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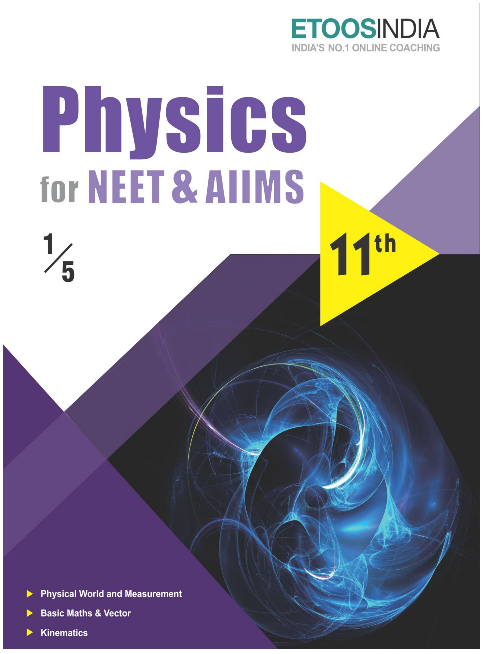
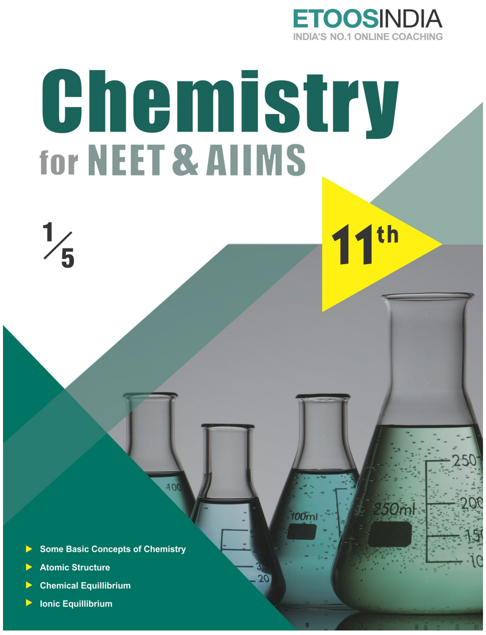
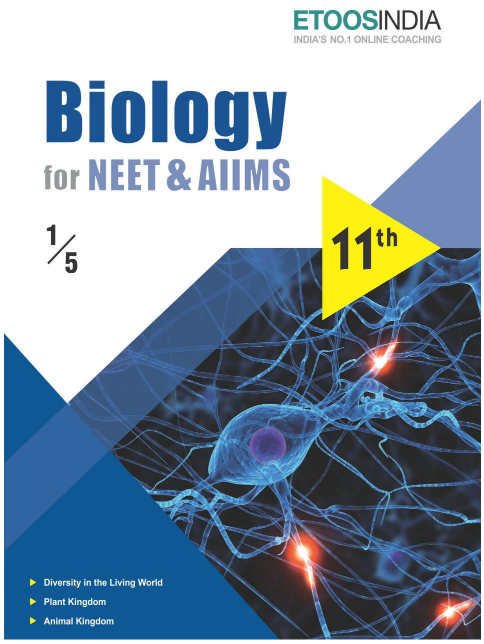
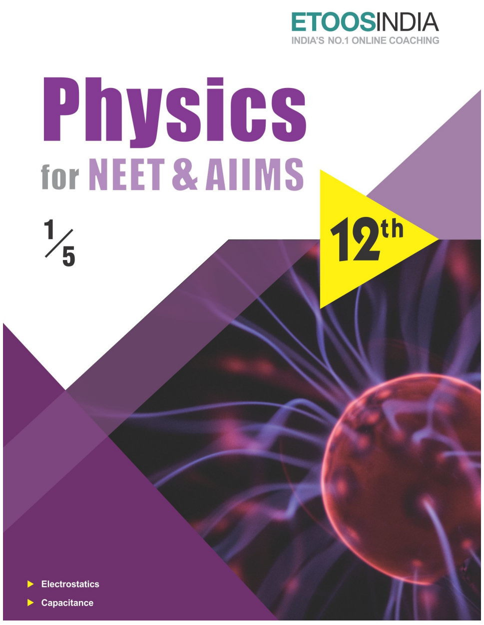
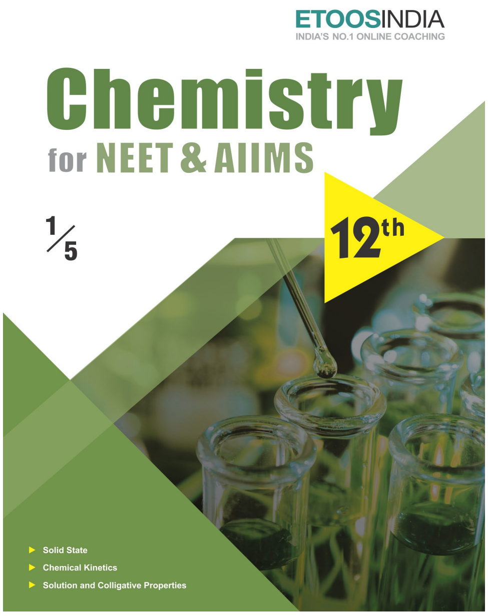
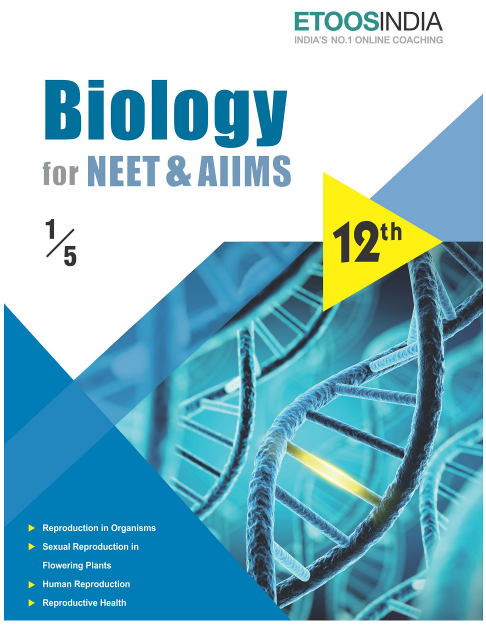












