PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12 FOR PHYSICS

ATOMIC PHYSICS

Example

1. An electron beam moving with a speed of $2.5 \times 10^7 ms^{-1}$ enters into the magnetic field $4 \times 10^{-3} Wb/m^2$ directed perpendicular to its direction of motion. Find the intensity of the electron moves undeflected .

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2. A mono energetic electron beam with a speed of $5.2 \times 10^6 ms^{-1}$ enters into a magnetic filed of induction $3 \times 10^{-4} T$, directed normal to the beam . Find the radius of the circul traced by the beam $(Take e/m = 1.76 \times 10^{11} Ckg)$

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3. The deflecting plats in a thomas's setup are x meters long . Intensity of electric field applied between the plates is E. The plates are maintained at a $p.d$ of V volts electrons accelerated through a $p.dV$ volts enter from one edge of the plates midway in a direction parellel to the plates . Find the deflection at the other edge of the plates.

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4. The specific charge of a person is $9.6 \times 10^7 C/kg$. The specific charge of an alpha particle is

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5. A beam of electron enter at right angle to an uniform electric field with a velocitgy $3x10^7 m/s, E = 1800v/m$ while travelling through a distance of $10cm$, the beam deflected by $2mm$ then specific charge of electron is

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6. In Thomson's experiment for determining e/m the potential different between the cathod and the anod (in accelerating coloumns) is same as that between the deflecting plates (in the regions of crossed field) . If the $p.d$ is doubled , by what factor should the magnetic field be increased to ensure that the electron beam remains undeflected

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7. In a cathods ray tube ,a $p.d$ of $3000V$ is maintained betweens the deflector plates whose seperation is $2cm$. A magnetic filed of $2.5x10^3$ at right angle to the electric field gives no deflection of electern beam , which received an initial acceleration by a $p.d$ of $10,000V$, the e/m of electron is

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8. In Milikan's oil drop experiment, an oil drop of radius r and charge q is held in equilibrium between the plates of as charged parallell plate capacitor when the potential difference is V. To keep as drop of radius 2r and with a charge $2q$ in equilibrium between the plates the potential difference V required is

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9. A charge oil drop of charge q is falling under gravity with termined velocity v in the absence of electric filed . A electric field can keep the oil drop stationary . If the drop acquires an additional charge , it moves up with velocity $3v$ in that field . find the new charge on the drop.

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10. In millikon's method of determining the charge of an electron, the terminal velocities of oil drop in the presence and in the absence of an electric field are xcm/s upward and ycm/s downwards respectively. Find the ratio of electric force to gravitational force on the oil drop . (Neglect Buoyancy)

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11. In a Millikon's Experiment and oil drop of radius $1.5 \times 10^{-6} m$ and density $890 Kg/m^3$ is held stationary between two condenser plates $1.2cm$ apart and kept at a $p.d$ of $2.3kV$. If upthrust due to air is ignored , then the number of excees electron carries by the drop will be

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12. A charge oil drop of charge q is falling under gravity with termined velocity v in the absence of electric filed . A electric field can keep the oil drop stationary . If the drop acquires an additional charge , it moves up with velocity $3v$ in that field . find the new charge on the drop.

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13. A charged oil drop fall with a terminal velocity V in the absence of elcectric field . An electric field E keep keep the oil drop stationary in it . When the drop acquire a charge 'q' it moves up with same velocity. Find the initial charge on the drop.

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14. Two oil drop in millikon's experiment are falling with terminal velocity in the ratio $1:4$. The rario of their de-Broglie wave length is

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15. The electron in a hydrogen atom makes a transition $n_1 \to n_2$, where n_1 and n_2 are the principle quantum numbers of the two states. Assume the Bohr 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

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16. Find the kinetic energy, potential energy and total energy in

first and second orbit of hydrogen atom if potential energy in first orbit is taken

to be zero.

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17. A small particle of mass m moves in such a way that the potential energy $U = ar^2$, where a is constant and r is the distance of the particle from the origin. Assuming Bhor model of quantization of angular momentum and circular orbits, find the radius of nth allowed orbit.

18. Consider a hydrogen-like atom whose energy in nth excited state is given by

$$E_n = \frac{13.6Z^2}{n^2}$$

When this excited makes a transition from excited state to ground state , most energetic photons have energy $E_{\max} = 52.224eV$. and least energetic photons have energy

$$E_{\max} = 1.224eV$$

Find the atomic number of atom and the intial state or excitation.

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19. A hydrogen like atom (atomic number Z) is in a higher excited state of quantum number n. The excited atom can make a transition to the first excited state by successively emitting two photons of energy 10.2 eV and 17.0 eV, respectively. Alternatively, the atom from the same excited state can make a transition to the second excited state by successively emitting two photons of energies 4.25 eV and 5.95 eV, respectively Determine the values of n and Z. (Ionization energy of H-atom = 13.6 eV)

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20. A doubly ionized lithium atom is hydrogen like with atomic number 3. Find the wavelength of the radiation required to excite the electron in Li^{++} from to the third Bohr orbit (ionization energy of the hydrogen atom equals 13.6 eV).

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21. A hydrogen atom in a state of binding energy $0.55eV$ make a trasisition to a state of excitation energy of $10.2eV$

(i) what is the initial state of hydrogen atom?

(ii) what is the final state of hydrogen atom?

(iii) what is the wavelength of the photon emitted?

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22. A hydrogen atom initally in the ground level absorbs aphoton, which excites it to be $n = 4$ level, Determine the wavelength and frequency of photon . To find the wavelength and frequency of photon use the relation of energy of electron in hydrogen atom is

$$E_n = -\frac{13.6}{n^2} eV$$

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23. (a) Using the Bohr's model, calculate the speed of the electron in a hydrogen atom in the n=1,2 and 3 levels. (b) Calculate the orbital period in each of these levels.

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24. The radius of innermost electron orbit of a hydrogen atom is $5.3 \times 10^{-11} m$. What are the radii of n=2 and n=3 orbits.?

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25. A $12.5 eV$ electron beam is used to bombard gaseous hydrogen at room temperature. What serious of wavelength will be emitted?

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26. In accordance with the Bohr's model, find the quantum number that characterizes the earth's revolution around the sun in an orbit of radius $1.5 \times 10^{11} m$ with orbital speed $3 \times 10^{4} m/s$. (Mass of earth=$6.0 \times 10^{24} kg$)

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C.U.Q

1. If'C' denotes the velocity of light , velocity of cathod rays is

A. equal to C

B. greater than C

C. less than C

D. either greater or less than C

Answer: C

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2. If an electron has an initial velocity in a direction different from that of an electric field, then the path of the electron is

A. a straight line

B. a circle

C. a parabola

D. an ellipse

Answer: A

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3. Cathode rays enter into a unifrom magnetic field perpendicular to the direction of the field. In the magnetic field their path will be

A. a parabola

B. a circle

C. a straight line

D. an ellipse

Answer: A

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4. when the electron in the discharge tube is accelerated to high speed (i.e. comparable with speed of light)

A. the charge on the electron will decrease

B. the specific charge will decrease

C. the charge of the electron will increase

D. the value of e/m will increase

Answer: B

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5. The discovery of the elctrons was a consequence of study of the

A. discharge of electricity through atmosphere

B. discharge of electricity through rarefied gases .

C. photoelectric effect

D. nuclear fission

Answer: B

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6. If a proton in an elctorn an an elctron are accelerated through the same potential difference

A. both the proton and electron have same K.E

B. both the proton and electron have same momentum

C. both the proton and electron have same velocity

D. both the proton and electron have same temperature

Answer: A

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7. A cathod ray tube has a potential different of V between the cathod and anode . The speed of the cahtod rays is given by

A. $v \propto V$

B. $V \propto V^{-1}$

C. $v \propto \sqrt{V}$

D. $v \propto V^{2}$

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8. In a region of space , cathod rays mov along positive $Z-$ axis . If and a uniform magnetic field applied along $x-$ axis . If cathod rays pass undevited , the direction of electron field will be along

A. Negative x-axis

B. positive y-axis

C. negative y-axis

D. positive z-axis

Answer: C

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9. A cathod rays particle is accelerated from rest through a potential difference of V volt. The speed of the particle is

A. $\sqrt{\frac{2eV}{m}}$

B. $\frac{m}{ev}$

C. $\sqrt{mev}$

D. $\sqrt{\frac{4eV}{m}}$

Answer: A

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10. in $j.\ j$ thomson's method ,electric field of intensity E, magnetic field of induction B and velocity V of the electron were in mutually perpendicular direction . The condition for velocity is

A. $V = E/B$

B. $V = B/E$

C. $V = BE$

D. $V = \sqrt{\frac{B}{E}}$

Answer: A

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11. An electron of charge 'e' coulomb passes through a potential difference of V volts. Its energy in 'joules' will be

A. eV joule

B. MeV joule

C. Me/V joule

D. eV/M joule

Answer: A

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12. The increasing order of specific charge for electron (e), proton (p), neutron (n) and alpha particle(a) is

A. e, p, n, α

B. n, α, p, e

C. n, p, e, α

D. n, p, α, e

Answer: B

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13. A uniform magnetic field and a uniform electric field are produced, pointing in the same direction. An electron is projected with its velocity pointed in the same direction. What will be the effect on electron?

A. the electron will turn to its right

B. the electron will turn to its left

C. the electron velocity will increase in magnitude

D. the electron velocity will decrease in magnitude

Answer: D

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14. when a positively charged particle enter a uniform magnetic field with uniform velocity its trajectory can be

(a) straight line (b) a cicle a (c)helix

A. a only

B. a or b

C. a or c

D. any one of a,b and c

Answer: D

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15. the rartio e/m of electron is independent of

(a) Nature of cathod, anode (b) Nature of gas of discharge tube (c) Applied voltage (d) Size discharge tube

A. a,b,c are only correct

B. a,b,d are only correct

C. b,c,d are only correct

D. a,b,c,d are correct

Answer: D

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16. An electron is not deflected on passing through a certain region , because

A. there is magnetic field in that region and the electron enters into it in any direction .

B. there may be magnetic field but the velocity of electron may be parallel to the direction of magnetic field

C. electron is an charge-less particle

D. there is electric field and the electron enters into it in any direction

Answer: B

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17. In Thomson's experiment, when the electron strikes the undeflected spot, then its moves with

A. constant acceleration

B. non uniform velocity

C. constant velocity

D. constant retardation

Answer: C

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18. An electron enters perpendicular to a uniform magnetic field with a speed o $10^8 cm/s$. The particle ecperiences a force due to the magnetic field and the speed of the electron

A. will decrease

B. will increase

C. will remain constant

D. may increase or decrease

Answer: C

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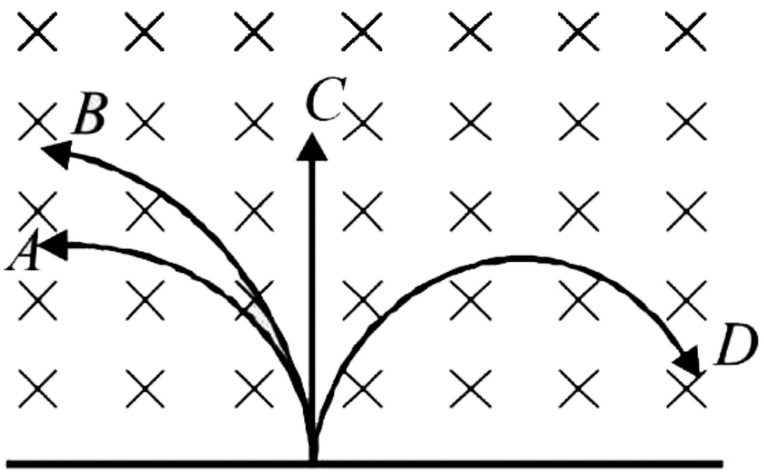
19. A neutron, a proton , and an electron and an alpha particle enter a region of constant magnetic field with equal velocities . The magnetic field is along the inward normal to the plane of the paper . The tracks of the particles are labelled in fig. the electron follows track .... and the alpha particle follows track.....



A. C, D

B. B, A

C. A, C

D. A, D

Answer: C

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20. When a charged particle moves through a magnetic field , the quantity which is not affected in the magnetic field is

A. particle velocity

B. particle acceleration

C. linear momentum of the particle

D. kinetic energy of the particle

Answer: D

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21. A nagatively charge electroscope with zinc disc discharge when irradiated by an ultraviolet lamp. What caused this ?

A. a - particle from the source combine with electron of the disc

B. electron escape from the disc when ultraviolet radiation fall on it,

C. ultraviolet rays ionize the air surrounding the electroscop

D. the disc becomes hot and thermionic emission take palce

Answer: B

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22. The force felt by an electron on entering into a magnetic field is indepent of its

A. charge

B. strength of the field

C. mas

D. direction ot its velocity

Answer: C

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23. when an electron moves through a magnetic field , its speed will

A. decrease

B. increase

C. remain the same

D. increase first and then decrease

Answer: C

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24. The direction of a cathod ray particle passing through a magnetic field can by found by

A. Fleming's left hand rule

B. Laplace's law

C. Maxwell's cork screw rule

D. Ampere's rule

Answer: A

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25. which of the particle cannot be defected by magnetic field

A. electrons

B. neutrons

C. α-particle

D. protons

Answer: B

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26. A charged particle enters a region of uniform magnetic field at an angle of 85° to the magnetic line of force. The path of the particle is a circle. Is this statement true or false?

A. circular

B. elliptical

C. spiral

D. a straight line

Answer: C

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27. An eletron and a proton are injected into a uniform magnetic field at right to its direction with the same momentum . Then

A. electron's path is less curved than proton's path

B. proton's path will be less curved than electron's path

C. the paths of both will be equally curved

D. both the trajectories will be straight

Answer: C

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28. An proton and an electron simultaneously enter into a region in which a uniform magnetic field acts normal to the motion of both the particles. The frequency of revolution of

A. the proton is greater than that of the electron

B. the electron is greater than that of the proton

C. the proton is equal to that of the electrons

D. both are having same frequency , but revolve in opposite direction

Answer: B

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29. You are sitting in a room in which uniform magnetic field is present in vertically downward direction. At the centre of room an electron is projected horizontally with a certain speed. Discuss the speed and path of the electron in this field.

A. clockwise in vertical plane

B. clockwise in horizontal plane

C. anticlockwise in vertical plane

D. anticlockwise in horiozontal plane

Answer: B

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30. A charged particle of charge Q and mass$m$ moves with velocity v in a circular path due to transverse magnetic field, B, then its frequency is

A. $\frac{QB}{2\pi m}$

B. $\frac{QvB}{2\pi m}$

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

D. $\frac{vb}{2\pi Qm}$

Answer: A

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31. A proton and an elctron simultaneously enter a region in which a magnetic field acts normal to the motion of both the particle . The frequency of revolution of

A. proton is greater than that of elcctron

B. electron is greater than that of proton

C. proton is equal to that of electron

D. proton depend on its velocity

Answer: B

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32. Imagine you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the from wall, is deflected by a strong magnetic field to your right side. What is the direction of the magnetic field?

A. Vertically upwards

B. vertically downwards

C. horizontal perpendicular to the direction of motion of the elctron beam

D. horizontal and parallel to the direction of motion of the electron beam

Answer: B

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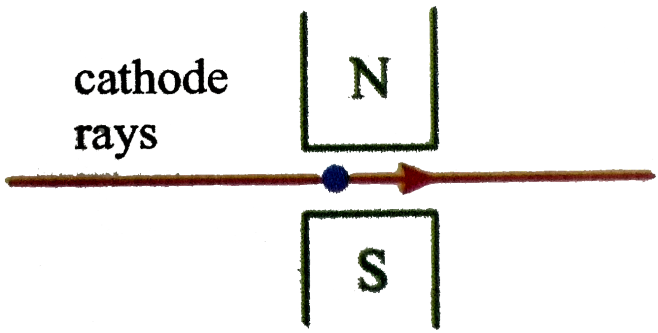
33. Cathode rays are made to pass between the poles of a magnet as shown in figure. The effect of magnetic field is



A. to deflect them toward the south pole

B. to deflect them perpendicular to the plane of the paper and toward the observer

C. to deflect them toward the norht pole

D. to increase the velocity of the rays

Answer: B

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34. In which of the following field cathod rays show minimum deflection

A. Electric field

B. Magnetic Field

C. Plasma field

D. Gravitational

Answer: D

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35. An oil drop of mass m and charge +q is balanced in vaccum by a uniform electric field of intensity E. the direction of this field should be

A. Vertically upwards

B. verticallu down

C. horizontal perpendicular to the direction of motion of the elctron beam

D. inclined at 45^0 to the horizontal

Answer: A

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36. An oil drop of mass m and falls through a medium that offers a viscous drag force. F. if the velocity of the drop is constant it means that

A. $F > mg$

B. $F < mg$

C. $F > mg$

D. $F = mg$

Answer: B

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37. An oil drop of mass m fall through a viscous medium. The viscous drag force. F is proportional to the velocity of the drop . At the instant it begins to fall the force that acts on the oil drop is (neglect buoyancy)

A. mg

B. $mg - F$

C. $F - mg$

D. F

Answer: A

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38. An oil drop of mass m fall through air with a terminal velocity in the presence of upward electric field of intensity E. the drop carries a charge $+q$. R is the viscous drag force and f is the buoyancy force . Them for the motion of the drop.

