PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

ATOMS

Jee Main 5 Years At A Glance

1. The de-Broglie wavelength (λ_B) associated with the electron orbiting in the second excited state of

hydrogen atom is related to that in the ground state (λ_G) by :

A. $\lambda_B = \lambda_{g/3}$

B. $\lambda_B = \lambda_{G/2}$

C. $\lambda_B = 2\lambda_G$

D. $\lambda_B = 3\lambda_G$

Answer: D

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2. The energy required to remove the electron from a singly ionized Helium atom is 2.2 times the energy required to remove an electron from Helium atom. The total energy required to ionize the Helium atom ompletelyis:

A. 20eV

B. 79eV

C. 109eV

D. 34eV

Answer: B

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3. If the series limit frequency of the Lyman series is ν_L, then the series limit frequency of the Pfund series is

A. $25v_L$

B. $16v_L$

C. $v_L/16$

D. $v_L/25$

Answer: D

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4. The acceleration of electron in the first orbits of hydrogen atom is

A. $\frac{h^2}{\pi^2 m^2 r^3}$

B. $\frac{h^2}{8\pi^2 m^2 r^3}$

C. $\frac{h^2}{4\pi^2 m^2 r^3}$

D. $\frac{h^2}{4\pi m^2 r^3}$

Answer: C

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5. A hydrogen atom makes a transition from $n = 2$ to $n = 1$ and emits a photon. This photon strikes a doubly ionized lithium atom $(Z = 3)$ in excited state and completely removes the orbiting electron. The least quantum number for the excited stated of the ion for the process is:

A. 2

B. 4

C. 5

D. 3

Answer: B

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6. If one were to apply Bohr model to a particle of mass $'m'$ and charge $'q'$ moving in a plane under the influence of a mgentic filed $'B'$, the energy of the cahrged particle in the n^{th} level will be :-

A. $n\left(\frac{hqB}{2\pi m}\right)$

B. $n\left(\frac{hqB}{8\pi m}\right)$

C. $n\left(\frac{hqB}{4\pi m}\right)$

D. $n\left(\frac{hqB}{\pi m}\right)$

Answer: C

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7. As an electron makes a transition from an excited state to the ground state of a hydrogen - like atom /ion

A. kinetic energy decreases, potential energy increases but total energy remains same

B. kinetic energy and total energy decrease but potential energy increases

C. its kinetic energy increases but potential energy and total energy decrease

D. kinetic energy, potential energy and total energy decrease

Answer: C

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8. If the binding energy of the electron in a hydrogen atom is $13.6eV$, the energy required to remove the electron from the first excited state of Li^{++} is

A. $122.4eV$

B. $30.6eV$

C. $13.6 eV$

D. $3.4 eV$

Answer: B

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9. The radiation corresponding to $3 \rightarrow 2$ transition of hydrogen atom falls on a metal surface to produce photoelectrons . These electrons are made to enter circuit a magnetic field $3 \times 10^{-4} T$ if the ratio of the largest circular path follow by these electron is `10.0 mm , the work function of the metal is close to

A. $1.8 eV$

B. $1.1 eV$

C. $0.8 eV$

D. $1.6 eV$

Answer: B

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Exercise 1 Concept Builder Topicwise

1. The electrons of Rutherford's model would be expected to lose energy because, they

A. move randomly

B. jump on nucleus

C. radiate electromagnetic waves

D. escape from the atom

Answer: C

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2. The significant result deduced from the Rutherford's scattering experiment is that

A. whole of the positive charge is concentrated at the centre of atom

B. there are neutrons inside the nucleus

C. α-particles are helium nuclei

D. electrons are embedded in the atom

Answer: A

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3. Rutherford's atomic model was unstable because

A. nuclei will break down

B. electrons do not remain in orbit

C. orbiting electrons radiate energy

D. electrons are repelled by the nucleus

Answer: B:C

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4. 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. $10^{-12} cm$

B. $10^{-10} cm$

C. $10^{-20} cm$

D. $10^{-15} cm$

Answer: A

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5. Which one did Rutherford consider to be supported by the results of experiments in which a-particles were scattered by gold foil?

