PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12

FOR PHYSICS

ATOMS

Illustrstion

1. A single electron orbits around a stationary nucleus of charge $+Ze$, where Z is a constant

and e is the magnitude of the electronic charge. It requires 47.2eV to excite the electron from second Bohr orbit to the third bar Bohr orbit. Find :

(a) the value of Z,

(b) the energy required to excite the electron from $n = 3$ to $n = 4$.

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2. Find the ratio of magnetic moment of an electron to its angular momentum is an

atomic orbit.

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3. The first excitation potential of a hypothetical hydrogen- like atom is $15V$. Find the third excitation potential of the atom.

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4. (a) Find the maximum wavelength λ_0 of light which can ionize a hydrogen atom in its

ground (b) light of wavelength λ_0 is inclined on a hydrogen atom which is in its first excited state find the kinetic energy of the electron coming out

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5. Find the maximum frequency, the X-ray emitted by an X-ray tube operating at $30kV$

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6. (a) (i) Find the wavelength of the radiation required to excite thye elctron in $Li(++)$ from the first to the third Bohr orbit.

(ii) How many spectal lines are observed in the emission spectrum of the above excited system ?

(b) The energy needed to detach the electron of a hydrogen-like ion in ground state in 4 rydberg.

(i) What is the wavelength of the radiation emitted when the electron jumps from the first excited state ot the ground state ?

(ii) What is the radius of first orbit ?

(c) A hydrogen sample is prepared in a particular excited state A. Photons of energy 2.55 eV get absorbed into the sample to take some electrons to a further excited state B. Find the quantum number of the A and B.

(d) A hydrogen atom in a state having a binding energy of 0.85 eV makes transition to a state with excitation energy 10.2 eV. (i) Identify the quantum number n of the upper and the lower energy states.

Find λ.

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

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8. If the shorts series limit of the balmer series for hydrogen is 3644Å, find the atomic number of the element which gives X-ray wavelength down to 1Å. Identify the element.

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Evaluate Yourself 1

1. Calculate the wavelength of radiation emitted when He^{+} makes a transition from the state n =3 to the state n=2.

A. 164.0nm

B. 164.0 μ m

C. 114.0 nm

D. 416.0nm

Answer: A

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2. If the difference of energies of an electron in the second and the fourth orbits of an atom is E. Find the ionisation energy of that atom.

A. $\frac{12E}{3}$

B. $\frac{8E}{2}$

C. $\frac{16E}{3}$

D. $\frac{15E}{2}$.

Answer: C

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3. Find the radius of Li^{++} ions in its ground state assuming Bohr's model to be valid.

A. $12 \times 10^{-10} m$

B. $12 \times 10^{-12} m$

C. $16 \times 10^{-10} m$

D. $18 \times 10^{-12} m.$

Answer: D

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4. Which state of the triply ionized Be^{+++} has the same orbital radius as that of the ground state of hydrogen? Compare the energies of two states.

A. 8

B. 6

C. 2

D. 4

Answer: D

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5. The total energy of electron in the first excited state of hydrogen is about -3.4eV. Find potential energy of electron in this state.

A. $-3.8eV$

B. $-6.8eV$

C. $3.8eV$

D. $6.8eV$.

Answer: B

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Evaluate Yourself 2

1. Calculate the energy of a $He^{+}ion$ in its first excited state

A. $-13.6eV$

B. $-16.3eV$

C. $-11.6eV$

D. $11.3.$

Answer: A

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2. What is the ratio of the magnetic moment of an electron to its angular momentum in the ground state of a hydrogen atom ?

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

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

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

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

Answer: B

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Evaluate Yourself 3

1. How many different wavelength may be observed in the spectrum from a hydrogen sample if the atoms excited to states with principal quantum number n?

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2. The wavelength of a spectral life for an electronic transition inversely proportional to:

A. The difference of energies associated with the transition levels

B. To the nuclear charge of atom

C. The number of electron taking part in transition

D. The velocity of electrons taking part in transitions.

Answer: A

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3. In Rutherford's scattering experiment of α-particles by metallic foils, with the increase of atomic number of nucleus, the scattering angle .

A. Remains uncharged

B. Decreases

C. Increases

D. None of these

Answer: C

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C U Q Introduction

1. To explain his theory, Bohr used

A. conservation of linear momentum

B. conservation of angular momentum

C. conservation of quantum frequency

D. conservation of energy.

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. Electron beam enter an electric field normal to the field. Then their path in the electric field is .

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 electrons 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 atom and an electron 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. Isotopes are atoms having.

A. same number of protons, but different number of neutrons.

B. same number of neutrons but different number of protons.

C. same number of protons and neutrons.

D. all of the above.

Answer: C

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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 electron beam 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. $V = \sqrt{B/E}$

Answer: A

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11. An electron of mass m and charge e is accelerated from rest through a potential difference V in vacuum. The final speed of the electron will be

A. e V joule

B. Me V joule

C. Me / V joule

D. e V/M joule

Answer: A

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12. Momentum of a photon of wavelength λ is

:

A. h / λ

B. zero

C. $h\lambda / c^2$

D. $h\lambda / c$

Answer: B

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13. A uniform electric field and a uniform magnetic field are produced, pointed in the same direction. An electron is projected with

its velocity pointing in the same direction. Then,

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 decreases in magnitude.

