DPP – 7 [de-Broglie Equation]

Chapter: Structure of Atom

"Shayad tumhe abhi apni progress nahi dikh rahi… Par every page you solve is quietly changing your future."

TYPE 1 : de-Broglie Wavelength Numericals

Q.1 **A 0.66 kg ball is moving with a speed of 100 m/s. The associated wavelength will be ($h = 6.6 \times 10^{-34}$ Js)**

(1) 6.6×10^{-34} m
(2) 1.0×10^{-35} m
(3) 1.0×10^{-32} m
(4) 6.6×10^{-32} m

Q.2 **What is the wavelength (in m) of a particle of mass 6.62×10^{-29} g moving with a velocity of 10^3 ms^{-1}?**

(1) 6.62×10^{-4} (2) 6.62×10^{-3} (3) 10^{-5} (4) 10^{5}

Q.3 **The de-Broglie wavelength of a particle with mass 1 g and velocity 100 m/s is**

(1) 6.63×10^{-35} m
(2) 6.63×10^{-34} m
(3) 6.63×10^{-33} m
(4) 6.65×10^{-35} m

Q.4 **Which of the following should be the wavelength of an electron if its mass is 9.1×10^{-31} kg, its velocity is $\frac{1}{10}$ of that of light, and the value of h is 6.6252×10^{-34} joule second?**

(1) 2.426×10^{-11} metre
(2) 2.446×10^{-7} metre
(3) 2.246×10^{-9} metre
(4) 2.246×10^{-13} metre

Q.5 **Calculate de-Broglie wavelength of an electron (in m) travelling at 1% of the speed of light.**

(1) 2.73×10^{-24}
(2) 2.42×10^{-10}
(3) 242.2×10^{10}
(4) None of these

Q.6 **The wavelength associated with an electron moving with velocity 10^{10} ms^{-1} is**

(1) 6.62×10^{-10} m
(2) 7.27×10^{-14} m
(3) 3.69×10^{-12} m
(4) 4.92×10^{-11} m

Q.7 **A ball weighing 25 g moves with a velocity of 6.6×10^4 cm s^{-1}. Find out the de-Broglie λ associated with it.**
($h = 6.6 \times 10^{-34}$ erg s)

(1) 4×10^{-33} cm
(2) 4×10^{-29} cm
(3) 4×10^{-36} cm
(4) 2×10^{-33} cm

Q.8 The mass of a particle is 1 mg and its velocity is 4.5×10^{5} cm per second. What should be the de-Broglie wavelength of this particle?
($h = 6.652 \times 10^{-27}$ erg second)

(1) 1.4722×10^{-29} cm
(2) 1.4722×10^{-24} cm
(3) 1.4722×10^{-32} cm
(4) 1.4722×10^{-34} cm

TYPE 2 : de-Broglie wavelength and kinetic energy

Q.9 The de-Broglie relationship between λ of a moving particle with K.E. is

(1) $\lambda = \dfrac{h}{2m(\text{K.E.})}$
(2) $\lambda = \dfrac{\sqrt{2m(\text{K.E.})}}{h}$
(3) $\lambda = \dfrac{h}{\sqrt{2m(\text{K.E.})}}$
(4) $\lambda = \dfrac{h}{2m\sqrt{\text{KE}}}$

Q.10 If the kinetic energy of an electron is 2.5×10^{-24} J, calculate its de-Broglie wavelength.
($m_e = 9.1 \times 10^{-31}$ kg, $h = 6.626 \times 10^{-34}$ Js)

(1) 311.1 nm (2) 155.5 nm (3) 622.2 nm (4) 77.8 nm

Q.11 An electron has a kinetic energy of 2.8×10^{-23} J. de-Broglie wavelength will be nearly
($m_e = 9.1 \times 10^{-31}$ kg)

(1) 9.28×10^{-24} m
(2) 9.28×10^{-7} m
(3) 9.28×10^{-8} m
(4) 9.28×10^{-10} m

Q.12 If the kinetic energy of an electron is increased four times, the wavelength of the de-Broglie wave associated with it would become **[JEE-Main(online) 2012]**

(1) Two times (2) Half (3) One fourth (4) Four times

Q.13 If kinetic energy of a proton is increased nine times, the wavelength of the de-Broglie wave associated with it would become

(1) 3 times
(2) 9 times
(3) $\frac{1}{3}$ times
(4) $\frac{1}{9}$ times

TYPE 3 : de-Broglie wavelength and Voltage

Q.14 **de-Broglie wavelength is related to applied voltage as**

(1) $\lambda = \frac{12.3}{\sqrt{h}}\,\text{A}^\circ$
(2) $\lambda = \frac{12.3}{\sqrt{V}}\,\text{A}^\circ$
(3) $\lambda = \frac{12.3}{\sqrt{r}}\,\text{A}^\circ$
(4) $\lambda = \frac{12.3}{\sqrt{m}}\,\text{A}^\circ$