A. The nucleus of an atom is held together by forces which are much stronger than electrical or gravitational forces

B. The force of repulsion between an atomic nucleus and an a-particle varies with distance according to inverse square law

C. a particles are nuclei of Helium atoms

D. Atoms can exist with a series of discrete energy levels

Answer: B

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6. Rutherford scattering experiment was explained by making following assumptions that

A. the colllision is inelastic

B. the nucleus can be treated as a point particle

C. the nucleus is light

D. None of these

Answer: B

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7. Which of the following statements is correct in case of Thomson's atomic model?

A. It explains the phenomenon of thermionic emission, photoelectric emission and ionisation.

B. It could not explain emission ofline spectra by elements.

C. It could not explain scattering of a-particles

D. All of the above

Answer: C

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8. When an a-particle of mass 'm' moving with velocity 'v' bombards on a heavy nucleus of charge 'Ze', its distance of closest approach from the nucleus depends on v as:

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

B. $\frac{1}{\sqrt{v}}$

C. $\frac{1}{v^2}$

D. v

Answer: C

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9. In Rutherford scattering experiment, what will b ethe correct angle for α scattering for an impact parameter $b=0$?

A. 90°

B. 270°

C. 0°

D. 180°

Answer: D

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10. Value of Impact parameter will be zero, when scattering angle is

A. $\pi / 2$

B. π

C. $2\frac{\pi}{3}$

D. $3\pi / 2$

Answer: B

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11. The correct relation between scattering angle (θ), impact parameter (b) and distance of closest approach (D) is

A. $\sin\theta = Db$

B. $\tan\frac{\theta}{2} = \frac{D}{2b}$

C. $\frac{\cos\theta}{b} = D$

D. $\cot\frac{\theta}{2} = \frac{b}{2D}$

Answer: B

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12. The distance of closest approach of a certain nucleus is 7.2 fm and it has a charge of 1.28×10^{-17} C. The number of neutrons inside the nucleus of an atom is

A. 111

B. 142

C. 140

D. 132

Answer: A

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13. In Rutherford's experiment, the number of α-particles scattered through an angle of 60° by a silverfoil is 200 per minute. When the silver foil is replaced by a copper foil of the same thickness, the number of a particles scattered through an angle of 60° per minute is:

A. $\frac{200 \times Z_{Cu}}{Z_{Ag}}$

B. $200 \times \left(\frac{Z_{cu}}{Z_{Ag}}\right)^2$

C. $200 \times \frac{Z_{Ag}}{Z_{Cu}}$

D. $200 \times \left(\frac{Z_{Ag}}{Z_{Cu}}\right)$

Answer: B

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14. The distance between the a-particle and target nucleus in an α-scattering experiment is equal to distance of closest approach, when the scattering angle is

A. $\pi / 2$

B. π

C. $\pi / 4$

D. $\pi / 3$

Answer: B

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15. In a Rutherford scattering experiment when a projectile of change Z_1 and mass M_1 approaches s target nucleus of change Z_2 and mass M_2, te distance of closed approach is r_0. The energy of the projectile is

A. directly proportional to Z_1, Z_2

B. inversely proportional to Z_1

C. directly proportional to mass M_1

D. directly proportional to $M_1 \times M_2$

Answer: A

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16. In Rutherford scattering experiment, the number of α-particles scattered at 60° is 5×10^6. The number of α-particles scattered at 120° will be

A. 15×10^6

B. $\frac{3}{5} \times 10^6$

C. $\frac{5}{9} \times 10^6$

D. None of these

Answer:

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17. If in Rutherford's experiment, the number of particles scattered at 90° angle are 28 per min, then number of scattered particles at an angle 60° and 120° will be

A. 117 per minute, 25 per minute

B. 50 per minute, 12.5 per minute

C. 100 per minute, 200 per minute

D. 112 per minute, 12.4 per minute

Answer: D

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18. In Rutherford scattering experiment, α-particles scattered at angle $\theta$by a target, then which of the following is correct for Impact parameter "b" ?

A. $b \propto \sec^2 \theta$

B. $b \propto \sec^3 \theta$

C. $b \propto \tan\left(\frac{\theta}{2}\right)$

D. $b \propto \cot\left(\frac{\theta}{2}\right)$

Answer: D

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19. In the ground state in ...A... electrons are in stable equilibrium while in ...B... electrons always experiences a net force. Here, A and B refer to

A. Dalton's theory, Rutherford model

B. Rutherford's model, Bohr's model

C. Thomson's model, Rutherford's model

D. Rutherford's model, Thomson's model

Answer: C

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

A. directly proportional to n

B. inversely proportional to $\sqrt{n}$

C. inversely proportional to n^2

D. inversely proportional to n^3

Answer: D

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21. Which of the following statement concerning Bohr's model is /are true ?