Answer: D

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14. When a positively charged particle enters a uniform magnetic field with uniform velocity, its trajectory can be

$a)$ a straight line $b)$ a circle $c)$ a 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 energy of a photon (in ev) of wavelength 5000 Å will be

A. 2.48

B. 24.8

C. 0.248

D. 0.0248

Answer: A

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

A. There is magnetic fiedl in that region and the electron enters into itin 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 a chargeless 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 of $10^8 cm / s$. The particle experiences 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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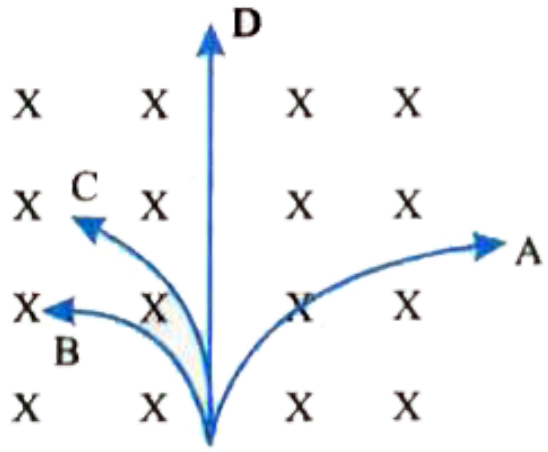
19. A neutron, a proton , an electron and an alpha particle enter a region of constant magnetic field with equal velocities. The magnetic field is along the inward normal to the plane of the paper. The tracks of the particles are labled in the figure. The electron follows _____track and alpha particle 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. α-particles from the source combine with electrons of the disc

B. electrons escapes from the disc when ultraviolet radiation falls on it

C. ultraviolet rays ionize the airsurrounding the electroscope

D. the disc becomes hot and thermionic emission takes place.

Answer: B

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

A. Charge

B. Strength of the field

C. Mass

D. Direction of 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 cathode 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 following while in motion cannot be deflected by magnetic field?

A. electrons

B. neutrons

C. α-particles

D. protons

Answer: B

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26. A β-particle enters a magnetic field making an angle of 45° with the field lines. The path of the particle is

A. circular

B. elliptical

C. spiral

D. a straight line

Answer: C

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

A. electron's path os 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 thant hat of the proton

C. the proton is equal to that of the electron

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 horizontal 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. 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. proton is greater than that of electron

B. electron is greater than that of proton

C. proton is equal to that of electron

D. proton depends 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 and perpendicular to the direction of motion of the electron beam

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

Answer: B

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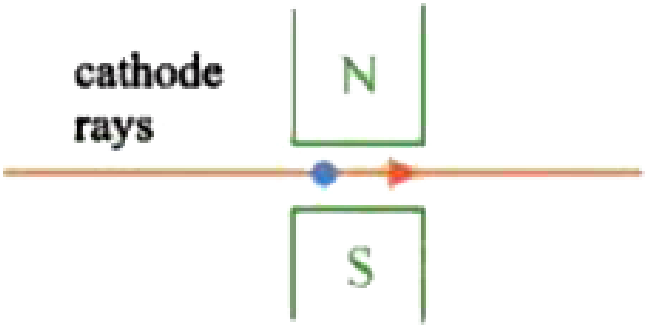
33. Electron beam is made to pass between the poles of a magnet as shown in figure. The effect of magnetic field is



A. to deflect them towards the south pole

B. to deflect them perpendicular to the plane of the paper and towards the

observer

C. to deflect them towards the north pole

D. to increase the velocity of the rays.

Answer: B

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

A. Electric field

B. Magnetic field

C. Plasma field

D. Gravitational field

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 up

B. vertically down

C. horizontal

D. inclined at 45° 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. Ground state energy of H-atom is -13.6 eV. The energy needed to ionise H-atom from its second excited state is

A. 1.51eV

B. 3.4eV

C. 13.6eV

D. 12.1eV

Answer: A

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39. Consider the spectral line resulting from the transition from n=2 to n=1, in atoms and ions given below. The shortest wavelength is produced by

A. Hydrogen atom

B. Deuterium atom

C. Signly ionised hellium

D. Doubly ionised lithium.

Answer: D

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40. If the electron in a hydrogen atom jumps from an orbit with level $n_2 = 3$ to orbit with level $n_1 = 2$, the emitted radiation has a wavelength given by .

A. $\lambda = \frac{36}{5R}$

B. $\lambda = \frac{5R}{36}$

C. $\lambda = \frac{6}{R}$

D. $\lambda = \frac{R}{6}$.

Answer: A

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

A. One

B. Two

C. Three

D. Four

Answer: B

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42. The momentum of a photon of energy 1 MeV in kg-m/s, will be

A. 5×10^{-22}

B. $0.33 \times 10\& +^{6}$

C. 7×10^{-24}

D. 10^{-22}.

Answer: A

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43. In a discharge tube ionization of enclosed gas is produced due to collisions between

A. Neutral gas atoms/molecules

B. Positive ions and neutral atoms/ molecules

C. Negative electrons and neutral atoms/molecules

D. Photons and neutral atoms/ molecules .

Answer: C

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44. If λ_1 and λ_2 are the maximum wavelength limits of Lyman and Balmer series of H atom, $\frac{\lambda_1}{\lambda_2}$ will be .