A. there is a net force directed upward

B. there is a net force directed downward

C. $mg = Eq + F + R$

D. $mg + Eq = F + R$

Answer: C

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39. If g_E and g_M are the acceleration due to gravity on the surfaces of the earth and the moon respectively and if Millikan's oil drop experiment could be performed on the two surfaces, one will find the ratio

electronic charge on the moon/electronic charge on the earth to be

A. g_E / g_M

B. 1

C. 0

D. g_M / g_E

Answer: B

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40. In millikan's oil drop method, electron charge is accurately measured by conducting an experiment in which

A. Apparent weight of drop is balanced by electric forced on it

B. Apparent weight of drop is balanced by magnetic forced

C. Electic force of drop is equal to magnetic force

D. Apparent force of drop of balanced by force due to surface tension

Answer: A

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41. In Millilan's experiment , the oil drop acquire charge by

A. induction

B. Friction

C. electic field

D. magnetic field

Answer: B

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42. If V is Velocity of oil drop , than according to stok's law, the viscous drag force on an oil drop is proportional to

A. $\sqrt{V}$

B. V^2

C. V^{-1}

D. V

Answer: D

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43. An oil drop of radius r carrying a charge q remain stationary in the presence of electric field of intensity E. If the density of oil ρ , then

A. $E = \frac{4}{3}\pi r^3 \rho g q$

B. $E = \frac{4}{3}\pi r^3 \rho g$

C. $E = \frac{4}{3}\pi r^3 \rho g / q$

D. $E = \frac{4}{3}\pi r^3 \rho / g^3$

Answer: C

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44. The important conclusion given by millikan's experiment about the charge is

A. charge is never quantised

B. charge has no definite value

C. charge is quantised

D. charge on an oil drop always increases

Answer: C

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45. Coulomb 's law correctly describe the electric force is that (pick the wrong statement)

A. bind the electrons and neutrons in the nucleus of an atom

B. bind electron to nucleus

C. binds atom togather to form molecules

D. bind atom and molecules to from solid

Answer: A

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46. Is the probability of backward scattering (i.e. scattering of a-particals at angle greater than 90^0) predicated by Thomson's model much less, about the same , or much greater than less, about the same , or much greater than that predicted by Ruthorford's model ?

A. Much greater

B. much less

C. same

D. slightly greater

Answer: B

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47. An electron with kinetic energy $5eV$ is incident on a hydrogen atom in its ground state.The collision

A. must be elastic

B. may be partially elastic

C. must be completely inelastic

D. may be partially inelastic

Answer: A

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48. The angular momentum of the α- particles which are scattered through large angle by the heavier nuclei, is conserved because of the

A. nature of repulsive force

B. conservation of kinetic energy

C. conservation of potential energy

D. there is no external torque

Answer: D

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49. The Incorrect statement regarding Rutherford's atomic model is

A. Atom contain nucleus

B. Size of nucleus is very small in comparison to that of atom

C. Nucleus contains about 90% mass of the atom

D. Electrons revolve round the nucleus with uniform speed

Answer: C

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50. a-particles are

A. helium nuclei

B. sodium nuclei

C. ionised nuclei

D. hydrogen nuclei

Answer: A

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51. In scattering experiment , the force that scatters particles is

A. nuclear force

B. coulomb force

C. Both(1) and (2)

D. gravitational Force

Answer: B

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52. Bohr'satom model assumes

A. The nucleus is of infinite mass and is at rest

B. electron in a quantized orbit will not radiate energy

C. mass of the electrons remain constant.

D. $1, 2, 3$ are correct

Answer: D

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53. The rartio $(\text{in}S1units)$ of magnetic dipole moment to that of the angular momentum of an electron of mass mkg and charge e coulomb in Bohr's orbit of hydrogen atom is

A. $\frac{e}{m}$

B. $\frac{e}{2m}$

C. $\frac{e}{3m}$

D. $\frac{2e}{m}$

Answer: B

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54. The radius of hydrogen atom , when it is in its second excite state , becomes:

A. half

B. double

C. four times

D. nine times

Answer: D

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55. For electron moving in n^{th} orbit of the atom , the angular velocity is proportional to:

A. n

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

C. n^3

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

Answer: D

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56. The size of atomic nucleus is of the order of............ m and size of the atom is of the order of........... .

A. $10^{-14}m, 10^{-10}m$

B. $10^{-10}m, 10^{-8}m$

C. $10^{-20}m, 10^{-16}m$

D. $10^{-8}m, 10^{-6}m$

Answer: A

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57. In the lowest energy level of hydrogen atom, the electron has the angular momentum

A. $\frac{\pi}{h}$

B. $\frac{h}{\pi}$

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

D. $\frac{2\pi}{h}$

Answer: C

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58. Atomic hydrogen is excited to the nth energy level . The maximum number of spectral lines which it can emit while returning to ground state,is:

A. $\frac{1}{2}n(n-1)$

B. $\frac{1}{2}n(n+1)$

C. $n(n+1)$

D. $n(n+1)$

Answer: A

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59. As the orbit number increase , the distance between two consecutive orbits in an atom or ion having single electron:

A. increases

B. decreases

C. remain the same

D. first increases and then become constant

Answer: A

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60. Ionization energy of a hydrogen like A is greater than that of another hydrogen like ion Let r, u, E and L represent the radius of the orbit, speed of the electron energy of the atom and orbital angular momentum of the electron respectively, in ground state

A. $r_A > r_B$

B. $u_a > u_B$

C. $E_A . E_B$

D. $L_A > L_B$

Answer: B

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61. The classification of discrete energy levels in atom was first given experimentally by

A. Thomson's experiment

B. Millikan's oil drop experiment.

C. Frank -Hertz experiment

D. Leonard experiment

Answer: C

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62. An atomic nucleus contains

A. only electrons

B. only protons

C. only neutrons

D. both proton and neutrons

Answer: D

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63. On decreasing principal quantum number n, the value of r and v will

A. decrease

B. increase

C. r will increase but v will decrease.

D. r will decrease but v will increase

Answer: D

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64. The possible values of principal quantum number can be

A. $1, 2, 3...8.$

B. $0, 1, 2...8.$

C. only zero

D. only odd numbers

Answer: A

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65. According to sommerfeld , an electron revolves round a necleus in

A. Circular orbits.

B. Elliptical orbits.

C. Hyperbolic

D. orbits

Answer: B

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66. The main defect of Bohr's atom model is

A. mixing of classical and quantum theories

B. exclusion of nuclear motion

C. failed to explain the fine strcucture of spectural lines

D. failed to explain other atom

Answer: A

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67. According to Bhor's discrete quantium is

A. Momentum

B. Angular Velocity

C. potential energy

D. Angular momentum

Answer: D

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68. If E_n and L_n denote the total energy and the angular momentum of an electron in the nth orbit of Bohr atom, then

A. $E_n \propto j_n^2$

B. $E_n \propto \frac{1}{j_n^2}$

C. $E_n \propto j_n$

D. $E_n \propto \frac{1}{J_n}$

Answer: B

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69. If the radius of first Bohr's orbit is r, then radius of second orbit will be

A. $2r$

B. $\frac{r}{2}$

C. $4r$

D. $\sqrt{2}r$

Answer: C

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70. According to quantum mechanics, one of the following is wrong about spin of electron

A. it is releted to intrinsic angular momentum

B. spin is rotation of electron about its own axis

C. value of spine quantum number must not be 1

D. $+1/2$ value of spin quantum number represents up spin

Answer: B

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71. According to classical theory, the circular path of an electron in Rutherford atom is

A. straight line

B. spiral

C. circular

D. parabolic

Answer: B

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72. one of the following radiation are not emitted by electron transition in atom , choose the option

A. ultra violet rays

B. infrared radiations

C. visible rays

D. $\alpha - rays$

Answer: D

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73. The energy emitted by a source is in the form of

A. photons

B. electrons

C. protons

D. neutrons

Answer: A

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74. The unit of planck's constant is equivalent to that of

A. energy

B. angular momentum

C. velocity

D. force

Answer: B

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75. Hydrogen atom will be in its ground state , if its electrons is in

A. any energy level

B. the lowest energy state

C. the highest energy state

D. the intermediate state

Answer: B

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76. The wavelength involved in the spectrum of deuterium $_(1)^2D$ are slightly different from that of hydrogen spectrum because

A. the size of the nuclei are different

B. the nuclear forces are different in two cases

C. the mases of the two nuclei are different

D. the attraction and the nucelus is different in the two cases

Answer: C

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77. When an electron jumps from $n_1 th$ orbit to n_2 th orbit, the energy radiated is given by

A. $E_1 - E_2 = hv$

B. $E_2 - E_1 = hv$

C. $E_2 + E_1 = hv$

D. $E_2 - 2E_1 = hv$

Answer: A

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78. Which of the following parameters are the same for all hydrogen like atoms and ions in their ground state?

A. radius of the orbit

B. speed of the electron

C. energy of the atom

D. orbital angular momentum of electrons

Answer: D

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79. The Fine structure of hydrogen spectrum can be explained by

A. the presence of neutrons in the nucleus

B. the finite size of nucleus

C. the obtical angular momentum of electrons

D. the spin angular momentum of the electron

Answer: D

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80. The visible region of hydrogen spectrum was first studied by

A. Lyman

B. Balmer

C. Pfund

D. Brackett

Answer: B

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81. With the increase in peinciple quantum number, the energy difference between the two successive energy levels

A. remains constant

B. decreases.

C. increases

D. sometime increases somtime decreases

Answer: B

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82. Can a hydrogen atom emit characteristic X-ray?

A. its energy levels are too close to each other

B. its energy levels are too for apart

C. it has a very small mass

D. it has a single electron

Answer: A

Watch Video Solution

83. An electron makes transition form $n = 3$, $n = 1$ state in a hydrogen atom. The maximum possible number of photons emitted will be

A. 1

B. 2

C. 3

D. 6

Answer: C

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84. Assertion : Rydberg's constant varies with mass no. of a given element.

Reason: The 'reduced mass' of the electron is dependent on the mass of the nucleus only.

A. A and R are true and R is the correct explaination of A

B. A and R are true and $R$is not the correct explaination of A

C. A is true and R is false.

D. A is false but R is true

Answer: D

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85. Assertion (A), study of discharge of electricity through gases at low pressure resulted in the discovery of cathod rays .

Reason (R): cathod rays are deflected by both magnetic and electric fields and the direction of deflection shows that they are nagatievly charged .

A. A and R are true and R is the correct explaination of A

B. A and R are true and $R$is not the correct explaination of A

C. A is true and R is false.

D. A is false but R is true

Answer: B

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86. Assertion (A),If electrons travel undefeccted by the electric field$E$ and magnetic field B then the velocity of electrons is given by $V = \frac{e}{b}$.

Reason (R): When both electric and magnetic field are applied simultaneously on electron beam. If force due to electric field is equal and opposite to force due to magnetic field then they travel undeflected.

A. A and R are true and R is the correct explaination of A

B. A and R are true and $R$is not the correct explaination of A

C. A is true and R is false.

D. A is false but R is true

Answer: A

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87. Assertion (A),In the Thomson's e/m experiment of electrons, the specific charge of electrons is independent of natural of the discharge tube

Reason (R): Charge of a body is quantized

A. A and R are true and R is the correct explaination of A

B. A and R are true and $R$is not the correct explaination of A

C. A is true and R is false.

D. A is false but R is true

Answer: B

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88. Assertion (A), Between any two given energy levels, the number of absorption transition is always less than number of emission transition.

Reason (R): Absorption transitiion start from the lowest energy lovely only and may end at any higher energy level. but emission transition may start from any higher energy level and end at any energy level below it.

A. A and R are true and R is the correct explaination of A

B. A and R are true and $R$is not the correct explaination of A

C. A is true and R is false.

D. A is false but R is true

Answer: A

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LEVEL-I (C.W)

1. An electron passes undeflected through perpendicular electric and magnetic filed of intensity $3.4 \times 10^3 V/m$ and $2 \times 10^{-3} Wb/m^2$ respectively . Then its velocity un m/s is

A. 1.7×10^6

B. 6.8×10^6

C. 6.8

D. 1.7×10^8

Answer: A

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2. The ratio of specific charge of an electron to that of a hydrogen ion is

A. $2:1$

B. $1:1$

C. $1:1840$

D. $1840:1$

Answer: D

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3. An a - particle and a protein are subjected to the same electric field , then the ratio of the force acting on them is

A. $2:3$

B. $1:3$

C. $3:2$

D. $2:1$

Answer: D

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4. An electron is accelerated in an electric field of $40 V cm^{-1}$. If e/m of electron is $1.76 \times 10^{11} C kg^{-1}$, then its acceleration is

A. $14.0 \times 10^{14} ms^2$

B. $14.0 \times 10^{10} ms^{-2}$

C. $7.0 \times 10^{10} ms^{-2}$

D. $7.04 \times 10^{14} ms^{-2}$

Answer: D

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5. An electron beam moving with a speed of $2.5 \times 10^{7} ms^{-1}$ enters into the magnetic field $4 \times 10^{-3} Wb/m^{2}$ directed perpendicular to its direction of motion. Find the intensity of the electron moves undeflected .

A. $10^{4} N/C$

B. $10^{5} N/C$

C. $10^{7} N/C$

D. $10^{3} N/C$

Answer: B

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6. A particle carrying a charge moves perpendicular to a uniform magnetic field of induction B with a momentum p then the radius of the circular path is

A. Be/p

B. pe/B

C. p/Be

D. Bep

Answer: C

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7. A Water of mass $3.2 \times 10^{-18} kg$ and carrying a charge of $1.6 \times 10^{-19} C$ is suspended stationary betwaeen two plates of an electric field. Given $g = 10 m / s^2$, the intensity of the electric field required is

A. $2V / m$

B. $200V / m$

C. $20V / m$

D. $2000V / m$

Answer: B

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8. In a millikon's oil drop experiment, an oil drop of mass $0.64 \times 10^{-14} kg$, carrying a charge $1.6 \times 10^{-19} C$ remain stationary between two plates seperated by a distance of $5mm$. Given $g = 9.8m / s^2$, the voltage that must be applied between the plates being

A. $980V$

B. $1960V$

C. $3920V$

D. $2880V$

Answer: B

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9. a-particle are projected toward the nuclei of the different metals , with the same kinetic energy . The distance of closest approach is minimum for

A. $Cu(Z = 29)$

B. $Ag(Z = 47)$

C. $Au(Z = 79)$

D. $Pd(Z = 46)$

Answer: A

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10. 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. 56

B. 112

C. 60

D. 120

Answer: B

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11. for given impact parameter b, does the angle of deflection increase or decrease with increase in energy?

A. Decrease

B. incerease

C. become zero

D. become

Answer: A

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12. Find the frequency of revolution of the electron in the first orbit of H-atom

A. $6 \times 10^{14} Hz$

B. $6.6 \times 10^{10} Hz$

C. $6.6 \times 10^{-10} Hz$

D. $6.6 \times 10^{15} Hz$

Answer: D

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13. What is the energy of a hydrogen atom in the first excited state if the potential energy is taken to be zero in the ground state?

A. $10.2 eV$

B. $13.6 eV$

C. $23.8 eV$

D. $27.2 eV$

Answer: C

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14. According to bohr model, the diameter or first orbit of hydrogen atom will be

A. $1.058 A^0$

B. $0.529 A^0$

C. $2.25 A^0$

D. $0.725A^0$

Answer: A

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15. If the angular momentum of an electron is $\vec{J}$ then the magnitude of the magnetic moment will be

A. $\frac{mJ}{2e}$

B. $\frac{eJ}{2m}$

C. $\frac{2m}{eJ}$

D. $\frac{emJ}{2}$

Answer: B

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16. The radius of the shortest orbit in a one electron system is 18 pm it may be

A. $._{1}^{1}H$

B. $._{1}^{2}$

C. He^{+}

D. Li^{+}

Answer: D

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17. 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. $Zero$

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

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

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

Answer: C

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18. The energy required to remove an electron in a hydrogen atom from $n = 10$ state is

A. $1.36eV$

B. $0.0136eV$

C. $13.6eV$

D. $0.136eV$

Answer: D

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19. The ratio of the energies of the hydrogen atom in its first to second excited state is

A. $3/1$

B. $1/4$

C. $4/9$

D. $9/4$

Answer: D

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20. The number of different wavelengths may be observed in the spectrum from a hydrogen sample if the atoms are excited to third excited state is

A. 3

B. 4

C. 5

D. 6

Answer: A

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21. The ratio of the frequencies of the long wavelength limits of the balmer and Lyman series of hydrogen is

A. $27:5$

B. $5:27$

C. $4:1$

D. $1:4$

Answer: A

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22. When an electron jumps from higher orbit to the second orbit in hydrogen, the radiation emitted out will be in $\left(R = 1.09 \times 10^7 m^{-1}\right)$

A. ultraviolet

B. visible region

C. infrared region

D. X-ray region

Answer: B

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23. The energy required to separate a hydrogen atom into a proton and an electron is $1.6eV$ then the velocity of electron in a hydrogen atom is

A. $2.2 \times 10^4 m / s$

B. $2.2 \times 10^2 m / s$

C. $2.2 \times 10^6 m / s$

D. $2.2 \times 10^{10} m / s$

Answer: C

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LEVEL-II (C.W)

1. Two ions having masses in the ratio $1:1$ and charges $1:2$ are projected into uniform magnetic field perpendicular to the field with speeds in th ratio $2:3$. The ratio of the radius of circular paths along which the two particles move is

A. $4:3$

B. $2:3$

C. $3:1$

D. $1:4$

Answer: A

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2. In thomson's experiment, a magnetic field of induction $10^{-2} wb/m^2$ is used. For an undeflected beam of cathod rays , $a.p$ of $500V$ is applied between the plates which are 0.5 cm. apart . Then the velocity of the cathod ray beam is ....m/s.