ETOOS Comprehensive Study Material For NEET & AIIMS

CHAPTER 02

ATOMIC STRUCTURE

Nothing exists excpet atoms and empty space: everything else is opinion

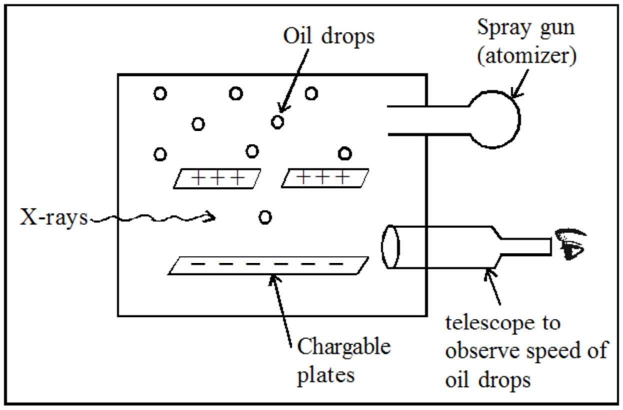
"DEMOCRITUS"

INTRODUCTION

The continued subdivisions of matter would ultimately yield atoms which would not be further divisible. The word atom has been derived from the Greek word 'a-tomio' which means uncutable or non divisible. These earlier ideas were mere speculations and there was no way to test them experimentally. These ideas remained dorment for a very long time and were revived again be scientists in the nineteenth century.

The atomic theory of matter was first proposed on a firm scientific basis by John Dalton, a British school teacher in 1808. His theory, called Dalton's atomic theory, regarded the atom as the ultimate particle of matter.

In this unit we start with the experimental observations made by scientists towards the end of nineteenth and beginning of twentieth century. These established that atoms can be further divided into sub atomic particles, i.e., electrons, protons and neutrons a concept very different from that of Dalton.



measured by R.A. Milikan in 1909 by the Milikan's oil drop experiment.

- The apparatus used by him is shown in fig.
- An oil droplet falls through a hole in the upper plate. The air between the plates is then exposed to X-rays which eject electrons from air molecules. Some of these e^- are captured by the oil droplet and it acquires a negative charge.

The metal plates were given an electric charge, and as the electric field between the plates was increased, it was possible to make some of the drops travel upwards at the same speed as they were previously falling.

