PHYSICS

BOOKS - MTG-WBJEE PHYSICS (HINGLISH)

ATOMIC PHYSICS

Wbjee Workout Category 1 Single Option Correct Type

1. The ionisation potential of hydrogen atom is -13.6 eV. An electron in the ground state of a hydrogen atom absorbs a photon of energy 12.75 eV. How many diggerent spectral lines can one expect when the electron make a downward transition

A. 1

B. 4

C. 2

D. 6

Answer: D

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2. If the electron in a hydrogen atom jumps from an orbit with level $n_1 = 2$ an orbit with level $n_2 = 1$. The emitted radiation has a wavelength given by

A. $\lambda = \frac{5}{3R}$

B. $\lambda = \frac{4}{3R}$

C. $\lambda = \frac{R}{4}$

D. $\lambda = \frac{3R}{4}$

Answer: B

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3. In an inelastic collision an electron excites a hydrogen atom from its ground state to a M-Shell state. A second electron collides instantaneously with the excited hydrogen atom in the m-Shell state and ionizes it. At leas

how much energy the second electron transfors to the atom is the M-shell state?

A. $+3.4eV$

B. $+1.51eV$

C. $-3.4eV$

D. $-1.51eV$

Answer: B

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4. Two elements A and B with atomic numbers Z_A and Z_B are used to produce charateristic X-rays with frequencies v_A and v_B respectively. If $Z_A : Z_B = 1:2,$ then $v_A : v_B$ will be

A. $1:\sqrt{2}$

B. $1:8$

C. $4:1$

D. $1:4$

Answer: D

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5. The total energy of eletcron in the ground state of hydrogen atom is $-13.6eV$. The kinetic enegry of an electron in the first excited state is

A. 6.8 eV

B. 13.6 eV

C. 1.7 eV

D. 3.4 eV

Answer: D

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6. Radius of the first orbit of the electron in a hydrogen atom is 0.53Å . So, the radius of the third orbit will be

A. 1.12 $\overset{\circ}{A}$

B. 4.77 $\overset{\circ}{A}$

C. 1.06 $\overset{\circ}{A}$

D. 1.59 $\overset{\circ}{A}$

Answer: B

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7. Energy of the electron in nth orbit of hydrogen atom is given by $E_n = -\frac{13.6}{n^2}eV$. The amount of energy needed to transfer electron from first orbit to third orbit is

A. 13.6 eV

B. 3.4 eV

C. 12.09 eV

D. 1.51 eV

Answer: C

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8. The ratio of the speed of the electrons in the ground state of hydrogen to the speed of light in vacuum is

A. $\frac{e^2}{2\varepsilon_0 hc}$

B. $\frac{2e^2\varepsilon_0}{hc}$

C. $\frac{e^3}{2\varepsilon_0 hc}$

D. $\frac{2\varepsilon_0 hc}{e^2}$

Answer: A

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9. When the wave of hydrogen atom comes from infinity into the first then the value of wave number is

A. $109700 cm^{-1}$

B. $1097cm^{-1}$

C. $109cm^{-1}$

D. None of these

Answer: A

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10. In which of the following systems will the radius of the first orbit (n=1) be minimum?

A. Single ionised helium

B. Deuteron atom

C. Hydrogen atom

D. Doubly ionised lithium

Answer: D

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11. Which of the following atoms has the lowest ionization potential ?

A. ${}_8O^{16}$

B. ${}_7N^{14}$

C. ${}_{55}Cs^{133}$

D. ${}_{18}Ar^{40}$

Answer: C

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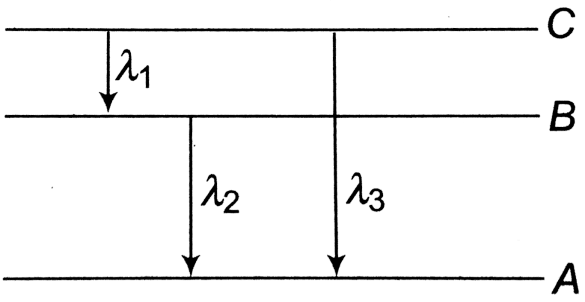
12. Energy levels A, B, C of a certain atom corresponding to increasing values of energy i.e., $E_A < E_B < E_C$. If $\lambda_1, \lambda_2, \lambda_3$ are the wavelengths of radiations correspnding to the

transitions C to B, B to A and C to A respectively, which o fthe following statements is correct?



A. $\lambda_3 = \lambda_1 + \lambda_2$

B. $\lambda_3 = \dfrac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

C. $\lambda_1 + \lambda_2 + \lambda_3 = 0$

D. $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

Answer: B

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13. Calculate the minimum wavelength of X-rays produced by an X-ray tube operating at 30 kV.