A. Orbiting speed of electron decreases as it shifts to discrete orbits away from the nucleus

B. Radii of allowed orbits of electron are inversely proportional to the principal quantum number

C. Frequency with which electrons orbit around the nucleus in discrete orbits is inversely proportional to the cube of principal quantum number

D. The force with which the electron is bound to the nucleus increases as it shifts to outer orbits

Answer: A

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22. According to Bohr's Model of hydrogen atom

A. the linear velocity of the electron is quantised

B. the angular velocity of the electron is quantised

C. the linear momentum of the electron is quantised

D. the angular momentum of the electron is quantised

Answer: D

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23. when an electron jumps from the fourth orbit to the second orbit, one gets the

A. second line of Lyman series

B. second line of Paschen series

C. second line of Balmer series

D. first line of Pfund series

Answer: C

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24. Which of the following series in the spectrum of the hydrogen atom lies in the visible region of the electromagnetic spectrum

A. Paschen series

B. Balmer series

C. Lyman series

D. Brackett series

Answer: B

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25. The balmer series for the H-atom can be observed

A. if we measure the frequencies of light emitted when an excited atom falls to the ground state

B. if we measure the frequencies of light emitted due to transitions between excited states and the first excited state

C. in any transition in a H-atom

D. None of these

Answer: B

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26. As the n (number of orbit) increases, the difference of energy between the consecutive energy levels

A. remain the same

B. increases

C. decreases

D. sometimes increases and sometimes decreases.

Answer: C

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27. In Bohr's model of hydrogen atom, the period of revolution of the electron in any orbit is proportional to

A. n^3

B. n^2

C. n

D. 1/n

Answer: A

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28. In a hydrogen atom following the Bohr's postulates the product of linear momentum and angular momentum is proportional to n^x where 'n' is the orbit number. Then 'x' is:

A. 0

B. 2

C. -2

D. 1

Answer: A

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29. The energy of electron in the nth orbit of hydrogen atom is expressed as $E_n = \frac{-13.6}{n^2} eV.$ The shortest and longest wavelength of Lyman series will be

A. 910 Å

B. 5436Å

C. 1315Å

D. none of these

Answer: A

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30. In the hydrogen atom, an electron makes a transition from n=2 to n=1. The magnetic field produced by the circulating electron at the nucleus

A. decreases 16 times

B. increases 4 times

C. decreases 4 times

D. increases 32 times

Answer: D

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31. In terms of Rydberg constant R, the shortest wavelength in the Balmer series of the hydrogen , atom spestrum will have wavelength

A. 656.3 nm, n= 3

B. 486.1 nm, n=4

C. 410.2 nm, n=5

D. 364.6 nm, n=∞

Answer: D

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32. In an inelastic collision an electron excites as hydrogen atom from its ground state to a M -shell state. A second electron collides instantaneously with the excited hydrogen atom in the M-state and ionizes it. At least how much energy the second electron transfers to the atom in the M-state ?

A. $+3.4eV$

B. $+1.51eV$

C. $-3.4eV$

D. $-1.51eV$

Answer: B

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33. According to the Bohr theory of Hydrogen atom, the speed of the electron, its energy and the radius of its orbit varies with the principal quantum number n, respectively, as

A. $\frac{1}{n}, n^2, \frac{1}{n^2}$

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

C. $n, \frac{1}{n^2}, \frac{1}{n^2}$

D. $\frac{1}{n}, \frac{1}{n^2}, n^2$

Answer: D

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34. In terms of Bohr radius a_0, the radius of the second Bohr orbit of a hydrogen atom is given by

A. $4a_0$

B. $8a_0$

C. $\sqrt{2}a_0$

D. $2a_0$

Answer: A

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35. The ionisation potential of H-atom is $13.6eV$. When it is excited from ground state by monochromatic radiations of 970.6Å, the number of emission lines will be (according to Bohr's theory)

A. 10

B. 8

C. 6

D. 4

Answer: C

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36. If the radiation of $Mo(Z=42)$ has a wevelength of 0.71Å, calculate wevelength of the corresponding radiation of $Cu, i.e., k_{\alpha}f$ or $Cu(Z=29) as \sum \in gb = 1.$