By measuring the speed, and knowing things like the strength of the field and the density of the oil, radius of oil drops, Milikan was able to calculate the magnitude of the charge on the oil drops. He found that the smallest charge to be found on them was approximately **1.59 ×10–19 C**. This was recognised as the charge on an e^-. The modern value is **1.602 × 10–19 C**.

Mass of the electron :

Mass of the e^- can be calculate from the value of e/m and the value of e

$$m = \frac{e}{e/m} = \frac{-1.602\times10^{-19}}{-17588\times10^{8}} = 9.1096\times10^{-28}\text{ g} \quad \text{or} \quad = 9.1096\times10^{-31}\text{ kg}$$

This is termed as the rest mass of the electron i.e. mass of the electron when moving with low speed. The mass of a moving e^- may be calculate by applying the following formula.

$$\text{Mass of moving } e^- = \frac{\text{rest mass of } e^-}{\sqrt{1-(v/c)^2}}$$

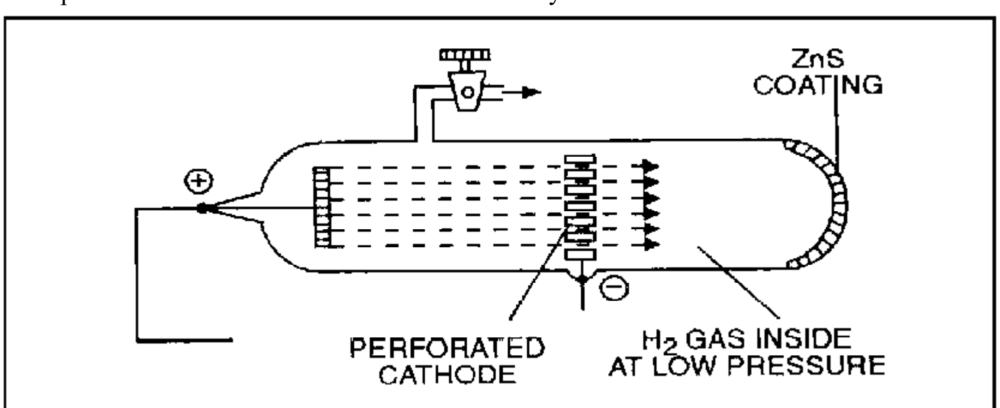
Where v is the velocity of the e^- and c is the velocity of light.

When $v = c \Rightarrow$ mass of $e^- = \infty$

$v > c \Rightarrow$ mass of e^- = imaginary

(ii) Anode rays or Positive rays (Discovery of Proton)

- The first experiment that lead to the discovery of the +ve particle was conducted by 'Goldstein'.
- He used a perforated cathode in the modified cathode ray tube.



Production of Anode rays or Positive rays

Etoos Tips & Formulas

1. Frequency, $\nu = \frac{c}{\lambda}$

2. Energy/photon, $E = h\nu = \frac{hc}{\lambda}$

Also, $E = \frac{12375}{\lambda} eV$, if λ is in Å

3. Electronic energy change during transition, $\Delta E = E_{n_2} - E_{n_1}$

$n_2 > n_1$, emission spectra if electron jumps from n_2 to n_1 shell and absorption spectra if electron excites from n_1 to n_2 shell.

4. Radius of n^{th} Bohr orbit of H atom, $r_n = \frac{n^2h^2}{4\pi^2 me^2 K}$ (where $K = 9 \times 10^9$)

r_1 for H = 0.529 Å ; r_n for H like atom $r_n = 0.529 \times \frac{n^2}{Z}$ Å

5. Velocity of electron in n^{th} Bohr orbit of H atom, $v = \frac{2\pi KZe^2}{nh}$

$v = 2.18 \times 10^8 \frac{Z}{n} cm/sec$.

6. Energy of electron in n^{th} Bohr orbit of H atom, $E = \frac{2\pi^2 mZ^2 e^4 K^2}{n^2h^2}$

where n = 1, 2, 3..........