$h = 6.6 \times 10^{-27} erg - \sec]$

A. 42.4 nm

B. 4.2 $\overset{\circ}{A}$

C. 0.4125 $\overset{\circ}{A}$

D. $4.8\mu m$

Answer: C

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14. A sample of hydrogen atom gas contains 100atom. All the atoms are excited to the same n^{th} excited state. The total energy released by all the atoms is $\frac{4800}{49}Rch$ (where $Rch = 13.6eV$), as they come to the ground

state through various types of transitions, Find

A. $\frac{48}{49}Rch$

B. $\frac{49}{49}Rch$

C. $\frac{4900}{48}Rch$

D. $\frac{48}{49Rch}$

Answer: A

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15. The ratio of wavelength of the lest line of Balmer series and the last line Lyman series is:

A. 2

B. 1

C. 4

D. 0.5

Answer: C

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16. An energy of $24.6eV$ is required to remove one of that electrons from a neutal helium atom. The enegy (in eV)required to remove both the electrons from a netural helium atom is

A. 38.2

B. 49.2

C. 51.8

D. 79

Answer: D

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17. If the atom$(\ _{}100)Fm^{257}$ follows the Bohr model the radius of $\ _{}(100)Fm^{257}$ is n time the Bohr radius , then find n .

A. 4

B. $1/4$

C. 100

D. 200

Answer: B

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18. A free atom of iron emits K_α X-rays of energy 6.4 keV. Calculate the recoil kinetic energy of the atom. Mass of and iron atom $= 9.3 \times 10^{-26} kg.$

A. $39 \times 10^{-4} eV$

B. $3.9 \times 10^{-4} eV$

C. $0.39 \times 10^{-4} eV$

D. $3.9 \times 10^{-2} eV$

Answer: B

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19. One increasing the operating voltage in a x-ray tube by 1.5 times, the shortest wavelength decreases by $26\mathrm{pm}$. Find the original value of operating voltage.

A. $1 \cdot 24 \times 10^{4} V$

B. $15 \cdot 9 \times 10^{-2} V$

C. $3 \times 10^{6} V$

D. $15 \cdot 9 \times 10^3 V$

Answer: D

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20. Characteristic X-rays of frequency 4.2×10^{18} Hz are produced when transitions from L-shell to K-shell take place in a certain target material. Use Mosley's law to determine the atomic number of the target material. Given Rydberg constant $R = 1.1 \times 10^7 m^{-1}$.

A. 43

B. 44

C. 42

D. 10

Answer: C

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21. Monochromatic radiation of wavelength λ are incident on a hydrogen sample in ground state. Hydrogen atoms absorb the light and

subsequently emit radiations of 10 different wavelength . The value of λ is nearly :

A. 6

B. 5

C. 3

D. 4

Answer: B

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22. If a hydrogen atom emit a photon of energy $12.1eV$, its orbital angular momentum changes by $\Delta L. \ then$Delta L` equals

A. $1.05 \times 10^{-34} Js$

B. $2.11 \times 10^{-34} Js$

C. $3.16 \times 10^{-34} Js$

D. $4.22 \times 10^{-34} Js$

Answer: B

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23. An electron in hydrogen atom jumps from n_1 state to n_2 state, where n_1 and n_2 represent the quantum number of two states. The time period of revolution of electron in initial state is 8 times that in final state. Then the ratio of $n_1 \text{ and } n_2$ is

A. $1:2$

B. $4:1$

C. $1:4$

D. $2:1$

Answer: D

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24. In Rutherford's scattering experiment , 60 particles were scattered per min for $\theta_1 = 90^\circ$. How many particles will be scattered per min for $\theta_2 = 60^\circ$?

A. 60

B. 120

C. 180

D. 240

Answer: D

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25. A beam of fast moving alpha particles was directed toward a thin film of gold.

The parts A', B' and C' of the transmitted and reflected beams corresponding to the incident parts A, B and C of the beam are as shown in the diagram. The number of alpha

particle in

A. C' will be minimum and in B' maximum

B. A' will be minimum and in B' maximum

C. A' will be maximum and in B' minimum

D. B' will be minimum and in C' maximum.

Answer: C

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26. Calculate the impact parameter of a 5 MeV particle scattered by 90°, when it approach a gold nucleus (Z=79).