A. 1.52Å

B. 2.52Å

C. 0.52Å

D. 4.52Å

Answer: A

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37. The third line of Balmer series of an ion equivalent to hydrogen atom has wavelength of $108.5mm$. The ground state energy of an electron of this ion will e

A. `3.4 eV

B. 13.6eV

C. 40.8eV

D. 27.2 eV

Answer: C

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38. Excitation energy of a hydrogen like ion in its first excitation state is 40.8 eV. Energy needed to remove the electron from the ion in gruond state is

A. 54.4 eV

B. 13.6 eV

C. 40.8 eV

D. 27.2 eV

Answer: A

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39. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 5. Then the number of spectral lines in the emission spectra will be:

A. 9

B. 15

C. 8

D. 10

Answer: D

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40. If the angular momentum of an electron in an orbit is J then the K.E. of the electron in that orbit is

A. $\frac{j^2}{2mr^2}$

B. $\frac{jv}{r}$

C. $\frac{J^2}{2m}$

D. $\frac{J^2}{2\pi}$

Answer: A

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41. In two individual hydrogen atoms electrons move around the nucleus in circular orbits of radii R and 4R. The ratio of the time taken by them to complete one revolution is:

A. $4/1$

B. $4/1$

C. $8/1$

D. $\frac{j^2}{2\pi}$

Answer: D

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42. The energy of electron in an excited hydrogen atom is $-3.4eV$. Its angular momentum according to bohr's theory will be

A. $3.72 \times 10^{-34} Js$

B. $2.10 \times 10^{-34} Js$

C. $1.51 \times 10^{-34} Js$

D. $4.20 \times 10^{-34} Js$

Answer: B

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43. 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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44. Taking Rydberg's constant $R_H = 1.097 \times 10^7 m$ first and second wavelength of Balmer series in hydrogen spectrum is

A. 3000 Å

B. 2960 Å

C. 4280 Å

D. 4863 Å

Answer: D

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45. The ratio of areas within the elctron orbits for the first excited state to the ground sate for hydrogen atom is

A. $2:1$

B. $4:1$

C. $8:1$

D. $16:1$

Answer: D

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46. Consider an eelctron in the nth orbit of a hydrogen atom in the Bohr model. The circumference of the orbit can be expressed in terms of the de Broglie wavelength λ o fthat electron as

A. $0.529n\lambda$

B. $\sqrt{n}\lambda$

C. $(13.6)\lambda$

D. $n\lambda$

Answer: D

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47. In hydrogen spectrum the wavelength of H_a line is $656nm$, where in the spectrum of a distance galaxy H_a line wavelength is $706nm$. Estimated speed of the galaxy with respect to earth is ,

A. $2x10^8 m/s$

B. $2 \times 10^7 m/s$

C. $2 \times 10^6 m/s$

D. $2 \times 10^5 m / s$

Answer: B

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48. The wavelength of K_α –line characteristic X–rays emitted by an element is 0.32Å. The wavelength of K_β–line emitted by the same element will be :–

A. $0.27 Å$

B. $0.32 Å$

C. $0.39 Å$

D. $0.49Å$

Answer: A

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49. Out of the following which one is not a possible energy for a photon to be emitted by hydrogen atom according to Bohr's atomic model?

A. $1.9eV$

B. $11.1eV$

C. $13.6eV$

D. $0.65eV$

Answer: B

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50. Ground state energy of H-atom is -13.6 eV. The energy needed to ionise H-atom from its second excited state is

A. 1.51 eV

B. 3.4 eV

C. 13.6 eV

D. 12.1 eV

Answer: A

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51. In a hydrogen atom the electron makes a transition from $(n+1)^{th}$ level to then^{th} level .If $n > > 1$ the frequency of radiation emitted is proportional to :

A. n

B. n^3

C. n^4

D. n^2

Answer: B

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52. An electron jumps from the $4th$ orbit to the $2nd$ orbit of hydrogen atom. Given the Rydberg's constant $R = 10^5 cm^{-1}$. The frequency in Hz of the emitted radiation will be

A. $\frac{3}{16} \times 10^5$

B. $\frac{3}{16} \times 10^{15}$

C. $\frac{9}{16} \times 10^{15}$

D. $\frac{3}{4} \times 10^{15}$

Answer: C

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53. The average current due to an electron orbiting the proton in the n^{th} Bohr orbit of the hydrogen atom is

A. $1/n^3$

B. n^3

C. n^2

D. n

Answer: A

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54. The ratio of the longest to shortest wavelength in Brackett series of hydrogen spectra is

A. $25/9$

B. $17/6$

C. $9/5$

D. $4/3$

Answer: A

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55. The ionisation energy of hydrogen atom is $13.6eV$. Following Bohr's theory, the energy corresponding to a transition between the 3rd and the 4th orbit is

A. 3.40 eV

B. 1.51 eV

C. 0.85 eV

D. 0.66 eV

Answer: D

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56. The energy of a hydrogen atom in the ground state is $-13.6eV$. The eneergy of a He^{+} ion in the first excited state will be

A. $-13.6eV$

B. $-27.2eV$

C. $-54.4eV$

D. $-6.8eV$

Answer: A

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57. Electron in hydrogen atom first jumps from third excited state to second excited state and then form second excited state to first excited state. The ratio of wavelength $\lambda_1 : \lambda_2$ emitted in two cases is

A. $7/5$

B. $27/20$

C. $27/5$

D. $20/7$

Answer: C

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58. If λ_1 and λ_2 are the wavelengths of the first members of the Lyman and Paschen series respectively, then $\lambda_1 : \lambda_2$ is

A. $27/32$

B. $32/27$

C. 4//9`

D. $9/4$

Answer: A

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59. The transition form the state $n = 3$ to $n = 1$ in a hydrogen-like atom results in ultraviolet radiation. Infared radiation will be obtained in the transition from

A. $2 \rightarrow 1$

B. $3 \rightarrow 2$

C. $4 \rightarrow 2$

D. $4 \rightarrow 3$

Answer: D

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60. The wavelength of the first line of Lyman series for hydrogen atom is equal to that of the second line of Balmer series for a hydrogen-like ion. The atomic number Z of hydrogen-like ion is

A. 3

B. 4

C. 1

D. 2

Answer: D

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Exercise 2 Concept Applicator

1. If the series limit wavelength of the Lyman series for hydrogen atom is 912Å, then the series limit wavelength for the Balmer series for the hydrogen atom is

A. 912Å

B. $912 \times 2\text{Å}$

C. $912 \times 4 \text{Å}$

D. $\frac{912}{2} \text{Å}$

Answer: C

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2. An α-particle with kinetic energy K is heading towards a stationary nucleus of atomic number Z. Find the distance of the closest approach.

A. $D \propto \frac{1}{T}$

B. $D \propto T$

C. $D \propto T^2$

D. $D \propto \frac{1}{T^2}$

Answer: A

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3. Ultraviolet light of wavelength λ_1 and λ_2 (with $\lambda_2 > \lambda_1$) when allowed to fall on hydrogen atoms in their ground state is found to liberate electrons with kinetic energies E_1 and E_2 respectively. The value of the planck's constant can be found from the relation

A. $h = \left|\dfrac{(KE_2 - KE_1)(\lambda_1 + \lambda_2)}{C(\lambda_1 - \lambda_2)}\right|$

B. $h = \left|\left(\dfrac{(KE_1 - KE_2)(\lambda_2 - \lambda_1)}{C\lambda_1\lambda_2}\right)\right|$

C. $h = \left|\dfrac{(KE_1 - KE_2)\lambda_1\lambda_2}{C(\lambda_2 - \lambda_1)}\right|$

D. none of these

Answer: C

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4. The difference between the longest wavlength line of the Balmar series and shortest wavelength line of the Lyman series for a hydrogen like atom (atomic number Z) equal to Deltalambda. The value of the Rydberg constant for the given atom is

A. $\frac{5}{31}(1)\left(\Delta\lambda Z^2\right)$

B. $\frac{5}{36}\frac{Z^2}{\Delta\lambda}$

C. $\frac{31}{5}\frac{1}{\Delta\lambda Z^2}$

D. none of these

Answer: C

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5. Ionization potential of hydrogen atom is 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be

A. three

B. four

C. one

D. Fwo

Answer: A

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6. Electrons in a certain energy level $n = n_1$ can emit 3 spectral lines. When they are in another energy level, $n = n_2$, they can emit 6 spectral lines. The orbital speed of the electrons in the two orbits are in the ratio

A. $4 : 3$

B. $3 : 4$

C. $2 : 1$

D. $1 : 2$

Answer: A

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7. The electron in a hydrogen atom jumps from ground state to the higher energy state where its velcoity is reduced to one-third its initial value. If the radius of the orbit in the ground state is r the radius of new orbit will be

A. $3r$

B. $9r$

C. $r/3$

D. $r/9$

Answer: B

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8. In a hypothetical system , a partical of mass m and charge $-3q$ is moving around a very heavy partical chaRGE q. Assume that Bohr's model is applicable to this system , then velocuity of mass m in the first orbit is

A. $\frac{3q^2}{2\varepsilon_0 h}$

B. $\frac{3q^2}{4\varepsilon_0 h}$

C. $\frac{3q}{2\pi\varepsilon_0 h}$

D. $\frac{3q}{4\pi\varepsilon_0 h}$

Answer: A

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9. One of the lines in the emission spectrum of Li^{2+} has the same wavelength as that of the 2nd line of Balmer series in hydrogen spectrum. The electronic transition corresponding to this line is n = 12 $\rightarrow$ n=x. Find the value of x.

A. 8

B. 6

C. 7

D. 5

Answer: B

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10. The wavelength of the first spectral line in the Balmer series of hydrogen atom is 6561 Å. If the wavelength of the spectral line in the Balmer series of singly-ionized helium atom is 1215 when electron jumps from n_2 to n_1, then n_2 and n_1, are

A. $4, 2$

B. $5, 3$

C. $6, 3$

D. $6, 2$

Answer: A

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11. A 12.5eV electron beam is used to bombard gaseous hydrogen at room temperature What series of wavelengths will be emitted.

A. 2 lines in the Lyman series and 1 line in the Balmar series

B. 3 lines in the Lyman series

C. 1 line in the Lyman series and 2 lines in the Balmar series

D. 3 lines in the Balmer series

Answer: A

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12. Orbits of a particle moving in a circle are such that the perimeter of the orbit equals an integer number of de-Broglie wavelengths of the particle. For a charged particle moving in a plane perpendicular to a magnetic field, the radius of the n^{th} orbital will therefore be proportional to:

A. n^2

B. n

C. $n^{1/2}$

D. $n^{1/4}$

Answer: C

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13. A stationary hydrogen atom emits photon corresponding to the first line of Lyman series. If R is the Rydberg constant and M is the mass of the atom, then the velocity acquired by the atom is

A. $\frac{3}{4}\frac{Rh}{M}$

B. $\frac{Rh}{4M}$

C. $\frac{Rh}{2M}$

D. $\frac{Rh}{M}$

Answer: A

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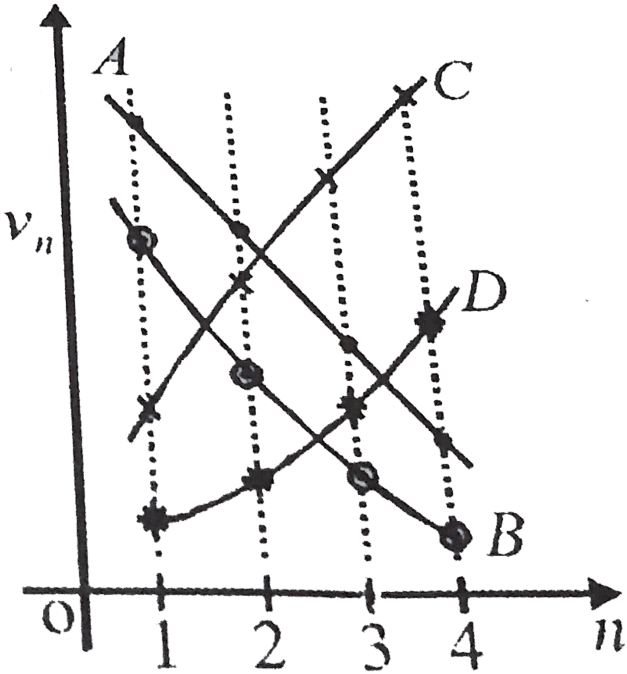
14. Which of the plots shown in the figure represents speed (v_n) of the electron in a hydrogen atom as a function of the principal quantum number (n)?