A. 4×10^7

B. 2×10^7

C. 2×10^8

D. 10^7

Answer: D

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3. A cathode ray beam is bent into an arc of a circle of radius $0.02m$ by a field of magnetic induction 4.55 milli tesla. The velocity of electron is (given $e = 1.6 \times 10^{-19} c$ and $m = 1.9 \times 10^{-31} kg$)

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

B. $3 \times 10^7 m/s$

C. $1.6 \times 10^7 m/s$

D. $3.2 \times 10^7 m/s$

Answer: C

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4. When two electrons enter into a magnetic field with different velocities , they defect in different circular parts , in such a way that radius of one path is double that of the other. $1 \times 10^7 ms^{-1}$ is the velocity of electron in smaller circle of radius $2 \times 10^{-3} m$. The velcoity of electron in the other circular path is:

A. $4 \times 10^7 ms^{-1}$

B. $2 \times 10^6 ms^{-1}$

C. $2 \times 10^7 ms^{-1}$

D. $2 \times 10^6 ms^{-1}$

Answer: C

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5. A charged oil drop fall with a terminal velocity V in the absence of elcectric field . An electric field E keep

keep the oil drop stationary in it . When the drop acquire a charge 'q' it moves up with same velocity. Find the initial charge on the drop.

A. $4q$

B. $2q$

C. q

D. $q/2$

Answer: C

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6. A charge oil drop is moving with a velcoity v_1 As it acquire charge it moves up with the velcity V_2 in the same electric field . It fall freely with a velocity $'V'$ in the absence before and after acquiring additional charge is

A. $\dfrac{V_1 + V}{V_2 - V_1}$

B. $\dfrac{V_1 + V_2}{2} V$

C. $\dfrac{V + V_1}{V + V_2}$

D. $\dfrac{V_2 V_2 V_1}{2V_1 + V}$

Answer: C

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7. A proton of mass m moving with a speed v_0 apporoches a stationary proton that is free to move. Assuming impact parameter to be zero., i.e., head-on collision. How close will be incident proton go to other proton ?

A. $\frac{e^2}{4\pi\varepsilon m v_0^2}$

B. $\frac{e^2}{\pi\varepsilon_0 m v_0^2}$

C. $\frac{e^2}{m v_0^2}$

D. zero

Answer: B

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8. A closest distance of approach of an a particle travelling with a velocity V towards Al_{13} nucleus . d . The closest distacne of approach of an alpha particle travelling with velocity $4V$ toward Fr_{26} nucleus is

A. $d/2$

B. $d/4$

C. $d/8$

D. $d/16$

Answer: C

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9. The energy required to excition an electron from $n=2$ to $n=3$ energy state is $47.2eV$. The charge number of the nucleus, around which the electrons revolving will be

A. 5

B. 10

C. 15

D. 20

Answer: A

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10. The de-Broglie wavelength of an electron in the first Bohr orbit is

A. Equal to the circumference of the first orbit

B. $1/2th$ circumference of the first orbit

C. $1/4th$ circumference of the first orbit

D. $3/4th$ circumference of the first orbit

Answer: A

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11. The radius of first Bohr orbit is x. The de-Broglie wavelength of electron in 3rd orbit is $n\pi x$ where n=?

A. $2\pi x$

B. $6\pi x$

C. $9x$

D. $x/3$

Answer: B

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12. The angular momentum of the electron in third orbit of hydrogen atom, if the angular momentum in the second orbit of hydrogen is L is

A. L

B. $3L$

C. $(3/2)L$

D. $2/3L$

Answer: C

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13. The `De-Broglie wave length of electron in second exited state of hydrogen atom is

A. $3.33A^{\circ}$

B. $6.66A^{\circ}$

C. $9.99A^{\circ}$

D. $1.06A^{\circ}$

Answer: B

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14. The maximum wavelength of Brackett series of hydrogen atom will be _____A°

A. $35, 890$

B. $14, 440$

C. $62, 160$

D. $40, 477$

Answer: D

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15. A hydrogen atom emits a photon corresponding to an electron transition from $n = 5$ to $n = 1$. The recoil speed of hydrogen atom is almost (mass of proton $\approx 1.6 \times 10^{-27} kg$).

A. $10^{-4} m/s$

B. $2 \times 10^{-2} m/s$

C. $4 m/s$

D. $8 \times 10^{-2} m/s$

Answer: C

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16. An orbital electron is the ground state of hydrogen has the magnetic moment μ_1. This orbital electron is excited to 3rd excited state by some energy transfer to the hydrogen atom. The new magnetic moment fo the electron is μ_2 then

A. $\mu_1 = 2\mu_2$

B. $2\mu_1 = \mu_2$

C. $16\mu_1 = \mu_2$

D. $4\mu_1 = \mu_2$

Answer: D

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LEVEL-III

1. Magnetic moment due to the motion of the electron in nth energy of hydrogen atom is proportional to

A. n

B. n^0

C. n^5

D. n^3

Answer: A

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2. The ratio between total acceleration of the electron in singly ionized helium atom and hydrogen atom (both in ground state) is

A. 1

B. 8

C. 4

D. 16

Answer: B

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3. The shortest wavelength of the Brackett series of a hydrogen-like atom (atomic number of Z) is the same as the shortest wavelength of the Balmer series of hydrogen atom. The value of z is

A. 2

B. 3

C. 4

D. 6

Answer: A

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4. According to Bohr's theory of hydrogen atom , the product of the binding energy of the electron in the nth orbit and its radius in the nth orbit

A. is proportional to n^2

B. is inversely proportional to n^3

C. has a constant value of $10.2eV - A^\circ$

D. has constant value $7.2eV - A^\circ$

Answer: D

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5. If an electron drop from $4th$ orbit to $2nd$ orbit in an H-atom, then

A. it gains 2.55eV of potential energy

B. it gain 2.55eV electron

C. it emits a 2.55eV electron

D. it emits a 2.55 eV photon

Answer: D

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6. The enrgy of an atom (or ion) in the ground state is $-54.4eV$ .If may be

A. He^{+}

B. Li^{2+}

C. hydrogen

D. deuterium

Answer: A

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7. An atom absorb $2eV$ energy and is excited to next energy state . The wavelength of light absorbed will be

A. $2000A^{\circ}$

B. $4000A^{\circ}$

C. $8000A^{\circ}$

D. $6206A^{\circ}$

Answer: D

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8. When an electron in the hydrogen atom in ground state absorb a photon of energy $12.1eV$, its angular momentum

A. decrease by 2.11×10^{-34}

B. decreaseby1.055×10^{-34}

C. increaseby 2.11×10^{-34}

D. increase by 1.055×10^{-34}

Answer: C

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9. Magnetic field at the center (at nucleus) of the hydrogen like atom $(\text{atomic number} = z)$ due to the motion of electron in nth orbit is proporional to

A. $\frac{n^3}{Z^5}$

B. $\frac{n^4}{Z}$

C. $\frac{Z^2}{n^3}$

D. $\frac{Z^3}{n^5}$

Answer: D

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10. A neutron moving with a speed v makes a head-on collision with a hydrogen in ground state kept at rest which inelastic collision will be take place is (assume that mass of photon is nearly equal to the mass of neutron)

A. $10.2eV$

B. $20.4eV$

C. $12.1eV$

D. $16.8eV$

Answer: B

Watch Video Solution

11. A charge particle is moving in a uniform magnetic field ib a circular path. The energy of the particle is doubled . If the initial radius of he circular path was R, the radius of the new circular path after the energy is doubled will be

A. $R/2$

B. $\sqrt{2}R$

C. $2R$

D. $R/\sqrt{2}$

Answer: B

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12. An electron in hydrogen atom after absorbing an energy photo jumps from energy state n_1 to n_2. Then it returns to ground state after emitting six different wavelength in emission spectrum. The energy of emitted photons is either equal, to less than or greater than the absorbed photons . then n_1 and n_2

A. $n_2 = 4, n_1 = 3$

B. $n_2 = 5, n_2 = 3$

C. $n_2 = 4, n_1 = 2$

D. $n_2 = 4, n_1 = 1$

Answer: C

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13. the photon radiated from hydrogen corresponding to the second line of Lyman series is absorbed by a hydrogen like atom X in the second excited state. Then, the hydrogen-like atom X makes a transition of nth orbit.

A. $X = He^{+}, n = 4$

B. $X = Li^{++}, n = 6$

C. $X = He^{+}, n = 6$

D. $X = Li^{++}, n = 9$

Answer: D

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14. Consider a hydrogen-like atom whose energy in nth excited state is given by

$$E_n = \frac{13.6Z^2}{n^2}$$

When this excited makes a transition from excited state to ground state , most energetic photons have energy $E_{\max} = 52.224eV$. and least energetic photons have energy

$E_{\max} = 1.224 eV$

Find the atomic number of atom and the intial state or excitation.

A. $Z = 2, n = 5$

B. $Z = 2, n = 4$

C. $Z = 3, n = 6$

D. $Z = 4, n = 6$

Answer: A

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15. The ionisation energy o Li^{2+} atom in ground state is,

A. $13.6 \times 9eV$

B. $13.6J$

C. $13.6erg$

D. $13.6 \times 10^{-19}J$

Answer: A

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16. A photon of energy $15eV$ collides with $H-$ atom. Due to this collision, $H-$ atom gets ionized. The maximum kinetic energy of emitted elecrtron is:

A. $1.4eV$

B. $5eV$

C. $15eV$

D. $13.6eV$

Answer: A

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

A. $80mm$

B. $97.5mm$

C. $105mm$

D. $60mm$

Answer: B

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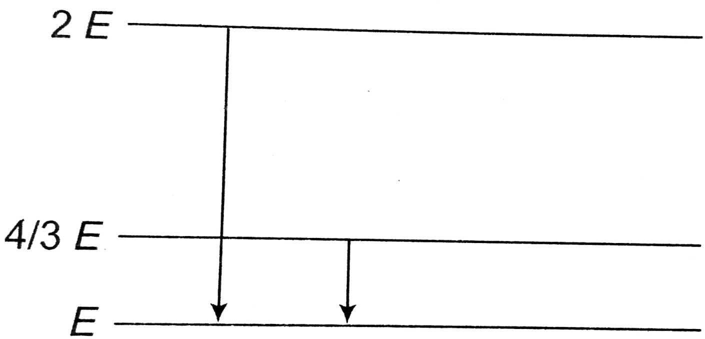
18. The follwing diagram indicates the energy levels of a certain atom when the system moves from $2E$ level to

E, a photon of wavelength λ is emitted. The wavelength of photon produced during its transition from $\frac{4E}{3}$ level to E is



A. 3λ

B. $3/4\lambda$

C. $\lambda/4$

D. 2λ

Answer: A

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19. When the elecrton in the hydrogen atom jupms from $2nd$ orbit to 1st orbit, the wavelength of radiation emitted is λ. When the electrons jupms from $3rd$ orbit to $1st$ orbit, the wavelength of emitted radiation would be

A. $\frac{9}{4}\lambda$

B. $\frac{4}{9}\lambda$

C. $\frac{27}{32}\lambda$

D. $\frac{32}{27}\lambda$

Answer: C

20. The ratio of the largest to shortest wavelength in Balmer series of hydrogen spectra is,

A. $\frac{25}{9}$

B. $\frac{17}{6}$

C. $\frac{9}{5}$

D. $\frac{5}{4}$

Answer: C

21. An electron in a hydrogen atoms makes a transition form n_1 to n_2 where n_1 and n_2 are two principal quantum numbers of two states. If time period of electron in state n_1 is 8 times the time period in state n_2, find the ratio (n_2 / n_1), assuming Bohr model to be true.

A. $8:1$

B. $4:1$

C. $2:1$

D. $1:2$

Answer: C

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22. The wave number of energy emitted when electron jumps from fourth orbit to second orbit in hydrogen in $20, 497 cm^{-1}$. The wave number of energy for the same trasition in He^{+} is

A. $5, 099 cm^{-1}$

B. $20, 497 cm^{-1}$

C. $40, 994 cm^{-1}$

D. $81, 988 cm^{-1}$

Answer: D

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23. If the wavelength of the first member of Balmer series of hydrogen spectrum is $6564A^{\circ}$, the wavelength of second member of Balmer series will be:

A. $1215A^{\circ}$

B. $4848A^{\circ}$

C. $6050A^{\circ}$

D. data given is insufficient to calculate the value

Answer: B

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24. photon from $n = 2$ to $n = 1$ in hydrogen atom is made to fall on a metal surface with work function $1.2eV$. the maximum velocity of photo electron emitted is nearly equal to

A. $6 \times 10^5 m / s$

B. $3 \times 10^5 m / s$

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

D. $18 \times 10^5 m / s$

Answer: D

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25. 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. $\vartheta^1 - \vartheta^2 = \vartheta_3$

B. $\vartheta_2 - \vartheta_1 = \vartheta_3$

C. $2\vartheta_3 = \vartheta_1 + \vartheta_2$

D. $\vartheta - (1) + \vartheta_2 = \vartheta_3$

Answer: A

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26. (a)Find the wavelength of the radiation required to excited the electron is Li^{++} from the first to the third Bohr orbit (b) How many spectral lines are observed in the emission spectrum of the above excited system?

A. $108.8eV, 3$

B. $13.6eV, 4$

C. $54.4eV, 2$

D. $10.2eV, 3$

Answer: A

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27. Find the wavelength in a hydrogen spectrum between the range $500nm \rightarrow 700nm$

A. $540nm$

B. $580nm$

C. $654nm$

D. $696nm$

Answer: C

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28. The largest wavelength in the ultraviolet region of the hydrogen spectrum is $122nm$. The smallest wavelength in the infrared region of the hydrogen spectrum (to the nearest interger) is (a) $802 nm$ (b) $823 nm$

(c) $1882 nm$ (d) $1648 nm$.

A. $802 nm$

B. $823 nm$

C. $1882 nm$

D. $1648 nm$

Answer: B

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29. If elements of quantum number greater than n were not allowed , the number of possible element in nature would be ?

A. $\frac{1}{2}n(n+1)$

B. $\left\{\frac{n(n+1)}{2}\right\}^2$

C. $\frac{1}{2}n(n+1)(2n+1)$

D. $\frac{1}{3}n(n+1)(2n+1)$

Answer: D

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30. Magnetic field at the center (at nucleus) of the hydrogen like atom $(\text{atomic number} = z)$ due to the motion of electron in nth orbit is proporional to

A. $\frac{n^3}{z^5}$

B. $\frac{n^4}{Z}$

C. $\frac{z^2}{n^3}$

D. $\frac{z^3}{n^5}$

Answer: D

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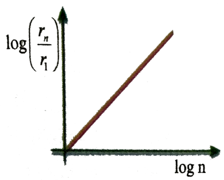
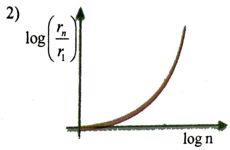
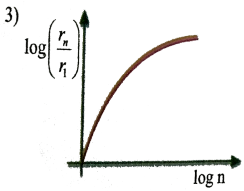
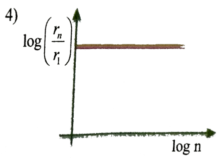
31. In hydrogen atom, the radius of n^{th} Bohr orbit is V_n.

The graph Beetween $\log.\left(\frac{r_n}{r_1}\right)$ will be

A. 

B. 

C. 

D. 

Answer: A

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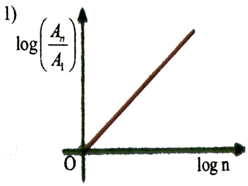
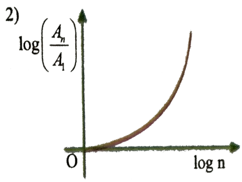
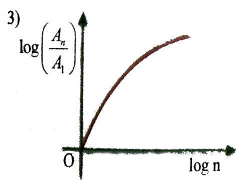
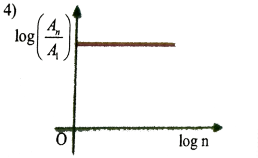
32. In hydrogen atom, the area enclosed by n^{th} orbit is A_n. The graph between log $\left(\frac{A_n}{A_1}\right)$ log will be

A. 

B. 

C. 

D. 

Answer: A

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33. If we assume only gravitational attraction between protect and electron in hydrogen atom and the Bohr's quantization rule kto be allowed , then the expression for the ground state energy of the atom will be (the mass of proton is M and that of electron is m)

A. $\dfrac{G^2 M^2 m^2}{h^2}$

B. $\dfrac{2\pi^2 G^2 M^2 m^3}{h^2}$

C. $\dfrac{2\pi^2 GM^2 m^3}{h^2}$

D. $\dfrac{h^2}{G^2 M^2 n^2}$

Answer: B

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34. A particle of charge equal to that of an electron - e, and mass 208 times the mass of electron (called a mu meson) moves in a circular orbit around a nucleus of charge$+3e$ (Take the mass of the nucleus to be infinite) Assuming that the bohr model of the atom is applicable to this system

(i) Derive an expression for the radius of the bohr orbit

(ii) find the value for which the radius is approximately the same as that of the bohr orbit fo the hydrogen atom

(iii) find the wavelength of the radiation emitted when the mu- meson jump from the third orbit of the first orbit

A. $\frac{\varepsilon_0 n^2 h^2}{208 \pi m_e e^2}$

B. $\frac{\varepsilon_0 n^2 h^2}{3 \pi m_e e^2}$

C. $\frac{\varepsilon_0 n^2 h^2}{624 \pi m_e e^2}$

D. $\frac{\varepsilon_0 n^2 h^2}{64 \pi m_e e^2}$

Answer: C

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35. A particle known as mu meson has a charge equal to that of no electron and mass 208times 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. 10

B. 15

C. 25

D. 30

Answer: C

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36. A particle of charge equal to that of an electron - e, and mass 208 times the mass of electron (called a mu meson) moves in a circular orbit around a nucleus of charge$+3e$ (Take the mass of the nucleus to be infinite) Assuming that the bohr model of the atom is applicable to this system

(i) Derive an expression for the radius of the bohr orbit

(ii) find the value for which the radius is approximately the same as that of the bohr orbit fo the hydrogen atom

(iii) find the wavelength of the radiation emitted when the mu- meson jump from the third orbit of the first orbit

A. $0.4500A^{\circ}$

B. $0.5500A^{\circ}$

C. $0.6500A^{0}$

D. None of these

Answer: B

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37. photoelectron are emitted when $4000A^0$ radiation is incident on a surface of work fuction $1.9eV$. these photoelectrons pass through a region has a- particles to form He^+ ion, emitting a single photon in this process He^+ ions thus formed are in their fourth excited state.