A. 1.5×10^{-14}m

B. $2.27 \times 10^{-14} m$

C. $3 \times 10^{-14} m$

D. $3.37 \times 10^{-17} m$

Answer: B

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27. The approximate value of quantum number n for the circular orbit of hydrogen of $0.0001nm$ in diameter is

A. 100

B. 60

C. 81

D. 31

Answer: D

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28. The product of linear momentum and angular momentum of an electron of the hydrogen atom is proportional to n^x, where x is

A. 1

B. -2

C. 2

D. 0

Answer: D

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29. In hydrogen atom, if the difference in the energy of the electron in $n = 2$ and $n = 3$ orbits is E, the ionization energy of hydrogen atom is

A. 3.2 E

B. 5.6 E

C. 7.2 E

D. 13.2 E

Answer: C

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30. What is the radius of iodine atom (at no. 53, mass number 126)?

A. $2.5 \times 10^{-9} m$

B. $7 \times 10^{6} m$

C. $7 \times 10^{-9} m$

D. $2.5 \times 10^{-11} m$

Answer: D

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Wbjee Workout Category 2 Single Option Correct Type

1. Which of the following transitions will have highest emission wavelength ?

A. n = 2 to n = 1

B. n = 1 to n = 2

C. n = 2 to n = 5

D. n = 5 to n = 2

Answer: D

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2. An alpha particle of energy $5MeV$ is scattered through 180° by a found uramiam nucleus . The distance of closest approach is of the order of

A. $1\overset{\circ}{A}$

B. 10^{-10}cm

C. $10^{-12}cm$

D. $10^{-15}cm$

Answer: C

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3. An element of atomic number 9 emits K_α X-ray of wavelength λ. Find the atomic number

of the element which emits K_α X-ray of wavelength 4λ.

A. 11

B. 44

C. 6

D. 5

Answer: C

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4. The largest wavelength in the ultraviolet region of the hydrogen spectrum is 122 nm. The smallest wavelength in the infrared region of the hydrogen spectrum (to the nearest integer) is

A. 802 nm

B. 823 nm

C. 1882 nm

D. 1648 nm

Answer: B

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5. The electric potential between a proton and as electron is given by $V = V_0 \frac{\ln(r)}{r_0}$, where r_0 is a constant . Assuming Bohr's model to be applicable , write variation of r_n with n, n being the principal quantum number ?

A. $r \propto n^2$

B. $r \propto n$

C. $r \propto \frac{1}{n}$

D. $r \propto \frac{1}{n^2}$

Answer: B

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6. Let A_n be the area enclosed by the n^{th} orbit in a hydrogen atom. The graph of $ln(A_n / A_t)$ against In (n)

A. will not pass through the origin

B. is a straight line with slope 4

C. will be a monotonically increasing non-linear curve

D. will be a circle.

Answer: B

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7. The wavelength of K_α X-rays of two metals A and B are $4/1875R$ and $1/675R$, respectively , where R is rydberg 's constant.

The number of electron lying between A and B according to this lineis

A. 3

B. 6

C. 5

D. 4

Answer: D

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8. At what minimum kinetic energy must a hydrogen atom move for it's inelastic headon collision with another stationary hydrogen atom so that one of them emits a photon? Both atoms are supposed to be in the ground state prior to the collision.

A. 20.4 eV

B. 36.3 eV

C. 108.8 eV

D. 122.4 eV

Answer: A

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9. Let v_1 be the frequency of series limit of Lyman series, v_2 the frequency of the first line of Lyman series and v_3 the frequency of series limit of Balmer series. Then which of the following is correct ?

A. $v_1 - v_2 = v_3$

B. $v_2 - v_1 = v_3$

C. $v_3 = \frac{1}{2}(v_1 + v_2)$

D. $v_2 + v_1 = v_3$

Answer: A

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10. Electrons with energy $80keV$ are incident on the tungsten target of an X - rays tube , k-shell electrons of tungsten have $72.5keV$ energy X- rays emitted by the tube contain only

A. a continuous X-ray spectrum (Bremsstrahlung) with a minimum wavelength of 0.155 $overerset(\circ)(A)$

B. a continuous X-ray spectrum (Bremsstrahlung) with all wavelengths.

C. a continuous X-ray spectrum of tungsten.

D. a continuous X-ray spectrum (Bremsstrahlung) with a minimum wavelength of 0.155 $\overset{\circ}{A}$ and the

characteristic X-ray spectrum of tungsten.

Answer: D

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11. A. How many photons of a tradiation of wavelength $\lambda = 5 \times 10^{-7}$ m must fall per second on a blackened plate in order to produce a force of 6.62×10^{-5}N?

B. At what rate will the temperature of plate

rise if its mass is 19.86kg and specific heat is equal to $2500J\left(kgK^{-1}\right)$?

