d^1$

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

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25. An electron is in one of the $3d$ orbitals. Give the possible values of $n, l,$ and m for this electron.

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26. An atom of an element contains 29 electrons and 35 neutrons. Deduce

a. The number of protons and

b. The electronic configuration of the element.

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27. Give the number of electrons in the species

H_2^+, H_2 and $O_2^{\oplus}$

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28. a. An atomic orbital has $n = 3$. What are the possible values of l and m?

b. List the quantum numbers $(m \text{ and } l)$ of electrons for $3d$ orbital.

c. Which of the following orbitals are possible" $1p$, $2s$, $2p$, and $3f$?

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29. Using s, p, d notations, describe the orbital with the following quantum numbers.

a. $n = 1, l = 0,$ b. $n = 3, l = 1$

c. $n = 4, l = 2,$ d. $n = 4, l = 3$

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30. Explain , giving reason , which of the following sets of quantum number are not possible

a	$n = 0$	$l = 0$	$m_1 = 0$	$m_s = +1/2$
b	$n = 1$	$l = 0$	$m_1 = 0$	$m_s = -1/2$
c	$n = 1$	$l = 1$	$m_1 = 0$	$m_s = +1/2$
d	$n = 2$	$l = 1$	$m_1 = 0$	$m_s = -1/2$
e	$n = 3$	$l = 3$	$m_1 = -3$	$m_s = +1/2$
f	$n = 3$	$l = 1$	$m_1 = 0$	$m_s = +1/2$

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31. How many electron in an atom may have the following quantum number ?

a. $n = 4, m_s = -\frac{1}{2}$

b. $n = 3, l = 0$

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32. Show that the circumference of the Bohr orbit for the hydrogen atom is an integral multiple of the de Broglie wavelength

associated with the electron revolving around the orbit.

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

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34. Calculate the energy required for the process ,

$He^+(g) \rightarrow He^{2+}(g) + e$

The ionization energy for the H-atom in the grounds state is $2.18 \times 10^{-18} J \text{atom}^{-1}$.

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35. If the diameter of a carbon atom is $0.15nm$, calculate the number of carbon atom which

can be placed side by side in a straight line length of scale of length $20cm$ long.

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36. 2×10^8 atoms of carbon are arranged side by side. Calculate the radius of carbon atom if the length of this arrangement is $2.4cm$.

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37. The diameter of zinc atom is $2.6A$. Calculate (a) radius of zinc atom in pm and (b) number of atoms present in a length of $1.6cm$ if the zinc atoms are arranged side by side lengthwise.

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38. A certain particle carries $2.5 \times 10^{-16}C$ of static electric charge. Calculate the number of electrons present in it.

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39. In Milikan's experiment, static electrons charge on the oil drops has been obtained by shining X-rays. If the static electric charge on the oil drop is $-1.282 \times 10^{-18} C$, calculate the number of electrons present on it.

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40. In Rutherford's experiment, generally the thin foil of heavy atoms, such as gold,

platinum, etc. have been used to be bombarded by the α-particles. If the thin foil of light atoms such as aluminium etc. Is used, what difference would be observed form the above results?

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41. Symbols $._{35}^{79}Br$ and ^{79}Br can be written whereas symbols $\_(79)^{35}Br$ and ^{35}Br are not acceptable. Answer briefly.

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42. An element with mass number 81 contains $31.7\,\%$ more neutrons as compared to protons. Assign the atomic symbol.

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43. An ion with mass number 37 possesses one unit of negative charge. If the ion contains $11.1\,\%$ more neutrons than the electrons, find symbol of the ion.

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44. An ion with mass number 56 contains 3 units of positive charge and 30.4% more neutrons then electrons. Assign the symbol to this ion.

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45. Arrange the following type of radiations in increasing order of frequency: (a) radiation from microwave oven (b) amber light from

traffic signal (c). radiation from FM radio (d) cosmic rays from outer space and (e) X-rays

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46. Nitrogen laser produces a radiation at a wavelength of $33.71nm$. If the number of photons emitted is 5.6×10^{24}. calculate the power of this laser.

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47. Neon gas is generally used in the sign boards. If it emits strongly at $616nm$, calculate

a. The frequency of emission,

b. The distance traveled by this radiation in $30s$

c. The energy of quantum and

d. The number of quanta present if it produces $2J$ of energy.