A. B

B. D

C. C

D. A

Answer: A

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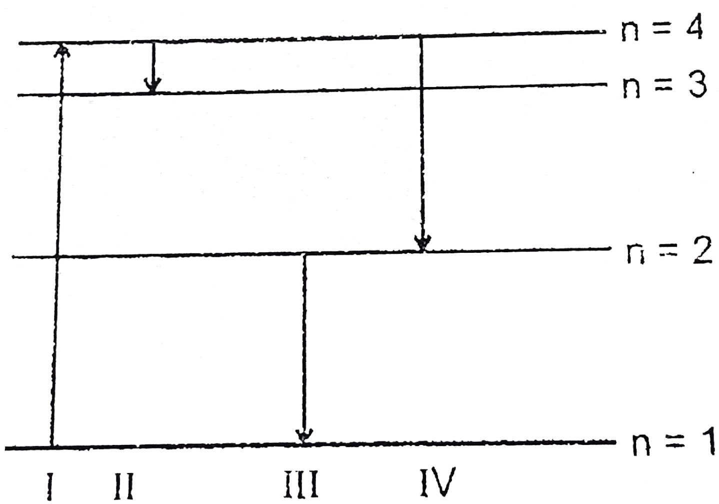
15. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of photon with the most enegy ?



A. IV

B. III

C. II

D. I

Answer: B

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16. In the Bohr model an electron moves in a circular orbit around the proton. Considering the orbiting electron to be a circular current loop, the magnetic moment of the hydrogen atom, when the electron is in nth excited state, is :

A. $\left(\frac{e}{2m}\frac{n^2h}{2pi}\right)$

B. $\left(\frac{e}{m}\right)\frac{nh}{2\pi}$

C. $\left(\frac{e}{2m}\right)\frac{Rh}{2\pi}$

D. $\left(\frac{e}{m}\right)\frac{n^2h}{2\pi}$

Answer: C

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17. An electron , in a hydrogen-like atom, is in excited state. It has a total energy of -3.4 eV. Calculate

(a) the kinetic energy and

(b) the de Broglie wavelength of the electron.

A. $+3.4eV, 0.66 \times 10^{-9}m$

B. $-3.4eV, 1.99 \times 10^{-9}m$

C. $2.8eV, 2.38 \times 10^{-10}m$

D. $1.1eV, 1.28 \times 10^{-9}m$

Answer: A

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18. The ionization energy of a hydrogen like Bohr atom is 4 Rydbergs. If, λ_1 is the wavelength of the radiation emitted when the electron jumps from the first excited state to the ground state then

A. $\lambda_1 = 300\text{Å}$

B. $\lambda_1 = 600\text{Å}$

C. $\lambda_1 = 100\text{Å}$

D. $\lambda_1 = 900\text{Å}$

Answer: A

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19. 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. 1

C. 4

D. 5

Answer: C

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20. Suppose an electron is attracted toward the origin by a force $\frac{k}{r}$ where k is a constant and r is the distance of the electron from the origin .By applying Bohr model to this system the radius of the n^{th} orbital of the electron is found to be r_n and the kinetic energy of the electron to be T_n , Then which of the following is true ?

A. $T_n \propto \frac{1}{n^2}, r_n \propto n^2$

B. T_n independent of $n, r_n \propto n$

C. $T_n \propto \frac{1}{n}, r_n \propto n$

D. $T_n \propto \frac{1}{n}, r_n \propto n^2$

Answer: B

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21. In the Bohr model of a $\pi - mesic$ atom , a $\pi - mesic$ of mass m_{π} and of the same charge as the electron is in a circular orbit of ratio of radius r about the nucleus with an orbital angular momentum $h/2\pi$. If the radius of a nucleus of atomic number Z is given by $R = 1.6 \times 10^{-15} Z^{\frac{1}{3}} m$, then the limit on Z for which $(\varepsilon_0 h^2 / \pi m e^2 = 0.53 \text{Å and } m_{\pi} / m_e = 264) \pi - mesic$ atoms might exist is

A. < 105

B. > 105

C. < 37

D. > 37

Answer: C

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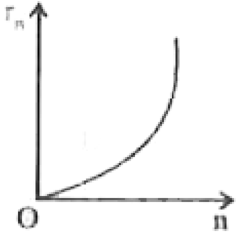
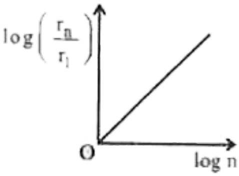
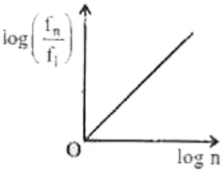
22. If in hydrogen atom, radius of n^{th} Bohr orbit is r_n., frequency of revolution of electron in n^{th} orbit is f_n choose the correct option.