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

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

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

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

Answer: A

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C U Q Alpharay Scattering

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

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

B. binds electrons to nucleus.

C. binds atoms together to from molecules

D. binds atoms and molecules to from solids.

Answer: A

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2. Answer the following questions, which help you understand the difference between Thomson's model and Rutherford's model better.

(a) Is the average angle of deflection of -

particles by a thin gold foil predicted by Thomson's model much less, about the same, or much greater than that predicted by Rutherford's model?

(b) Is the probability of backward scattering (i.e., scattering of α-particles at angles greater than 90°) predicted by Thomson's model much less, about the same, or much greater than that predicted by Rutherford's model?

(c) Keeping other factors fixed, it is found experimentally that for small thickness t, the number of α-particles scattered at moderate angles is proportional to t. What clue does

this linear dependence on t provide?

(d) In which model is it completely wrong to ignore multiple scattering for the calculation of average angle of scattering of α -particles by a thin foil?

A. much greater

B. much less

C. same

D. slightly greater

Answer: B

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3. An electron with KE 6 e V 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 parially inelastic.

Answer: A

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4. 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 forces

B. conservation of kinetic energy

C. conservation of potential energy

D. there is no external torque

Answer: D

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

A. Atom contains 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 spee.

Answer: C

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6. Alpha particles are

A. helium nuclei

B. sodium nuclei

C. ionised nuclei

D. hydrogen nuclei

Answer: A

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C U Q Bohr S Theory

1. 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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2. Bohr's atomic model assumes

A. the nucleous is of infinite mass and is at rest

B. electron is a quantized orbit will not radiate energy.

C. mass of the electron remains constant.

D. 1,2,3, are correct.

Answer: D

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3. The ratio of magnetic dipole moment to angular momentum of electron is

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

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

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

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

Answer: B

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

A. half

B. double

C. four times

D. nine times

Answer: D

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5. 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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6. The order of size of nucleus and Bohr's radius of an atom respectively are :

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

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

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

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

Answer: A

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7. 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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8. Atomic hydrogen is excited to the n^{th} 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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9. As the orbit number increase , the distance between two consecutive orbits in an atom or ion having single electron:

A. increases

B. decreases

C. remains the same

D. first increase and then becomes contant

Answer: A

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10. 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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11. 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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12. An atomic nucleus contains

A. only electrons

B. only protons

C. only neutrons

D. both protons and neutrons

Answer: D

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13. 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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14. 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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15. According to sommerfeld , an electron revolves round a necleus in

A. Circular orbits

B. Elliptical orbits.

C. Hyperbolic orbits

D. parabolic

Answer: B

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16. 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 structure of spectral lines

D. failed to explain other atoms.

Answer: A

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17. According to Bohr's theory, discrete quantity is

A. Momentum

B. Angular velocity

C. Potential energy

D. Angular momentum

Answer: D

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18. 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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19. 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. $\sqrt{2r}$

Answer: C

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CUQ

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

A. it is related to intrinsic angular momentum

B. spin is rotation of electron about its own axis

C. value of spin quantum number must not be 1

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

Answer: B

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

A. ultra violet

B. infrared radiations

C. visible rays

D. α-rays

Answer: D

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4. 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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5. 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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6. 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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7. The wavelength involved in the spectrum of deuterium $_{}(1)^{2}D$ 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 masses of the two nuclei are different

D. the attraction between electron and the nucleus is different in the two cases.

Answer: C

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8. 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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9. 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 anuglar momentum of the electron .

Answer: D

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10. 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 orbital angular momentum of electrons

D. the spin angular momenum of electrons.

Answer: D

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

A. Lyman

B. Balmer

C. Pfund

D. Brackett

Answer: B

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12. Whith increasing principal quantum number, the energy difference between adjacent energy levels in H-atom:

A. remains constant

B. Decreases

C. Increases

D. sometimes increases sometimes decreases.

Answer: B

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13. Hydrogen atom does not emit X-rays because

A. its energy levels are too close to each other

B. its energy levels are too far part

C. it has a very small mass

D. it has a single electron

Answer: A

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14. 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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Exercise 1 C W Introduction

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 In m / s is

A. 1.7×10^6

B. 6.8×10^6

C. 6.8

D. $1.7 \times 10^8 m / s$

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 proton are subjected to the same electric field , then the ratio of the force acting on them is

A. $2:3$

B. $1:2$

C. $3:2$

D. $2:1$

Answer: D

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4. An electron is accelerated in an electric field of $40Vcm^{-1}$. If e/m of electron is $1.76 \times 10^{11}Ckg^{-1}$, 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. The total energy of an electron in the first excited state of hydrogen atom is about $-3.4eV$. Its kinetic energy in this state is

A. $-3.4eV$

B. $3.4eV$

C. $6.8eV$

D. $-6.8eV$

Answer: B

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Exercise 1 C W Alpharay Scattering

1. 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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2. In rutherford's experiment, the mumber of alpha-particles scattered through an angle of 90° is 28 per minute. Then,the number of particles scattered through an angle of 60° per minute by the same nucleus is