$[E = -13.6 \times \frac{Z^2}{n^2}$ kcal/mole (1 cal = 4.18 J)]

E_1 for H = -21.72×10^{-12} erg = -13.6 eV, E_1 for H like atom = E_1 for H $\times Z^2$

7. Wavelength emitted during transition in H atom,

$$\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = \frac{2\pi^2 me^4}{ch^3}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] \text{ (in C.G.S.)}$$

8. Photoelectric effect $h\nu = w + \frac{1}{2}mu^2$ or $h\nu$ = I.E. + K.E.

9. Possible transitions for a jump from n_2 to n_1 = $\sum(n_2 - n_1)$

10. Angular momentum of electron in an orbit = n. $(h/2\pi)$

11. Angular momentum of electron in an orbital = $(nh/2\pi)\sqrt{[\ell(\ell+1)]}$

12. Total spin = $\pm\left(\frac{1}{2} \times n\right)$; where n is no. of unpaired electrons.

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. $E^n = \frac{-313.6}{n^2}$ 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. $\bar{\nu} = \frac{1}{\lambda} = \left(\frac{1}{2^2} - \frac{1}{4^2}\right) RZ^2 = \frac{3}{4}R$

In H–spectrum for the same $\bar{\nu}$ 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. $\frac{hc}{\lambda} = \frac{430.53 \times 10^3}{6.023 \times 10^{23}} + K.E.$

$K.E. = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{253.7 \times 10^{-9}} - \frac{430.53 \times 10^3}{6.023 \times 10^{23}}$

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

$\therefore$ Fraction $= \frac{6.9 \times 10^{-20}}{7.83 \times 10^{-19}} = 0.088 = 8.86\%$

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

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

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.

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

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)

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

1. The energy of photon is given as : Δe/atom = 3.03×10^{-19} J atom^{-1}, then the wavelength (λ) of the photon is [CBSE AIPMT 2000]
(Given, h(Planck's constant) = 6.63×10^{-34} Js, c (velocity of light) = 3.00×10^{8} ms^{-1})
(A) 6.56 nm (B) 65.6 nm
(C) 656 nm (D) 0.656 nm

2. The following quantum number are possible for how many orbital(s) n = 3, l = 2 and m = + 2? [CBSE AIPMT 2001]
(A) 1 (B) 2
(C) 3 (D) 4

3. The hydrogen atom, energy of first excited state is – 3.4 eV. Then, KE of same orbit of hydrogen atom is [CBSE AIPMT 2002]
(A) + 3.4 eV (B) + 6.8 eV
(C) – 13.6eV (D) + 13.6 eV

4. The value of Planck's constant is 6.63×10^{-34} Js. The velocity of light is 3.0 × 108 ms–1. Which value is closest to the wavelength in nanometers of a quantum of light with frequencey of 8×10^{15} s^{-1} ? [CBSE AIPMT 2002]
(A) 4×10^{1} (B) 3×10^{7}
(C) 2×10^{-25} (D) 5×10^{-18}

5. 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) 1.54×10^{15} s^{-1} (B) 1.03×10^{15} s^{-1}
(C) 3.08×10^{15} s^{-1} (D) 2.00×10^{15} s^{-1}

6. 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}

7. 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) 5.79×10^{6} ms^{-1} (B) 5.79×10^{7} ms^{-1}
(C) 5.79×10^{8} ms^{-1} (D) 5.79×10^{5} ms^{-1}

8. 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

9. 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)

10. 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) $\sqrt{\frac{h}{\pi}}$

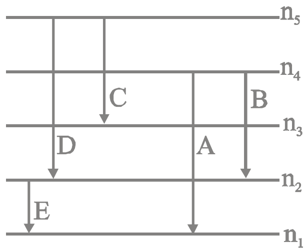
11. The measurement of the electrons position is associated with an uncertainty in momentum, which is equal to 1×10^{-18} gcm s^{-1}, The uncertainty in electron velocity is (mass of an electron is 9×10^{-28} g) [CBSE AIPMT 2008]
(A) 1×10^{9} cm s^{-1} (B) 1×10^{6} cm s^{-1}
(C) 1×10^{5} cm s^{-1} (D) 1×10^{11} cm s^{-1}

12. 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) $2n^2$

13. 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

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) $\nu \propto n^{2/3}$

11th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1
1. Electrostatics
2. Capacitance

Module-2
1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3
1. Electromagnetic Induction
2. Alternating Current

Module-4
1. Geometrical Optics
2. Wave Optics

Module-5
1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)
1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)
1. Electrochemistry
2. Surface Chemistry

Module-3(IC)
1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)
1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)
1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1
1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2
1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3
1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4
1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5
1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues