1. The radius of the first Bohr orbit of a hydrogen atom is

A. 0.529 Å
B. 1.06 Å
C. 0.1059 nm
D. 5.29 nm

Answer: A
Explanation: According to Bohr's model, the radius of the nth orbit is given by:
$r = 0.529 \times n^2$ Å for hydrogen.
For n = 1 → r = 0.529 Å (most commonly accepted value for the ground state).

2. In Bohr's model of the hydrogen atom, the quantization of angular momentum is expressed as

A. mvr = nh
B. mvr = nh / 2π
C. mvr = h / n
D. mvr = n / h

Answer: B
Explanation: Bohr's quantization rule: angular momentum (mvr) of electron is an integral multiple of h/2π → mvr = nh/2π, where n = 1, 2, 3,...

3. The total energy of an electron in the nth orbit of hydrogen atom is

A. 13.6 × n eV
B. $-13.6 / n^2$ eV
C. $-13.6 \times n^2$ eV
D. -13.6 × n eV

Answer: B
Explanation: Bohr derived the energy of electron in nth orbit as:
$E_n = -13.6 / n^2$ eV for hydrogen atom (Z = 1).
The energy is negative, showing that the electron is in a bound state.

4. The speed of an electron in the first orbit of hydrogen atom is approximately

A. 3×10^8 m/s

B. 2.18×10^6 m/s
C. 1.5×10^7 m/s
D. 3×10^6 m/s

Answer: B
Explanation: Speed of electron in nth orbit:
$v_n = 2.18 \times 10^6 \times (Z/n)$ m/s.
For hydrogen (Z = 1), n = 1 → v = 2.18×10^6 m/s.

5. The wavelength of the first line in the Balmer series of hydrogen spectrum is

A. 656.3 nm
B. 434.2 nm
C. 486.1 nm
D. 121.5 nm

Answer: A
Explanation: The first Balmer transition is from n = 3 to n = 2, which corresponds to a wavelength of 656.3 nm (visible red light).

6. The energy required to excite a hydrogen atom from its ground state to the first excited state is

A. 3.4 eV
B. 10.2 eV
C. 12.1 eV
D. 13.6 eV

Answer: B
Explanation:
Ground state energy = -13.6 eV
First excited state (n=2) energy = -3.4 eV
Energy needed = -3.4 - (-13.6) = 10.2 eV

7. The radius of the third orbit of hydrogen is

A. 4.76 Å
B. 3.17 Å
C. 1.59 Å

D. 0.529 Å

Answer: A
Explanation:
$r_n = 0.529 \times n^2$ Å
For n = 3 → r = 0.529 × 9 = 4.761 Å

8. The transition from n = 2 to n = 1 in hydrogen atom lies in

A. Infrared region
B. Visible region
C. Ultraviolet region
D. Microwave region

Answer: C
Explanation:
Transition to n = 1 belongs to Lyman series which lies in the UV region.
n = 2 → n = 1 gives high energy UV photon.

9. The number of spectral lines possible when an electron jumps from n = 4 to n = 1 level is

A. 3
B. 4
C. 6
D. 5

Answer: C
Explanation:
Number of spectral lines = n(n - 1)/2
= 4(3)/2 = 6 lines

10. In a hydrogen atom, the kinetic energy of the electron in the nth orbit is given by

A. $+13.6 / n^2$ eV
B. $-13.6 / n^2$ eV
C. $27.2 / n^2$ eV
D. Zero

Answer: A
Explanation:
Kinetic Energy (K.E.) = $+13.6 / n^2$ eV
It's positive and half of the magnitude of potential energy but opposite in sign.

11. The potential energy of an electron in the second orbit of hydrogen is

A. -13.6 eV
B. -6.8 eV
C. -3.4 eV
D. -27.2 eV

Answer: B
Explanation:
P.E. = $2 \times E = 2 \times (-13.6 / n^2)$
For $n = 2 \rightarrow$ P.E. = $2 \times (-13.6 / 4) = -6.8$ eV

12. The maximum number of lines obtained in emission spectra when electron jumps from n = 5 to n = 1 is

A. 4
B. 5
C. 10
D. 6

Answer: C
Explanation:
Number of lines = $n(n - 1)/2 = 5(4)/2 = 10$

13. In Bohr’s model, total energy of the electron is related to its kinetic energy (K.E.) as

A. E = -K.E.
B. E = K.E.
C. E = -2K.E.
D. E = 2K.E.

Answer: A
Explanation:
From Bohr’s theory:

Total energy = K.E. + P.E.
But P.E. = -2K.E. → E = K.E. - 2K.E. = -K.E.

14. The frequency of revolution of an electron in the first orbit of hydrogen atom is approximately

A. 4.1×10^{14} Hz
B. 1.3×10^{16} Hz
C. 6.6×10^{15} Hz
D. 2.2×10^{6} Hz

Answer: A
Explanation:
For n = 1 → frequency of revolution = ~4.1×10^{14} Hz
This matches visible light frequency.

15. The ratio of velocities of an electron in the first and third orbit of hydrogen atom is

A. 1 : 3
B. 3 : 1
C. 1 : 9
D. 9 : 1

Answer: B
Explanation:
$v \propto 1/n$
So, $v_1/v_3 = 3/1 = 3 : 1$

16. The energy difference between two levels in a hydrogen atom is 10.2 eV. What is the frequency of the emitted photon during this transition?

A. 2.46×10^{14} Hz
B. 1.55×10^{15} Hz
C. 2.00×10^{15} Hz
D. 3.08×10^{14} Hz

Answer: B
Explanation:
$E = h \times f \Rightarrow f = E/h$

$f = (10.2 \text{ eV} \times 1.6 \times 10^{-19} \text{ J}) / (6.63 \times 10^{-34} \text{ J·s}) \approx 1.55 \times 10^{15}$ Hz

17. Which of the following transitions in hydrogen atom will emit photon of maximum energy?

A. n = 3 to n = 2
B. n = 4 to n = 1
C. n = 2 to n = 1
D. n = 5 to n = 4

Answer: B
Explanation:
Photon energy ∝ difference in energy levels
$E_4 = -13.6/16 = -0.85$ eV, $E_1 = -13.6$ eV
$\Delta E = 13.6 - 0.85 = 12.75$ eV → maximum among options

18. The ionization energy of hydrogen atom is

A. 3.4 eV
B. 13.6 eV
C. 10.2 eV
D. 27.2 eV

Answer: B
Explanation:
Ionization energy is energy required to remove the electron from ground state to infinity
$E_1 = -13.6$ eV ⇒ Ionization energy = +13.6 eV

19. Which of the following series lies in the infrared region?

A. Lyman
B. Balmer
C. Paschen
D. None

Answer: C
Explanation:
Paschen series (n > 3 to n = 3) lies in IR region
Lyman → UV, Balmer → visible

20. The velocity of electron in nth orbit of hydrogen-like ion is proportional to

A. Z / n
B. n / Z
C. Z^2 / n^2
D. 1 / n

Answer: A
Explanation:
$v_n \propto Z / n$
From Bohr's derivation: $v_n = (2.18 \times 10^6$ m/s$) \times (Z / n)$

21. The ratio of kinetic energy to potential energy of an electron in a hydrogen atom is

A. 1 : 2
B. 2 : 1
C. -1 : 2
D. -1 : 1

Answer: B
Explanation:
From Bohr model:
K.E. = -½ P.E. ⇒ K.E. / P.E. = -½
But numerically, ratio = 2 : 1

22. Which statement is true for Bohr's model?

A. Electron loses energy continuously
B. Angular momentum is quantized
C. Orbit radii are independent of n
D. Energy is directly proportional to n

Answer: B
Explanation:
Bohr proposed that angular momentum = $n(h/2\pi)$, i.e., quantized.