A. 56

B. 112

C. 60

D. 120

Answer: B

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3. For a given impact parameter (b), if the energy increase then the sacttering angle (θ) will

A. Decrease

B. increase

C. become zero

D. become

Answer: A

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Exercise 1 C W Bohr S Model Of Atom

1. 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

Watch Video Solution

2. 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. 13.6eV

C. 23.8eV

D. 27.2eV

Answer: C

Watch Video Solution

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

A. $1.\ A^0$

B. $0.529A^0$

C. $2.25A^0$

D. $0.725A^0.$

Answer: A

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4. The angular momentum of electron is J. if e=charge of electron , m= mass of electron , then its 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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5. The radius of the shortest orbit in a one electron system is 18 pm it may be

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

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

C. He^{+}

D. Li^{+}.

Answer: D

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6. In the Bohr model of a hydrogen atom, the centripetal force is furnished by the coulomb attraction between the proton and the electron. If a_0 is the radius of the ground state orbit, m is the mass and e is the chargeon the electron and ε_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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7. The energy necessary to remove the electron from $n = 10$ state hydrogen atom will be

A. 1.36 e V

B. 0.0135 e V

C. 13.6 e V

D. 0.136 e V

Answer: D

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8. The ratio of energies of first two excited states hydrogen atom is

A. $3/1$

B. $1/4$

C. $4/9$

D. $9/4$

Answer: D

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Exercise 1 C W Atomic Spectra

1. 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: D

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Watch Video Solution

2. 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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3. 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

Watch Video Solution

4. The energy required to separate a hydrogen atom into a proton and an electron is 13.6eV. 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

Watch Video Solution

Exercise 1 H W Introduction

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. 2.88m A

B. 28.8m A

C. 7.2 m A

D. 6.4 m A

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. 562.5

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 1×10^4V (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 particals enters an electrical field normal to the electric lines of force with a velocity of $3 \times 10^{7} m/s$. The electric intensity is 1800 V/m . Then the specific charge value of in CKg^{-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. The minimum enegry required to excite a hydrogen atom from its ground state is

A. 3.4 e V

B. 13.6 e V

C. 12.1 e V

D. 10.2 e V

Answer: C

Watch Video Solution

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

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

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

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

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

Answer: C

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Exercise 1 H W Alpha Ray Scattering

1. 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. r/2

D. r/4

Answer: A

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2. In α- ray scattering, the scattering angle (θ) for impact parameter (b) to become zero is

A. 0°

B. 90°

C. 180°

D. 45°.

Answer: C

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3. The impact parameter at which the scattering angle is 90^0, $z = 79$ and initial energy $10MeV$ is

A. $1.137 \times 10^{-14} m$

B. $1.137 \times 10^{-16} m$

C. $2.24 \times 10^{-17} m$

D. $2.24 \times 10^{-18} m$

Answer: A

Watch Video Solution

Exercise 1 H W Bohr S Model Of Atom

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

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

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

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

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

Answer: B

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2. 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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3. The ionisation potential of hydrogen atom is

A. 12.97V

B. $10.2V$

C. $13.6V$

D. $27.2V$

Answer: C

View Text Solution

4. 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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5. The velocity of an electron in its fifth orbit, if the velocity of an electron in the second orbit of sodium atom (atomic number =11) is v, will be :

A. v

B. $\frac{22v}{5}$

C. $\frac{5}{2}v$

D. $\frac{2}{5}v$

Answer: D

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6. The ratio of the kinetic energy and the potential energy of electron in the hydrogen atom will be

A. $1:2$

B. $-1:2$

C. $2:1$

D. $-2:1$

Answer: B

Watch Video Solution

7. If the potential energy of a H-atom in the ground state be zero then its potential energy in the first excited state will be

A. 10.2ev

B. 20.4eV

C. 23.8eV

D. 27.2eV

Answer: B

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Exercise 1 H W Atomic Spectra

1. The vale of wavelength radiation emitted due to transition of electrons from $n = 4$ to $n = 2$ state in hydrogen atom will be

A. $\frac{5R}{36}$

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

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

D. $\frac{3R}{16}$.

Answer: B

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2. 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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3. For a certain atom, there are energy levels A,B,C corresponds to energy values $E_A < E_B < E_C$. Choose the correct option if $\lambda_1, \lambda_2, \lambda_3$ are the wavelength of rediations

corresponding to the transition from C to B,B to A and C to A respectively.

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

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

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

D. $3\lambda_2 = \lambda_3 + 2\lambda_2.$

Answer: B

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4. If $13.6eV$ energy is required to separate a hydrogen atom into a proton and an electron, then the orbital radius of electron in a hydrogen atom is

A. $5.3 \times 10^{-11}m$

B. $5.3 \times 10^{-12}m$

C. $7.6 \times 10^{-13}m$

D. $7.6 \times 10^{-14}m$

Answer: A

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Exercise 2 C W Introduction

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 , $ap.d.$ 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 $m = 9.1 \times 10^{-31}kg$)

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 deflected 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. $4 \times 10^6 ms^{-1}$

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 falls terminal velocity V_0 in the absence of electric field . An electric field E keeps it stationary . The drop acquires additional charge q and starts moving

upwards with velocity V_0. The intial charge on the drop was .