A. 

B. 

C. 

D. Both (a) and (b)

Answer: D

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23. In the Bohr model of a hydrogen atom, the centripetal force is furnished by the Coulomb attraction between the proton and the electrons. If a_0 is the radius of the ground state orbit, m is the mass and e is the charge on the electron and e_0 is the vacuum permittivity, the speed of the electron is

A. 0

B. $\frac{e}{\sqrt{\varepsilon_0 a_0 m}}$

C. $\frac{e}{\sqrt{(4\pi\varepsilon_0 a_0 m)}}$

D. $\sqrt{\frac{4\pi\varepsilon_0 a_0 m}{e}}$

Answer: C

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24. An electron in the hydrogen atom jumps from excited state n to the ground state. The wavelength so emitted illuminates a photo-sensitive material having work function $2.75eV$. If the stopping potential of the photoelectron is $10V$, the value of n is

A. 13.4 eV

B. 12.75eV

C. 5.1 eV

D. 2.31 eV

Answer: B

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25. In the Bohr's model of hydrogen-like atom the force between the nucleus and the electron is modified as $F = \frac{e^2}{4\pi\varepsilon_0}\left(\frac{1}{r^2} + \frac{\beta}{r^3}\right)$, where B is a constant. For this atom, the radius of the nth orbit in terms of the Bohr radius $\left(a_0 = \frac{\varepsilon_0 h^2}{m\pi e^2}\right)$ is :

A. $r_n = a_0 n - \beta$

B. $r_n = a_0 n^2 + \beta$

C. $r_n = a_0 n^2 - \beta$

D. $r_n = a_0 n + \beta$

Answer: C

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26. the wavelength of radiation emitted is λ_0 when an electron jumps. From the third to second orbit of hydrogen atom. For the electron jumping from the fourth to the second orbit of the hydrogen atom, the wavelength of radiation emitted will be

A. $\frac{16}{25}\lambda_0$

B. $\frac{20}{27}\lambda_0$

C. $\frac{27}{20}\lambda_0$

D. $\frac{25}{16}\lambda_0$

Answer: B

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27. In Bohr's model of the hydrogen atom, let R, V, T and E represent the radius of the orbit, speed of the electron, time period of revolution of electron and the total energy of the electron respectively. The quantity proportional to the quantum number n is

A. VR

B. E

C. r

D. T

Answer: A

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28. An electron in hydrogen atom makes a transition $n_i \rightarrow n_2$ where n_1 and n_2 are principal quantum numbers of the two states. Assuming Bohr's model to be valid the time period of the electron in the initial state is eight times that in the final state. The possible values of n_1 and n_2 are

A. $n_1 = 4 \text{ and } n_2 = 2$

B. $n_1 = 6 \text{ and } n_2 = 2$

C. $n_1 = 8 \text{ and } n_2 = 1$

D. $n_1 = 8 \text{ and } n_2 = 2$

Answer: A

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29. The ionization enegry of the electron in the hydrogen atom in its ground state is $13.6ev$. The atoms are excited to higher energy levels to emit radiations of 6 wavelengths. Maximum wavelength of emitted radiation corresponds to the transition between

A. n=3 to n= 1 states

B. n=2 to n= 1 states

C. n=4 to n = 3 states

D. n=3 to n=2 states

Answer: C

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30. If potential energy between a proton and an electron is given by $|U| = ke^2 / 2R^3$, where e is the charge of electron and R is the radius of atom , that radius of Bohr's orbit is given by $(h = Plank's cons\tan t, k = cons\tan t)$

A. $\dfrac{ke^2m}{h^2}$

B. $\dfrac{6\pi^2}{n^2}\dfrac{ke^2m}{h^2}$

C. $\dfrac{2\pi}{n}\dfrac{ke^2m}{h^2}$

D. $\dfrac{4\pi^2ke^2m}{n^2h^2}$

Answer: B

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