23. A hydrogen atom is excited from ground state to n = 3 level. The number of spectral lines emitted during de-excitation will be

A. 3
B. 1
C. 6
D. 0

Answer: A
Explanation:
Number of lines = $n(n - 1)/2 = 3 \times 2 / 2 = 3$ lines

24. The transition responsible for the emission of Lyman-alpha line in hydrogen atom is

A. n = 3 to n = 1
B. n = 2 to n = 1
C. n = 4 to n = 1
D. n = 3 to n = 2

Answer: B
Explanation:
Lyman-alpha corresponds to transition from n = 2 to n = 1

25. The minimum energy required to remove an electron from the first orbit of He^+ (helium ion) is

A. 13.6 eV
B. 27.2 eV
C. 54.4 eV
D. 24.6 eV

Answer: C
Explanation:
Ionization energy of hydrogen-like ion: $E = 13.6 \times Z^2$
For He^+, $Z = 2 \rightarrow E = 13.6 \times 4 = 54.4$ eV

26. The energy emitted when an electron jumps from n = 4 to n = 2 in hydrogen is

A. 2.55 eV

B. 1.89 eV
C. 2.86 eV
D. 4.09 eV

Answer: A
Explanation:
$E_4 = -13.6/16 = -0.85$ eV
$E_2 = -13.6/4 = -3.4$ eV
$\Delta E = 3.4 - 0.85 = 2.55$ eV

27. Radius of nth orbit in hydrogen-like atom is directly proportional to

A. n^2 / Z
B. Z^2 / n
C. n / Z^2
D. $1 / n^2$

Answer: A
Explanation:
$r_n \propto n^2 / Z$
This is derived from Bohr's formula for radius:
$r_n = 0.529 \times (n^2 / Z)$ Å

28. The number of photons emitted per second by a hydrogen atom making transition from n = 3 to n = 2, if it emits 1 mW of power is (energy of one photon = 3.03×10^{-19} J)

A. 3.3×10^{15}
B. 3.3×10^{16}
C. 6.6×10^{16}
D. 6.6×10^{15}

Answer: A
Explanation:
$P = nh\nu \Rightarrow n = P / E = (1 \times 10^{-3}$ W$) / (3.03 \times 10^{-19}$ J$)$
$n \approx 3.3 \times 10^{15}$ photons/sec

29. In Bohr's model, the time period of electron in orbit is proportional to

A. n^3
B. n
C. 1 / n
D. n^2

Answer: A
Explanation:
$T \propto n^3$
Time period $T = 2\pi r / v$
Since $r \propto n^2$ and $v \propto 1/n \Rightarrow T \propto n^3$

30. Which of the following transitions will emit radiation of lowest frequency?

A. n = 3 to n = 2
B. n = 4 to n = 3
C. n = 5 to n = 4
D. n = 2 to n = 1

Answer: C
Explanation:
Lowest energy difference = lowest frequency
ΔE (5 to 4) is the least → hence emits lowest frequency radiation.

31. The wavelength of the first line of the Balmer series in hydrogen is approximately

A. 656 nm
B. 486 nm
C. 434 nm
D. 410 nm

Answer: A
Explanation:
First line of Balmer series (n = 3 to n = 2) corresponds to 656 nm (H-alpha line in red region of visible spectrum).

32. What is the angular momentum of an electron in the second orbit of hydrogen atom? (Use $h = 6.63 \times 10^{-34}$ J·s)

A. 6.63×10^{-34} J·s

B. 3.31×10^{-34} J·s
C. 1.33×10^{-33} J·s
D. 1.11×10^{-33} J·s

Answer: D
Explanation:
$L = n(h/2\pi) = 2 \times (6.63 \times 10^{-34}) / (2\pi) \approx 1.11 \times 10^{-33}$ J·s

33. Energy of an electron in the third orbit of hydrogen atom is

A. -1.51 eV
B. -3.4 eV
C. -13.6 eV
D. -0.85 eV

Answer: A
Explanation:
$E_n = -13.6/n^2 \rightarrow E_3 = -13.6/9 \approx -1.51$ eV

34. The ratio of velocities of electron in 1st and 2nd orbit of hydrogen atom is

A. 2 : 1
B. 1 : 2
C. 4 : 1
D. √2 : 1

Answer: A
Explanation:
$v_n \propto 1/n \rightarrow v_1/v_2 = 2 : 1$

35. In hydrogen atom, the shortest wavelength of Lyman series corresponds to the transition

A. n = ∞ to n = 1
B. n = 2 to n = 1
C. n = 3 to n = 1
D. n = 4 to n = 1

Answer: A

Explanation:
Shortest wavelength = highest energy transition = from $n = \infty$ to $n = 1$