A. 4q

B. 2q

C. q

D. q/2

Answer: C

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6. The wavelength of yellow line of sodium is 5896Å. Its wave number will be

A. 50883×10^{10} per second

B. 16961 per cm

C. 17581 per cm

D. 50883 per cm

Answer: C

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Exercise 2 C W Alpharay Scattering

1. 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. $\frac{e^2}{4\pi\varepsilon m v_o^2}$

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

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

D. zero

Answer: B

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2. 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/84

D. d/16

Answer: C

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Exercise 2 C W Bohr R Theory

1. 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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2. The de broglie wavelength of an electron in the first Bohr orbit is equal to

A. Equal to the circumference of the first orbit

B. 1/2 th circumference of the first orbit

C. 1/4 th circumference of the first orbit

D. 3/4 th circumference of the first orbit

Answer: A

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3. The radius of first Bohr orbit is x, then de-Broglie wavelength of electron in 3rd orbit is nearly

A. $2\pi x$

B. $6\pi x$

C. $9x$

D. $x/3$

Answer: B

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

A. L

B. 3L

C. $(3/2)L$

D. $2/3L$

Answer: C

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5. The de-broglie wavelength of the electron in the second Bohr orbit is (given the radius of the first orbit r_1 = 0.53 Å)

A. $3.33A^\circ$

B. $6.66A^\circ$

C. $9.90A^\circ$

D. $1.06A^\circ$

Answer: B

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Exercise 2 C W Atomic Spectra

1. 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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2. 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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Exercise 2 H W Introduction

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 0.9 m 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. $5 \times 10^{4} wb/m^{2}$

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. Whenever a hydrogen atom emits a photon in the Balmer series .

A. It need not emit any more photon

B. It may emit another photon in the Paschen series

C. It must emit another photon in the Lyman series

D. It may emit another photon in the Balmer series

Answer: B

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Exercise 2 H W Alpharay Scattering

1. 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. $1A^\circ$

B. $10^{-10}cm$

C. $10^{-12}cm$

D. $10^{-16}cm$

Answer: C

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2. An alpha nucleus of energy $\frac{1}{2}mv^2$ 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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Exercise 2 H W Bohr S Theory

1. In the Bohr's model of hydrogen atom, the ratio of the kinetic energy to the total energy of the electron in n^{th} quantum state is:

A. 1

B. -1

C. 2

D. -12

Answer: B

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2. The number of revolutions done by an electron 'e' in one second in the first orbit of hydrogen atom is

A. 6.57×10^{15}

B. 6.57×10^{13}

C. 1000

D. 6.57×10^{14}.

Answer: A

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3. 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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4. In Bohr's orbit of hydrogen atom m kg is more of an electron and e couomb is the charge on it. The ratio (in SI units) of

magnetic dipole moment to that of the angular momentum of electron is :

A. e/2m

B. e/m

C. 2e/m

D. 2e/3m

Answer: A

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5. 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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Exercise 2 H W Atomic Spectra

1. Let f_1 be the frequency

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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2. 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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3. 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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4. In each situation of Column I, a physical quantity related to orbiting electron in hydrogen -like atom is given.

The terms 'Z' and 'n' given in Column II have usual meaning in Bohr's theory. Match the quantities in Column I with the terms they depend on it Column II.

Column-I

a. Frequency of orbiting electron

b. Angular momentum of electron

c. Magnetic moment of electron

d. The average current due to orbiting of electron

Column-II

p. is directly proportional to n

q. is inversely proportional to n

r. is inversely proportional to n^3

s. is independent of Z

A. a-p,s , b-q,s , c-q,s , d-q,s

B. a-q,s , b-p,r , d-q,r , c-q,s

C. a-q,r , b-q,s , c-q,s , a-p,r

D. a-p,r , b-q,r , c-q,s , d-q,s

Answer: A

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5. Column -I

a. Radius of orbit is related with atomic number(Z)

b. Current associated due to orbital motion of electron with atomic number(Z).

c. Magnetic field at the center due to orbital motion of electron related with Z

d. Velocity of an electron related with atomic number(Z)

Column- II

p. is proportional to Z

q. is inversely proportion to Z

r. is proportional to Z^2

s. is proportional to Z^3.

A. a-q b-r c-r d-p

B. a-q b-s c-r d-p

C. a-p b-r c-s d-p

D. a-p b-s c-s d-q

Answer: A

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6. The spectral lines of hydrogen -like atom fall witin the wavelength range from $950A^{\circ}$ to

$1350A^\circ$ Then, match the following .

Column-I	Column-II
a. If it is atomic hydrogen atom and energy $E=-0.85\ eV$	p. $\lambda=1212A^0$ and it corresponds to transition from 2 to 1
b. If it is atomic hydrogen atom and energy atom and energy $E=-3.4\ eV$	q. $\lambda=134A^0$ and it corresponds to transition from 2 to 1
c. If it is double ionized lithium atom, then	r. $\lambda=303A^0$ and it corresponds to transition from 2 to 1
d. If it is singly ionized helium atom, then	s. $\lambda=970A^0$ and it corresponds to transition from 4 to 1

A. a-s b-p c-q d-r

B. a-s b-q c-p d-r

C. a-p n-p c-r d-s

D. a-q b-r c-s d-p

Answer: A

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7. Excitation energy of hydrogen atom is 13.6eV. Match the following .