Q.15 **What is the ratio of the de-Broglie wavelengths for electrons accelerated through 200 volts and 50 volts?**

(1) 1 : 2
(2) 2 : 1
(3) 3 : 10
(4) 10 : 3

TYPE 4 : comparative applications of de-Broglie relation

Q.16 **Two particles X and Y are in motion. If the wavelength associated with particle X is 4×10^{-8} m, calculate the wavelength associated with particle Y if its momentum is half of X.**

(1) 8×10^{-8} m
(2) 2×10^{-8} m
(3) 4×10^{-8} m
(4) 16×10^{-8} m

Q.17 **The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths i.e. λ_1 and λ_2 will be**

(1) $\lambda_1 = \lambda_2$
(2) $\lambda_1 = 2\lambda_2$
(3) $\lambda_1 = 4\lambda_2$
(4) $\lambda_1 = \frac{1}{2}\lambda_2$

Q.18 **A particle X moving with a certain velocity has a de-Broglie wavelength of 1 Å. If particle Y has a mass of 25% that of X and velocity 75% that of X, the de-Broglie wavelength of Y will be**

(1) 3 Å
(2) 5.33 Å
(3) 6.88 Å
(4) 48 Å

Q.19 **A particle is moving 3 times faster than the speed of e^-. The ratio of wavelength of the particle to that of the electron is 1.8×10^{-4}. The particle is**

(1) Neutron
(2) α-particle
(3) Deutron
(4) Tritium

Q.20 **Two particles A and B are in motion. If the wavelength associated with particle A is 5×10^{-8} m, calculate the wavelength associated with particle B if its momentum is half of A.**

(1) 5×10^{-8} m
(2) 10^{-5} cm
(3) 10^{-7} cm
(4) 5×10^{-8} cm

TYPE 5 : Theortical Questions

Q.21 Which of the following has the least de-Broglie λ?

(1) e^- (2) p (3) CO_2 (4) SO_2

Q.22 The de-Broglie wavelength associated with a matter particle is

(1) Directly proportional to the momentum of the particle
(2) Directly proportional to the velocity of the particle
(3) Inversely proportional to the momentum of the particle
(4) Inversely proportional to Planck's constant

Q.23 The de-Broglie wavelength associated with a material particle is **[NCERT Pg. 49]**

(1) Directly proportional to its energy
(2) Inversely proportional to its energy
(3) Inversely proportional to momentum
(4) Directly proportional to momentum

Q.24 Which of the following statements is true?

(1) The kinetic energy of an electron is inversely proportional to square of its momentum.
(2) de-Broglie wavelength associated with a particle is directly proportional to its mass.
(3) de-Broglie wavelength associated with a particle is directly proportional to square of its velocity.
(4) The kinetic energy of an electron is directly proportional to accelerating potential.

Q.25 Velocity of de-Broglie wave is given by

(1) $\frac{c^2}{v}$
(2) $\frac{h\nu}{mc}$
(3) $\frac{mc^2}{h}$
(4) $v\lambda$

TYPE 6 : de-Broglie interpretation of Bohr's quantization condition.

Q.26 For a valid Bohr orbit, its circumference should be

(1) $= n\lambda$
(2) $= (n-1)\lambda$
(3) $> n\lambda$
(4) $< n\lambda$

Q.27 The number of waves in the third orbit of H-atom is

(1) 1 (2) 2 (3) 4 (4) 3

Q.28 Number of waves in the fourth orbit is

(1) 4 (2) 5 (3) 0 (4) 1

Q.29 The circumference of second orbit of H-atom, if the wavelength of electron is 5×10^{-9} m, is

(1) 50×10^{-9} m
(2) 10^{-8} m
(3) 10^{-10} m
(4) 10^{-18} m

Q.30 If the de-Broglie wavelength of the fourth Bohr orbit of hydrogen atom is 4 Å, the circumference of the orbit will be

(1) 4 Å (2) 4 nm (3) 16 Å (4) 16 nm

Q.31 What is the de-Broglie wavelength associated with the hydrogen electron in its third orbit?

(1) 9.96×10^{-10} cm
(2) 9.96×10^{-8} cm
(3) 9.96×10^{4} cm
(4) 9.96×10^{8} cm

Q.32 If the radius of first orbit of H atom is a_0, the de-Broglie wavelength of an electron in the third orbit is **[JEE-Main(online) 2012]**

(1) $6\pi a_0$ (2) $8\pi a_0$ (3) $2\pi a_0$ (4) $4\pi a_0$

Q.33 Energy of electron in orbit of H-atom is -1.51 eV. Wavelength produced by the electron in same orbit if 1st orbit of H has radius x.

(1) $2\pi x$
(2) $3\pi x$
(3) $6\pi x$
(4) $9\pi x$

Q.34 The number of waves made by a Bohr electron in an orbit of maximum magnetic quantum number $+2$ is

(1) 3 (2) 4 (3) 2 (4) 1