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48. In astronomical observations, signals observed from the distant stars are generally weak. If the photon detector receives a total of $3.15 \times 10^{-18} J$ from the radiations of $600 nm$, calculate the number of photons received by the detector.

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49. Lifetimes of the molecules in the excited states are often measured by using pulsed

radiation source of duration nearly in the nano second range. If the radiation source has the duration of 2 ns and the number of photons emitted during the pulse is 2.5×10^{15}, calculate the energy of the source.

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50. The longest wavelength doublet absorption is observed at 589 and $589.6nm$. Calculate the frequency of each transition and energy difference between two excited states.

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51. The work function for caesium atom is $1.9eV$. Calculate (a) the threshold wavelength and (b) the threshold frequency of the radiation. If the caesium element is irradiated with a wavelength $500nm$, calculate the kinetic energy and the velocity of the ejected photoelectron.

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52. Following results are observed when sodium metal is irradiated with different wavelengths. Calculate (a) threshold wavelength and (b) Planck's constant.

$\lambda(nm)$	5000	450	400
$v \times 10^{-5}\left(cms^{-1}\right)$	2.55	4.35	5.35

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53. The ejection of the photoelectron from the silver metal in the photoelectric effect experiment can be stopped by applying the

voltage of $0.35V$ when the radiation $256.7nm$ is used. Calculate the work function for silver metal.

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54. If the photon of the wavelength $150pm$ strikes an atom and one of its inner bound electrons is ejected out with a velocity of $1.5 \times 10^7 ms^{-1}$, calculate the energy with which it is bound to the nucleus.

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55. Emission transitions in the Paschen series end at orbit $n = 3$ and start from orbit n and can be represented as $v = 3.29 \times 10^{15}(Hz)\left[1/3^2 - 1/n^2\right]$ Calculate the value of n if the transition is observed at $1285nm$. Find the region of the spectrum.

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56. Calculate the wavelength for the emission transition if it starts from the orbit having radius $1.3225nm$ ends at $211.6pm$. Name the series to which this transition belongs and the region of the spectrum.

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57. Dual behaviour of matter proposed by de Broglie led to the discovery of electron microscope often used for the highly

magnified images of biological molecules and other type of material. If the velocity of the electron in this microscope is $1.6 \times 10^{6} ms^{-1}$. Calculate de Broglie wavelength associated with this electron.

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58. Similar to electron diffraction, neutron diffraction microscope is also used for the determination of the structure of molecules. If the wavelength used here is $800pm$, calculate

the characteristic velocity associated with the neutron.

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59. If the velocity of the electron in Bohr's first orbit is $2.19 \times 10^6 ms^{-1}$, calculate the de Broglie wavelength associated with it.

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60. If the position of the electron is measured within an accuracy of $\pm 0.002nm$. Calculate the uncertainty in the momentum of the electron. Suppose the momentum of the electron is $h/4\pi_m \times 0.05nm$, is there any problem in defining this value.

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61. The quantum numbers of six electrons are given below. Arrange them in order of

increasing energies. If any of these combination(s) has/have the same energy lists:

1. $n = 4, l = 2, m_i = -2, m_s = -1/2$

2. $n = 3, l = 2, m_l = 1, m_s = +1/2$

3. $n = 4, l = 2, m_l = -2, m_s = -1/2$

4. $n = 3, l = 2, m_i = -1, m_s = +1/2$

5. $n = 3, l = 1, m_l = -1, m_s = +1/2$

6. $n = 4, l = 1, m_l = 0, m_s = +1/2$

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62. The bromine atom possesses $3s$ electrons. It contains six electrons in $2p$ orbitals, six electrons in $3p$ orbitals and five electrons in $4p$ orbitals. Which of these electrons experience the lower effective nuclear charge?

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63. Among the following pairs of orbital which orbital will experience the larger effective

nuclear charge?

a. $2s$ and $3s$, b. $4d$ and $4f$, c. $3d$ and $3p$

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64. The unpaired electrons in Al and Si are present in $3p$ orbital. Which electrons will experience more effective nuclear charge from the nucleus?

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65. Indicate the number of unpaired electrons in:

a. P, $b.$ Si, $c.$ Cr,

d. Fe, $e.$ Kr

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66. a. How many sub-shell are associated with $n = 4$?

b. How many electron will be present in the sub-shell having m_s value of $-1/2$ for $n = 4$?

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67. a. How many sub-shell are associated with $n = 4$?

b. How many electron will be present in the sub-shell having m_s value of $-1/2$ for $n = 4$?

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