Energy of the fourth excited state is approx

A. $-4.2eV$

B. $-2.2eV$

C. $-3.2eV$

D. $-1.2eV$

Answer: B

Watch Video Solution

38. phtoelectron are emitted when $4000A^0$ radiation is incident on a surface of work fuction $1.9eV$. these photoelectrons pass through a region has a- particles to form He^+ ion, emitting a single photon in this process He^+ ions thus formed are in their fourth excited state.

Energy released during during the combination of He^+ ions is

A. $5.38eV$

B. $3.38eV$

C. $2.38eV$

D. $1.38eV$

Answer: B

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39. phtoelectron are emitted when $4000A^0$ radiation is incident on a surface of work fuction $1.9eV$. these photoelectrons pass through a region has a- particles to form He^+ ion, emitting a single photon in this process He^+ ions thus formed are in their fourth excited state.

Energy of emitted photon in range of $3eV$ & $4eV$ after combination is

A. $3.86 eV$

B. $3.24 eV$

C. $3.29 eV$

D. $5.24 eV$

Answer: A

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40. A sample of hydrogen gas in its ground state is irradiated with photons of $10.02 eV$ energies. The radiation from the above sample is used to irradiate two other sample of excited ionized He^{+} and excited ionized Li^{2+}, repectively. Both the ionized samples absorb the incident radiation.

How many spectral lines are obtained in the spectra of Li^{2+}?

A. 10

B. 15

C. 20

D. 17

Answer: B

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41. A sample of hydrogen gas in its ground state is irradiated with photons of $10.02 eV$ energies. The radiation from the above sample is used to irradiate two other sample of excited ionized He^{+} and excited ionized Li^{2+}, repectively. Both the ionized samples absorb the incident radiation.

What is the smallest wavelength that will be observed in spectra of He^{+} ion ?

A. $24.4 nm$

B. $28.8 nm$

C. $22.2 nm$

D. $30.6 nm$

Answer: A

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42. A sample of hydrogen gas in its ground state is irradiated with photons of $10.02 eV$ energies. The radiation from the above sample is used to irradiate two other sample of excited ionized He^{+} and excited ionized Li^{2+}, repectively. Both the ionized samples absorb the incident radiation.

How many spectral lines are obtained in the spectra of He^{+} ion?

A. 2

B. 4

C. 6

D. 8

Answer: C

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43. A sample of hydrogen gas in its ground state is irradiated with photons of $10.02eV$ energies. The radiation from the above sample is used to irradiate two other sample of excited ionized He^{+} and excited ionized Li^{2+}, repectively. Both the ionized samples absorb the incident radiation.

Which is the smallest wavelength that will be observed in spectra of Li^{2+} ?

A. $8.6nm$

B. $10.4nm$

C. $12.8nm$

D. $4.6nm$

Answer: B

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44. A sample of hydrogen gas in its ground state is irrdation with photon of $10.2eV$ energies The radiation from the above the sample is used to irradiate two other the sample of excited ionized He^{+} and excited ionized Li^{2+}, respectively . Both the ionized sample absorb the incident radiation.

Consider the spectra lines resulting from the transition $n = 2$ to $n = 1$ in the atom and the ions given below. The shortest wavelength is produced by

A. hydrogen atom

B. deuterioum atom

C. singly ionized helium

D. doubly ionized lithium

Answer: D

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45. A sample of hydrogen gas in its ground state is irrdation with photon of $10.2eV$ energies The radiation from the above the sample is used to irradiate two other the sample of excited ionized He^{+} and excited ionized Li^{2+}, respectively . Both the ionized sample absorb the incident radiation.

A gas of monoatomic hydrogen is bombared with a stream of electron that have been accelerated from rest through a potential difference of 12.75 volt. in the emission spectrum, one cannot observed any line of

A. Lyman series

B. Balmer series

C. Paschen series

D. Pfund series

Answer: D

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46. A sample of hydrogen gas in its ground state is irrdation with photon of $10.2eV$ energies The radiation from the above the sample is used to irradiate two other the sample of excited ionized He^{+} and excited ionized Li^{2+}, respectively . Both the ionized sample absorb the incident radiation.

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

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

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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47. A sample of hydrogen gas in its ground state is irrdation with photon of $10.2eV$ energies The radiation from the above the sample is used to irradiate two other the sample of excited ionized He^{+} and excited ionized Li^{2+}, respectively . Both the ionized sample absorb the incident radiation.

With increasing quantum number, the energy different between adjacent energy level in atoms

A. decerease

B. increase

C. remain constant

D. decrease fro low Z and increase for high Z

Answer: A

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48. Which of the following statement is true regarding Bohr's model of hydrogen atom ?

(I) Orbiting speed of electrons decreases as if falls to discrete orbits away from the nuclues.

(II) Radii of allowed orbits of electrons are proportional to the principle quantum number.

(III) Frequency with which electrons orbit around the nucleus in discrete orbits is inversely proportional to the principle quantum number.

(IV) Binding froce with which the elctron is bound to the nuclues increases as it shifts to outer orbits.

Selected the correct answer using the codes given below:

A. Iand III

B. II and IV

C. I,II and III

D. II,III and IV

Answer: A

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49. A hydrogen atom and a Li^{2+} ion are both in the second excited state. If l_H and l_{Li} are their respective electronic angular momenta, and E_H and E_{Li} their respective energies, then

(a) $l_H > l_{Li}$ and $|E_H| > |E_{Li}|$

(b) $l_H = l_{Li}$ and $|E_H| < |E_{Li}|$

(C) $l_H = l_{Li}$ and $|E_H| > |E_{Li}|$

(d) $l_H < l_{Li}$ and $|E_H| < |E_{Li}|$

A. $I_H > I_{Li}$ and $|E_H| > |E_{Li}|$

B. $I_H = I_{Li}$ and $|E_H| < |E_{Li}|$

C. $I_H = I_{Li}$ and $|E_H| > |E_{Li}|$

D. $I_H < I_{Li}$and $|E_H| < |E_{Li}|$

Answer: B

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50. Consider the spectral line resulting from the transition $n = 2 \rightarrow n = 1$ in the atoms and ions given . The shortest wavelength is produced by

A. hydrogen atom

B. deuterioum atom

C. singly ionized helium

D. doubly ionized lithium

Answer: D

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51. For hydrogen like system,

(I) Ratio of magnetic moment to angular momentum is $e/2m$.

(II) energy of the electron is directly proportional to $1/n^2$.

(III(angular momemtum varies inversely with n.

(IV) radius of an orbit is inversely related to n.

A. I, II

B. II, IV

C. I, II, IV

D. III, IV

Answer: A

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52. As per Bohr model,

(I) minimum energy required to remove an electron from ground state of doubly ionized Li atom $(Z = 3)$ is $122.4eV$.

(II) energy of transition $n = 3$ to $m = 2$ is less than that of $m = 2$ to $n = 1$.

(III) minimum energy required to remove an electron from ground state of singly-ionised He atom $(z = 2)$ is $27.2eV$

(IV) A Trasnsition from state $n = 3$ to $n = 2$ in a hydrogen atom result in $U - V$ radiation

A. II, III, IV

B. I, II

C. II, III

D. I, III, IV

Answer: B

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53. Assertion : A discharge tube appears dark when evacuated to very low pressures.

Reasoning , No Colour is left at such low pressure.

A. If both assertion and reason are true and reason is the correct explaination of assertion.

B. If Both assertion and reason are true but reason is not the corrrect explaination of assertion

C. If assertion is true and reason Is false

D. If assertion is false but reason is true

Answer: C

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54. Assertion : An electron in hydrogen in hydrogen atom passes from $n = 4$ to $n = 1$ level . The mximum number of photons that can be emitted is 6.

Reasoning : maximum nymber of photons omitted can only be 4.

A. If both assertion and reason are true and reason is the correct explaination of assertion.

B. If Both assertion and reason are true but reason is not the Correct explaination of assertion

C. If assertion is true and reason is false

D. If assertion is false but reason is true

Answer: C

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55. An H atom in ground state is moving with initial kinetic energy K .It collides head on with He^+ ion in ground state kept at rest but free to move. Find minimum value of K so that both the particles can excite to their first excited state.

A. $63.75eV$

B. $51eV$

C. $54.4eV$

D. $13.05eV$

Answer: A

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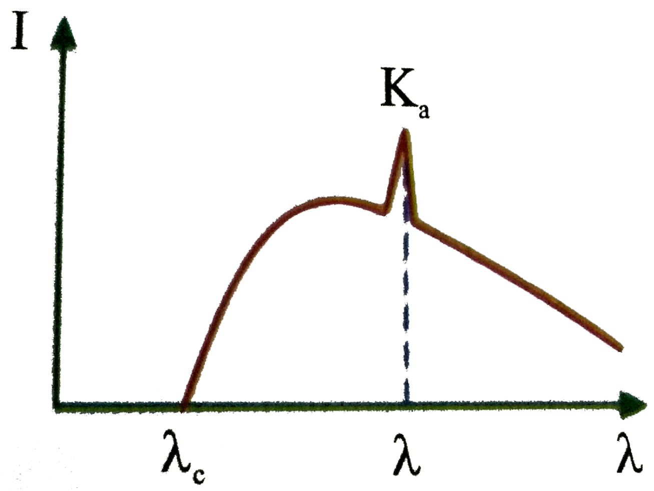
56. Given X-ray spectrum is for a coolidge tube having accelerating potential V. If accelerating potential is decreased to $V/4$, then $\Delta\lambda = \lambda - \lambda_c$ becomes four times with change in anode element . If Z is the atomic number of the original element, them the atomoc number of new element is (neglect screening effect)



A. Z

B. $Z/2$

C. $2Z$

D. $Z/3$

Answer: B

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57. The innermost orbit of the hydrogen atom has a diameter of 1.06Å .What is the Diameter of the tenth orbit:

A. 5.3Å

B. 10.6Å

C. 53Å

D. 106Å

Answer: D

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58. The energy different between the first two levels of hydrogen atom is $10.2eV$. What is the corresponding energy difference for a single ionized helium atom?

A. $10.2eV$

B. $20.4eV$

C. $40.8eV$

D. $81.6eV$

Answer: C

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59. 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. 79.0

Answer: D

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60. Which energy state of doubly ionized lithium Li^{++} has the same energy as that of the ground state of hydrogen?

A. $n = 1$

B. $n = 2$

C. $n = 3$

D. $n = 4$

Answer: C

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61. If an orbital electron of the hydrogen atom jumps from the groud state to a higher energy state, its orbital value. If the radius of the electron orbit in the ground state is r, then the radius of the new orbit would be:

A. $2r$

B. $4r$

C. $8r$

D. $16r$

Answer: B

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62. The relation between $\lambda_1 =$ wavelength of series limit of Lyman series ,$\lambda_2 =$ the wavelength of the series limit of Balmer sereis & $\lambda_3 =$ the wavelength of first line of Lyman series:

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

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

C. $\lambda_2 = \lambda_3 - \lambda_1$

D. none of these

Answer: D

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63. According to Bohr's theory of the hydrogen atom , the speed v_n of the electron in a stationary orbit is related to the principal quantum number $n$as (C is a constant):

A. $v_n = C/n^2$

B. $v_n = C/n$

C. $v_n = C \times n$

D. $v_n = C \times n^n$

Answer: B

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64. The orbital speed of the electron in the ground state of hydrogen is v. What will be its orbital speed when it is excited to the enrgy state $-3.4eV$?

A. $2v$

B. $\frac{v}{2}$

C. $\frac{v}{4}$

D. $\frac{v}{8}$

Answer: B

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65. In the Bohr model of the hydrogen atom, the ratio of the kinetic energy to the total energy of the electron in a quantum state n is ....

A. -1

B. $+1$

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

D. $\frac{1}{n_2}$

Answer: A

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66. The total energy of an electron in the first excited state of hydrogen atom is -3.4 eV.

(a) What is kinetic energy of electron in this state?

(ii) What is potential energy of electron in this state?

(c) Which of the answers above would change if the choice of zero of potential energy is changed?

A. $+1.7eV$

B. $+3.4eV$

C. $+6.8eV$

D. $-13.4eV$

Answer: B

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67. The total energy of an electron in the first excited state of hydrogen atom is -3.4 eV.

(a) What is kinetic energy of electron in this state?

(ii) What is potential energy of electron in this state?

(c) Which of the answers above would change if the choice of zero of potential energy is changed?

A. $-1.7eV$

B. $-3.4eV$

C. $-6.8eV$

D. $-13.4eV$

Answer: C

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68. The highest energy state , that unexcited hydrogen atoms can reach when they are bombarded with $12.2eV$ electron , is

A. $n=1$

B. $n=2$

C. $n=3$

D. $n = 4$

Answer: C

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69. In the spectrum of hydrogen atom, the ratio of the longest wavelength in Lyman series to the longest wavelangth in the Balmer series is:

A. $\frac{3}{23}$

B. $\frac{5}{27}$

C. $\frac{7}{29}$

D. $\frac{9}{31}$

Answer: B

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70. The frequency of the first line in Lyman series in the hydrogen spectrum is v. What is the frequency of the corresponding line in the spectrum of doubly ionized Lithium?

A. n

B. $3n$

C. $9n$

D. $27n$

Answer: C

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71. The electron in a hydrogen atom makes a transition from an excited state to the ground state. Which of the following statements is true?

A. Its Kinetic energy increase and its potential and total energies decrease

B. Its Kinetic energy decrease , potential energy increases and its total remian the same

C. Its Kinetic and total energies decrease and its potential energy increases

D. Its Kinetic , potential and total energies decrease

Answer: A

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72. Three photons coming from excited atoms hydrogen sample are picked up .There energies are $12.1eV, 10.2eV$ and $1.9eV$ these photons must come from

A. a single atom

B. two atoms

C. three atoms

D. either two atoms or three atoms

Answer: D

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

A. one

B. two

C. three

D. four

Answer: C

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74. The wavelength of the first line in blamer series in the hydrogen spectrum is λ. What is the wavelength of the second line:

A. $\frac{20\lambda}{27}$

B. $\frac{3\lambda}{16}$

C. $\frac{5\lambda}{36}$

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

Answer: A

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75. An electron with kinetic energy $5eV$ is incident on a hydrogen atom in its ground state.The collision

A. must be kinetic

B. may be partially elastic

C. mustbe completely inelastic

D. may be completely inelastic

Answer: A

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76. Consider a photon of continuous X-ray coming from a Coolidge tube. Its energy comes from

A. the kinetic energy of the stricking electron

B. the kinetic energy of the free electron of the target

C. the kinetic energy of the ions of the target

D. an atomic transition in the target

Answer: A

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77. 50% of the X-ray coming from a Cooling tube is able to pass through a 0.1 mm thick aluminium foil. The potential difference between the target and the filament is increased. The thickness of aluminium foil, which will allow 50% of the X-ray to pass through, will be

A. zero

B. $< 0.1mm$

C. $0.1mm$

D. $> 0.1mm$

Answer: B

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78. The characteristic X-rays spectrum is emitted due to transition of

A. valence electrons of the atom

B. inner electron of the atom

C. nucleus of the atom

D. both, the inner electrons and the nucleus of the atom

Answer: B

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79. According to Moseley's law, the ratio of the slope of graph between $\sqrt{f}$ and Z for K_β and K_α is

A. $\sqrt{\frac{32}{27}}$

B. $\sqrt{\frac{27}{32}}$

C. $\sqrt{\frac{33}{22}}$

D. $\sqrt{\frac{22}{33}}$

Answer: A

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80. An X-rays tube is operated at $66kV$. Then , in the continous spectrum of the emitted X-rays :

A. wavelengths 0.01nm and 0.02nm will both be absent

B. wavelengths $0.01nm$ and $0.02nm$ will both be absent

C. wavelengths $0.01nm$ will be present but wavelengths $0.02nm$ will be absent

D. wavelengths $0.01nm$ will be absent but wavelength $0.02nm$ will be present

Answer: D

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NCERT Based Questions

1. Find the ratio of Li^{++} ions in its ground state assuming Bohr 's model to be vaild

A. 53pm

B. 27pm

C. 18pm

D. 13pm

Answer: C

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2. The binding energy of a H-atom considering an electron moving around a fixed nuclei (proton), is

$$B = -\frac{me^4}{8n^2\varepsilon_0^2h^2} \text{ (m= electron mass)}$$

If one decides to work in a frame of refrence where the electron is at rest, the proton would be movig around it. By similar arguments, the binding energy would be :

$$B = -\frac{me^4}{8n^2\varepsilon_0^2h^2} \text{ (M = proton mass)}$$

This last expression is not correct, because

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3. The simple Bohr model cannot be directly ap-plied to calculate the energy level of an atom with may electrons . This is because.