A. 3×10^{19}

B. 5×10^{22}

C. 2×10^{22}

D. 1.67×10^{18}

Answer: B

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12. A Bohr's hydrogen atom undergoes a transition $n = 5 \rightarrow n = 4$ and emits a photon of frequency f. Frequency of circular motion of electron in $n = 4$ or $bitisf_4$. The ratio f/f_4 is found to be $18/5m$. State the value of m.

A. 4

B. 2

C. 5

D. 1

Answer: C

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13. Monochromatic radiation of wavelength λ is incident on a hydrogen sample in ground state. Hydrogen atoms absorb a fraction of light and subsequently emit radiations of six different wavelength . Find the wavelength λ.

A. 97.5 nm

B. 12.75 nm

C. 14.42 $\overset{\circ}{A}$

D. 0.85 nm

Answer: A

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14. A single electron orbits around a stationary nucleus of charge +Ze. It requires 47.2 eV to excite the electron from the 2^{nd} to 3^{rd} Bohr orbit. Find atomic number 'Z' of atom .

A. $Z = 4$

B. $Z = 5$

C. $Z = 3$

D. $Z = 2$

Answer: B

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15. A proton has kinetic energy $E = 100$ keV which is equal to that of a photon. The

wavelength of photon is λ_2 and that of proton is λ_1. The ratio of λ_2 / λ_1 is proportional to

A. E^2

B. $E^{1/2}$

C. E^{-1}

D. $E^{-1/2}$

Answer: D

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Wbjee Workout Category 3 One Or More Than One Option Correct Type

1. Mark out the correct statement regarding X-rays.

A. When fast moving electrons strike the metal target, they enter the metal target and in a very short time, they come to rest, and thus an accelerated charged electron produces electromagnetic waves (X-rays).

B. Characteristic X-rays are produced due to transition of an electron from higher energy levels to vacant lower energy levels.

C. X-rays spectrum is a discrete spectra just like hydrogen spectra.

D. Both (a) and (b) are correct.

Answer: B

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2. The potential difference applied to an X-ray tube is increased. As a result, in the emitted radiation,

A. the intensity increases

B. the minimum wavelength increases

C. the intensity remains unchanged

D. the minimum wavelength decreases.

Answer: C::D

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3. The electron in a hydrogen atom make a transtion $n_1 \rightarrow n_2$ where n_1 and n_2 are the priocipal quantum number of the two states . Assume the Bohr model to be valid . The time period of the electron in the initial state is eight time that in the final state . The possible values of n_1 and n_2 are

A. $n_1 = 4, n_2 = 2$

B. $n_1 = 8, n_2 = 2$

C. $n_1 = 8, n_2 = 1$

D. $n_1 = 6, n_2 = 3$

Answer: A::D

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4. The minimum kinetic energy required for ionization of a hydrogen atom is E_1 in case electron is collided with hydrogen atom , it is E_2 if the the hydrogen ion is collided and E_1 when helium ion collided . Then.

A. $E_1 = E_2 = E_3$

B. $E_1 > E_2 > E_3$

C. $E_1 < E_2 < E_3$

D. $E_1 > E_3 > E_2$

Answer: C

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5. The energy needed to detach the electron of a hydrogen like ion in ground state is a system(a) what is the wavelength of the radiation emitted when the electron jumps

from the first excited state to the ground state? (b) What is the radius of the orbit for this atom?

A. $\lambda = 12.42 \text{ nm and } r = 53 \text{ pm}$

B. $\lambda = 30.4 \text{ nm and } r = 106 \text{ pm}$

C. $\lambda = 40.8 \text{ nm and } r = 26.5 \text{ pm}$

D. $\lambda = 30.4 \text{ nm and } r = 26.5 \text{ pm}$

Answer: D

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6. A particle known as mu meson has a charge equal to that of no electron and mass 208 times the mass of the electron B moves in a circular orbit around a nucleus of charge $+3e$ Take the mass of the nucleus to be infinite Assuming that the bohr's model is applicable to this system (a)drive an expression for the radius of the nth Bohr orbit (b) find the value of a for which the radius of the orbit it appropriately the same as that at the first bohr for a hydrogen atom (c) find the

wavelength of the radiation emitted when the u - mean jump from the orbit to the first orbit

A. 20

B. 25

C. 30

D. 40

Answer: B

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7. Which one of the following statement is $WRONG$ in the context of X- rays generated from X- rays tube ?