	Column-I	Column-II
a.	Energy of second excited state of hydrogen	p. – 3.4 eV
b.	Energy of fourth state	q – 13.6eV of He^{+}
c.	Energy of first excited	r. – 1.5 eV state of Li^{+2}
d.	Energy of third excited state of Be^{+3}	s.None

A. a-r b-p c-s d-q

B. a-r b-s c-p d-q

C. a-s b-p c-q d-r

D. a-q b-p c-s d-r

Answer: A

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8. Match the column -I with column -II

Column – I	Column – II
(a) Radius of orbit depends on principal quantum number as	(p) Increase
(b) Due to orbital motion of electrons, magnetic field arises at the centre of nucleus is proportional to principal quantum number as	(q) Decrease
(c) If electron is going from lower energy level to higher energy level than velocity of electron will	(r) Is proportional to $\frac{1}{n^2}$
(d) If electron is going from lower energy level to to n^2 higher energy level than total energy of electron will	(s) Is proportional
	(t) Is proportional

A. a-s b-t c-q d-p

B. a-t b-s c-p d-q

C. a-p b-q c-t d-s

D. a-p b-q c-s d-t

Answer: A

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9. Match the column - I with column -II

A certain amount of $He+$ ions are subjected to excitation and subsequently the emission spectrum for the same is observed. Column - I shows four different series to which the

spectral lines different series to which the spectral lines belong and column - II shows five different energies of the photons emitted during the process

Column – I	Column – II
(a) Lyman series	(p) 1.33 eV
(b) Balmer series	(q) 12.09 eV
(c) Paschen series	(r) 51 eV
(d) pfund sereis	(s) 5.5 eV
	(t) 3.87 eV

A. a-r b-q c-s,t d-p

B. a-q b-r c-p,t d-s

C. a-r b-p c-q d-t,s

D. a-s b-q c-p d-t

Answer: A

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Exercise 3

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

A. 1.7eV

B. 3.4eV

C. 6.8eV

D. 13.6eV

Answer: B

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2. Which of the following transition in hydrogen atom emit photons of biggest frequency ?

A. n=2 to n=1

B. n=1 to n=2

C. n=2 to n=2

D. n=6 to n=2

Answer: A

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3. The groud state energy of hydrogen atom is $-13.6eV$. When its electron is in first excited state, its exciation energy is

A. 0

B. 3.4eV

C. 6.8eV

D. 10.2eV

Answer: D

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4. In a Rutherford scattering experiment when a projectile of change Z_1 and mass M_1 approaches s target nucleus of change Z_2 and

mass M_2, te distance of closed approach is r_0.

The energy of the projectile is

A. directly proportional to $M_1 \times M_2$

B. directly proportional to $z_1 z_2$

C. inversely proportional to z_1

D. directly proportional to mass M_1.

Answer: B

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

A. N=3 to n=2 states

B. n=3 to n=1 states

C. n=2 to n=1 states

D. n=4 to n=3 states

Answer: D

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6. The radius of an electron orbit in a hydrogen atom is of the order of

A. $10^{-8}m$

B. $10^{-9}m$

C. $10^{-11}m$

D. $10^{-13}m$

Answer: C

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7. Among the following four spectral regions, the photon has the highest energy in

A. Infrared

B. Violet

C. Red

D. Blue

Answer: B

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

A. $-6.8eV$

B. $-13.6eV$

C. $-27.2eV$

D. $-54.4eV$

Answer: B

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

A. 2

B. 3

C. 4

D. 5

Answer: C

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10. Electron in hydrogen atom first jumps from third excited state to second excited state and then form second excited state to first excited

state. The ratio of wavelength $\lambda_1 : \lambda_2$ emitted in two cases is

A. $27/5$

B. $20/7$

C. $7/5$

D. $27/20$

Answer: B

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11. The electron in hydrogen atom makes a transition $n_1 \rightarrow n_2$ where n_1 and n_2 are the principal quantum number of two states. Assuming 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 value of n_1 and n_2 are:

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

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

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

D. $n_1 = 8$ and $n_2 = 2$

Answer: A

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12. Hydrogen atom in ground state is excited by a monochromatic radiation of $\lambda = 975\text{Å}$. Number of spectral lines in the resulting spectrum emitted will be

A. 10

B. 3

C. 2

D. 6

Answer: C

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13. The wavelength of the first line of Lyman series for hydrogen atom is equal to that of the second line of Balmer series for a

hydrogen-like ion. The atomic number Z of hydrogen-like ion is

A. 3

B. 4

C. 1

D. 1

Answer: D

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

A. 0.65ev

B. 1.9eV

C. 11.1eV

D. 13.6eV

Answer: C

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

A. $\frac{7}{5}$

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

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

D. $\frac{20}{7}$

Answer: D

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16. An electrons of a stationary hydrogen aton passes form the fifth enegry level to the ground level. The velocity that the atom acquired as a result of photon emission will be (m is the mass of the electron, R, Rydberg constanrt and h, Planck's constant)