A. of the electrons not being subject to a central force

B. of the electrons collliding eith each other

C. of screening effects

D. the force between the nucleus and an electron will no longer be given by coulomb's law

Answer: A

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4. For he ground state , the electron int eh H-atom has an angular momentum $= h$, accord-ing to the simple Bohr model. Angular momentum is a vector ans hence there will be infi-nitely many orbits with the vector pointing in alll possible direction . In actuality , this is not true,

A. because Bohr model gives incorrect value of angular momentum

B. because only one of these woul have a minimum energy

C. angular momentum must be in the direction of spin of electron

D. because electrons go around only in horizontal orbits

Answer: A

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5. O_2molecules consists of two oxygen atoms. In the molecules , nuclear force between the nuclei of the two atoms

A. is not important because nuclear force are short-range

B. is as important as electrostatic force for binding the two atoms

C. Cancels the repulsive electrost atic force between the nuclei

D. is not important because oxygen nucleus have equal number of neutrons and protons

Answer: A

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6. Two H atoms in the ground state collide in elastically. The maximum amount by which their combined kinetic energy is reduced is

A. $10.20eV$

B. $20.40eV$

C. $13.6eV$

D. $27.2eV$

Answer: A

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7. A set of atom in an excited state decays

A. in general to any of the states with lower energy

B. into a lower state when excited by an ex-ternal electric field

C. all to gether simultaneously into a lower staet

D. to emit photon only when they collides

Answer: A

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8. An ionised H-molecules consists of an electron and wo protons. The protons are seperated by a small distance of the order of angstrom. In the ground state,

A. the electron would not move in circular orbits.

B. the energy would be $(2)^2$ time that's of a H atom

C. the electrons, orbit would go around the pro-tons

.

D. the molecules will soon decay in a protons and a H-atom

Answer: A::C

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9. Consider aimimg a beam of free electrons to wards free atoms . When they scatter, an electron and a protons cannot combine be produced a H-atom,

A. beacause of energy conservation

B. with simulataneously releasing energy in the form or radiation .

C. because of momentum conservation

D. because of angular momentum conservation .

Answer: A::B

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10. The bhor model for the spectra of H-atom

A. wil not be applicable to hydrogen in the molecular form.

B. will not be applicable as it is for a He-atom

C. is valdi at room temerature

D. predicts continious as well as discrete spectral lines.

Answer: A::B

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11. The balmer series for the H-atom can be ob-served

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

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

C. in any trasition in a H-atom

D. as a sequence of frequencies with the higher frequencies getting closely packed.

Answer: B::D

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12. Let $E = \frac{-1me^4}{8\varepsilon_0^2 n^2 h^2}$ be the energy of the n^{th} level of H-atom state and radiation of frequency $(E_2 - E_1)/h$

falls on it ,

A. it will not be absorbed at all

B. some of atoms will moves to the first excited state

.

C. all atom will be excited to the $n=2$ state

D. no atom will make a transition to the $n=3$ state.

Answer: B::D

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13. The simple Bohr model is not applicable to He^{4} atom because

A. He^4 is an inert gas

B. He^4 has neutrons in the nucleus.

C. He^4 has one more electron.

D. electrons are not subjected ot central forces.

Answer: C::D

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14. Positronium is just like a H-atom with the proton replaced by the positively charged anti-particle of the electron (called the positron which is as massive as the electron). What would be the ground state energy of positronium ?

A. $-136eV$

B. $-6.8eV$

C. $-3.4eV$

D. $-1.51eV$

Answer: B

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15. Assume that their is no repulsive force be -tween the electrons in an atom but the force between positive and negative charges is given by Coulomb's law as usual . Under such circumtences, calculate the ground state energy of a He-atom.

A. $-54.4eV$

B. $-108.8eV$

C. $-216.4eV$

D. $-32.2eV$

Answer: B

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16. Using Bohr model, calculate the electric current created by the electron when the H-atom is in the ground state.

A. $\frac{ev_0}{2\pi a_0}$

B. $\frac{ev_0}{3\pi a_0}$

C. $\frac{ev_0}{\pi a_0}$

D. $\frac{ev_0}{4\pi a_0}$

Answer: A

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17. Show that the first few frequencies of light that are emitted when electrons falls to the nth level form levels higher than n, are approximate harmonics (i.e., in the ratio 1 : 2: 3...) when $n > > 1$.

A. $1 : 2 : 3. \dots . n > 1$

B. $1 : 3, 5 : \ldots n > 1$

C. $1 : 2! : 3! \ldots . n > 1$

D. $1 : 2^2 : 3^2 \ldots . n > 1$

Answer: A

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18. What is the minimum energy that must be given to a H atom in ground state so that it can emit an $H\gamma$ line in Balmer series. If the angular momentum of the system is conserved, what would be the angular momentum of such $H\gamma$ photon ?

A. $10.2eV$

B. $12.1eV$

C. $13.06eV$

D. $13.6eV$

Answer: C

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19. The first four spectral lines in the Lyman series of a H-atom are $\lambda = 1218\text{Å}, 1028\text{Å}, 974.3\text{Å}$ and 951.4Å. If instead of Hydrogen, we consider Deuterium, calculate the shift in the wavelength of these lines.

A. $03Å$

B. $0.6Å$

C. $1.4Å$

D. $1.9Å$

Answer: A

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20. Deutrium was discovered in 1932 by Harold Urey by measuring the small change in wavelength for a particular transition in $.^1 H$ and $.^2 H$. This is because, the wavelength of transition depend to a certain extent on the nuclear mass. If nuclear motion is taken into account, then the electrons and nucleus revolve around their common centre of mass.

Such a system is equivalent to a single particle with a reduced mass μ, revolving around the nucleus at a distance equal to the electron -nucleus separation. Here $\mu = m_e M / (m_e + M)$, where M is the nuclear mass and m_e is the electronic mass. Estimate the percentage difference in wavelength for the $1st$ line of the Lyman series in $.^1 H$ and $.^2 H$. (mass of $.^1 H$ nucleus is 1.6725×10^{-27} kg, mass of $.^2 H$ nucleus is 3.3374×10^{-27} kg, Mass of electron $= 9.109 \times 10^{-31} kg.$)

A. 8.1×10^{-2} %

B. 2.7×10^{-2} %

C. 0.81%

D. 0.27%

Answer: B

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21. If a proton had a radius R and the charge was uniformaly fistributed , Calculate using bohr theory, the ground state energy of a H-atom When $R = 10\text{Å}$

A. $-13.6eV$

B. $-0.68eV$

C. $-0.72eV$

D. $-1.51eV$

Answer: C

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22. In the Angular process as atom makes a transition to a lower state without emitting a photon. The excess energy is transferred to an outer electron which may be ejected by the atom. (this is called an Augar elecrons) . Assuming the nuclesu to be massive , calculate the kinetic energy of an $n=4$ Augar electron emitted by chromium by absorbing the energy from a $n=2$ to $n=1$ transition .

A. $5.4keV$

B. $10.2KeV$

C. $13.6KeV$

D. $7.3KeV$

Answer: A

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23. The inverse sequare law in electrostatic is $|F| = \frac{e^2}{(4\pi\varepsilon_0)r^2}$ for the force between an electron and a proton. The $\left(\frac{1}{r}\right)$ dependence of $|F|$ can be understood in quantum theo ry as being due to the fact that the particle of light (photon) is massless. If photons had a mass m_p, force would be modified to $|F| = \frac{e^2}{(4\pi\varepsilon_0)\pi^2}\left[\frac{1}{r^2} + \frac{\lambda}{r}\right]$ .exp$(-\lambda r)$ where $\lambda = \frac{m_p c}{h}$ and $h = \frac{h}{2\pi}$. Estimate the change in the gound state energy of a H-atom if m_p were 10^{-6} times the mass of the electron.

A. $(81.3\lambda r_B)eV$

B. $(27.2\lambda r_B)eV$

C. $(54.6\lambda r_B)eV$

D. $(108.3\lambda r_B)eV$

Answer: B

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24. The Bohr model for the H-atom relies on the Coulomb's law of electrostatics . Coulomb's law has not directly been varified for very short distances of the order of angstroms. Suppos-ing Coulomb's law between two oppsite charge $+q_1, -q_2$ is modified to

$$\left|\overrightarrow{F}\right| = \frac{q_1 q_2}{(4\pi\varepsilon_0)r^2}\frac{1}{r^2}, r \geq R_0$$

$$= \frac{q_1 q_2}{(4\pi\varepsilon_0)r^2}\frac{1}{R_0^2}\left(\frac{R_0}{r}\right)^{\varepsilon}, r \leq R_0$$

Calculate in such a case , the ground state enenergy of H-atom , if $\varepsilon 0.1, R_0 = 1\text{Å}$

A. $-11.4eV$

B. $-7.9eV$

C. $-13.1eV$

D. $-15.2eV$

Answer: A

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LEVEL-V

1. If a hydrogen atom at rest, emits a photon of wavelength λ, the recoil speed of the atom of mass m is given by :

A. $\dfrac{h}{m\lambda}$

B. $\dfrac{mh}{\lambda}$

C. $mh\lambda$

D. none of these

Answer: A

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2. A positronium "atom" is a system that consists of a positron and an electron that orbit each other. Campare the wavelengths of the spectral lines of positronium with those of ordinary hydrogen.

A. $2:1$

B. $1:1$

C. $2:3$

D. $4:1$

Answer: A

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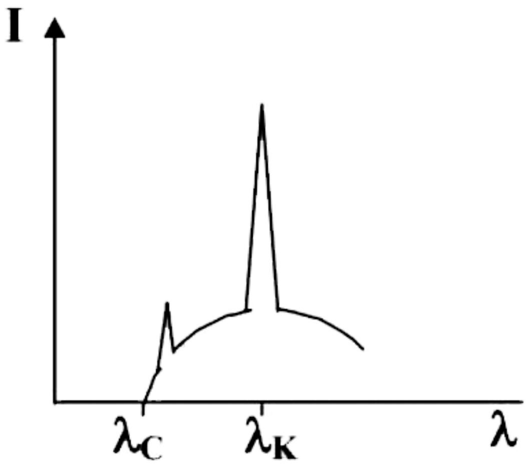
3. The intensity of X- ray from a coolidge tube is plotted againest wavelength λ as shown in the figure . The minimum wavelength found λ_c and the wavelength of thek_a line is λ_λ, As the accelerating voliage is increase



A. $\lambda_k - \lambda_c$ increases

B. $\lambda_k - \lambda_c$ decreases

C. λ_k increases

D. λ_k decreases

Answer: A

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4. The potential difference applying to an X- ray tube is $5kV$ and the current through it is $3.2mA$. Then the number of electrons striking the target per second is

A. 2×10^{10}

B. 5×10^{16}

C. 1×10^{17}

D. 4×10^{15}

Answer: A

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5. A hydrogen atom and a Li^{2+} ion are both in the second excited state. If l_H and l_{Li} are their respective electronic angular momenta, and E_H and E_{Li} their respective energies, then

(a) $l_H > l_{Li}$ and $|E_H| > |E_{Li}|$

(b) $l_H = l_{Li}$ and $|E_H| < |E_{Li}|$

(C) $l_H = l_{Li}$ and $|E_H| > |E_{Li}|$

(d) $l_H < l_{Li}$ and $|E_H| < |E_{Li}|$

A. $l_H > l_{Li}$and $|E_H| > |E_{Li}|$

B. $l_H = l_{Li}$and $|E_H| < |E_{Li}|$

C. $l_H = l_{Li}$and $|E_H| > |E_{Li}|$

D. $l_H < l_{Li}$and $|E_H| < |E_{Li}|$

Answer: A

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6. 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. 100

B. 200

C. 4

D. $\frac{1}{4}$

Answer: D

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7. The electric potential between a proton and as electron is given by $V = V_0 \frac{\ln(r)}{r_0}$, wherer_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. $r \alpha n$

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

C. $r \alpha n^2$

D. $r \alpha \frac{1}{n}$

Answer: A

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8. The wave length of $K\beta$ X-ray of certain metal is 12.42 pm . It takes $10 Kev$ to remove the electron from M shell of an atom of that metal the minimum accelerating voltage that should be applied across the X-ray tube , so that a K_a X-ray would be produced is ($hc = 1242eVnm$)

A. $10KV$

B. $100KV$

C. $110KV$

D. $90KV$

Answer: C

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9. A photon collides with a stationary hydrogen atom in ground state inelastically. Energy of the colliding photon is 10.2 eV. After a time interval of the order of micro second another photon collides with same hydrogen atom inelastically with an energy of 15eV. What wil be observed by the detector?

(a) 2 photons of energy 10.2 eV

(b) 2 photons of energy 1.4 eV

(c) One photon of energy 10.2 eV and an electron of energy 1.4 eV

(d) One photon of energy 10.2 eV and another photon of energy 1.4 eV

A. one photon of $10.2eV$ and an electron of energy $1.4eV$

B. 2 photons of energy $10.2eV$

C. 2 photon of energy $3.4eV$

D. 1 photon of $3.4eV$ and one electron of $1.4eV$

Answer: A

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10. The potential energy of a particle of mass m is given by

$V(x) = E_0$ when $x = \ \leq x \leq 1$and $x > 1$ repectively.

λ_1 and λ_2 are the de - Broglie wavelength of the particle, ,if the total energy of particle is $2E_0$ find λ_1 / λ_2

A. $\sqrt{2}$

B. $\frac{1}{\sqrt{2}}$

C. $2:1$

D. $4:1$

Answer: A

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11. 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. $802nm$

B. $823nm$

C. $1882nm$

D. $1648nm$

Answer: B

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12. Electrons with de- Broglie wavelength λ fall on the target in an X- rays tube . The cut off wavelength of the emitted X- rays is

A. $\lambda_0 = \frac{2mc\lambda^2}{h}$

B. $\lambda_0 = \frac{2h}{mc}$

C. $\lambda_0 = \frac{2m^2c^2\lambda^3}{h^2}$

D. $\lambda_0 = \lambda$

Answer: A

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13. 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 decrease when the atomic number of the target increases

B. Cut-off wavelength of the continous X-rays depend on the atomic number of the target

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

D. Cut-off wavelength of the continous X-rays depend on the energy of the electronsin the X-rays tube.

Answer: B

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14. The potential different across the Coolidge tube is $20kV$ and $10mA$ current flows through the voltage supply. Only 0.5% of the energy carried by the electrons striking the largest is converted into X-ray. The power carried by the X-ray beam is p. Then

A. 0.1

B. $1W$

C. $2W$

D. $10W$

Answer: B

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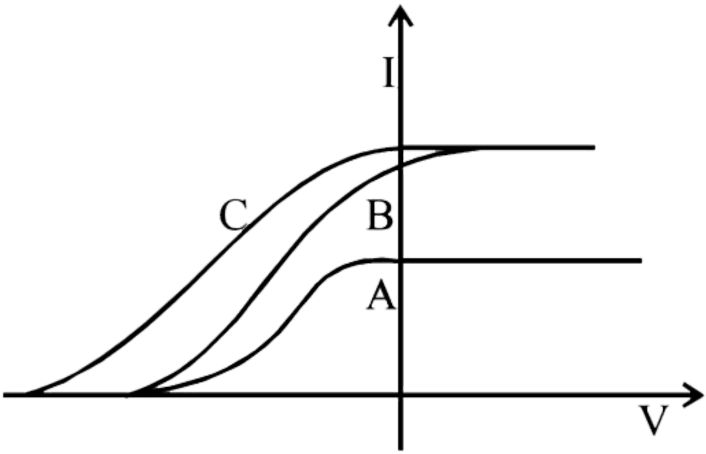
15. In a photoelectric experiment anode potential is ploted against plate current.



A. A and B will have different intensities while B and C will have different frequencies .

B. B and C will have different intensities while A and C will have different frequencies

C. A and B will have different intensities while A and C will have equal frequencies

D. A and B will have equal intensities while B and C will have different frequencies

Answer: A

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16. Let A_0 be the area enclined by the orbit in a hydrogen atom .The graph of in (A_0 / A_1) against $\ln(n)$

A. will pass through the origin

B. will be certain point lyman on a straight line with slopes 4

C. will be a monotonically increasing nonlinear curve

D. will be a circle

Answer: A::D

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

A. the intensity increase

B. the minimum wavelength increases

C. the intensity remian unchanged

D. the mininmum wavelength decreases

Answer: A::B::C

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18. When a hydrogen atom is excited from ground state to first excited state, then

A. its kinetic energy increses by $10.2eV$

B. its kinetic energy decrease by $10.2eV$

C. its potential energy increases by $20.4eV$

D. its angular momentum increasedby

$1.05 \times 10^{-34} j - s$.

Answer: A::C::D

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19. Two electrons starting from rest are accelerated by equal potential difference.

A. they will have kinetic energy

B. they will have same lineat momentum

C. they will have same de Broglie wave length

D. They will produce X-rays of same minimum wave length when they strikes different different targets.

Answer: A::B::C

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20. When an electron moving at a high speed strikes a metal surface, which of the following are possible?

(i) The entire energy of the electron may be converted into an X-ray photon

(ii) Any fraction of energy of the electron may be converted into an X-ray photon

(iii) The entire energy of the electron may get converted to heat

(iv) The electron may undergo elastic collision with the metal surface

A. the entire energy of the electron may be converted into an X-ray photon

B. any fraction of the energy of the electron may be converted into an X-ray photon

C. the entire energy of the electron may get converted to heat

D. the electron may under go elastic collision with the metal surface.

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

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21. consider a hypothetical atom with single electron . In this atom, when an electron de-excites from energy level $n = \times$ to $n = 2,$ wavelength (lambda) of the radiation emitted is given by lambda =$\dfrac{Ax^2}{x^2 - 4}$(where$A$ is a eonstant). Choose the correct alternatives.

A. Least energetic photon emitted during such a transition will have wavelength $1.8A$.

B. Most energetic photon emitted in such trasition will have Wavelength A.

C. Ionization potential of the atom in its ground state is $\frac{hc}{1.8eA}$

D. Ionization potential of the atom in its first excited statei (hc)/(eA)

Answer: A::B::D

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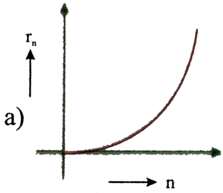
22. If, in a hydrogen atom, radius of nth Bohr orbit is r_n frequency of revolution of electron in nth orbit is f_n and area enclosed by the nth orbit is A_n , then which of the pollowing graphs are correct?