A. Wavelength of characteristic X-rays decreases when the atomic number of the target increases

B. Cut-off wavelength of the continuous X-- rays depends on the atomic number of the target.

C. Intensity of the characteristic X-rays depends on the electrical power given to the X-ray tube

D. Cut-off wavelength of the continuous X-rays depends on the energy of the electrons in the X-ray tube.

Answer: B

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8. In Bohr's model of the hydrogen atom:

A. the radius of the n^{th} orbit is proportional to n^2

B. the total energy of the electron in n^{th} orbit is inversely proportional to n.

C. the angular momentum of electron in an n^{th} orbit is an integral multiple of $h/2\pi$.

D. the magnitude of potential energy of the electron in any orbit is greater than

its kinetic energy.

Answer: A::C::D

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9. For a given material, the energy and wavelength of characterstic X-rays satisfy

A. $E(K_\alpha) > E(K_\beta) > E(K_\gamma)$

B. $E(M_\alpha) > E(L_\alpha) > E(K_\alpha)$

C. $\lambda(K_\alpha) > \lambda(K_\beta) > \lambda(K_\gamma)$

D. $\lambda(M_\alpha) > \lambda(L_\alpha) > \lambda(K_\alpha)$

Answer: C::D

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10. Hydrogen $\left(._1 H^1\right)$, Deuterum $\left(._1 H^2\right)$, singly ionised Hellium $\left(._2 He^4\right)^+$ and doubly ionised lithium $\left(._3 Li^6\right)^{++}$ all have one electron around the nucleus. Consider an electron tranition from $n = 2$ to $n = 1$. If the wave lengths of emitted radiation are

$\lambda_1, \lambda_2, \lambda_3$ and λ_4 respectively then approximately which one of the follwing is correct ?

A. $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

B. $\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

C. $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$

D. $\lambda_1 = 2\lambda_2 = 3\lambda_3 = 4\lambda_4$

Answer: C

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Wbjee Previous Years Questions Category 1 Single Option Correct Type

1. The ionisation potential of hydrogen atom is $13.6eV$. The energy required to remove an electron in the $n = 2$ state of the hydrogen atom is

A. $+3.4eV$

B. $-3.4eV$

C. $+6.8eV$

D. $-6.8eV$

Answer: D

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2. The ionisation energy of hydrogen is 13.6 eV . The energy of the photon released when an electron jumps from the first excited state (n=2) to the ground state of hydrogen atom is

A. 3.4 eV

B. 4.53 eV

C. 10.2 eV

D. 13.6 eV

Answer: C

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3. A photon of wavelength 300nm interacts with a stationary hydrogen atom in ground state. During the interaction, whole energy of the photon is transferred to the electron of the atom. State which possibility is correct, (consider, Plank's constant $= 4 \times 10^{-15}$ eVs,

velocity of light $= 3 \times 10^8 ms^{-1}$ ionisation energy of hydrogen =13.6 eV)

A. Electron will be knocked out of the atom

B. Electron will go to any excited state of the atom

C. Electron will go only to first excited state of the atom

D. Electron will keep orbiting in the ground state of atom

Answer: D

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4. The wavelength of second Balmer line in Hydrogen spectrum is 600 nm. The wavelength for its third line in Lymann series is

A. 800 nm

B. 600 nm

C. 400 nm

D. 200 nm

Answer:

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5. The de-Broglie wavelength λ_n of the electron in the n^{th} orbit of hydrogen atom is

A. 1

B. 2

C. 3

D. 4

Answer: B

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6. How the linear velocity v of an electron in the Bohr orbit is related to its quantum number n ?

A. $v \propto \frac{1}{n}$

B. $v \propto \frac{1}{n^2}$

C. $v \propto \frac{1}{\sqrt{n}}$

D. $v \propto n$

Answer: A

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7. The angular speed of the electron in the n^{th} Bohr orbit of the hydrogen atom is proportional to

A. n^2

B. $\frac{1}{n^2}$

C. $\frac{1}{n^{3/2}}$

D. $\frac{1}{n^3}$

Answer: D

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Wbjee Previous Years Questions Category 3 One Or More Than One Option Correct Type

1. Let v_n and E_n be the respective speed and energy of an electron in the n-th orbit radius r_n in a hydrogen atom, as predicted by Bohr's model . Then

A. plot of $E_n r_n / E_1 r_1$ as a function of n is a straight line of slope 0.

B. plot of $r_n v_n / r_1 v_1$ as a function of n is a straight line of slope 1.

C. plot of $\ln\left(\frac{r_n}{r_1}\right)$ as a function of ln(n) is a straight line of slope 2.

D. plot of $\ln\left(\frac{r_n E_1}{E_n r_1}\right)$ as a function of ln(n) is a straight line of slope 4.

Answer: A::B::C::D

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