36. The total number of spectral lines possible when an electron in hydrogen atom de-excites from n = 5 to n = 1 is

A. 10
B. 4
C. 5
D. 6

Answer: A
Explanation:
Number of spectral lines = $n(n - 1)/2 = 5 \times 4 / 2 = 10$

37. Which of the following transitions in hydrogen will emit photon in the visible range?

A. n = 2 to n = 1
B. n = 3 to n = 2
C. n = 4 to n = 3
D. n = 5 to n = 4

Answer: B
Explanation:
Balmer series ($n > 2 \rightarrow n = 2$) is in visible range.
n = 3 to 2 → H-alpha (red visible light)

38. If the radius of first Bohr orbit is 0.53 Å, the radius of third orbit will be

A. 0.53 Å
B. 1.59 Å
C. 4.77 Å
D. 3.27 Å

Answer: C
Explanation:
$r_n = r_1 \times n^2 = 0.53 \times 9 = 4.77$ Å

39. The energy required to excite hydrogen atom from n = 1 to n = 3 is

A. 12.09 eV
B. 10.2 eV
C. 1.89 eV
D. 13.6 eV

Answer: A
Explanation:
$E_1 = -13.6$ eV, $E_3 = -1.51$ eV
$\Delta E = 13.6 - 1.51 = 12.09$ eV

40. The number of photons emitted when 13.6 J of energy is released due to n = 2 to n = 1 transition in hydrogen is (energy per photon = 10.2 eV)

A. 8.5×10^{19}
B. 1.2×10^{20}
C. 1.3×10^{20}
D. 1.0×10^{20}

Answer: C
Explanation:
$E = nh\nu \rightarrow n = 13.6 \text{ J} / (10.2 \text{ eV} \times 1.6 \times 10^{-19})$
$= 13.6 / (1.632 \times 10^{-18}) \approx 1.3 \times 10^{20}$ photons

41. The wave number (in cm^{-1}) of a spectral line for transition from n = 3 to n = 2 in hydrogen atom is ($R = 1.097 \times 10^7 \text{ m}^{-1}$)

A. 15200
B. 20564
C. 45710
D. 12800

Answer: B
Explanation:
Wave number:
$R \times [1/2^2 - 1/3^2] = R \times (5/36)$
$= 1.097 \times 10^7 \times 5 / 36 = 1.52 \times 10^6 \text{ m}^{-1} = 20564 \text{ cm}^{-1}$

42. The kinetic energy of an electron in second orbit of hydrogen atom is

A. 6.8 eV
B. 3.4 eV
C. 1.7 eV
D. 13.6 eV

Answer: B
Explanation:
K.E. = -½ × E = -½ × (-13.6 / 4) = 3.4 eV

43. A hydrogen atom de-excites from 5th level to 2nd. What is the wavelength of emitted photon? (Use hc = 12400 eV·Å)

A. 4340 Å
B. 1280 Å
C. 4850 Å
D. 6560 Å

Answer: A
Explanation:
$E_5 = -13.6/25 = -0.544$ eV, $E_2 = -3.4$ eV
$\Delta E = 2.856$ eV
$\lambda = hc / \Delta E = 12400 / 2.856 \approx 4340$ Å

44. In hydrogen atom, the number of revolutions per second of an electron in the first orbit is approximately

A. 6.6×10^{15}
B. 4.1×10^{16}
C. 3.2×10^{15}
D. 2.0×10^{6}

Answer: A
Explanation:
Frequency = v / (2πr)
$v \approx 2.18 \times 10^{6}$ m/s, $r \approx 0.53 \times 10^{-10}$ m
$f \approx (2.18 \times 10^{6}) / (2\pi \times 0.53 \times 10^{-10}) \approx 6.6 \times 10^{15}\ s^{-1}$

45. The speed of electron in first Bohr orbit is

A. 2.18×10^6 m/s
B. 3.0×10^8 m/s
C. 1.5×10^6 m/s
D. 6.6×10^5 m/s

Answer: A
Explanation:
From Bohr model:
$v_1 = 2.18 \times 10^6$ m/s for hydrogen atom