A. 

B. ` (##NAR_PHY_XII_V05_C02_E01_253_O02.png"

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C. ` (##NAR_PHY_XII_V05_C02_E01_253_O03.png"

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D. ` (##NAR_PHY_XII_V05_C02_E01_253_O04.png"

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Answer: A::B::C

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23. The electron in a hydrogen atom makes a transition $n_1 \to n_2$, where n_1 and n_2 are the principle quantum numbers of the two states. Assume the Bohr 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. $n_1 = 4, n_2$

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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24. In a mixture of $H - He^{+}$ gas $(He+$ is singly ionized He atom), H atom and $He+$ ions are excited to their respective first excited state. Subsequently H atoms transfer their total excitation energy to $He+$ ions (by collisions) Assume that the bohr model of atom is exactly valid.

The quantum number n of the state finally populated in He^{+} inos is -

A. 2

B. 3

C. 4

D. 5

Answer: C

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25. In a mixture of $H - He^{+}$ gas ($He +$ is singly ionized He atom), H atom and $He +$ ions are excited to their respective first excited state. Subsequently H atoms transfer their total excitation energy to $He +$ ions (by collisions) Assume that the bohr model of atom is exactly valid.

The wavelength of light emitted in the visible region by $He +$ Ions after collisions with H atoms is -

A. $6.5 \times 10^{-7} m$

B. $5.6 \times 10^{-7} m$

C. $4.8 \times 10^{-7} m$

D. 4.0×10^{-7m}

Answer: C

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26. In a mixture of $H - He^{+}$ gas ($He +$ is singly ionized He atom), H atom and $He +$ ions are excited to their respective first excited state. Subsequently H atoms transfer their total excitation energy to $He +$ ions (by collisions) Assume that the bohr model of atom is exactly valid.

The ratio of the kinetic energy of the $n = 2$ electron for the H atom to the of He^+ Ion is -

A. $\frac{1}{4}$

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

C. 1

D. 2

Answer: A

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27. The key feature of Bohr's spectrum of hydrogen atom is the quantization of angular momentum when an electron is revolving around a proton. We will extend this to a general rotational motion to find quantized rotational energy of a diatomic molecule assuming it to be rigid.The rule to be applied is Bohr's quantization condition.

A diatomic molecule has moment of inertia I. By Bohr's quantization condition its rotational energy in the n^{th} level ($n = 0$ is not allowed) is

A. $\frac{1}{n^2}\frac{h^2}{8\pi^2 I}$

B. $\frac{1}{n}\frac{h^2}{8\pi^2 I}$

C. $n\frac{h^2}{8\pi^2 I}$

D. $n^2\frac{h^2}{8\pi^2 I}$

Answer: D

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28. The key feature of Bohr's spectrum of hydrogen atom is the quantization of angular momentum when an electron is revolving around a proton. We will extend this to a general rotational motion to find quantized rotational energy of a diatomic molecule assuming it to be rigid.The rule to be applied is Bohr's quantization condition.

it is found that the excitation from ground to the first excited state of rotation for the CO molecule is close to $\frac{4}{\pi} \times 10^{11} Hz$ then the moment of inertia of CO molecule about its center of mass is close to

$(Take h = 2\pi \times 10^{-34} Js)$

A. $2.76 \times 10^{-46} kgm^2$

B. $1.87 \times 10^{-46} kgm^2$

C. $4.67 \times 10^{-46} kgm^2$

D. $1.17 \times 10^{-46} kgm^2$

Answer: B

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29. The key feature of Bohr's spectrum of hydrogen atom is the quantization of angular momentum when an electron is revolving around a proton. We will extend this to a general rotational motion to find quantized rotational energy of a diatomic molecule assuming it to be rigid.The rule to be applied is Bohr's quantization condition.

In a CO molecule, the distance between $C(mass = 12a.m.u)$ and $O(mass = 16a.m.u)$ where $1a.m.u = \frac{5}{3} \times 10^{-27}kg$, is close to

A. $2.4 \times 10(-10)m$

B. $1.9 \times 10^{-10}m$

C. $1.3 \times 10^{-10}m$

D. $4.4 \times 10^{-10}m$

Answer: C

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30. When a particle is restricted to move along x-axis between $x = 0$ and $x = a$, where α if of nenometer dimension, its energy can take only certain specific values. The allowed energies of the particle moving in such a restricted region, correspond to the formation of standing waves with nodes at its ends $x = 0$ and $x = a$. The wavelength of this standing wave is related to the linear momentum p of the particle according to the de Broglie relation. The energy of the particle of mass m is related to its linear momentum as $E = \frac{p^2}{2m}$. Thus the energy of the particle can be denoted by a quantum number n taking values 1,2,3, ...($n = 1$, called the ground state) corresponding to the number of loops in the standing wave.

Use the model described above to answer the following three questions for a particle moving along the line from $x = 0$ to $x = \alpha$. Take $h = 6.6 \times 10^{-34} Js$ and $e = 1.6 \times 10^{-19}$ C.

Q. The allowed energy for the particle for a particular value of n is proportional to

A. a^{-2}

B. $a^{-3/2}$

C. a^{-1}

D. a^{a}

Answer: A

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31. When a particle is restricted to move along x-axis between $x = 0$ and $x = a$, where α if of nenometer dimension, its energy can take only certain specific values. The allowed energies of the particle moving in such a restricted region, correspond to the formation of standing waves with nodes at its ends $x = 0$ and $x = a$. The wavelength of this standing wave is related to the linear momentum p of the particle according to the de Broglie relation. The energy of the particle of mass m is related to its linear momentum as $E = \frac{p^2}{2m}$. Thus the energy of the particle can be denoted by a quantum number n taking values 1,2,3, ...($n = 1$, called the ground state) corresponding to the number of loops in the standing wave.

Use the model described above to answer the following three questions for a particle moving along the line from $x = 0$ to $x = \alpha$. Take $h = 6.6 \times 10^{-34} Js$ and $e = 1.6 \times 10^{-19}$ C.

Q. If the mass of the particle is $m = 1.0 \times 10^{-30}$kg and $\alpha = 6.6nm$, the energy of the particle in its ground state is closest to

A. $0.8nmV$

B. $8meV$

C. $80meV$

D. $800meV$

Answer: B

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32. When a particle is restricted to move along x-axis between $x = 0$ and $x = a$, where α if of nenometer dimension, its energy can take only certain specific values. The allowed energies of the particle moving in such a restricted region, correspond to the formation of standing waves with nodes at its ends $x = 0$ and $x = a$. The wavelength of this standing wave is related to the linear momentum p of the particle according to the de Broglie relation. The energy of the particle of mass m is related to its linear momentum as $E = \frac{p^2}{2m}$. Thus the energy of the particle can be denoted by a quantum number n taking values 1,2,3, ...($n = 1$, called the ground state) corresponding to the number of loops in the standing wave.

Use the model described above to answer the following three questions for a particle moving along the line from $x = 0$ to $x = \alpha$. Take $h = 6.6 \times 10^{-34} Js$ and $e = 1.6 \times 10^{-19}$C

Q. The speed of the particle that can take discrete values is proportional to

A. $n^{-3/2}$

B. n^{-1}

C. $n^{1/2}$

D. n

Answer: B

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33. STATEMENT - 1

If the accelerating potential in an X - rays tube is increased, the wavelength of the characteristic X- rays do not change .

STATEMENT -2

When an electron beam strikes the target in an X- rays tube, part of the kinectic energy is converted into X - rays energy .

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34. This question has statement - 1 and statement - 2 of the four choice given after the statements choose the one that best describes the two statements statement - 1 : A metallic surface is irradiated by a monochromatic light of frequency $v > v_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are $K_{\max}$ and V_0 respectively if the frequency incident on the surface is doubled , both the $K_{\max}$ and V_0 are also doubled

statement - 2 : The maximum kinetic energy and the stopping potential of photoelectron emitted from a surface are linearly dependent on the frequency of incident light

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35. A hydrogen atom emits a photon corresponding to an electron transition from $n = 5$ to $n = 1$. The recoil speed of hydrogen atom is almost (mass of proton $\approx 1.6 \times 10^{-27} kg$).

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36. K_{α} wavelength emitted by an atom of atomic number Z=11 is λ. Find the atomic number for an atom that emits K_{α} radiation with wavelength 4λ.

(a) Z=6 (b) Z=4

(c) Z=11 (d) Z=44.

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37. An electron in nth excited state in a hydrogen atom comes down to first excited state by emitting ten different wavelength. Find value of n (an integer).

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38. The ratio between total acceleration of the electron in singly ionized helium atom and hydrogen atom (both in ground state) is

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39. The shortest wavelength of the Brackett series of a hydrogen-like atom (atomic number of Z) is the same as the shortest wavelength of the Balmer series of hydrogen atom. The value of z is

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40. A hydrogen like atom (atomic number Z) is in a higher excited state of quantum number 6. The excited atom can make a transition to the first excited state by successively emitting two photons of energies $10.2eV$ and $17.0eV$ respectively . Determine the value of X . (ionization energy of H-atom is $13.6eV$.)

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41. The electric potential between a proton and as electron is given by $V = V_0 \frac{\ln(r)}{r_0}$, wherer_0 is a constant . Assuming Bohr's model to be applicable , write variation of r_n with n, n being the principal quantum number ?

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42. 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. $\frac{3q^2}{2 \in_0 h}$

B. $\frac{3q^2}{4 \in_0 h}$

C. $\frac{3q}{4\pi \in_0 h}$

D. $\frac{3q}{4\pi \in_0 h}$

Answer: A

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43. 29 electron are remove from Zn atom $(Z = 30)$ by certain means . The minimum energy needed to remove the $30th$ electron , will be :

A. $12.24keV$

B. $408keV$

C. $0.45keV$

D. $765keV$

Answer: A

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44. Any radiation in the ultra violet region of Hydrogen from a metal . Then the metal is, nearly

A. $3.3 \times 10^{15}Hz$

B. $2.5 \times 10^{15} Hz$

C. $4.6 \times 10^{14} Hz$

D. $8.2 \times 10^{14} Hz$

Answer: A

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45. A hydrogen atom emits a photon corresponding to an electron transition from $n = 5$ to $n = 1$. The recoil speed of hydrogen atom is almost (mass of proton $\approx 1.6 \times 10^{-27} kg$).

A. $10^{-4} m/s$

B. $2 \times 10^{-2} m/s$

C. $4m/s$

D. $8 \times 10^{-2} m/s$

Answer: C

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46. In a Bohr atom the electron is replaced by a particle of mass 150 times the mass of the electron and the same charge. If a_0 is the radius of the first Bohr's orbit of the orbital atom, then that of the new will be .

A. $150a_0$

B. $\sqrt{150}a_0$

C. $\frac{a_0}{\sqrt{150}}$

D. $\frac{a_0}{150}$

Answer: D

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47. A hydrogen like atom (atomic number Z) is in a higher excited state of quantum number 'n' this excited atom can make a transition to the first excited state by emitting a photon of first $27.2eV$. Alternatively the atom from the same excited state can make a transition of energy $10.20eV$ the value of n and z are given (ionization energy of hydrogen atom is 13.6eV)

A. $n = \quad = 6$ and $z = 3$

B. $n = 3$ and $z = 6$

C. $n = 8$ and $z = 4$

D. $n = 4$ and $z = 8$

Answer: A

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48. The electric potential between a proton and as electron is given by $V = V_0 \frac{\ln(r)}{r_0}$, wherer_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. $r_n \propto n2$

B. $r_n \propto 1/n$

C. $r_n \propto n^n$

D. $r_n \propto 1/n^2$

Answer: A

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49. The recoil speed of a hydrogen atom after it emits a photon is going form n=5 state to n =1 state is ..... m/s.

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50. The binding energy of the electron in the ground state of He atom is equal to $E_0 = 24.6eV$. Find the energy required to remove both the electrons from the atom.

A. $24.6eV$

B. $79.0eV$

C. $54.4eV$

D. `none of these

Answer: B

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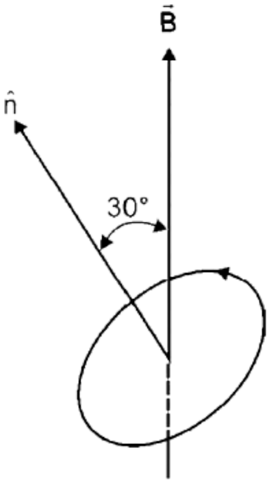
51. An electron in the ground state of hydrogen atom is revolving in anticlock-wise direction in a circular orbit of radius R.

(i) Obtain an experssion for the orbital magnetic dipole moment of the electron.

(ii) The atom is placed in a uniform magnetic induction $\vec{B}$ such that the plane - normal of the electron - orbit makes an angle of 30° with the magnetic induction .

Find the torque experienced by the orbiting electron.



A. $\dfrac{ehB}{8\pi m}$

B. $\dfrac{eh}{8\pi Bm}$

C. $\dfrac{eB}{8\pi mh}$

D. $\dfrac{hB}{8\pi em}$

Answer: A

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LEVEL-VI

1. Two hydrogen atom in ground state are moving on opposite direction with the same speed and collide head on . The minimum kinetic energy of each hydrogen atom for the collision to be inelastic so that both the atoms are excited is

A. $13.6eV$

B. $10.2eV$

C. $20.4eV$

D. $27.2eV$

Answer: B

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2. the elastric field of an electromagnetic wave changes with the time as

$E = K(1 + \cos\Omega t)\cos \omega t$,where

$\Omega = 5 \times 10^{15} s_{-1}, \omega s^{-1}$ and K is constant . This radiation is incident on a sample of hydrogen atoms initially in ground state. assume that atom absorbs light as photons. Neglecting , what will be the energy of ejected electron from hydrogen . [the ionisation energy of hydrogen a tom =$13.6 eV$ and

$h = 2\pi \times 6.6 \times 10^{-16} eV - s$]

A. $0.7 eV$

B. $0.9 eV$

C. $1.4eV$

D. $2.9eV$

Answer: D

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3. Electrons in a sample of gas containing hydrogen-like atom $(Z = 3)$ are in fourth excited state. When photons emitted only due to transition from third excited state to second excited state are incident on a metal plate photoelectorns are ejected. The stopping potential for these photoelectorns is $3.95eV$. now, if only photons emitted due to transition from fourth excited state to third excited state are incident on the same metal plate, the stopping potential for the emitted photoelectrons will be appoximetely equal to

A. $0.85V$

B. $0.75V$

C. $0.65V$

D. `none of these

Answer: B

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4. the photon radiated from hydrogen corresponding to the second line of Lyman series is absorbed by a hydrogen like atom X in the second excited state. Then, the hydrogen-like atom X makes a transition of nth orbit.

A. $X = He(+), n = 4$

B. $X = Li^{++}, n = 6$

C. $X = He^{+}, n = 6$

D. $X = Li^{++}, n = 9$

Answer: D

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5. 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. decrease16 times

B. increase 4 times

C. decrease 4 time

D. increases 32 times

Answer: D

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6. An electron in a hydrogen atom makes a transition from first excited state to ground state . The equivelent currect due to circulating electron :

A. increases 2 time

B. increases 4 times

C. increases 8 times

D. remains the same

Answer: C

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7. An α-particle with a kinetic energy of $2.1eV$ makes a head on collision with a hydrogen atom moving towards it with a kinetic energy of $8.4eV$. The collision

A. must be perfectly elastic

B. may be perfectly inelastic

C. may be inelastic

D. must be perfectly inelastic

Answer: C

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8. A monochromatic radiation of wavelength λ is incident on a sample containig $He+$. As a result the Helium sample stars radiating. A part of this radiation is allowed to pass through a sample of atomic hydrogen gas in ground state. It is noticed that the hydrogen sample has stared emitting electrons whose maximum kinetic energy is $37.4eV$.

$\left(hc = 12400eV\text{Å}\right)$. Then λ is

A. 275Å

B. 243Å

C. 656Å

D. 386Å

Answer: B

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9. 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 si

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

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

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

D. none

Answer: C

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10. The energy ratio of two k_{α} photons obtined in x -ray from two metal targets of atomic numbes, Z_1 and Z_2 is ,

A. $\frac{Z_1}{Z_2}$

B. $\left(\frac{Z_1}{Z_2}\right)^2$

C. $\left(\frac{Z_1 - 1}{Z_2 - 1}\right)^2$

D. $\sqrt{\frac{(Z_1 - 1)}{(Z_2 - 1)}}$

Answer: C

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11. In an x ray, if the accelerating potential different is changed , then:

A. The frequency of characterictic x-rays of a material will get changed

B. number of electrons emitted will change

C. the difference betweenλ_0 (minimum wavelength) and $\lambda_{k\alpha}$ (wavelength of K_{α}x` ray) will get changed

D. difference between $\lambda_{k\alpha}$ and $\lambda_{k\beta}$ will get changed .

Answer: C

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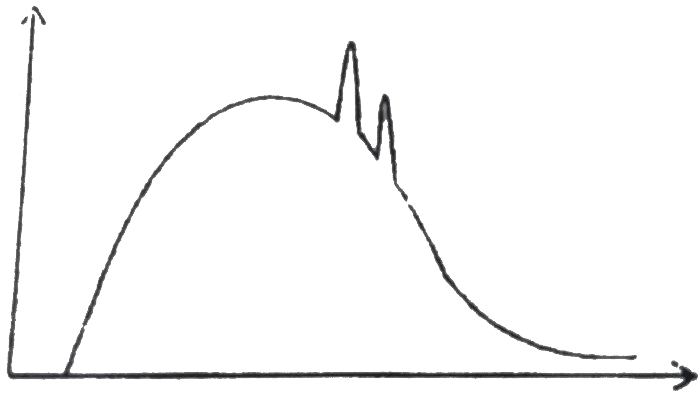
12. 