A. $\frac{24hR}{25m}$

B. $\frac{25hR}{24m}$

C. $\frac{25m}{24hR}$

D. $\frac{24m}{25hR}$

Answer: A

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

A. $2 \rightarrow 1$

B. $3 \rightarrow 2$

C. $4 \rightarrow 1$

D. $4 \rightarrow 3$

Answer: D

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18. Ratio of longest wavelengths corresponding to Lyman and Balmer series in hydrogen spectrum is

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

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

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

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

Answer: C

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19. In the spectrum of hydrogen atom, the ratio of the longest wavelength in Lyman

series to the longest wavelength in the Balmer series is

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

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

C. $\frac{4}{9}$

D. $\frac{9}{4}$

Answer: B

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20. If an electron in a hydrogen atom jumps from the $3rd$ orbit to the $2nd$ orbit, it emits a photon of wavelength λ. When it jumps form the $4th$ orbit to the $3dr$ orbit, the corresponding wavelength of the photon will be

A. $\frac{20}{7}\lambda$

B. $\frac{20}{13}\lambda$

C. $\frac{16}{25}\lambda$

D. $\frac{9}{16}\lambda$

Answer: A

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Exercise 4

1. Magnetic moment due to the motion of the electron in n^{th} energy state 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 $10.2eV - A^0$

D. has constant value $7.2eV - A^0$

Answer: D

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

A. it gains 2.55 e V of potential energy

B. it gains 2.55 e V of total energy

C. it gains 2.55 e V of total energy.

D. it emits a 2.55 e V electron

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

B. decreases by $1.055 \times 10^{-34} Js$

C. Increases by $2.11 \times 10^{-34} Js$

D. increases by $1.055 \times 10^{-34} Js$.

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

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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 photon 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 are

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 2^{nd} of Lyman series is abosorbed by a hydrogen like atom $'X'$ in 2^{nd} excited state. As a result the hydrogen like atom $'X'$ makes a transition to n^{th} orbit. Then :

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. 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. $\frac{3q}{2\pi \in_0 h}$

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

Answer: A

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15. 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.

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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16. 29 electrons are removed 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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17. The ionisation energy of 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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18. 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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19. Monochromatic radiation of wavelength λ is incident on a hydrogen sample in ground state. Hydrogen atoms absorb a fraction of light and subsequently emit radiations of six different wavelength . Find the wavelength λ.

A. 80nm

B. 97.5nm

C. 105nm

D. 60nm

Answer: B

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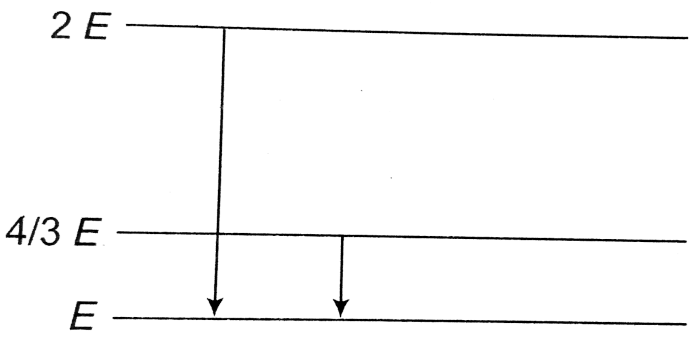
20. The follwing diagram indicates the energy levels of a certain atom when the system moves from $2E$ level to E, a photon of wavelength λ is emitted. The wavelength of photon produced during its transition from

$\frac{4E}{3}$ level to E is



A. 3λ

B. $3/4\lambda$

C. $\lambda/4$

D. 2λ

Answer: A

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21. When the electron in a hydrogen atom jumps from the second orbit to the first orbit , the wavelength of the radiation emitted is λ . When the electron jumps from the third orbit to the first orbit , of the same atom , the wavelength of the 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

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22. 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

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23. The electron in hydrogen atom makes a transition $n_1 \rightarrow n_2$ where n_1 and n_2 are the principal quantum number of two states. Assuming 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 value of n_1 and n_2 are:

A. $8:1$

B. $4:1$

C. $2:1$

D. $1:2$

Answer: C

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24. Any radiation in the ultraviolet region of hydrogen spectrum is able to eject photoelectrons from a metal. What should be the maximum value of threshold frequency for the metal?

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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25. 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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26. 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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27. 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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28. 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. $1215A^{0}$

B. $4848A^{0}$

C. $6050A^{0}$

D. data given insufficient to calculatethe vale

Answer: B

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29. 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 to the 2nd excited state by emitting photon of

energy $10.20eV$ the value of n and z are given

(ionization energy of hydrogen atom is 13.6eV)

A. n=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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30. 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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31. Let ν_1 be the frequency of the series limit of the lyman series ν_2 be the frequency of the first line of th lyman series and ν_3 be the frequency of the series limit of the Balmer series. Then

A. $\theta_1 - \theta_2 = \theta_3$

B. $\theta_2 - \theta_1 = \theta_3$

C. $2\theta_3 = \theta_1 + \theta_2$

D. $\theta_1 + \theta_2 = \theta_3$.

Answer: A

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32. (a) (i) Find the wavelength of the radiation required to excite thye elctron in $Li(++)$ from the first to the third Bohr orbit.