A beam of electrons striking a cooper target produces X-rays. Its spectrum is as shown. Keeping the voltage same if the copper target is replaced with a different metal, the cut-off wavelength and characteristic lines of the new spectrum will change in comparison with old as:

A. cut-off wavelength will remain unchanged while characteristic lines will be different.

B. Both cut-off wavelength and characteristic lines will remain unchanged.

C. Both Cut-off wavelength and characteristic lines will be different

D. Cut-off wavelength will be different while characteristic lines will remain unchanged

Answer: A

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13. 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

Watch Video Solution

14. A cobalt (atomic no. =27) target is bombereded with electrons and the wavelength of its characteristic x-rays spectrum are measured. A seconf weak characteristic spectrum is also found due to an impurity in the target. The wavelength of the K_{α} lines $225.0 \pm$ (cobalt) and $100.0 \pm$ (impurity). Atomic number of the impurity is $(take b = 1)$

A. 39

B. 40

C. 59

D. 60

Answer: B

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15. The wavelength of the first spectral line in the Balmer series of hydrogen atom is $6561 A^{\circ}$. The wavelength of the second spectral line in the Balmer series of singly - ionized helium atom is

A. $1215 A^{0}$

B. $1640 A^{0}$

C. $2430 A^{0}$

D. $4687 A^{0}$

Answer: A

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16. Two identical non-relativitic partcles A and B move at right angles to each othre, processing de Broglie wavelengths λ_1 and λ_2, respectively. The de Broglie wavelength of each particle in their centre of mass frame of reference is

A. $\lambda_1 + \lambda_2$

B. $\frac{\lambda_1 \lambda_2}{\sqrt{\lambda_1^2 + \lambda_2^2}}$

C. $\frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

D. $\frac{2\lambda_1 \lambda_2}{\sqrt{\lambda_1^2 + \lambda_2^2}}$

Answer: D

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17. which of the following statement about $x$rays is false?

A. $E(K_\alpha) + E(L_\beta) + E(M_\alpha) = E(K_\gamma)$ where E is the energy of respective x-rays

B. for the harder x-rays the intensity is higher then soft x-rays

C. the continous and characteristic x-rays differ only in the method of creation

D. the cut-off wavelength lambda_(min) depend only on the acceleration voltage applied between the target and the filament.

Answer: B

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18. Peak emission from a black body at a certain temperature occures at a wavelength lambda. On increasing its temperature , total radiation emitted is increasing 16 times . At the initial temperature when peak radiation from the black body is incident on a metal surface , it does not cause photoemission from surface . After the increasing the peak radiation from black body caused photoemission. to bring these photoelectrons to rest, a potential equivalent to the excitation energy between $n = 2$ to $n = 3$ Bohr levels of hydrogen atom is required. if eork function of metal is $2.24eV$, then value of lambda is [hc=12400eV-Å]

A. 3000Å

B. 6000Å

C. 9000Å

D. 12000Å

Answer: B

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19. An X-ray tube is operated at $50kV$ and $20mA$. The target material of the tube has mass of $1kg$ and specific heat $495 Jkg^{-1}$^(@)C^(-1)`. One perent of applied electric power is converted into X-rays and the remaining energy goes into heating the target. Then,

A. the average rate of rise of temperature of the target would be $2_0 C / \sec$

B. the minimum wavelength of the X-rays emitted is about $0.25 \times 10^{-10} m$

C. a suitable target material must have a high melting temperature

D. a suitable target material must have thermal conductivity

Answer: B

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20. Hydrogen atom absorbs radiations of wavelength λ_0 and consequently emit radiations of 6 different wavelengths, of which two wavelengths are longer than λ_0. Chosses the correct alternative(s).

A. the final excited state of the atom is $n = 4$

B. the initial state of the atom may be $n = 2$

C. the initial state of the atoms may be $n = 3$

D. there are three transition belonging to Lyman series

Answer: A::B::C

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21. A neutron moving with a speed , v makes a head on collosion with a hydrogen atom in atom in ground state which is at rest. Choose the correct options (s) of the following (assume mass of neutron is nearly equal to the mass of hydrogen atom) .

A. For the collision to the inelastic, the minimum value of kinetic energy of neutron before collision is $10.2eV$

B. For the collision to the elastic , the minimum value of initila kinetic energy of the neutron before collision is $10.2eV$

C. for any value of initial kinetic energy of neutron the collision may be elastic .

D. If initial Kinetic energy of neutron before collision is $27.2eV$, the collision may be elastic or inelastic or prefectly inelastic

Answer: A::C::D

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22. In Bohr model of the hydrogen atom, let R,v and E represent the radius of the orbit, speed of the electron and the total energy respectively. Which of the following quantities are directly proportional to the quantum number n?

A. VR

B. RE

C. $\frac{T}{R}$

D. $\frac{V}{E}$

Answer: A::C::D

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23. For a cartain metal, the K absorption edge is at 0.72Å. The wavelength of $K_{\alpha}, K_{\beta}. And K_{\gamma}$ lines of of K series are $0.210\text{Å}, 0.192\text{Å}, \text{ and } 0.180\text{Å}, respectively. Thee\neg giesof$ K, L and M $\text{ or } bitare$E_(K), E_(L) and E_(M)`, respectively. Then

A. $E_K = -13.40eV$

B. $E_L = -7.52KeV$

C. $E_M = -3.21KeV$

D. $E_K = 13.04KeV$

Answer: A::B::C

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24. A gas containing hydrogen like atoms with atomic number Z, emit photons in transition $n+2 \rightarrow n$, where $n = Z$ and work function of metal is $4.2eV$. The photons are incident on the metal emitting electrons of minimum de Broglie wavelength $5A^0$

A. the maximum $K.E$ of photonelectron is $6eV$

B. the maximum $K.E$ of photonelectron is $5eV$

C. the value of Z is

D. the value of Z is 3

Answer: A::C

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25. the radiation emitted when an electron jumps from $n=4$ to $n=3$ in a lithium atom ($z=3$) fall on a metal surface to produce photoelectron , when the photoelectron with maximum Kinetic energy are made to move perpendicular to a magnetic field of $2 \times 10^{-4} T$, it traces a circular path of radius $\sqrt{\frac{9.1}{1.6}} cm$, [RhC=13.6eV] (mass of electron=$9.1 \times 10^{-31} kg$)

A. the wavelength of radiation falling on metal is $208 nm$ (nearly)

B. the work function of metal is $3.95 eV$

C. the kinetic energy of photoelectron is $6 eV$

D. the energy of incident photonn is $5.95eV$

Answer: A::B::D

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26. A monoenergetic beam a alpha particle , each of them having kinetic E is incident on a sample of singly ionised Helium gas in ground state . The Helium gas in ground state. The Helium sample may start emitting radiation Since the Kinetic energy of incident alpha particle in sufficiently high . A part of this radiation (if any) is allowed to pass through atomic Hydrogen sample in ground state. A detector placed near the hydrogen records both radiation and electrons. Assume all He^{+} ions to be initially at rest.

If maximum Kinetic energy of electrons interpected by the detector is $27.2eV$, the minimum kinetic of alpha paticle energy of alpha particle ,must be-

A. $81.6eV$

B. $96.8eV$

C. $102eV$

D. 40.8eV`

Answer: A

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If maximum Kinetic energy of electron intercepted by the detector is $27.2eV$, the K.E of particle must be lower than -

A. $81.6eV$

B. $96.8eV$

C. $102eV$

D. there is no upper limit

Answer: B

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28. A monoenergetic beam a alpha particle , each of them having kinetic E is incident on a sample of singly ionised Helium gas in ground state . The Helium gas in ground state. The Helium sample may start emitting radiation Since the Kinetic energy of incident alpha particle in sufficiently high . A part of this radiation (if any) is allowed to pass through atomic Hydrogen sample in ground state. A detector placed near the hydrogen records both radiation and electrons. Assume all He^{+} ions to be initially at rest.

If no electrons are interpected by the detector the energy of photons detected by it can be -

A. $10.2eV$

B. $40.8eV$

C. $12.1eV$

D. none of these

Answer: D

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29. The properties of x -rays as put forwarded by Rontgen in his pioneering paper on the topic are as follos:

X-rays posses a very strong pentrative power it can penetrate wood upto $3cm$ and and aluminium foil upto $15mm$. If the hand if the hand is held between the discharge tube and the screen the dark shadow of the of the bones os visible within the slightly dark shadow of the hand"

photographc plates and film "show themselves susceptible to x- rays " Hence , photography provided a valuable method of studying the effect of x-rays

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X-rays are generated when the cathode rays of the discharge tube strike any solid body .A heavier element , such as plantium , however is much more efficient as a generator of X - rays than a lighter element , such as aluminium . Most of Rontgen 's observation stood the test of time, though some of them needed to be modified later. ,brgt Now today we know if electron are accelerated through a potential difference V, then maximum energy of emitted photon could be $E_{\max} = eV, \frac{hc}{\lambda_{\min}} = \frac{hc}{eV}$

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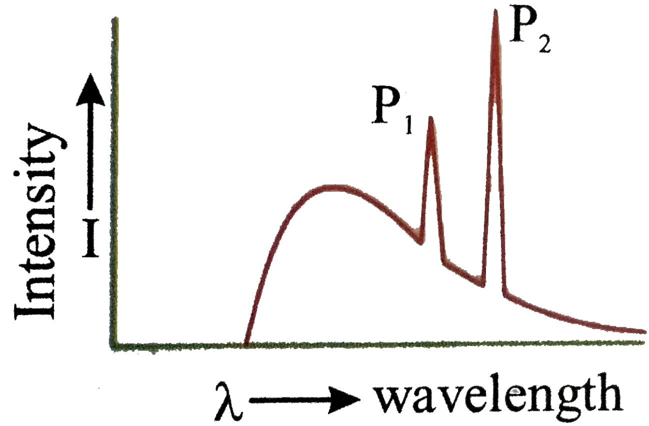
A line spectrum result when an electra having sufficient energy collides with a heavy atom, and an electr in an inner energy level is ejected from the atom . An electra from an outer energy level then fills the vacant inner energy level, resulting in emission of an X-ray photon.



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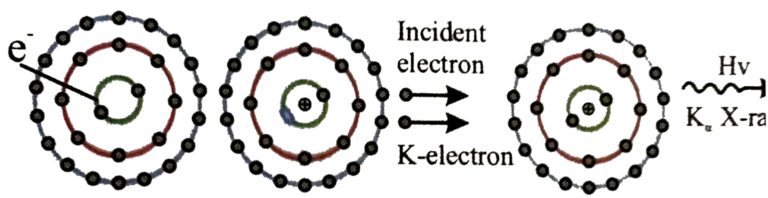

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where a and b are constants. Z is the atomic number of target atom n is the frequency .

In intensity V//s wavelength graph, which of the following process is reponsible for the intensity of peaks p_1 and p_2?

A. Bremsstrahlung

B. Absorption of X-ray photon resulting in electronic excitations in atom

C. Emission of X-rays photons as a result of electronic transition in atoms

D. Both A and C

Answer: C

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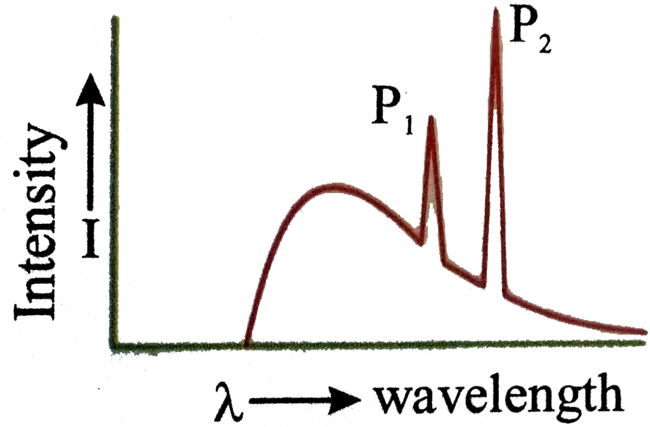

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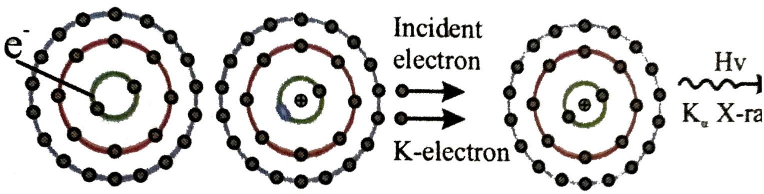

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C. ` (##NAR_PHY_XII_V05_C02_E01_312_O03.png"

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D. ` (##NAR_PHY_XII_V05_C02_E01_312_O04.png"

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Answer: D

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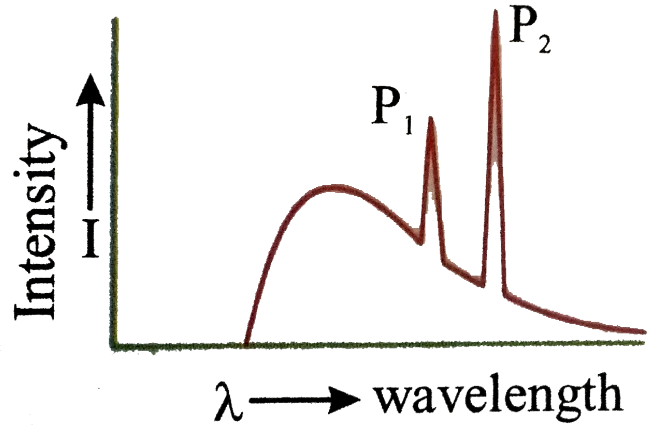

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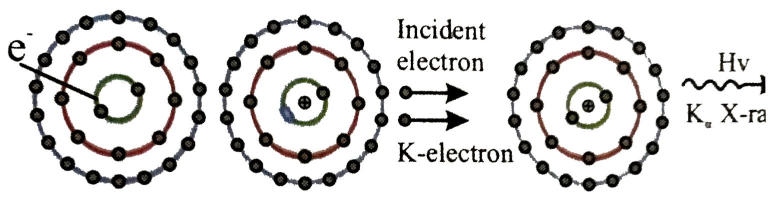

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where a and b are constants. Z is the atomic number of target atom n is the frequency .

X-rays of high penetratrating power are called hard X-ray. Hard X-rays have energy of the order of $10^5 eV$. the minimum potential differece through ehich the electron should be accelerated in an X-ray tube to obtain X-ray of energy $10^5 eV$ is:

A. $10^5 eV$

B. $50 kV$

C. $50 keV$

D. $10^5 V$

Answer: D

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32. A positronium atom consist of an electron and a positron revolving about their common centre of mass . Calculate

Separation between the electron and positron in their first excited state.

A. 4.232Å

B. 5.232Å

C. 6.2Å

D. $7.\ \text{Å}$

Answer: A

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33. A positronium atom consist of an electron and a positron revolving about their common centre of mass . Calculate

Kinetic energy of the electron in ground state

A. $4.5eV$

B. $6.8eV$

C. $7.6eV$

D. $8.0eV$

Answer: B

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34. A neutrons beam, in which each neutron has same Kinetic energy , is passed through a sample of hydrogen like gas (but not hydrogen) in ground state and at rest . Due to collision of neutrons with the ions of the gas, ions are excited and then they emit photons . Six spectral lines arer obtained in which one of the lines is of wavelength $(6200 / 51)\ nm$

which gas is this ?

A. H

B. He^{+}

C. Li^{+}

D. None of these

Answer: B

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35. A neutrons beam, in which each neutron has same Kinetic energy , is passed through a sample of hydrogen like gas (but not hydrogen) in ground state and at rest . Due to collision of neutrons with the ions of the gas, ions are excited and then they emit photons . Six spectral lines arer obtained in which one of the lines is of wavelength $(6200/51)nm$ ltbr. what is the minimum possible value of kinetic energy of the neutrons for this possible . The mass of neutron and protons can be assumed to be nearly same . Use $hc = 12400$

A. $10.5eV$

B. $63.75eV$

C. $6.9eV$

D. $8.9eV$

Answer: B

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36. If an electrons jumps from m^{th} orbit to the nth orbit $(m > n)$ the energy of the atom changes from E_m. This extra energy $E_m - E_n$ is emitted as a photon whose wavelength is given by $\frac{1}{\lambda} = RZ^2\left(\frac{1}{n^2} - \frac{1}{m^2}\right)$ Where $R = 1.09 \times 10^7 m^{-1}$ (Rydberg constant) A photon ejected from the transition of electron from m^(th) excited state of He^+ ion to n^{th} state is allowed to fall on a photoelectric material with work function, $\phi = 7eV.$ [Given $h = 4.14 \times 10^{-15} eVs$ and $c = 3 \times 10^8 ms_1]$

The photo -electric effect will take place for the transition of electron from

A. 3^{rd} orbit to 2^{nd}

B. 4^{th} orbit to 3^{rd} orbit

C. 5^{th} orbit to 3^{rd} orbit

D. Photoelectron can not ejected

Answer: A

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37. If an electrons jumps from m^{th} orbit to the nth orbit $(m > n)$ the energy of the atom changes from E_m . This extra energy $E_m - E_n$ is emitted as a photon whose wavelength is given by $\frac{1}{\lambda} = RZ^2\left(\frac{1}{n^2} - \frac{1}{m^2}\right)$ Where $R = 1.09 \times 10^7 m^{-1}$ (Rydberg constant) A photon ejected from the transition of electron from m^(th) excited state of He^+ ion to n^{th} state is allowed to fall on a photoelectric material with work function, $\phi = 7eV$. [Given $h = 4.14 \times 10^{-15} eVs$ and $c = 3 \times 10^8 ms_1]$

The stopping potential for the photon-element ejected due to transition from 2^{nd} orbit to ground state is

A. $30.5V$

B. 40.5

C. $50.5V$

D. $60.5V$

Answer: B

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38. A beam of alpha paricles is incident on a target of lead. A particular alpha paticles comes in 'head- on' to a particular lead nucleus and stops 6.50×10^{-14} m away from the center of the nucleus. (This point is well outside the nucleus.) Assume that the lead nucleus, which has 82 protons, remains at rest. The mass of alpha particle is $6.64 \times 10^{-27} kg$

Calculate the electrostatic potential energy at the instant when the alpha particle stops?