(ii) How many spectal lines are observed in the emission spectrum of the above excited system ?

(b) The energy needed to detach the electron of a hydrogen-like ion in ground state in 4

rydberg.

(i) What is the wavelength of the radiation emitted when the electron jumps from the first excited state ot the ground state ?

(ii) What is the radius of first orbit ?

(c) A hydrogen sample is prepared in a particular excited state A. Photons of energy 2.55 eV get absorbed into the sample to take some electrons to a further excited state B. Find the quantum number of the A and B.

(d) A hydrogen atom in a state having a binding energy of 0.85 eV makes transition to a state with excitation energy 10.2 eV. (i)

Identify the quantum number n of the upper and the lower energy states.

Find λ.

A. 108.8 e V ,3

B. 13.6e V, 4

C. 54.4 e V, 2

D. 10.2 e V, 3

Answer: A

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33. 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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34. 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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35. 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. $r_n \propto n$

B. $r_n \propto 1/n$

C. $r_n \propto n^2$

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

Answer: A

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36. If elements of quantum number greater than n were not allowed , the number of possible electrons 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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37. 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. $\frac{z^4}{n^3}$

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

Answer: D

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38. The recoil speed of a hydrogen atom after it emits a photon in going from $n = 5$, state to $n = 1$ state is (in ms^{-1})

A. 4.718

B. 7.418

C. 4.178

D. 7.148

Answer: C

39. The binding energy of an electron in the ground state of He atom is $E_0 = 24.7eV$. The

energy required to remove both the elements from the atom is

A. 24.6eV

B. 79.0eV

C. 54.4eV

D. None of these

Answer: B

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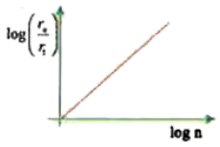
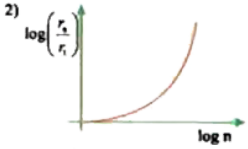
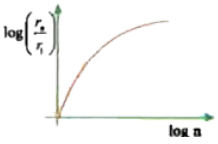
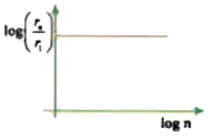
40. In hydrogen atom, the radius of n^{th} Bohr orbit is r_n. The graph Beetwee n $\log.\left(\frac{r_n}{r_1}\right)$ will be

A. 

B. 

C. 

D. 

Answer: A

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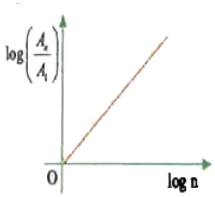
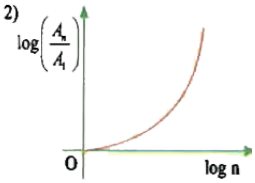
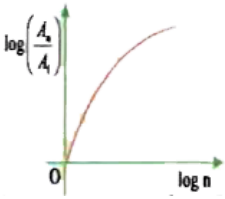
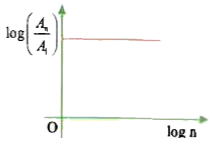
41. In hydrogen atom, the area enclosed by n^{th} orbit is A_n. The graph between $\log\left(\frac{A_n}{A_1}\right)$ log will be

A. 

B. 

C. 

D. 

Answer: A

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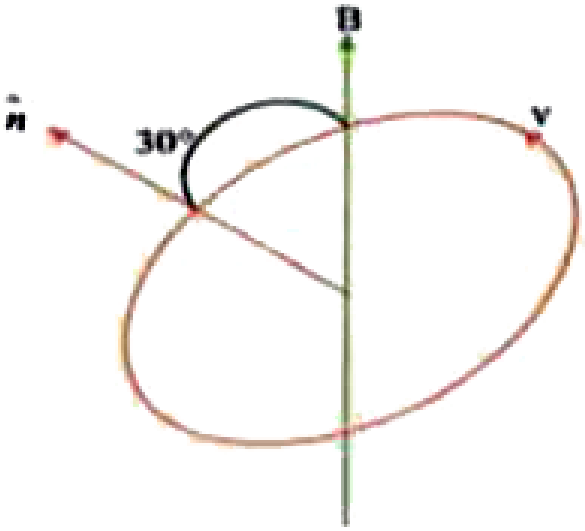
42. An electron in the ground state of hydrogen atom is revolving in anticlockwise direction in the circular orbit of radius R. The atom is placed in a uniform magnetic induction B such that the plane normal of electron orbit makes an angle 30° with B, as

shown in figure. The torque experienced by electron will be



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

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

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

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

Answer: A

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43. if we assume only gravitational attraction between proton and electron in hydrogen atom and the Bohr quantizaton rule to be followed, 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. $\frac{G^2M^2m^2}{h^2}$

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

C. $\frac{2\pi^2 G M^2 m^3}{h\&2}$

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

Answer: B

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44. Taking the Bohr radius $a_0 = 53$ pm, the radius of Li^{++} ion in its gnround state, on the basis of Bohr's model, will be about.

A. 53pm

B. 27pm

C. 18pm

D. 13pm

Answer: C

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

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

B. of the electrons colliding with 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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46. 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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47. 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 only when excited by an external electric field.

C. all together simultaneously into a lower state .

D. to emit photons only when they collide.

Answer: A

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