A. $3.63 MeV$

B. $40 MeV$

C. $45 MeV$

D. $36.3 MeV$

Answer: A

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39. A beam of alpha paricles is incident on a target of lead. A particular alpha paticles comes in 'head- on' to a particular lead nucleus and stops $6.50 \times 10^{-14} m$ away from the center of the nucleus. (This point is well outside the nucleus.) Assume that the lead nucleus, which has 82 protons, remains at rest. The mass of alpha particle is $6.64 \times 10^{-27} kg$

What initial kinetic energy (in joule and in MeV)did the alpha particle have?

A. $3.82 \times 10^{-13} J$

B. $5.82 \times 10^{-13} J$

C. $1.32 \times 10^{-12} J$

D. $3.82 \times 10 \wedge (-12) J$

Answer: B

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40. A beam of alpha paricles is incident on a target of lead. A particular alpha paticles comes in 'head- on' to a particular lead nucleus and stops 6.50×10^{-14} m away from the center of the nucleus. (This point is well outside the nucleus.) Assume that the lead nucleus, which has 82 protons, remains at rest. The mass of alpha particle is $6.64 \times 10^{-27} kg$

What was the initial speed of the alpha particle?

A. $1.32 \times 10^{7} m/s$

B. $13.2 \times 10^2 m / s$

C. $0.13 \times 10^7 m / s$

D. $132 \times 10^2 m / s$

Answer: A

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41. In each of the following questions, a statement is given and a corresponding statement or reason is given just below it. In the statement, mark the correct answer as

Statement-I: Though light of a single frequency (monochromic light) is incident ona metal, the energies of emitted photoelectrons are different

Statement-II: The energy of electrons just after they absorb photons incident on the metal surface may be lost in collision with other atoms in the metal before the electron is ejected out of the metal.

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42. Statement-2: When a beam of highly energetic neutrons is incident on a tungsten target, no X -rays will be produced.

Statement-2: Neutrons do not exert any electrostatics force on electrons or nucleus of an atom

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43. Assertion: In the duration electron jumps from fist excited state to ground state in a stationary isolated hydrogen atom, angular momentum of the electron about the nucleus is conserved.

Reason: As the electron jumps from first excited state to ground state, in a hydrogen atom, the electrostatic force on electron is always directed twoards the nucleus.

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44. Statement -1: In process of photoelectric emission , all emitted electrons donot have sam Kinetic energy

Statement-2: If radiation falling on photosensitive surface of a metal consits of different wavelength, then energy acquired by electrons absorbing photons of different wavelength shall be different.

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45. Statement-1: The de-Broglie wavelength of a molecules (in a sample of ideal gas) varies inversely as the square root of absolute temperature

The arm velocity of a molecules (in a sample of ideal gas) depend in temperature.

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46. Statement -1: When applied potential difference Between cathode and anode is increased in a cooliedge tube , cute off wavelength decreases.

Statement-2: Cut off wavelength for X-rays depend on atomic number of target material.

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47. Statement-1: In Photoelectric effect , electrons absorbing the photon can not be a free electron.

Statement -2: A free electron can't absorb a photon completely

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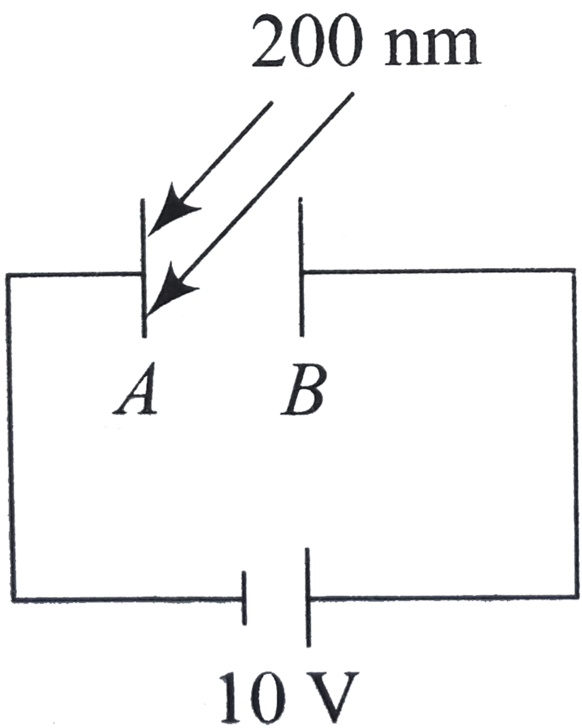

48.

In Fig. electromagnetic radiations of wavelength 200nm are incident on a metallic plate A. the photoelectrons are accelerated by a potential difference of 10 V. These electrons strike another metal plate B from which electromagnetic radiations are emitted. The minimum wavelength of emitted photons is 100nm. If the work function of metal A is found to be $(\times x10^{-1})ev$, then find the value of x. (Given $hc = 1240eV$ nm)

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49. Consider Bohr's theory for hydrogen atom. The magnitude of angular momentum, orbit radius and frequency of the electron in n^{th} energy state in a hydrogen atom are l, r &f respectively. Find out the value of x. If (frl) is directly proportional to n^{x}.

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50. An gas of H-atom in excited state n_2 absorbs a photon of some energy and jump in hiegher energy state n_1. Then it returns to ground state afer emitted six different wavelengths in emission spectrum. The energy of emitted photon is equal, less or greater than the energy of absorbed photon then n_1 and n_2 will be

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51. Hydrogen aton in a sample are excited to $n = 5$ state and it is found that photons of all possible wavelength are present in the emission spectra. The min imum number of hydrogen atom in the sample would be

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52. A proton is fired from very far away towards a nucleus with charge Q = 120 e, where e is the electronic charge. It makes a closest approach of $10 fm$ to the nucleus. The de - Broglie wavelength (in units of fm) of the proton at its start is take the proton mass, $m_p = 5/3 \times 10^{-27} kg, h/e = 4.2 \times 10^{-15} J - s/C$, $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 m/F, 1 fm = 10^{-15}$.

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53. The average life time of an excited state of an electron in Hydrogen is of order of

$10^{-8} s. It makes (\times x 10^6)$ revolutions when it is in the state $n = 2$ and before it suffers a transition $n = 1$ state. Find the value of $\times$. Given $\frac{h}{4\pi^2 ma^2_{-0}} = 64 \times 10^{14}$, where m is mass of electron and a_0 is Bohrs radius .

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54. A monochromatic light soure of frequency f illuminates a metallic surface and ejects photoelectrons. The photoelectrons having maximum energy are just able to ionize the hydrogen atoms in ground state. When the whole experiment is repeated with an incident radiation of frequency $\frac{5}{6} f$, the photoelectrons so emitted are able to excite the hydrogen atom beam which then emits a radiation of wavelength $1215 \AA$. (a) What is the frequency of radiation? (b) Find the work-function of the metal.

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55. A small particle of mass m move in such a way the potential energy $\left(U = \frac{1}{2} m^2 \omega^2 r^2\right)$ when a is a constant and r is the distance of the particle from the origin Assuming Bohr's model of quantization of angular momentum and circular orbits , show that radius of the nth allowed orbit is proportional to in

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LEVEL-I (H.W)

1. A cathode emits 1.8×10^{17} electron per second and all the electrons reach the anode when it Is given a positive potential of $400V$. Given $e = 1.6 \times 10^{-19}$C, the maximum anode current is .

A. $2.88mA$

B. $28.8mA$

C. $7.2mA$

D. $6.4mA$

Answer: B

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2. An electron of mass 9×10^{-31} Kg movie with a speed pf $10^7 m / s$. It acquires a $K.E$ of (in eV)

A. 562.50

B. 1125

C. 1250

D. 281.25

Answer: D

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3. Two electrons Beams having velocities in the ratio $1:2$ are subjected to the same transverse magnetic field . The ratio of the deflections is

A. $1:2$

B. $2:1$

C. $4:1$

D. $1:4$

Answer: B

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4. The Velocity of electrons accelerated bt potential difference of 1×10^{4}V (the charge of the electron is 1.6×10^{-19}C and mass is 9.11×10^{-31} kg) is

A. $5.93 \times 10^{7} ms^{-1}$

B. $2.94 \times 10^{7} ms^{-1}$

C. $6.87 \times 10^{7} ms^{-1}$

D. $3.98 \times 10^{7} ms^{-1}$

Answer: A

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5. Cathode ray tube is operating at$5KV$. . Then the $K.E.$ acquire by the electrons is

A. $5eV$

B. $5MeV$

C. $5KeV$

D. $5V$

Answer: C

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6. A steam of similar negatively charged particles enters an electrical field normal to the elctric lines of force with a velocity of $3 \times 10^7 m / s$. The electric intensity is $100m$, the electrons beam is deflected by $2mm$. Then the specific charge value of in$C\ kg^{-1}$ is

A. 2×10^{10}

B. 2×10^7

C. 2×10^{11}

D. 2×10^4

Answer: A

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7. An oil drop having a mass 4.8×10^{-10}g. and charge 2.4×10^{-18}C stand still between two charged horizontal plates seperated by a distance of $1cm$. If now the polarity of the plates is changed the instantaneous acceleration of the drop is $\left(\text{in} ms^{2}\right)$, $\left(g = 10ms^{-2}\right)$

A. 5

B. 10

C. 20

D. 40

Answer: C

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8. In Millikan oil drop experiment, a charged drop of mass $1.8 \times 10^{-14} kg$ is stationary between its plates. The distance between its plates is $0.90 cm$ and potential difference is 2.0 kilo volts. The number of electrons on the drop is

A. 2

B. 4

C. 5

D. `1

Answer: C

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9. An alpha-particle accelerated through V volt is fired towards a nucleus . Its distance of closest approach is . r If a protons is accelerated through the same potential and fired towards the same nucleus , the distance of closest approach of proton will be .

A. r

B. $2r$

C. $\frac{r}{2}$

D. $\frac{r}{4}$

Answer: A

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

A. 0^0

B. 90^0

C. 180^0

D. 45^0

Answer: C

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11. The impact parameter at which the scattering angle is 90^0, $z = 79$ and initial energy $10 MeV$ is

A. 1.137×10^{-14}m

B. $1.137 \times 10^{-16} m$

C. 2.24×10^{-17}m

D. 2.24×10^{18}m

Answer: A

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

Delta L` equals

A. 1.05×10^{-34}J-s

B. 211×10^{-34}J-s

C. 3.16×10^{-34}J-s

D. 4.22×10^{-34}J-s

Answer: B

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13. In an excited state of hydrogen like atom an electron has total energy of $-3.4eV$. If the kinetic energy of the electron is E and its de-Broglie wavelength is λ, then

A. $E = 6.8eV. \lambda = 6.6 \times 10^{-10}$m

B. $E = 3.4eV, \lambda = 6.6 \times 10^{-10}$m

C. $E = 3.4eV. \lambda = 6.6 \times 10^{-11}$m

D. $E = 6.8eV. \lambda = 6.6 \times 10^{-11}$m

Answer: B

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14. What is the ionisation potential of hydrogen atom?

A. $12.97V$

B. $10.2V$

C. $13.6V$

D. $27.2V$

Answer: C

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

A. $\frac{h}{\pi}$

B. $\frac{h}{2\pi}$

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

D. $\frac{3}{2\pi h}$

Answer: A

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16. The velocity of an electron in the second orbit of sodium atom (atomic number $= 11$) is v. The veocity of an electron in its fifth orboit wil be

A. $v$prop$V$

B. $\frac{22v}{5}$

C. $\frac{5}{2}v$

D. $\frac{2}{5}v$

Answer: D

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17. In any Bohr orbit of the hydrogen atom, the ratio of kinetic energy to potential eenrgy of the electron is

A. $1:2$

B. $-1:2$

C. $2:1$

D. $-2:1$

Answer: B

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18. Let the potential energy of the hydrogen atom in the ground state be zero . Then its energy in the excited state will be

A. $10.2ev$

B. $20.44ev$

C. $23.8ev$

D. $27.2ev$

Answer: B

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19. The value of wavelength radiation emitted by an H-atom, if atom is excited to state with principal quantum number four is :

A. $\frac{5R}{36}$

B. $\frac{16}{15R}$

C. $\frac{36}{5R}$

D. $\frac{3R}{16}$

Answer: B

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20. the maximum number of photons emitted by an H-atom , if atom is excited to state with principal quantum number four is

A. 4

B. 6

C. 2

D. 1

Answer: B

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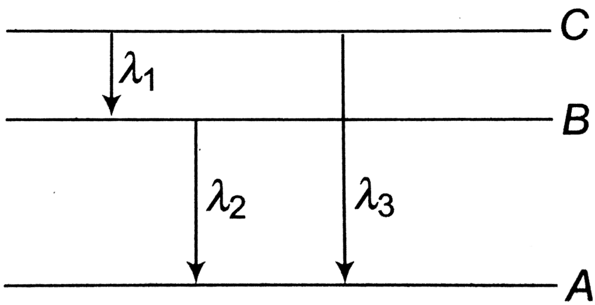
21. Energy levels A, B, C of a certain atom corresponding to increasing values of energy i.e., $E_A < E_B < E_C$. If $\lambda_1, \lambda_2, \lambda_3$ are the wavelengths of radiations correspnding to the transitions C to B, B to A and C to A respectively, which o fthe following statements is correct?



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. $3\lambda_2 = \lambda_3 + 2\lambda_2$

Answer: B

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22. It is found experimentally that $13.6eV$ energy is required to separated a hydrogen atom into a proton and an electron. Compute the orbital radius and velocity of electron in a hydrogen atom.

A. 5.3×10^{-11}m

B. 5.3×10^{-12}m

C. 7.6×10^{-13}m

D. 7.6×10^{-14}

Answer: A

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LEVEL-II (H.W)

1. A proton and an alpha-particle enter a magnetic field in a direction perpendicular to it. If the force acting on the proton is twice that acting on the alpha-particle , the ratio of their velocities is

A. $4:1$

B. $1:4$

C. $1:2$

D. $2:1$

Answer: A

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2. A protons , a deuteron and an alpha-particle are accelerated through the same p.d of V volt. The velocities acquired by them are in the ratio

A. $1:1:\sqrt{2}$

B. $1:\sqrt{2}:1$

C. $1:1:1$

D. $\sqrt{2} : 1 : 1$

Answer: D

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3. An electron starts from rest and travels 0.9m in an electric field of 200V//m. After this , it enters a magnetic field at right angle to its direction of motion . If the radius of circular path of the electron is 9cm, the magnetic field induction is (Given e=1.6×10^{-19}C, $m = 9 \times 10^{-31}$g) `

A. $5 \times 10^{9} - 4wb / m^{2}$

B. $5 \times 10^{-5} wb / m^{2}$

C. $5 \times 10^{-3} wb/m^2$

D. $5 \times 10^{-2} wb/m^2$

Answer: A

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4. In the Millikan's experiment, the oil drop is subjected to a horizontal electric field of 2 N//S and the drop moves with a constant velocity making an angle of 45^0 with the horizontal . If the weight of the drop is W, then the electric charge, in coulomb, on the drop is

A. W

B. $W/2$

C. $W/4$

D. $w/8$

Answer: B

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5. 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. 1Å

B. $10^{-10}cm$

C. $10^{-10} cm$

D. $10^{-12} cm$

Answer: C

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6. An alpha nucleus of energy $\frac{1}{2}m\nu^2$ bombards a heavy nucleus of charge Ze . Then the distance of closed approach for the alpha nucleus will be proportional to

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

B. $\frac{1}{Ze}$

C. v^2

D. $\frac{1}{m}$

Answer: D

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7. In the Bohr model of the hydrogen atom, the ratio of the kinetic energy to the total energy of the electron in a quantum state n is ....

A. 1

B. -1

C. 2

D. -12

Answer: B

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8. The number of revolutions per second made by an electron in the first Bohr orbit of hydrogen atom is of the order of 3:

A. 6.57×10^{15}

B. 6.57×10^{13}

C. 1000

D. 6.57×10^{14}

Answer: A

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9. If $\left(\frac{0.51 \times 10^{-10}}{4}\right)$ m is the radius of smallest electron orbit in hydrogen like atom, then this atom is.

A. hydrogen atom

B. He^{+}

C. Li^{2+}

D. Be^{3+}

Answer: D

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10. The rartio $(\text{in} S1 units)$ of magnetic dipole moment to that of the angular momentum of an electron of mass mkg and charge e coulomb in Bohr's orbit of hydrogen atom is

A. $e/2m$

B. e/m

C. $2e/m$

D. $2e/3m$

Answer: A

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11. In a sample of hydrogen like atoms all of which are in ground state, a photon beam containing photos of various energies is passed. In absorption spectrum, five dark line are observed. The number of bright lines in the emission spectrum will be (assume that all transitions take place)

A. 21

B. 10

C. 15

D. 12

Answer: C

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12. 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. $f_1 - f_2 = f_3$

B. $f_2 - f_1 = f_3$

C. $f_3 = \frac{1}{2}(f_1 + f_2)$

D. $f_1 + f_2 = f_3$

Answer: A

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13. Ratio of difference of spacing between the energy levels with $n = 3$ and $n = 4$ and the spacing between the energy levels with $n = 8$ and $n = 9$ for a hydrogen like atom or ion is

A. 0.71

B. 0.41

C. 2.43

D. 14.82

Answer: B

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14. 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. $\frac{3Rh}{4m}$

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

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

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

Answer: A

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